MOTOROLA

Installation and Operation Manual

APEX1000 All-Purpose Edge QAM

Software Version 2.4.x

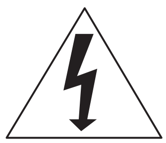
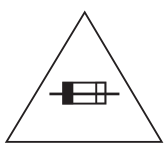
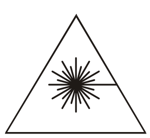
i

Safety and Regulatory Information

Caution

These servicing instructions are for use by qualified personnel only. To reduce the risk of electrical shock, do not perform any servicing other than that contained in the Installation and Troubleshooting Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Special Symbols That Might Appear on the Equipment

	This symbol indicates that dangerous voltage levels are present within the equipment. These voltages are not insulated and may be of sufficient strength to cause serious bodily injury when touched. The symbol may also appear on schematics.
	The exclamation point, within an equilateral triangle, is intended to alert the user to the presence of important installation, servicing, and operating instructions in the documents accompanying the equipment.
	For continued protection against fire, replace all fuses only with fuses having the same electrical ratings marked at the location of the fuse.
	Electrostatic discharge (ESD) can damage the APEX1000 unit and circuit card assemblies. Wear an antistatic wrist strap attached to a chassis ground to prevent ESD damage.
	This product contains a Class I laser and is intended for operation in a closed environment with fiber attached. CAUTION — Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING: THIS EQUIPMENT OPERATES OVER THE MARKED VOLTAGE AND FREQUENCY RANGE WITHOUT REQUIRING MANUAL SETTING OF ANY SELECTOR SWITCHES. DIFFERENT TYPES OF LINE CORD SETS MAY BE USED FOR CONNECTIONS TO THE MAINS SUPPLY CIRCUIT AND SHOULD COMPLY WITH THE ELECTRICAL CODE REQUIREMENTS OF THE COUNTRY OF USE. THIS EQUIPMENT REQUIRES A GROUNDING CONDUCTOR IN THE LINE CORD.

CAUTION: THIS UNIT HAS UP TO TWO (2) 100 – 240 V ∿ OR TWO (2) -48 V ⎓ INPUT POWER FEEDERS. DISCONNECTING LESS THAN THE MAXIMUM WILL NOT DE-ENERGIZE THE SYSTEM.

TO REDUCE THE RISK OF INJURY, DISCONNECT THE TWO (2) POWER FEEDERS WHEN REMOVING POWER TO THE SYSTEM.

WARNING: TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS PRODUCT TO RAIN OR MOISTURE. THE APPARATUS SHALL NOT BE EXPOSED TO DRIPPING OR SPLASHING AND NO OBJECTS FILLED WITH LIQUIDS, SUCH AS VASES, SHALL BE PLACED ON THE APPARATUS.

CAUTION: SLIDE/RAIL MOUNTED EQUIPMENT IS NOT TO BE USED AS A SHELF OR A WORK SPACE.

CAUTION: TO PREVENT ELECTRICAL SHOCK, IF THIS UNIT IS PROVIDED WITH A POLARIZED PLUG, DO NOT CONNECT THE PLUG INTO AN EXTENSION CORD, RECEPTACLE, OR OTHER OUTLET UNLESS THE PLUG CAN BE FULLY INSERTED WITH NO PART OF THE BLADES EXPOSED.

CAUTION: TO ENSURE REGULATORY AND SAFETY COMPLIANCE, USE ONLY THE PROVIDED POWER CABLES.
EQUIPMENT MUST BE CONNECTED TO PROTECTIVE EARTH.

THIS DEVICE WHEN POWERED BY DC MUST BE PROTECTED BY A LISTED BRANCH CIRCUIT PROTECTER RATED MAXIMUM 25 A.

CAUTION: INSTALLATION OF THIS PRODUCT MUST BE IN ACCORDANCE WITH NATIONAL WIRING CODES AND CONFORM TO LOCAL REGULATIONS.

CAUTION: THE POWER SUPPLY PLUG IS INTENDED TO SERVE AS A POWER DISCONNECT DEVICE. THE SOCKET OUTLET SHALL BE INSTALLED NEAR THE EQUIPMENT AND SHALL BE EASILY ACCESSIBLE.

It is recommended that the customer install an AC surge arrestor in the AC outlet to which this device is connected. This is to avoid damaging the equipment by local lightning strikes and other electrical surges.

FCC COMPLIANCE

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the Installation Manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

Any changes or modifications not expressly approved by Motorola could void the user's authority to operate this equipment under the rules and regulations of the FCC.

CANADIAN COMPLIANCE

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

EN 55022/CISPR 22 COMPLIANCE

Warning

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

International Declaration of Conformity

We — Motorola, Inc.
101 Tournament Drive
Horsham, PA 19044, U.S.A.

declare under our sole responsibility that the

All Purpose Edge QAM	Model APEX1000

to which this declaration relates is in conformity with one or more of the following standards:

EMC Standards

EN 300 386	EN 55022	EN 61000-3-2	EN 61000-3-3	EN 50083-2	CISPR 22

Safety Standards

EN 60950-1	IEC 60950-1

following the provisions of the Directive(s) of the Council of the European Union:

EMC Directive 2004/108/EC	Low Voltage Directive (LVD) 2006/95/EC
Restriction of Hazardous Substances Directive 2002/95/EC	Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

APEX1000 CMM TTT Chart

MPN (541928-001-00)

The Toxic and Hazardous Substance disclosure table and Environmentally Friendly Use Period (EFUP) Logo are provided in accordance with Section 5 & 6 of the People's Republic of China's "Electronic Industry Marking Standard for Control of Pollution Caused by Electronic Information Products". The Toxic and Hazardous Substance disclosure table and EFUP Logo cover all electronic information products (EIP) supplied by the Home and Networks Mobility business of Motorola, Inc.

部件名称	有毒有害物质或元素					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
APEX1000 - AC	**X**	**X**	**X**	**X**	**O**	**O**

○：表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006标准规定的限量要求以下。

×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。

Caring for the Environment by Recycling	
	When you see this symbol on a Motorola product, do not dispose of the product with residential or commercial waste. **Recycling your Motorola Equipment** Please do not dispose of this product with your residential or commercial waste. Some countries or regions, such as the European Union, have set up systems to collect and recycle electrical and electronic waste items. Contact your local authorities for information about practices established for your region. If collection systems are not available, call Motorola Customer Service for assistance. Please visit http://www.motorola.com/recycle for instructions on recycling.

Contents

Figures

1 Introduction

All-Purpose Edge QAM

The APEX1000 is Motorola's next-generation All-Purpose Edge QAM. The APEX1000 combines flexibility, high availability, high QAM density, MediaCipher® or SimulCrypt encryption, and low power in an extremely cost-effective 1 RU platform.

The unique attributes of the APEX1000 allow for the installation of up to three removable and hot-swappable QAM modules in the chassis. The APEX1000 also presents the following features:

- Each module provides two RF ports, which support up to eight QAM channels each.
- Any of the available 48 QAM channels can perform Video-on-Demand (VOD), Switched Digital Video (SDV), or broadcast services.
- The APEX1000 provides four SFP slots, allowing for up to four optical or electrical GigE inputs. These slots also enable the APEX1000 to support full transport stream redundancy covering all 48 QAM channels.
- The APEX1000 supports three session control modes allowing it to function as an SDV edge QAM in any RTSP and RPC cable network:
    - D6 (VREP) and R6 (RTSP) SDV
    - RPC SDV
    - ERMI-1 (ERRP) and ERMI-2 (RTSP), MHA SDV and session VOD interfaces
- To support MPT Mode DEPI, the APEX acts as EQAM in an M-CMTS system. It receives data over DEPI from one or multiple M-CMTS cores; data packets are forwarded to the appropriate QAM. (DEPI MPT control plane and PSP Mode will be supported in a future release).

    Additionally, the APEX1000 performs:

    - Network de-jittering
    - MPEG multiplexing
    - Message insertion
    - PSI generation (following MPEG-2 transport specifications)

Figure 1-1 — APEX1000 front panel

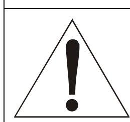
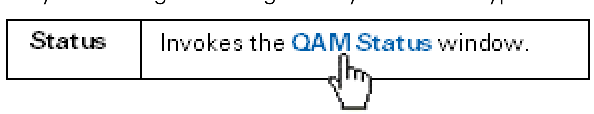
Related Documentation

- SmartStream Device Manager (SDM) User Guide
- NE1000 Network Encryptor User Guide
- REM1000 User Guide

Note: The SDM is the required device to perform any upgrades with the APEX.

Document Conventions

Before you begin using the APEX1000, familiarize yourself with the stylistic conventions used in this manual:

Convention	Description
Bold type	**tier_match(1,524)** Indicates text that you must type exactly as it appears or indicates a default value.
SILK SCREEN	Denotes silk screening on the equipment, typically representing front- and rear-panel controls and input/output (I/O) connections, and LEDs.
* (asterisk)	Indicates that *Note* and *Caution* information applies to several topics in a list (items marked with the asterisk).
Variable	Denotes a displayed variable, a variable that you must type, or is used for emphasis.
`System Output`	Indicates displayed text.
>	Points to the next window in navigation paths.
Italics	The field *must* be. . . .
`Courier Font`	`validate_string`
Note:	Information that is *useful* to the process: *Note:* You may choose to record the starting time…
Caution	Information that is *essential* to the process: *Caution: Do not reboot until the upgrade completes…*
	Information that is *necessary* to the process or may pose a physical danger: *Warning! Keep hands away from the fan blades …*
Hyperlink	Body text strings in blue generally indicate a hyperlink to a related topic: 

Getting Help

To get assistance with your Motorola product or solution, or to access learning materials, use one of the following channels:

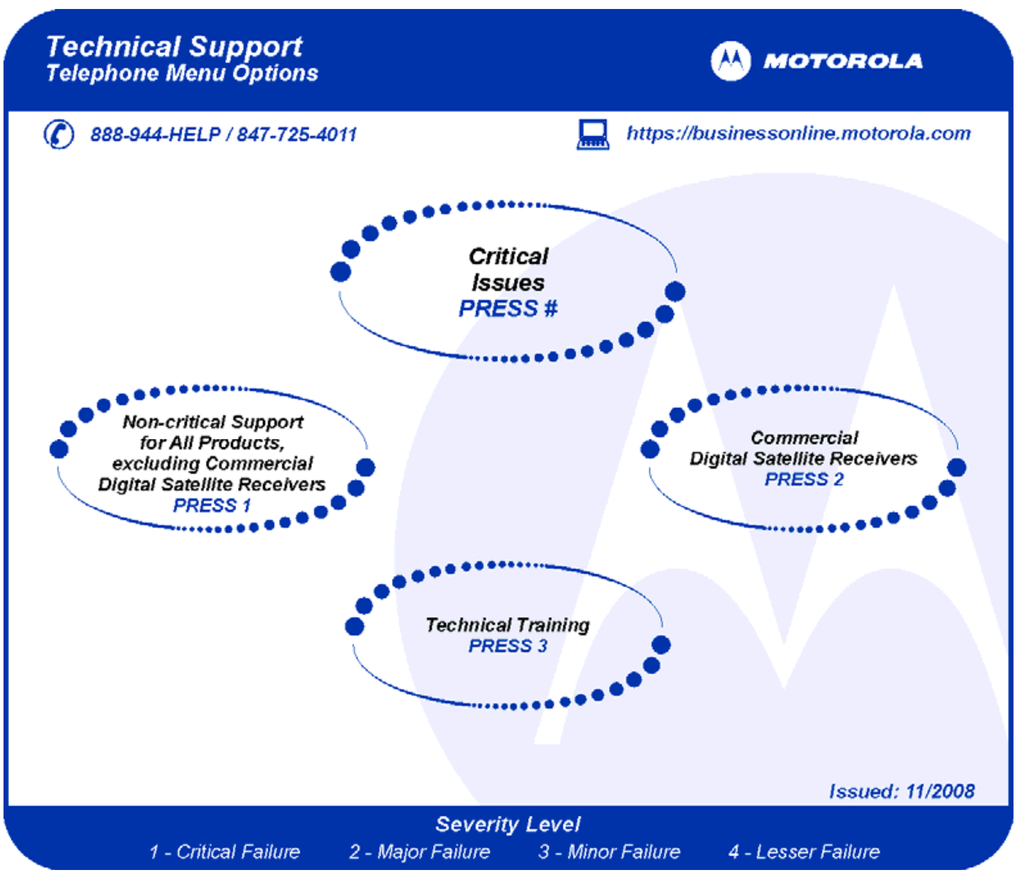
Technical Assistance Center (TAC) provides access to technicians 24 hours a day, 7 days a week for all products. Contact the TAC at 888-944-HELP (888-944-4357) or dial direct 847-725-4011.

Motorola Online (MOL) provides technical documentation and low-priority issue creation and tracking at http://businessonline.motorola.com (PON and BSR users see Extranet Support below).

Digital Configuration Management provides access to software downloads and release notes. Or you can order from our digital configuration management servers by going to http://digitalcm.motorola.com (PON users see Extranet Support below).

Learning Portal provides self-paced product training and course descriptions of instructor-led training classes at http://www.motorolatraining.com. In many cases training can be given at your location.

Extranet Support provides access to technical publications for **PON (FTTx)** users at http://compass.motorola.com/go/ftth site; and software downloads and technical publications for **BSR** users at http://bsr.motorola.com.



Calling for Repairs

If repairs are necessary, call the Technical Assistance Center nearest you for a Return for Service Authorization (RSA) number before shipping the unit. The RSA number must be prominently displayed on all equipment cartons. When shipping equipment for repair, follow these steps:

1. Pack the unit securely.
2. Complete and enclose the checklist provided with the unit.
3. Enclose a copy of the invoice that verifies the warranty status.
4. Ship the unit PREPAID to the address supplied by the Tech Support representative during your call.

List of Countries and Phone Numbers

BELGIUM	0-800-72-163
DENMARK	80-88-6748
FINLAND	0-800-114-263
FRANCE	0-800-90-7038
GERMANY	0-800-18-73019
HUNGARY	06-800-18164
IRELAND	1-800-55-9871
ISRAEL Golden Lines **ISRAEL Bezeq** **ISRAEL Barak**	1-809-25-2071 1-809-42-9181 1-809-31-5435
ITALY	800-788-304
NETHERLANDS-HOLLAND	0-800-022-0176
NORWAY	800-15-670
POLAND	00-800-111-3671
PORTUGAL	800-81-3461
SPAIN	900-99-1771
SWEDEN	020-79-0241
SWITZERLAND	0-800-561-872
UNITED KINGDOM	0-800-404-8439
ALL OTHER COUNTRIES	+1 847 725 4011

Note: If you find a toll-free number that is not valid, please dial +1 847 725 4011.

2 Overview

APEX1000 Features

The APEX1000 offers a feature set that is based on the existing SEM V8/V12 products. To allow for full use of all 48 QAM output streams, however, the APEX1000 allows each output to be configured *separately*. In addition, you can apply many configuration settings *without* rebooting the system (changes to the QAM Transmission Mode *require a reboot* before taking effect).

The APEX1000 also:

- Provides downstream QAM transport streams at RF for distribution on the HFC cable network
- Receives input content from video servers, encoders, and/or satellite IRDs through the GigE interface
- Receives the GigE transport streams and performs de-jittering at the input to remove jitter induced by network delays and/or delays caused by the packing of MPEG packets into UDP datagrams
- Performs multiplexing and PSI generation per MPEG-2 transport specifications
- Performs QAM modulation and up-conversion
- Performs encryption supporting SimulCrypt, MediaCipher, and SCTE-52 encryption standards

Specifications

- **Physical Chassis**: One RU chassis with support for up to 48 DRFI-compliant QAM channels, allowing up to three removable and hot-swappable QAM modules per chassis (two block upconverted RF ports per QAM module)
- **QAM Modules**: Available in *2x4* configuration (up to four QAM channels per port), *2x8* configuration (up to eight QAM channels per port), and a QAM module software upgrade to field-convert a 2x4 module to a 2x8 module

  *Note: in Annex A, a **2x6** instead of 2x8 configuration is supported.*

- **Extremely Low Power Consumption**: <4.5 W/QAM when fully loaded, 216 W typical
- **GigE Interface**: Four GigE interfaces (SFP slots) with support for IGMPv3 and transport stream redundancy
- **Power Supplies**: Supports up to two dual hot-swappable redundant load sharing power supplies of the *same* type. The system operates with one single unit, AC *or* DC, or two units, two AC *or* two DC

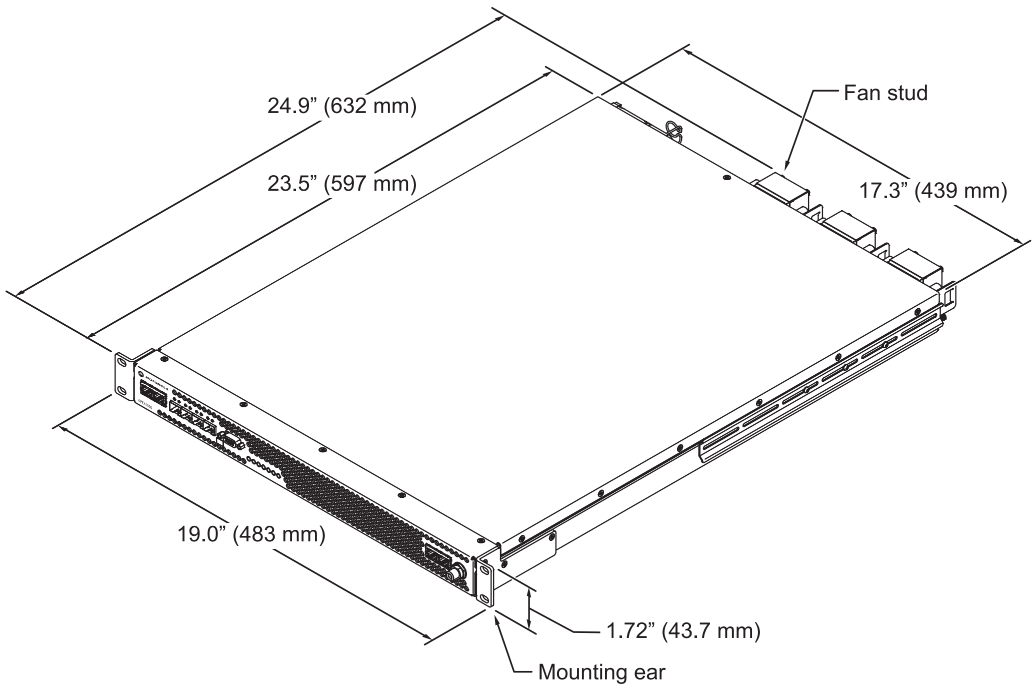
- **Full Video EQAM Feature Set**:
  - De-jitters CBR and VBR input streams
  - Receives either MPTS or SPTS
  - Encrypts received transport streams
  - Transmits MPTS, Support for MPEG remultiplexing, PID remapping, PSI generation, and PSI monitoring
  - Supports SNMP for configuration, control, alarms, and traps
- **SDV and VOD Standards**: Supports RTSP, RPC, and MHA specifications

Physical Overview

APEX1000 physical characteristics:

- Mounts in a standard 19-inch equipment rack
- Occupies one rack unit (1.75 vertical inches)
- Does NOT require a one rack unit blank panel cooling space; cooling air is drawn in the front panel and exits out the rear fan

Figure 2-1 — APEX1000 dimensions



APEX1000 Physical Specification	Value
Overall depth from front panel to end of fan studs	24.9 inches (632mm)
Depth from mounting ears to rear panel	23.5 inches (597mm)
Width	19 inches (483mm)
Height	1.72 inches (43.7 mm)
Approximate Weight	23 lbs (10.4 Kgs)
Mounting	Rack mount

For complete physical, electrical, and environmental details, see the Specifications section of this guide.

APEX1000 Front Panel

The Front Panel of the APEX1000 includes:

- Four Gigabit Ethernet
- Two Fast Ethernet interfaces
- Two DTI (DOCSIS® Timing) interfaces

The APEX1000's front panel also includes a bank of LEDs that provide status associated with RF output ports (such as an RF error), and an overall Summary Status of the device. Each GbE, FastE, and DTI port also includes integrated LEDs to provide status information.

For additional LED/Error Conditions details, see LED/Error Indications.

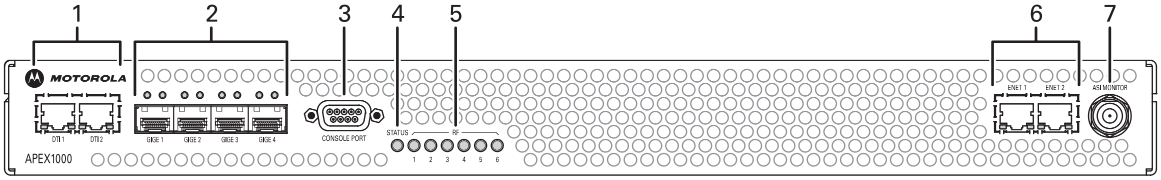
Monitoring Ports

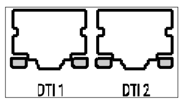
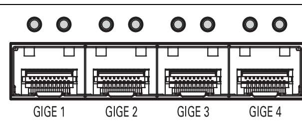
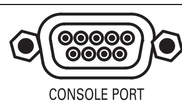
For easy access, a Console Port and an ASI Monitor Port are also located on the APEX1000's front panel. To allow user access to a set of limited menus, such as boot mode selection and OAM&P Fast Ethernet IP address/mask entry, the Console Port provides a *serial interface*.

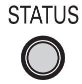
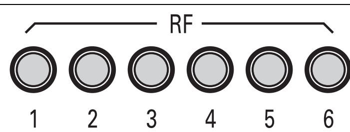
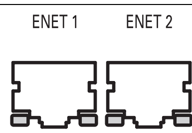
The ASI monitor port provides access to any one of the 48 possible Multi Program Transport Streams created by the APEX1000. This output is provided to the ASI monitor port in parallel with the MPTS's targeted output to a QAM port.

For further information, see RS-232 Test Console Port.

Front Panel Indicators and Connectors



Key	Connector/Indicator	Description
1		**DTI (DOCSIS Timing Interface) Ports 1 & 2** These inputs (RJ-45 female connectors) provide redundant connections to the DTI servers. Located inside each input, each LED illuminates to indicate status as follows: • **Off** – Warm-up, free-run, holdover, or unit off • **Yellow** – Fast • **Green** – Normal or bridging *Note: Version 2.4.x of the APEX1000 supports DEPI in MPT mode only. Support for PSP mode will be offered in a future release.*
2		**GigE Inputs 1 through 4** **GigE indicators** – Located above each input, each LED illuminates to indicate Ethernet link, data, and optics status as follows: • **Off** – No link or link down (the auto-negotiation failed, no communication to partner, or no link pulse observed) • **Solid Green** – Link up (auto-negotiation link pulse activity, partners agree on capabilities, but no data traffic) • **Blinking Green** – Link up and traffic (both transmit and receive) • **Solid Red** – Faulty or failed optical interface (can also indicate that a GigE port is enabled, but no SFP modules are installed)
3		**Nine-pin Console Port** • Top row connector pins are: 5, 4, 3, 2, 1 • Bottom row connector pins are: 9, 8, 7, 6 See RS-232 Test Console Port for further information on menu item selections.

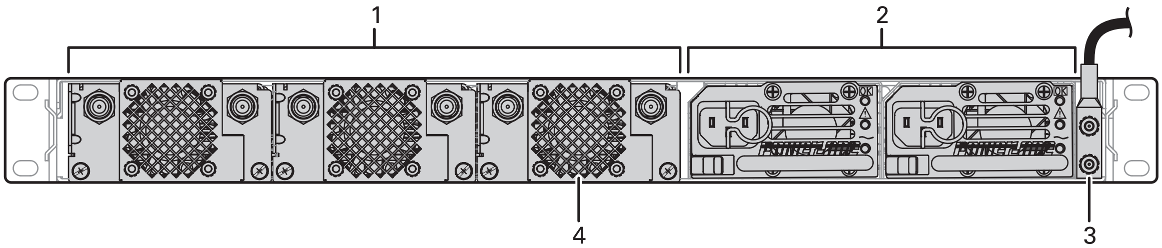
Key	Connector/Indicator	Description
4		**Status/Summary Alarm Indicator** – Illuminates during the power-on or reboot cycle for the following conditions: • **Blinking Red** – Unit is powered on and performing initial boot code memory tests • **Blinking Green** – The APEX1000 has loaded the application code, and is performing final hardware initialization (also includes start up of all software tasks) When the APEX1000 completes booting, the Status/Summary Alarm Indicator illuminates for the following conditions: • **Solid Green** – Power on and no faults • **Solid Yellow** – LED indicates a Minor alarm • **Solid Red** – LED indicates that a *critical* or *major* alarm has occurred Alarm conditions are further described in Alarms Window Field Definitions.
5		**QAM LEDs** – There are six QAM LEDs that show the output status for each QAM RF output. These LEDs are controlled by firmware, and the status is updated every five seconds. The LED conditions below display according to current unit status: • **Off** – Unit is un-powered or there is no QAM module installed • **Solid Green** – No errors, RF not muted, no enabled QAM channels in test mode • **Solid Yellow** – RF muted or one or more enabled QAM Channels in test mode • **Solid Red** – Error on QAM Module, RF Port, or enabled QAM Channel
6		**Enet1 and Enet2** (OAM&P and Application Network Interfaces) – These are full duplex interfaces that provide network connectivity to external devices such as the DAC 6000, SDM, or the Session Resource Manager (SRM). (Can also be used for the delivery of relatively low-rate application data.) **10/100Base-T Ethernet indicators** – Located at the bottom left and right of each input, each LED illuminates to indicate Ethernet link, data, and collision status as follows: • **Off** – No link or link down (the auto-negotiation failed, no communication to partner, or no link pulse observed) • **Solid Green** – Link up (auto-negotiation link pulse activity, partners agree on capabilities, but no data traffic) • **Blinking Green** – Link up and traffic (both transmit and receive) • **Alternating Green-Yellow** – Collision detected (if in half-duplex mode, 10/100Base-T only). Lights LED for 100 msec *after* detection of collision (during high collisions, this LED also appears as alternating green-yellow)
7		**ASI Monitor Port** – This port is available for monitoring a selected output stream.

APEX1000 Rear Panel

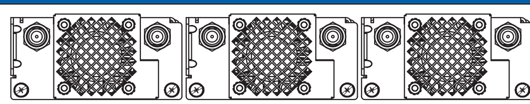
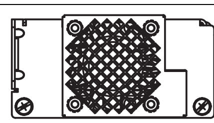
The rear panel of the APEX1000 provides access to up to three replaceable QAM modules with two RF connectors each. The replaceable power supply modules and ground stud are also located on the back of the unit.

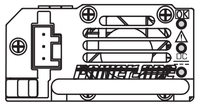
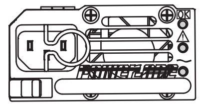
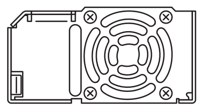
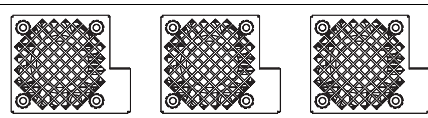
The following figure illustrates the APEX1000's rear panel, shown with (optional) redundant AC power supplies:

Figure 2-2 — APEX1000 rear panel



APEX1000 rear panel connectors

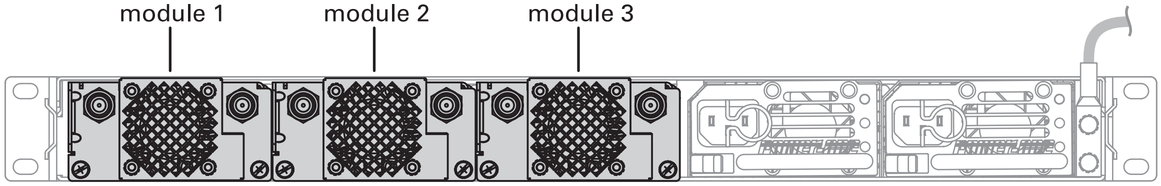
Key	Connector/Indicator	Description
1		Replaceable, hot-swappable QAM modules (maximum three units). Each has QAM/UC "**F**" type output connectors RF #1 & RF #2. See RFPM and Power Supply Modules for additional details on identifying and replacing a QAM module.
	 QAM slot filler module	In APEX1000 units with less than the maximum allowable three (3) QAM modules, a corresponding number of filler units must *always* be installed in the empty slots. *Caution: For proper operation, all QAM slots must be occupied at all times!*

Key	Connector/Indicator	Description
2	 DC  AC	*Replaceable, hot-swappable AC *or* DC power supplies (maximum two units): • Accepts AC inputs from 100 through 240 VAC (50 through 60 Hz) • Accepts DC inputs from –40 through –60 VDC Note that power supply cooling fan units are not field-replaceable. Contact the TAC to order complete cooling fan replacement units.
	 PS slot filler module	For proper operation, all inactive PS slots must be occupied by a filler module. If a redundant power supply configuration is not used, then a filler module must always be installed in the empty slot.
3		Ground stud assembly.
4		Field-replaceable QAM module fans. See Fan Field Replacement Procedure for additional details on replacing a fan assembly.
The APEX1000 is available with an optional redundant power supply that is of the same type (such as AC and AC* ***or* *DC and DC).*		

CAUTION *For proper function of the internal RF Power Level detector, all RF Outputs must be terminated with 75 Ohms. Unterminated RF Outputs may trigger an APEX RF Low Alarm.*

Hot-swappable QAM Modules

The APEX1000 supports up to three hot-swappable QAM modules:



Each QAM module has two RF output ports, each of which supports either four or eight adjacent QAM carriers. The 2x4 QAM modules support up to four QAMs per port and the 2x8 QAM modules support up to eight QAMs per port, allowing the following configurations:

- When three 2x8 QAM modules are installed, the APEX1000 supports up to 48 QAM channels (six RF outputs, each carrying up to eight QAM channels)
- When three 2x4 QAM modules are installed, the APEX1000 supports up to 24 QAM channels (six RF outputs, each carrying up to four QAM channels)

CAUTION *All QAM channels on a given RF output must be assigned to adjacent carrier frequencies and must be assigned the same modulation mode, all either 64QAM or 256QAM.*

QAM Module Ordering Options

Customers typically order one of four package configurations of the APEX1000. The first two package configurations (1 and 2) include the chassis and three (2x8) RFPM modules. *Configuration 1* includes a single AC power supply module and *Configuration 2* includes a single DC power supply module. The last two package configurations (3 and 4) include the chassis and three (2x4) RFPM modules. *Configuration 3* includes a single AC PS module and *Configuration 4* includes a single DC PS module.

- If you want to use dual-redundant power supply, order any one of the package configurations and the second power supply module *separately*. An APEX1000 chassis supports either one AC PS module, one DC PS module, two AC PS modules, or two DC PS modules. (The APEX1000 does not support the inclusion of both one AC and one DC PS module at the *same time*.)
- If you do not want to use one of the fixed package configurations, you can build your own custom configuration by ordering the APEX components *individually*. You can order the chassis, either one, two, or three RFPM modules (each either 2x4 or 2x8), and either one or two PS modules.

Note: For Annex A, High Density modules provide a ***2x6*** *instead of a 2x8 configuration.*

See QAM Module Upgrade for the procedural steps on submitting a purchase order, acquiring a conversion key, and upgrading your current version of the APEX1000.

8QRM/RF Redundancy

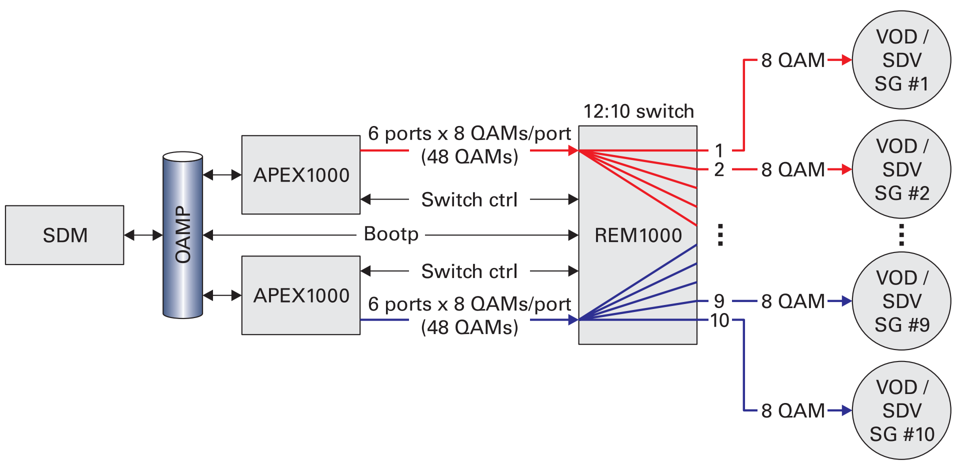
Each APEX1000 unit contains up to three RFPM QAM modules, and each RFPM QAM module consists of two Octal QAM modules (8QRM) sub modules. There are, as a result, six 8QRM sub modules in a fully loaded APEX chassis. The APEX1000 includes support for 8QRM/RF port *narrowcast* redundancy, provided by the *REM1000*. In the APEX module redundancy scheme, one of the 8QRM sub modules within an APEX chassis is designated as the backup; the other five are designated as primaries. If any primary sub module fails, the backup module takes over, and the APEX internally handles the re-routing of the necessary GigE inputs to the backup module.

The following functions are available on an APEX/REM redundancy pair:

- **RF Redundancy** — The APEX provides a redundant backup port which is activated when one of the five remaining primary ports fails. The backup port becomes a copy of the primary port sourcing identical OTSs to the primary prior to its failure.
- **RF Failover** — Occurs when the APEX switches data from the primary port to the backup port (due to a failure event or operator command).
- **RF Switchback** — Occurs when the APEX switches data back from the backup port and returns to the primary port (due to operator intervention or resolution the failure).

On an 8QRM failure, the REM10000 RF switch handles the APEX RF outputs to make certain that the RF signals previously sourced by the failed 8QRM module to a specific downstream service group are now sourced by the backup 8QRM module to the *same* downstream service group.

The graphic below illustrates the association between the REM and the APEX:



- For information on purchasing the REM1000, please contact the Motorola TAC.
- For additional details on 8QRM/RF Redundancy, reference the QAM RF Redundancy Configuration section of this guide.

1:1 Chassis Redundancy

Beginning with software release 2.3.8, the APEX1000 includes support for 1:1 physical chassis redundancy. This is a *broadcast* redundancy scheme in which you may configure a **primary** and a **secondary** APEX.

The Routing, OTS, and QAM Module configurations are synchronized between the two APEXs. The primary and secondary APEXs communicate through heartbeat messages, constantly informing each other about their configuration, role and operating state.

Note: The Chassis Redundancy Configuration section of this guide covers this topic in further details.

Operating Modes

The APEX1000 allows you to dynamically change a QAM channel's operational mode without rebooting the unit; this avoids disturbing the other QAM channels on the QAM Module.

The APEX1000 supports the following operating modes:

- **Session Controlled Mode** — Indicates the mode of a given output, whereby streams are routed to that output under the control of an external controller using either the RTSP, MHA, or RPC protocols.

  A QAM channel in Session Controlled mode can support a combination of SDV and VOD streams. Furthermore, a Session Controlled QAM channel is either in RPC Mode or RTSP Mode, as follows:

  - **RPC Mode** — Indicates the Session Controlled mode that conforms to **ISA** specifications.
  - **RTSP Mode** — Indicates the Session Controlled mode that conforms to **NGOD** specifications.
  - **MHA Mode** – Indicates the Session Controlled mode that conforms to **ERMI** specifications.

- **Manual Routing** — In this mode, you configure the APEX1000 to manually route and re-multiplex input MPEG services, transport streams, or PID streams to a designated output QAM channel.
- **UDP Port Mapping** — Denotes Legacy VOD mode.
- **M-CMTS DOCSIS Enabled** — QAMs designated for this mode will be enabled to receive a DOCSIS PID stream from an M-CMTS using D-MPT encapsulation. (PSP L2TPv3 support will be offered in a future APEX1000 release.)

CAUTION *The APEX1000 does not allow you to change the operating mode or PID remapping mode of QAM output that has any active service or stream mappings. To perform these modifications, you must first delete all service and stream mappings to that output.*

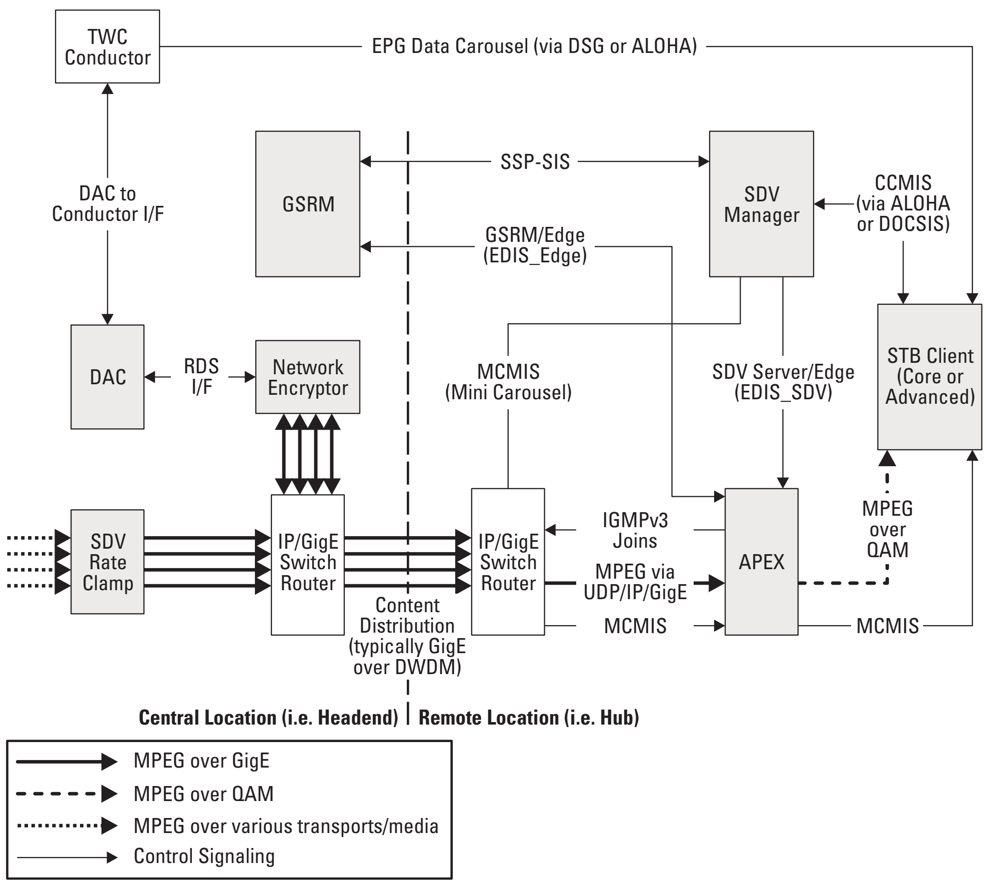
Switched Digital Video

Switched Digital Video (SDV) is a system feature that allows channels on the broadcast line-up to be dynamically switched on and off the HFC network as a function of real time subscriber viewing, such as *channel changes*. In an SDV environment, channels that are not being watched by any subscribers on a given segment of the HFC network (in a given *service group*) can be temporarily removed from the HFC network to make room for other channels that subscribers *do* want to watch. In a network which is properly working, SDV channels and traditional broadcast (linear) channels are indistinguishable to the subscriber. However, using SDV, an MSO can offer a given set of channels that use half (or less) of the HFC bandwidth, as compared to the linear broadcast method.

As previously discussed in Session-Oriented VOD, there are also two major industry architectures that address SDV, *RPC* and *RTSP*.

RPC Mode SDV

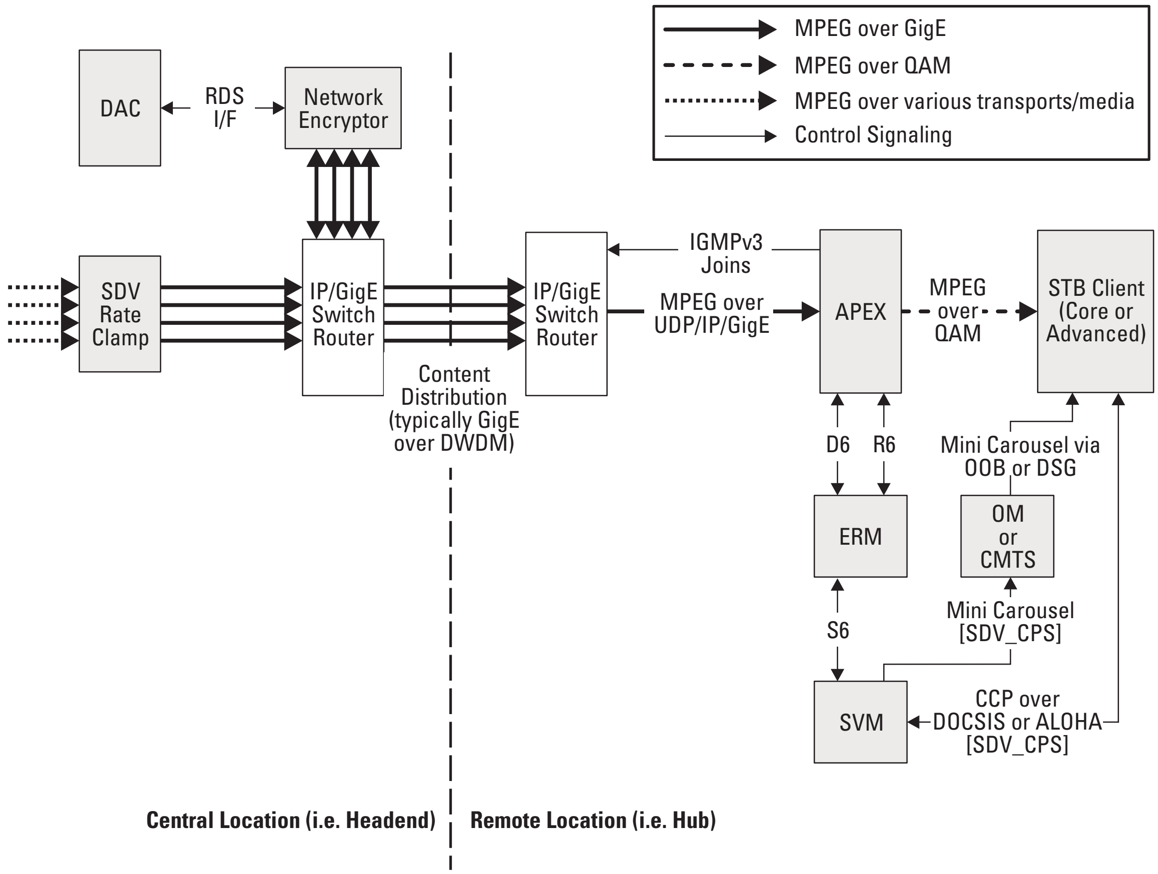
The figure below illustrates the RPC Mode SDV architecture:



Note: Shown with Motorola components, as well as the Time Warner Conductor required to support the TWC guide/SDV client (MDN/ODN) running in the set-top.

RTSP/MHA Mode SDV

The following figure illustrates the RTSP Mode SDV architecture, shown with Motorola components. Note that in MHA mode, the D6 and R6 interfaces are ERMI-1 and ERMI-2 respectively:



CAUTION *In the RTSP system, the ERM (Edge Resource Manager) is the complete manager of the edge device; RTSP does not split the creation of shell sessions and binding of sessions between two separate controllers (as is the case in RPC).*

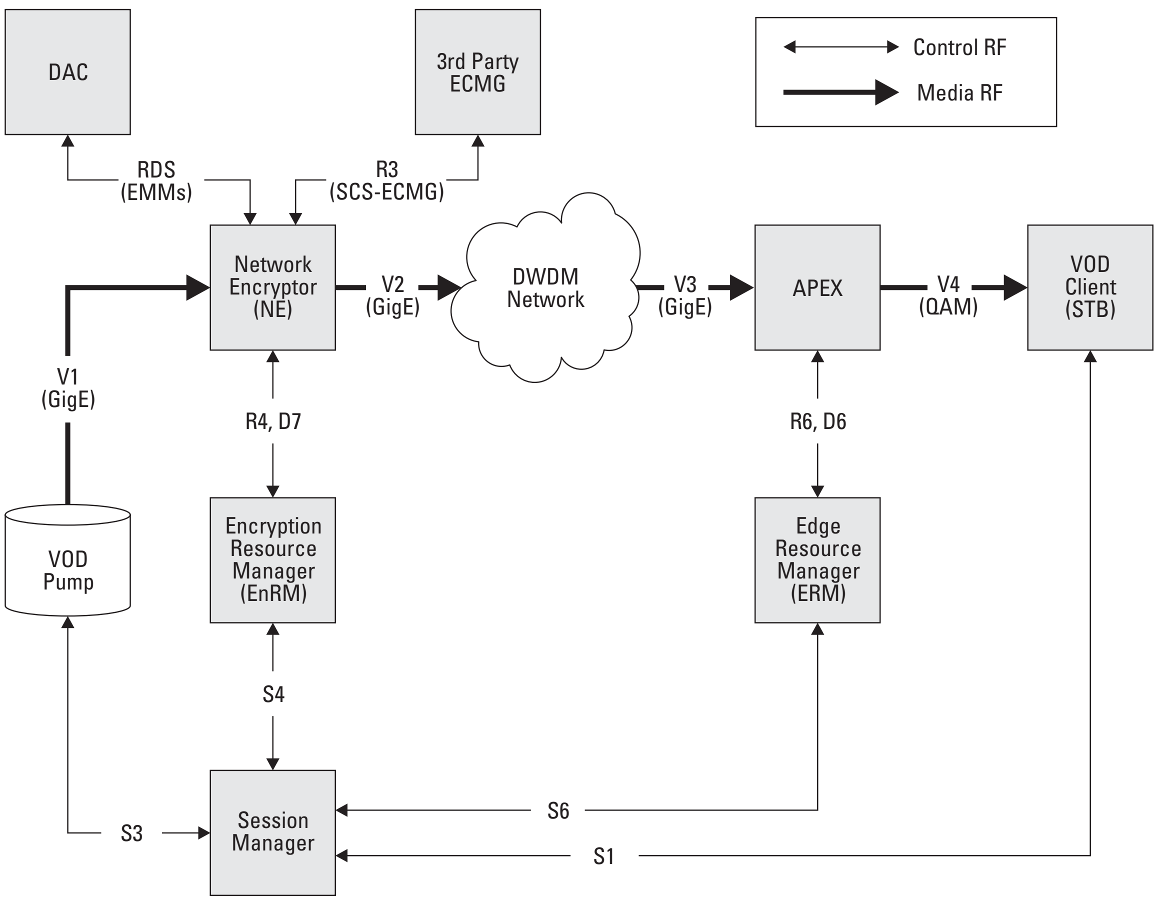
Session-Oriented VOD

There are three leading session VOD architectures, *RTSP, MHA,* and *RPC*.

- **Legacy** VOD architectures are based on *UDP port mapping* algorithms, which are static from the view of the Edge QAMs.
- **Emerging** VOD architectures are *session oriented*, whereby each VOD session is signaled through the whole network.

RTSP/MHA Architecture

RTSP (Real Time Streaming Protocol) and MHA are on-demand network control systems. MHA and RTSP are similar and utilize the same protocols for communication and control. The figure below illustrates this architecture:



The following table briefly describes the various interfaces shown in the preceding figure:

Interface Name	Description	Related/Underlying Protocols
S1	Session control between Session Manager and Client (STB)	RTSP and/or DSM-CC
S3	Session control between Session Manager and VOD server	Based on RTSP
S4	Session control between Session Manager and Encryption Resource Manager (EnRM)	Based on RTSP
S6	Session control between Session Manager and Edge Resource Manager (ERM1000)	Based on RTSP
R3	Encryption Control Word exchange between ECMG and encryptor (essentially the SCS-ECMG SimulCrypt interface with some extensions)	ECMG-SCS SimulCrypt
R4	Right Meta Data (RMD) provided from EnRM to encryptor	RTSP
R6	Session signaling between ERM1000 and Edge QAM	Based on RTSP
D6	Auto-discovery from Edge QAM to ERM1000	Based on VREP
D7	Auto-discovery from encryptor to EnRM	Based on VREP
V1	Video streams at the output of the VOD server	SPTS MPEG/UDP/IP over GigE
V2	Encrypted Video streams at the output of the encryptor	SPTS MPEG/UDP/IP over GigE
V3	Video streams as carried over the IP/GigE network	SPTS MPEG/UDP/IP over GigE
V4	Video over QAM to HFC network	MPTS over QAM

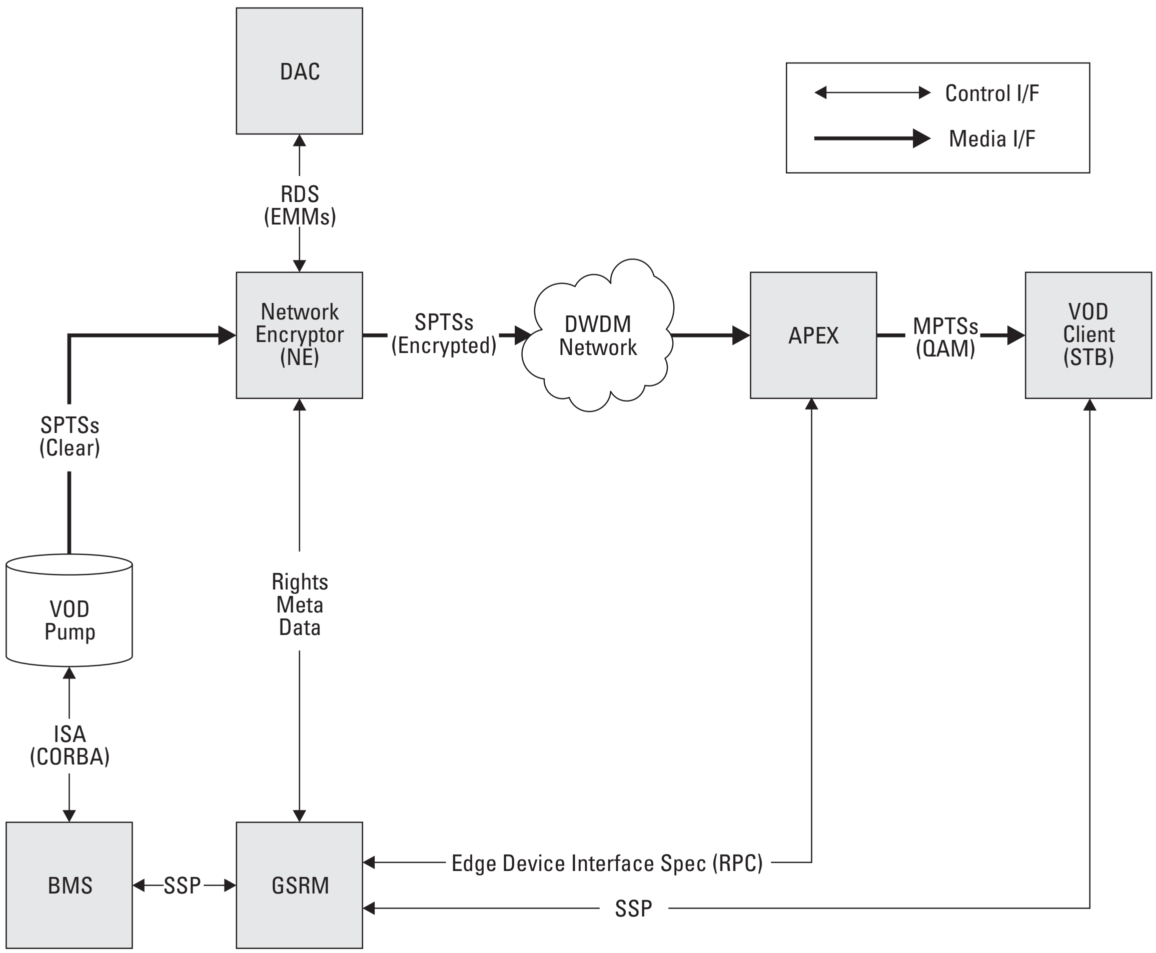
From the perspective of the APEX1000, the major RTSP/MHA VOD control interfaces are *R6* and *D6* from the Edge Resource Manager (ERM1000).

- The ERM1000 uses **D6** to discover the Edge QAM (the APEX1000) and its capabilities.
- **R6** routes individual VOD sessions through the APEX1000, from an SPTS input at the GigE interface to a program in an MPTS QAM output.

The other interfaces shown above relate to other functions and components in the RTSP/MHA network, from the STB client, to the VOD streaming server, to the encryptor. These are all controlled by the Session Manager.

RPC Architecture

The figure below illustrates the RPC session VOD architecture:



From the APEX1000 perspective, the major difference between the RTSP and RPC session VOD systems is that with RPC, sessions are routed through the APEX1000 using the Edge Device Interface Specification (RPC-based protocol) rather than the R6 (RTSP-based protocol); otherwise, the APEX1000 performs basically the same function in both architectures.

Encryption in RPC Session VOD

As previously described in RTSP/MHA Architecture, the encryption and Edge QAM pieces are nominally separated in the RPC architecture. Therefore, as shown in the preceding graphic, the Network Encryptor (NE) is positioned to perform the encryption. The APEX1000 then takes already encrypted SPTSs at its input and routes them to the appropriate output per the Edge Device Interface Specification (EDIS).

MC Encryption and Access Control

The APEX1000 architecture uses a custom encryption FPGA as its encryption engine. In the SEM, MediaCipher® (MC) devices are used to encrypt transport streams. The APEX1000 still uses MCs, which are used to generate the encryption keys, but the actual packet encryption is done by two Encryption FPGAs.

Each FPGA can support the encryption of 24 full rate MPTSs (48 MPTSs in total). Using this architecture, the APEX1000 is able to support the encryption of up to 768 services across all 48 QAM outputs.

Encryption Algorithms

The APEX1000 supports several encryption standards and algorithms. These algorithms operate at the packet scrambling level, and are compatible with any of the access control modes that the APEX1000 supports. Each APEX1000 chassis may be configured for a single encryption algorithm, which is then applied to all encrypted streams on that chassis.

The supported encryption algorithms are:

- **DES (DCII)**
- **DES (SCTE-52)**
- **DVB-CSA**
- **DVB-CSA SimulCrypt**

Supported Encryption Types

The APEX1000 supports three encryption types:

- **Broadcast Encryption** (BE) — This encryption type is used with traditional broadcast services in Manual Routing mode.
- **Common Tier Encryption (CTE)** — This encryption type is typically used for legacy VOD in UDP Port Mapping mode, or Session-Controlled mode.
- **Session VOD Encryption (SVE)** — This encryption type is used for encrypting VOD services in Session-Controlled mode. (Only available in MHA SDV mode.)

In addition, the APEX1000 can take in services which have been encrypted by another device (either pre-encrypted by an OLES, or encrypted by an upstream Network Encryptor), and properly mux in those services to the appropriate output(s).

NOTE: The APEX1000 will not re-encrypt a service that has already been encrypted.

Entitlement Control Message Generation

In contrast to the traditional DAC 6000-queued operation supported by the SEM, the APEX1000 internally generates the appropriate ECMs *at the same time as* it performs the encryption.

While in all cases the APEX1000 internally creates the ECMs, the access requirements (Rights Meta Data) for a given stream are determined by the APEX1000 by the DAC (through its RDS interface), by the session controller setting up a VOD session, or through configured defaults on the APEX1000. The actual method depends on the encryption mode:

- **Broadcast Encryption**
- **Common Tier Encryption**
- **Session VOD Encryption**

Broadcast Encryption

RMD from the DAC — Use this mode for unique tier and other access requirements applied to each service, and retrieved using the DAC's Rights Data Server (RDS) XML interface. In this manner, the APEX1000 behaves similarly to the NE1000 Network Encryptor.

CAUTION *Use the RMD from the DAC mode only for manually routed services.*

Common Tier Encryption (CTE)

RMD configured on the APEX — Use this mode to apply default access requirements across all services. The same operator configured tier value is applied to all services encrypted in this mode.

Note: This mode is typically used for UDP port mapped VOD services or session controlled switched digital video services, but you can also use it for manually routed services.

MHA VOD Session Encryption

The APEX1000 supports session-based encryption in MHA mode.

In this mode, a set-top client is assigned a unique tier by the DAC. When the set-top requests a VOD session, in addition to access requirements for the VOD service, the session controller passes a set-top identifier to the APEX1000 in the RTSP session setup message. The APEX1000 uses this information to encrypt the session with the same unique tier assigned to the set-top by the DAC and the appropriate rights meta data.

Note: Only the requesting set-top may decrypt the session.

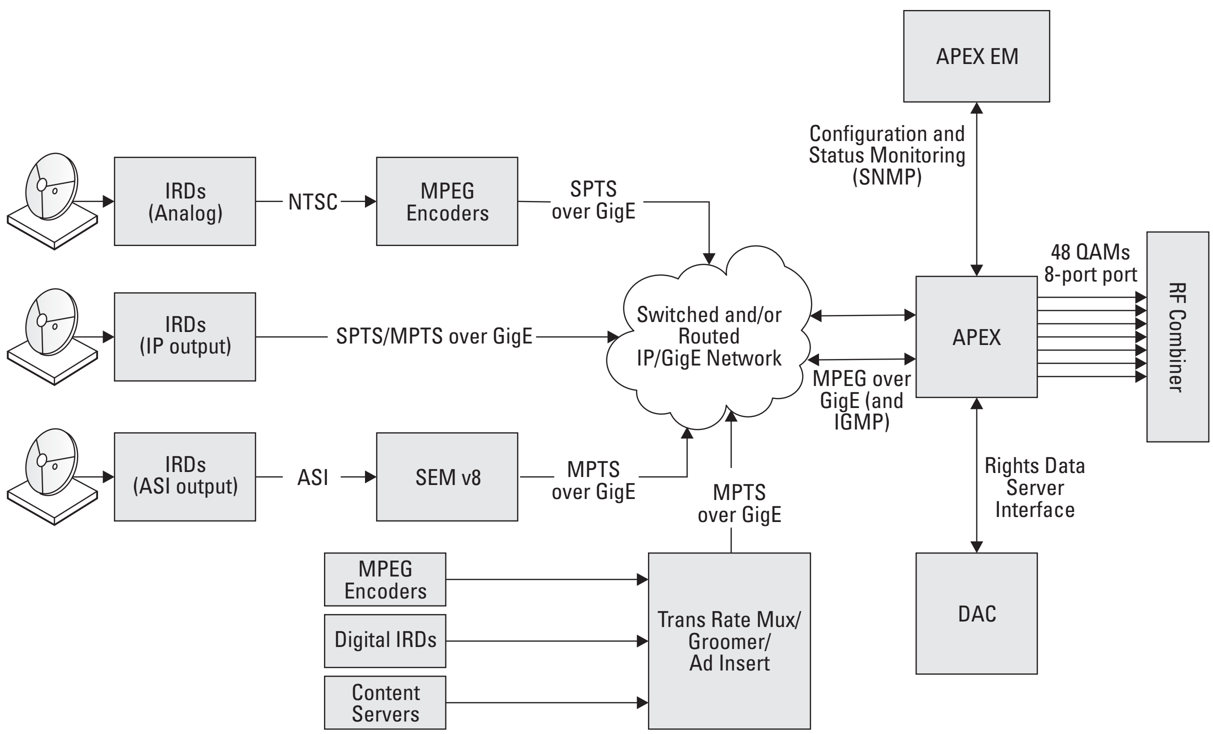
The following table lists the individual characteristics of each encryption mode:

Mode	Application	RMD Source/Interface	Access Characteristics
Broadcast Encryption	Broadcast/Linear content	DAC by means of the RDS Interface Protocol	Unique tier(s) and copy protection are applied to each service
Common Tier Encryption	UDP Port Mapped VOD, Session Controlled, and Manual Route	Configured statically in the APEX1000	Single tier and copy protection are applied to all streams
Session VOD Encryption	VOD Session Controlled in MHA mode only	SVM/ERM by means of the ERMI-2 interface	Unique tier and copy protection settings are applied to each service

Broadcast Encryption

Broadcast Encryption in Manual Routing Mode

The APEX1000 supports the processing of linear broadcast services with encryption:



CAUTION *You must convert all ASI outputs from IRDs or encoders to GigE before sending them to the APEX1000. As shown in the preceding graphic, you can perform this conversion using a SEM v8. Additionally, the Motorola AGB240 (ASI to GigE Bridge) can also be used to convert ASI into GigE.*

Please note that for *broadcast services*:

- Services are not queued by the DAC 6000
- Stream input to the APEX1000 must be over GigE interface
- The APEX1000 Element Manager (EM) is responsible for configuring the device, including the routing of all services. The DAC 6000 provides EMMs and service-specific rights data through the RDS interface
- The APEX1000 can remux services, but does not support trans-rating
- The APEX1000 will (or will not) encrypt each individual stream based on the data for that service received from the DAC using the RDS. The APEX1000 will also insert the appropriate copy protection data (CCI, APS, CIT)
- The APEX1000 can accept incoming services that are already encrypted and route them appropriately, without disrupting the timing between ECMs and video/audio packets

Note: The APEX1000 does not currently support IPPV/PPV services; a future version will offer this support.

Broadcast Services — Rights Meta Data

When encrypting linear broadcast streams, the APEX1000 extracts the associated access control related information such as the Rights Meta Data (RMD) from the DAC 6000 using the RDS (Rights Data Server) interface.

This information includes the following:

- The tier(s) associated with the service
- The encryption mode:
  - Clear/Unencrypted (no ECMs are inserted)
  - Unencrypted with CCI
  - Pre-Encrypted (same as Clear/Unencrypted, with the exception that input service is checked for pre-encryption)
  - Full encryption
  - Fixed program key
  - Fixed working key
- The copy control data (CCI, APS, and CIT settings)

Common Tier Encryption (CTE)

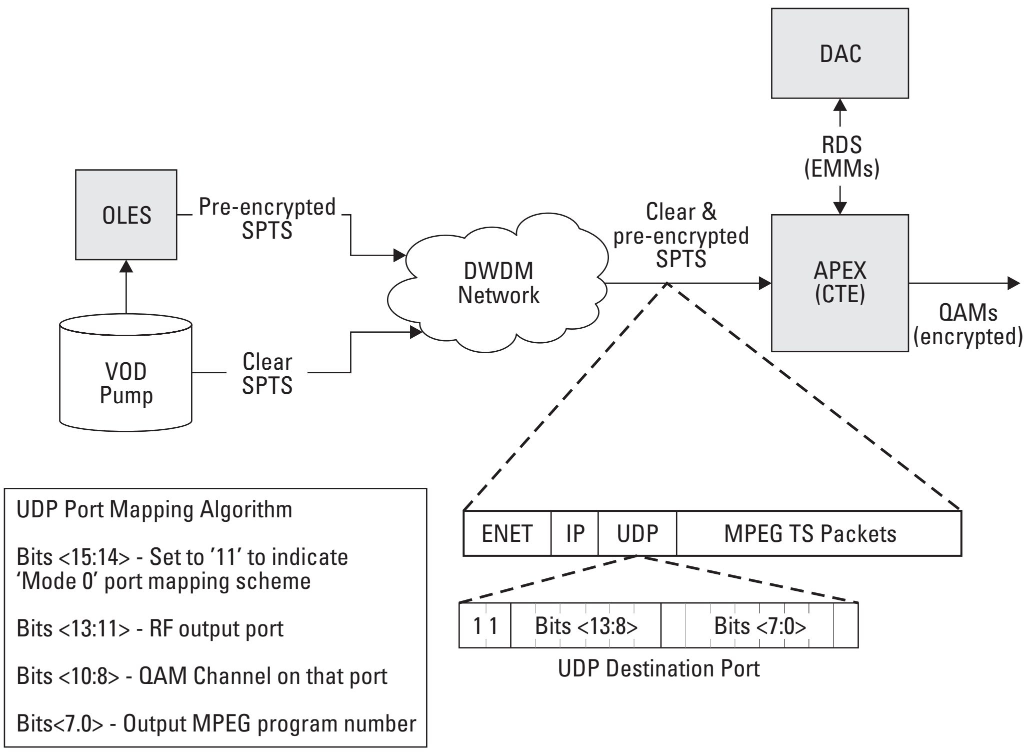
When enabled, all services on a QAM channel are encrypted with the same encryption mode, tier, and RMD (configured on the APEX1000 through the EM).

Note: This encryption applies to both legacy VOD and switched digital modes of operation.

CTE in UDP Port Mapping Mode (Legacy VOD)

The APEX1000 supports the legacy VOD operation, also known as the UDP Port Mapping scheme. In this UDP Port Mapping scheme, VOD SPTSs are delivered to the APEX1000 through GigE and muxed by the APEX1000 onto outgoing QAM MPTSs.

In this mode, the APEX1000 is not signaled regarding individual VOD sessions; instead, it routes each incoming stream to the appropriate QAM with the appropriate MPEG Program Number as a static function of the destination UDP Port of the incoming SPTS. The following graphic shows this architecture:



Note: The figure above shows the standardized port mapping mode as defined by Harmonic. While other schemes have been used (and were supported by the SEM), the APEX1000 will only support this exact scheme.

Additional Notes:

1. To apply a basic level of encryption (mostly for privacy) to each stream, the APEX1000 is typically configured for CTE (common tier encryption).

2. Incoming streams may already be encrypted (perhaps using the OLES for pre-encryption), in which case the APEX1000 muxes the stream as is, without disrupting the encryption or ECMs.

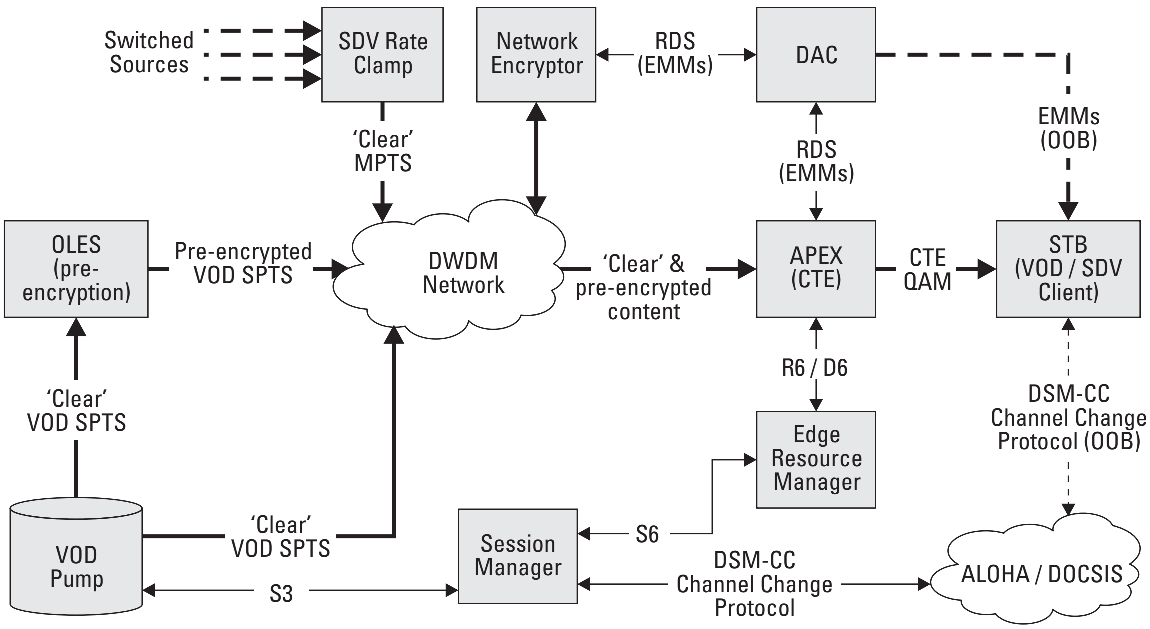
3. Typically, the VOD streams will be Constant Bit Rate (CBR), usually 3.75 Mbps for video services, to allow for simpler and well-behaved remuxing (10 services per 256 QAM mux).

CTE in RTSP/MHA Mode (SDV)

In a typical switched digital headend, the encryption and modulation functions are separated. The APEX1000 can perform both of these functions.

While operating in RTSP mode, the APEX1000 can encrypt switched content using Common Tier Encryption. In this mode, all switched QAMs in a service group will have the same configured RMD and encryption settings.

The following graphic demonstrates how CTE can be applied in an RTSP switched digital headend:



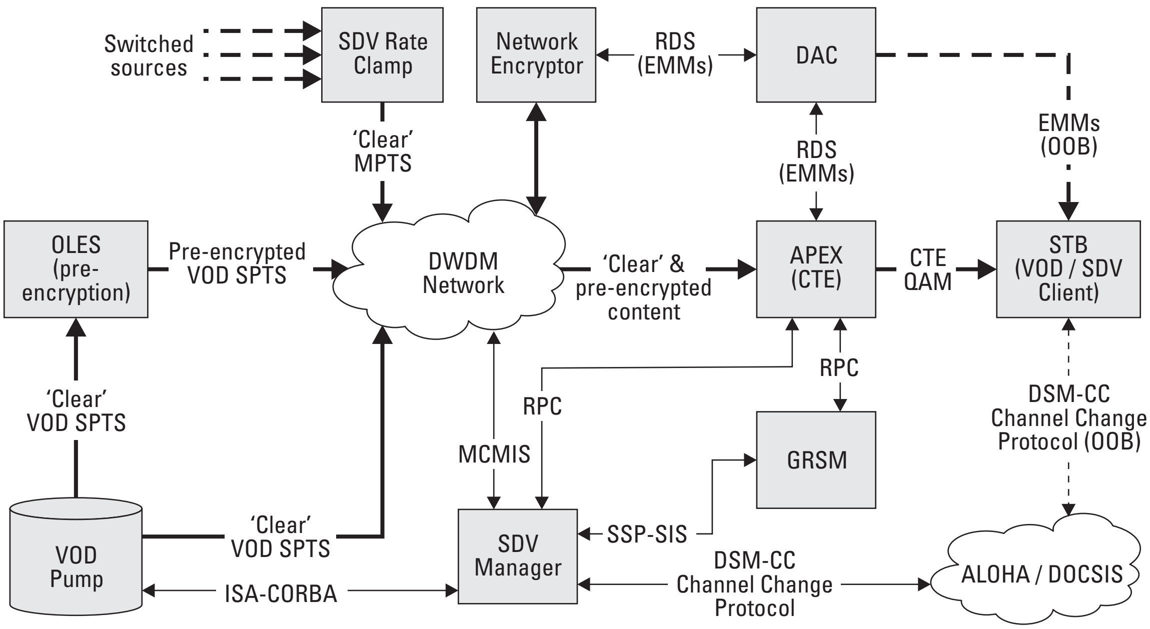
Note: Multiple encryption paths are possible using an OLES, the Network Encryptor, or the APEX1000 itself.

CTE in RPC Mode (SDV)

As shown in CTE in RTSP/MHA Mode, the Encryption and Edge QAM pieces are nominally separated in the SDV architecture. Therefore, as demonstrated in the preceding graphic, the Network Encryptor is positioned to perform the encryption.

The APEX1000 receives already encrypted SPTSs at its input, and routes them to the appropriate output according to the RPC control. This encryption procedure may also be performed at the edge level through the APEX1000 using CTE.

The following graphic demonstrates this architecture:



Maximizing Throughput in SDV Operation

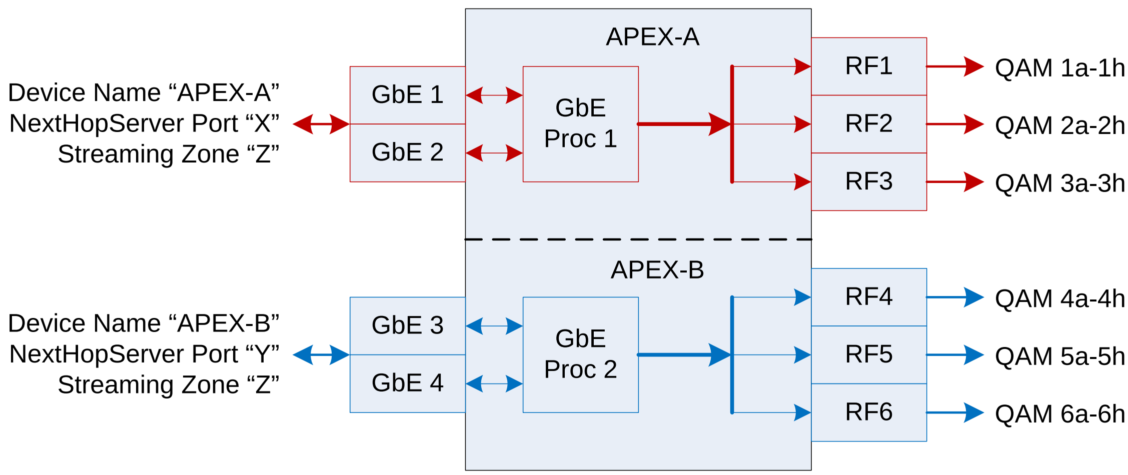
RTSP/MHA Paired Port Assignment

Prior to APEX1000 2.0, the APEX1000 could report a single pair of GigE ports to the ERM. Users could then enable all 48 QAMs for SDV mode, allowing the ERM to map streams from any enabled GigE input port to any enabled QAM output port. However, this also meant that the APEX1000 was constrained by the output bandwidth of a single GigE processor limited to 931 Mbps output bandwidth (approximately 24 QAMs).

APEX1000 2.0 introduced an RTSP/MHA mode option known as *Paired Port Assignment*. This mode logically divides the APEX into two devices which are reported to the ERM:

- **GigE Port 1 and 2:** QAMs 1 – 24 (1a-1h, 2a-2h, 3a-3h)
- **GigE Port 3 and 4:** QAMs 25 – 48 (4a-4h,5a-5h,6a-6h)

Each GigE processor is assigned a strict *input-to-output* mapping:

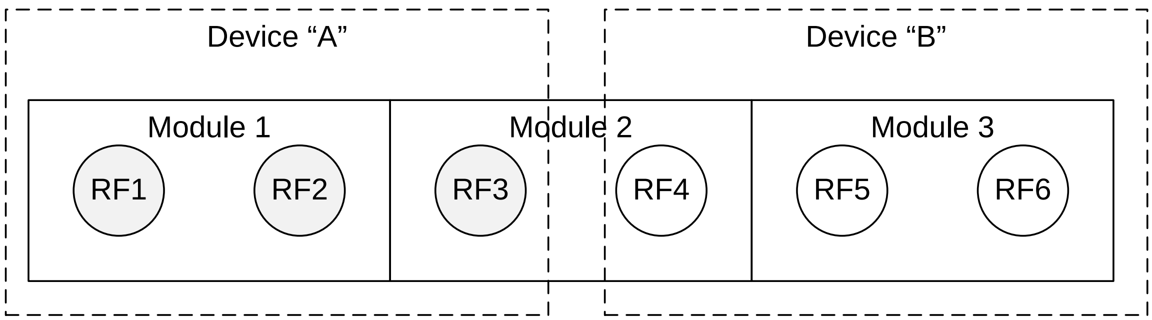


RTSP options

Reporting Mode	Input	Output	Available Bandwidth
None	N/A	N/A	N/A
GigE 1 & 2	GigE Ports 1 – 2	QAMs 1 – 48	931 Mbps
GigE 3 & 4	GigE Ports 3 – 4	QAMs 1 – 48	931 Mbps
Paired Port Assignment	GigE Ports 1 – 2 GigE Ports 3 – 4	QAMs 1 – 24 QAMs 25 – 48	1.862 Mbps

In RTSP/MHA Paired Port Assignment mode, the APEX is logically split across physical port boundaries. The APEX initiates two VREP sessions, one for each logical device. Sessions are distinguished by `VREP Device ID` and `NextHopServer Port Number` parameters, and each session advertises a different device name and port. Within these sessions, the APEX reports the set of QAMs allocated to each logical device using the mapping shown in the previous figure and in the figure below. Out of these, only QAMs allocated to session control are reported.

The I/O mapping is still *any to any* from the perspective of the ERM, which sees two 24 QAM devices, instead of a single 48 QAM device:



Transitioning Between Modes

As session-controlled QAM capacity on the APEX increases and decreases, you can transition the APEX into and out of RTSP Paired Port Assignment mode.

- The APEX is able to transition to paired port mapping mode from a single GigE pair reporting mode—or from startup—without rebooting.
- The APEX can transition from paired port mapping mode to a single GigE pair reporting mode.

All active switched sessions are withdrawn between transitions, as the device logically reconfigures itself, reporting this configuration change to the ERM.

RPC Mode

When configuring the APEX1000 for RPC mode, you must provide the input-to-output mapping through the EM or SDM configuration screens. As is the case with RTSP mode, you should avoid assigning more than 24 QAMs to a single GigE input pair.

Note: There are no updated options to support over 24 QAMs in RPC mode; as this mode is natively supported, you need only assign 24 or fewer QAMs to each GigE input pair.

3 Installation

Step-by-Step Instructions

The following topics cover the basic steps required to install the APEX1000:

- Mounting the APEX1000
- Connecting the Interface Cables
- Applying Power to the Unit
- Confirming APEX1000 Power-on Sequencing

To make the procedure as quick and easy as possible, take a few minutes to review the installation information, gather any special tools, procure any items not supplied with shipment, and complete the tasks listed below *before* you begin the installation.

Package Contents

Confirm that you have received the following items with the APEX1000 shipment:

Item	Quantity	Description
APEX1000 unit	1	The APEX1000 device configured with hardware as ordered
Mounting screws, 10-32, 0.5 inches long, Phillips, round, with plastic washer	4	Provided to mount front of unit in the rack
Rear mounting brackets	2	Provided to support rear of unit in the rack
Mounting screws, 10-32, 0.5 inches long, Phillips	4	Provided to mount rear brackets to the rack
As applicable: **AC cord, 3 conductor, 7 feet 6 inches, 18AWG** ***or*** **DC cord, 3 conductor, 15 feet**	1 or 2 (depending on ordering criteria)	Power cord(s) for unit

Other Required Items

As determined by the APEX1000 system implementation and installed options, to complete the installation you will also need the items listed below:

Front Panel Connections	
User-Supplied Item	**Description**
Ethernet cable with RJ 45 connector	Use this cable for connecting to OAM&P system interface ENET1.
Ethernet cable with RJ 45 connector	Use this cable for In-band data service connection to ENET2.
Up to Four SFP GigE Modules*	Required for the four GigE ports to establish connections with the GigE network.
** Motorola now supplies certain types of SFP modules. For additional information, see Certified SFP Transceiver Vendors.*	

Rear Panel Connections	
User-Supplied Item	**Description**
Up to Six RF coaxial cables with "F" type connectors	Use for connection to the three optional QAM module RF #1 and RF #2 connectors.

CAUTION *The user-supplied items listed above are not included with the APEX1000. To complete the installation, you must obtain or fabricate any necessary cables.*

Check the cabling guidelines provided in Cabling Specifications for the length restrictions, connector, and cable or wire type for each connection required for your system.

Mounting the APEX1000

Mount the APEX1000 in a standard 19-inch rack. It is not necessary to provide an open space above and below the unit for air flow. If the equipment operates continuously in a closed cabinet, use forced air circulation to ensure maximum equipment life and optimum performance. Please keep in mind the following important points:

- Improper grounding may damage the APEX1000. Refer to national guidelines or local standards for properly grounding the unit to equipment racks, and to the building grounding system.
- Secure the rack to the building structure before APEX1000 operation.
- The APEX1000 chassis rear support brackets must be installed and secured to the equipment rack.

The correct equipment rack mounting instructions for the APEX1000 are provided below:

- **Elevated Operating Ambient** — If the units are installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tmax) specified by the manufacturer.
- **Reduced Air Flow** — Installation of the equipment in a rack should not compromise the amount of air flow required for safe operation of the equipment.
- **Mechanical Loading** — Mounting of the equipment in the rack so that uneven mechanical loading does not create a hazardous condition.
- **Circuit Overloading** — Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring.

Warning! Use appropriate consideration of equipment nameplate ratings when addressing this concern.

- **Reliable Earthing** — **CAUTION:** Separate protective earthing terminals are provided on the rear of the chassis. These earthing terminals must be permanently connected to earth by a SERVICE PERSON.

Rack Mounting

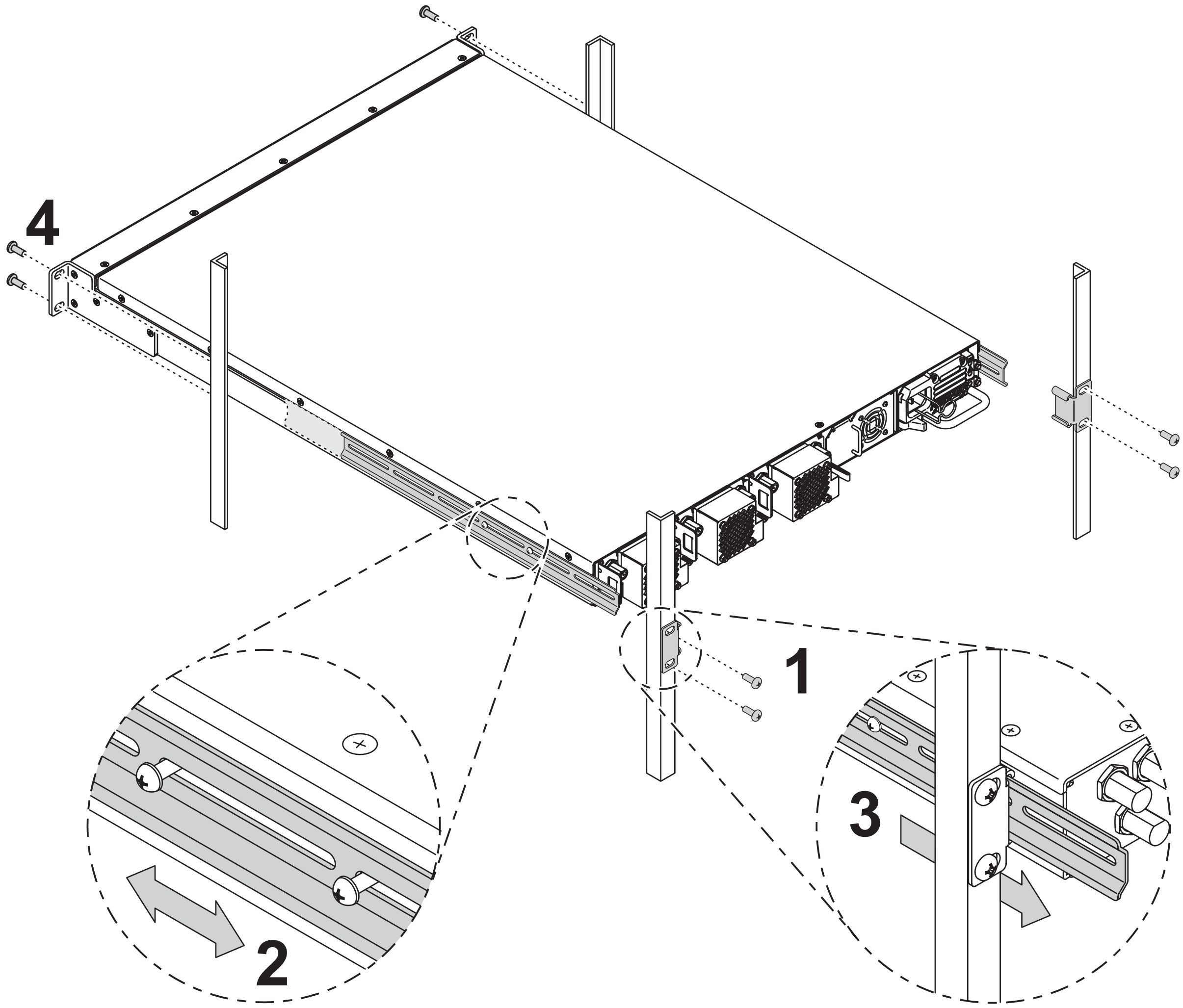
To mount the APEX1000 in the rack:

1. Install the two mounting brackets to the rear mounting angles on the rack using four #10 32 x .50-inch long screws (without plastic washers).

CAUTION *Do not tighten the screws for each bracket at this time.*

Figure 3-1 shows a detailed diagram of the APEX1000 rack mounting procedure.

Figure 3-1 — APEX1000 rack mounting



2. Extend the two pre-attached support rails on the sides of the APEX1000 as necessary to ensure they will pass-through their respective rear brackets when the APEX1000 is mounted to the rack.
3. Insert the APEX1000 into the rack by sliding the side support rails through the rear mounting brackets.
4. Secure the front of the APEX1000 to the front rack angles with the four #10 (32 x .50-inch) long screws and plastic washers.
5. Tighten all screws.

Installing or Removing GigE SFP Transceivers

The GigE requires certified Small Form Factor Pluggable (SFP) transceivers.

- For a list of approved SFP transceivers, reference Certified SFP Transceiver Vendors.
- Refer to vendor documentation for proper handling, cleaning, and maintenance of SFP transceivers. For further information, visit that vendor's website:
  - http://www.avagotech.com/
  - http://www.ocp-inc.com
  - http://www.methode.com
  - http://www.finisar.com
- Generic SFP transceiver installation and removal instructions are listed below. Refer to vendor documentation for specific SFP transceiver installation and removal instructions.

Installing Transceivers

1. Remove the dust plug from the selected APEX1000 front panel GigE port. Save the dust plug, should it become necessary to recap the port when not in use.
2. As shown in Figure 3-2, make certain that the SFP transceiver door is closed and the hinge faces down, toward the bottom of the APEX1000.
3. Gently push the SFP transceiver into the GigE port.
4. Repeat steps 1–3 to install the remaining GigE SFP transceivers.

Removing Transceivers

1. Open the hinge door of the SFP transceiver.
2. Gently pull the SFP transceiver from the GigE port.

Note: Install a dust plug in the GigE port if it is not being used at this time.

SFP Transceiver Status

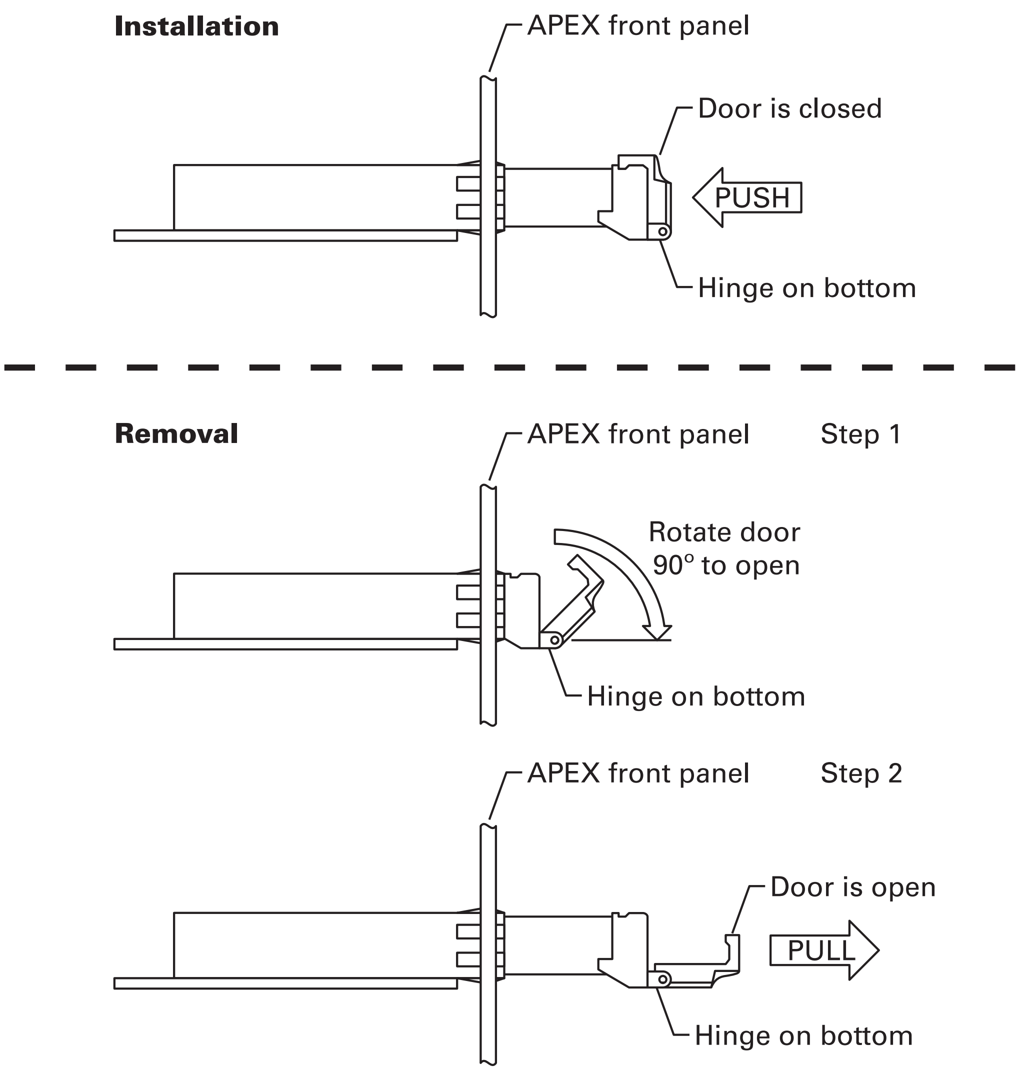
To confirm the functionality of certified installed SFPs, use the SFP Status window.

From this window, you can also access the following information:

- Supplier and Motorola part numbers
- Nominal bit rate
- Laser wavelength
- Supply voltage
- Diagnostics

For further details and a complete list of values, reference SFP Status.

Figure 3-2 — Typical SFP transceiver installation/removal



Connecting the Interface Cables

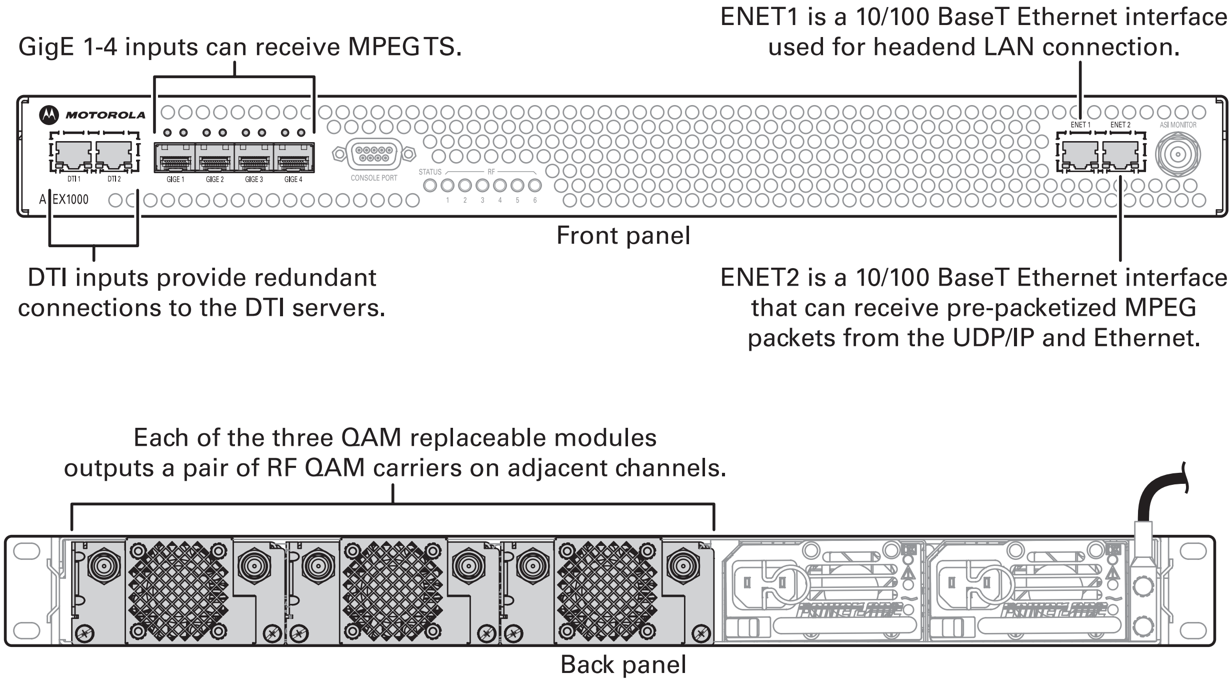
The Ethernet interface cable from ENET1 to the headend LAN is the only standard cabling. All other interface cabling is contingent upon the APEX1000 configuration (as defined by the specific system implementation).

Inserting or Removing Cables

Common *F and BNC* tools facilitate the insertion or removal of connectors from the APEX1000. Typical tools are:

- The "**F**" connector removal tool from Toner (part number XQT)
- The **BNC** tool from Techni Tool (part number 702SC007)

Figure 3-3 — APEX1000 front/rear panel I/O cable connectors



CAUTION	*To function properly, all RF Outputs must be terminated with 75 Ohms for the internal RF Power Level detector. Unterminated RF Outputs may trigger an APEX RF Low Alarm.*

APEX1000 Power Connections

Connecting to AC Power

Warning! To prevent electrical shock, do not use the polarized power cord with an extension cord, receptacle, or other outlet unless all blades can be fully inserted to prevent blade exposure.

- For AC units:
  - Use only an AC power cord that complies with the destination country's product safety requirements.
  - Connect the AC power cord *after* all I/O connections are complete. The power supply automatically senses and adapts to any input from 100 through 240 V AC, at 50 through 60 Hz.

Connecting to DC Power

Warning! The APEX1000 with DC power must be installed in a restricted access area.

Typical –48 V DC system installation specifications

Line Cord Wire Color	Description	Typical Connection for –48 V DC System
Red	Hot (–)	Connect to negative terminal of 48 V DC source
Black	Return (+)	Connect to positive terminal of 48 V DC source (Positive terminal of 48 V DC source may be connected to chassis ground)
Green with yellow stripe	Chassis Ground	Connect to chassis ground
Note: The input of the power supply is isolated from chassis ground. Either the positive or the negative input terminal can be grounded, as determined by the application.		

CAUTION: This equipment is designed to permit the connection of the earthed conductor of the DC supply circuit to the earthing conductor at the equipment. (APEX1000 DC version only).

- For DC units:
  - Use the DC power cord assembly provided.
  - Only connect the DC power cord *after* all I/O connections are complete. The power supply automatically senses and adapts to any input from –40 through –60 V DC.
  - Connect this equipment directly to the DC supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the DC supply system earthing electrode is connected.
  - Locate this equipment in the same immediate area (such as adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same DC supply circuit and the earthing conductor, and also the point of earthing of the DC system. Do not earth the DC system elsewhere.
  - Place the DC supply source within the same premises as the equipment.
  - Do not position switching or disconnecting devices in the earthed circuit conductor between the DC source and the point of connection of the earthing electrode conductor.

CAUTION *This unit has up to two (2) 100 –240 V ∿ or two (2) –48 V ⎓ input power feeders. Disconnecting less than the maximum will not de-energize the system. To reduce the risk of injury, disconnect all power feeders when removing power to the system.*

Confirming APEX1000 Power-on Sequencing

When power is applied, the STATUS LED indicates APEX1000 sequencing as follows:

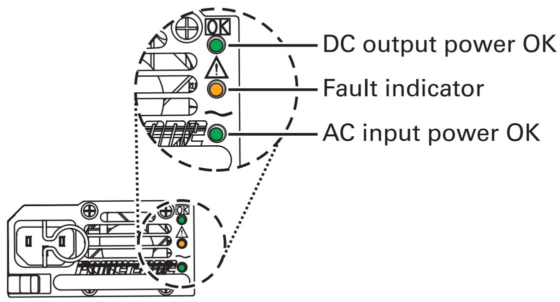
LED Color	Condition
Blinking Red	Initially, the STATUS LED blinks red to indicate the APEX1000 is performing a memory test.
Blinking Yellow	Sequentially, the STATUS LED blinks yellow to indicate a successful memory test completion and boot code execution.
Blinking Green	The STATUS LED then starts blinking green to indicate that the application code is configuring the APEX1000 for operation.
Blinking Red and Green	Finally, all of the LEDs blink red, and then green.
Solid Green	When the STATUS LED is solid green, it indicates the unit is operational.

- If the STATUS LED is yellow or solid red, but the error does not prevent activating the APEX1000 EM, proceed to APEX1000 Verification.
- If the STATUS LED is yellow or solid red and the error precludes activating the APEX1000 EM to perform the APEX verification, reference Troubleshooting for help with many common problems.

Power Supply External Status Indicators

Each AC or DC power supply's rear panel is equipped with three status indicator LEDs. These LEDs monitor AC/DC Input Power, DC Output Power, and Fault conditions.

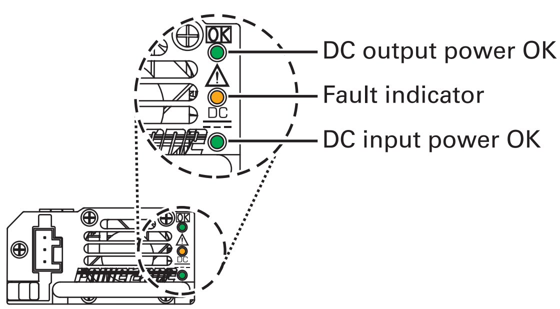
AC Module



The following table describes AC module LED indicator conditions:

Indicator	LED Color	PS LED Location
DC Output Power OK	Green	Top
Fault Indicator	Amber	Middle
AC Input Power OK	Green (input>85VAC)	Bottom

DC Module



The following table describes DC module LED indicator conditions:

Indicator	LED Color	PS LED Location
DC Output Power OK	Green	Top
Fault Indicator	Amber	Middle
DC Input Power OK	Green (input <-40VDC)	Bottom

APEX1000 Verification

The following procedure is a quick and simple method to determine if the APEX1000 is operating properly.

CAUTION *Verification requires the use of the APEX1000 EM. If you have not yet downloaded the EM Java applet, see Initiating an EM Session for additional information.*

To begin the verification procedure:

1. Login at the Element Manager.
2. Select **Status > Alarms**.

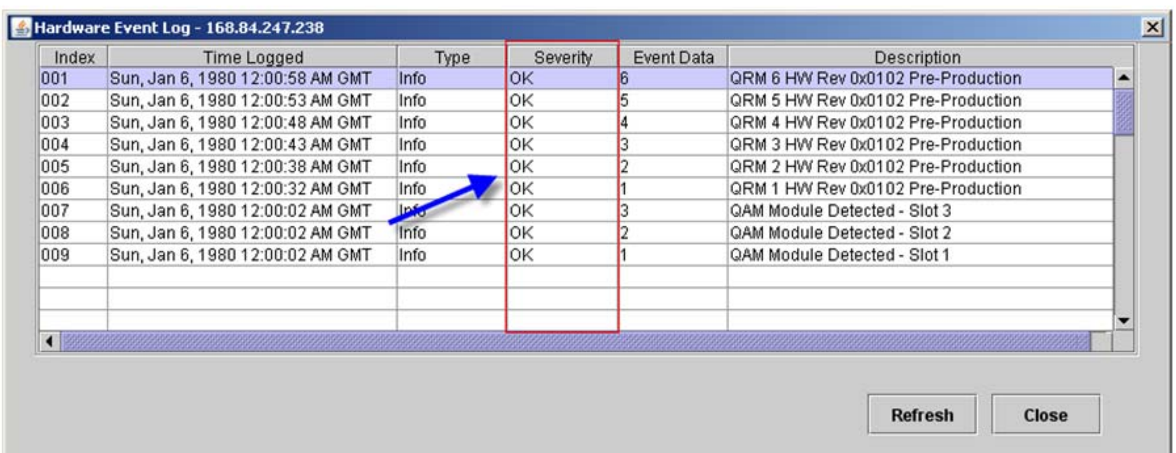
   The Alarms window displays.
3. Verify current alarms status.

   Alarm Color Schemes:

   - Solid **Green** — indicates power on and no faults
   - Solid **Yellow** — indicates a Minor or Warning alarm
   - Solid **Red** — indicates a Critical or Major alarm

   Note: The Alarms Status displays automatically upon login if any alarm is currently active on the unit. The Alarms GUI will not display on login if NO alarms conditions exist.
4. Select **Status > Hardware Events**.

   The Hardware Events Log screen displays:



Index	Time Logged	Type	Severity	Event Data	Description
001	Sun, Jan 6, 1980 12:00:58 AM GMT	Info	OK	6	QRM 6 HW Rev 0x0102 Pre-Production
002	Sun, Jan 6, 1980 12:00:53 AM GMT	Info	OK	5	QRM 5 HW Rev 0x0102 Pre-Production
003	Sun, Jan 6, 1980 12:00:48 AM GMT	Info	OK	4	QRM 4 HW Rev 0x0102 Pre-Production
004	Sun, Jan 6, 1980 12:00:43 AM GMT	Info	OK	3	QRM 3 HW Rev 0x0102 Pre-Production
005	Sun, Jan 6, 1980 12:00:38 AM GMT	Info	OK	2	QRM 2 HW Rev 0x0102 Pre-Production
006	Sun, Jan 6, 1980 12:00:32 AM GMT	Info	OK	1	QRM 1 HW Rev 0x0102 Pre-Production
007	Sun, Jan 6, 1980 12:00:02 AM GMT	Info	OK	3	QAM Module Detected - Slot 3
008	Sun, Jan 6, 1980 12:00:02 AM GMT	Info	OK	2	QAM Module Detected - Slot 2
009	Sun, Jan 6, 1980 12:00:02 AM GMT	Info	OK	1	QAM Module Detected - Slot 1

5. Make certain that there are no Critical Events listed in the *Severity* column of the Hardware Events Log screen.

   For more information on the Hardware Events Log and other alarm conditions, see the Alarms section of this manual.

4 Setup and Operation

Configuring the APEX1000

To configure the APEX1000, you must use the Element Manager (APEX1000 EM). For more information on downloading and activating this application, see the APEX1000 EM Requirements section of this guide.

Booting the APEX1000

The APEX1000 supports the BOOTP protocol.

Security Requirements

To configure the APEX1000, you must use the Element Manager (APEX1000 EM). For more information on downloading the Element Manager, see Downloading the JRE.

Establishing Network Connections

At power up, the operating configuration of the APEX1000 is determined by data stored internally in flash memory, or by data that is downloaded from a bootstrap protocol (BOOTP) server; the particular method used to set up initial operation depends on the system configuration.

After setting the initial operating configuration, modify the configuration by:

- Sending commands from an SNMP network manager (such as the APEX1000 EM)
- Forcing a reboot to download a new configuration to the APEX1000 from the BOOTP server. The APEX1000 only processes BOOTP responses from the OAM&P interface (ENET1)

Note: The MAC addresses for the four GigE ports and the two Ethernet ports are listed on the serial number label, attached to the bottom of the APEX1000.

Verifying the Network Connection

Ping the APEX1000 OAM&P interface to confirm that the IP address was assigned. At bootup, the OAM&P interface (ENET1) should be connected to the local network. The APEX1000 always attempts to auto-negotiate at bootup, and sets the duplex and data rate (10 Mbps or 100 Mbps) according to the results of the auto-negotiation process.

Note: If you plan to use the Data IP interface ENET2, it should also be connected to its own network at bootup. ENET1 and ENET2 must always be on separate networks.

APEX1000 EM Requirements

The APEX1000 includes an embedded Element Manager (EM) that can be uploaded to your PC. The EM's SNMP Manager sets up SNMP sessions between itself and the APEX1000's SNMP Agent, allowing you to use the APEX-EM to configure and retrieve status information.

The EM standalone application runs under JRE 1.5.0, which you can download from the APEX1000 using HTTP. To view the Java(TM) enabled console, you also must download the Sun® Java Runtime Environment, JRE version 1.5.0 (or later).

To download the JRE, visit the Sun website at: http://java.sun.com/getjava

Browsers

To run the APEX-EM, Motorola recommends current versions of Mozilla Firefox 2.0 + or Microsoft® Internet Explorer 5.0 + web browsers. (Browser or proxy settings are not required.)

You can download the latest versions of these browsers from the following web sites:

- http://www.mozilla.com/
- http://www.microsoft.com (click *Downloads and Trials*)

Note: The 'look and feel' of the application may vary according to your choice of browsers. All screen captures in this guide were created using Internet Explorer.

Hardware

The APEX-EM, like most Windows® applications, runs faster on newer processors with greater memory. Motorola recommends systems a minimum of 1.5 GB of memory.

In addition, the APEX-EM displays better on larger monitors.

APEX1000 minimum and recommended hardware specifications

Item	Minimum Specification	Recommended Specification
PC Processor	Pentium 4 2.0 GHz	Pentium 4 2.8 GHz
RAM	1 GB RAM	1.5 GB RAM
Disk free space	50 MB	50 MB
Display resolution (minimum)	800 x 600	1024 x 768*
**The maximum size of an EM screen is 1024 x 768.*		

Operating System

The APEX-EM runs under Java Virtual Machine (JVM).

Initiating an EM Session

The EM provides a user interface to the APEX1000 for configuration and status monitoring, and communicates with the APEX1000 through SNMP. This procedure allows you to configure and gather status from the APEX1000 under the following conditions:

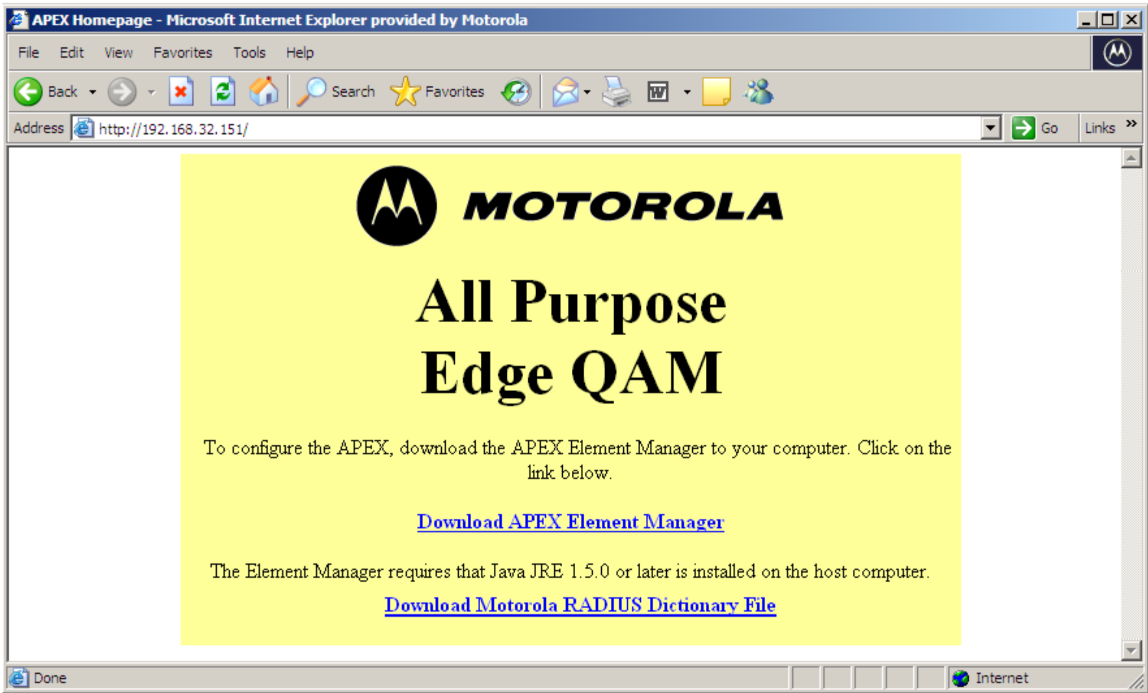
- Data is read from the APEX1000 using SNMP *get* and *getnext* functions, and sent to the APEX1000 using SNMP *set* functions.
- When configuration data is set on the APEX1000 using the Element Manager, it is read back by the EM so that the EM window stays synchronized with the APEX1000 database.

Typically, the OAM&P network is used to communicate with the APEX1000 through the APEX1000 EM. However, the Data IP network may also be used (after it is properly configured).

To initiate a session using the APEX1000 EM:

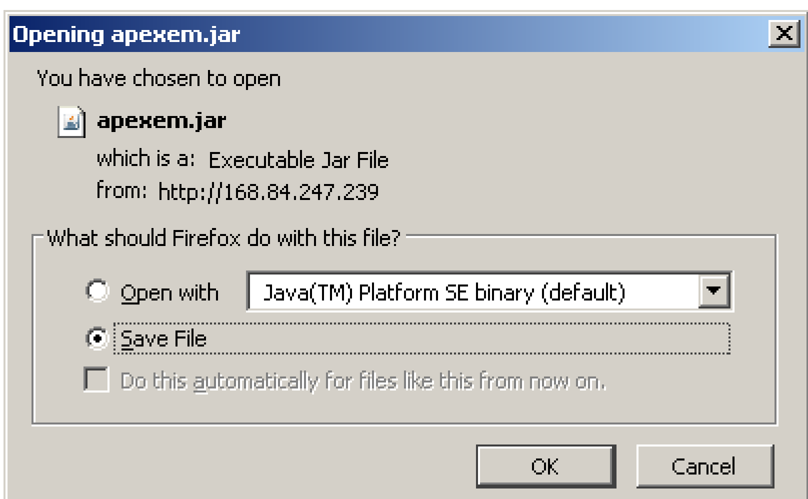
1. Open an Internet web browser and enter the APEX1000 IP address in the URL address field.

The addressed APEX1000 home page displays:



2. To download the APEX1000 EM application, click **Download APEX Element Manager**.

   The file download pop-up displays (A typical Firefox screen is shown):



3. Check the **Save File** box and select a download folder.

CAUTION *If your browser has named the EM files* ****zip****, you will need to change this to* ****jar*** *for it to open properly after download. Otherwise, WinZip (or an equivalent application) will be invoked due to the *zip extension.*

4. To launch the APEX1000 EM after the application downloads, double click the downloaded **`apexem.jar`** file icon.
5. The APEX-EM login window displays. See Logging In for more information.

Downloading the JRE

If the Java Runtime Environment is not present in your system, download the latest version of the JRE from the Sun website at: http://java.sun.com/getjava.

Note: Each APEX1000 firmware release has an accompanying EM release. To establish a successful connection, both versions of the APEX1000 and APEX1000 Element Manager must match.

Downloading the Motorola Dictionary File

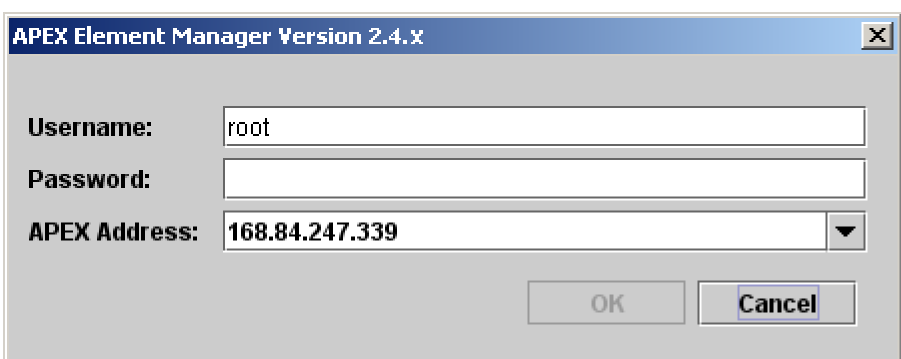
The Motorola dictionary file is bundled with all firmware releases that support RADIUS.

1. To download this file, click Download Radius Dictionary File.
2. The motdict.htm file will download to your desktop or a location of your choice.

For more information, reference RADIUS Configuration.

Logging In

The following graphic shows a sample of the APEX1000 EM Login window:



Note: The typical IP address shown above is for illustration purposes only.

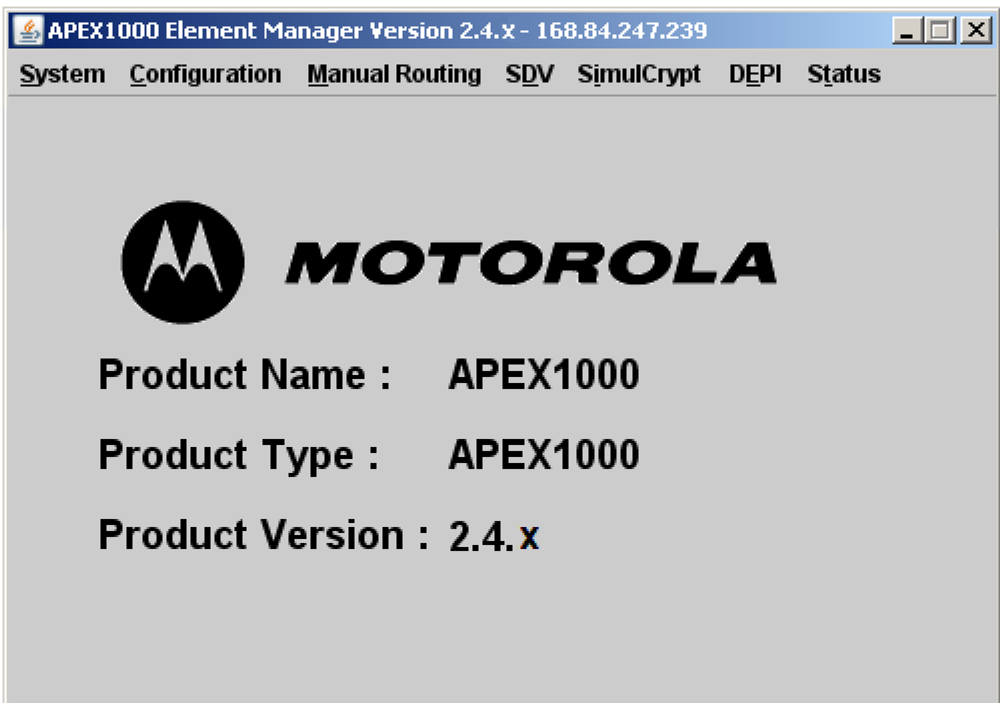
To log in at the APEX1000 EM window:

1. Type a <*Username*> (*root* is the default).
2. Type a <*Password*> (*password* is the default. This password can be changed, but the user *root* cannot be removed).

   Note: For added security, the password will not echo on screen as asterisks (the cursor will not appear to move), but the system will accept your (correctly typed) password.

3. Type the <*APEX1000 IP address*> or select an APEX1000 from the drop-down list. (The drop-down list contains the most recently accessed APEX1000s.)
4. Click **OK**.

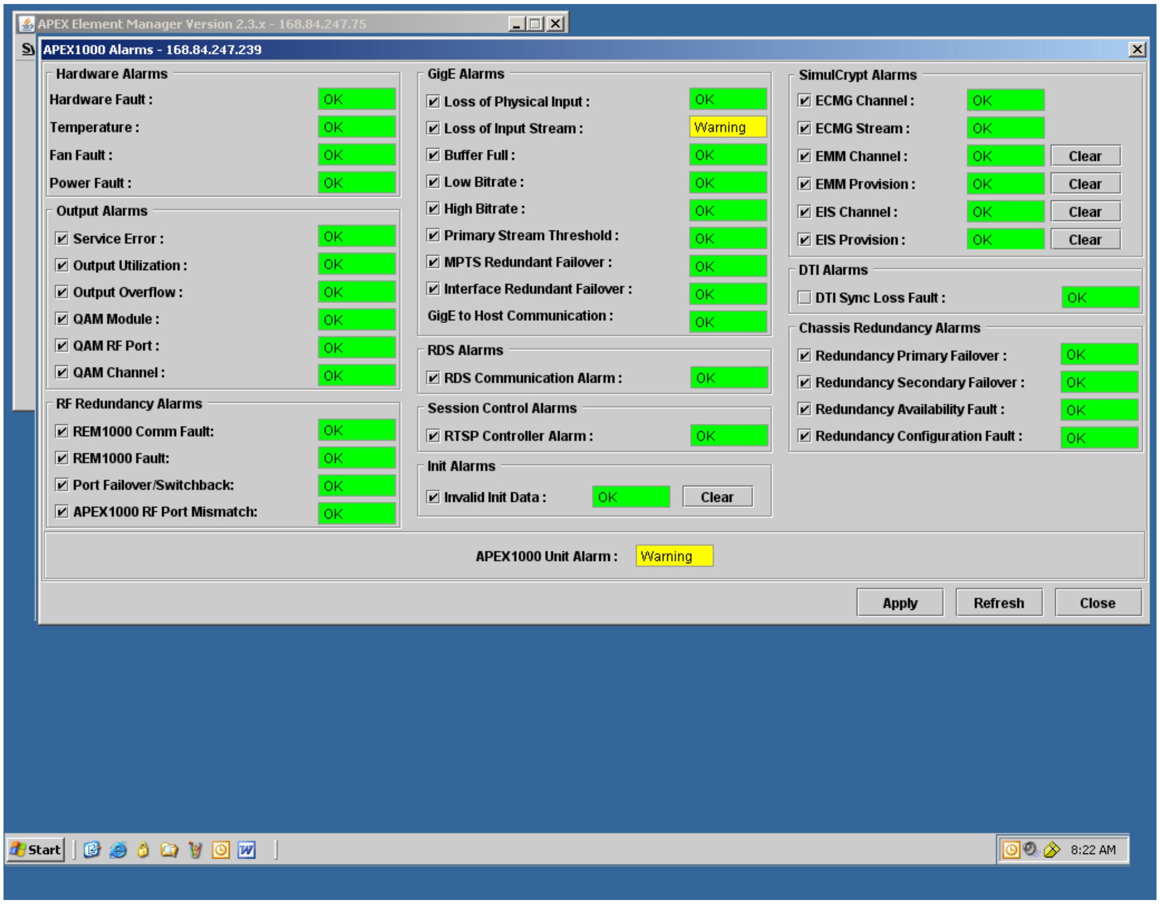
   The main APEX1000 EM window displays, showing the product's name, type, and version:



Active Warnings

The Active Warnings feature allows the operator to take immediate action to correct the fault or deactivate the alarm, as current conditions dictate:

- If the APEX1000 does not have an active alarm at the time of login, only the EM main window displays, as shown in the preceding graphic.
- If there is an active warning (yellow), a major alarm (magenta), or a critical APEX1000 Unit Alarm (red), the Alarms window also displays when you first log in, as shown in the example below:



Note: You can only disable alarms ***with checkboxes*** *through the APEX Alarms window.*

APEX1000 EM Toolset

The APEX1000 EM is the primary interface to the APEX1000 for set-up and operation. Based on a Java application, it is a remote user interface that enables you to monitor an APEX1000 (remotely or locally).

To allow access to other windows, the software toolset has seven drop-down menus:

- **System** — Provides menu options to reboot the APEX1000, manage users and passwords, obtain information about the APEX1000, download configuration files, or exit the Element Manager application.
- **Configuration** — Provides dialogs to define initial APEX1000 System parameters, as well as the configuration of the following functions:
    - Chassis Redundancy
    - DTA
    - RADIUS
    - EAS
    - PSIP
    - GigE
    - QAM
    - QAM RF Redundancy
    - Encryption
    - Output TS
- **Manual Routing** — Provides dialogs to configure Program Mapping, UDP Mapping, Stream Pass Thru, Ancillary PID Mapping, Input Stream Redundancy, and Data Stream Identification. (A shortcut to quick enabling/disabling of selected features is also available from this tab.)
- **SDV** — Provides dialogs to configure Session Control and view QAM Status. Additionally, you can use this tab to configure Controller/GigE Group and view QAM Status and Events.
- **SimulCrypt** — Provides dialogs to configure SimulCrypt, EMMG, and SCS-ECMG parameters. You can also access this tab to view SimulCrypt Events and EMMG, ECMG, and EIS Statistics.
- **DEPI** — Use to configure DEPI Control Connections and Session Mapping.
- **Status** — Provides the capability to view and save the status of different functions to a text file.

Navigating the Element Manager

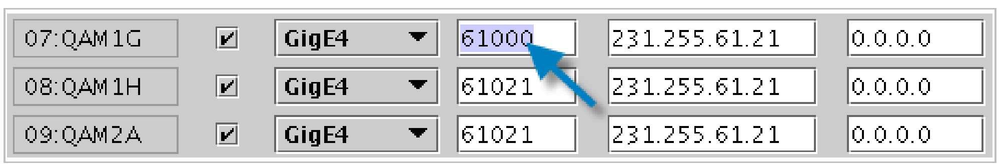
- You can open sub-screens within a majority of the windows by selecting a *tab*.
- Each window has operating buttons that appear at the bottom right:

Button	Function	State
Close	Closes the current window. Any changes *not applied* are lost.	Always enabled
Apply	Saves (writes) all changes to the APEX1000.	Always enabled
Refresh	Loads (reads) values for all fields from the APEX1000. Any changes *not applied* are lost. If you change a field and do not apply it, click **Refresh** to restore the original values.	Always enabled
Submit	Saves (writes) user name and password changes to the APEX1000.	Always enabled

Entering Text

Many Element Manager screens contain tables that require your input for modification. To activate the text entry area within any editable window:

1. Highlight existing text or *click twice* on any table cell, as shown below:

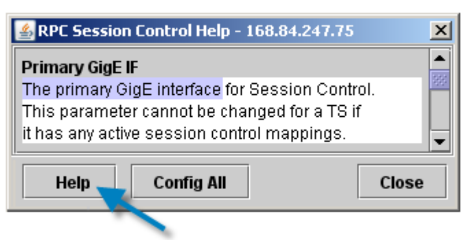


2. Enter new (or modify existing) text, and click **Apply** to implement any new changes.

   Some functions require a system reboot prior to becoming effective. Any cells that are either gray or inactive are read-only, and cannot be altered.

Accessing Help Screens

Some pages accessible through the Element Manager contain additional product support windows:

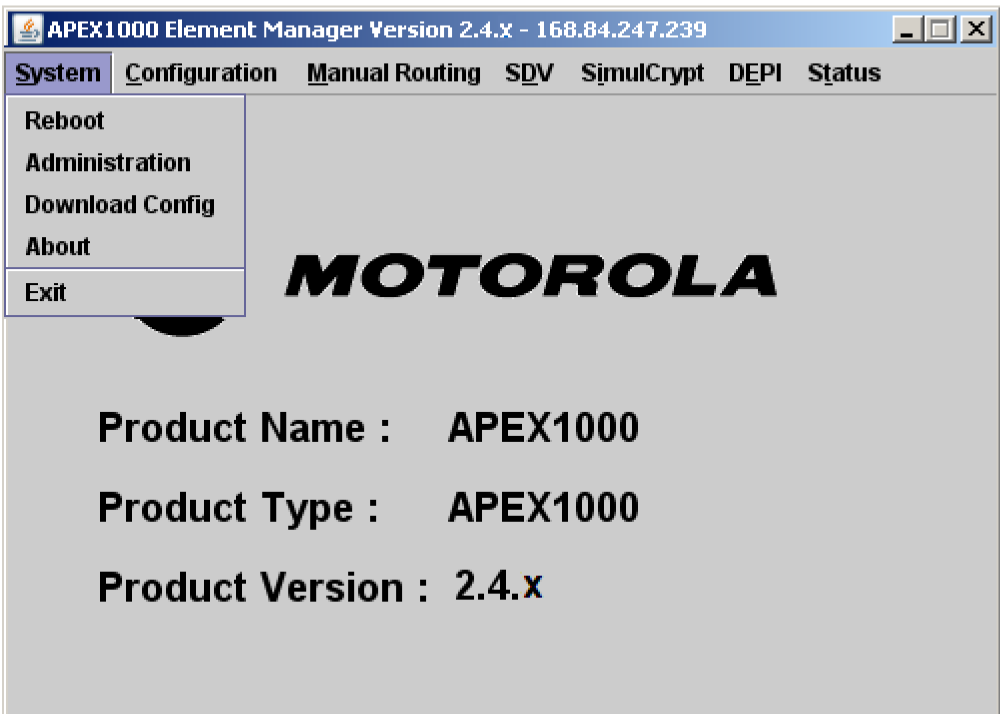


To display page-sensitive help topics, click **Help** (if available for that page).

5 System Settings

Managing Users

When logged in as *root*, click **System** on the EM menu bar to display the drop-down menu that includes Administrator’s functions:



From the *System* drop-down list you can:

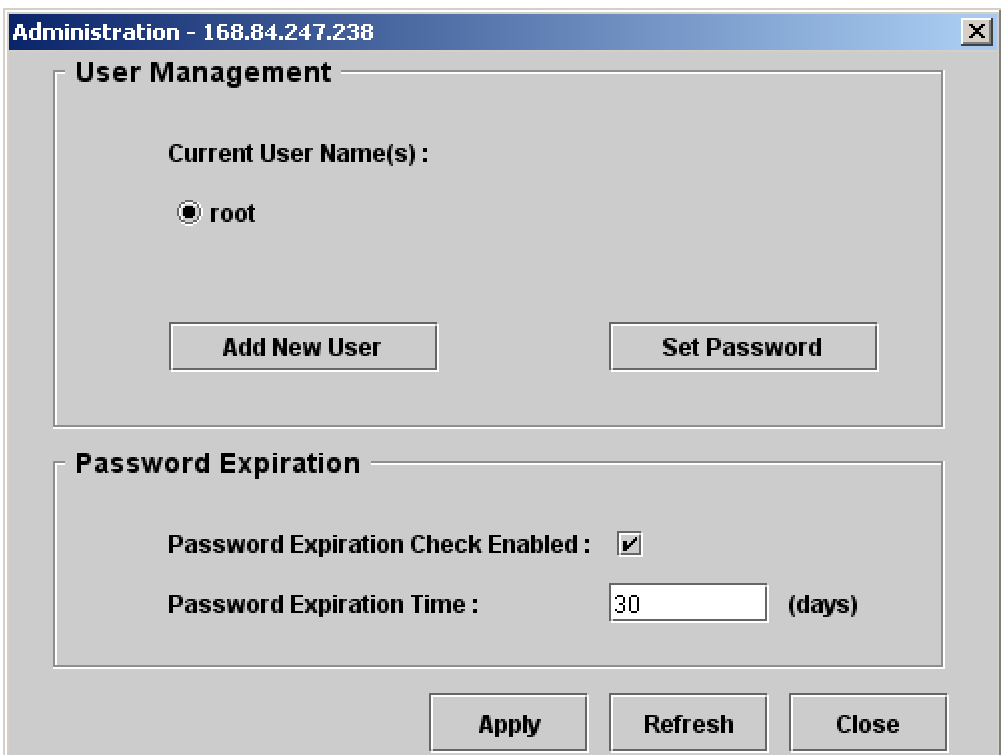
- Reboot the APEX1000
- Manage your user name and passwords
- Download Configuration files
- View Element Manager version and build date
- Exit the APEX-EM application

Root User Privileges

From the System drop-down menu, using the Administration window, a user logged in as *root* can:

- Reboot the system
- Add a user
- Set password expiration
- Change a user's password
- Remove a user
- Download configuration files
- View Element Manager version and build date
- Exit the system

Figure 5-1 — Administration window



The following functions are available on the *Administration* GUI:

- **Current User Names** — User *root* always displays. If an additional user is added, that user's name also displays in this area.
- **Add New User** — Opens the *Add New User* window.
- **Remove User** — Deletes the selected user name from the APEX1000 EM. (This option only becomes available when a *new* user has been added. User *root* cannot be removed.)
- **Set Password** — Opens the Set Password window, which allows users to change the current password.
- **Password Expiration Check Enabled** — If enabled, the APEX1000 EM checks for password expiration each time a login occurs or right after a reboot or reprogram. (If this option is disabled, the password will never expire.)
- **Password Expiration Time** — Shows the number of days a password remains valid after it is created.

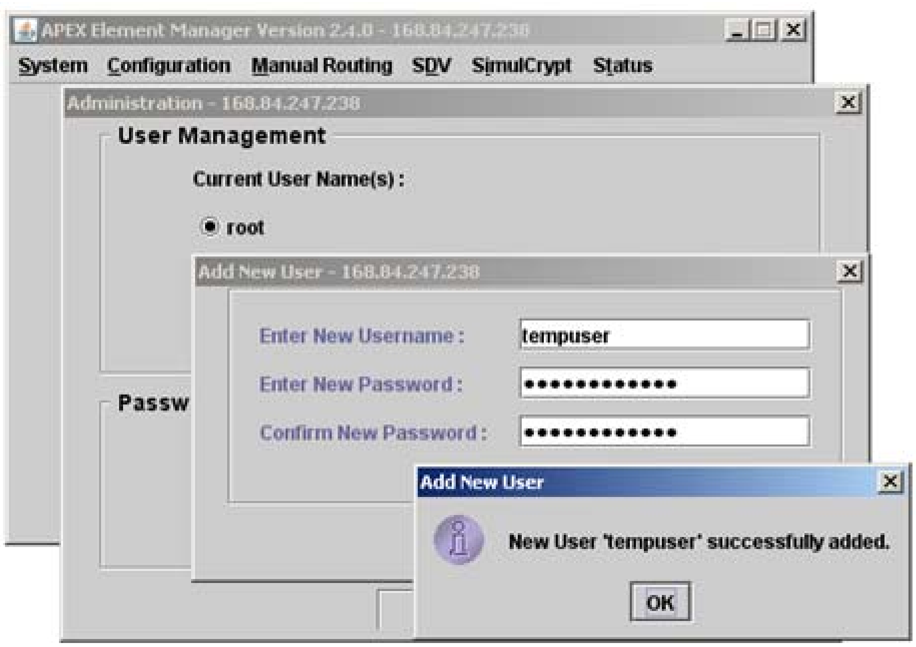
  Expiration Time Values: 1 – 999 days; default value = 30 days.

Adding or Removing User Profiles

To add a new user profile:

1. When logged in as *root*, select **System > Administration**.
2. Click **Add New User**.

   The *Add New User* dialog displays:



3. Enter the new username, which must be between 6 and 32 characters.
4. Enter the new password.

   *Note: Password length must be between 6 and 16 characters, must contain at least one numeral (**0~9**), one uppercase (**A~Z**), and one lowercase (**a~z**) character.*

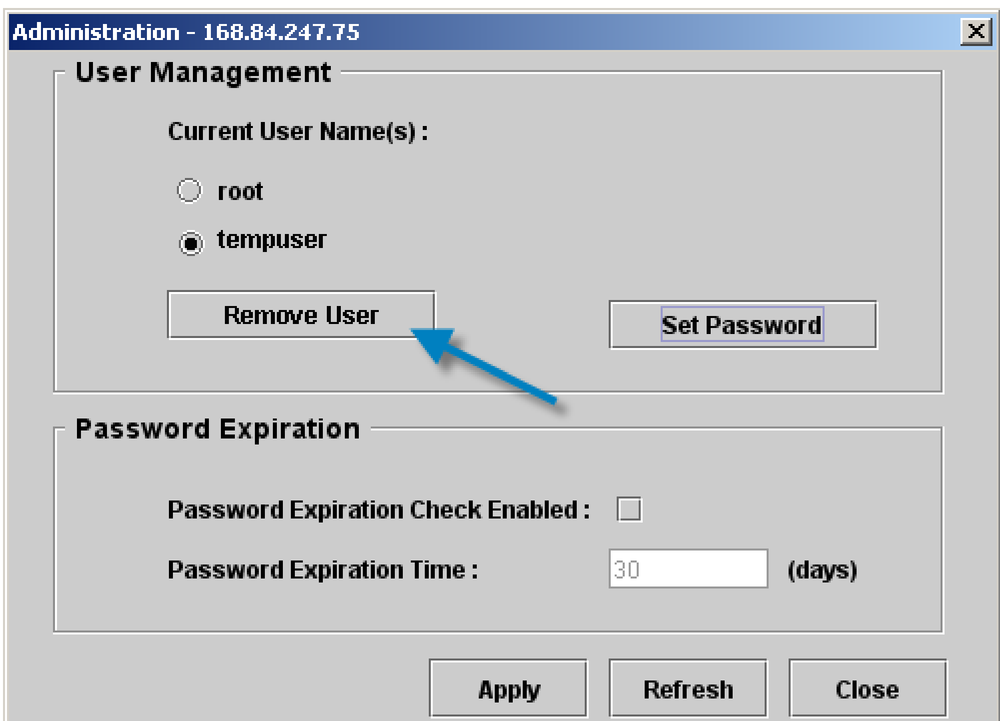
5. Confirm the new password by re-typing it into the corresponding text entry area.
6. Click **Submit**. If the procedure is successful, click **OK** to close the dialog box. Otherwise, retry steps 4–7 using a different username and password data.
7. If desired, set a password expiration date by clicking the checkbox and setting a date between 1 and 999 days; the default value is 30 days.
8. Click **Apply** to implement the changes.

Removing a User Profile

If it becomes necessary to remove a user:

1. Select **System > Administration**.

   The Administration window displays:



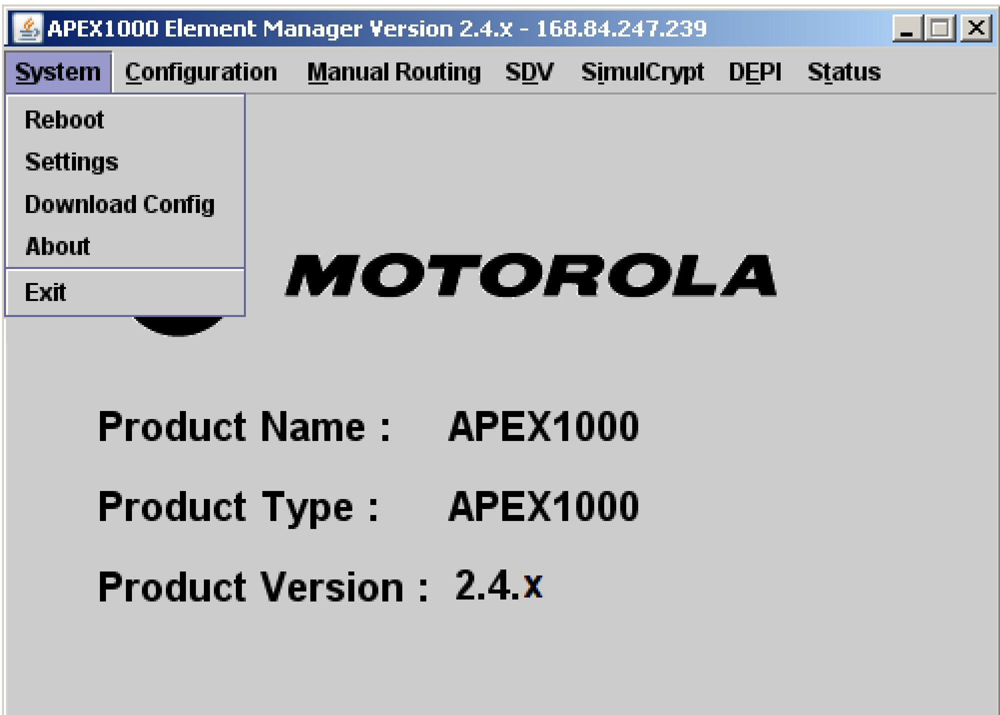
2. Check the radio button next to the desired user name.
3. Click **Remove User**.
4. Click **OK** when prompted.

   The user profile is removed.

Other User Privileges

To display the *other* user drop-down list when logged in as a user other than *root*, click **System** on the APEX1000 EM menu bar:

Figure 5-2 — System drop-down list as *other user*



From the System drop-down menu, operators logged in as any user other than *root* can:

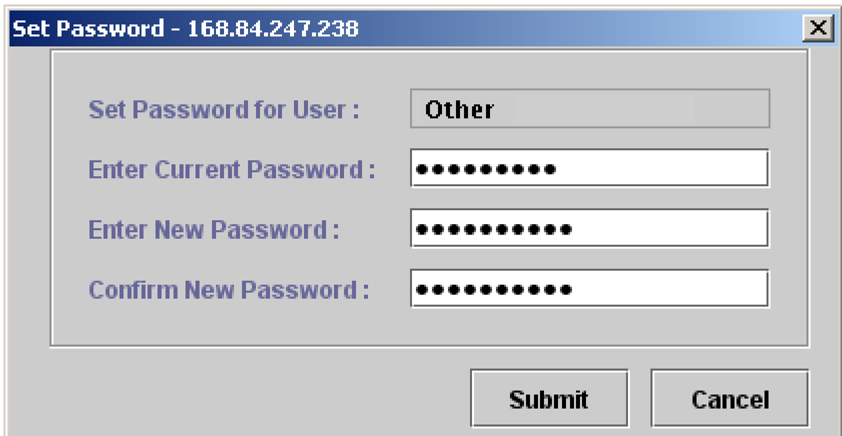
- Reboot the system
- Reset their own password
- Download configuration files
- View Element Manager software version and build date
- Exit the system

Note: User Management is the only function restricted to the Administrator. Users other than root have normal access to all other APEX1000 functions in the Element Manager.

Setting a Password

The *Setting* menu item is only accessible to an operator logged in as a user other than *root*. This action opens the *Set Password* window, allowing only the current user's password to be modified:

Figure 5-3 — Set Password window



Notes:

1. Consistent with standard software procedures, changing requires entering the current user name or password followed by the new one.

*2. A password change requires a new password to be entered twice (Enter/Confirm) before clicking **Submit**.*

Common System Tasks

The following menu options are available to *all users*:

- Rebooting the System
- Downloading Configuration Files
- Displaying the Current EM Version
- Ending a Session

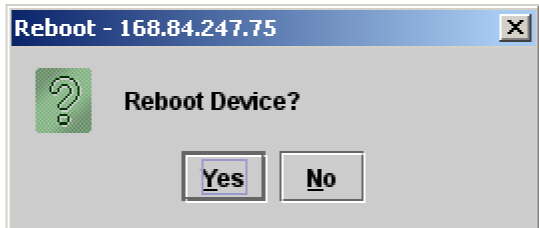
Rebooting the System

You can modify most configuration parameters uninterruptedly, but any changes to the QAM Transmission Mode *require a reboot* before taking effect.

To reboot the system:

1. Select **System > Reboot** from the System drop-down list.

   The Reboot message displays:



2. Click **Yes** to reboot the APEX1000.

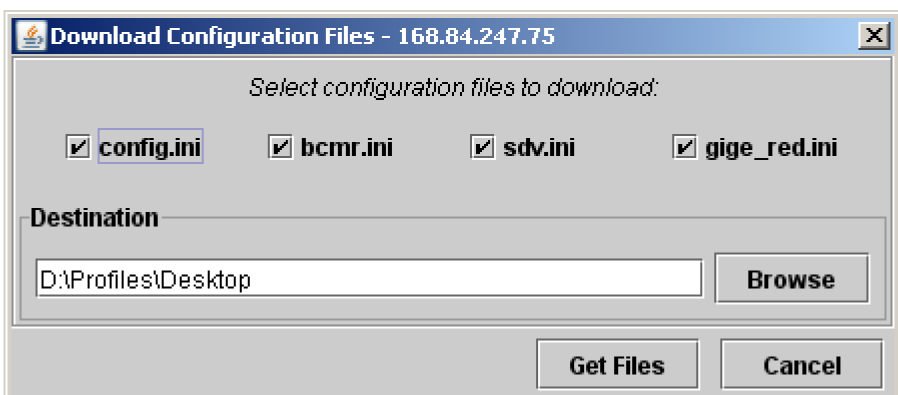
Downloading Configuration Files

You can download the latest configuration files to the folder destination of your choice.

The four checkboxes are enabled by default. (To exclude specific configuration files from the download, clear the checkmark from any of the boxes.)

To download the configuration files:

1. Select **System > Download Config**:



2. Click to de-select any of the checkboxes next to the desired files.
3. Type (or click **Browse** to select) the *Destination* for the configuration file(s).
4. Click **Get Files**.

   The file(s) are placed in the destination folder.

Downloaded File Names

The downloaded configuration files do not use the same names as the original released configuration files. The following list shows the names *as they are stored on the APEX1000*:

- **`config.ini`** — Same as apex1000.ini file, it contains all main configuration items.
- **`bcmr.ini`** — Same as apexbcmr.ini file, it contains all Manual Routing, Ancillary PID mapping, and stream pass-through mappings.
- **`sdv.ini`** — Same as apexsdv.ini file, it contains all SDV configuration settings.
- **`gige_red.ini`** — Same as apexred.ini file, it contains all GigE redundancy configuration settings.

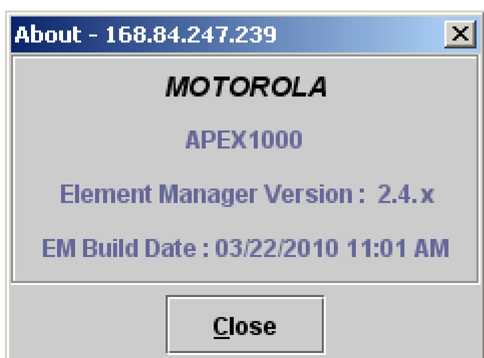
You can download these files and then load them onto the same (or a different) APEX1000 using BOOTP. This makes it possible to quickly configure another APEX1000 in a similar manner.

CAUTION *Although you **can** edit these files, it is not recommended that you do so. Loading a corrupted configuration file onto an APEX1000 unit forces you to reconfigure the unit through the EM, as most (or all) configuration settings will be lost. In the event that you decide to edit these files, then use WordPad instead of Notepad. Notepad will corrupt these files and cause them to be unusable when loaded onto an APEX.*

Displaying the Current EM Version

To display current EM version information and build date:

1. Select **System > About** to activate the About pop-up.



2. Click **Close** to exit the dialog.

Ending a Session

To terminate a session, select **System > Exit**.

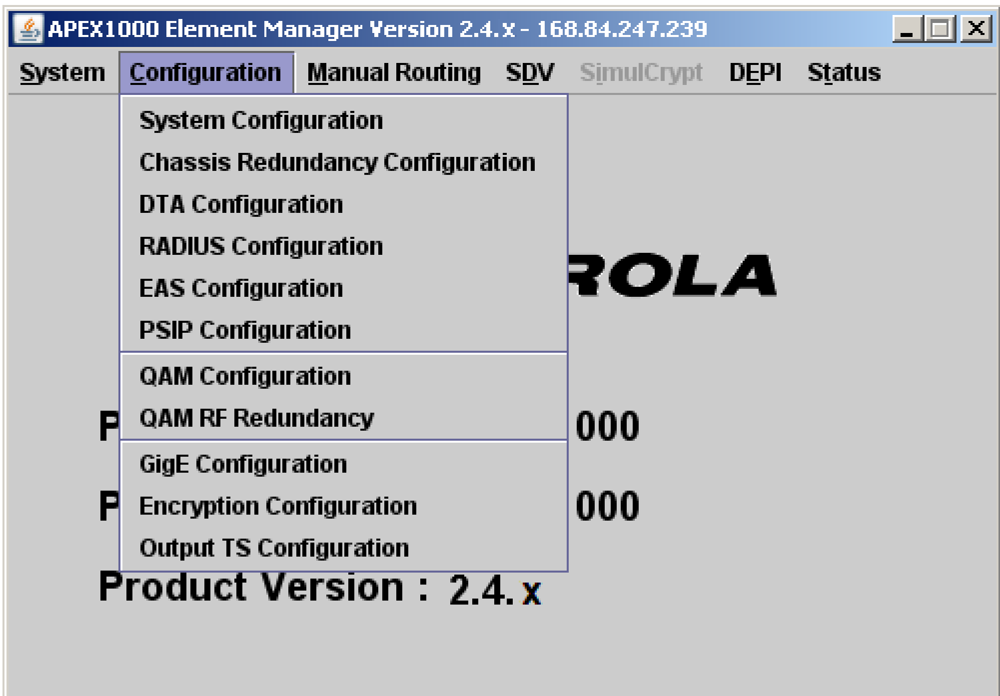
The EM application window closes; no further steps are required to end a session.

6 Configuration

Initial Settings

For the APEX1000 to become fully functional, you must first configure specific settings such as System Time, Transport Streams, GigE ports, Encryption, PSIP Configuration, QAM outputs, and other essential parameters covered in this section.

To display the configuration items drop-down list, click **Configuration** on the APEX-EM menu bar:



System Configuration

- System Time
- Fast Ethernet
- Traps
- Advanced Settings

Chassis Redundancy Configuration

- APEX Redundancy Mode
- Multicast Redundancy Mode
- Suspend Switch Over
- Redundancy Failovers
- Redundancy Triggers

DTA Configuration

- Chassis Selection
- DTA NET PID
- DTA Enabling
- CAT Source
- CAT Interface

RADIUS Configuration

- Primary/Secondary Shared Secrets
- Server Timeout
- NAS IP Interface

EAS Configuration

- EAS Input / Output Configuration
- EAS Messages Received Status
- EAS Invalid Messages Status

PSIP Configuration

- Enabling PSIP Processing
- EAS Messages Received Status
- Message Insertion Settings
- DST Settings

QAM Configuration

- QAM Transmission Mode
- QAM RF Parameters

- QAM RF Ports
- Mute or Un-mute
- EIA/RF Frequency
- Enable or Disable QAM channels
- Attenuation
- Interleaver
- QAM Channel Count and Test Mode
- QAM Module Upgrade

QAM RF Redundancy

- Configure Redundancy Settings
- Configure REM1000 Connection
- Configure Auto Switchback
- Configure Suspend Failover
- Force a Failover or Switchback
- View Redundancy Status
- View REM1000 Connection Status
- View REM1000 Status

GigE Configuration

- IP Address
- Subnet Mask
- GARP Periodicity
- Nominal Buffer Level
- Auto Negotiation
- Enable or Disable the Interface and Default Gateway
- Enable or Disable GigE Interface Redundancy

Encryption Configuration

- Encryption Algorithm
- RDS IP Address
- RDS TCP Port
- RDS Poll Randomization
- CTE Poll Interval

- RMD Poll Interval
- Epoch Duration
- CCI and APS Levels
- Common Tier

Output TS Configuration

- PID Remapping
- Operating Modes
- ASI Monitor Port Output
- PAT TS ID
- Encryption Type

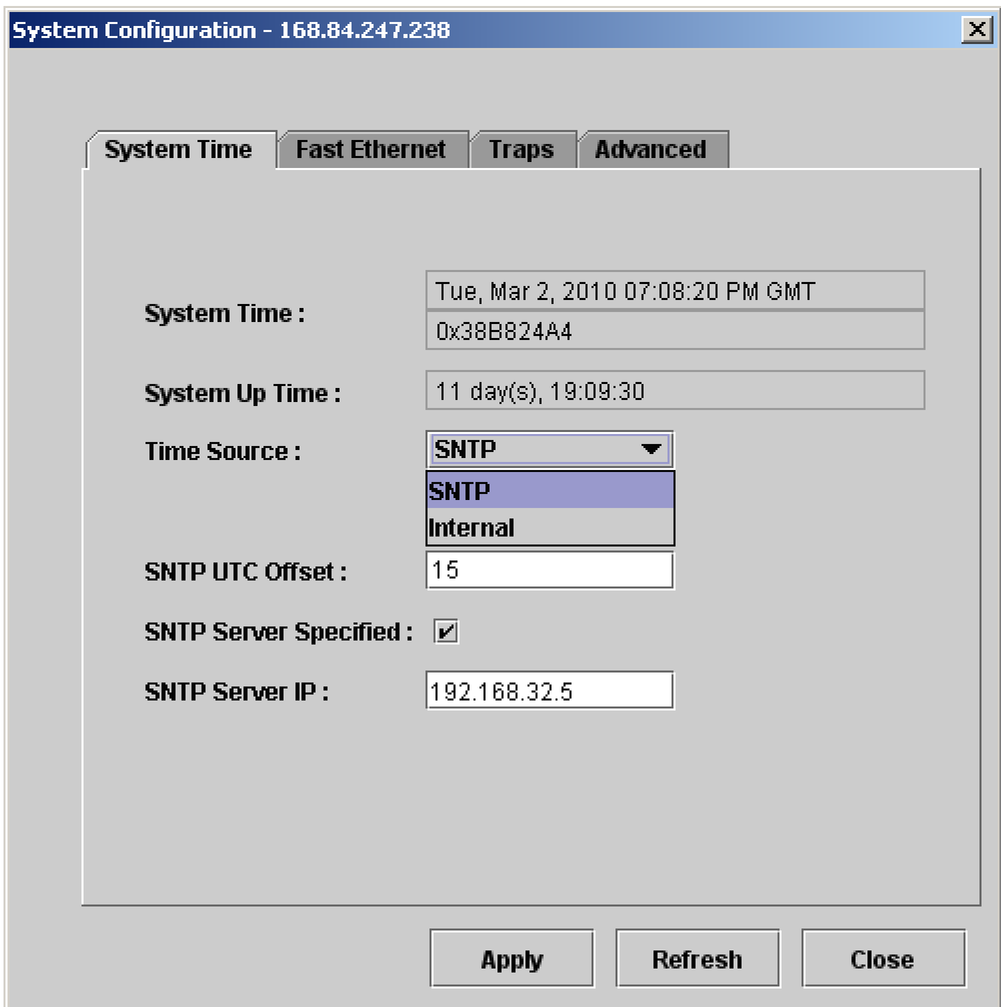
System Configuration

System Time

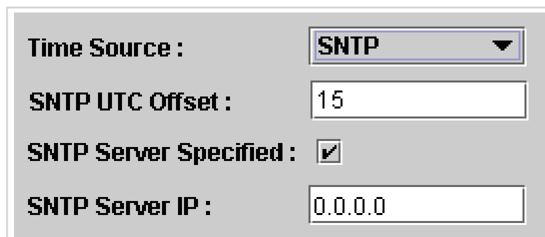
Use this window to define the system time source and view the current APEX1000 up time. You can select between SNTP and Internal as the time source. SNTP can be either from a specific SNTP server, or the APEX1000 can 'listen' for any SNTP server.

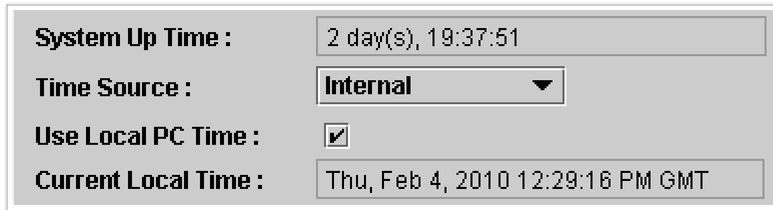
To configure system time, select **Configuration > System Configuration**. The System Configuration window opens in the default *System Time* tab:

Figure 6-1 — System Time Configuration



System Time tab functions

Item	Definition
System Time	This read-only value is the Internal Time. The second line shows the system time reported in Global Positioning System (GPS) seconds. The time displayed is only relevant when the APEX1000 is configured to receive GPS time from an external source. When the time source is set to Internal, the APEX1000 System Time is not used. This change requires an APEX1000 reboot.
System Up Time	This read-only value indicates the run time of the APEX1000 since the last reboot.
Time Source	Values are **SNTP** or **Internal**. The available drop-down options are: **1. SNTP** – Time Source is from an SNTP server.  The following options are available when *SNTP* is selected as the time source: **SNTP UTC Offset** – This is the number of leap second insertions required to synchronize UTC/NTP with the earth’s rotation (GPS time). The International Earth Rotation Service (IERS) is responsible for notifying the public when a leap second will be inserted. A UTC offset of 0 sets the APEX1000 to use UTC time. The current number of leap seconds is 15. *Note: SNTP time is in UTC format and therefore, to allow the APEX1000 to correctly calculate GPS time, you must specify the UTC offset to match the UTC value used by the SNTP server.* **SNTP Server Specified** – Check this box to specify an SNTP server. When a server is specified, the APEX will poll this server for SNTP updates every 64 seconds. If an SNTP server is not specified, time is received from any SNTP server. When no SNTP server is specified, the APEX1000 will ‘listen’ for SNTP messages, and accept SNTP replies from any SNTP server. **SNTP Server IP** – Manually enter the SNTP Server IP in this textbox.

Item	Definition
	2. INTERNAL – Time Source is internal (no actual GPS time is maintained).  The following options are available when Internal time source is selected: **Use Local PC Time** – Sets APEX1000 System Time to the Current Local PC Time. This setting is applicable only if Time Source is set to Internal. *Caution: This setting is not preserved during a reboot (must be re-applied upon rebooting the APEX1000).* **Current Local Time** – Displays the read-only current time and date of the PC that is running the APEX1000 EM. (This field is only viewable if Time Source is set to Internal and the Use Local PC Time box is enabled.) These settings are useful when no external time source is available (such as an SNTP server), allowing the APEX1000 to use a current time reference for logs.

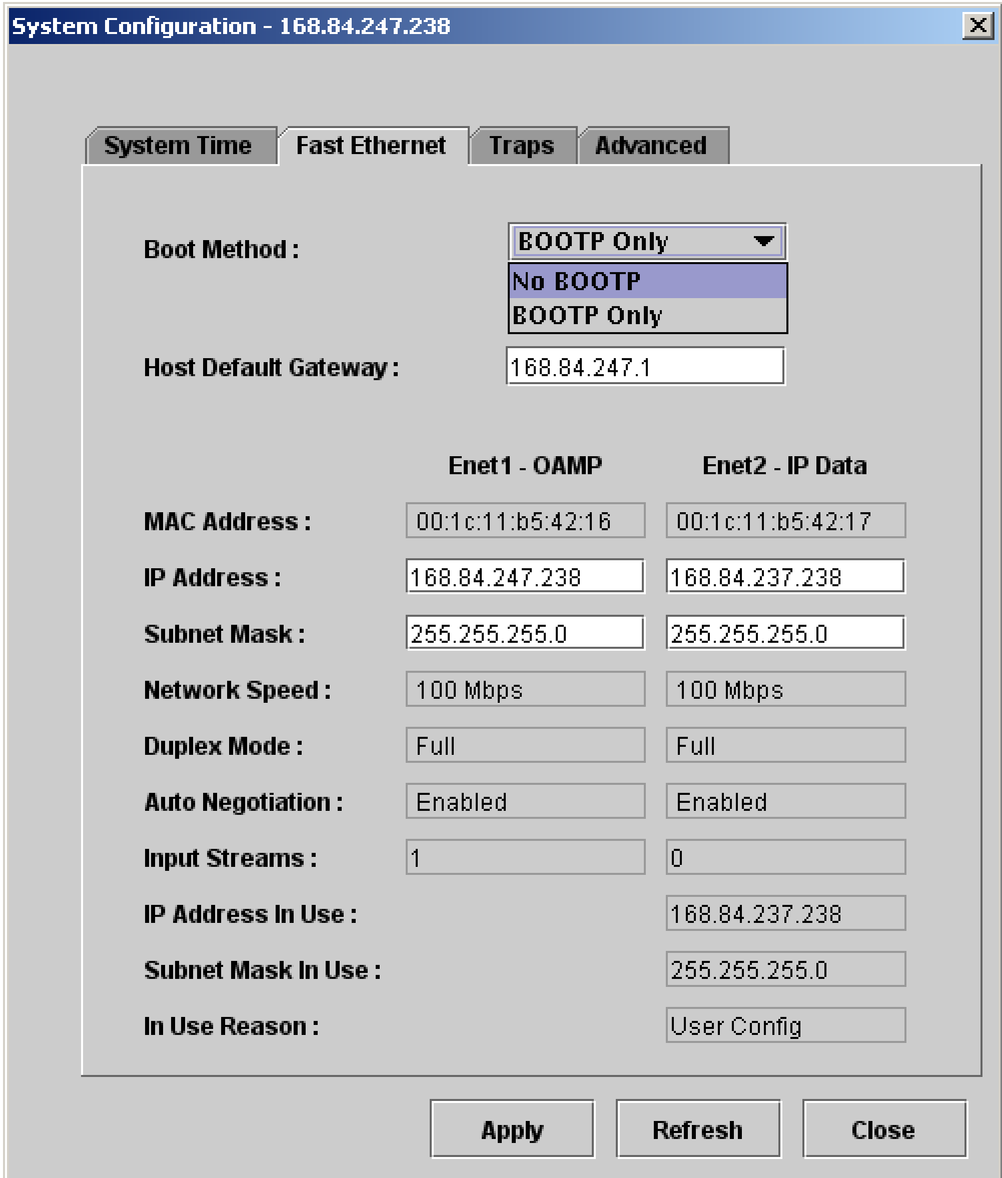
Fast Ethernet

Using the Fast Ethernet tab of the System Configuration window, you can select the boot method and identify the host default gateway, and also:

- View MAC addresses of ENET1 and ENET2
- Define IP Addresses
- Define Subnet Masks
- Configure the Gateway
- Configure the Boot Mode
- View Input Stream information, Subnet Masks, and IP Addresses, as well as the *reasons* for their usage

Note: The Fast Ethernet window also shows Network Speed and Duplex Mode (read-only) information for both of these Ethernet ports.

Figure 6-2 — Fast Ethernet Configuration



CAUTION *As shown in Figure 6-2, ENET1 and ENET2 must be on* ***separate*** *networks.*

Fast Ethernet tab functions

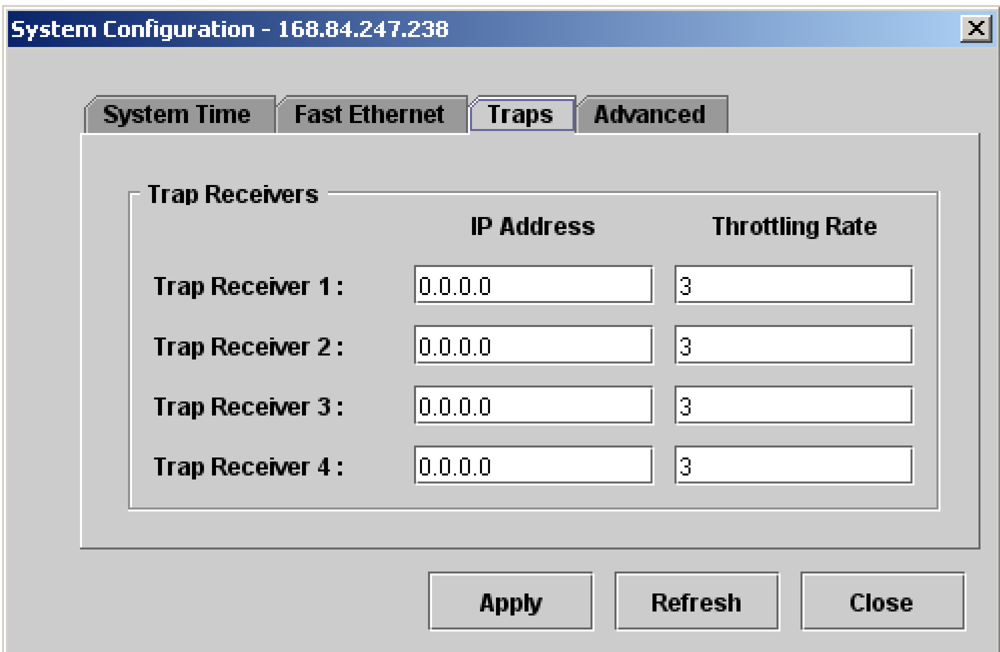
Item	Definition
***Boot Method**	The Boot Method determines how the APEX1000 performs the bootup process on the next reboot. When setting the APEX1000 to *No BOOTP*, this ensures that the APEX1000 does not download a new configuration file or a new code image. This drop-down menu provides two selections to set the boot method of the APEX1000: **BOOTP Only** – Use this setting during the initial configuration, or after making configuration changes. **No BOOTP** – To ensure that the internal configuration settings are preserved, use this setting at all other times.
***Host Default Gateway**	This is the 32 bit IP address of the router interface acting as a gateway to remote or foreign networks. This address is normally provided during the BOOTP process, but you can also change it after the APEX1000 successfully boots.
MAC Address	Read-only MAC addresses of ENET1 and ENET2. These addresses are also provided on the serial number label on the bottom of the APEX1000. The string length is 17 characters in the format '**hh:hh:hh:hh:hh:hh,**' where '**hh**' is a hexadecimal number. *Note: The addresses are set at the factory and cannot be changed.*
***IP Address**	Shows the APEX1000 ENET1 and ENET2 32-bit network addresses are in the **xxx.xxx.xxx.xxx** format. The ENET1 address is for the OAM&P network connection, and the ENET2 address is for a user-specified network connection. *Caution: ENET1 and ENET2 must be configured on separate networks.*
***Subnet Mask**	Shows ENET1 and ENET2 32 bit subnet masks for their respective networks. When masking is employed, it indicates the network address and host ID portion of the IP address.
Network Speed	Shows the Ethernet speed (10 Mbps or 100 Mbps). This is determined by the results of the auto-negotiation process. The default is 100 Mbps.
Duplex Mode	Shows the Ethernet duplex mode (full or half), determined by the results of the auto-negotiation process. The default is Full.
Auto Negotiation	This setting is predefined by the APEX1000, and it is not user-configurable. (The APEX1000 Host Ethernet interfaces always perform auto negotiation upon booting.)
Input Streams	This setting shows the number of input streams for each connection. This is the number of input streams opened or assigned to this interface. Enet 1 will typically always have one (1) input stream assigned. This is due to the EAS default assignment, which opens one input stream on Enet 1.

Item	Definition
• **IP Address in Use** • **Subnet Mask in Use** • **In Use Reason**	These settings provide an immediate alert when ENET 2 is in use for communication with the REM1000 when in Direct Mode. ENET 2 configuration parameters are grayed out and unchangeable when QAM Redundancy is enabled and REM1000 Communication mode is set to Direct.
Any changes to these parameters require an APEX1000 system reboot.	

Traps

This tab provides settings for Trap Receivers. You can configure up to four trap receiver IP addresses as well as different throttling rates for each trap receiver:

Figure 6-3 — Traps Configuration



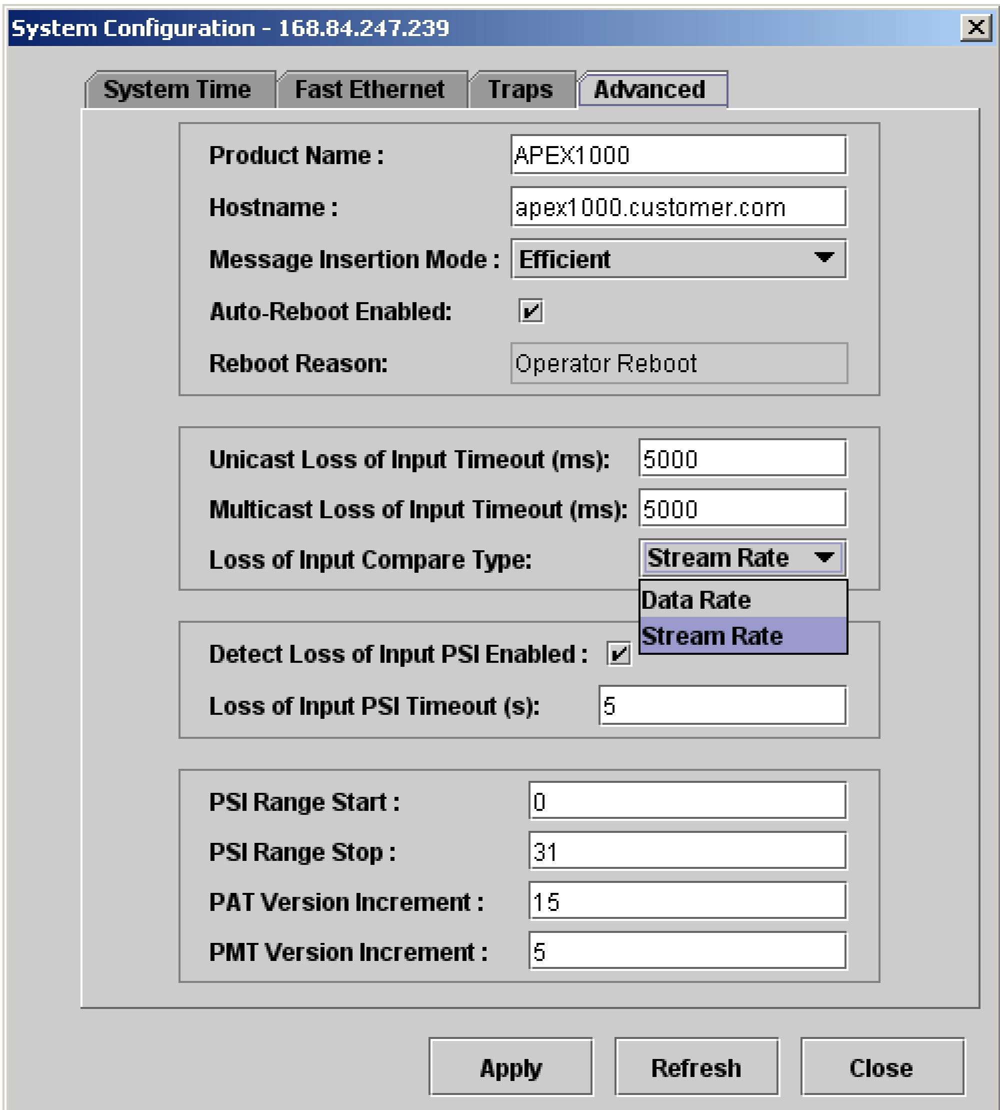
Trap Receiver values

Item	Definition
IP Address	Shows the IP address of the destination trap receiver. This value can be a valid Singlecast or Multicast IP address (class A, B, C, or D). A value of 0.0.0.0 indicates that no destination receiver address is defined for the corresponding index.
Throttling Rate	Applicable values are 1 – 10, representing the maximum number of traps the APEX1000 will issue in one second (to a specific trap receiver).

Advanced

Use the *Advanced* Configuration screen to control the insertion mode, auto reboot, and the loss of PSI detection parameters, as well as other functions:

Figure 6-4 — Advanced Configuration



Advanced tab functions

Item	Definition/Range
Product Name	Displays the product name. This is a configurable parameter; the name can be user-specified.
Hostname	Displays the host's name and Web address.
Message Insertion Mode	This drop-down menu provides two selections to set the message insertion method of the APEX1000: • **Efficient** – The default mode of insertion and recommended use case for the APEX. This allows the APEX to insert generated PSI and ECM messages as efficiently as possible into the output stream. • **Single Section** – This mode forces the APEX to start every new message at the beginning of an MPEG packet. This will typically increase the amount of bandwidth required for the APEX to insert PSI and ECM messages. This is the least efficient method of insertion and should only be selected if the output streams have the proper bandwidth for PSI and ECM messages.
Auto-Reboot Enabled	Select the *Auto-Reboot Enabled* checkbox to allow the APEX1000 to automatically reboot when specific hardware errors occur. Range: On/Off *Note: Currently, only a Loss of Host-to-GigE communication can trigger an automatic reboot.*
Reboot Reason	Read-only function that indicates the reason for the last APEX1000 boot: • **Power Cycle** – Power-up or power cycled • **Operator Reboot** – Operator-commanded reboot • **Hardware Fault** – An automatic reboot has occurred
Unicast Loss of Input Timeout (ms)	Displays the period for *waiting for packet to appear* on input for a unicast (VOD) stream (the maximum allowable time between packets for unicast streams before the stream is considered lost). Range: 600 ms – 6000 ms (configurable in steps of 200 ms) The default is 5000 ms.
Multicast Loss of Input Timeout (ms)	Displays the period for *waiting for packet to appear* on input for a multicast (broadcast/SDV) stream (the maximum allowable time between packets for multicast streams before the stream is considered lost). Range: 600 ms – 6000 ms (configurable in steps of 200 ms) The default is 5000 ms.
Loss of Input Compare Type	This is the comparison type that you use when comparing the input Primary stream against the input Secondary stream. Range: Data Rate/ Stream Rate • **Stream Rate** includes all packets, include Null packets • **Data Rate** includes only non-Null packets (video, audio, and data packets) The default is Stream Rate.
Detect Loss of Input PSI Enabled	Range: On/Off Reference Detection of Lost Input Services below for more information.

Item	Definition/Range
Loss of Input PSI Timeout	The APEX1000 can detect the loss of an input stream based on missing PSI on the input (missing PATs and/or PMTs). (This field is grayed out if *Detect Loss of PSI Enabled* is not checked.) Range: 1 – 21600 (seconds) See Loss of Input PSI Timeout below for more information. *Note: For VOD input streams, this setting should be set to at least 10 minutes (600 seconds).*
PSI Range Start	Insert a value to bound the minimum PSI version number for PATs and PMTs. Range: 0 – 30 *Caution: PSI Range Stop must be greater than PSI Range Start.*
PSI Range Stop	Insert a value to bound the maximum PSI version number for PATs and PMTs. Range: 1 – 31 *Caution: PSI Range Stop must be greater than PSI Range Start.*
PAT Version Increment	Insert a value to randomize the starting PAT version number after a reboot. Range: 0 – 15
PMT Version Increment	Insert a value to randomize the starting PMT version number after a reboot. Range: 0 – 15

Loss of Input PSI Timeout

Loss of PSI is used to determine when a service that was previously received is no longer on the input stream. For a service to be remultiplexed by the APEX1000, the input PAT must reference the applicable service number. In addition, the input PMT must be received.

The **Input PAT** is used to determine the input PMT PID value. If either the PAT or the PMT are determined to be missing, the APEX1000 will stop remultiplexing the service. This provides you with a real time update for each service.

Detection of Lost Input Services

The APEX1000 can detect the loss of an input service, based on missing PSI on the input. This is an option that may allow some receivers/decoders to better react to lost services.

If this mode is enabled, the behavior described below may be expected:

- *If an Input PMT is deemed lost*: To ensure that the associated SN reference is removed, the APEX1000 will remove the associated output PMT and will update the output PAT. If the input PMT reappears, the APEX1000 will immediately begin re-inserting the output PMT.

- *If an Input PAT is deemed lost*: The APEX1000 will remove all associated output PMTs and will not forward any component PIDs associated with those input services. If the input PAT re-appears, the associated output service streams, and output PMTs will be re-established there on the output.

A PAT associated with a defined output MPTS will always persist, regardless of the availability of associated input services or PMTs. Maintaining an output PAT prevents the occurrence of a *dead* QAM channel (should there be no services currently available to stream to the output).

CAUTION *This process is not applicable to SDV sessions. SDV sessions have the PAT updated to contain the PMT reference regardless of the input PSI. (This method reduces the tuning time when an SDV session is first requested.)*

Notes:

1. The APEX1000 maintains the routes associated with lost PMT, for the purpose of re-establishing the flow of the service should the service re-appear. The same behavior holds true if the input PMT is missing, even though the associated components may be there.

2. To reflect the loss of services within the output due to missing PATs or PMTs on the associated input, the output PAT will be updated accordingly.

Detect Loss of Input PSI Configuration

Use the APEX-EM to enable or disable the detection of loss of input PSI messages.

- If *enabled*, the aforementioned behavior will take place, due to missing input PMTs or PATs associated with an output MPTS.
- If *disabled*, the APEX1000 will not react to missing PSI on the input. In this eventuality, the current behavior will be maintained, wherein the APEX1000 will maintain the output PMT and SN references within the PAT, even though the input PSI is missing.

The APEX1000 EM/SDM allows you to configure the length of time input PSI can be missing *before declaring the service lost*. The time interval can be set in one second increments from a minimum of one (1) second up to 21600 seconds. The default is five (5) seconds.

VOD Warning

Some VOD servers stop sending PATs and/or PMTs during trick play modes (FFWD, RWD, or Pause). For this reason, when the APEX is used for VOD, the loss of PSI detection timeout value must be set to at least ten (10) minutes (600 seconds). This prevents the APEX from considering the input program missing during a trick play mode.

In a VOD environment, if the APEX discovers that a program is missing, it stops inserting the PMT and removes the PMT reference from the PAT. The set-top box then assumes that the program is missing; this will necessitate a re-ordering of the program.

Unicast and Multicast Loss of Input Stream Processing

The APEX uses the unicast and multicast timeout values (600-6000ms) to determine if an input stream exists. This is used mainly for RTSP and MHA Session Control modes to determine when service mapping exists. It is also used for Manual Routing mode to alarm when an input stream is missing.

Note: These timeout values do NOT apply to UDP Port Mapping mode services.

- For RTSP and MHA sessions, the unicast timeout value is used for VOD sessions. The ERM is informed when a VOD service is found or is missing based on the timeout value. The multicast timeout value is used for SDV sessions. This timeout value is used to determine if a multicast join was successful or not (reception of a stream within the timeout period determines success). The loss of input stream via the multicast timeout is also used to determine when to failover for SDV sessions setup with redundant streams. A failover to the secondary input stream occurs when a multicast input stream is determined to be missing (based on the multicast timeout value).
- For Manual Routing programs, the timeout values are used to alarm when an input stream is detected as missing. No failover or other action is taken when an input stream is missing. The APEX alarms to notify a user that a manually routed stream is no longer being received.
- For UDP Port Mapping (VOD) services, the unicast and multicast timeout values are not applicable. Because UDP Port Mapping sets up static VOD routes, the input streams are not always expected to be present. Therefore, no alarming is performed when input streams are missing.

1:1 Chassis Redundancy Overview

Starting with APEX firmware release version 2.1, the APEX1000/REM1000 RF redundancy pair provides support for *narrowcast* content delivery. Firmware release version 2.4.x offers a solution for *broadcast* content delivery. This option employs a chassis redundancy design where a *secondary* APEX backs up a *primary* APEX, and where each unit is capable of acting as either the **active** or the **standby**.

Please note the following system characteristics:

- The APEXs autonomously failover when a fault is detected on the active APEX
- Switchback from the standby APEX to the active APEX is manual
- Encryption keys and ECMs are unique between APEXs in a redundancy pair
- The primary and secondary APEXs use discrete PID spaces to prevent cross streaming following a failover
- Configuration is synchronized between the APEXs in the redundancy pair

Redundancy with Heartbeat

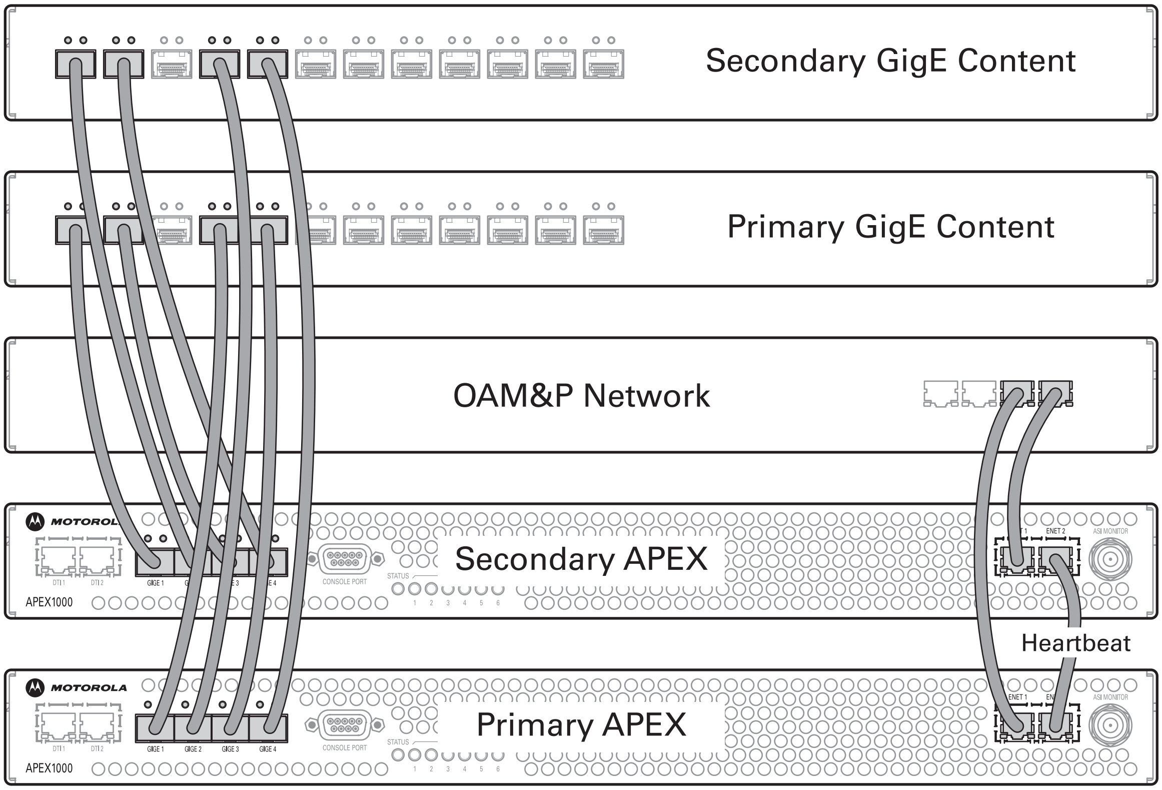
The APEXs communicate by means of a simple heartbeat message, continually informing each other of their current state, role, and configuration. On cold reboot or power cycling, both APEXs boot to a *standby* state; each then determines the correct state into which it will transition. (Typically, the primary APEX enters the *active* state and the secondary APEX enters the *standby* state.)

The primary and secondary APEXs use the heartbeat to synchronize their configurations. Both APEXs receive encryption information from the DAC’s RDS interface and, if so configured, both APEXs join the same multicast routes. In this scenario, both APEXs generate PIDs, ECMs, and EMMs, but the secondary APEX has its RF ports muted.

When the secondary APEX recognizes that the primary APEX has failed (or is in a fault state), it transitions to the active state and un-mutes its RF ports.

Note: This feature does not un-mute QAM channels that were explicitly muted by the operator using the EM (when transitioning to the active state).

Figure 6-5 — Redundancy with Heartbeat



A properly configured and functioning Chassis Redundancy scheme requires you to:

- Configure both APEXs by designating one as *primary* and the other as *secondary*
- Configure the routes on the primary APEX
- Configure the correct redundant APEX IP address (either ENET1 or ENET2)
- Configure the redundancy mode, either warm or hot
  - In **hot** redundancy mode, mappings are activated on both active and standby APEXs (both APEXs join multicasts and process the input streams)
  - In **warm** redundancy mode, mappings are only activated on the active APEX (only the active APEX joins multicasts and processes the input streams)

Additionally, the RF outputs from both APEXs must be wired into the same combiners (only one APEX RF output can be active at any given time).

Because both APEXs are wired into the same combiners, all QAM channel outputs will mute following a fault detection; this procedure enables the secondary QAM channels to come online without colliding with primary QAM channels.

Primary and Secondary APEX Roles

- The primary APEX is the **master** device in the redundancy pair, and is typically expected to source broadcast content to the cable plant. This is the device which is normally *on* and *active* (assuming that no faults have occurred).
- The secondary APEX is the **backup** device in the redundancy pair; it has its QAM Module outputs muted, and is *standing by*. The secondary device only acts when the primary APEXs heartbeat indicates a failover should occur, or when communication with the primary times out.

Failover Procedure

1. Each APEX sends a heartbeat at one second intervals. As soon as the primary and secondary exchange heartbeats, the redundancy link is established. The heartbeat informs each APEX of the status of the other APEX in the redundancy pair, and includes configuration synchronization information.
2. Each APEX then verifies if the configurations are synchronized. If they are not, the standby APEX retrieves configuration information from the active APEX.
3. When the primary APEX experiences a fault, it transitions from the active state to the fault state, muting its QAM outputs. If possible, the primary sends a heartbeat to signal this transition.
4. The secondary APEX (previously in a standby state) then transitions to the active state, un-muting its broadcast QAM outputs upon reception of the heartbeat from the primary APEX, or times out while waiting for the heartbeat from the primary.

You can view the status of both primary and secondary APEX on each APEX-EM. When the primary is in a standby state, you can force a failback from the secondary back to the primary.

CAUTION *There is no auto-switchback option; you must manually failback to the primary after the primary comes back online. However, if the secondary experiences a fault, the primary becomes active.*

The APEX will enter a fault state on the following critical alarms:

- **HW Fault**
- **Temperature Fault**
- **QAM Module Fault**
- **QAM RF Port Fault**
- **QAM Channel Fault**

Note: HW Fault is enabled by default; you can enable or disable the other alarms.

Additionally, you can also determine if the link loss of the following interfaces will result in the APEX entering a fault state:

- **GigE1 and GigE2**
- **GigE3 and GigE4**
- **ENET1**
- **ENET2**

Note: By default, the APEX will enter a fault if an enabled GigE interface experiences a link loss.

To configure the failover options listed, use the Redundancy Triggers window.

Interface Fault Detection

Interface faults are based on link detection, not on data rate. By default, loss of link on an enabled GigE interface causes a link fault. If transport stream redundancy is configured, you must configure the APEX to failover *only* when both GigE interfaces lose link by selecting either *GigE 1 and 2 Link Loss* and / or *GigE 3 and 4 Link Loss.* If you select GigE 1 and 2 and *both* interfaces experience a link loss, then the APEX fails to the standby.

- When Link Loss is enabled on ENET1, it causes the APEX to enter a fault state when the link is lost on the OAM&P control interface.
- When Link Loss is enabled on ENET2, it causes the APEX to enter a fault state when the link is lost on the ENET2 application interface.

Note: ENET2 link loss should not be enabled if a crossover cable is connecting the two APEXs. Loss of power on one APEX in a direct connect mode causes the link to be down on both APEXs.

See also Alarms Window Field Definitions.

Chassis Redundancy Configuration

In a Chassis Redundancy pair, you must configure one APEX as *primary* and the other APEX as *secondary*.

Note: Use the Quick Enable/Disable window to Disable mappings prior to enabling chassis redundancy. The PID spaces are unique from primary to secondary to prevent any stream erroneous acquisition following a failover. (The streams must be re-mapped after redundancy is enabled.)

To ensure a successful synchronization of the configurations, you must follow the procedures listed below:

1. Configure both APEXs with the *same* types of QAM modules (2x4 or 2x8) in the same slots.
2. Configure both APEXs with the *same* GigE inputs enabled (GigE1 to 4).

   In addition:

   - Make certain that both APEX RF outputs are wired into the same combiners.
   - Make certain that RF redundancy is disabled, otherwise 1:1 redundancy is not selectable (EM option is grayed out).
   - Make certain that primary and secondary APEXs have different GigE IP addresses.

Configuring the Primary APEX

Your first step is to configure the APEX selected as the primary.

Configure APEX Routes

1. Using the QAM Configuration window, define the QAM-associated configuration parameters.
2. Using the Program Mapping window, configure program mappings in Manual Routing operation mode. (Manual routing is the main driver for 1:1 chassis redundancy.)

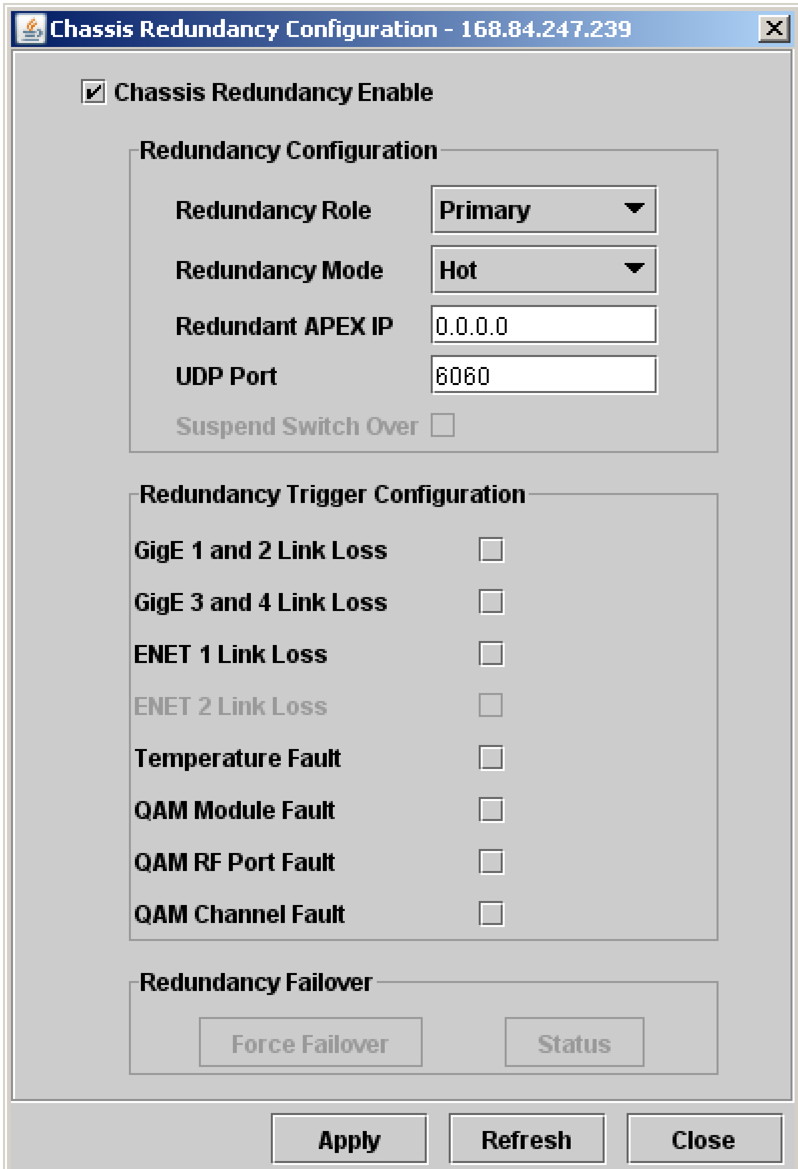
CAUTION *Leave the routes disabled until chassis redundancy is enabled.*

Configure Redundancy Parameters

1. Click **Configuration > Chassis Redundancy Configuration**.

   The Chassis Redundancy Configuration window displays:

Figure 6-6 — 1:1 Chassis Redundancy Configuration



2. To configure the upper section (Redundancy Configuration), check the box next to Chassis Redundancy Enable.
3. From the Redundancy Role menu, select *Primary*.
4. From the Redundancy Mode menu, select *Hot or Warm*.

Note: Hot means multicasts are joined by the standby. Warm means multicasts are not joined until the APEX is active.

5. Configure the redundant APEX IP address. If you are connected directly via ENET2, this will be the ENET2 IP address of the secondary APEX. This is the address the heartbeats are sent to. If you want to use the OAM&P network for heartbeats, type in the secondary APEX's ENET1 IP address.
6. Click **Apply**.

   The primary APEX will now start sending heartbeats to the *secondary* APEX. It enters the active state, and un-mutes its QAM outputs.
7. Configure the lower section (Redundancy Trigger Configuration) by defining the conditions which cause the APEX to enter a fault state:
   - GigE x and y Link Loss: If TS redundancy is enabled, enable each pair of GigE link loss. The default behavior is to enter a fault state if a single GigE port fails. If TS redundancy is enabled, it is preferable for the APEX to fail over to the backup GigE port rather than to the backup APEX. This way, *both* GigE interfaces must experience a link loss for the APEX to failover.

     Note: This option may be inaccessible or grayed out if TS redundancy is not in use.
   - ENET1 Link Loss: If ENET1 fails or the OAM&P cable is pulled, the APEX enters a fault state — **Enable this option**.
   - ENET2 Link Loss: If ENET2 fails or the cable is pulled, the APEX enters a fault state.

CAUTION *Do not enable ENET2 link loss if directly connected to the other APEX through ENET2. The secondary APEX also enters a fault state when it detects a link loss, and will not takeover. This is intended to be used ONLY IF ENET2 is connected to a hub or switch.*

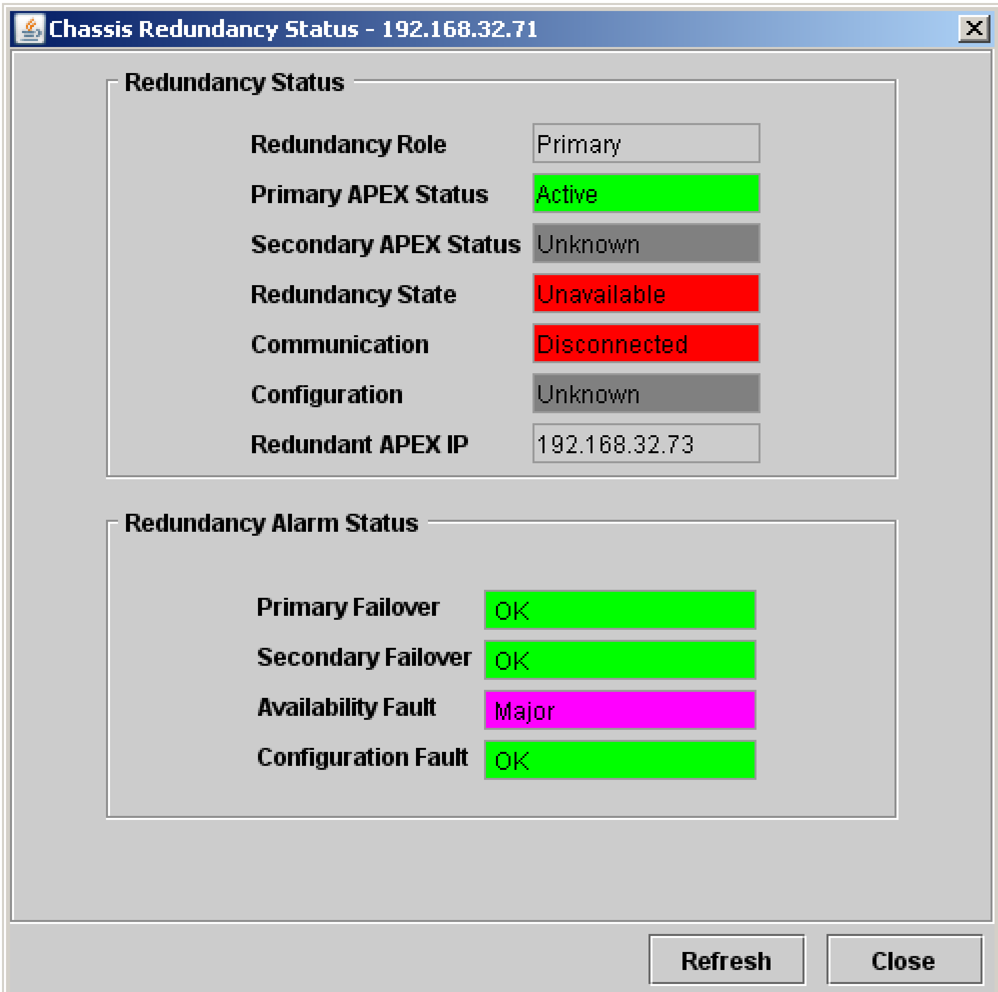
   - Temperature Fault: APEX enters a fault state if operating temperature is exceeded — **Enable this option**.
   - QAM Faults: APEX enters a fault state if a module, port, or channel fails.
8. Click **Apply**. Because the secondary is not yet configured, the primary APEX becomes active.
9. **Enable** the routes that were previously configured.

Note: To Enable or Disable program mappings as a group, click ***Program Mappings > Quick Enable/Disable****.*

Verify Primary Status

1. Click **Status > Chassis Redundancy Status**.

   The Chassis Redundancy Status window displays:



The Chassis Redundancy Status window shows that the APEX is the Primary and is *active*. The secondary is not yet configured, so its status is Unknown, the redundancy state is Unavailable and communication is Disconnected. After the secondary is configured and a heartbeat is received, the redundancy link is established and the status is updated.

Note: The availability fault is Major because the redundant APEX is not connected, therefore redundancy is unavailable.

Configuring the Secondary APEX

After configuring the primary, you must configure the secondary APEX with the same QAM modules and the same GigE ports enabled. The secondary will synchronize the routing configuration and QAM parameters from the primary.

Configure Redundancy Parameters

1. Click **Configuration > Chassis Redundancy Configuration**.

   The Chassis Redundancy Configuration window displays.
2. To configure the upper section (Redundancy Configuration), place a checkmark on the box next to Chassis Redundancy Enable.
3. From the Redundancy Role drop-down menu, select *Secondary*.
4. From the Redundancy Mode drop-down menu, select *Hot* or *Warm*.
5. Configure the *primary* APEX IP address.

   If you are connected directly via ENET2, this will become the ENET2 IP address of the *primary* APEX. This is the address the heartbeats are sent to. If you want to use the OAM&P network for heartbeats, type in the *primary* APEX's ENET1 IP address.
6. Click **Apply**.

   The secondary APEX enters the standby state, because it is receiving heartbeats from the primary (active) APEX.
7. Configure the lower section (Redundancy Trigger Configuration) by defining the conditions which will cause the APEX to enter a fault state.

   - GigE x and y Link Loss: If TS redundancy is enabled, enable each pair of GigE link loss. The default behavior is to enter the fault state if a single GigE port fails. If TS redundancy is enabled, it is preferable for the APEX to fail over to the backup GigE port first. This way, *both* GigEs must experience a link loss for the APEX to failover.
   - ENET1 Link Loss: If ENET1 fails or the OAM&P cable is pulled, the APEX enters a fault state — **Enable this option**.
   - ENET2 Link Loss: If ENET2 fails or the cable is pulled, the APEX enters a fault state.

CAUTION *Do not enable ENET2 link loss if directly connected to the other APEX through ENET2. The secondary APEX will also enter a fault state when it detects a link loss, and will not take over for the failed primary. This is intended to be used ONLY IF ENET2 is connected to a hub or switch.*

   - Temperature Fault: APEX enters a fault state if the operating temperature is exceeded — **Enable this option**.
   - QAM Faults: APEX enters a fault state if a module, port, or channel fails.

8. Click **Apply**.

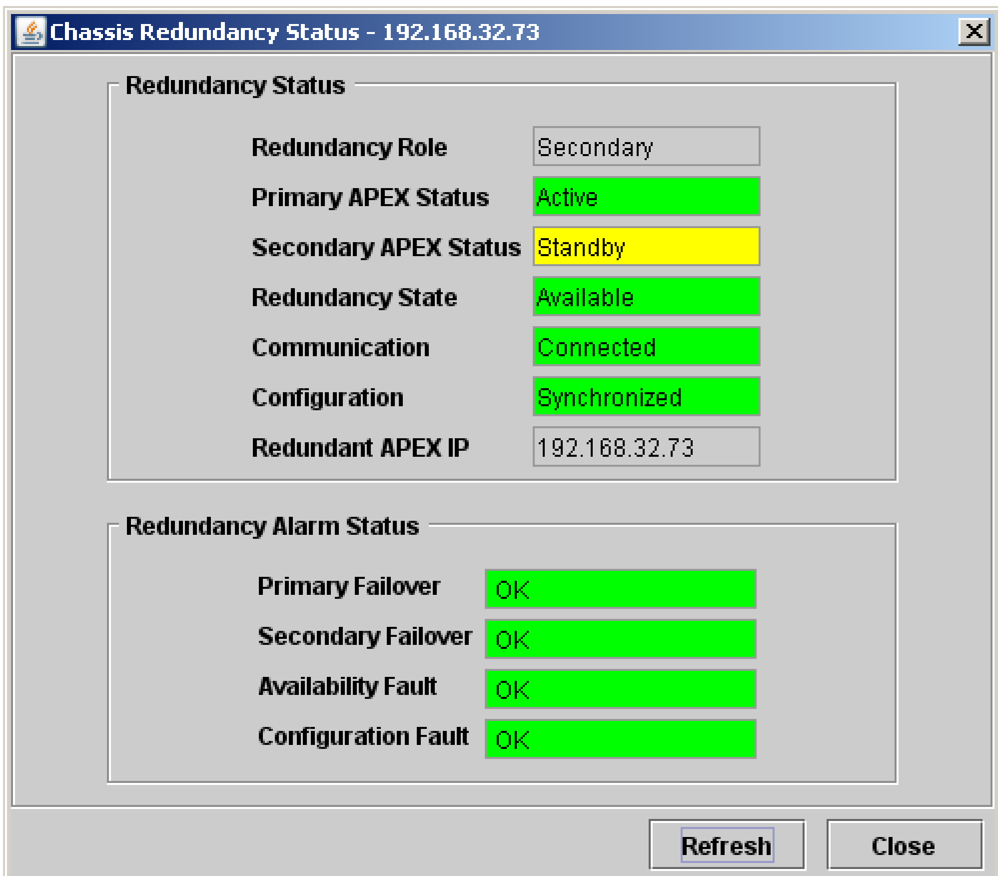
Verify the Configuration

On a secondary APEX, the configuration is synchronized from the primary. The QAM RF parameters, OTS configuration, and routes should all be synchronized (this process may take a few minutes).

Verify the Status of the Pair

When logging into either the primary or secondary APEX, the status should show:

- Redundancy State: **Available**
- Communication: **Connected**
- Configuration: **Synchronized**
- All alarms should be **OK**



Notes:

1. The Primary APEX should be in Active *status, and should be sourcing content.*

2. The Secondary APEX should be in Standby *status, and should have its RF ports muted.*

Redundancy Configuration

The following table describes the values found in the *Redundancy Configuration* portion of the Chassis Redundancy Configuration window:

Parameter	Description
Chassis Redundancy Enable	Check this box to enable/disable the chassis configuration.
Redundancy Role	Use this menu to configure the desired APEX 1000 role. Values are: • **Primary** – Configures this APEX as the primary APEX (active output ports) • **Secondary** – Configures this APEX as the secondary APEX (inactive with output ports muted until a failover occurs) The default is Primary.
Redundancy Mode	Defines the Multicast Redundancy Mode. Values are: • **Hot** – Indicates that mappings are enabled and multicast routes are joined by the APEX even when it is in standby • **Warm** – Shows that multicast routes are joined and routes enabled only when the APEX is active The default is Hot.
Redundant APEX IP	Shows the IP of the dedicated redundant APEX heartbeat interface.
UDP Port	Shows the UDP Port of the designated *primary* or *secondary* APEX.
Suspend Switch Over	Check this box to suspend this APEX from switching over. When in a suspended state, this APEX does not transition to an active state even if the other APEX fails. This option allows you to reboot and/or reconfigure the active APEX and prevent the standby APEX from coming online. (If the active APEX fails, the standby APEX *does not become active* until the suspend switch over parameter is disabled.) *Note: The configuration is not synchronized when the standby APEX is suspended.*

Configuring Redundancy Triggers

An alarm may be enabled (active) but not enabled for redundancy; for example, the over-temperature alarm may be active, but unless it has been enabled for redundancy, the APEX *will not failover* to the backup due to an over-temperature fault.

Using the *Redundancy Triggers* window, you must individually select which alarms are required for redundancy in your configuration scheme. When these triggers are enabled, the APEX will failover to the standby unit whenever any triggering conditions take place.

You can configure the following parameters in the *Redundancy Trigger Configuration* section of the Chassis Redundancy Configuration window:

Parameter	Description
• **GigE 1 and 2 Link Loss** • **GigE 3 and 4 Link Loss** • **Enet 1 Link Loss** • **Enet 2 Link Loss**	You can configure the APEX to failover due to link faults. By default, a link loss condition on an enabled GigE interface will cause a failover because it is a critical fault. If *transport stream redundancy* is in use (where a secondary stream is received on a different interface), you may configure the APEX1000 to failover *only* after the pair of GigE links are lost. You may also define whether ENET1 and ENET2 link loss will cause a failover. *Notes:* *1. GigE link loss is only selectable when GigE interfaces are enabled.* *2. ENET2 link loss should not be enabled if directly connected to the secondary APEX by means of a crossover cable.*
Temperature Fault	The APEX will failover due to over-temperature detected.
QAM Module Fault	The APEX will failover due to QAM module fault detected. • *Critical* indicates clock, PLL, data sync, communication, configuration, RF output level, unsupported HW faults, invalid code versions, code downloading, or code download failed.
QAM RF Port Fault	The APEX will failover due to QAM RF port fault detected. • *Critical* indicates clock, PLL, or data synchronization problem. • QRM code download in progress, QRM code download failed, and unsupported QRM.
QAM Channel Fault	The APEX will failover due to QAM channel fault detected. • *Critical* indicates data fault.

To configure any the parameters available in the Redundancy Triggers screen:

1. Place a checkmark in the corresponding checkbox to certify that failover will occur upon detection of that specific fault.
2. Click **Apply** to implement the changes in the APEX1000.

For more information on specific alarm triggers, see Alarms Window Field Definitions.

Configuring Redundancy Failover

You can configure the following parameters in the *Redundancy Failover* portion of the Chassis Redundancy Configuration window.

Parameter	Description
Force Failover	Use to failover from active to standby. *Note: This button is grayed out when the APEX is not in the active state.*
Status	Opens the Chassis Redundancy Status window. *Note: This button is grayed out when chassis redundancy is disabled.*

Redundancy Availability

The APEX1000 reports the status of the 1:1 redundancy system, whether or not redundancy is available. Note that the APEX can only failover when redundancy is *available*; additionally, the heartbeat interface link *must be detected* for the system to be available.

Not all configuration parameters are redundant; make certain to define the Gigabit Ethernet configuration parameters (Enable, IP Address, Subnet Mask, etc.) prior to enabling Chassis Redundancy on both units. (The same ports must be enabled for each unit.)

Depending on the current status, the APEX reports the following values:

- **Available** – Indicates that both APEXs are healthy, configurations are synchronized, and there is no fault on either APEX.
- **Protected** – Indicates that one APEX is active, and protecting an APEX in a fault state. For example, if APEX1 is in a fault state and APEX2 is active, APEX1 will remain protected.
- **Unavailable** – Indicates that redundancy is not available, either because the heartbeat indicates the other APEX is in fault or suspended, or because the APEX completely fails to receive a heartbeat.
- **Synchronizing** – Indicates that redundancy is unavailable until the primary and secondary configurations are synchronized. (The secondary APEX's configuration is being synchronized by the primary at this time.)

Synchronizing the Configuration

If the standby APEX detects that the configuration is out of sync, it will synchronize its configuration from the active APEX.

Some configuration parameters require a reboot. For example, if the secondary APEX is configured to use CSA encryption algorithm and the primary APEX is configured to use DCII DES encryption algorithm, the secondary will need to reboot in order to change the *config* value. In this case, it may be appropriate to copy the configuration files which are read at boot up. The APEX-EM will configure the active APEX, which in turn will setup the standby APEX.

Note that redundancy will be unavailable while the configuration is *not synchronized*. If the active APEX fails during synchronization, the standby APEX will become active. The configuration may be out of sync, so you may have to re-apply the configuration. (The standby APEX will not be able to apply most configuration parameters, including OTS, QAM, and routing configuration; this configuration is synchronized from the *active* APEX.)

IMPORTANT:

1. The QAM modules must be the *same type* (2x4 or 2x8) in both the primary and secondary APEXs.
2. The *same GigE ports* must be enabled on the primary and secondary APEXs.
3. The primary and secondary APEXs must have *unique IP addresses*.

CAUTION *The GigE configuration does not automatically synchronize between the Primary and Secondary APEXs. Make certain that the same GigE ports are enabled on both primary and secondary units.*

Removing QAM Modules from the APEX in Chassis Redundancy

QAM Modules cannot be removed from an APEX that is enabled for Chassis Redundancy, because this creates a QAM Module mismatch and causes RF to mute on both APEXs of the redundant pair.

IMPORTANT:

1. Chassis Redundancy must be disabled before removing a QAM Module from the APEX

2. A Primary or Secondary APEX with an Active APEX Status cannot have Chassis Redundancy disabled without first disabling Program Mappings

3. An APEX with a Standby APEX Status can have Chassis Redundancy disabled (the APEX automatically disables Program Mappings)

CAUTION *Removing QAM Modules from an APEX enabled for Chassis Redundancy causes RF to mute on both APEXs of the redundant pair.*

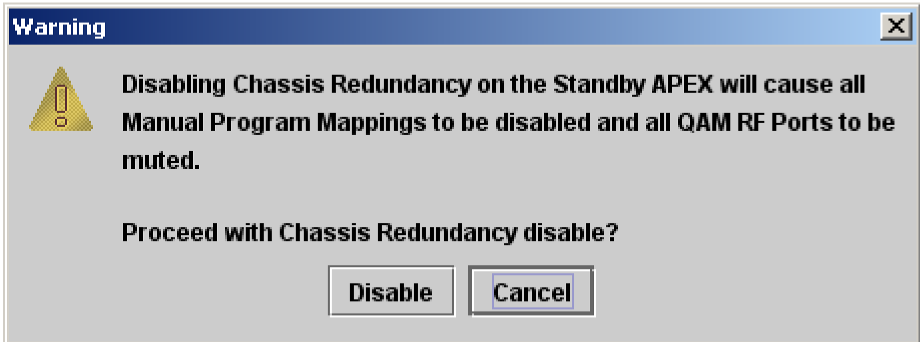
To replace a QAM Module in an APEX (that is part of a Chassis Redundancy pair) without interrupting service to the downstream plant, perform the following steps:

1. Verify the APEX Status for the APEX from which a QAM Module is to be removed.
2. If the APEX Status is Standby, proceed to step 4.
3. If the APEX Status is Active, open the QAM RF Redundancy window, and apply Force Failover on the other APEX in the pair.

   Note: Make certain that the APEX from which a QAM Module is to be removed is the Standby APEX.

4. Disable Chassis Redundancy on the **Standby** APEX.

   The following pop-up window displays:



5. Click Disable.
6. Verify the APEX Status to confirm that Chassis Redundancy is now disabled.
7. Remove the QAM Module from the APEX.
8. Insert the replacement QAM Module into the APEX.
9. Use the QAM Status window to confirm that the QAM Module configuration completes without errors; otherwise, correct the fault before proceeding.
10. Additionally, use the QAM Status window to confirm that the QAM Module is of the same type (2x4, 2x8, etc.) as the QAM Module in the same slot on the Active APEX. If not, swap out the module for a correct module or upgrade the module as necessary before proceeding.
11. If there are no errors on the QAM Module, and it is of the same type as the QAM Module in the same slot on the Active APEX, enable Chassis Redundancy on the APEX.

DTA Support Overview

The Digital Terminal Adapter (DTA) is a device which allows digital, MPEG-2 standard definition transports to be decoded and remodulated as NTSC analog signals intended for display on analog-only display devices. DTA video services are configured as manual routes, with a configured multicast joined to retrieve in-band messages for insertion.

Note: The current APEX1000 firmware release does NOT include support for DTA content protection. This feature will be included in a future release.

The APEX inserts DTA In-Band Messages (CAT and EMM) in each DTA-enabled OTS, and updates the PAT to include a reference to the Network PID. The Network PID contains the in-band Channel map and service information for DTA set-top boxes.

The APEX supports reception of DTA in-band messages on any of the Host Fast Ethernet (FE) Interfaces. When CAT and EMM messages are received, they are re-inserted onto an output stream under the following conditions:

- The output stream must be active, and DTA Support must be enabled for that output stream.
- The output transport stream is not configured for stream pass through.
- The CAT PID, NET PID, and EMM PID must not be currently mapped from an input to that output.
- The multicast group for CAT/EMM PID and Network PID are not used by other manual routings.

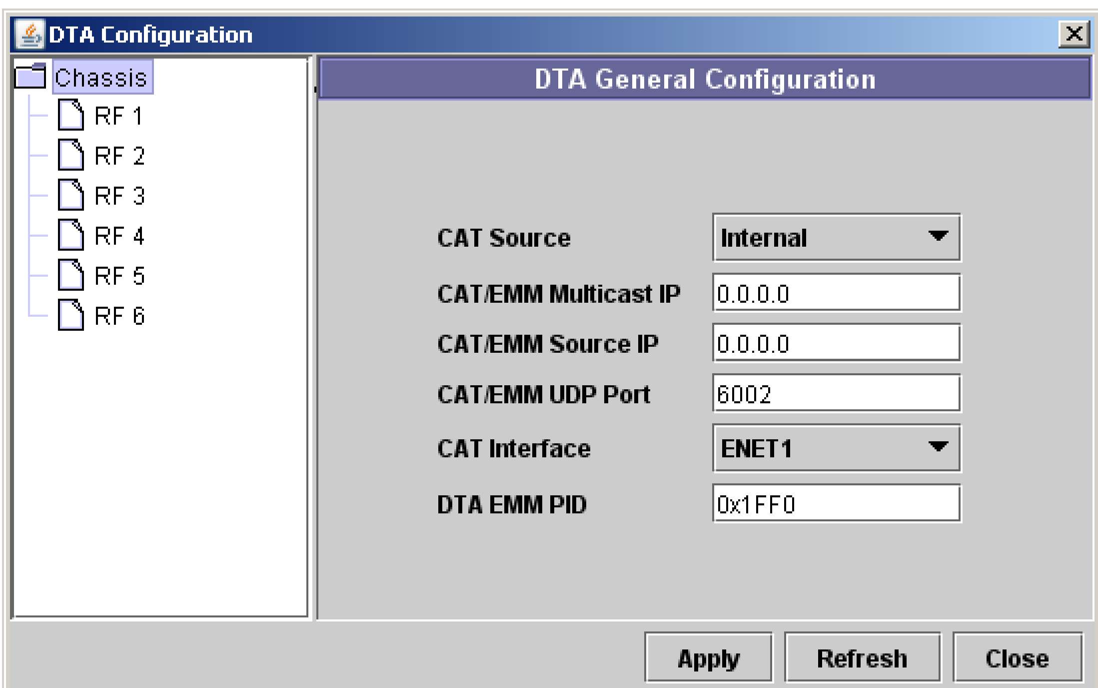
If any of the conditions mentioned above is not met, then the APEX removes existing routings and displays an error message for the operator to perform the corrective action.

DTA Configuration (General)

To begin configuring DTA support, click **Configuration > DTA Configuration**.

The DTA General Configuration screen displays:

Figure 6-7 — DTA General Configuration



CAT/EMMs for DTA are generated on the DAC (DAC 3.11-18), or the CASMR (DAC 4.0 and higher). Settings in this window must match those found in the DAC for DTA to function on the APEX.

CAUTION	*Complete all Network/CAT/EMM Configuration tasks **prior** to enabling any QAMs for DTA. Before making changes to an existing configuration, you must also disable DTA on all applicable QAMs.*

Use the DTA *General Configuration* screen to configure the following CAT/EMM PID parameters for each APEX:

Parameter	Description
CAT Source	Use to select whether the APEX generates a CAT, or inserts CAT received from DAC when required to insert EMMs in the DTA OTS. Range: Internal, External The default is Internal.
CAT/EMM Multicast IP	IPv4 address to receive the PID stream. 0.0.0.0 indicates Unicast stream.
CAT/EMM Source IP	IPv4 address of the multicast source 0.0.0.0 indicates that SSM is not used.
CAT/EMM UDP Port	UDP port of externally-generated CAT. Range: 1024 – 65535 The default is 6002. (Matches the default value configured in the DAC.)
CAT Interface	Ethernet Interface for PID stream. Range: ENET1 – ENET2 The default is ENET1.
DTA EMM PID	EMM PID to retrieve from input stream and insert on output stream (no remapping). Range: 0x1C00-0x1FFE The default is 0x1FF0. *Caution: Even if CAT source is set to Internal, it is necessary to generate EMMs on the DAC.* *The DTA EMM PID must be data-filled to match the DAC EMM configuration, or users will not be able to Init/Refresh DTA tuned to OTSs on this APEX1000.*

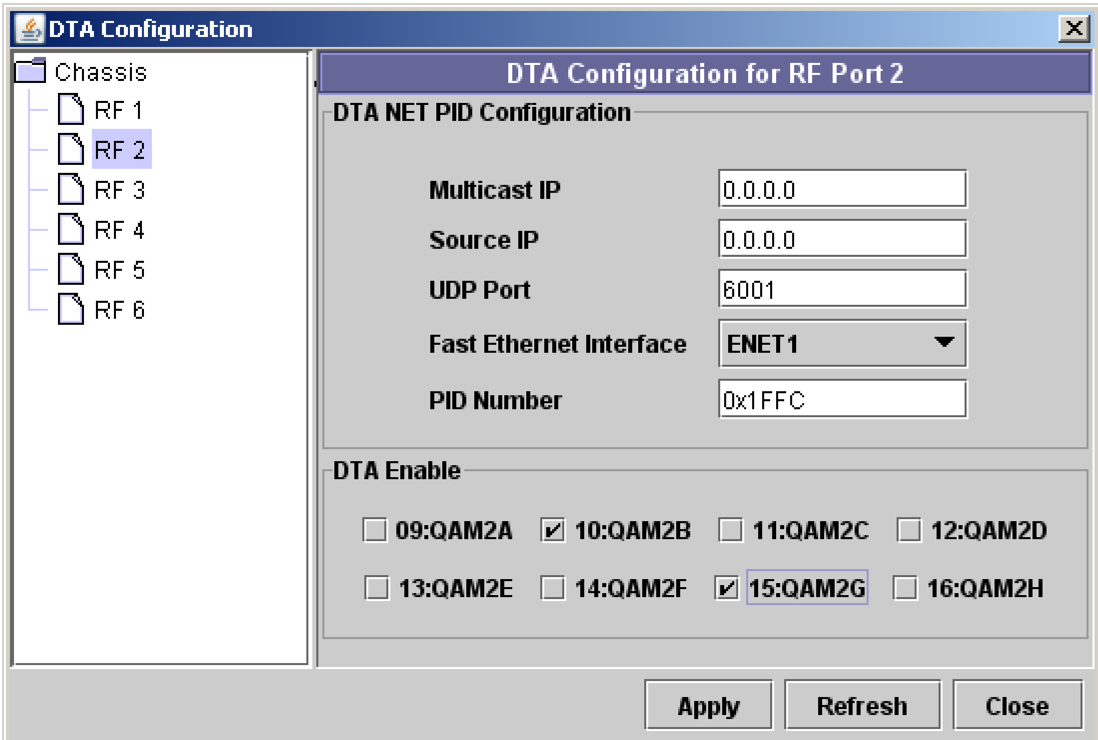
DAC Support Notes

- The SIgen and dtatm processes must be configured and running on the DAC (3.1.1 and 3.3.1) before configuring the DTA on the APEX1000.
- Customers using DAC 4.0 and later will require a CASMR system to generate DTA tables.

DTA Configuration (RF Port)

To continue configuring DTA support, click one of the RF Port folder tabs. The corresponding DTA RF Port Configuration screen (RF 1–6) displays:

Figure 6-8 — DTA RF Port Configuration



RF 1 through RF 6 represent the 48 QAM channels available, in increments of eight per RF port. You can configure the following Network PID parameters (per RF Port) in the DTA RF Port Configuration screen:

Parameter	Description
Multicast IP	IPv4 address to receive PID stream. Range: Multicast IPv4 The default is 0.0.0.0 0.0.0.0 indicates Unicast stream.
Source IP	IPv4 address of multicast source. Range: Multicast IPv4 The default is 0.0.0.0 0.0.0.0 indicates that SSM is not used.

Parameter	Description
UDP Port	UDP port of Network PID. Range: 1024 – 65535 The default is 6001. (Matches the default value configured in the DAC.)
Fast Ethernet Interface	Ethernet Interface for PID stream. Physical Host Ethernet Port (ENET-1 or ENET-2) The default is ENET-1.
PID Number	Network PID to retrieve from input stream and insert on output stream (no remapping). Network PID (0x1C00-0x1FFE) The default is 0x1FFC.
DTA Enable	Enables DTA message insertion on selected OTS / QAM channel. Range: Enable, Disable The default is Disable. (No checkmarks in any of the boxes.)

RADIUS Authentication

Remote Authentication Dial-In User Service (RADIUS) is a client/server protocol, established to manage modem pools. Its main objective is the centralized management of user access policy; at its core is a standard framework for the exchange of Attribute-Value Pairs (AVPs).

RADIUS AAA functions comprise three elements:

- **Authentication** – The function of checking user credentials (username and password)
- **Authorization** – The function of defining the rights or privileges available after the user is authenticated. For example, *super user* vs. *read only user*
- **Accounting** – The function of tallying time and resource usage for each user

Note: The current APEX firmware only supports Authentication, Authorization and Integration with a SecurID server. RADIUS Accounting will be supported in a future release of the APEX1000.

Redundancy Overview

Two Authentication and Authorization servers are supported, a primary and a backup. Each must be configured with an IP address, UDP port, and a shared secret.

Authentication Operation

If configured to authenticate by way of RADIUS, the communication flow follows this sequence:

1. The operator enters credentials into the EM, such as username and password.
2. The APEX transmits an Access-Request message to the RADIUS server.
3. The RADIUS server replies with an Access-Accept, Access-Reject, or Access-Challenge message.
4. The EM sends the user a message indicating success, reject, or challenge.
5. If the headend device receives the Access-Challenge message, the EM prompts the user for additional information, which is sent to the headend device.
6. The Headend device issues an Access-Request message with new information retrieved from the operator.

Note: Following an APEX reboot, users must be re-authorized by re-logging into the APEX-EM.

Idle Timeout

The idle timeout is defined on the RADIUS server, and indicates how long the user session may be idle before the connection is closed (activity is defined as an SNMP GET or SET operation initiated by the EM).

If the idle timeout expires, the EM informs the APEX that the timeout has expired, and logs the user out of the EM.

Note: To properly interoperate with RSA SecurID, the timeout window must be wider than two seconds.

Concurrent Sessions

Each user logon is authenticated by the headend device. There is no limit to the number of users which may be authenticated by RADIUS.

Local Fallback

After failing to authenticate against both primary and backup RADIUS authentication servers, the headend device reverts to local authentication (if so configured).

Local authentication is the same as the current log in, with *root* and *other* users.

Privilege Levels

The headend device supports three types of accounts:

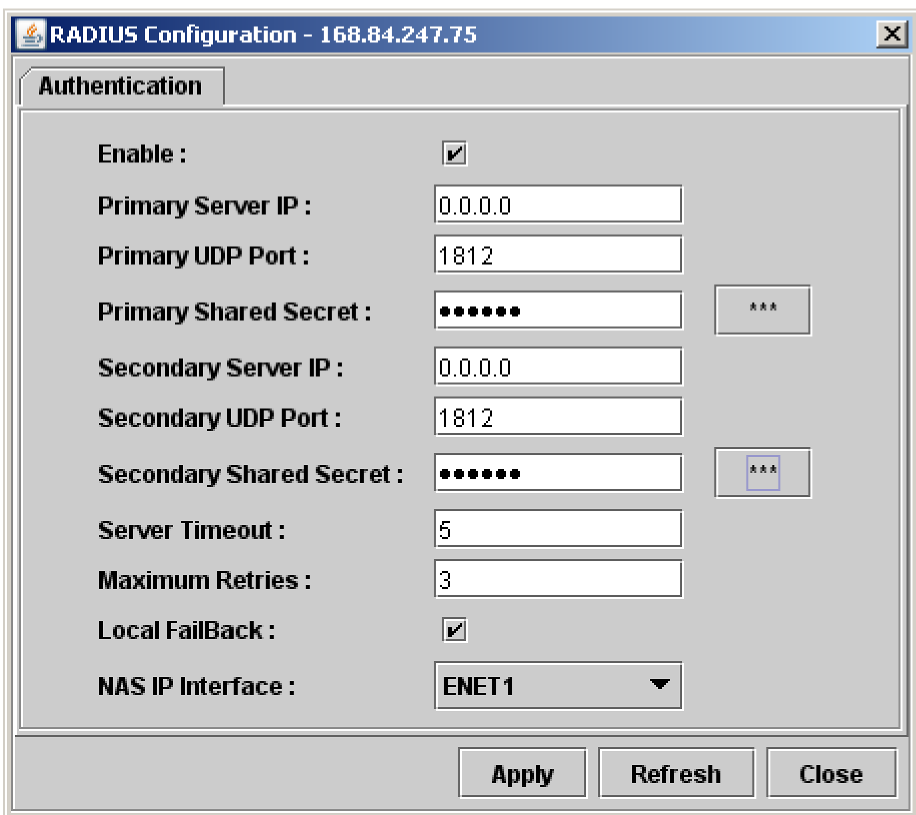
- **Administrator** – equivalent to the current *root* user, with read/write access to all parameters on the headend device.
- **Operator** – can configure all parameters except the RADIUS configuration parameters.
- **Monitor** – read-only; user may only view parameters, but may not apply changes to any field.

RADIUS Configuration

You can define the following parameters in the RADIUS Configuration *Authentication* window for a locally authenticated *root* user, and by the *administrator* user.

To begin setting up authentication parameters, click **Configuration > RADIUS Configuration**:

Figure 6-9 — RADIUS Configuration



RADIUS Configuration window field definitions

Parameter	Description
Enable	Place a checkmark in this box to enable RADIUS log in. Range: Enabled/Disabled The default is Disabled.
Primary Server IP	IP address of the primary RADIUS server. Range: Unicast IPv4 address The default is 0.0.0.0.
Primary UDP Port	Authentication/Authorization port for primary server. Range: 1 – 65535 The default is 1812.
Primary Shared Secret	Displays the shared secret for the primary server. Range: 127 char string The default is empty string. **** allows the root or administrator user to view the shared secret.*
Secondary Server IP	IP address of the secondary RADIUS server. Range: Unicast IPv4 address The default is 0.0.0.0.
Secondary UDP Port	Authentication/Authorization port for secondary server. Range: 1 – 65535 The default is 1812.
Secondary Shared Secret	Displays the shared secret for the secondary server. Range: 127 char string The default is empty string. **** allows the root or administrator user to view the shared secret.*
Server Timeout	Timeout before retrying. (Must be greater than two seconds to allow time for SecurID server to generate a response.) Range: 5 s – 600 s The default is 5 s.
Maximum Retries	Allowable number of retries per server. Range: 0 – 5 The default is 3.
Local Failback	Allows for local authentication if RADIUS authentication fails. Range: Enabled/Disabled The default is Enabled.
NAS IP Interface	Selects which interface IP address is included in the NAS IP attribute in RADIUS messages. Range: ENET1/ENET2 The default is ENET1.

Motorola RADIUS Dictionary File

APEX100 firmware includes a dictionary file that includes RADIUS attribute value pairs defining user access levels:

- The Motorola-APEX1000-User-Access-Level is an APEX-specific user access level.
- The Motorola-DVS-User-Access-Level is applicable to all Motorola headend devices. Either AVP must be configured on the RADIUS server.

If both AVPs are present, the level configured for the APEX specific attribute takes precedence.

Note: The Motorola dictionary file is bundled with all firmware releases that support RADIUS. For information on downloading the file at a later time, see *Downloading the Motorola Dictionary File.*

Dictionary File Sample

Below is a sample of the motdict.htm file:

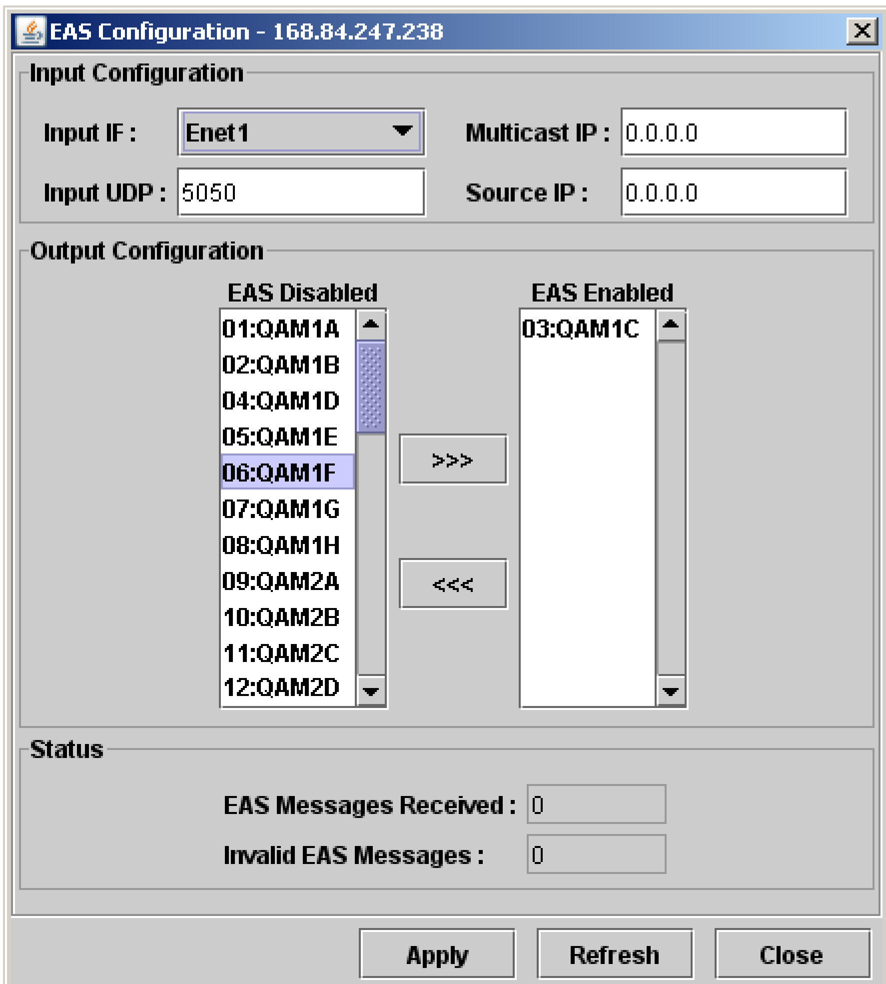
```
VENDOR          Motorola                    161

BEGIN-VENDOR    Motorola

ATTRIBUTE  Motorola-DVS-User-Access-Level 105    integer
VALUE      Motorola-DVS-User-Access-Level Motorola-
Administrator    15
VALUE      Motorola-DVS-User-Access-Level Motorola-Operator
      7
VALUE      Motorola-DVS-User-Access-Level Motorola-Monitor
      0

ATTRIBUTE Motorola-APEX1000-User-Access-Level    107
      integer
VALUE  Motorola-APEX1000-User-Access-Level Motorola-
Administrator    15
VALUE  Motorola-APEX1000-User-Access-Level Motorola-Operator
      7
VALUE  Motorola-APEX1000-User-Access-Level Motorola-Monitor
0

END-VENDOR Motorola
```

EAS Configuration

The EAS Configuration window controls the configuration of SCTE 18 Emergency Alert System messages. You can enable or disable the reception and insertion of EAS messages. Additionally, you can configure the Input Ethernet interface, Multicast and Source IP addresses, and the UDP port on which to receive the messages.

The *Status* section provides a count of the EAS messages received, as well as a count of Invalid EAS Messages:

Figure 6-10 — EAS Configuration



CAUTION *The EAS PID (0x1FFB) is not inserted if the output has been configured for pass-through mode, or if a user ancillary-mapped another PID to PID 0x1FFB.*

To configure EAS:

1. Select the desired Input Interface.
2. Enter the IP Addresses and the UDP Port for that interface.
3. Click to select a numbered row from the *EAS Disabled* column.
4. Click the **>>>** arrow to move that numbered row to the *EAS Enabled* column**.**
5. Click **Apply** to implement the changes.
6. Click **Refresh** to update the information as needed.

Note: To remove a numbered row from the EAS Enabled column, select the row and use the ***<<<*** *arrow to move the selection to the left column.*

EAS Configuration window field definitions

Item	Definition/Range
Input IF	Indicates the host fast Ethernet interface designated to receive the SCTE-18 EAS messages. Values are: • N/A • GigE1 • GigE2 • GigE3 • GigE4 • Enet1 • Enet2
Input UDP	Indicates the UDP port designated to receive SCTE-18 EAS messages. For Enet1 and Enet2, the EAS UDP Port must be set to a valid UDP Port range outside of the IANA reserved range. • Reserved: 0 – 1023 • Valid Range: 1024 – 65535 For GigE interfaces, the UDP port can be any valid UDP Port (0 – 65535).
Multicast IP	Indicates the Multicast IP address designated to receive SCTE-18 EAS messages. If the Multicast IP address is valid, EAS messages can be received as singlecast, network broadcast, or multicast. The EAS Multicast IP address must be a valid, non-reserved multicast address or set to 0.0.0.0 to indicate *not in use*. • Reserved: 224.0.0.0 – 224.0.0.255 • Valid Range: 224.0.1.0 – 239.255.255.255 • Not In Use: 0.0.0.0
Source IP	This is the IP address of the source device for multicast reception.
EAS Messages Received	Indicates the total number of EAS messages received since bootup.
Invalid EAS Messages	Indicates the total number of invalid EAS messages received since bootup.

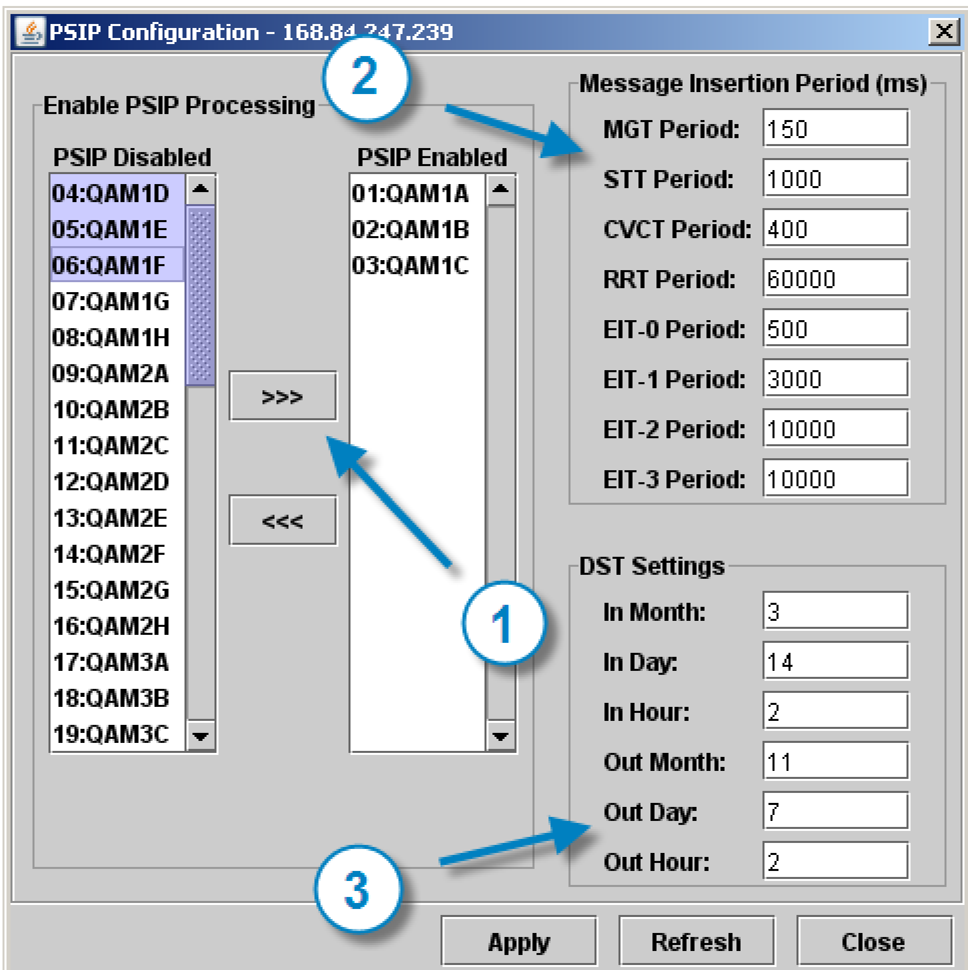
PSIP Configuration

PSIP is a small set of tables operating within every transport stream. These tables provide additional information at the system and event levels for all virtual channels carried in a particular transport stream. APEX1000 version 2.4.x adds support to *pass and fix* the PSIP information provided by any content provider from an input multiplex through the cable network for receipt by hosts / digital TV receivers.

Use the PSIP Configuration window to:

1. Enable PSIP processing.
2. Configure the message insertion periods.
3. Set Daylight Savings Time global parameters.

Figure 6-11 — PSIP Configuration



IMPORTANT: *PSIP processing requires that you set the Time Source to* ***SNTP****. For more information, see System Time.*

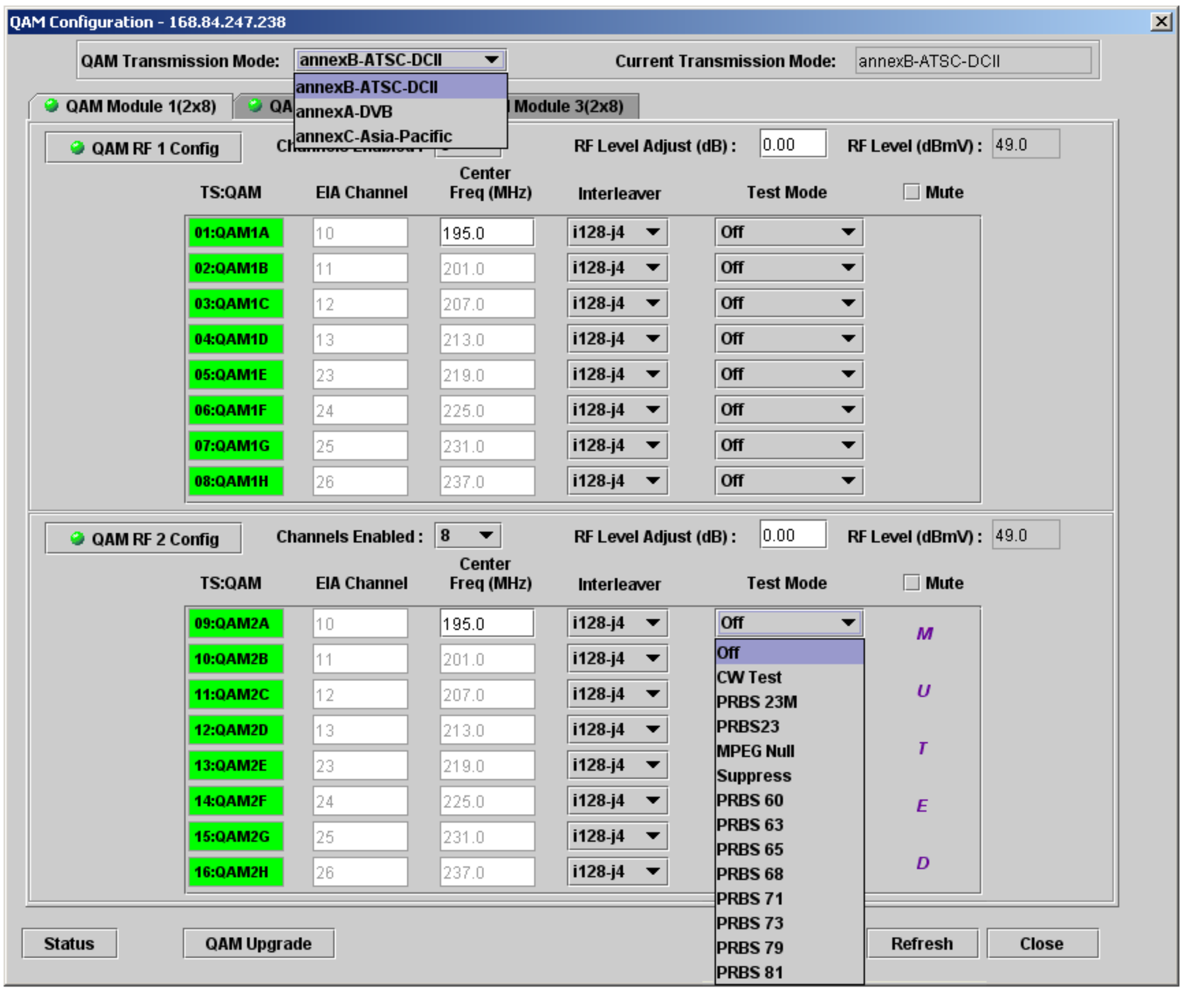
PSIP Configuration window field definitions

<table>
<tr><th>Item</th><th>Definition/Range</th></tr>
<tr><td>Enable PSIP Processing</td><td>Use this area to enable PSIP for the output transport stream. To enable a transport stream for PSIP, select the desired line(s) and click >>>. (Only applicable to manual route OTSs.)
IMPORTANT: PSIP processing also requires that Time Source be set to SNTP
The default is Disabled.
Note: You must click Apply to enable the transport stream.</td></tr>
<tr><td>Message Insertion Period (ms)</td><td>Shows the insertion rate for each PSIP table (global).
Default values are:
<table>
<tr><th>PSIP Table</th><th>Default Insertion Rate</th></tr>
<tr><td>MGT – Message insertion period in milliseconds for the PSIP Master Guide Table (MGT). This message is sent on the PSIP Base PID before the start of insertion of the first packet of the message.</td><td>150 ms</td></tr>
<tr><td>STT – Message insertion period in milliseconds for the PSIP System Time Table (STT). This message is sent on the PSIP Base PID before the start of insertion of the first packet of the message.</td><td>1000 ms</td></tr>
<tr><td>CVCT – Message insertion period in milliseconds for the PSIP Cable Virtual Channel Table (CVCT). This message is sent on the PSIP Base PID before the start of insertion of the first packet of the message.</td><td>400 ms</td></tr>
<tr><td>RRT – Message insertion period in milliseconds for the PSIP Rating Region Table (RRT). This message is sent on the PSIP before the start of insertion of the first packet of the message.</td><td>60000 ms</td></tr>
<tr><td>Event Information Table – Insertion period in milliseconds for the PSIP EIT messages.</td><td>Default Insertion Rate</td></tr>
<tr><td>EIT-0</td><td>500 ms</td></tr>
<tr><td>EIT-1</td><td>3000 ms</td></tr>
<tr><td>EIT-2</td><td>10000 ms</td></tr>
<tr><td>EIT-3</td><td>10000 ms</td></tr>
</table></td></tr>
<tr><td>DST Settings</td><td>Use this area for defining the DST values for In/Out Month, Day, and Hour.</td></tr>
</table>

QAM Configuration

The figure below shows the QAM Configuration window. Please note that QAM Channels that are not active are *grayed out*. QAM modules that are not installed are also grayed out, as well as the Backup RF Port when RF Redundancy is enabled. When RF Redundancy is enabled and the Backup RF Port is active, the failed over Primary RF Port is grayed out:

Figure 6-12 — QAM Configuration



CAUTION *The current firmware version supports QAM Transmission Modes of Annex* ***A****,* ***B****, and* ***C****. Any changes to the QAM Transmission mode require a reboot.*

QAM Configuration window field definitions

<table>
<tr><th>Item</th><th>Definition/Range</th></tr>
<tr><td>QAM Transmission Mode</td><td>Use to select the QAM transmission mode, based on the type of digital cable system. Current version supports Annex A – DVB, Annex B – ATSC DCII, and Annex C – Asia-Pacific. (Changes the QAM transmission mode require a reboot before taking effect.)</td></tr>
<tr><td>Current Transmission Mode</td><td>Displays the QAM Transmission Mode currently in use (read-only).</td></tr>
<tr><td>QAM Module Tab</td><td>Use to select one of the three removable QAM modules.
The LED on the tab is colored to indicate the highest current QAM Module, QAM RF Port, or QAM Channel alarm status of the QAM Module.</td></tr>
<tr><td>RF Config Button</td><td>Displays the QAM RF Port Configuration window.
The LED on the button is colored to indicate the highest current QAM RF Port or QAM Channel alarm status of the RF Port.</td></tr>
<tr><td>Channels Enabled</td><td>Maximum Channels Enabled in QAM Transmission Mode of Annex A is limited by the Channel Spacing you selected:
• Range for 2x4 channel QAM Module: 0, 2, and 4
• Range for 2x8 channel QAM Module: 0, 2, 4, 6, and 8</td></tr>
<tr><td>RF Level Adjust (dB)</td><td>Enter RF level adjustment here. Range: -8.00 to 3.00. Increment: 0.01. This value is applied to the block of channels on that output port.
Caution: Adjusting the level such that it exceeds the nominal RF level when measured at the APEX RF Connector may degrade RF performance. See list of nominal RF levels below.</td></tr>
<tr><td>RF Level (dBmV/Channel)</td><td>Displays the current configured per QAM channel RF level.
The per QAM channel levels noted below are the nominal values corresponding to an RF Level Adjustment of 0.00 dB:
<table>
<tr><th>Channels</th><th>RF Level (dBmV/Channel)</th></tr>
<tr><td>1</td><td>60</td></tr>
<tr><td>2</td><td>56</td></tr>
<tr><td>4</td><td>52</td></tr>
<tr><td>6</td><td>50</td></tr>
<tr><td>8</td><td>49</td></tr>
</table></td></tr>
<tr><td>TS:QAM</td><td>The Output Transport Stream numbers (1 – 16, 17 – 32, 33 – 48) and Output QAM channel.
Each field is colored to indicate the current QAM Channel alarm status. See APEX1000 LED Color Scheme for more information.</td></tr>
</table>

Item	Definition/Range
EIA Channel	Allows tuning based on EIA channel by entering the desired EIA channel number for channel A. Range: 1 – 158 • Only configurable for the "A" channel on each RF port. • Only configurable when QAM Transmission Mode is Annex B – ATSC DCII. • Only configurable when QAM Port Configuration Tuning Mode is *Channel*.
Center Freq (MHz)	Range: 1. 57.000 – 999.000 for QAM Transmission Mode Annex B – ATSC DCII and Annex C – Asia-Pacific. 2. 85.000 – 999.000 for QAM Transmission Mode Annex A – DVB. 250 kHz step size. • Only configurable for the "A" channel on each RF port. • Only configurable when QAM Port Configuration Tuning Mode is *Frequency*.
Interleaver	Selects one of the two interleaver depths pre-configured for this QAM channel. • Only configurable when QAM Transmission Mode is Annex B – ATSC DCII. • The pre-configured interleaver depths are set on the QAM RF Port Configuration window.
Mute	Turns off the output from the corresponding RF Port. Un-Mute turns on the output from the RF Port. (Muting does not affect the ability to map to the QAM channels of the RF Port.)

QAM RF Port Configuration

Use the QAM RF Port Configuration window to configure EIA Channel, Center Frequency, and Interleaver.

To access RF Port Configuration, click the associated **QAM RF # Config** button:

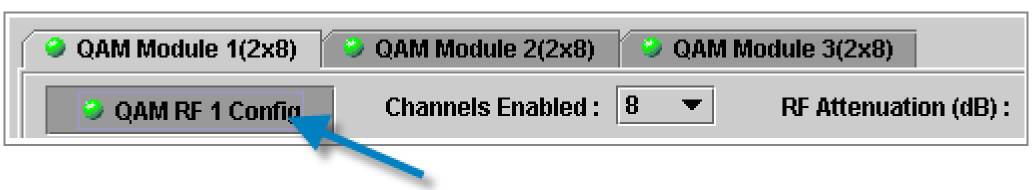
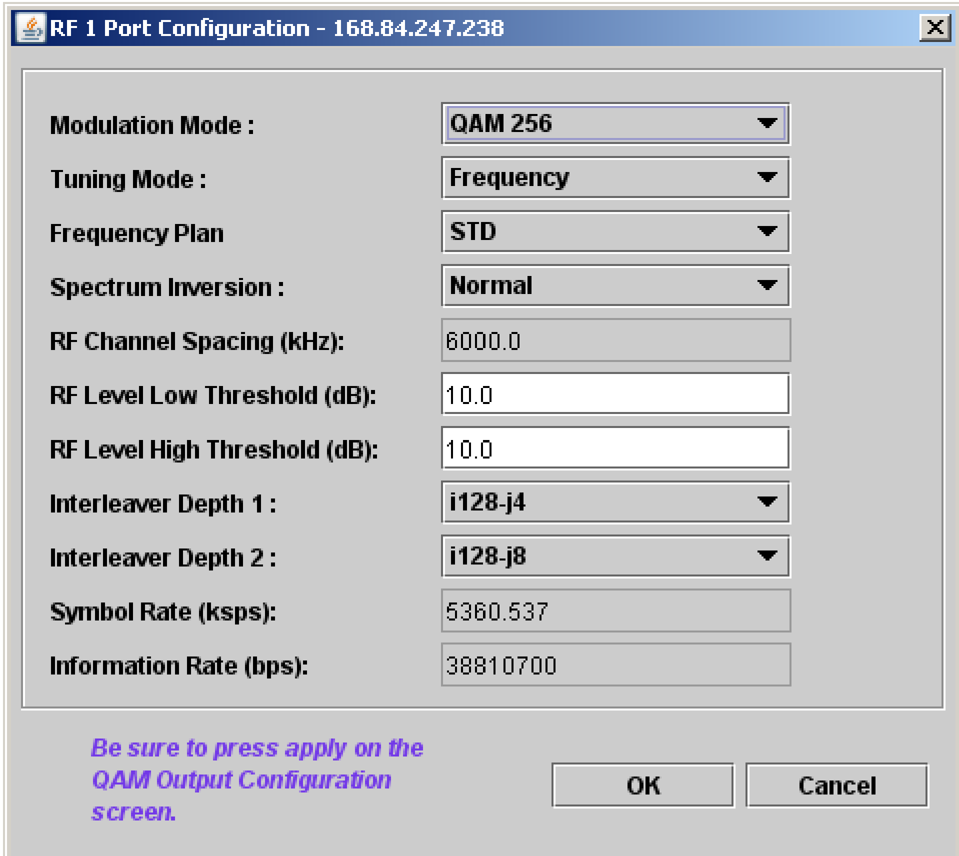


Figure 6-13 — QAM RF Port Configuration



*Note: Cells that are either gray or inactive are read-only and cannot be altered. When you make your selections, click **OK** on the RF Port Configuration window, and click **Apply** on the QAM Output Configuration window to make certain that the changes take effect.*

QAM RF Port Configuration window field definitions

Item	Definition/Range
Modulation Mode	Use to select the modulation mode. Range: • **QAM 64** • **QAM 256**
Tuning Mode	Use to select between the following tuning modes: • **Frequency** • **Channel** *Note: Channel tuning mode is only selectable when QAM Transmission Mode is Annex B – ATSC DCII.*

Item	Definition/Range
Frequency Plan	Use to select one of the Frequency Plan modes. Options are: • **STD** • **HRC** • **IRC** *Note: Only configurable when QAM Transmission Mode is Annex B – ATSC DCII.*
Spectrum Inversion	Use to select the Spectrum Inversion mode. Options are: • **Normal** • **Invert** Select *Normal* for normal operation, and *Invert* to accommodate non-standard systems.
RF Channel Spacing (kHz)	1. When QAM Transmission Mode is Annex A – DVB, the spacing between the A and B channel center frequencies is user-configurable. 2. When QAM Transmission Mode is Annex B – ATSC DCII or Annex C – Asia-Pacific, the channel spacing is fixed and cannot be changed.
RF Level Low Threshold	Use this text-entry box to configure RF *low level* limits for alarming.
RF Level High Threshold	Use this text-entry box to configure RF *high level* limits for alarming.
Interleaver Depth 1 and 2	Use to select Interleaver values for the RF Port. The drop-down menu lists available Ranges. QAM Transmission Mode Annex B – ATSC DCII allows for variable interleaver settings. The standard value for Annex B 256 QAM mode is I=128, J=4 and 64 QAM mode is I=128, J=1. If you select a non-standard value, be sure that all the set-tops in your system support those values. *Note: Only configurable when QAM Transmission Mode is Annex B – ATSC DCII.*
Symbol Rate (ksps)	When QAM Transmission Mode is Annex B – ATSC DCII, the symbol rate is fixed based on Modulation Mode and cannot be changed. *Note: Only configurable when QAM Transmission Mode is Annex A – DVB or Annex C – Asia-Pacific.*
Information Rate (bps)	The read-only information rate displays according to the selected symbol rate and Modulation mode, and cannot be changed directly.

The following fields are also available in the QAM Configuration main window:

Item	Definition/Range
Test Mode	Off, CW Test, PRBS 23M, PRBS 23, MPEG Null, Suppress, PRBS 60, PRBS 63, PRBS 65, PRBS 68, PRBS 71, PRBS 73, PRBS 79, PRBS 81. • The CW Test mode provides a CW carrier with the same average power as the QAM signal. This is useful for setting the output level using a spectrum analyzer, as it avoids the need to use bandwidth correction factors. • The PRBS test modes generate standard *Pseudo Random Bit Streams* with or without inserting the MPEG sync byte. (These are used for BER testing.) Select **Off** for normal operation.
Status	Click **Status** for a quick link to the QAM Status window.
QAM Upgrade	Click to begin an upgrade from 2x4 to 2x8. See RFPM and Power Supply Modules for more information on module removal and installation.

QAM Module Upgrade

You can upgrade a QAM Module while it continues to operate normally.

To field-upgrade the APEX1000's 2x4 QAM Modules to become a 2x8 QAM Module unit, use an upgrade string/code entered through the SDM or the APEX-EM user interfaces.

Note: All upgrades are permanent and cannot be revoked.

Upgrade Part Numbers

The following upgrade (or replacement) parts are available:

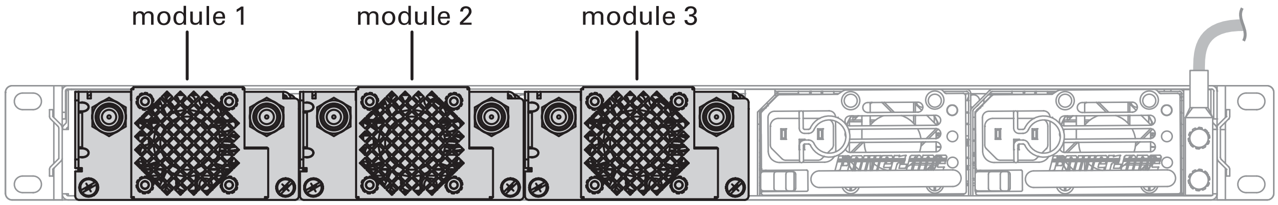
Module/Type	Part Number
APEX1000 2x4 QAM Module	540273-001-00
APEX1000 2x8 QAM Module	540273-002-00
QAM Module Upgrade	540400-001-00
PS Module - AC Power	540272-001-00
PS Module - DC Power	540271-001-00
RFPM Filler Module w/Fan	546494-001-00
PS Filler Module w/Fan	546495-001-00

Ordering Information

When ordered by itself, the APEX1000 chassis includes two RFPM fan filler modules and one power supply fan filler module. Because unit operation requires at least one RFPM module and one power supply module, it is not necessary to provide three RFPM fan filler modules or two power supply fan filler modules.

Identifying the QAM Modules

The back panel of the APEX1000 provides access to the three replaceable QAM modules with two RF connectors each, as shown in the figure below. When viewed from the back of the unit, #1 is the left QAM module, #2 is located in the middle, and #3 is located on the right:



Installing a QAM Module

See RFPM and Power Supply Modules for more details on removing and installing a QAM or power supply module.

QAM Conversion Procedure

This section provides instructions for field converting an APEX1000 QAM module from a standard density 2x4 module to a high density 2x8 module.

To begin the QAM module upgrade process:

1. A P.O. to Motorola for part number 540400-001-00 must be issued. The QAM module conversions are performed on a per QAM module basis, so the quantity on the P.O. should be equal to the number of modules that are to be converted to 2x8.

Note: A Purchase Order must be issued to Motorola for each QAM module conversion. One P.O. can cover multiple conversions. The P.O. must include the QAM conversion part number, the number of conversions requested (one per QAM module), and the unit price per conversion as shown below:

Item	Description
QAM Conversion Part Number	540400-001-00
QAM Conversion Price (per conversion)	Check with your sales representative

2. After Motorola processes the P.O., you will receive an e-mail from Motorola providing instructions and a link to a Motorola website where the conversion keys can be requested and received.

3. After following the link in the email to the Motorola website, you must supply the serial number of each QAM module to be upgraded. A conversion key will then be generated for each provided serial number and displayed on the website.

   Note: The conversion key(s) will also be provided via email to the requestor.

4. When you receive the conversion keys, you can apply them to the QAM module using the APEX1000 EM (Element Manager), as described below.

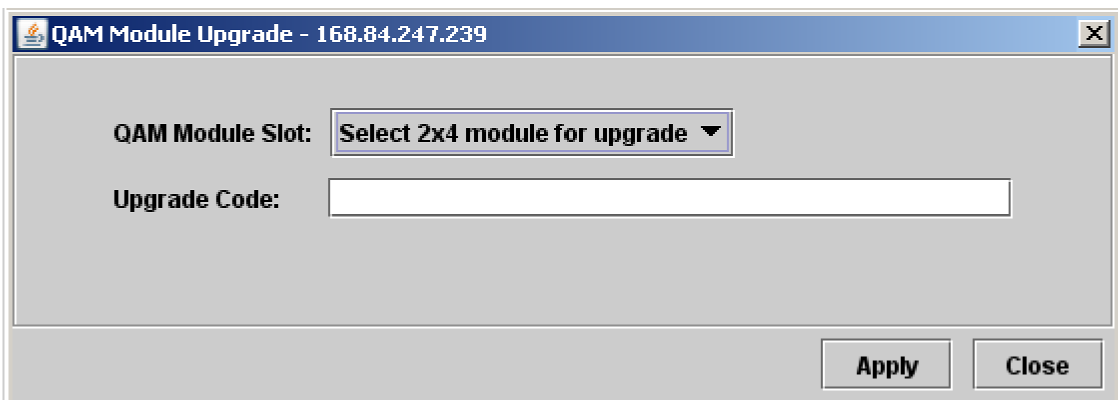
Applying the Conversion Key Using the APEX1000 EM

A QAM conversion is performed by typing the conversion key into the APEX GUI using the APEX-EM. After receiving the QAM conversion key from Motorola, the key must be applied to the QAM module *while the module is installed in an APEX1000 chassis*.

1. To initiate a module upgrade using the EM, select **Configuration > QAM Configuration**.
2. Click **Module Upgrade** (located on the bottom left corner of the window).

   The QAM Module Upgrade window displays:

Figure 6-14 — QAM Module Upgrade



3. Select a module slot containing a 2x4 QAM module from the drop-down menu.
4. Enter your upgrade code as supplied by the Motorola TAC. Make sure the upgrade code is for the selected QAM Module serial number.
5. Click **Apply**.

Contacting the TAC

A message dialog will inform you of a successful upgrade.

If this procedure does not succeed, check your upgrade code and retry performing the upgrade. Should the failure persist, contact the Motorola TAC number listed in the Getting Help section of this document.

QAM RF Redundancy Configuration

APEX1000 firmware version 2.4.x supports a physical chassis master/slave redundancy scheme, where two APEXs are configured as the primary and secondary (backup) units.

External RF Switch

The alternate method is to provide APEX redundancy through *an external RF switch*. This switch is necessary to fully enable APEX RF redundancy in this APEX internal module redundancy system, and is essential because each RF output is typically connected to a different physical downstream service group. The REM1000 (Redundant Edge Matrix) fulfills this role, providing system-level RF redundancy for two APEX units:

Figure 6-15 — REM1000 (Redundant Edge Matrix)

Notes:

- With RF redundancy enabled on the APEX1000, RF port 6 is configured as a redundant port, backing up RF ports 1 to 5. If a failure of an RF ports occurs, the APEX1000 re-routes the output transport streams to RF port 6.
- Because it is not feasible to manually rewire the RF cables after a failure, an external switch is required to perform the necessary automatic signal routing without operator intervention; the REM1000 allows the backup port to use the *same physical wiring* that was previously used by the failed APEX RF port.
- The REM1000 ensures that the backup APEX RF port can transmit its RF outputs downstream using the same physical cabling that was previously in use by the failed APEX RF port.
- The APEX1000 reports on the status of the REM1000, indicating which outputs are active, and also showing any faults or error conditions that the REM1000 might experience.

For detailed instructions on how to connect the APEX1000 to the REM1000, reference the REM1000 user guide (Motorola part # 559607-001).

For information on purchasing the REM1000, please contact the Motorola TAC.

RF Redundancy Configuration

To make certain that the RF redundancy scheme functions correctly, you must configure both the APEX1000 and the REM1000.

To begin enabling RF redundancy, use the QAM RF Redundancy window (illustrated in Figure 6-16) to set the following parameters:

Parameter	Values	Description
RF Redundancy	• Enabled • Disabled	Enables port #6 as a backup port, reserving its QAM channels for redundancy.
REM1000 communication mode	• None • Direct • Common	Configures the manner by which the APEX1000 connects to the REM1000 control interface.
APEX1000 ID	• APEX1 • APEX2	Identifies the set of RF inputs on the REM1000 rear-panel to which the APEX1000 is connected.
REM1000 IP address	• Valid unicast address in *common* mode or • Network IP address high byte in *direct* mode	OAM&P IP address of REM1000 if using *common hub* communication mode. Network IP (high byte) of REM1000 if using *direct* mode.

Connection Modes

You must first define how the APEX1000s will be connected to the REM1000 by configuring the REM1000 communication mode parameter through the APEX-EM GUI:

- **None** – No REM1000 is used.
- **Direct** – The APEX ENET2 port connects directly to the REM1000 APEX1 or APEX2 port (this is the default setting on the APEX1000, and the recommended communication mode).
- **Common** – The APEX communicates over the OAM&P network, using its ENET1 interface to communicate with the REM1000 ENET interface.

CAUTION *The APEX prevents you from selecting Direct REM communication mode if ENET2 has any active mappings, or if UDP port 6060 is already in use on that interface. To enable Direct mode, you must first clear ENET2 of all mappings.*

Destination IP Address

After defining the communication mode parameters, you must define the correct destination IP address (es).

Direct Mode Configuration

If an APEX1000 connects to the REM1000 through the direct interface, the APEX and REM must verify that the REM's APEX1 and APEX2 FastE interfaces are on the same network as the APEX1000's ENET2 port.

- The high-byte of the interface IP address value is configurable to avoid collisions with the ENET1 port IP address. The default value on both the APEX and the REM is 51.
- You must ensure that the APEX is configured with the same IP high-byte as configured on the REM if direct mode is used.

Refer to the REM1000 Installation and Operation Guide (Motorola part # 559607-001) for additional information.

Common Mode Configuration

If the APEX connects to the REM through the OAM&P network (Common Mode is used), you must configure the APEX1000 with the correct REM1000 IP address.

APEX Device ID

Each REM1000 supports a maximum of two APEX1000s. The APEX ID parameter pairs an APEX with a set of RF inputs.

You must configure the device ID of the APEX1000 according to the set of RF inputs to which it is connected on the REM1000, and make certain that the APEX ID corresponds to the set of connected inputs on the REM1000.

APEX1000 RF Failure Modes

The following RF failures are detected by the APEX1000 (with an SNMP trap issued for each occurrence):

- **QAM Channel Fault** — A single QAM channel has failed on the RF port.
- **QAM RF Port Fault** — A single RF port has failed, and all QAMs (up to 8) on that port are unavailable.
- **QAM Module Fault** — A QAM module (RFPM) has failed. Both RF ports are unavailable.

During a critical error on a channel, port, or module, the APEX1000 will failover to the redundant port. A critical error indicates that a QAM channel was active when the APEX detected the fault.

CAUTION *If there is a critical error on the redundant port or a major REM1000 error, the APEX cannot support RF redundancy, and failover will not occur.*

Failover Sequence

In the event of port failure on an APEX1000 connected to a REM1000, the following sequence of events takes place:

1. The APEX1000 detects a failed QAM channel, RF Port, or QAM Module, and issues a standard SNMP trap alarm.
2. The APEX1000 mutes the failed RF port, and configures the backup port identically to the failed port.
3. The APEX1000 re-routes mapped services from the failed port to the backup port.
4. The APEX1000 transmits a message commanding the REM1000 to switch to its redundant port, and issues the RF failover SNMP trap.
5. The APEX1000 receives confirmation of the switch-over from the REM1000, un-mutes the backup port, and updates the status.

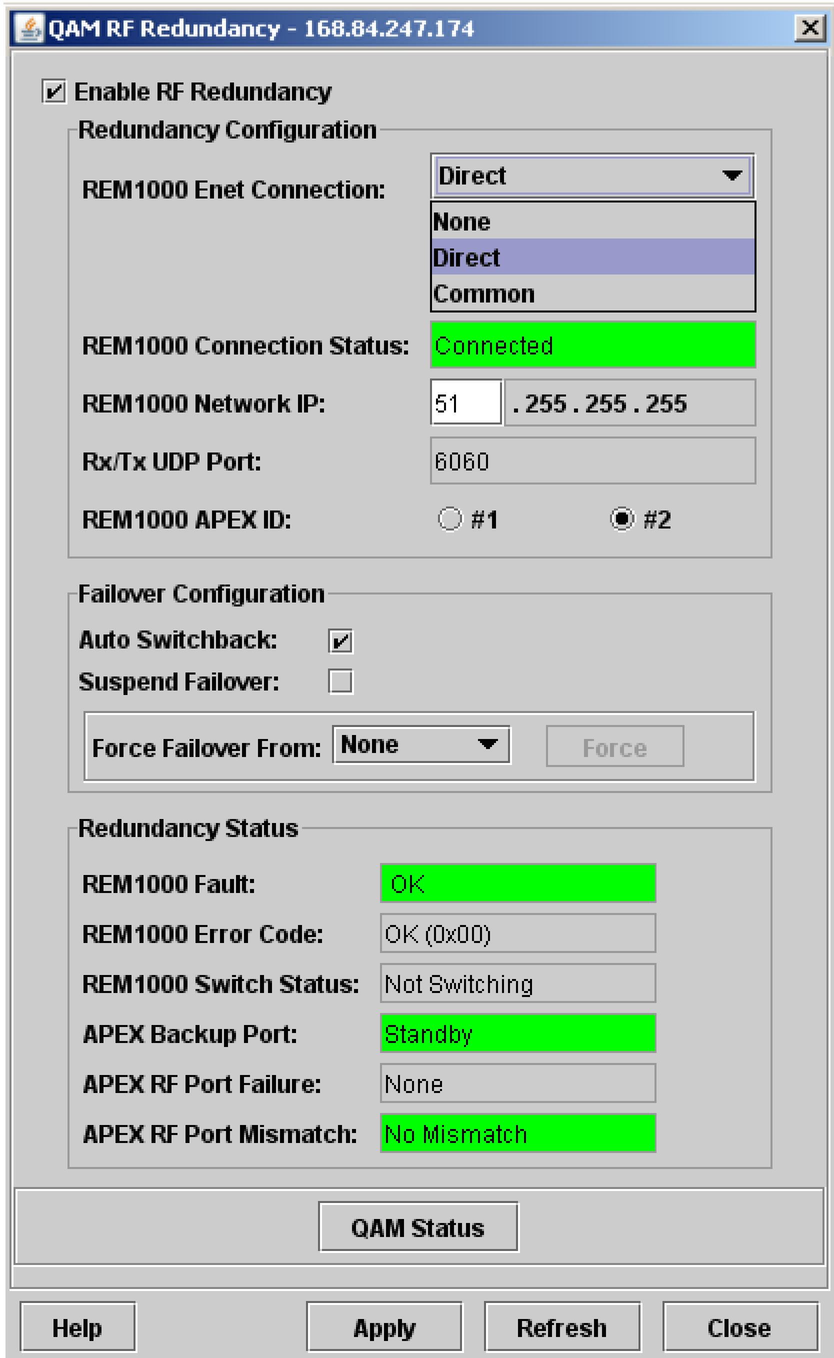
QAM RF Redundancy Window

Use the QAM RF Redundancy window to define the connection type for RF Redundancy and set (or suspend) failover.

After configuration is complete between the two APEXs and the REM, use this window to monitor Redundancy and Failover status, or to make further changes to the configuration.

The QAM RF Redundancy window is illustrated in Figure 6-16.

Figure 6-16 — QAM RF Redundancy



Note that when you enable RF Redundancy, you will no longer be able to select RF Port 6 and all channels on Port 6 on several screens, because it is reserved as the secondary (backup) port.

CAUTION *APEX1000 RF redundancy is configured primarily through the REM1000 Console Port.*

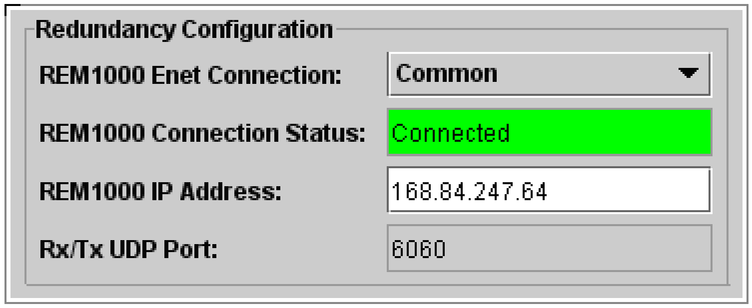
For further information, reference the REM1000 Installation and Operation Guide (Motorola part number 559607-001).

QAM RF Redundancy window field definitions

Item	Definition/Range
Enable RF Redundancy Checkbox	Use to enable or disable RF redundancy mode. (Enabling RF Redundancy allows the APEX to failover to the backup RF port and communicate with the REM1000.) RF Redundancy cannot be enabled if: 1. The backup port (RF Port 6) is not present (there is no QAM Module in QAM slot 3). 2. There are any mappings to any QAM Channel on the backup port. RF Port 6, QAM Channels 6A to 6H (Output Transport Streams 41 to 48). 3. If there are any DTA mappings on Channels 6A to 6H.
Redundancy Configuration	
REM1000 Enet Connection	Configures how the APEX is connected to the REM1000. Available network topologies: • **None** – Not connecting to REM1000. • **Direct** – Connected to the REM1000's dedicated IP interface through APEX Data IP (Enet2). *Broadcast* connection is always used in this case. You cannot set to *Direct* if the RF Redundancy UDP Port is in use on the Data IP Port Enet2. • **Common** – Connected to REM1000's OAM&P interface through APEX OAM&P IP Enet 1. Requires you to configure the REM1000 IP address, and cannot be set to *Common* if the QAM RF Redundancy UDP Port is in use on the OA&P IP (Enet 1). *Notes:* *1. Because IP-related configuration is automatic, Direct mode is typically used. Using the Element Manager (EM), you only need to designate the configuration mode (Direct Mode) and configure the associated APEX Identifier (APEX1 or APEX2).* *2. Because there is no additional network device (such as a hub or switch) to connect through, you can achieve greater reliability with Direct mode. This setting cannot be changed when the backup port is active.*
REM1000 Connection Status	Indicates the current connection between the APEXs and the REM. Depending on the current status, one of the following values will display: • **Not Applicable** – QAM RF Redundancy is not enabled and/or the connection to the REM is not enabled. • **Not Connected** – This is the initial condition. The APEX has not yet sent a *switch port* message. • **Connected** – Received *ack* message from the REM for current *switch port* message. • **Connection Lost** – The REM has not replied to the last three switch port messages.

<table>
<tr><th>Item</th><th>Definition/Range</th></tr>
<tr><td>REM1000 IP Address</td><td>Shows the target REM1000 IP address. Only displays and becomes editable when REM1000 Enet Connection is set to Common.

Values: Singlecast IP address

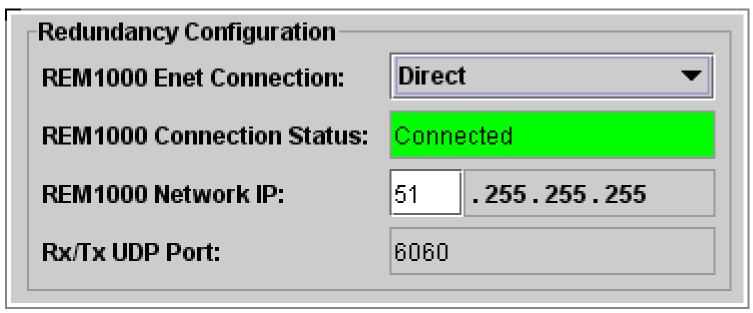


Caution: You cannot change this setting when the backup port is active.</td></tr>
<tr><td>REM1000 Network IP</td><td>Shows the target REM1000 Network IP.

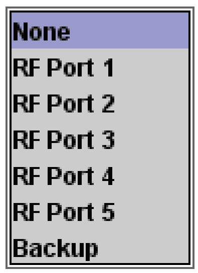
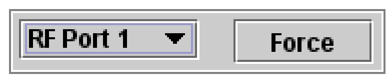
Only displays and becomes editable when REM1000 Enet Connection is set to Direct.

Range: 1 – 126

The Default is 51.



Caution: You cannot change this setting when the backup port is active.</td></tr>
<tr><td>Rx/Tx UDP Port</td><td>UDP Port that is used for QAM RF Redundancy communication between the APEX and the REM. UDP port 6060 is the REM/APEX communication port.
• Direct Connect – The APEX sends/receives broadcast on this UDP Port.
• Common Connect – The APEX sends/receives singlecast on this UDP Port. If in use for another purpose, you must free UDP port 6060 before enabling common mode.</td></tr>
<tr><td>REM1000 APEX ID</td><td>Identifies the set of RF inputs on the REM1000 associated with this APEX.</td></tr>
</table>

<table>
<tr><th>Item</th><th colspan="2">Definition/Range</th></tr>
<tr><td colspan="3">Failover Configuration</td></tr>
<tr><td>Auto Switchback</td><td colspan="2">This is the enable/disable of automatic switch back to the previous RF port from backup for QAM RF redundancy.
• When enabled, switch back to the previous RF port will automatically occur when the RF port comes back online.
• When disabled, you must force back to the previous RF port using the <code>apexQamRfRedundConfigForceSwitch</code> command.
Note: An error on the backup port or on the REM1000 overrides this setting.</td></tr>
<tr><td>Suspend Failover</td><td colspan="2">Enables and disables suspending of RF failover. Prevents failovers to or from the backup RF port.
Note: Force Failover overrides this setting. Also, an error on the backup port or on the REM1000 overrides this setting.</td></tr>
<tr><td>Force Failover From</td><td>
</td><td>This command:
• Forces a switch of an RF Port to or from the backup
• Selects which RF Port to switch from
• Overrides Suspend Failover
When any of the RF Ports are selected, the Force button becomes available:


Selecting Force From Backup will force back to the failed primary displayed in the APEX RF Port Failure field.
After a failover, you will still map service, PIDs, streams to the primary outputs, not the backup outputs. PID Remapping, Operating Mode, Encryption selection, etc., will all be done on the primary regardless of the current failover state. You will not be able to select any backup streams for any configuration.
Note: An error on the backup port or on the REM1000 overrides this setting. The APEX does not allow force to backup mode.</td></tr>
</table>

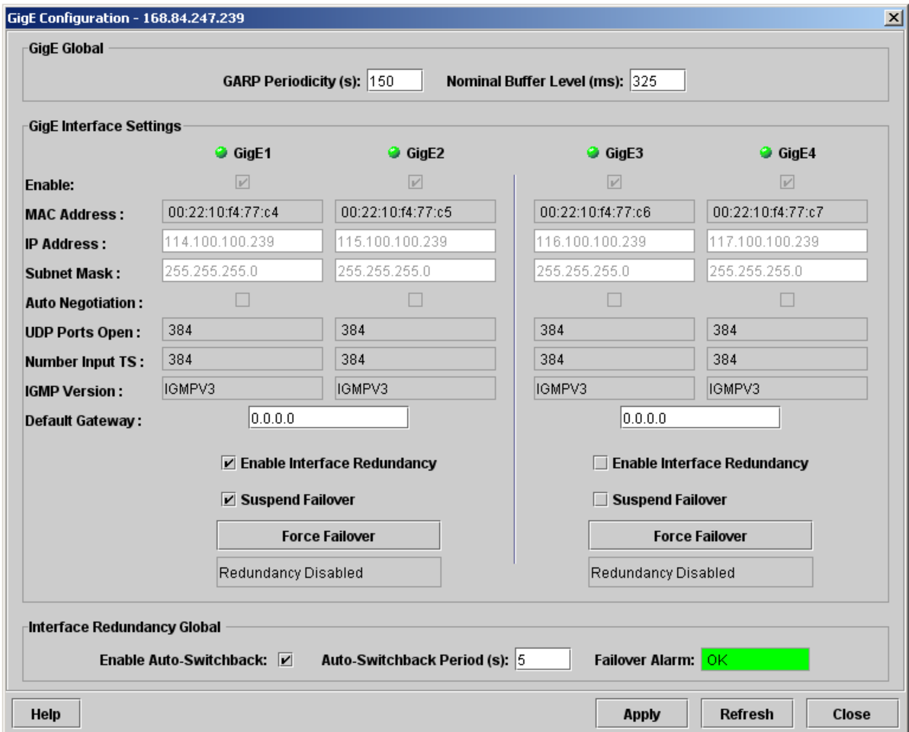
Item	Definition/Range
	Redundancy Status
REM1000 Fault	Indicates an REM1000 fault. Major error code received from the REM; it is reporting a switch status different from the commanded configuration, or an APEX ID status different from the commanded configuration.
REM1000 Error Code	Error status of the REM1000. Valid only when RF Redundancy Configuration Connection is other than *None*. Depending on the current status, one of the following values will display: • **OK** – No problems switching, parsing switch_port() message, or with HW. • **Invalid Parameter** – Invalid value in prior switch_port() msg. • **Switch Error** – Error switching in response to valid switch_port() msg. • **Hardware Error (minor)** – Error noted, but the REM can still switch. • **APEX ID Conflict (major)** – Switch_port() messages with the same apex_id have been received from multiple APEXs. Switch reset to pass-through configuration. • **Hardware Error** (**major)** – REM failure. Switch reset to pass-through configuration.
REM1000 Switch Status	Displays the Status of the REM1000 switches. Valid only when RF Redundancy Configuration Connection is other than *None*. Depending on the current status, one of the following values will display: • **Not Switching** – REM1000 is passing inputs 1 – 5 straight through to outputs 1 – 5. • **Switching Port *X*** – Where *X* is 1 to 5. The REM1000 is switching the backup input port to output port X, and is passing all other input ports to the corresponding output port.
APEX Backup Port	Displays the State of the configured backup port. • **Disabled** – QAM RF Redundancy is disabled. • **Standby** – QAM RF Redundancy is enabled, but the backup is inactive. No failure has occurred. • **Active** – Failover has occurred and the backup is active. • **Failed** – The backup port has failed, and the APEX cannot provide RF redundancy. • **Removed** – The QAM Module with backup port has been removed. The APEX cannot provide RF redundancy.
APEX RF Port Failure	Indicates which port (1 – 5) has failed over to the backup port: Range: None (0), 1, 2, 3, 4, 5 A zero indicates that the backup port is not active.

Item	Definition/Range
APEX RF Port Mismatch	Indicates whether there is a potential for channels being lost when failing to the backup, or when switching back to a primary due to a mixture of 2x4 and 2x8 QAM modules. • A 2x4 QAM Module is capable of supporting a maximum of 4 channels per RF port. • A 2x8 QAM Module is capable of supporting a maximum of 8 channels per RF port. Depending on the current status, one of the following values will display: • **N/A (Not Applicable)** – QAM RF Redundancy is disabled. • **No Mismatch** – Indicates that no channels would be lost, because there is no mismatch. • **Backup 2x4** – Indicates that a loss of channels could occur on failover to the backup because the backup RF Port is in a QAM *2x4* Module, and at least one primary RF Port is in a QAM *2x8* Module. • **Primary 2x4** – Indicates that a loss of channels could occur on switchback from the backup to the primary because the backup RF Port is in a QAM *2x8* Module, and the primary RF Port is in a QAM *2x4* Module. (This would occur if the failed 2x8 primary is replaced with a 2x4.)
QAM Status Button	Opens the QAM Status window.

GigE Configuration

The Gigabit Ethernet Configuration window enables the functionality and provides the network particulars of GigE 1 through GigE 4.

Figure 6-17 — GigE Configuration



Note: The APEX1000 does not transmit outgoing MPEG transport streams over its GigE interfaces.

GigE Configuration window field definitions

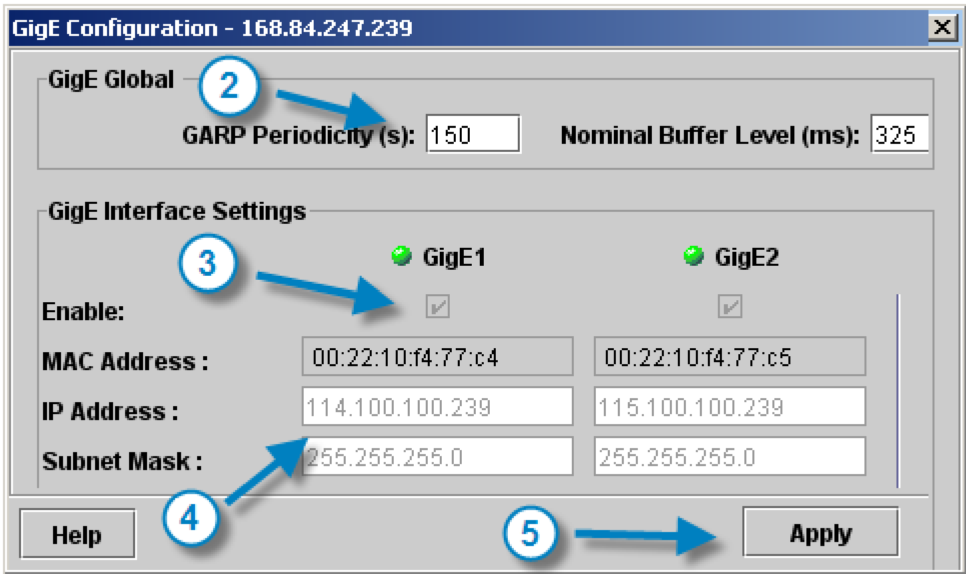
Window Section		Definition/Range
GigE Global	**GARP Periodicity (s)**	*Gratuitous ARP* requests can help detect IP conflicts that could happen after an APEX1000 is swapped out, for example. Devices (such as switches) on the network with the sender's IP address in their bridge table/cache should update their bridge table/cache with the new mapping. The APEX1000 sends a GARP (Gratuitous ARP) request on bootup (or if an IP address is changed) to detect duplicate IP addresses and advertise a new MAC address associated with an IP address. This value indicates the periodicity of these requests. The default value is 150.
	Nominal Buffer Level (ms)	This value indicates the delay generated when MPEG transport packets are transmitted over Ethernet. This allows the APEX to properly de-jitter an input stream. De-jittering takes into account normal network jitter, clock skew between the source and APEX, and also time between PCR packets. Range: 50 – 475 ms (in 5 ms steps) The default is 325 ms. This value has been defined as the optimal time for the APEX to allow for the input buffers to grow and shrink. *Motorola highly recommends that you not change this value. Changes to this value cause all input stream buffers to be reset, resulting in a momentary loss of data.*
GigE Interface Settings	**Enable**	Enables or disables a GigE interface (GigE 1 through GigE 4).
	MAC Address	Shows the MAC address of the APEX GigE interface.
	IP Address	This is the IP address of the APEX GigE interface. *Motorola highly recommends that you configure each GigE interface on a separate subnet.* The GigE network stack contains a single routing table. Therefore, each GigE interface should be on a separate network. If configured on the same network, responses to pings (ICMP) will be transmitted out the primary interface. Given that the APEX contains two GigE processors (one processor for GigE 1–2 and a second processor for GigE 3–4), GigE 1 and GigE 3 are the primary interfaces. This means that if you configure GigE 1 and 2 on the same subnet, a ping received on the GigE 2 interface will result in a reply being sent out on GigE 1. The same occurs for GigE 3 and 4, respectively. To avoid this condition, you should configure each GigE interface on a separate network.
	Subnet Mask	Indicates the network address and host ID portion of the IP address.
	Auto Negotiation	Indicates whether Auto Negotiation is Enabled or Disabled. Auto Negotiation is always enabled within the network stack. (The GigE interfaces can only function at 1000/Full.)

Window Section		Definition/Range
GigE Interface Settings (Continued)	**UDP Ports Open**	Indicates the number of UDP ports currently opened. You can change the IP and Subnet only if the UDP Ports Open value equals 0.
	Number Input TS	Indicates the number of input streams currently assigned to an interface. Input streams are assigned when a mapping is added to the APEX. This indicates whether or not an interface is in use. *Caution: You cannot change the IP address, subnet mask, and Enabled settings if there are any input streams assigned to an interface.*
	IGMP Version	Shows the Internet Group Management Protocol version.
	Default Gateway	Shows the IP address of the default gateway for GigE 1/2 and GigE 3/4.
	Enable Interface Redundancy	Enables or disables GigE interface redundancy. Interface Redundancy is based on GigE link status. Loss of link will cause an interface to failover to the backup.
	Suspend Failover	Enables or disables Suspend Failover (prevents failovers to or from the backup interface). Range: Enabled/Disabled (default)
	Force Failover Button	Initiates a force failover from one GigE interface to the other. *Note: Force failover overrides the Suspend Failover setting.*
	Status	Read–only display. Indicates whether GigE interface redundancy is enabled or disabled.
Interface Redundancy Global	**Enable Auto-Switchback**	Enables or disables Auto-Switchback to the primary GigE interface (when the primary interface is back online).
	Auto-Switchback Period (s)	This is the period of time (in seconds) to wait before switching back.
	Failover Alarm	Occurs when a primary GigE interface has failed over to the backup GigE interface, or the user has initiated a force failover from the primary GigE interface.
Help Button	Available in selected windows. Click to view corresponding help topics.	

Configuring GigE Ports

To configure a GigE port:

1. From the EM's Main Menu, select **Configuration > GigE Configuration** to display the set-up screen:



2. If desired, enter the GARP Periodicity, or accept the default value.
3. Enable the desired GigE interface (s) by clicking the corresponding checkbox.
4. Configure the GigE IP address and Subnet Mask for each interface.
5. Click **Apply**.

CAUTION *You can modify a GigE port only if both UDP Ports Open and Number Input TS are set to zero. Disable all Program Mappings, PID Mappings, and Pass Thru Mappings from each GigE port that you want to change.*

GigE Interface Redundancy

You can enable both sets of GigE interface pairs for interface redundancy separately.

This mode allows an entire interface to be used as a backup to another GigE interface. GigE 2 is a backup to GigE 1 and GigE 4 is a backup to GigE 3.

The following conditions apply:

- Loss of link is used to determine failover and fallback
- The loss of link is checked by the APEX every five seconds

CAUTION *GigE Interface Redundancy cannot be enabled when Chassis Redundancy or Transport Stream redundancy is enabled.*

Encryption Configuration

Use this window to select and configure the Encryption mode, and to define encryption settings.

Note: Before changes to the encryption algorithm can take effect, you must reboot the APEX1000.

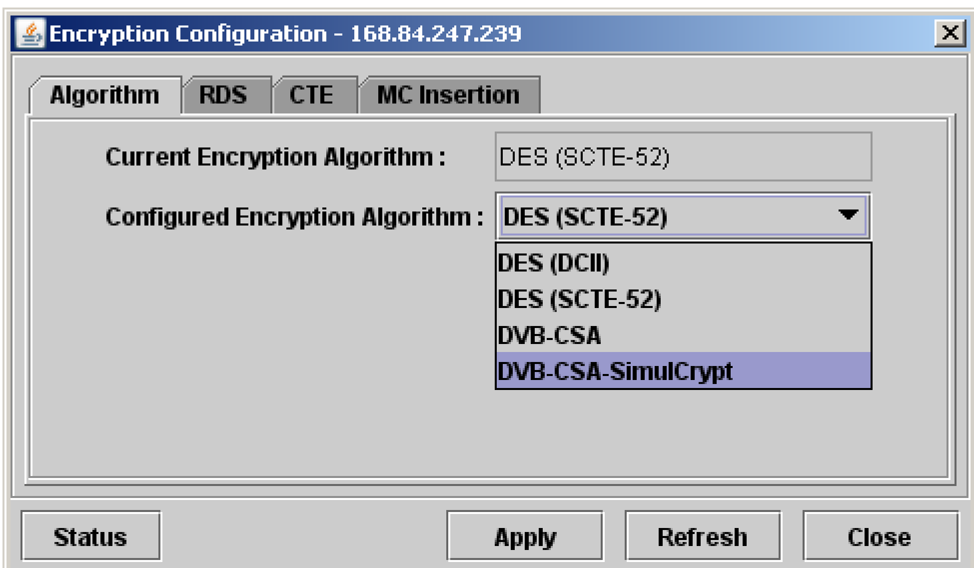
Algorithm Mode Settings

The APEX1000 supports the following encryption algorithms:

- **DES (DCII)**
- **DES (SCTE-52)**
- **DVB-CSA**
- **DVB-CSA SimulCrypt**

To begin configuring settings, select **Configuration > Encryption Configuration**.

The Encryption Configuration window displays in the default Algorithm tab:



Algorithm tab field definitions

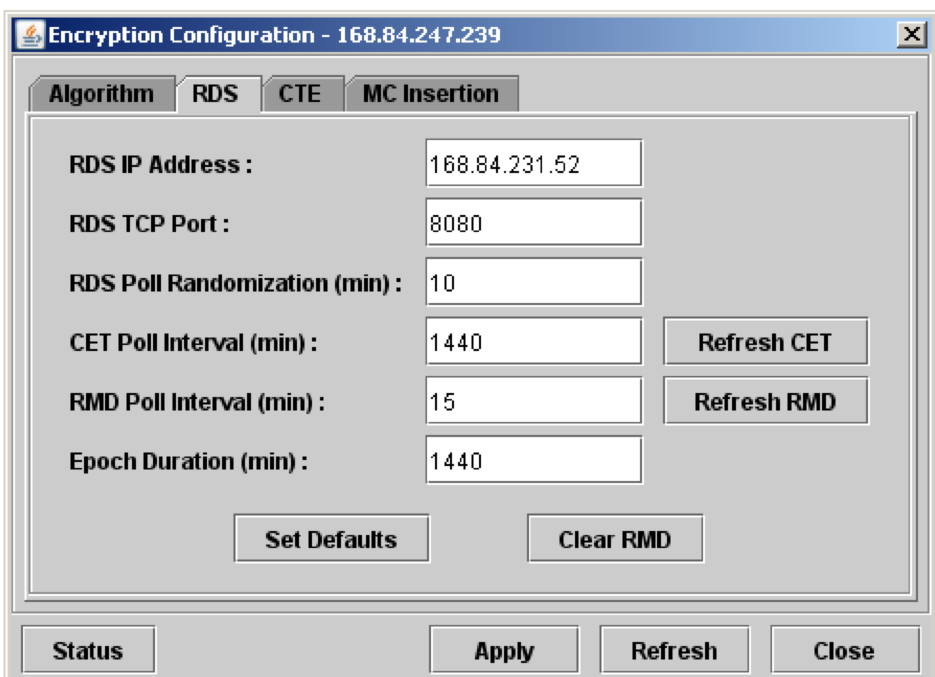
Item	Definition/Range
Current Encryption Algorithm	Shows the current scrambling mode of the APEX1000 (Read-only).
Configured Encryption Algorithm	Use to set the current scrambling mode of the APEX1000. Values are: • **DES (DCII)** – North America • **DES** (**SCTE-52)** – Standard Cipher Block Chaining Packet Encryption, formally DVS-042) • **DVB** – **CSA** (DVB Common Scrambling Algorithm) • **DVB** – **CSA** SimulCrypt *Caution: A reboot is required to change the encryption algorithm.*
Status	Opens the RDS Status window.

Rights Data Server (RDS) Settings

Use this interface when performing broadcast encryption. With this process, the APEX1000 retrieves EMMs and service specific rights meta data directly from the DAC 6000's RDS interface.

1. To begin configuring RDS settings, select **Configuration > Encryption Configuration**.
2. Select the *RDS* tab.

   The RDS screen displays:



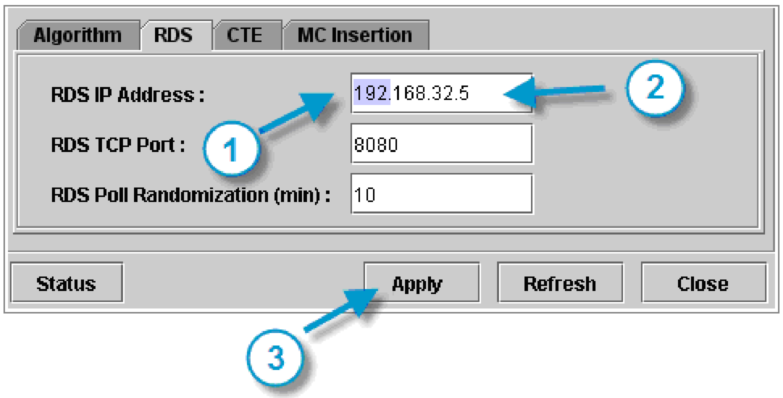
RDS tab field definitions

Item	Definition/Range
***RDS IP Address**	Shows the current DAC 6000's RDS Interface IP address.
***RDS TCP Port**	Shows the current DAC 6000's RDS Interface TCP Port. The default value is 8080.
***RDS Poll Randomization (min)**	Indicates the Poll Randomization span (in minutes). Maximum amount of time, in minutes, to delay the first EMM server poll following startup. This prevents the possibility of having too many APEXs polling the EMM server simultaneously. The actual delay time is randomly calculated by the APEX and is no greater than this value, which can range from 0 to 10 minutes. The default value is 10 minutes, with a range from 0 to 10 minutes. A value of 0 means no delay, and the APEX polls immediately at startup.
***CET Poll Interval (min)**	Indicates the Category Epoch Transition Poll Interval (in minutes). The APEX polls the EMM server for a category sequence number (CSN) and a state as often as this field specifies. The polling interval can range from 15 to 1440 minutes. If after receiving the CSN and state, the APEX determines that a CET has occurred, it requests new EMMs from the EMM server. If the APEX is unable to communicate with the EMM server, the APEX reverts to a 15-minute polling period interval until communication with the EMM server is re-established. The default value is 1440 minutes with a range from 15 to 1440 minutes.
***RMD Poll Interval (min)**	Indicates the Rights Meta Data (RMD) Poll Interval (in minutes). The APEX periodically polls the DAC6000's RDS to stay synchronized with tier/rights data changes that could occur outside of the APEX operator's knowledge. The default value is 15 minutes with a range from 15 to 1440 minutes.
***Epoch Duration (min)**	Indicates the duration in minutes for the encryption program epoch, the length of time that a given ECM is used before being changed with a new ECM. Changes to this parameter do not take affect until the start of the next program epoch (after the end of the current epoch). The default value is 1440 minutes with a range from 60 to 1440 minutes.
Refresh CET button	Click to retrieve an immediate refresh of the Category Sequence Number (CSN), which the APEX uses to detect if a Category Epoch Transition (CET) has occurred.
Refresh RMD button	Click to retrieve an immediate refresh of Rights Meta Data (RMD) from the Rights Data Server (RDS).
Set Defaults	Sets default values for all EMM related control variables.
Clear RMD	Click to clear all RMD data associated with all routes from memory. Use this setting to disable all Manual Routes and delete all RMD information from flash. Use only when moving an APEX from one DAC (RDS) system to another system. *Caution: This procedure causes a loss of all output streams and configured routes!*
** Editable text field.*	

Editing Values

To change any of the editable text-entry field settings:

1. Highlight the desired text to be replaced.
2. Type the new entry into the field.
3. Click **Apply** to implement your modifications.



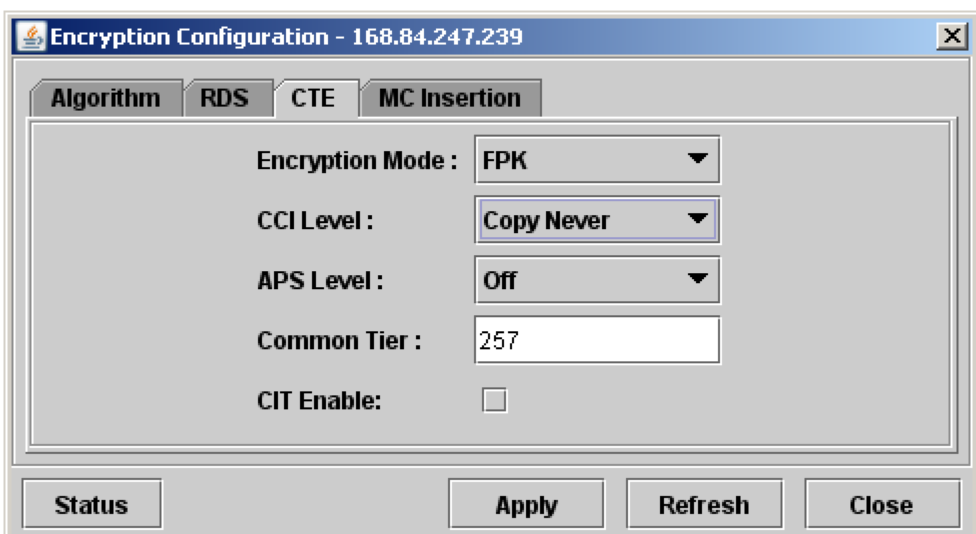
CTE Mode Settings

CTE is typically used for legacy VOD in UDP Port Mapping mode, or *session-controlled* mode.

To begin configuring algorithm encryption settings:

1. Select **Configuration> Encryption Configuration**.
2. Select the *CTE* tab.

   The CTE screen displays:



Note: To use Full Encryption mode in CTE, you must configure the RDS tab with the IP address and port of the EMM server (DAC 6000 RDS interface).

CTE tab field definitions

Item	Definition/Range
Encryption Mode	Use to configure the global encryption mode that the APEX attempts to use to encrypt output programs. Values are: • **Full** – The APEX attempts to use Full encryption. The APEX tries to get Entitlement Management Messages from an EMM server, configured through the RDS tab. (Full encryption requires the APEX to have received valid EMMs from an RDS.) • **FWK** (Fixed Working Key) – The APEX uses Fixed Working Key encryption. • **FPK** (Fixed Program Key) – The APEX uses Fixed Program Key encryption. • **Clear** – The APEX performs no encryption of output programs, and does not insert Entitlement Control Messages (ECM) into the output transport stream. The default value is Full**.**
CCI level	Use to configure Copy Control Information Level. Values are: • **Not Defined** – Set-top box applications can configure the CCI Level. • **Copy Freely** – No restriction on program copying. • **Copy Once** – Program can be copied only once. • **Copy Never** – Program can never be copied. • **No More Copies** – Maximum number of copies has been reached. The default value is Copy Never.
APS level	Use to configure Analog Protection System Level. Values are: • **Not Defined** – Set-top box applications can configure APS. • **Off** – No analog protection. • **Split Burst Off** – Split burst off. • **Split Burst 2 Line** – 2 line split burst on. • **Split Burst 4 Line** – 4 line split burst on. The default value is Off.
Common Tier	Use to configure the common tier associated with all QAMs operating with CTE enabled. The default value is 257.
CIT Enable	Use to configure the Constrained Image Trigger setting. Values are: • **Enabled** – The set-top box is notified to not allow a high quality digital output unless the receiving device also adheres to CIT processing. • **Disabled** – CIT processing is not used. The default value is Disabled. *Note: If the APS level is Not Defined, the CIT Setting has no effect.*
Status	Opens the RDS Status window.

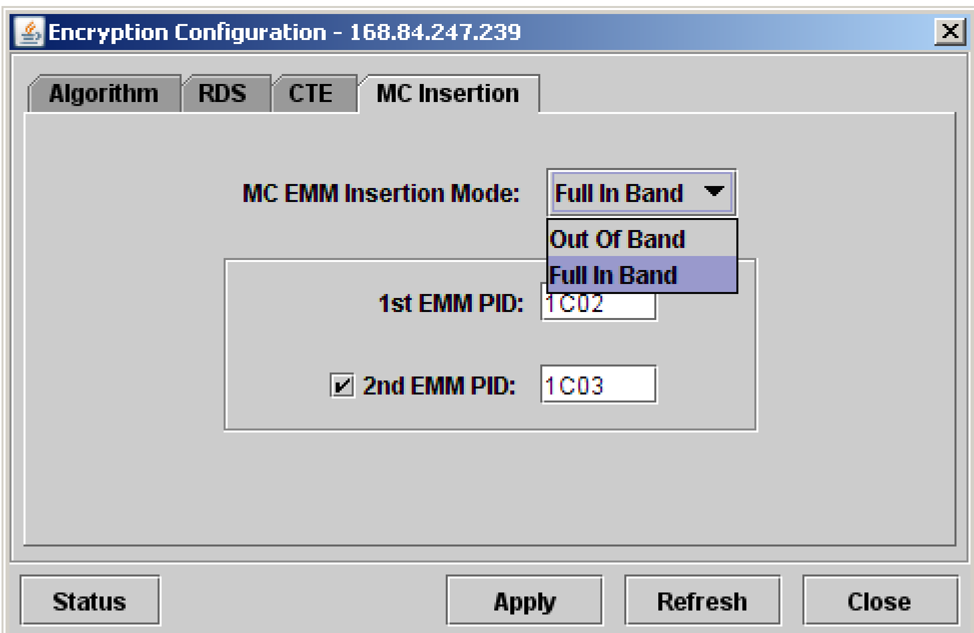
MediaCipher® (MC) Insertion Mode Settings

Instead of using a specific frequency, the APEX1000 can be utilized in a MediaCipher® Full-In-Band deployment, where EMM entitlement messages are sent in the same frequency as downstream services.

To allow set-top boxes to identify these streams, a specific descriptor must be inserted in the CAT referring to the PID values (allocated by the operator to these entitlement messages). The APEX1000 internally generates the CAT table when the encryption algorithm is configured as DVB-CSA-SimulCrypt.

1. To begin configuring MC Insertion settings, select **Configuration > Encryption Configuration**.
2. Select the *MC Insertion* tab.

   The MC Insertion screen displays:



MC Insertion tab field definitions

Item	Definition/Range
MC EMM Insertion Mode	Configures the MediaCipher encryption mode. Values are: **Out Of Band** — The APEX does not add any specific descriptor referring to entitlement messages as they are transferred over a different frequency. **Full In Band** — The APEX adds specific descriptors in the CAT referring to PID values allocated to EMM entitlement messages. Default value is Out Of Band.
1st EMM PID (Hex)	PID value allocated to the first MediaCipher CA_descriptor to be included in the CAT. Range: 0x1C00 to 0x1FFE The default value is 0x1C02.
2nd EMM PID (Hex)	When checked, PID value allocated to the second MediaCipher CA_descriptor to be included in the CAT. Range: 0x1C00 to 0x1FFE The default value is 0x1C03. *Caution: To prevent PID collisions when performing EMM PIDs configuration, be mindful of the PID assigned to other stream components, such as VCT (0x1C00), SNT (0x1C01), or background services.*
Status	Opens the RDS Status window.

Output TS Configuration

The APEX1000 does not allow editing or adding service routes, or changing QAM channel configuration settings, associated with *uninstalled or disabled* QAM channels.

Note: You can delete existing service routes on uninstalled or disabled QAM channels, but the APEX1000 does not allow you to make any changes to these service routings until the output QAM is installed and enabled.

Session Controlled mappings always require an active QAM channel (entitled and installed). This is necessary to immediately alert the SDV manager when a service mapping is not possible (considered to be failed).

The following table shows the various actions taken when performing service mappings:

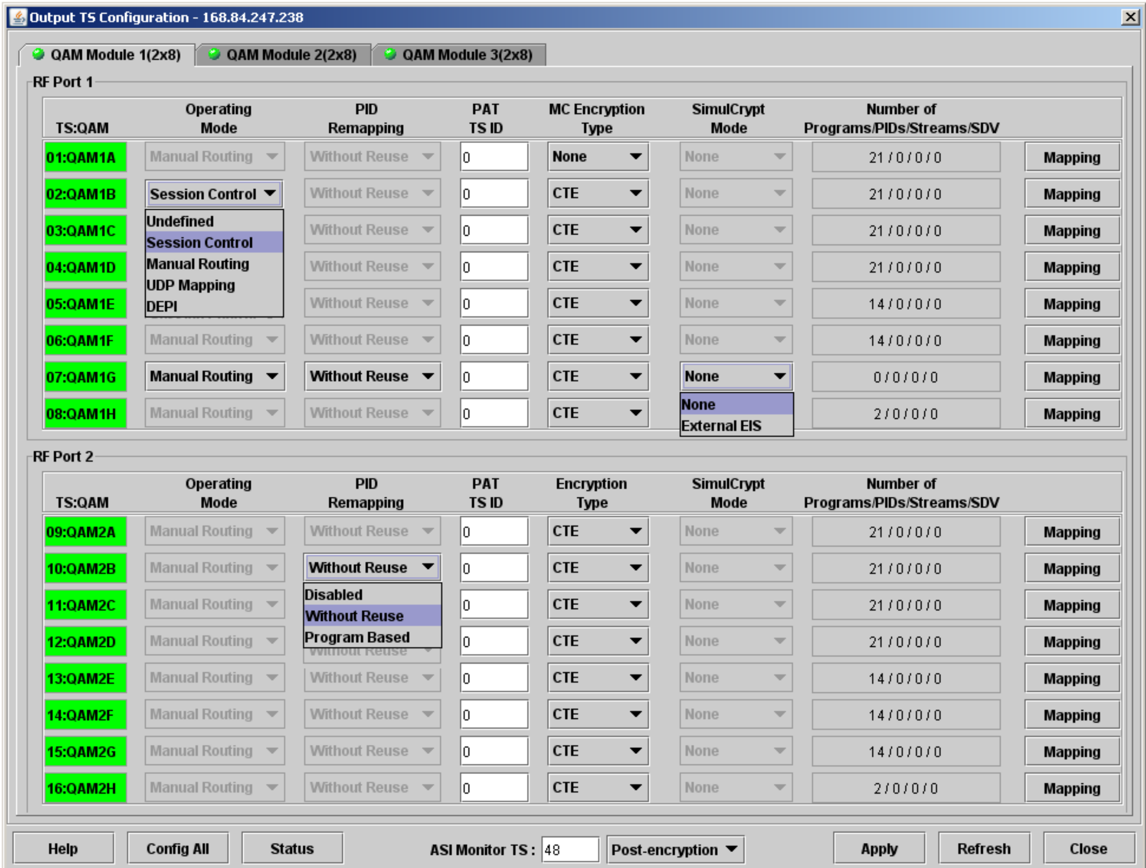
	QAM Channel Not Active	Not Active To Active State	QAM Channel Installed and Enabled	Active To Not Active State**
All Operating Modes	• You may not create or edit mappings. • You may delete existing mappings. • You may NOT edit QAM channel settings.	Activate Mappings.	• You may create, edit, or delete mappings. • You may edit QAM channel settings.	De-activate Mappings.
***An Active state implies that the RF module is installed, and the QAM channel is enabled. A Not Active state here could be brought about by removing an RF module or disabling the QAM channel.*				

Mapping Activation

The APEX1000 allows manual routing and UDP port mapping routings to be made to any output QAM that is installed and enabled (entitled).

- Activation of a mapping indicates that the mapping is attempted. The UDP port is opened, multicast group is joined (if needed), PSI is extracted, and data is routed through the APEX1000.
- De-activation means that the mapping is stopped, but the actual database holding the mapping remains. This allows you to remove an RF module and then plug it back in, causing all manual routings and UDP port mappings to be immediately re-activated.

Figure 6-18 — Output TS Configuration



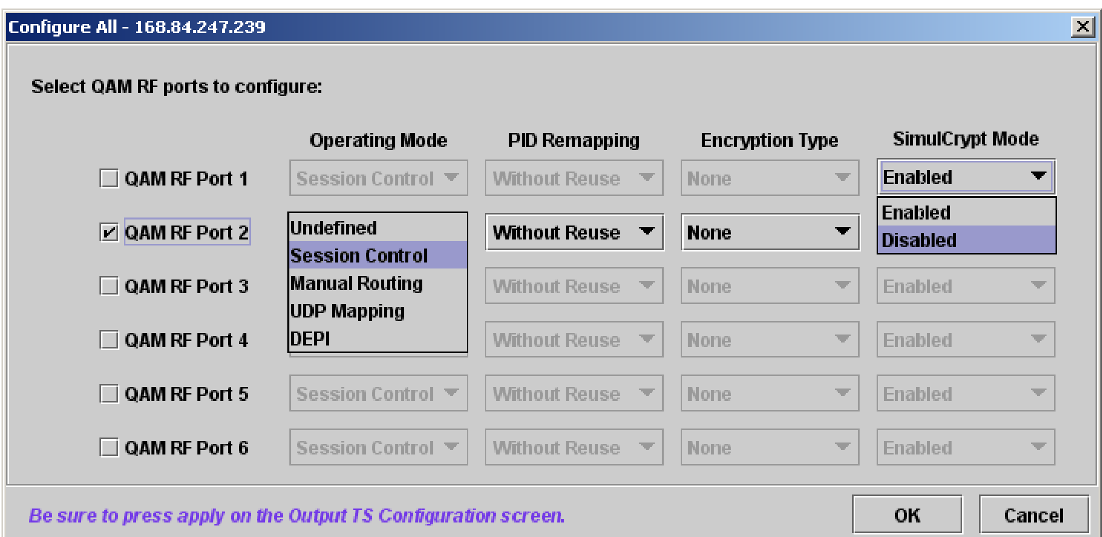
Output TS Configuration window field definitions

Item	Definition/Range
TS:QAM	The Output Transport Stream numbers (1-16, 17- 32, 33- 48) and Output QAM channel. Each field is colored to indicate current alarm status. See APEX1000 LED Color Scheme for more information.
Operating Mode	Use to select the operating mode. Available options are: • **Undefined** • **Session Control** • **Manual Routing** • **UDP Mapping** • **DEPI**
PID Remapping	This column provides the PID remapping conditions. Values are: • **Disabled** • **Without Reuse** (default) • **Program Based** (for VOD usage) *Caution: Do not change this setting without consulting PID Re-Mapping Options for additional information.*
PAT TS ID	The output transport stream ID to use for the output PAT in this output transport stream. For Session Control, this setting must be unique for each output stream. Range: 0 – 65535
MC Encryption Type	This column provides the type of encryption to be used for that TS:QAM. Values are: • **None** • **CTE** • **Broadcast** (only applicable to outputs in Manual Routing mode)
SimulCrypt Mode	Use this column to select the SimulCrypt mode. Values are: • **None** • **External EIS**
Number of Programs/PIDs/Streams /SDV	Shows the number of Routed Programs, Ancillary PID Routes, Input Streams, and SDV Sessions.
Mapping	The drop-down list offers a shortcut to the following Manual Routing tasks: • **Program Mapping** • **Stream Pass Thru** • **Ancillary PID Mapping** • **UDP Port Mapping** • **DEPI Session Mapping**

Item	Definition/Range
Config All	Clicking **Config All** displays the *Configure All* window. Use this window to specify and configure QAM RF Ports for operating mode, PID Remapping mode, and encryption mode. *Note: After configuring the outputs, click* ***Apply*** *to implement the changes.*
Status	Offers a list of quick links to various status windows.
ASI Monitor Port TS	Shows the number of the transport stream to route to the ASI Monitor Port on the front panel. Range: 0 – 48 A zero indicates that no stream is to be routed to the ASI Monitor Port.
Pre/Post Encryption	Use this drop-down menu to select *pre* or *post* encryption. • **Pre-encryption** outputs the stream being monitored prior to being encrypted (packets are not scrambled and *are viewable)*, but still contains all encryption messages (ECMs). • **Post-encryption** outputs the stream being monitored after the services have been encrypted (packets are scrambled and are *not viewable*).

Configuring QAM Ports

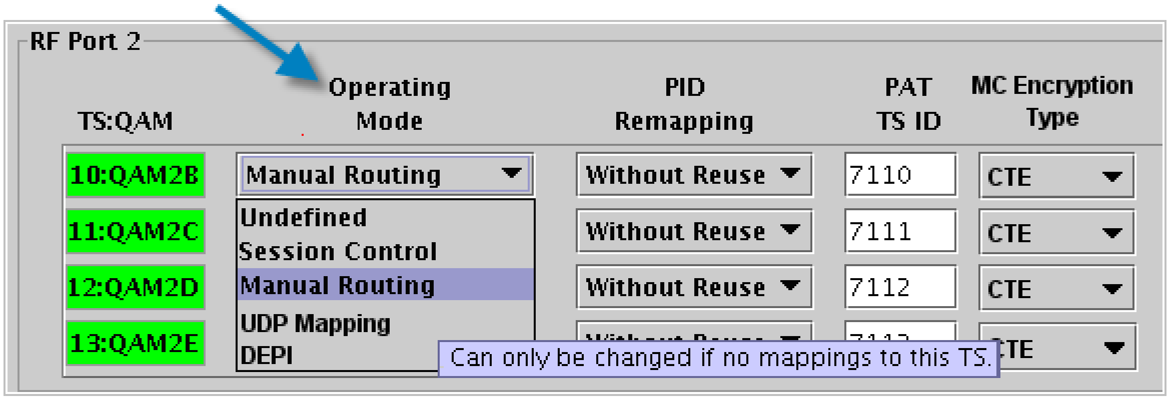
To configure Operating Mode and PID re-mapping settings, click **Config All** in the Output TS Configuration window:



CAUTION *Configuring QAM Ports is a bulk operation that affects all of the Output Transport Streams in that particular group.*

Setting the Operating Mode

Access the Operating Mode panel from the Output TS Configuration window:



There are four operating modes in the Operating Mode drop-down list:

1. **Undefined**
2. **Session Control:**
   - **RPC** — The APEX1000 acts as an edge device that receives and processes commands from two external sources using the RPC protocol.
   - **RTSP Session Mode** — The APEX1000 acts as an edge device that receives and processes commands and PID remapping using the RTSP protocol.
3. **Manual Routing** — Operator input controls the APEX, manually routing input transport streams to designated QAM outputs.
4. **UDP Mapping** — The sixteen-bit UDP port number on the incoming TS is routed to a specific output QAM port and output program number.
5. **DEPI** — In DEPI mode (M-CTMS/DOCSIS), the M-CMTS core performs transmission convergence and generates the DOCSIS SYNC messages.

CAUTION *Changes to the operating mode are only possible if there are no mappings or SDV sessions to that particular transport stream. Additionally, when you change the operating mode, you must click **Apply** to save the settings.*

PID Re-Mapping Options

PID Re-Mapping is enabled by default, and is used to prevent PID conflicts when services are multiplexed together. PID Re-Mapping parameters are used at initialization to determine how to partition the PMT, ECM, and elementary PIDs.

The APEX1000 uses a PID re-mapping scheme in which you can select from a number of PID re-mapping options on an output transport stream basis. The output PID values for PMTs and all components are then determined by the APEX1000.

PID Re-Mapping options

Option	Description
Disabled	Input PID values are simply re-used and are not re-mapped at the output. This setting should NOT be used for VOD or SDV (Session Control) outputs. *Note: You are responsible for avoiding PID collisions.*
Without Reuse	Use this mode to allow the APEX to select all PMT, ECM, and component PID values. The APEX attempts to *not reuse* the same PMT, ECM, or component PID value until all PID values reserved for these ranges have been exhausted. Note that the APEX ensures that all PIDs on an output are unique, and prevents any PID conflicts by remapping all input to output PIDs. • This mode is primarily required in VOD and SDV environments in which PID re-use is not desired, to prevent the unintended receipt of switched services from previous sessions that happened to use the same PID values • Additionally, this mode should be used when mapping multiple SPTS inputs to the same output (such as in a VOD or SDV case) The Program Based mode (as described below) is also intended for use in VOD systems.
Program Based	Use the Program Based mode in VOD environments. This mode allows the APEX to pre-allocate the PMT, ECM, and component PIDs for each program using a specific program mapping scheme. This scheme is based on the output program number to determine the PID values for each program: 1 — **PMT PID** = (Program number + 1) * 16- 32, 48, 64, …, 4096 2 — **Component PIDs** = (PMT PID+1), PMT+2, … PMT+15. (Example: 33, 34, … 47; 49, 50,… 63; 4097, 4098, …4111) 3 — **ECM PIDs** = Allocated from the reserved range This scheme only allows for output programs to be from 1 – 255. This is within the standard range of program numbers for VOD systems. This format can also be used for SDV and even broadcast systems, however, program numbers are limited to a maximum value of 255 and the number of component PIDs for a program cannot exceed 15.

Encryption Type Options

Option	Description
None	MediaCipher encryption is not required.
CTE	MediaCipher encryption is based on *Common Tier Encryption*.
Broadcast	MediaCipher encryption is based on *Broadcast Encryption*. *Note: Only available when the operating mode is Manual Routing.*

SimulCrypt Mode Options

Option	Description
Disabled	SimulCrypt is not performed.
Enabled	SimulCrypt is performed; connection with an EIS or utilization of Internal EIS is expected to define and schedule scrambling of services. *Note: Only applicable in Manual Routing and UDP Port Mapping operating modes.*

7 Manual Routing

Overview

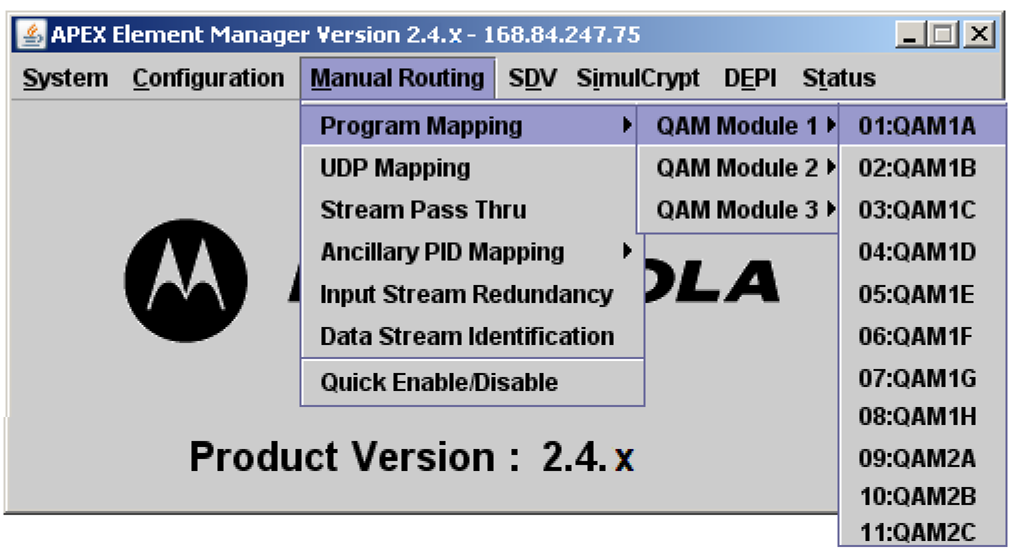
Using the Manual Routing option (also accessible from the Output TS Configuration window), you can manually route input MPEG services, transport streams, or PID streams to a designated output QAM channel. In addition, you can (optionally) enter a SourceID and ServiceProviderID associated with a routed service, or select one through a list of available services, which results in the retrieval of RMD from the DAC 6000 used to generate broadcast ECMs for encryption.

Manual Routing handles all manual routing changes and processing. When an output QAM channel is configured for Manual Routing, you can manually map using the EM input services from available GigEs to the QAM output.

CAUTION *Manually routed input streams cannot be the same as a redundant Manual Routing or redundant SDV input stream(s).*

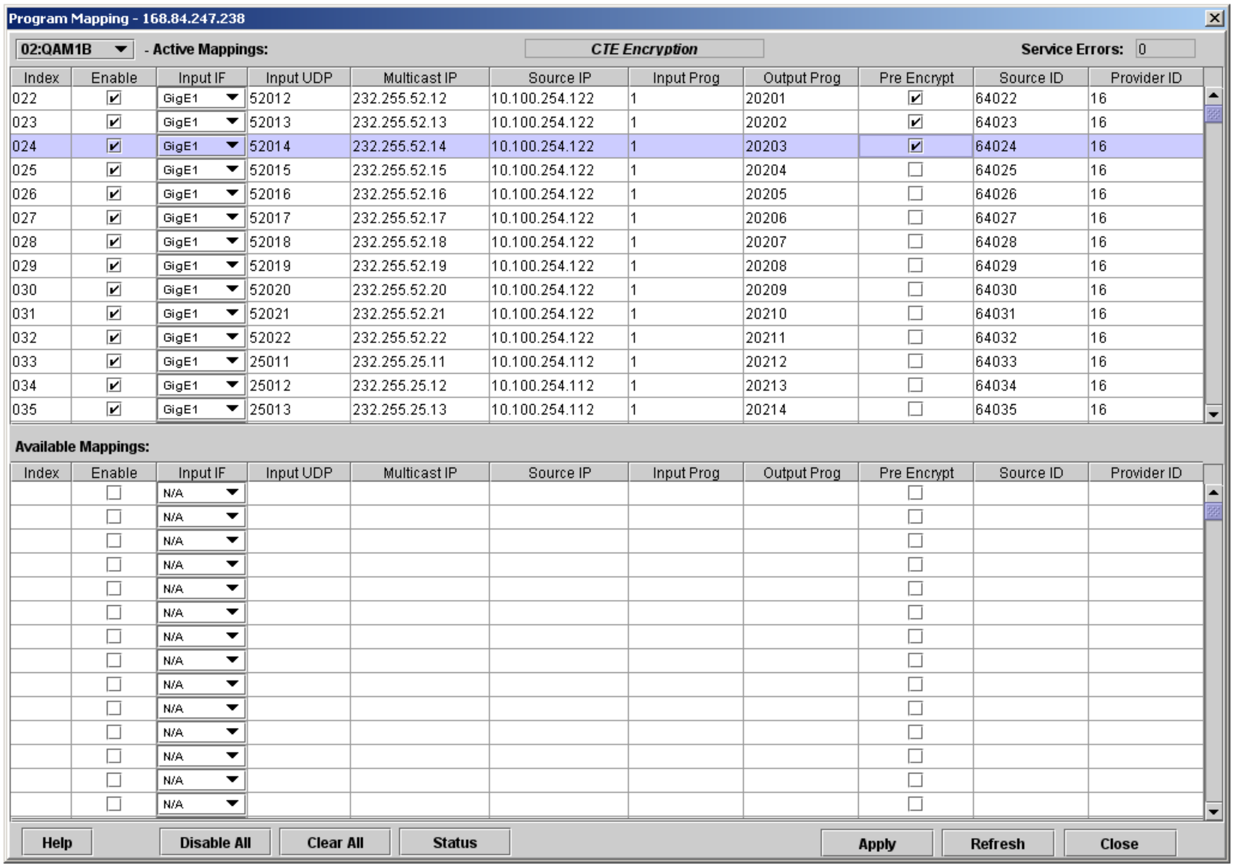
Program Mapping

To configure Active Mappings, select **Manual Routing > Program Mapping > QAM Module > QAM number**:



The Program Mapping window displays:

Figure 7-1 — Program Mapping window



In this window, you can manually map services or an entire transport stream from input to designated output interfaces.

Enabling Program Mappings

Every entry in both lists is directly editable. A mapping row that is not enabled will display in the *Available Mappings* panel.

To enable program mappings:

1. Check the **Enable** box to select one or more rows in the Available Mappings panel.
2. Enter the remaining selections for that row.
3. Repeat step 2 for each selected row.
4. Click **Apply**.
5. Click **Refresh** to update the screen.

Note: When a row is enabled, it moves to the Active Mappings panel.

Program Mappings window field definitions

Item	Definition
Index	Identifies the window line item.
Enable	Indicates that the particular route is enabled.
Input Interface	Specifies a GigE port (1 – 4) or Host port (1 – 2) as the input interface.
Input UDP Port	Specifies the input UDP port number for the transport stream. The input UDP Ports must be in the following range: • GigE UDP Ports: 0 – 65535 • Host UDP Ports: 1024 – 65535
Multicast IP	Specifies the Multicast IP address. (You MUST enter this value, if applicable.) • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Source IP	This is the IP address of the source device for multicast reception. The source IP address must be a valid singlecast address. (You MUST enter this value, if applicable.) *Only applicable when using multicast on a network that supports IGMP v3.*
Input Program	Identifies the input MPEG program number for the transport stream (0 – 65535). Input Program No. 0 is used as a *wild card* program. This informs the APEX1000 to map the first service listed in the input PAT message to the specified output. When mapping a program using input program number 0, only one service mapping from that specific input to an output can be performed.
Output Program	Identifies the output MPEG program number for the transport stream (1 – 65535).
Pre-Encrypt	A check mark indicates that the input service may be pre-encrypted. This informs the APEX1000 to check each input service for a CA ECM descriptor (in the PMT). Any input service that contains a PMT with a CA ECM descriptor is considered to be pre-encrypted. The CA ECM descriptor is checked at both the program level and component level. The APEX1000 will process the service as normal, but also will pass-through the ECM PID. (The APEX1000 can support only pre-encrypted services when the ECM and PMT PIDs are on *separate* input PIDs.) *Note: Only applicable when the encryption mode for the output is None or CTE (not Broadcast encryption).*
Source ID **Provider ID**	16-bit source ID to be used for Broadcast encrypted services. Use in conjunction with the Provider ID to identify a service to be mapped. See Source ID and Provider ID for more information.
Service Error	Provides a count of the number of services in error on the current output, and alerts you when a new mapping is in error.

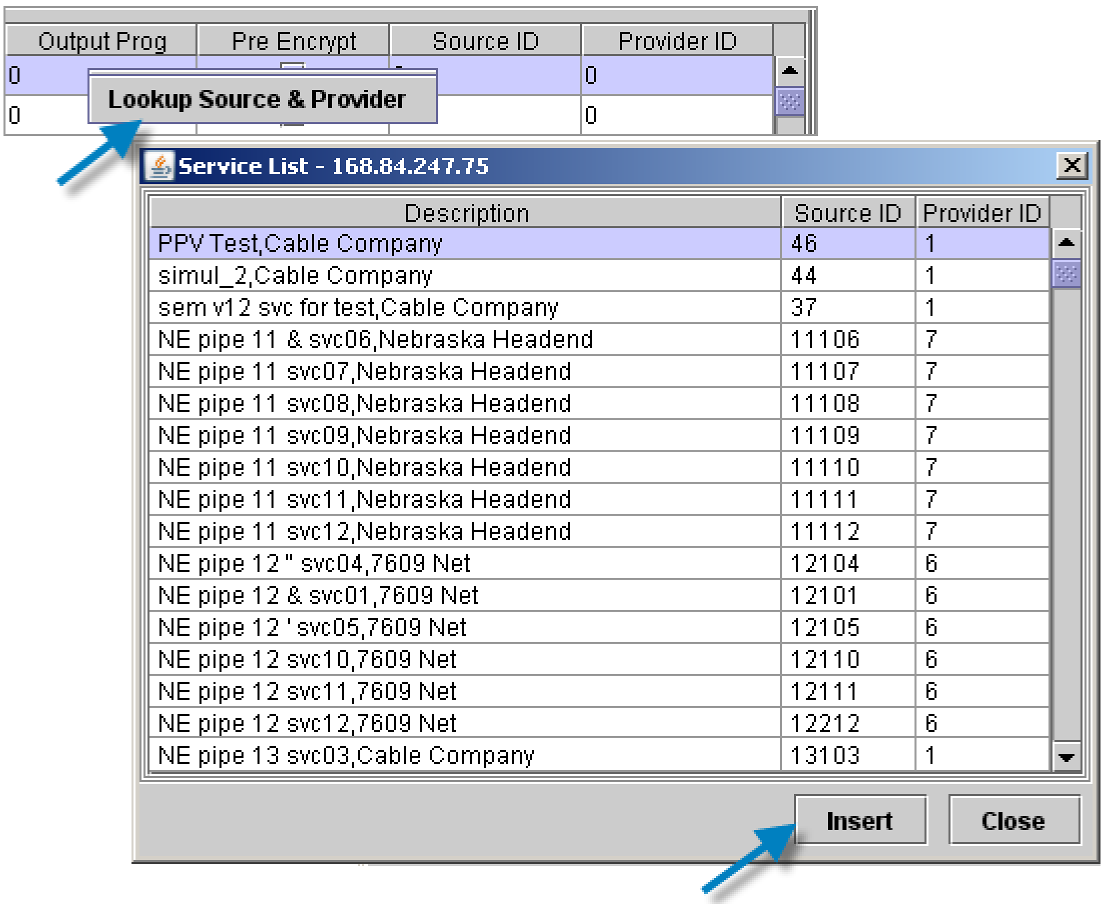
Source ID and Provider ID

For *Broadcast* encrypted services, the APEX retrieves the RMD information for the service from the RDS and uses this information to encrypt the service. The service is only remultiplexed after the APEX has received the RMD information identified by the Source ID and Provider ID. The service is encrypted using the RMD information received from the RDS; as a result, you must configure the RDS IP address when mapping any services in Broadcast Encrypted mode.

To select a Source ID and Provider ID from the Service List menu:

1. Right-click on any row in the Program Mapping window.
2. Select **Lookup Source & Provider**.

   The Service List window displays:



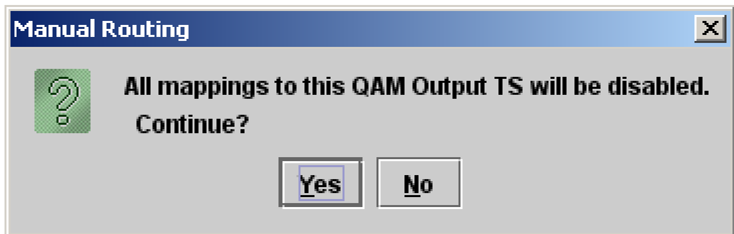
3. Scroll through the Service List to highlight the desired entries.
4. Click **Insert**.
5. Click **Close** to exit.

Disable All

To disable all program mappings to a QAM Output TS, use the **Disable All** function.

1. Click **Disable All** in the Program Mapping window.

   The corresponding Manual Routing pop-up displays:



2. Click **Yes** to disable all mappings, or click **No** to cancel.

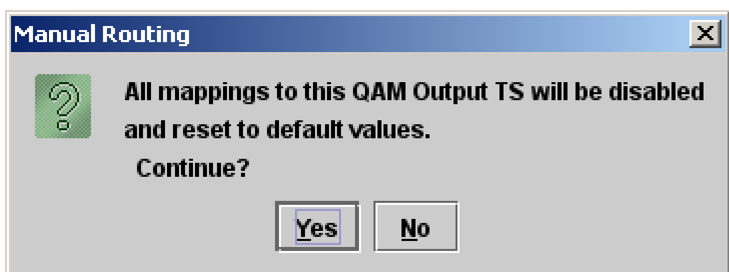
Note: If the QAM TS is not active, the only action available will be Disable All.

Clear All

You can disable and reset all program mappings to a QAM Output TS through the **Clear All** function.

1. Click **Clear All** in the Program Mapping window.

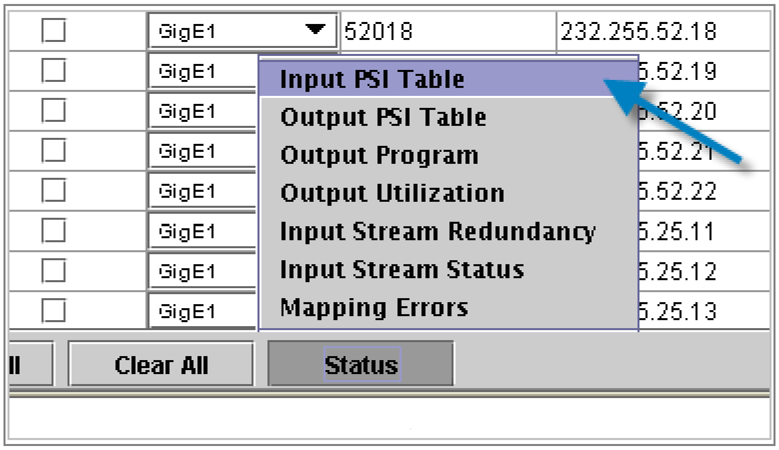
   The corresponding Manual Routing pop-up displays:



2. Click **Yes** to disable all mappings and reset to default values, or click **No** to cancel.

Quick Status View

Click **Status** on the Program Mapping window to display an auxiliary menu:



From this menu, you can view the status of specific APEX1000 functions, as shown in the examples below:

- **Input PSI Table** — Displays a list of program-specific information messages that are being *extracted* from the APEX1000 inputs.
- **Output PSI Table** — Displays a list of program-specific information messages that are being *inserted* into the APEX1000 outputs.
- **Output Program** — Shows what programs on the inputs are being remapped.
- **Output Utilization** — Provides a data rate summary presentation within a sampled time frame.
- **Input Stream Redundancy** — Allows the enabling of a Secondary input stream configuration for each GigE input.
- **Input Stream Status** — Use to establish where GigE ports are used.
- **Mapping Errors** — Displays a list of all mapping errors by time logged, type, and error code. For more information on these and other resources, see the Status section of this guide.
- **Help** — Displays information on using the Manual Routing screen.
- **Output TS Channel** — 

  Using a drop-down menu in the upper left section of the window, you can select another output stream to configure by switching between all 48 outputs (without having to exit this screen and then re-enter). This makes it easier to change mappings on multiple outputs.

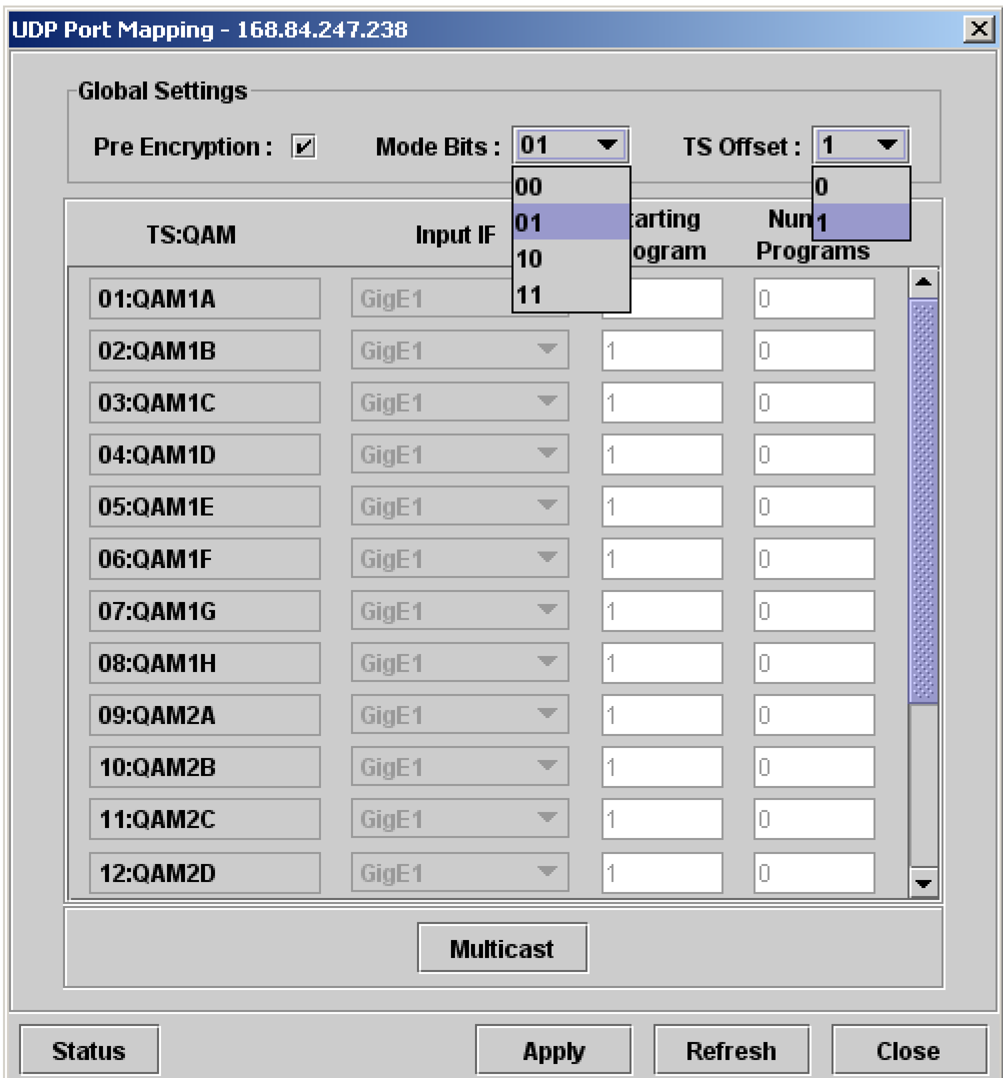
UDP Mapping

In UDP Port Mapping mode, an input streams UDP port provides the APEX with the destination output QAM and output program number.

Using the UDP Port Mapping window, you can configure the QAMs associated with UDP Port Mapping mode with the range of programs associated with the QAM, the GigE interface associated with the input streams, whether the stream is pre-encrypted, and the mode bits and transport stream offset associated with the UDP port.

To configure UDP Mappings, select **Manual Routing > UDP Mapping**:

Figure 7-2 — UDP Port Mapping



CAUTION	*Motorola strongly recommends that you configure the Program Based PID Remapping scheme for VOD outputs. For more information, see Output TS Configuration.*

UDP Port Mappings window field definitions

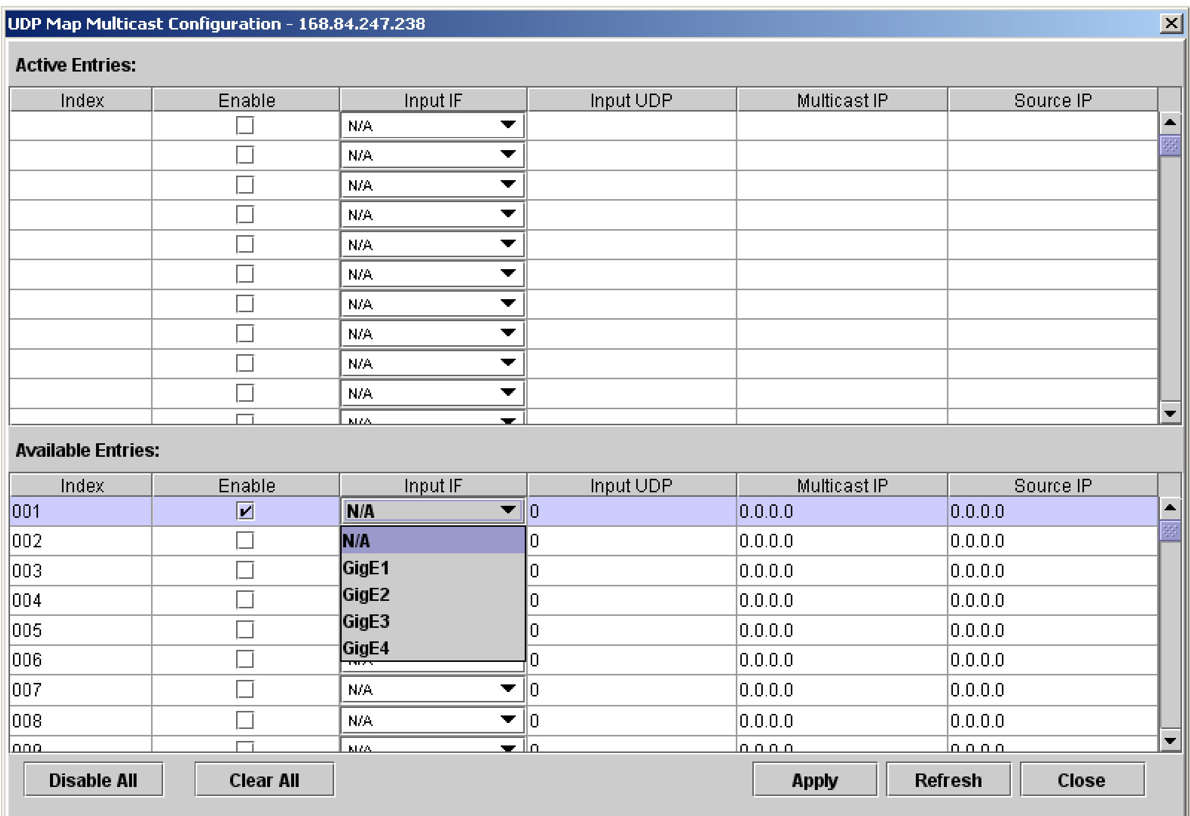
Item	Definition
Global Settings	***Pre-Encryption** – Select this checkbox to indicate that the stream is pre-encrypted. This means that you can process pre-encrypted programs through the APEX1000. *Note: Because many VOD services are pre-encrypted, the default is Enabled.*
	Mode Bits – Select the desired mode bits from this drop-down menu. Mode bits are used as part of the UDP port calculation. This setting represents the two MSBs of the UDP port. Range: 00,01,10,11 The default is 00 – This setting corresponds to the known SeaChange® VOD server setting. You should exercise care when changing this setting, as the UDP port values will change.
	***TS Offset** – Select the desired TS Offset mode from this drop-down menu as relative 0 or 1. The output transport stream index is used as part of the UDP port calculation and can be relative 0 (OTS 0 – 47) or relative 1 (OTS 1 – 48) Range: 0, 1 The default is 1 – This setting corresponds to the known SeaChange VOD server setting. You should exercise care when changing this setting, as the UDP port values will change.
TS: QAM	Shows the Output Transport Stream number and Output QAM channel.
***Input IF**	Indicates the GigE input port of the UDP algorithm from the VOD controller.
***Starting Program**	Configures the starting program number of the first program on the output. Range: 1 – 255
***Number Programs**	Indicates the number of programs associated with an output. Used with the Starting Program field to define a range of programs. Range: 0 – 200 *Note: The total number of mappings is limited to 768 across all output streams.*
Multicast	Opens the UDP Map Multicast Configuration window.
****Changing this setting causes all programs already mapped to be deleted and re-added, resulting in a momentary glitch in the video streams.***	

UDP Map Multicast Configuration

Use this screen to configure VOD streams (UDP Port Mapping) for multicast reception (instead of *unicast* reception). Typically, VOD streams are received via unicast. Some systems, however, may want to transmit a number of streams as multicast when in UDP Port Mapping mode.

To configure UDP Map Multicast settings, click **Multicast** in the UDP Port Mappings window:

Figure 7-3 — UDP Map Multicast Configuration



1. Check the Enable box (es) to select one or more rows in the *Available Mappings* panel and enter the remaining selections for that row. When a row is enabled, it will shift to the *Active Mappings* panel.
2. Repeat step 1 for each selected row.
3. Click **Apply**.
4. Click **Refresh** to update the screen.

Note: You can also disable all UDP Port Mappings by applying the Clear All /Disable All functions.

Stream Pass Thru Configuration

This window allows pass through of an entire input stream to a QAM Channel. Acting as a surrogate controller, the APEX1000 EM is used to configure the APEX1000 for service routings. When the APEX1000 EM is the APEX1000 controller, the APEX1000 can operate in Manual Routing, Undefined, or Session Control modes.

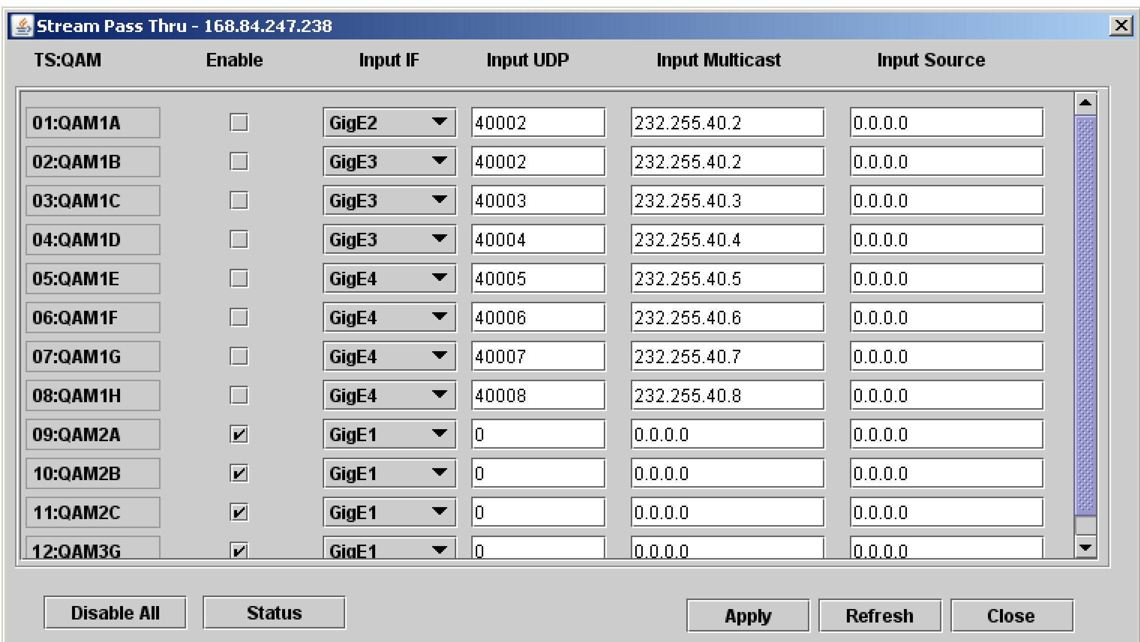
In addition to routing services, Manual Routing mode supports the ability to route an entire input stream to one or more output streams (Transport Stream Pass Thru).

Notes:

- Streams that are passed through to an output are passed through unchanged
- The output services cannot be encrypted, and no insertion (such as EAS) can occur

The figure below shows a *section* of the Stream Pass Thru Configuration window:

Figure 7-4 — Stream Pass Thru Configuration



Stream Pass Thru window field definitions

Item	Definition
TS:QAM	Shows the Output Transport Stream numbers (1–16, 17–32, 33–48), and the QAM Port.
Enable	A check mark indicates that the route is enabled.
Input Interface	Specifies a GigE port (1 – 4) or Host port (1 – 2) as the input interface.
Input UDP Port	Specifies the input UDP port number for the transport stream. • GigE: 0 – 65535 • Host: 1024 – 65535
Input Multicast IP	Specifies the Multicast IP address, if applicable.
Input Source	Specifies the Source IP address of the multicast group, if applicable.
Disable All	Prompts you to disable all 48 rows.
Status	Provides drop-list selections to quick status verification of: • Input PSI Table • Output PSI Table • Output Program • Output Transport Utilization • Input Stream Redundancy • Input Stream Status • Mapping Errors

Ancillary PID Mapping

Ancillary PID processing is similar to service processing, in that it is linked to a specific input stream object. The APEX1000 Ancillary PID Mapping window provides the capability to manually map non-service PIDs. Ancillary PIDs are non service-related, as they are not part of any service (not listed as a component of any PMT).

An example application would be the pass-through of EMMs. Ancillary PID mappings can be made to any output regardless of the operating mode.

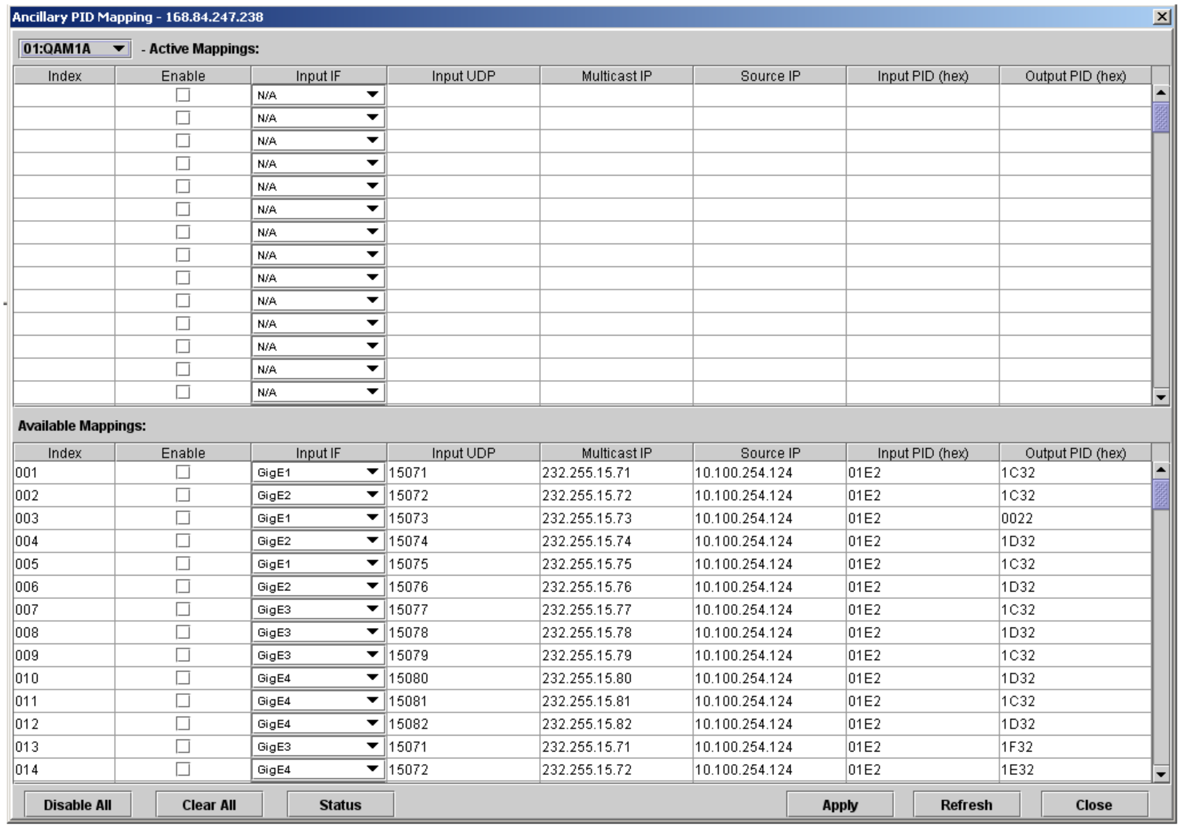
Notes:

- **Apply** (per row) is needed to modify a row
- Any rows already enabled and changed result in the PID mapping being deleted, and then the addition of a new one

Configuring Ancillary PID Parameters

To configure Ancillary PID processing, select **Manual Routing > Ancillary PID Mapping**:

Figure 7-5 — Ancillary PID Mapping


Ancillary PID Mapping - 168.84.247.238

01:QAM1A - Active Mappings:

Index	Enable	Input IF	Input UDP	Multicast IP	Source IP	Input PID (hex)	Output PID (hex)
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					
	☐	N/A					

Available Mappings:

Index	Enable	Input IF	Input UDP	Multicast IP	Source IP	Input PID (hex)	Output PID (hex)
001	☐	GigE1	15071	232.255.15.71	10.100.254.124	01E2	1C32
002	☐	GigE2	15072	232.255.15.72	10.100.254.124	01E2	1C32
003	☐	GigE1	15073	232.255.15.73	10.100.254.124	01E2	0022
004	☐	GigE2	15074	232.255.15.74	10.100.254.124	01E2	1D32
005	☐	GigE1	15075	232.255.15.75	10.100.254.124	01E2	1C32
006	☐	GigE2	15076	232.255.15.76	10.100.254.124	01E2	1D32
007	☐	GigE3	15077	232.255.15.77	10.100.254.124	01E2	1C32
008	☐	GigE3	15078	232.255.15.78	10.100.254.124	01E2	1D32
009	☐	GigE3	15079	232.255.15.79	10.100.254.124	01E2	1C32
010	☐	GigE4	15080	232.255.15.80	10.100.254.124	01E2	1D32
011	☐	GigE4	15081	232.255.15.81	10.100.254.124	01E2	1C32
012	☐	GigE4	15082	232.255.15.82	10.100.254.124	01E2	1D32
013	☐	GigE3	15071	232.255.15.71	10.100.254.124	01E2	1F32
014	☐	GigE4	15072	232.255.15.72	10.100.254.124	01E2	1E32

Disable All | Clear All | Status | Apply | Refresh | Close

Note: A mapping row that is not enabled displays in the Available Mappings panel. When you enable a row, it moves to the Active Mappings panel.

Every entry in both lists is directly editable.

Ancillary PID Routing window field definitions

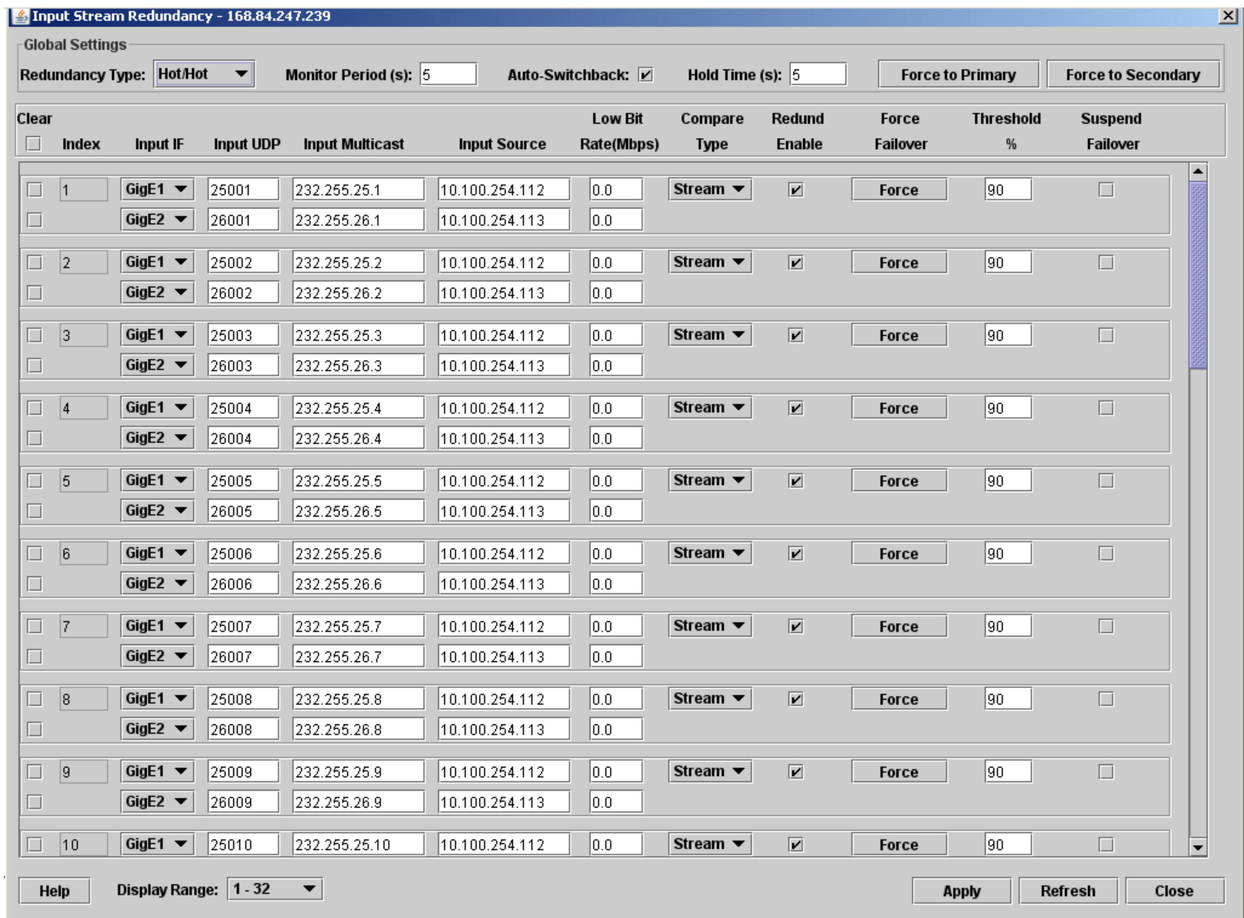
Item	Definition
Index	Index of the PID Mapping Table. Range: 1 – 128
Enable	Indicates whether this PID mapping is enabled or disabled. Once written, the change to this parameter will only take immediate effect after **Apply** is clicked. Click **Save** to allow this change to persist through subsequent reboots.
Input Interface	Number of the input type from which to obtain data: GigE 1 – 4 or Host 1 – 2
Input UDP Port	Input UDP port from which to obtain data: • GigE: 0 – 65535 • Host: 1024 – 65535
Multicast IP	The Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Source IP	This is the IP address of the source device for multicast reception. The source IP address must be a valid singlecast address. The value 0.0.0.0 is a valid entry.
Input PID (hex)	The input MPEG PID to multiplex. The PAT PID, 0x0000, and the Null PID, 0x1FFF, cannot be mapped as ancillary PIDs. The range of available input PIDs is 0x0001 – 0x1FFE.
Output PID (hex)	Output PID to use for the data. If PID remapping is disabled, the output PID value must match the input PID value. When PID Remapping is enabled, the APEX1000 will enforce a range of PIDs that can be remapped. The Range of PIDs is outside of the reserved range for services. You can only remap ancillary PIDs in the following ranges: • 0x0001 – 0x002F and 0x1C00 – 0x1FFE You should not map the following PIDs as ancillary PIDs, as they are defined for other uses in the system: PID 0x1FFB, reserved for the EAS message PID, and PIDs 0x1FED and 0x1FEE, reserved for the RPC mini-carousel PIDs in RPC mode. *Caution: Do not attempt mapping while in RPC mode.*
Disable All	This is an EM function which causes all mappings on this QAM TS to be disabled.
Clear All	Disables all mappings and resets default values.
Status	Provides drop-list selections to quick status verification of: • Input PSI Table • Output PSI Table • Output Program • Output Transport Utilization • Input Stream Redundancy • Input Stream Status • Mapping Errors

Input Stream Redundancy

Use this window to enable a Secondary GigE input stream configuration for each input. You can create up to 768 redundant GigE pairs of transport streams (Enet1 and Enet2 streams do not support redundancy). The configuration of Input Stream Redundancy is only for *Manually Routed streams* (Program Mapped, Ancillary Mapped, or Stream Pass Thru).

CAUTION *You cannot configure UDP Port Mapped streams for redundancy. Session Control services are not configured for redundancy through this screen. SDV services have redundancy configured by the ERM, and do not require any APEX user configuration.*

Figure 7-6 — Input Stream Redundancy



Input Stream Redundancy window field definitions

Window Section		Definition
Global Settings	**Redundancy Type**	Use to select between Hot/Hot and Hot/Warm redundancy. *Caution: Redundancy Type cannot be changed while there are currently any active mappings (all mappings must be disabled prior to changing the redundancy type).*
	Monitor Period (s)	Shows the time in seconds over which Redundant Gigabit Ethernet UDP Port Pairs will be monitored. Range: 1 – 30 seconds • This is the number of seconds that the Primary and Secondary will be compared to each other, before determining if a fail over or fall back is necessary. The higher the setting, the longer the delay between when a loss of input data occurs and when the APEX1000 will perform a fail over. *Note: Only applicable when the Redundancy Type is set to Hot/Hot.*
	Auto-Switchback	Range: On/Off When On, the APEX will automatically fallback to the Primary, when it determines that the primary input stream has been restored. *Note: Only applicable when the Redundancy Type is set to Hot/Hot.*
	Hold Time (s)	This is the time in seconds to wait before switching back to the Primary of a Redundant Gigabit Ethernet UDP Port pair after the Primary is healthy. Range: 0 – 3600 seconds *Note: Only applicable when the Redundancy Type is set to Hot/Hot.*
	Force to Primary	Force all input streams to use the primary stream in the input stream pair (used if *stream redundancy* is configured). *Note: Not applicable for Host Input streams.*
	Force to Secondary	Force all input streams to use the secondary stream in the input stream pair (used if *stream redundancy* is configured). *Note: Not applicable for Host Input streams.*
Clear		Clear is an EM function that sets a row to default values. Check this box and press **Apply** to cause the data for *all* rows to be cleared (delete entries). • Any multicast or redundancy setup will be disabled. • To clear selected rows, click each individual checkbox as desired.
Index		Index of Input Stream Redundancy table. Range: 1 – 768
Input Interface		Number of the input type from which to obtain data (GigE 1 – 4). The Input IF for a row must be either GigE1 and GigE2 or GigE3 and GigE4. *Select an Enabled GigE Interface or N/A to disable a row.*
Input UDP Port		Input UDP port from which to obtain data.

Window Section	Definition
Input Multicast IP	The Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Input Source	IP address of the source device for multicast reception. The source IP address must be a valid singlecast address. *Only applicable when using multicast on a network that supports IGMP v3.*
Low Bit Rate (Mbps)	The input service's minimum bit rate is below the level configured by the operator. See Low Bit Rate Alarm for more information.
Compare Type	For Redundancy comparison, the Primary Compare Type setting is the comparison type that you use when comparing the input Primary stream against the input Secondary stream. (Not applicable in Hot/Warm redundancy.) For Primary input streams, you MUST select a Compare Type (select either Data Rate or Stream Rate): • Select **Data Rate** to compare the data rate of the input streams. The data rate includes all non-Null PIDs (all video, audio, data, and PSI PIDs). • Select **Stream Rate** to compare the entire input transport stream rates. This includes the Data rate plus all Null PIDs. Select Stream Rate if the input stream is always null filled or if the input data rate is unknown and/or is variable. *For Secondary and non-Redundancy input streams, the Compare Type is used to determine the Low Bit Rate Alarm. Select N/A if NO low bit rate checking is desired.* *Note: Only applicable when the Redundancy Type is set to Hot/Hot.*
Redund Enable	Indicates whether this redundancy for the selected input transport stream pair is *enabled* or *disabled*. If Redund Enable is not checked, that index's Force, Threshold, and Suspend Failover controls, and secondary row are grayed out. Once written, the change to this parameter will only take effect when you click **Apply**.
Force Failover	Force Failover causes one or more GigE Input Streams, configured as the Primary stream of a Redundant Pair to *fail over* to the Secondary stream. Forced switch can only occur when there is at least one channel enabled on the selected primary RF port, and the primary RF port is not failed (in error). *Note: This function only becomes available when you check **Redund Enabled.***

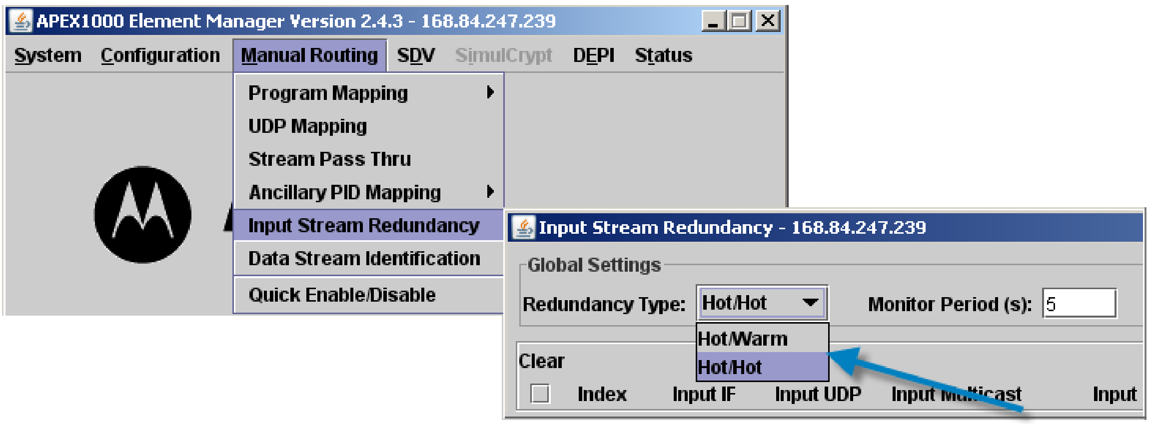
Window Section	Definition
Threshold	Displays the user-configured redundancy threshold percentage to compare the Primary vs. the Secondary input streams. Use this percentage to determine if a threshold change has occurred, and if a failover to the Secondary or fallback to the Primary is required. The threshold is applied to the secondary input stream when compared to the primary. A primary is determined to be below the secondary using the threshold as follows: **Primary < (Secondary * Threshold %)** Example: A threshold percentage of 90%, means that the Primary input stream would have to drop to less than 90% of the secondary before a failover occurs. Assuming the secondary has an input rate of 38.81, the primary would have to drop to a rate below 34.93% before a failover to the secondary would occur. *Note: Only applicable when the Redundancy Type is set to Hot/Hot.*
Suspend Failover	This function becomes available only when **Redund Enabled** is checked. Check this box to prevent a Primary stream from failing over to the Secondary, even if it is Redundancy Enabled.
Help	Opens a new window that displays usage information.
Display Range	Activates an auxiliary menu from which to select and display the Index range. Range: 1 – 768
*Note: The **Apply** function is set on a row basis rather than for the entire window. Apply is set only for rows that have changed.*	

Manual Routing TS Redundancy

There are two different redundancy selections methods for determining transport stream failover: Hot/Hot and Hot/Warm.

Hot/Hot and Hot/Warm

This setting is configurable on the Input Stream Redundancy screen:



- **Hot/Hot** is typically expected to be used for Manual Routed input streams. Hot/Hot means that a primary and secondary input stream are both opened at the same time. This indicates that the APEX is receiving *twice* the amount of input data as it is processing (primary is received and processed, secondary is received, counted, then discarded). The APEX monitors and compares the primary to the secondary using the user-configured threshold, compare type, and monitor period. A failover to the secondary occurs when the primary drops below the secondary based on the these settings. A fallback to the primary occurs using the same comparison algorithm but also takes into account the hold value.
- **Hot/Warm** mimics the Hot/Warm scheme employed for SDV sessions. Hot/Warm means that only one of the redundant input streams is opened at any one time. Either the primary or secondary input stream is received, but not both. This reduces the overall amount of input data the APEX is receiving. For this redundancy type, the APEX uses the unicast or multicast timeout values to determine when to failover. A failover occurs when the Primary input stream is determined to be missing for the unicast or multicast timeout period.

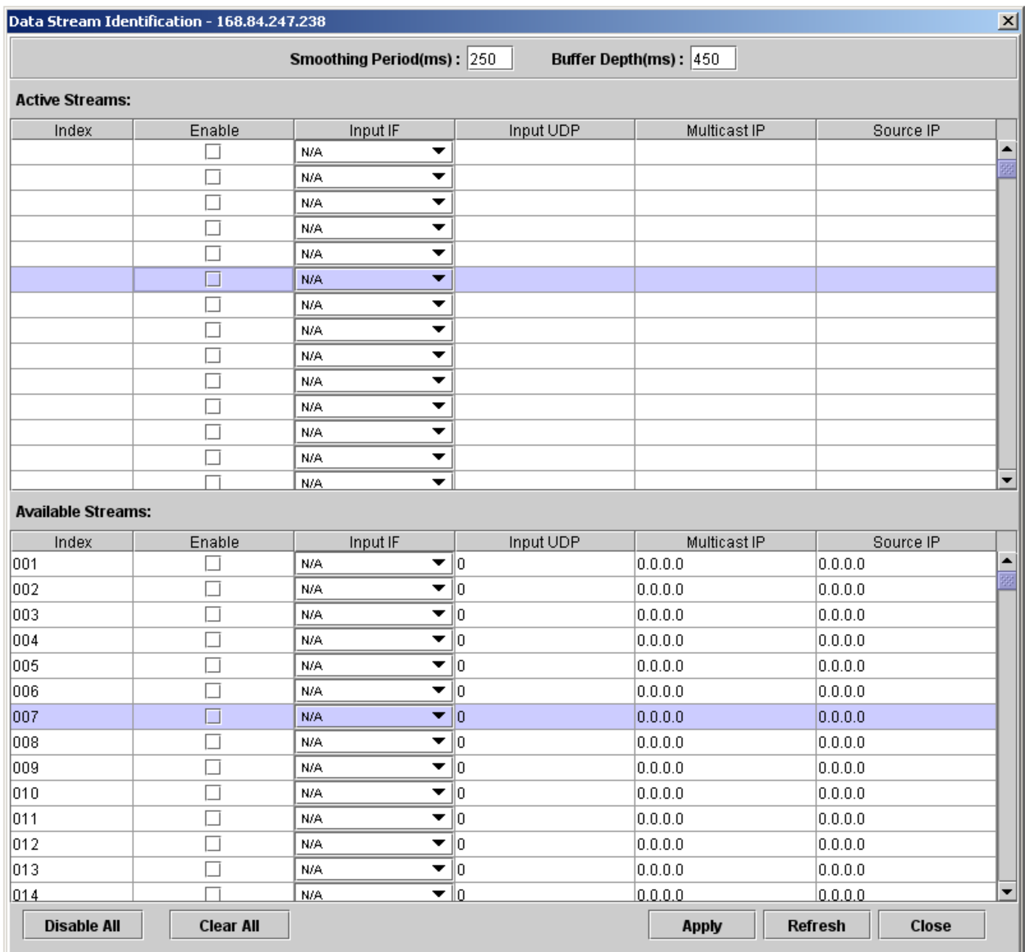
There is no direct comparison to the secondary input, as the primary is opened and used until a failover occurs. This means that the failover is performed before the condition of the secondary input stream is known. When a failover to a secondary occurs, there is no automatic fallback. To fallback to the primary, you must force the secondary to fallback to the primary.

Data Stream Identification

Use this window to identify specific GigE input streams as containing data PIDs only. These input streams do not contain PCRs, which are used to derive the play out data rate of video/audio streams.

For streams that are purely data only, identify each stream with an entry in this screen; the APEX will then attempt to buffer and smooth out these streams to avoid overflows. Data streams NOT identified in this screen will be played out of the GigE through the APEX at the rate they are received.

Figure 7-7 — Data Stream Identification



CAUTION *GigE streams may encounter network jitter, and the streams can cause overflows of the GigE buffers without proper identification and buffering. This will cause loss of data and packets.*

Data Stream Identification window field definitions

Item	Definition
Smoothing Period (ms)	Amount of time in milliseconds that the GigE will attempt to smooth out the received data stream. This value is used along with the Buffer Depth to best smooth out data streams. The GigE will use the total smoothing period and divide by the number of packets received during this time to determine an equal spaced out play out rate. Range: 250 – 650ms (must be less than or equal to Buffer Depth)
Buffer Depth (ms)	Buffer Depth in milliseconds for data-only input streams. This is the amount of time that data only input streams are buffered by the GigE processor. These streams are then played out using the Smoothing Period to attempt to transmit packets to the proper output at an equally spaced out rate. This will help to remove network jitter and remove bursts from the input stream. Range: 250 – 650ms (must be greater than or equal to Smoothing Period)
Active Streams / Available Streams	
Index	Index of table entry (1 – 768).
Enable	Enabled entry indicator. Set this to enable an input stream to identify it as a data-only input stream.
Input IF	Specifies the GigE port as the input interface.
Input UDP	Specifies the GigE input UDP port. Range: 0 – 65535
Multicast IP	The Gigabit Ethernet Receive Multicast IP Address.
Source IP	The Gigabit Ethernet IGMP v3 Source IP Address.

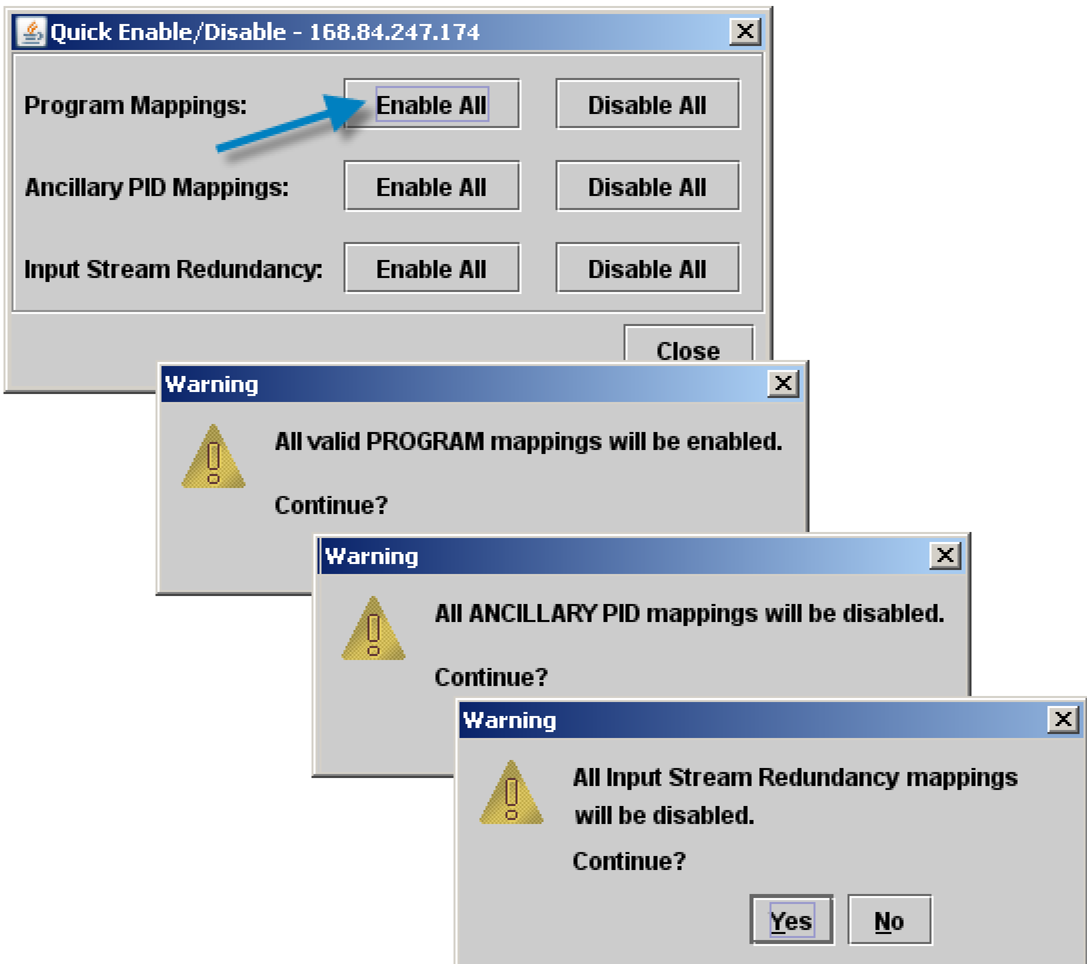
Warning! Only list streams without PCR packets in this table. Do NOT add video/audio input streams to this table.

Quick Enable/Disable

Use the APEX-EM window to enable or disable all Program Mappings, Ancillary PID Mappings, and Manual Routed Input Redundancy pairs.

1. To access these functions, select **Manual Routing > Quick Enable/Disable**.

   The Quick Enable/Disable window displays:



2. Click **Yes** to enable or disable all mappings.
3. Click **No** to exit without making any changes.

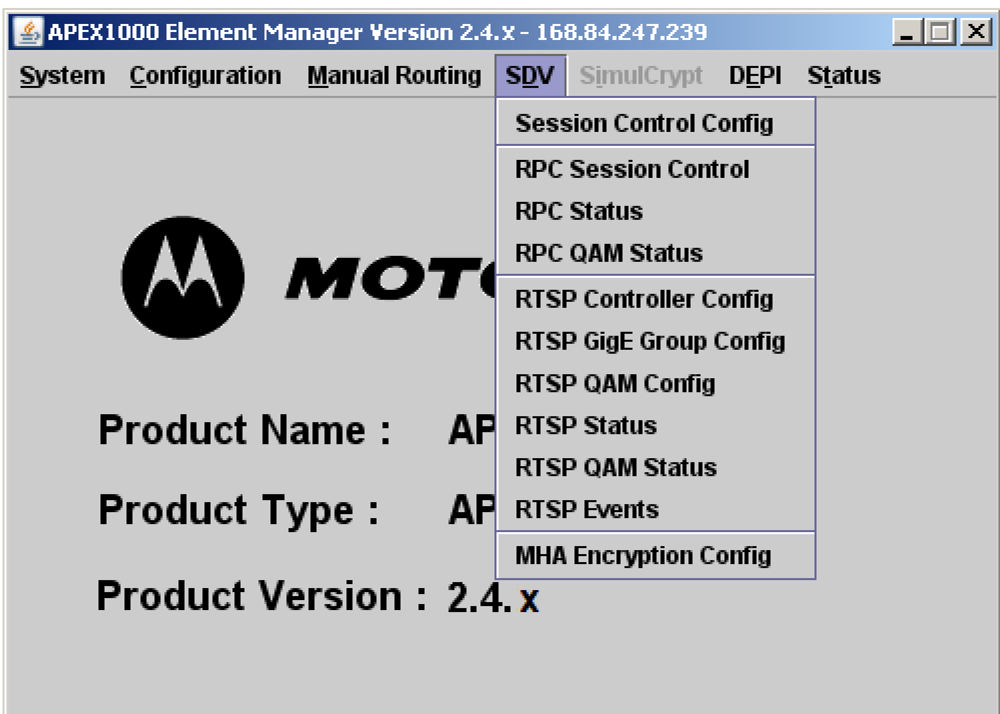
8 SDV — Switched Digital Video Controls

Session Controlled Mode

Session Controlled Mode indicates the mode of a given output, in which streams are routed to that output under the control of an *external controller*, using either RPC, RTSP, or MHA protocols.

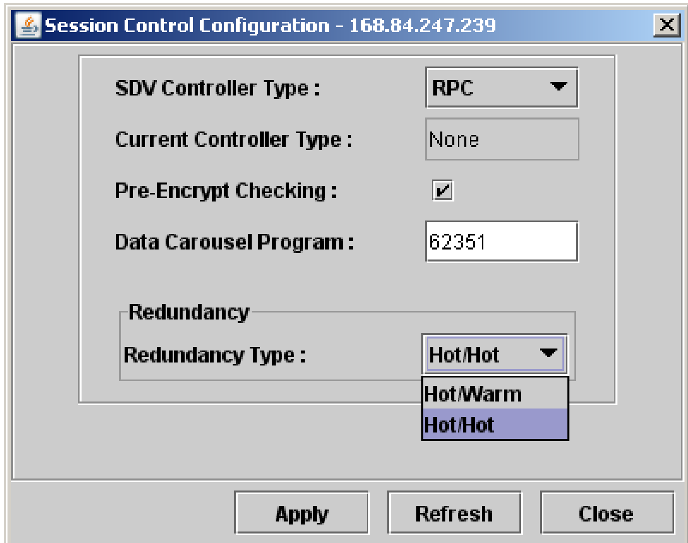
This section describes GUI functions and field reference values. For step-by-step Quick Start instructions, consult the Configuring the APEX1000 for Switched Digital Video section of this manual.

To begin configuring Session Control, select **SDV > Session Control Config**:



CAUTION *After choosing a controller type in the Session Control Configuration window, you must configure the APEX1000 for that mode (RPC, RTSP, or MHA)* ***only****. Do not use any other menus.*

Figure 8-1 — Session Control Configuration



Session Control Configuration window field definitions

Item	Definition/Range
SDV Controller Type	Provides four selections to set the SDV controller type of the APEX1000: • **None** • **RPC** • **RTSP** • **MHA** *Note: Any changes to the controller type require a system reboot before taking effect.*
Current Controller Type	Read-only. Displays the current controller type.
Pre-Encrypt Checking	Select this checkbox to enable the APEX1000 to check if the incoming service is pre-encrypted. This check box should normally be checked (enabled). Typically, SDV input streams may already be encrypted and this setting allows the APEX to check if the input is a pre-encrypted input stream.
Data Carousel Program	Displays the carousel program number, used to indicate a special program that cannot be remapped (component PID cannot be changed) or encrypted. *Caution: The Data Carousel program default is the well-known program # 62351, and should not be changed.*
Redundancy Type	Use to select between Hot/Hot and Hot/Warm redundancy. These modes determine the type of transport stream redundancy that is applied to all SDV sessions.
*Note: After you make your selections, click **Apply** in the Session Control Configuration window for the changes to take effect.*	

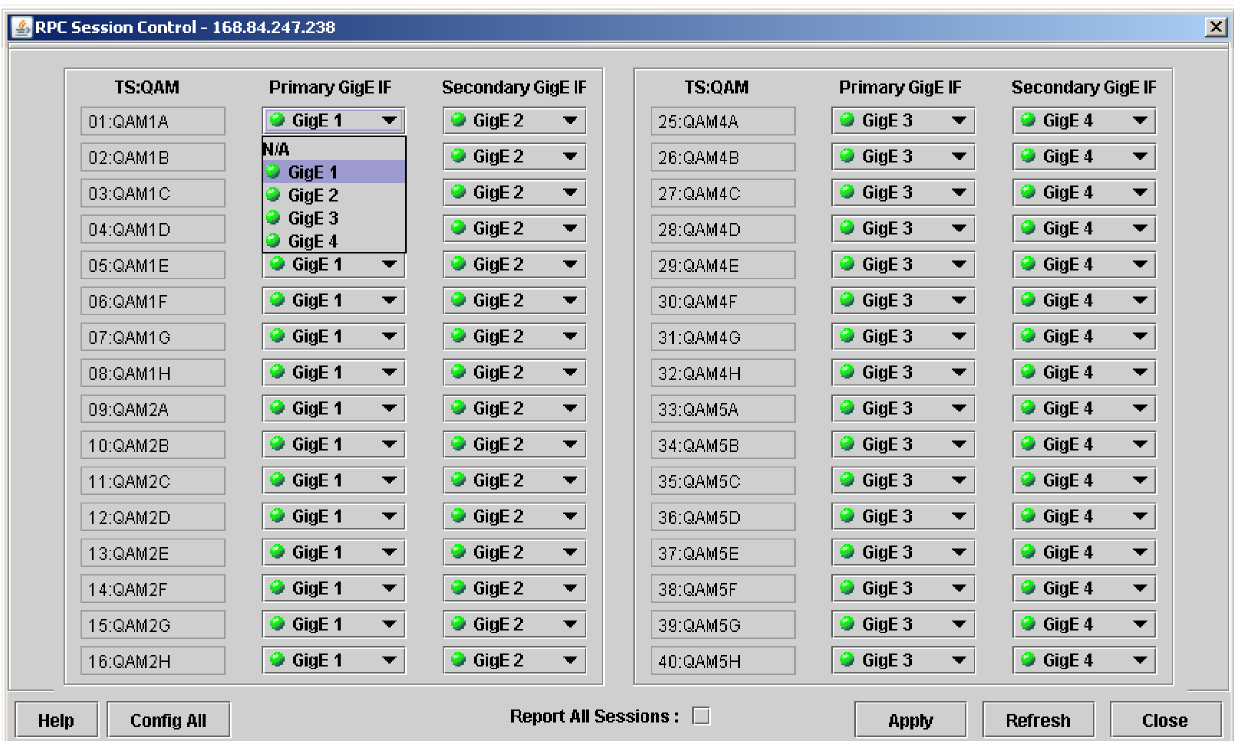
RPC Session Control

In RPC mode, the session controller is configured with the address of the edge devices. The controller establishes communication with the APEX1000 and requests information concerning the APEX1000 interfaces. The APEX1000 can be operating in either SDV or VOD/BC systems.

You must configure the APEX1000 to define those GigE inputs that map to a specific QAM output channel. The APEX uses the RPC Session Control window to generate this configuration.

To begin configuring this mode, select **SDV > RPC Session Control**.

Figure 8-2 — RPC Session Control



To configure an RPC Session:

1. Select a Primary and a Secondary GigE interface for each transport stream (must be either GigE1 *and* GigE2 or GigE3 *and* GigE4).
2. Click **Apply**.

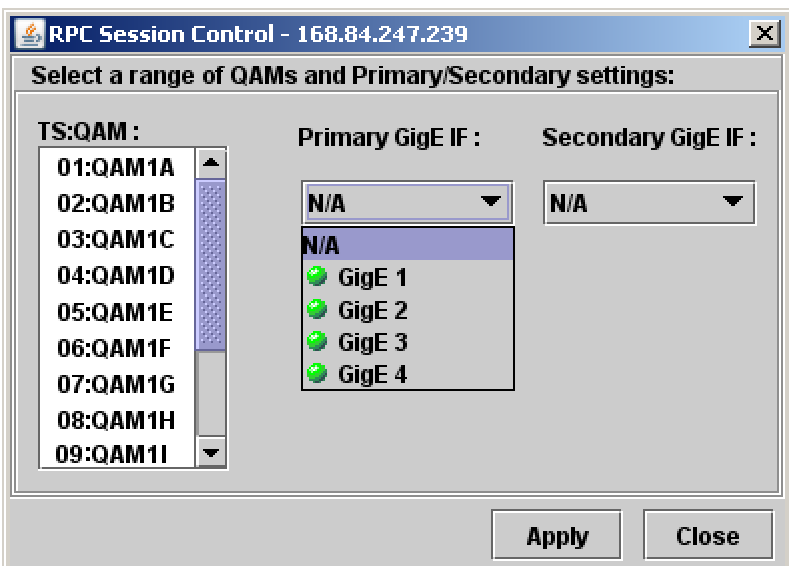
Note: While disabled, the APEX1000 only reports the sessions for the requesting manager. In addition, you cannot modify Primary and Secondary interfaces if there is an active session control mapping on the specified output stream.

RPC Session Control window field definitions

Item	Definition
TS:QAM	Shows the Output Transport Stream number and Output QAM channel.
Primary GigE IF	Specifies a GigE port (1 – 4) as the primary input interface.
Secondary GigE IF	Specifies a GigE port (1 – 4) as the secondary input interface. *N/A is also a valid entry.*
Config All	Opens the RPC Session Control screen (shown below).

RPC Session Control Pop-up

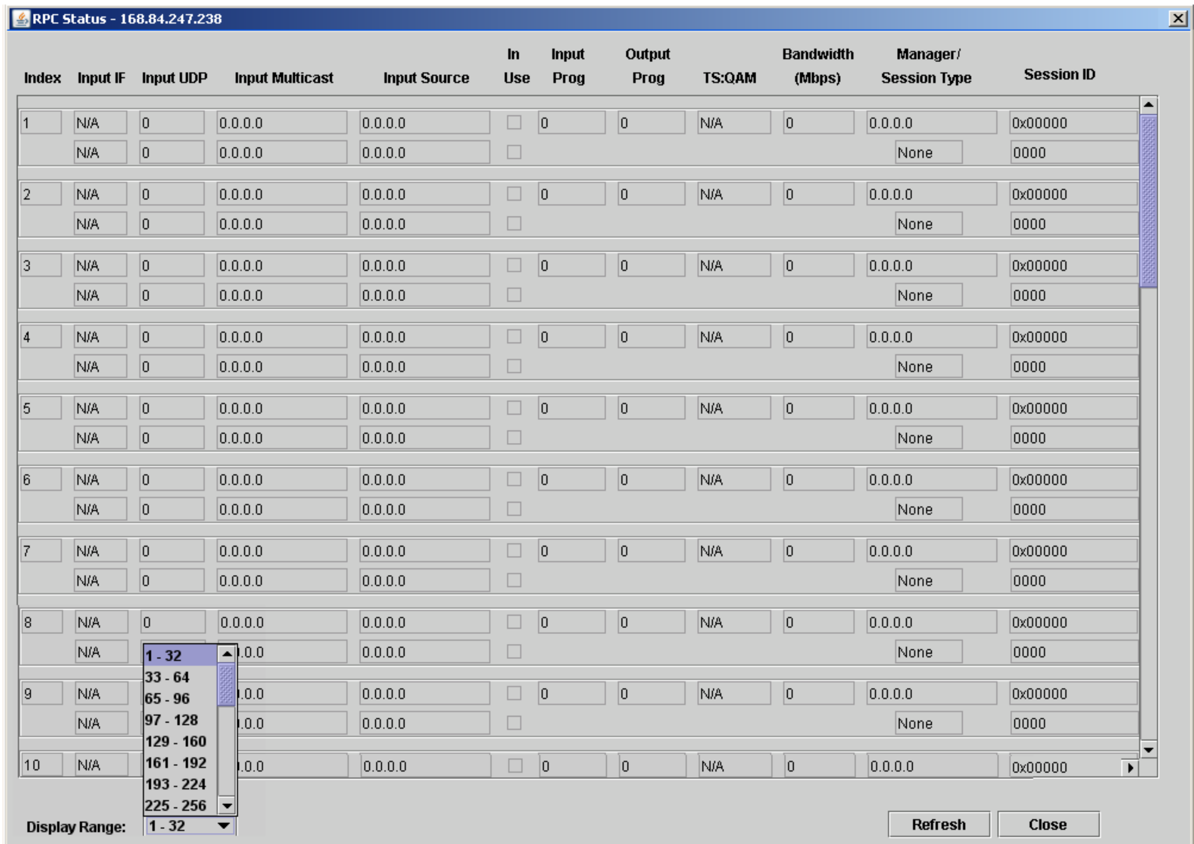
Use this window to select a range of QAMs and Primary/Secondary settings:



RPC Status

The RPC Status window displays the status of all RPC connections on the APEX1000. It shows a map of the (up to) 768 input multicast streams coming input on GigE and output to QAM RF:

Figure 8-3 — RPC Status



Notes:

1. This window displays read-only data regarding current RPC status.

2. 32 rows are displayed at one time.

3. The Display Range setting selects which rows are shown, from 1 – 768.

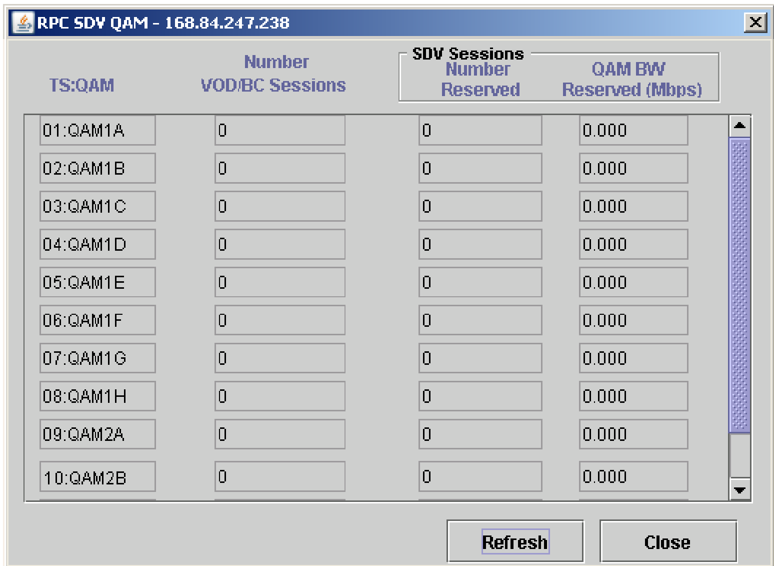
RPC Status window field definitions

Item	Definition
Index	Index of input transport streams. Range: 1 – 768
Input Interface	Specifies a GigE port (1 – 4) as the input interface.
Input UDP	Identifies the input UDP port for a service (UDP port opened to receive service).
Input Multicast IP	The Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Input Source	This is the IP address of the source device for multicast reception. *Note: The source IP address must be a valid singlecast address.*
In Use	Shows whether the Primary and/or Secondary interface are currently in use.
Input Program	Identifies the input MPEG program number for the transport stream (0 – 65535). This informs the APEX1000 to map the first service listed in the input PAT message to the specified output. *Note: Input Program No. 0 is used as a wild card program.*
Output Program	The Output Program Number (1 – 65535).
TS:QAM	Shows the Output Transport Stream number and Output QAM channel.
Bandwidth (Mbps)	Shows the Expected Program Bandwidth (Mbps). This is the bandwidth of the program as defined in the service mapping. A value of 0 indicates that the program BW is unknown.
Manager IP Address	Indicates the type of session (SDV or VOD/BC).
Session ID	Session IDs are stored as three 4-byte words.
Display Range	Displays a continuous section of the input transport streams. Range: 1 – 768

RPC QAM Status

This window displays the read-only status of each QAM output channel, the number of active sessions on the QAM channel, and the bandwidth reserved (if in *session controlled* mode).

Figure 8-4 — RPC QAM Status



RPC QAM Status window field definitions

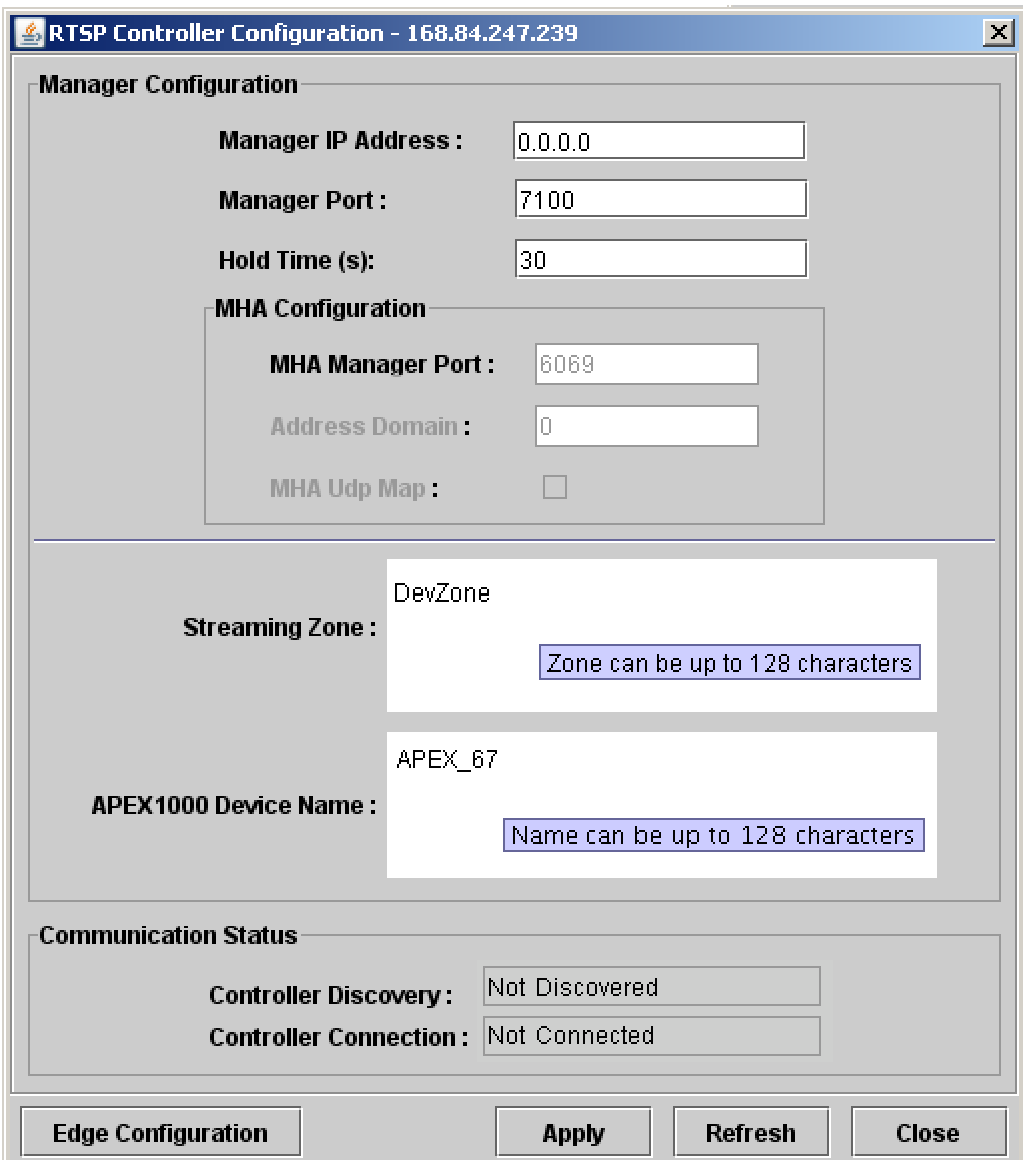
Item	Definition
TS:QAM	The Output Transport Stream number and Output QAM channel.
Number VOD/BC Sessions	The Number of VOD/Broadcast sessions on this QAM channel. This is the number of VOD/Broadcast sessions active on a QAM channel. *Given that VOD and Broadcast sessions are not required to be reserved for an output, this is the count of active VOD and Broadcast sessions on a specific QAM channel.*
Number Reserved	The Number of reserved SDV sessions on this QAM channel. • This is the number of SDV sessions that have been reserved by the manager. (Each SDV session requires that a manager reserve a QAM channel.) • This is the count of SDV sessions reserved (not the actual number of active SDV sessions).
QAM Reserved (Mbps)	The Group BW for SDV sessions (not used for VOD/Broadcast sessions). This is the total amount of BW allocated for all SDV sessions on a Port. • The total SDV BW for a port is defined by the session manager. • The manager reserves this BW for future SDV sessions. • This is not the BW of current active SDV sessions, but the total BW reserved by the manager for SDV sessions.

RTSP Controller Configuration

In RTSP and MHA mode, the APEX1000 operates in a SDV or VOD system which uses RTSP to set up sessions. The APEX needs to be configured with a Session Controller, GigE input groups, and QAM outputs. These settings are used to establish communication with the session controller and notify the controller about the APEX1000 interfaces.

Use this window to configure the communication with the RTSP Controller:

Figure 8-5 — RTSP Controller Configuration



RTSP Controller Configuration window field definitions

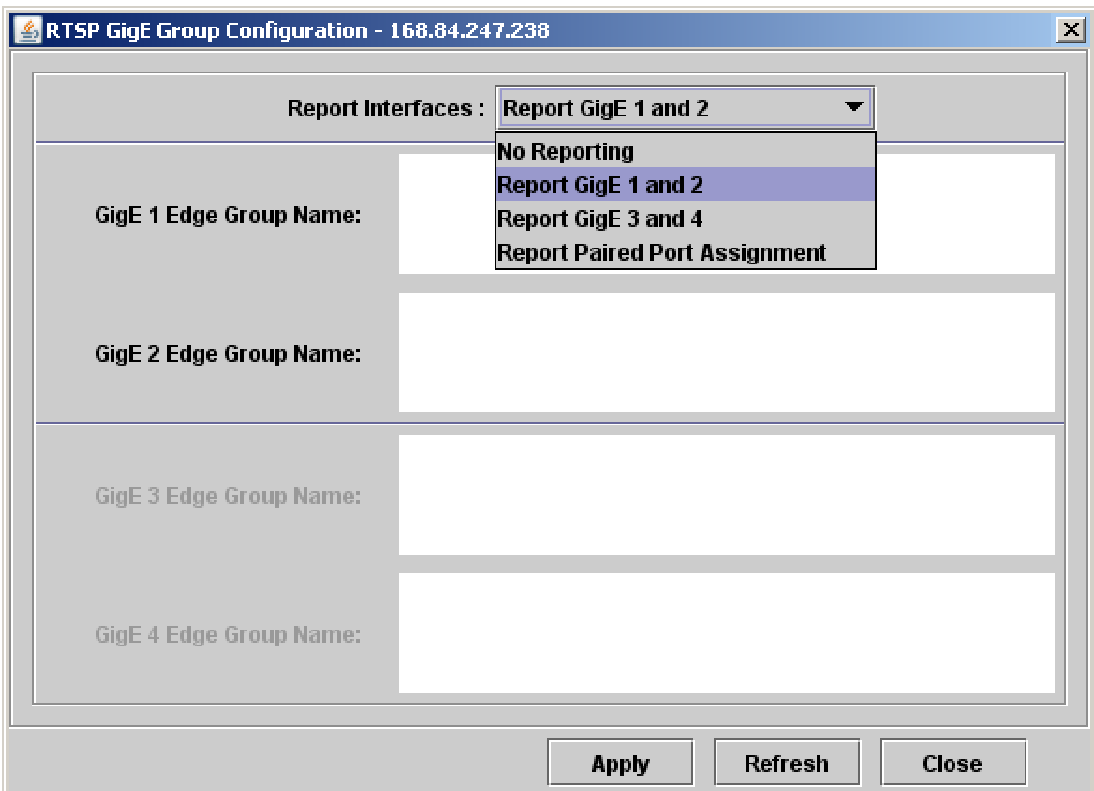
Item	Definition
Manager IP Address	IP address of the session manager.
Manager Port	Area reserved for entering the Manager Port number (RTSP SDV mode only). Range: 0 – 65535 The default value is 7100.
Hold Time (s)	This is the amount of time (in seconds) that the APEX1000 will wait for a *keepalive* message. If the timer expires, the connection to the manager is considered lost. The ERM and APEX1000 are both configured with a Hold Time. The lower of these two Hold Times is used, so the actual Hold Time may differ from what is configured on the APEX1000. Valid range: 0, 9 – 300 s The default value is 30 s.
MHA Manager Port	Area reserved for entering the MHA Manager Port number. (MHA mode only) Valid range: 1024 – 65535 The Default value is 6069.
Address Domain	Area reserved for entering the domain of the EQAM. The address domain must match between the APEX and the ERM. A value of 0 means the APEX will communicate with an ERM in any address domain. Range: 0 – 255 The default value is 0.
MHA UDP Map	Establishes whether the UDP map attribute reports all 0s (disabled), or the UDP ports associated with the QAM channel per the UDP port map algorithm (enabled). Range: Enabled, Disabled The default value is Disabled.
Streaming Zone	This is a user-configured parameter, up to 128 characters. This field generates the MPEG transport names, which are reported to the controller and shown in the RTSP QAM Configuration window – streaming zone. TSID (TSID – Transport Stream ID #). *Note: This field must match the value(s) configured in the controller.*
APEX Device Name	Area reserved for entering the Device Name.
Controller Discovery	Shows status of the APEX1000's knowledge of the Controller. Values are: • **Discovered** – Indicates that the Controller is known. • **Connection Lost** – Indicates that communication with the Controller was lost.

Item	Definition
Controller Connection	Shows the status of the APEX1000/Controller connection: Values are: • **Connected** – Indicates that the connection is established. • **Not Connected** – Indicates that the connection has not been established.
Edge Configuration	Provides links to the RTSP GigE Group and RTSP QAM configuration windows.

RTSP GigE Group Configuration

Use this window to configure RTSP GigE inputs:

Figure 8-6 — RTSP GigE Group Configuration



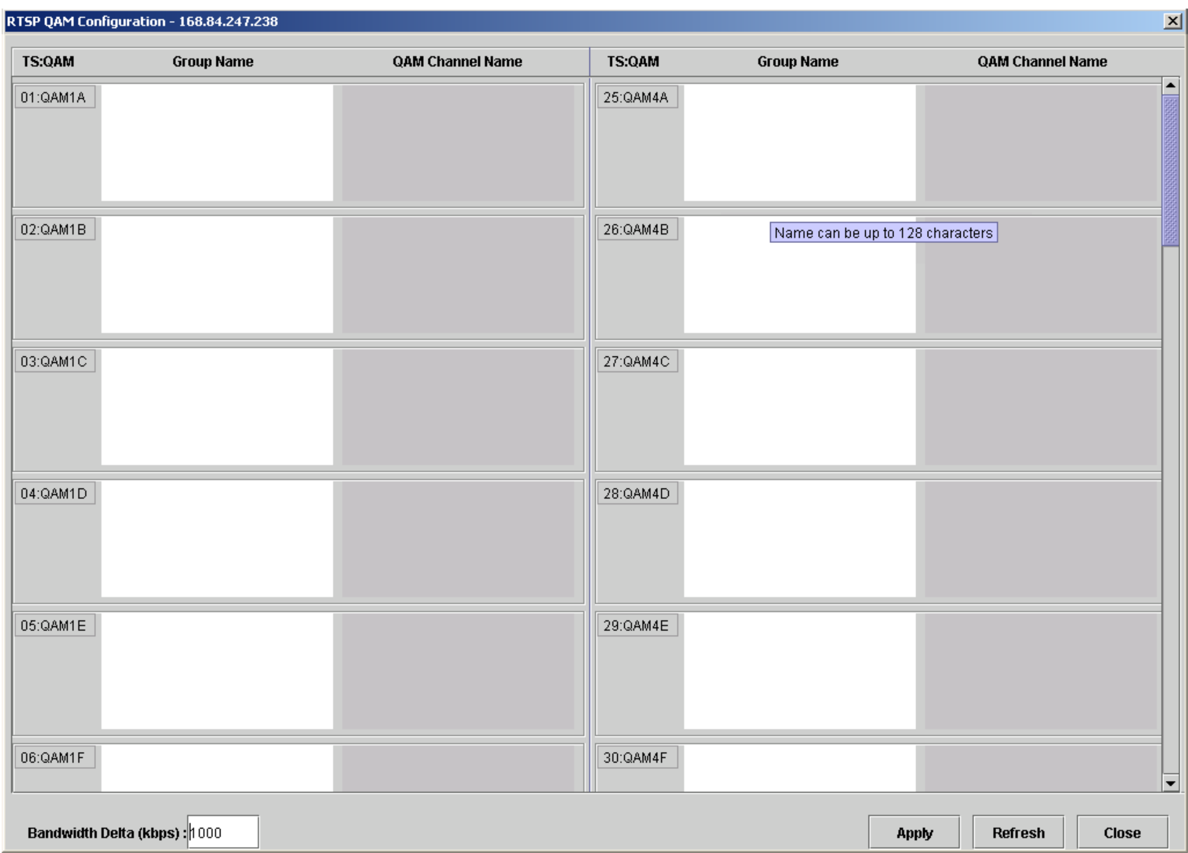
RTSP QAM Configuration window field definitions

Item	Definition
Report Interfaces	• **No Reporting** – Turns reporting capability On or Off. (Both text-entry windows are grayed-out.) • **Report GigE 1 and 2** – Toggles whether or not the (1 and 2) pair of GigE interfaces is reported to the controller. • **Report GigE 3 and 4** – Toggles whether or not the (3 and 4) pair of GigE interfaces is reported to the controller. (Currently, only one pair should be enabled.) • **Report Paired Port Assignment** – This setting allows reporting of all 4 GigE interfaces to the ERM.
GigE *n* Edge Group Name	Text String entry area for the selected GigE edge group name. This entry is reported to the ERM. For input redundancy, GigE 1 and 2 must have different names, and GigE 3 and 4 *must not* have the same name.

RTSP QAM Configuration

Use this window to configure RTSP QAM RF outputs:

Figure 8-7 — RTSP QAM Configuration



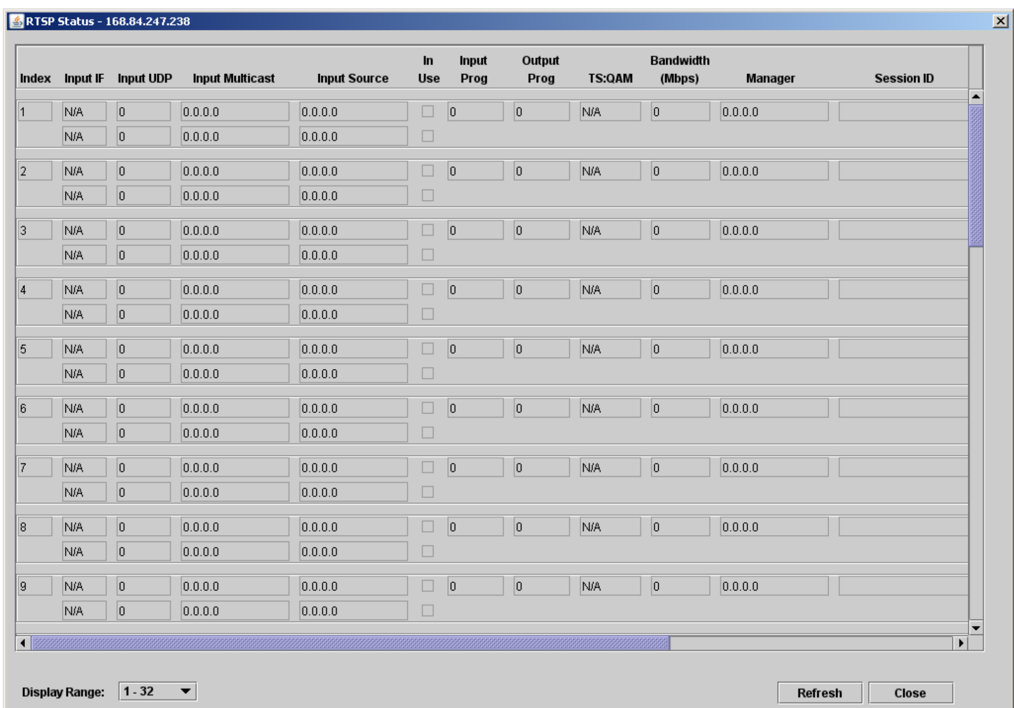
RTSP QAM Configuration window field definitions

Item	Definition
TS:QAM	This field shows the Output Transport Stream # and QAM #.
Group Name	Information that is reported to the ERM and useful for the operator to group QAMs together.
QAM Channel Name	This is automatically filled from the Streaming Zone and PAT TS ID. The QAM Channel Name must be in the following format: **`Streaming Zone.TSID`**
Bandwidth Delta (kbps)	The APEX1000 issues an *update* to the controller when its available bandwidth changes by a value exceeding this amount. The default value is 1000.

RTSP Status

This window shows the status of all RTSP connections on the APEX1000, as well as a map of the (up to) 768 input multicast streams coming in on GigE and going out to QAM RF:

Figure 8-8 — RTSP Status



Note: 32 rows display at one time. Use the Display Range setting to select the rows to display.

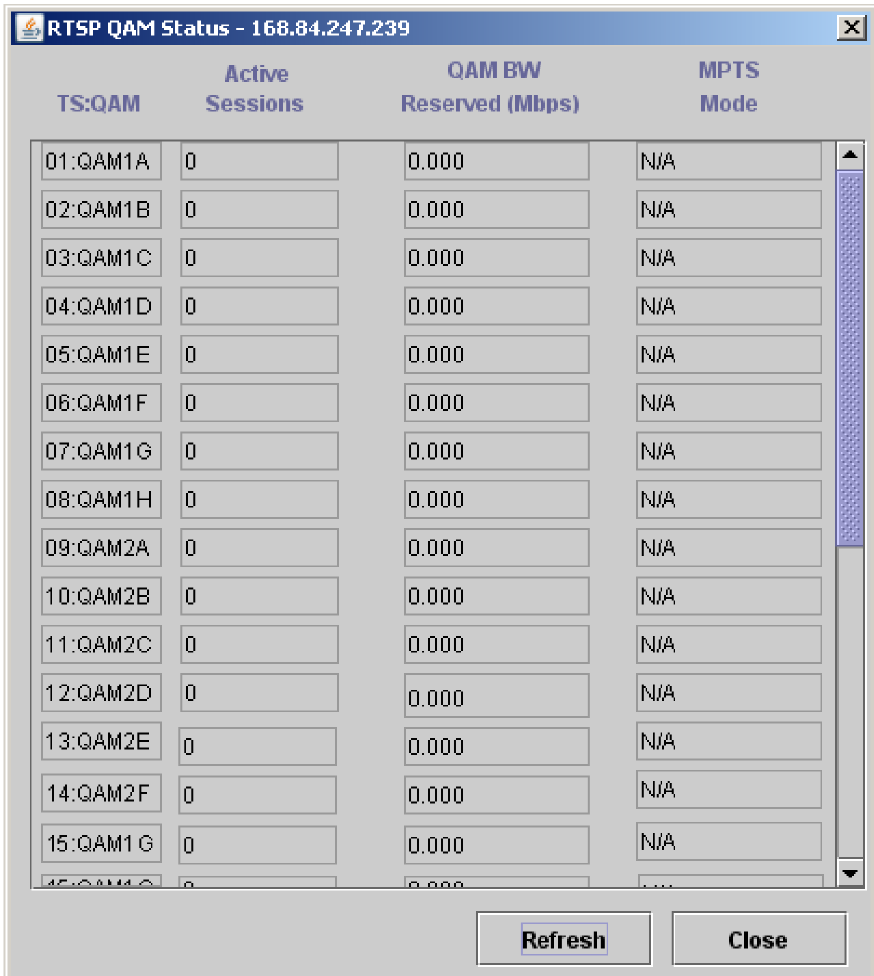
RTSP Status window field definitions

Item	Definition
Index	Displays the index of input transport streams. Range: 1 – 768
Input Interface	Specifies a GigE port (1 – 4) as the input interface.
Input UDP	Identifies the input UDP port for a service (UDP port opened to receive service).
Input Multicast IP	Displays the Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Input Source	This is the IP address of the source device for multicast reception. The source IP address must be a valid singlecast address.
In Use	Shows whether the Primary and/or Secondary are currently in use.
Input Program	Identifies the input MPEG program number for the transport stream (0 – 65535). Input Program No. 0 is used as a wild card program, and informs the APEX1000 to map the first service listed in the input PAT message to the specified output.
Output Program	The Output Program Number (1 – 65535).
TS:QAM	The Output Transport Stream number and Output QAM channel.
Bandwidth (Mbps)	The Expected Program Bandwidth (Mbps). This is the bandwidth of the program as defined in the service mapping. *Note: A value of 0 indicates that the program BW is unknown.*
Manager IP	Displays the IP address of the manager.
Session ID	Session ID established between the APEX1000 and the manager. Session IDs are stored as three 4-byte words.
Display Range	Displays a continuous section of the RTSP Status Table, 32 index units at a time. Range: 1 – 768

RTSP QAM Status

This window displays the status of each QAM output channel, the number of active sessions on the QAM channel, and the reserved bandwidth:

Figure 8-9 — RTSP QAM Status



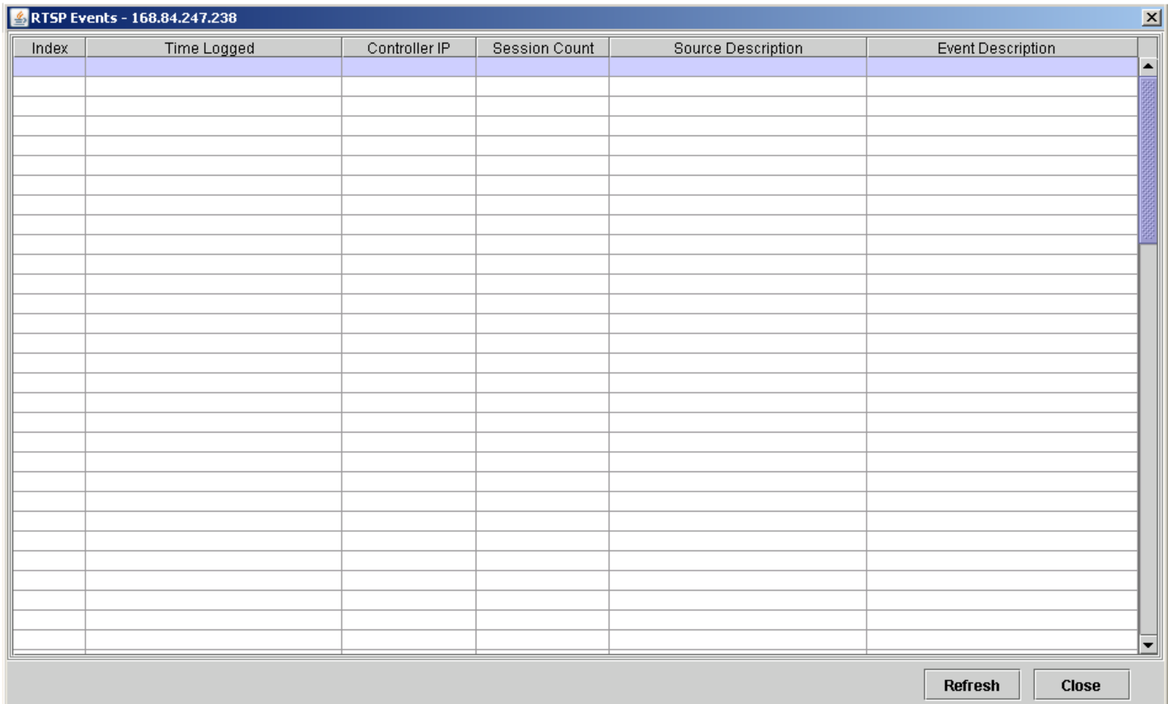
RTSP QAM Status window field definitions

Item	Definition
TS:QAM	The Output Transport Stream number and Output QAM channel.
Active Sessions	Number of active sessions on this QAM channel.
QAM Reserved	Bandwidth in Mbps reserved by the manager.
MPTS Mode	QAM channel processing mode (pass-through or multiplexing).

RTSP Events

This window shows the read-only status of QAM modules, controllers, and interfaces:

Figure 8-10 — RTSP Events



RTSP Events window field definitions

Item	Definition
Index	Shows an index for the event. *Note: A maximum of 100 events can be logged.*
Time Logged	Shows a timestamp of when the event occurred.
Controller IP	IP address of the controller which generated the event – external IP or 0.0.0.0 if the event was generated by an internal task.
Session Count	Number of sessions that were active at the time of the event.
Source Description	Identifier for the Source of the event (external controller or internal task).
Event Description	Text description of the event.

MHA Encryption Configuration

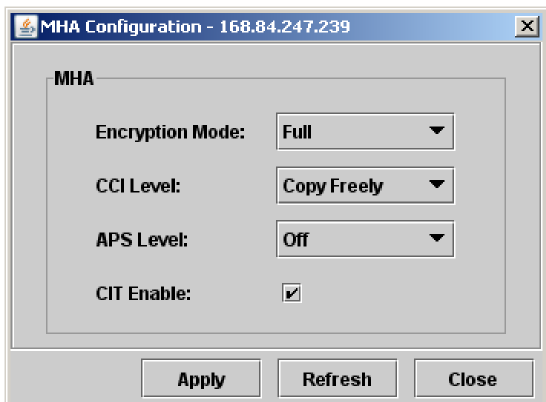
APEX1000 version 2.4.x offers support for Modular Headend Architecture.

The APEX1000 employs MHA mode to support session VOD encryption, where the encryption tier is unique for each client.

Notes:

- Because the encryption mode is not included in the session setup parameter, the APEX1000 must be configured with an encryption mode for dynamic VOD sessions.
- The APEX1000 must also be configured with default CCI, APS, and CIT settings to use, in the event that the session VOD encryption parameters for a session setup (from the ERM) are incomplete.

Figure 8-11 — MHA Configuration



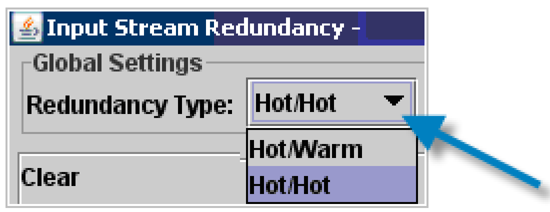
MHA Configuration window field definitions

Item	Definition
Encryption Mode	Shows the program encryption mode. Values are: • **Full** – The APEX attempts to use Full encryption. The APEX attempts to get Entitlement Management Messages from an EMM server, configured through the RDS tab. (Full encryption requires the APEX to have received valid EMMs from an RDS.) • **FWK** (Fixed Working Key) – The APEX uses Fixed Working Key encryption. • **FPK** (Fixed Program Key) – The APEX uses Fixed Program Key encryption.
CCI Level	Use to configure Copy Control Information levels. Values are: • **Not Defined** – Set-top box applications can configure the CCI Level. • **Copy Freely** – No restriction on program copying. • **Copy Once** – Program can be copied only once. • **Copy Never** – Program can never be copied. • **No More Copies** – Maximum number of copies has been reached.

Item	Definition
APS Level	Use to configure the Analog Protection System Level. Values are: • **Off** – No analog protection. • **Split Burst Off** – Split burst off.
CIT Enable	Enable/Disable the Constrained Image Trigger setting. The default is Disabled.

SDV TS Redundancy

Hot/Hot and Hot/Warm redundancy selections are the methods available for determining transport stream failover. Hot/Warm is typically expected to be used for SDV input streams. Both of these modes use the unicast and/or multicast timeout values to determine a loss of input stream (loss of input stream determines when a failover to the secondary occurs).



- **Hot/Hot** – a primary and secondary input stream are both opened at the same time. This means the APEX is receiving twice the amount of input data as it is processing (primary is received and processed, secondary is received, counted, then discarded). The APEX monitors both primary and secondary input streams, checking for a loss of input stream. The unicast and multicast timeout values are used for determining a loss of input stream. A failover occurs when the Primary input stream is determined to be missing but the secondary input stream is not missing. Once a failover to a secondary occurs, there is no mechanism to fallback to the primary.
- **Hot/Warm** –only 1 of the redundant input streams is opened at any one time. Either the primary or secondary input stream is received, but not both. This reduces the overall amount of input data the APEX is receiving. For this redundancy type, the APEX uses the unicast or multicast timeout values to determine when to failover. A failover occurs when the Primary input stream is determined to be missing for the unicast or multicast timeout period. Once a failover to a secondary occurs, there is no ability to fallback to the primary.

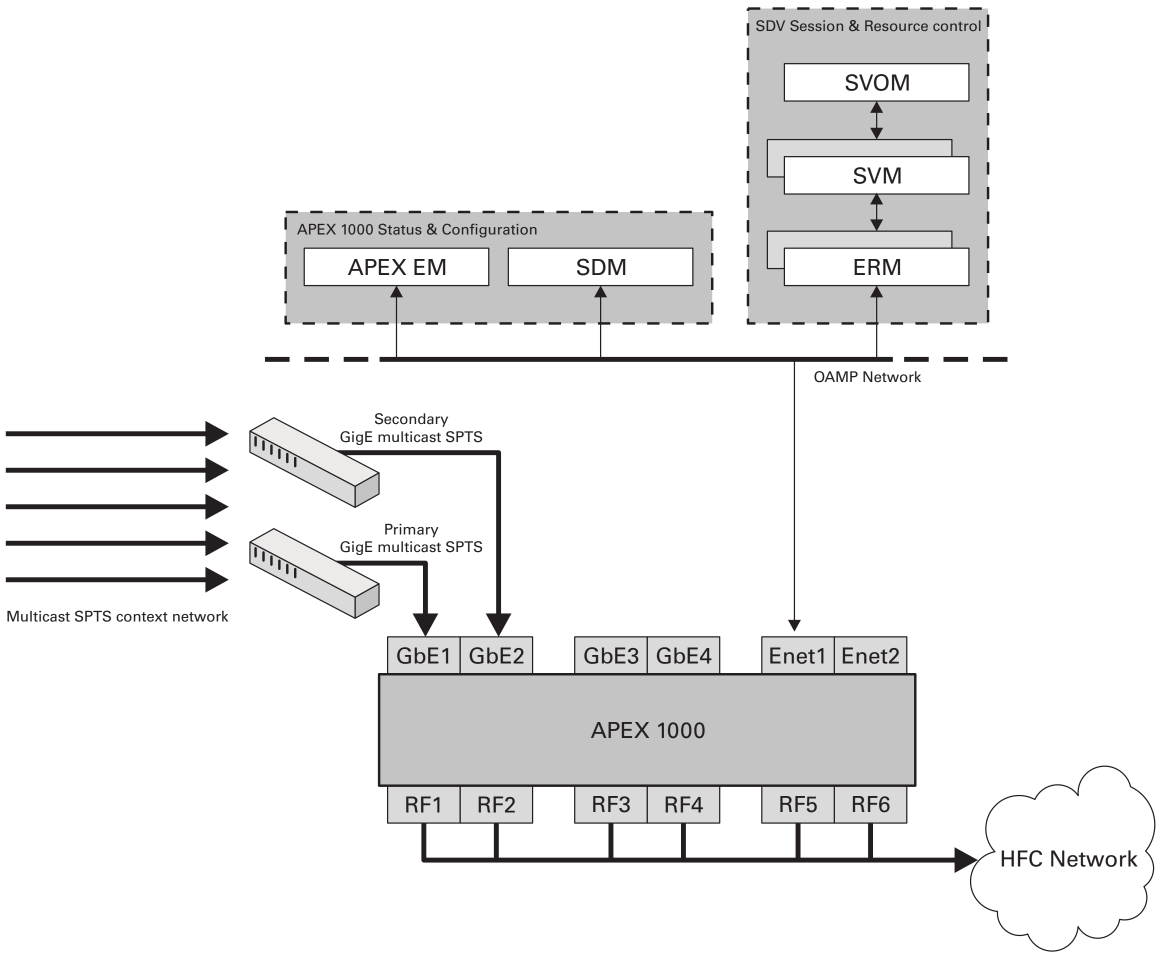
In both RTSP and MHA modes, the ERM is notified of all loss of input streams and notified of all failovers to the secondary input stream.

9 Configuring for Switched Digital Video

APEX1000 SDV Configuration

The figure below shows a typical SDV network configuration for the APEX1000, including devices which must be present for proper switched digital operation:

Figure 9-1 — APEX1000 Network Configuration



Minimum Requirements

At a minimum, an SDV network must include the following components:

- An OAMP network connected to the APEX1000 FastE input, providing access to:
  - The APEX1000 EM or SDM for configuration and status
  - The switched digital resource and session managers, SVM, ERM, SVOM for switched digital mode control
- A GigE source network, available through a router or switch
- An HFC network connected to the APEX1000 RF/QAM outputs

Step by Step Instructions

This section describes how to configure the APEX1000 for operation in a switched digital environment, and is intended to provide basic setup information for the APEX1000 for users familiar with Motorola products, such as the SEM and the NE1000.

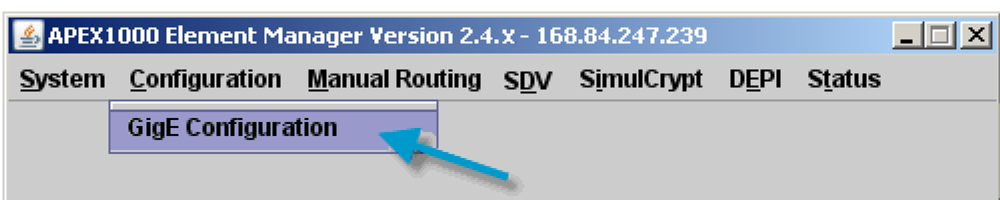
Common Switched Digital Configuration

The following configuration steps are necessary for a successful completion, regardless of session control (RPC, RTSP, or MHA) mode. If you are unfamiliar with these procedures, please see Setup and Operation for a more detailed description.

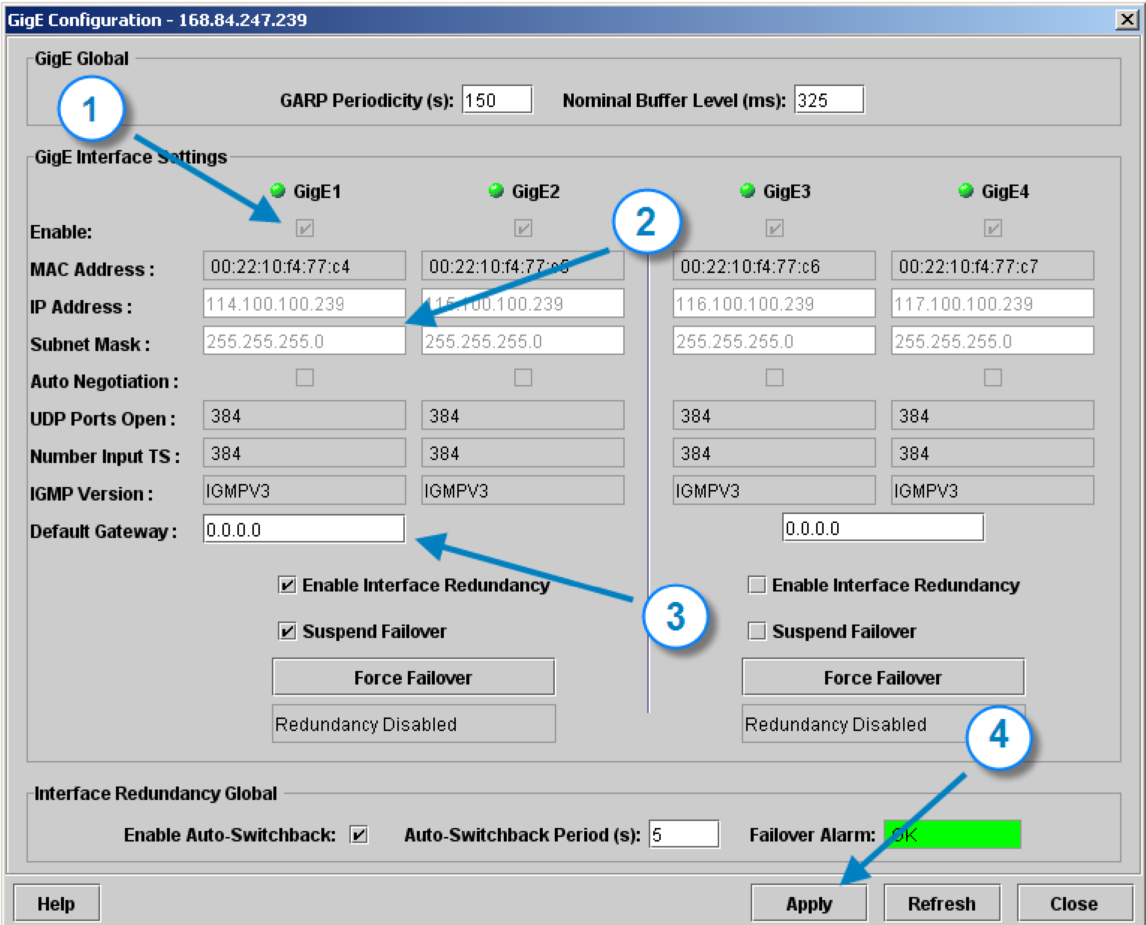
CAUTION *Before starting the procedure, you must boot the APEX1000 and download the APEX Element Manager (EM).*

Configuring GigE Modules

Before you attempt any other steps, configure the GigE input modules by selecting **Configuration > GigE Configuration**:



The GigE Configuration window displays:



To configure the GigE interface:

1. Enable the GigE ports to be used on the APEX1000.

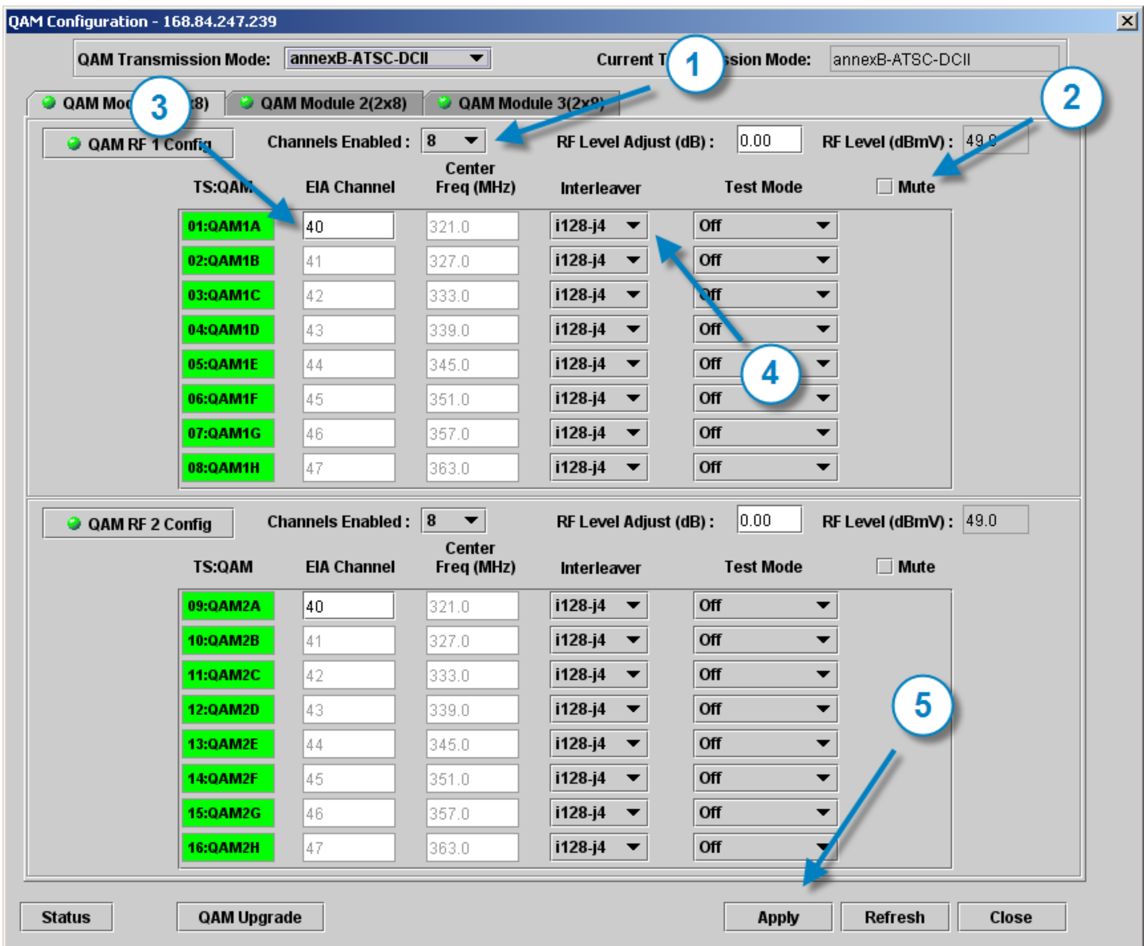
   Note: GigE1 and GigE2 are paired, and GigE3 and GigE4 are paired together.

2. Configure the IP address and the Subnet Mask for each enabled port.
3. Configure the Default Gateway for the enabled port pair.
4. Click **Apply** to incorporate these changes in the APEX1000.

Configuring QAM Modules

Next, to configure the QAM output modules, select **Configuration > QAM Configuration**:

The QAM Configuration window displays:



To configure the QAM/RF interface:

1. Select the number of channels to *enable* from the Channels Enabled drop-down menu.
2. Confirm that the QAMs are not muted by clearing the **Mute** checkbox.
3. Configure the EIA channel range for the QAM.

4. Configure the Interleaver depth for the QAM.

   Note: The values in steps 3 and 4 must match the values originally defined in the Session Controller.

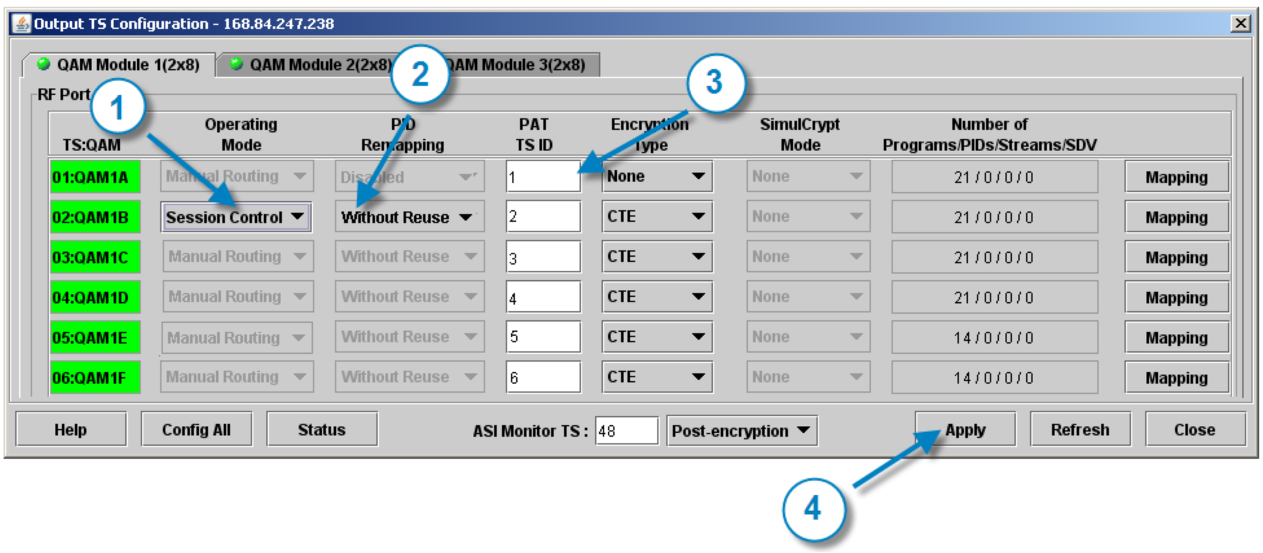
5. Click **Apply** to confirm the changes in the APEX1000.

Configuring QAMs for Session Control

If the APEX is to operate as a switched digital edge QAM, you must also configure the output QAM channels for *session controlled mode* (after the QAM module is successfully configured).

To configure QAMs for session control, select **Configuration > Output TS Configuration**.

The Output TS Configuration window displays:



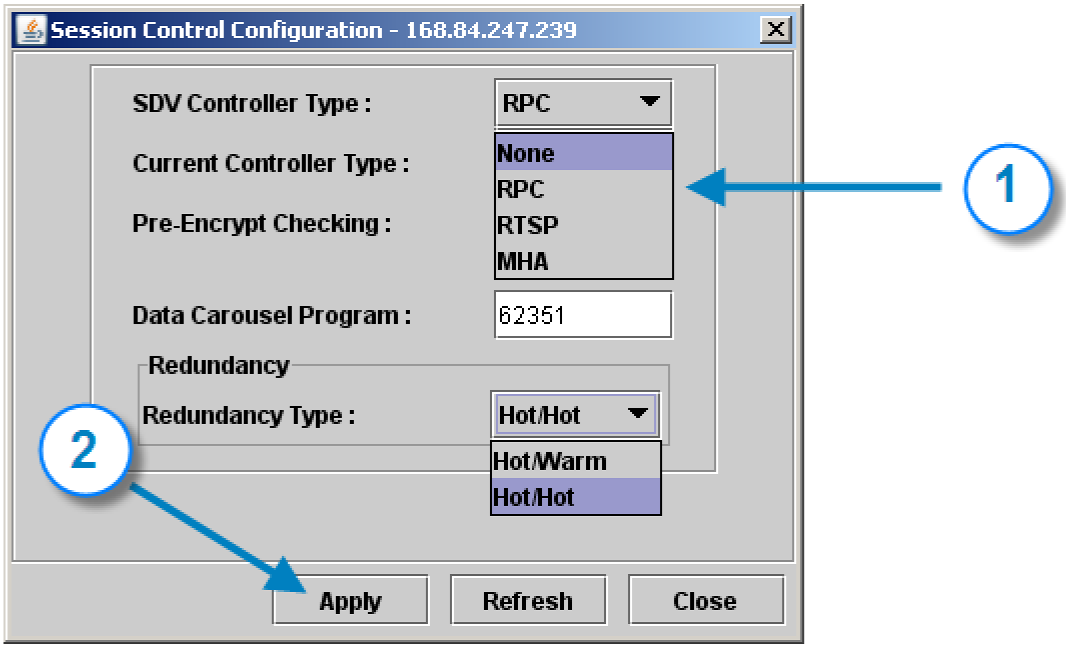
1. Select **Session Control** from the operating mode menu for each QAM.
2. Select **Without Reuse** from the PID Remapping menu for each Session Controlled QAM.
3. Configure the TSID for each QAM. This must match the value previously configured in the Session Controller.
4. Click **Apply** to apply these changes to the APEX1000.

*Note: You can also place all QAMs on an RF port in a specific mode by selecting **Config All** and selecting the appropriate operating mode.*

Configuring Switched Digital Mode

On this screen, you can configure the APEX1000 for a specific session control mode, by selecting **SDV > Session Control Config**.

You can also configure the Data Carousel PID in RPC Mode, and the Redundancy Type (Hot/Warm or Hot/Hot):



To configure the switched digital mode on the APEX1000:

1. Select the correct controller from the SDV Controller Type menu for your switched digital headend: *RPC, RTSP, or MHA*.
2. Click **Apply** to incorporate these changes in the APEX1000.

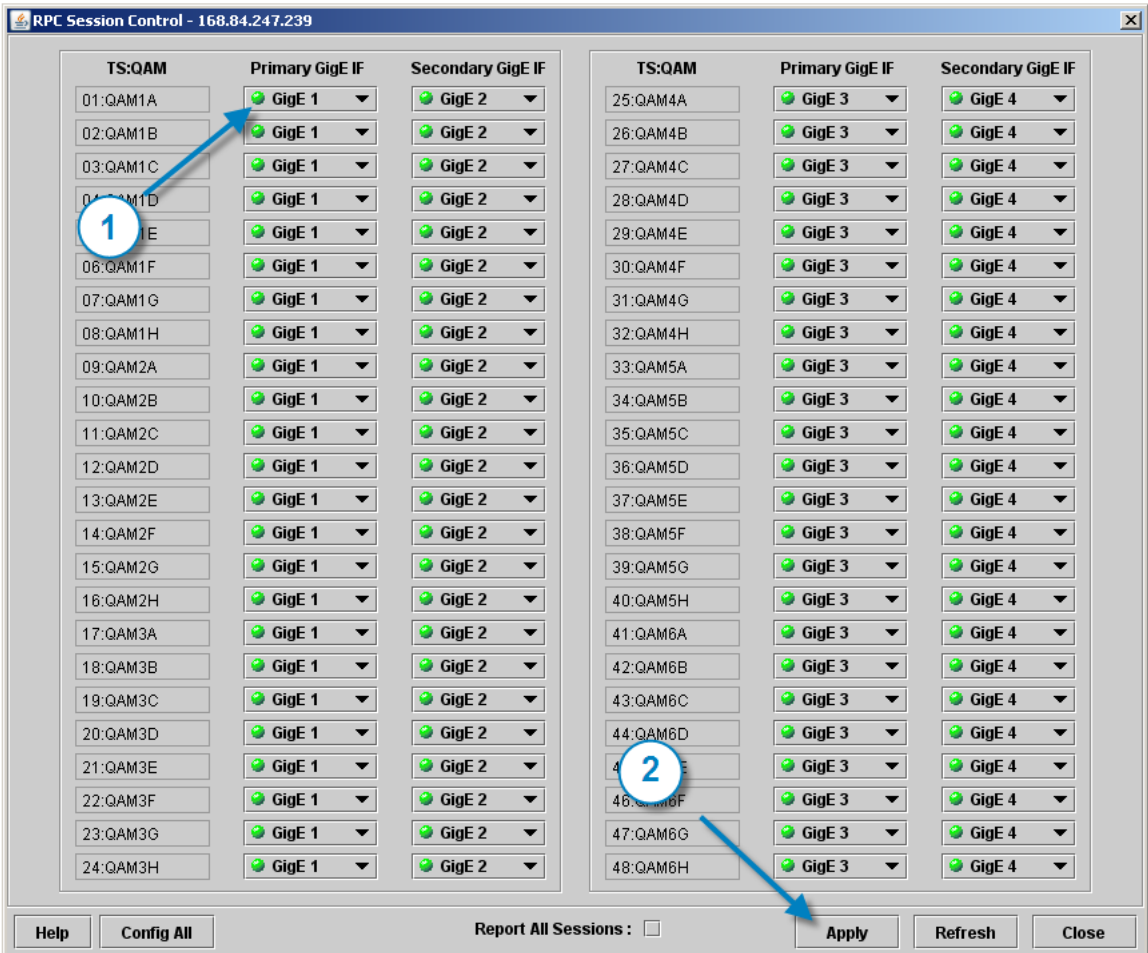
*Note: You must **reboot** after selecting the controller type.*

RPC Mode Specific Configuration

When the APEX1000 is configured for RPC SDV mode, only the input-output pairing must be configured through the EM. (This process assumes the RPC session controller is already configured *and* operating correctly.)

To configure session control mode specific settings, select **SDV > RPC Session Control**.

The RPC Session Control window displays:



To configure an RPC Session:

1. Select a Primary and a Secondary GigE interface for each QAM.

   Note: Primary and Secondary interfaces for a transport stream must be either GigE1 and GigE2 ***or*** *GigE3 and GigE4.)*

2. Click **Apply** to validate these settings in the APEX1000.

Confirming RPC Configuration

You can use the following screens to verify RPC operation on the APEX1000:

- **SDV > RPC Status** — Provides route information, including source IP, UDP port, program numbers, and bandwidth used.

  For more information, reference RPC Status.

- **SDV > RPC QAM Status** — Provides status on each QAM, including the number of active sessions and the bandwidth allocated to them.

  For more information, reference RPC QAM Status.

RTSP/MHA Mode-Specific Configuration

These parameters establish communication with the controller and inform the controller of the APEX1000 interfaces. To configure an RTSP or MHA session, you must first configure the APEX1000 with GigE input information and QAM output information. (The RTSP controller interface is configured last.)

CAUTION *This process assumes that the RTSP controller is already configured and operating correctly.*

Configuring GigE Input Groups

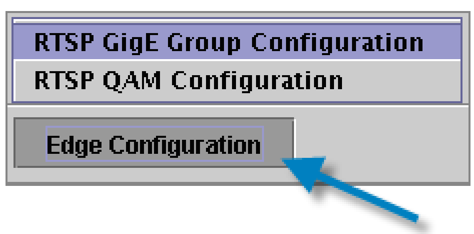
Use the RTSP GigE Group Configuration window to configure the GigE inputs which are reported to the session controller.

To open this window:

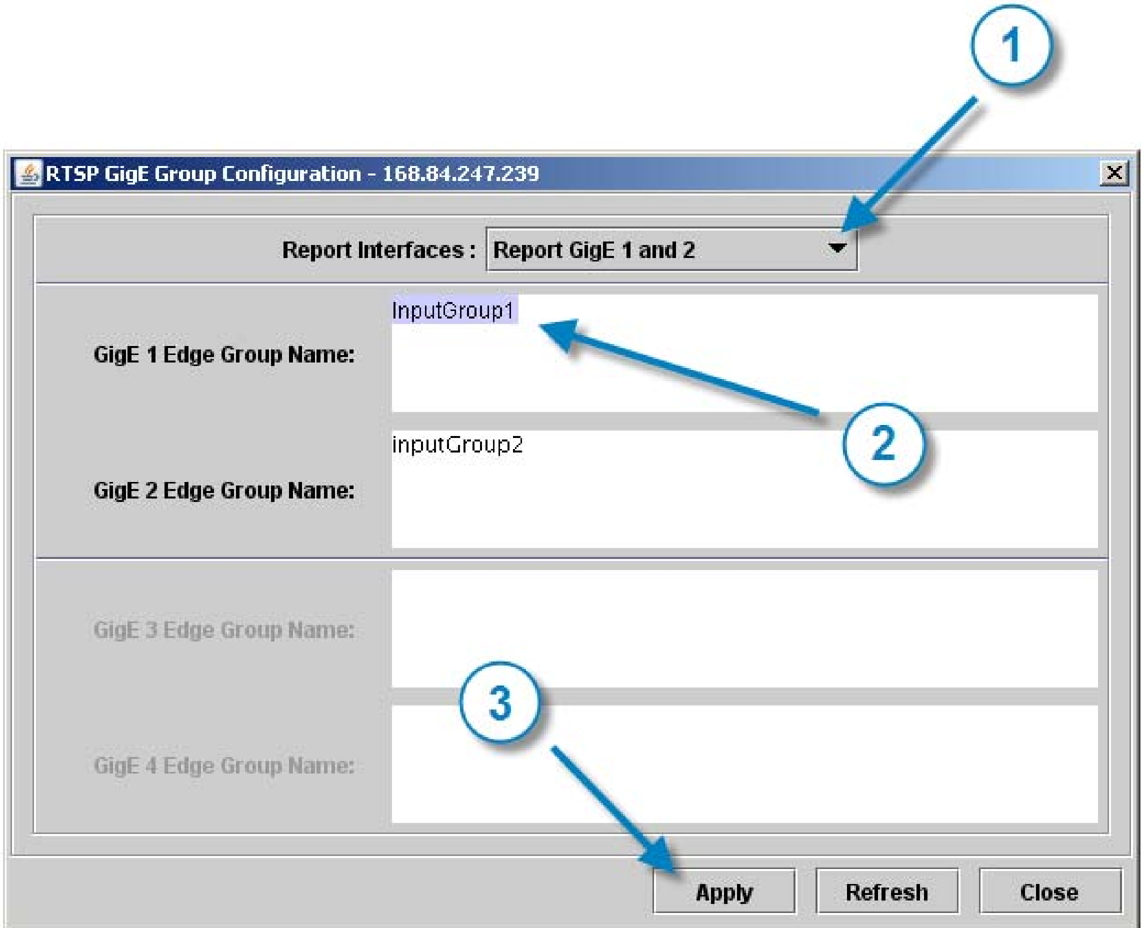
1. Select **SDV > RTSP GigE Group Configuration** from the top menu

   or

2. Click **Edge Configuration** on the RTSP Controller Configuration window and select RTSP GigE Group Configuration:



The RTSP GigE Group Configuration window displays:



To configure the RTSP GigE interface:

1. Select which pair of GigE inputs to enable.
2. Configure the GigE Edge Group Name by entering the name of the input group this Edge device belongs to.

   Note: Edge Group names must be unique within a GigE interface pair. Groups 1 and 2 should not be the same.

3. Click **Apply** to implement these changes in the APEX1000.

   The configuration changes are reported to the session controller.

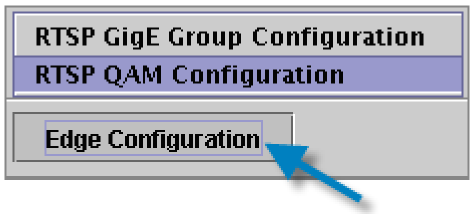
Configuring QAM Outputs

You must also use the RTSP QAM Configuration window to configure the APEX1000 QAM outputs:

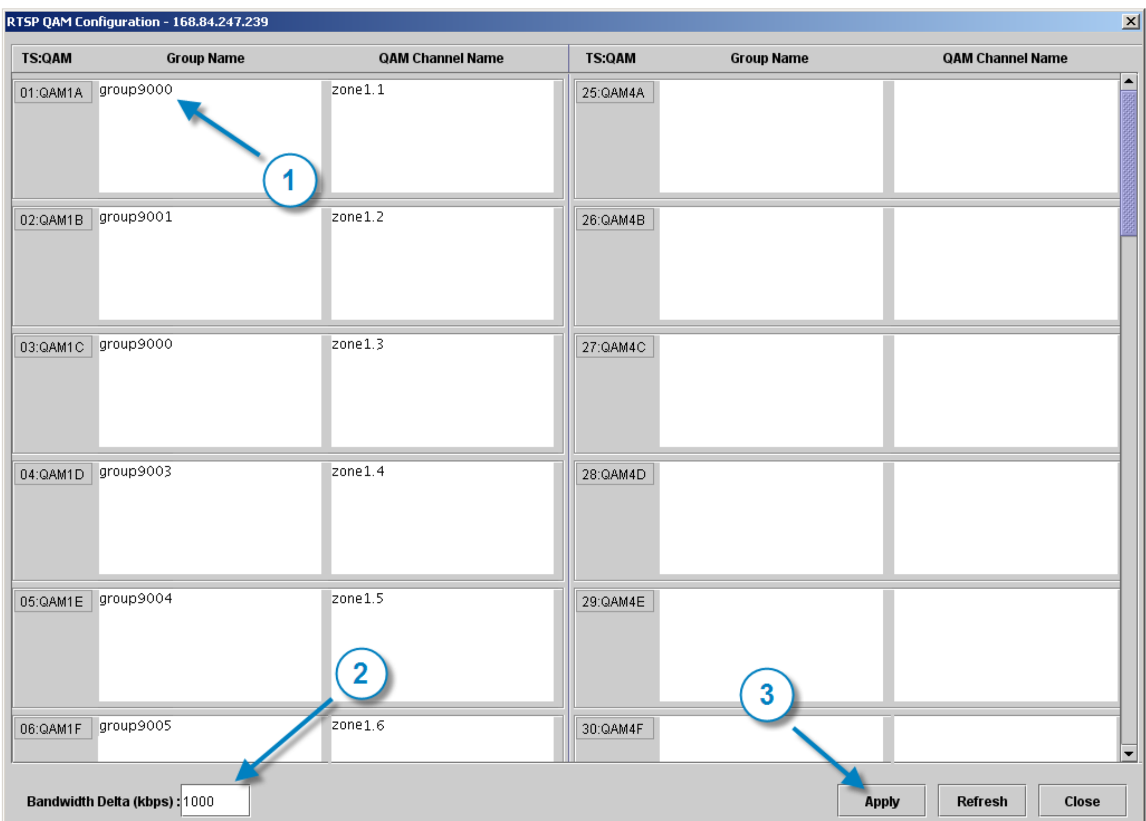
1. Select **SDV > RTSP QAM Config**

   or

2. Click the **Edge Configuration** button on the RTSP Controller Configuration window, and then select RTSP QAM Configuration:



The RTSP QAM Configuration window displays:



To configure RTSP QAM Channels:

1. Enter the QAM group name for each session-controlled QAM. The channel name for each QAM is automatically generated from the Output TS configuration screen and the controller configuration screen, and takes the form **<Streaming Zone>.<TSID>**.
2. Configure the Bandwidth Delta. An available bandwidth VREP message is sent by the APEX if the average bandwidth changes by more than this amount.

   Note: Motorola recommends keeping this parameter at the default value of 1000 kbps.

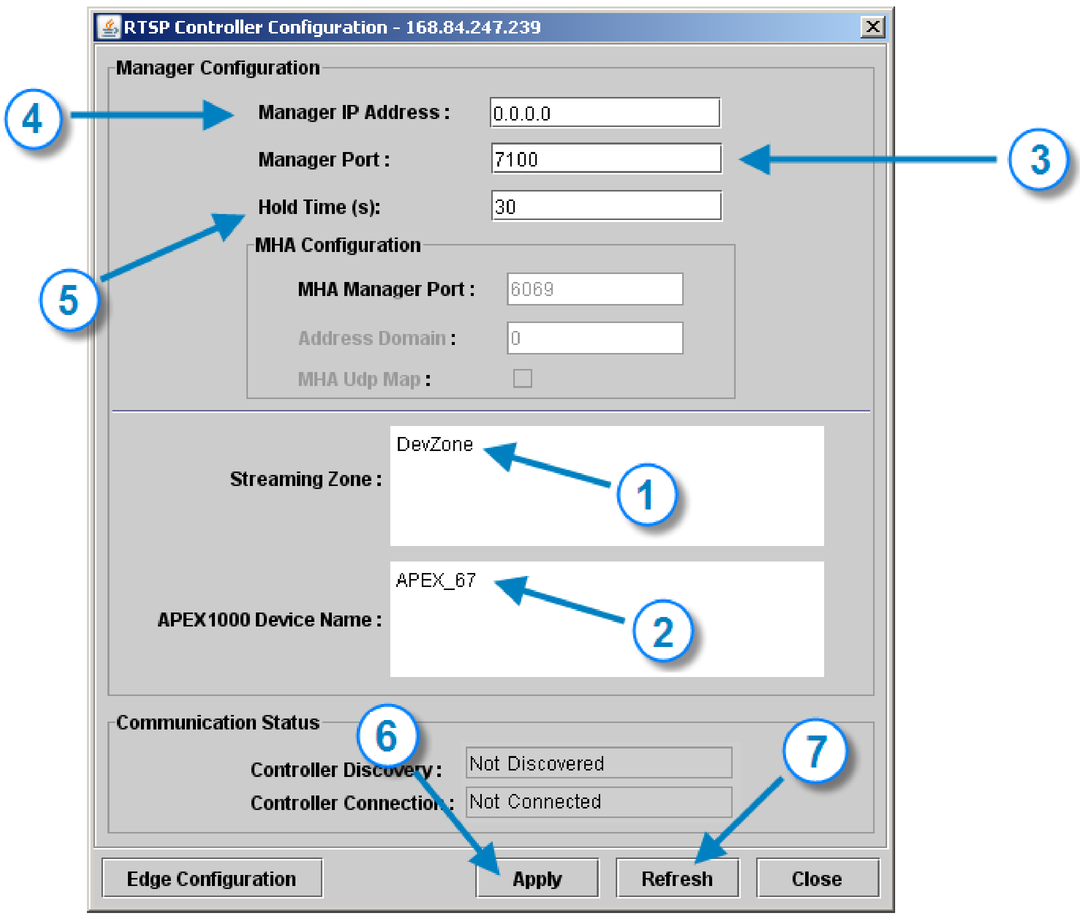
3. Click **Apply** to apply these changes to the APEX1000. The configuration changes are reported to the session controller.

Configuring the RTSP Controller

Use the RTSP Controller Configuration window to configure which parameters the APEX uses for communicating with the RTSP controller.

Select **SDV > RTSP Controller Configuration**.

The RTSP Controller Configuration window displays:



To configure the RTSP controller interface:

1. Configure the Streaming Zone.

   Note: This value must match the value previously configured in the Session Controller.

2. Configure the APEX Device Name.
3. Configure the Manager Port with the TCP Port on which the communication with the controller will occur (if not using the default TCP Port – 7100). (If in MHA mode, configure the MHA manager port and address domain.)
4. Configure the Manager IP Address with the IP address of the session controller.
5. Configure the Hold Time. This is the amount of time (in seconds) that the APEX waits for communication from the session controller before considering the connection as having been dropped.

   Note: Motorola recommends setting the Hold Time to 30 s.

6. Click **Apply** to apply these changes to the APEX1000. (A VREP session will be established with the controller.)
7. Click **Refresh** to update the Communication Status, and confirm that the controller is both *Discovered* and *Connected*.

Confirming RTSP Configuration

Use the following windows to verify RTSP operation on the APEX1000:

- **SDV > RTSP Controller Configuration** — Provides controller discovery information.

  For more information, see RTSP Controller Configuration.

- **SDV > RTSP Status** — Provides route information, including source IP, UDP port, program numbers, and bandwidth used.

  For more information, see RTSP Status.

- **SDV > RTSP QAM Status** — Provides status on each QAM, including the number of active sessions and the bandwidth allocated to them.

  For more information, see RTSP QAM Status.

10

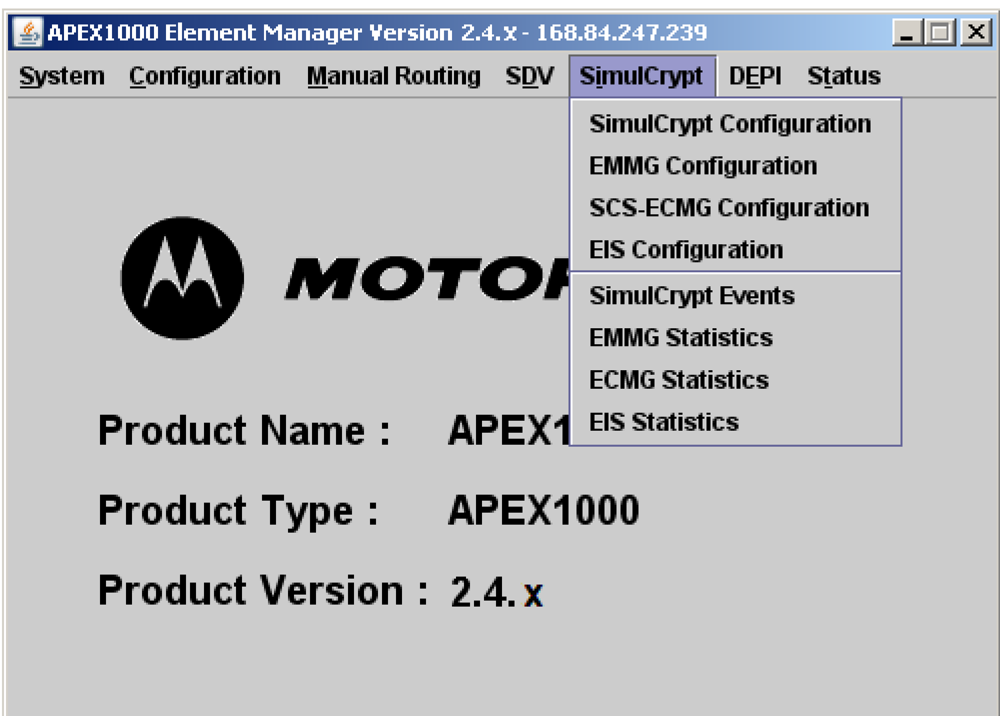
SimulCrypt

Overview

To allow integration with third party CA providers, the APEX1000 supports DVB SimulCrypt. SimulCrypt is a Digital Video Broadcasting (DVB) standard that defines specific interfaces to support interoperation between two or more conditional access systems at a digital video head-end or satellite uplink, and purposed to protect a service (or range of services) sharing a common scrambling code.

Note: Before SimulCrypt can become functional in the APEX1000, you must configure settings such as EMMG and SCS-EMCG. Also, to enable all of the screens, the scrambling algorithm must be configured as "DVB-CSA-SimulCrypt."

To display the configuration items drop down list, click **SimulCrypt Configuration**:



The SimulCrypt Configuration window sets described in the following sections are:

- SimulCrypt Configuration
- EMMG Configuration
- SCS-ECMG Configuration
- EIS Configuration

The following read-only screens are also detailed:

  - SimulCrypt Events
  - EMMG Statistics
  - ECMG Statistics
  - EIS Statistics

SimulCrypt Functions

The APEX1000 offers the following SimulCrypt functions:

- A CWG, generating random control words to be used as the basic for scrambling, and to produce entitlement messages from different conditional access providers
- An SCS interface between the head-end and different conditional access providers, to control the generation of ECMs and manage the scrambling of each SCG
- A MUX function, to insert entitlement messages from each different conditional access system into the Transport Stream flow
- A PSIG function, to modify or generate Program Specific Information for each Transport Stream
- A scrambling function that makes possible the encryption of group services with a common control word

SimulCrypt Interfaces

The APEX1000 supports the following SimulCrypt protocols:

Interface	Protocol Version	Description
ECMG ⇔ SCS	V2, V3	CW and ECM transfer between SCS and ECMG. Shortening of CP is not supported.
EMMG ⇔ MUX	V2, V3	Transfer of third party EMMs for insertion into multiplex.
EIS ⇔ SCS	V3, V4	Transfer of scrambling, scheduling and access criteria between EIS and SCS.

SimulCrypt General Overview

The APEX1000 allows a scheduling entity (EIS) to define scrambling control groups, which define a set of services that require scrambling with a common key to be shared by a set of conditional access systems. The APEX1000 then initiates the scrambling of services requested at the specific activation time indicated by the EIS, using the standard DVB-CSA scrambling algorithm, and based on a scrambling key that changes at a configurable rate.

Note: The value for the Crypto Period depends on several factors, such as your configuration, and the processing capabilities of different entities within the SimulCrypt network.

Prior to initiating the scrambling, the APEX1000 provides the common scrambling key to each of the ECMG entities configured for each conditional access system belonging to the scrambling group. Each ECMG then generates and sends back an ECM or entitlement control message to the APEX1000 (the APEX1000 requests a new ECM every crypto period to each ECMG).

The APEX1000 will play out a modulated MPEG stream including the scrambled services as well as the ECM information received from each conditional access system. Playing of the ECMs is performed following the timing restrictions (delay-start, delay_stop, etc.) as defined by each ECMG and negotiated at the initial communication.

The APEX1000 will also accept incoming data streams from EMMG entities from each conditional access systems, carrying EMMs or entitlement management messages, and will also insert this data into the output transport stream.

SimulCrypt Redundancy Support

For each Active ECMG channel configured in the APEX1000, it is possible to configure a Backup ECMG channel (the Backup ECMG channel needs to be linked to the same CAS). In the event of a failure situation with the active ECMG channel, the APEX1000 will failover all the active ECM streams that were setup on the failing ECMG channel to the (properly configured) corresponding Backup channel.

Note: You can configure one ECMG channel as a backup for several ECMG Active channels.

After a failover of all streams from one Active ECMG channel to the configured Backup ECMG channel (if the original ECMG channel happens to recover from the failure situation), when the TCP connection and channel are re-established, the APEX1000 performs a failback operation, moving the streams back to the original ECMG.

If there is an Active ECMG channel failure and there is not a Backup ECMG channel configured. or if the Backup ECMG channel also fails (even if there are other available ECMG channels for the same CAS). then an outage to retrieve ECMs for the services that were covered by such ECMG channel occurs, and subscriber impact would depend on the Crypto Period Extension configuration.

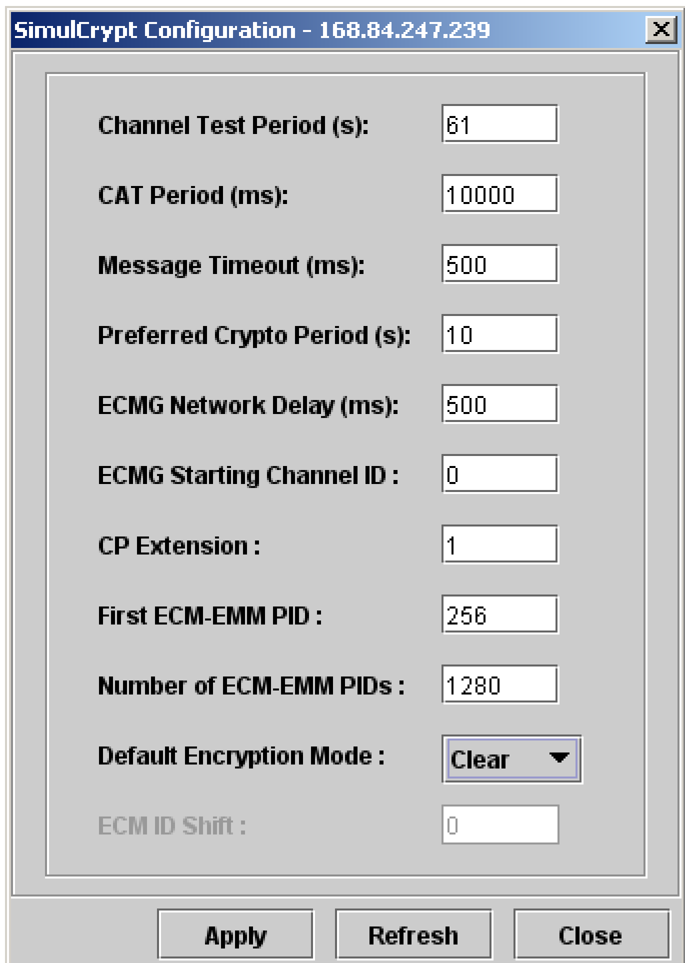
The common scrambling code does not change for as many crypto periods as it is configured, giving additional time for the failing ECMG to recover. Upon expiration of the configured Crypto Period Extension, the common scrambling code *will* change, and for this reason, no ECMs will be played out from the failing ECMG. This process renders decoders belonging to the affected conditional access system unable to descramble the service.

SimulCrypt Configuration

Use this window to configure general information governing the communication with different entities within the network related with SimulCrypt functionality.

For access, select **SimulCrypt > SimulCrypt Configuration**:

Figure 10-1 — SimulCrypt Configuration



SCS Overview

SCS functionality is the main component within the SimulCrypt architecture; its tasks consist of:

- Controlling the generation of ECMs from different CAS vendors
- Providing the information that each CAS requires to generate its own ECM
- Managing the play out of the entitlement messages at the appropriate time as requested by each CAS to be inserted into the Transport Stream

SCS functionality interfaces with EIS to receive the requests to start/stop scrambling for each scrambling group (typically a service or a set of services) and with CWG, ECMGs, MUX, and SCR to manage the synchronization between control words and entitlement messages.

SimulCrypt Configuration field definitions

Item	Definition/Range
Channel Test Period (s)	Determines the periodicity to check communication between APEX and other SimulCrypt entities. This parameter is common for all SimulCrypt interfaces. Range: 0 – 3600 (seconds) *Note: 0 means never (no channel testing procedure was performed).*
CAT Period (ms)	Indicates the periodicity to insert the CAT table in output transport streams. Range: 20 – 30000 (milliseconds)
Message Timeout (ms)	Indicates the time to wait for the response to SimulCrypt related control messages. This parameter is common for all SimulCrypt interfaces. Range: 100 – 60000 (milliseconds) *Note: This parameter must be lower than the value set for the channel test period.*
Preferred Crypto Period (s)	Shows the preferred length of crypto periods. Range: 1 – 3600 (milliseconds)
ECMG Network Delay (ms)	Indicates the additional time to account for network delays before timing out while waiting for an ECM response. Range: 10 – 30000 (milliseconds)
ECMG Starting Channel ID	This is the initial number to be assigned for identification of the connection with ECMG entities (ECMG channel identifier). This parameter is used to guarantee that channel connections from different APEX-SCS to the same ECMG entity use a unique identifier within the headend. Range: 0 – 20000

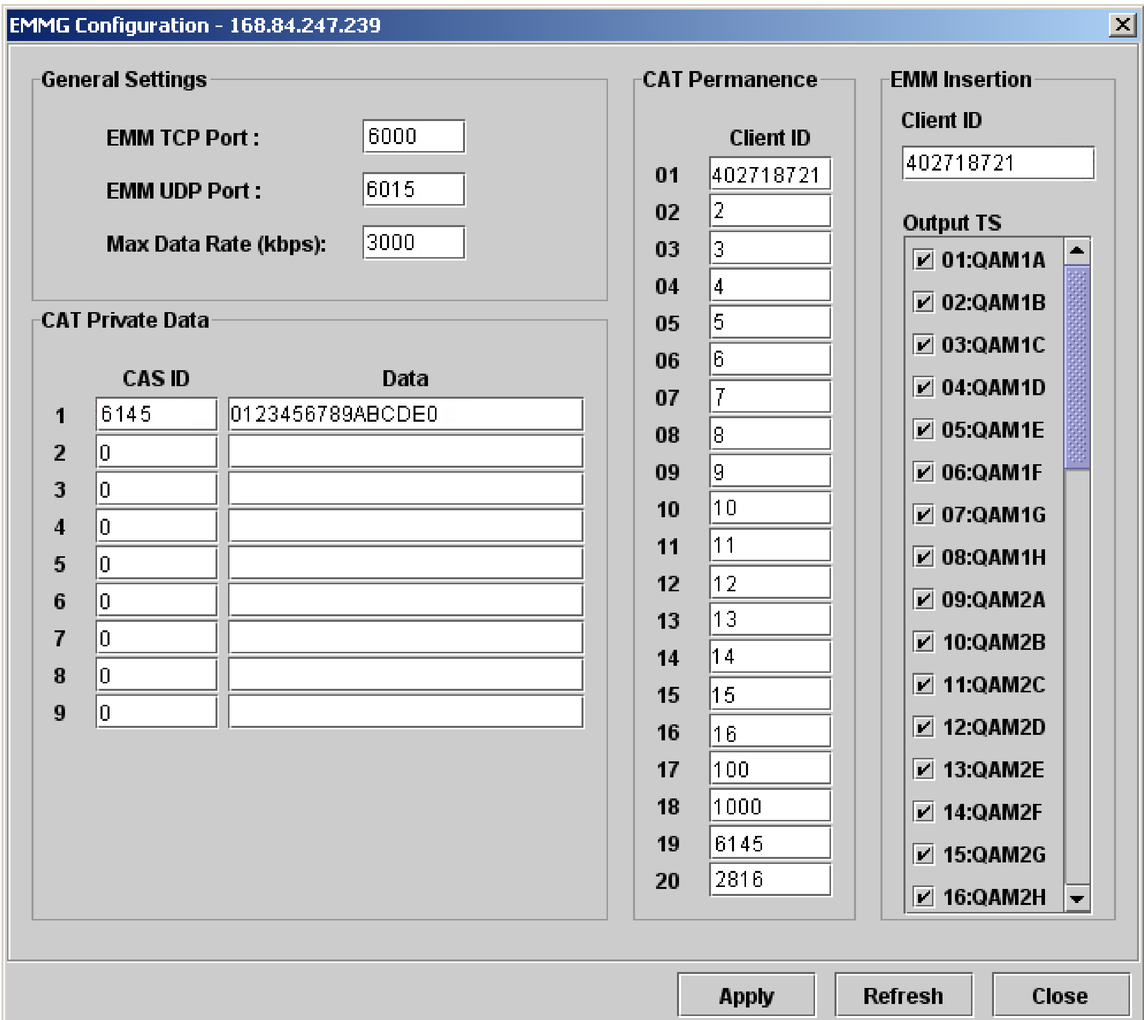
Item	Definition/Range
CP Extension	Specifies the maximum interval to wait for a failing ECMG before changing the scrambling key. Range: 0 – 1000 *Note: 0 means an infinite extension upon ECMG failure.*
First ECM-EMM PID	Defines the preferred range to be used for PID allocation when PID remapping is disabled. Range: 2 – 7590
Number of ECM-EMM PIDs	Defines the preferred range to be used for PID allocation when PID remapping is disabled. Range: 600 – 8189
Default Encryption Mode	Defines whether routed services must be encrypted (when received) before encryption is scheduled by EIS. Range: Clear or Encrypt
ECM ID Shift	This parameter is used to guarantee that ECM stream identifiers from active and redundant devices do not coincide, so that the ECMG does not reject ECM streams indicating that the ecm_id is already in use. If the ECMG does not care about the value of ecm_id in different ECM streams, then this parameter can be left to the (by-default) value of 0, so that no ecm_id shifting is performed for ECM streams created by the secondary APEX device. Range: 0 – 20000

EMMG Configuration

Use this window to configure specific parameters and define behavior when communicating with EMMG entities to receive EMM data from different Conditional Access Systems for SimulCrypt.

To access this feature, select **SimulCrypt > EMMG Configuration**:

Figure 10-2 — EMMG Configuration



EMMG Configuration screen field definitions

Item	Definition/Range	
General Settings	**EMM TCP Port**	Specifies the local TCP server port to receive incoming control messages and EMM streams (when TCP provisioning mechanism is used) from EMMG entities.
	EMM UDP Port	Specifies the local UDP port to receive EMM streams (when using the UDP provisioning mechanism) from EMMG entities.
	Max Data Rate (kbps)	Defines the maximum data rate expected per EMM stream. Range: 0 – 3000 (Kbps) This parameter also indicates the aggregated maximum for all incoming EMM streams. *Caution: To prevent overloading the device processing capabilities, you must configure it according to SimulCrypt configuration guidelines.*
CAT Permanence	**Client ID**	Indicates that the CA_descriptor for a specific EMMG entity (defined by the client identifier, including the concatenation of CAS system and subsystem) must still be played out–even if the connectivity with the client is discontinued. *Note: Only those clients included in the list keep the CA_descriptor in the CAT.*
CAT Private Data	**CAS ID**	Defines if private data is required in the CAT for an specific Conditional Access System. Only those conditional access systems included in the list include private_data within the CA_descriptor in the CAT.
	Data	Hexadecimal string (up to 20 values) to be inserted in the CAT as private data for a specific Conditional Access System.
EMM Insertion	**Client ID**	Defines what output transport streams must play out EMM messages for a specific EMMG entity (defined by the client identifier in decimal notation, including the concatenation of CAS system and subsystem). • Only one EMMG entity can be defined to exercise this functionality. • EMM messages from the specified EMMG entity will only be played out in transport streams that are checked. • EMM messages from for all the other EMMG entities will be played out in all output transport streams.

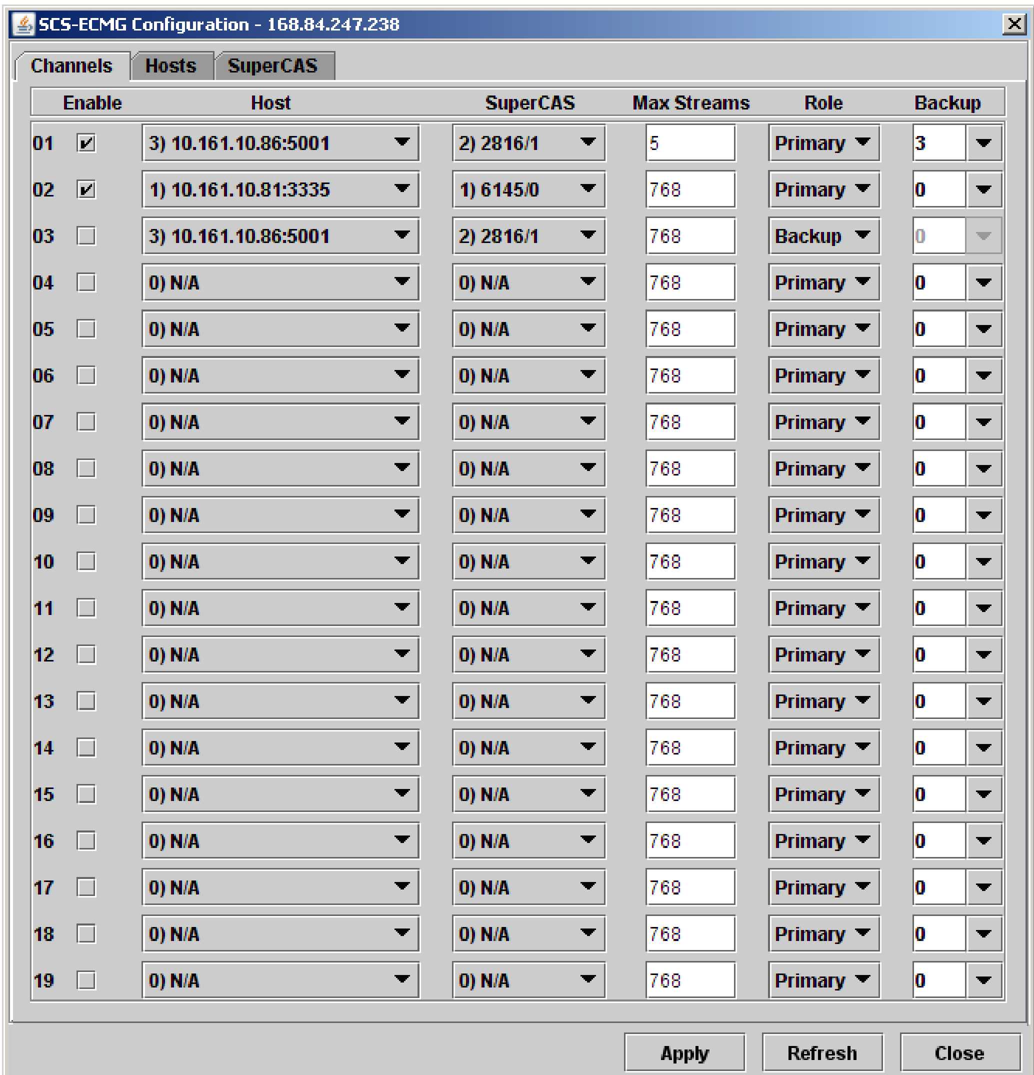
SCS-ECMG Configuration

When communicating with ECMG entities to receive ECM information from different Conditional Access Systems for SimulCrypt, use this window to configure specific parameters and define behavior.

For access, select **SimulCrypt > SCS-ECMG Configuration**.

The SCS-ECMG Configuration screen displays in the default *Channels* tab:

Figure 10-3 — SCS-ECMG Configuration — Channels



SCS-ECMG Configuration Channels

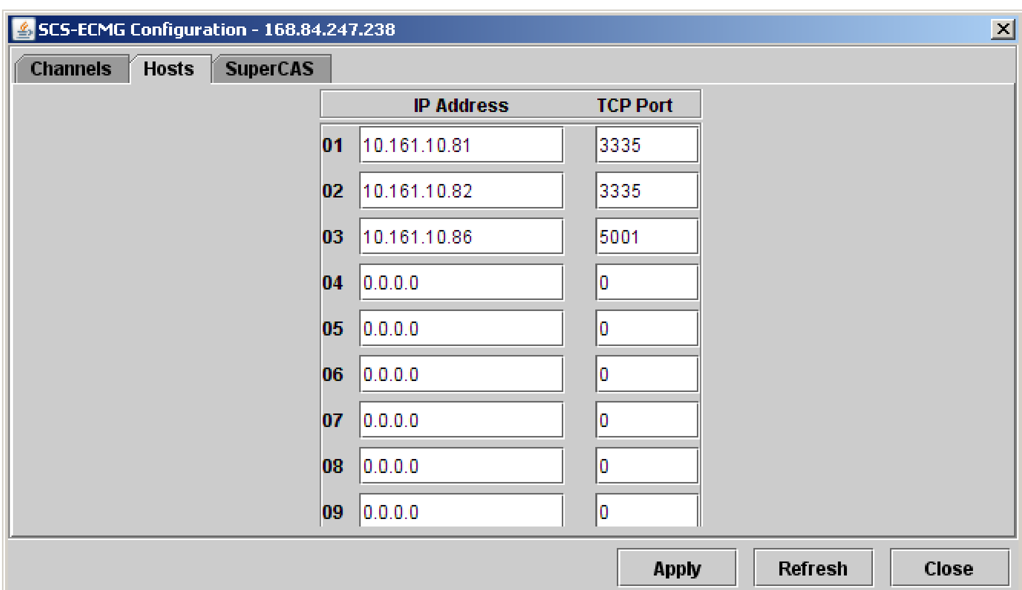
SCS-ECMG Configuration Channels field definitions

Item	Definition/Range
Enable	Enables connectivity with the corresponding ECMG.
Host	Links each existing ECMG channel to one physical device.
SuperCAS	Links each existing ECMG channel to one logical identifier.
Max Streams	Defines the maximum number of streams that can be requested to each ECMG channel. Range: 1 – 1536
Role	Indicates if the ECMG channel behaves as active or redundant entity. Options are: • **Primary** • **Backup**
Backup	Identifies the ECMG channel acting as redundant entity for this primary ECMG channel. *Note: Only available if role is Primary.*

SCS-ECMG Configuration Hosts

Use this window to configure the connectivity for each of the existing devices in the SimulCrypt network acting as ECMG entities:

Figure 10-4 — SCS-ECMG Configuration — Hosts



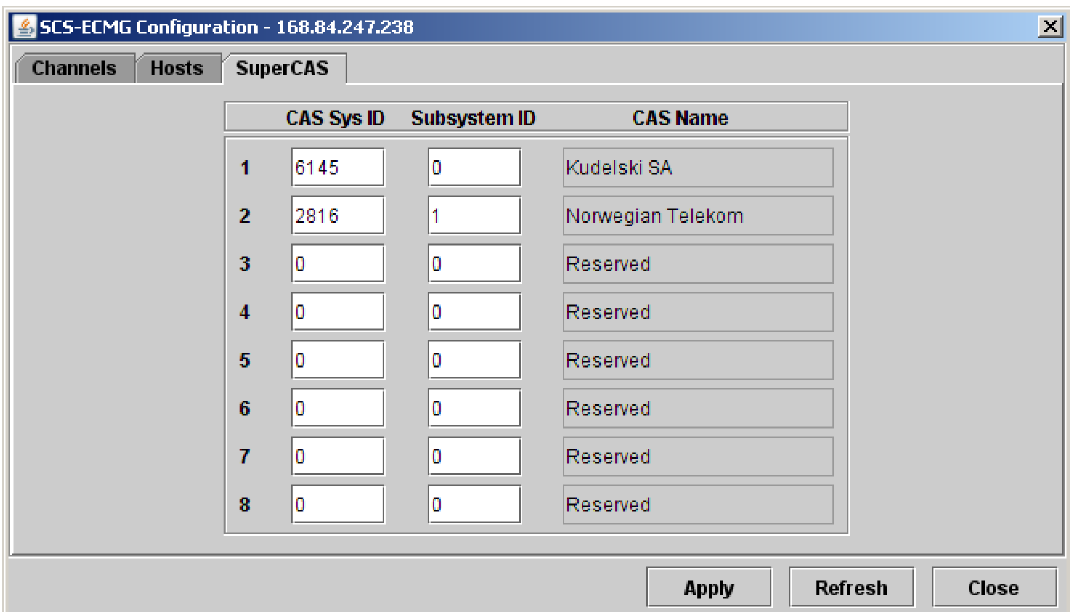
SCS-ECMG Configuration Hosts tab field definitions

Item	Definition/Range
IP Address	Specifies the remote interface IP address in each device running ECMG functionality.
TCP Port	Specifies the remote TCP server port in each device running ECMG functionality.

SCS-ECMG Configuration SuperCAS

Use this window to configure logical identifiers for each of the existing ECMG entities in the SimulCrypt network:

Figure 10-5 — SCS-ECMG Configuration — SuperCAS



SCS-ECMG Configuration SuperCAS tab field definitions

Item	Definition/Range
CAS Sys ID	Identifies the conditional access system or vendor. Range: 0 – 65535
Subsystem ID	Identifies the unique identifier for all possible ECMG entities for a given conditional access system or vendor. Range: 0 – 65535
CAS Name	This (read-only) value shows the conditional access system or vendor name officially assigned to the corresponding CAS Sys ID. Only vendors currently certified by the APEX1000 are identified. The complete list of CAS names is available in the ETSI-ETR162 standard document.

EIS Configuration

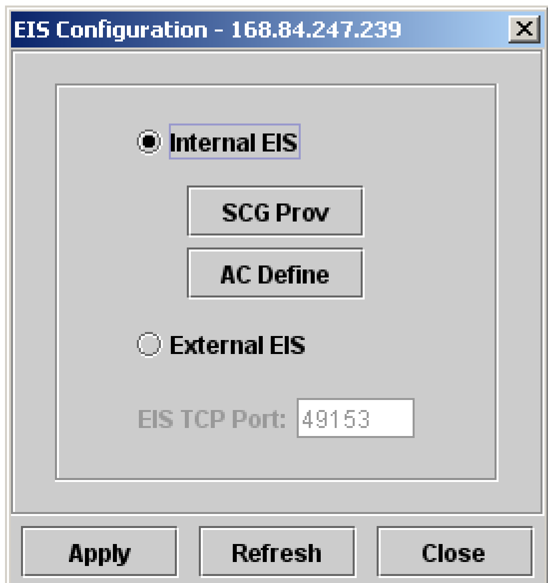
This window allows you to define if the scrambling provisioning is to be performed by an external EIS entity, or by means of direct configuration in APEX1000 element manager.

To access this feature, select **SimulCrypt > EIS Configuration**.

Internal EIS Configuration

Select this mode to manually perform provisioning of scrambling in the APEX1000.

Figure 10-6 — Internal EIS Configuration



.

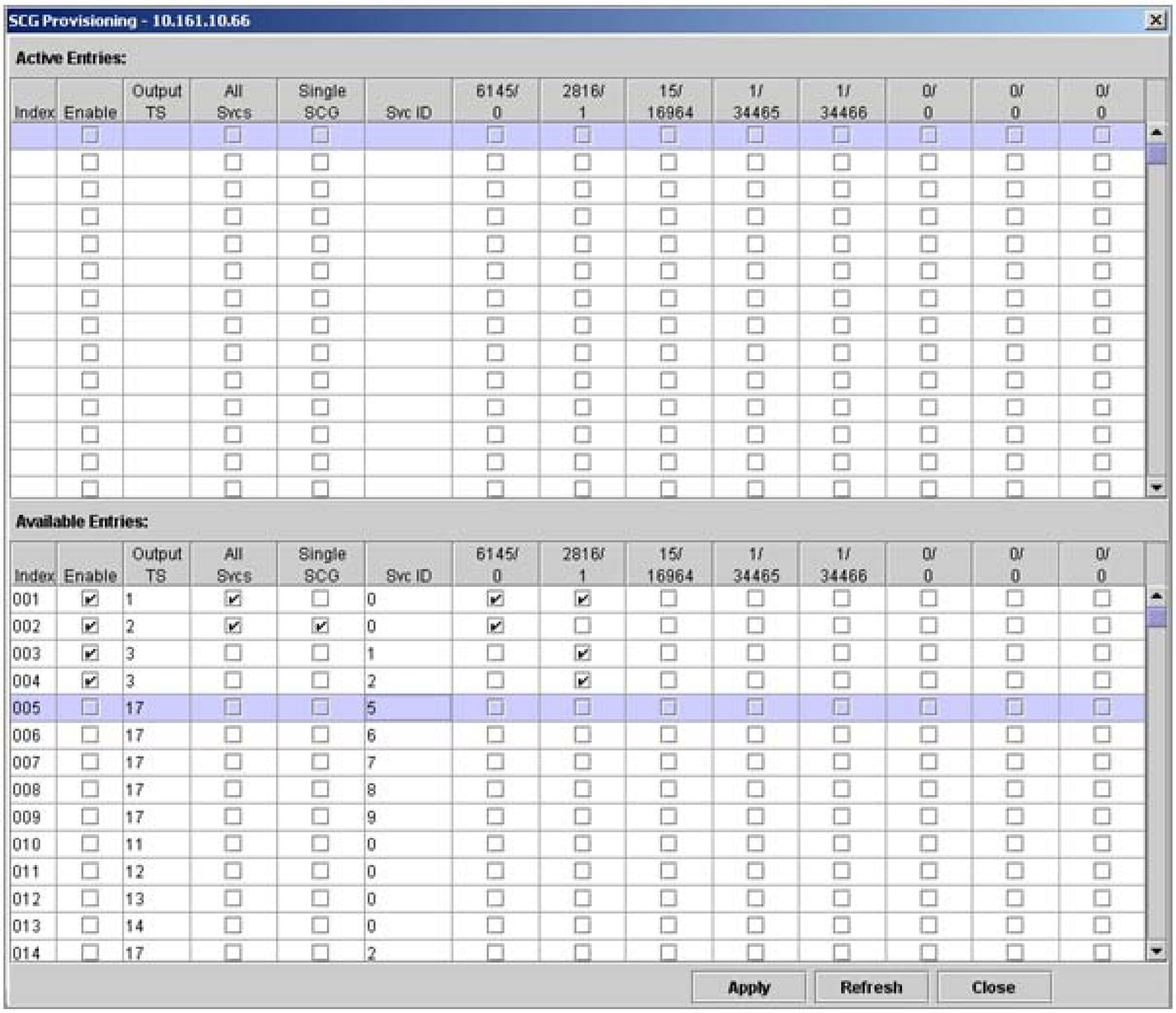
CAUTION	*The APEX must be rebooted for an EIS mode change to take effect.*

SCG Provisioning Configuration

To configure the services requiring scrambling and the conditional access to be used for each service, click **SCG Prov** in the EIS Configuration screen.

The SCG provisioning screen displays:

Figure 10-7 — SCG Provisioning window



Enabling SCG Provisioning

Every entry in both lists is directly editable. A mapping row that is not enabled will display in the *Available Mappings* panel.

To enable program mappings:

1. Check the *Enable* box to select one or more rows in the *Available Mappings* panel.
2. Enter the remaining selections for that row.

3. Repeat step 2 for each selected row.
4. Click **Apply**.
5. Click **Refresh** to update the screen.

Note: When you enable a row, it moves to the Active Mappings panel.

SCG Provisioning window field definitions

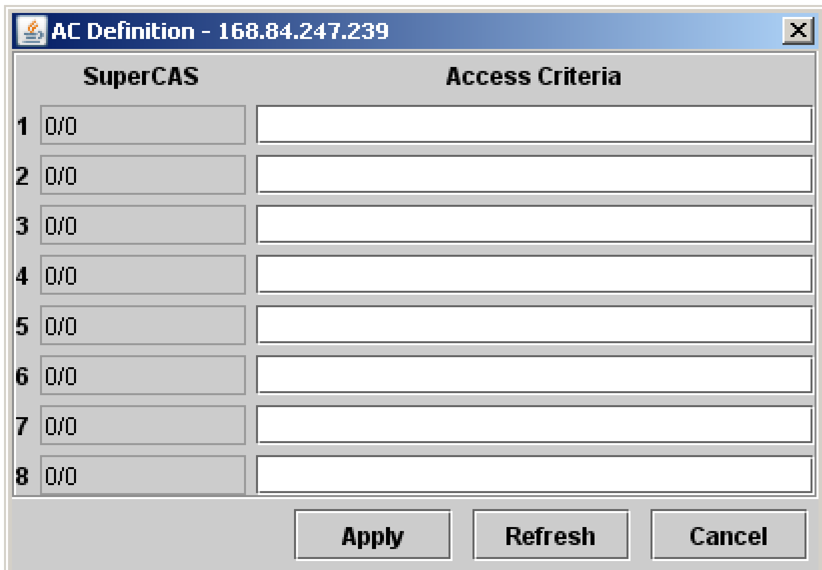
Item	Definition/Range
Active/Available Entries	
Index	Identifies the window line item.
Enable	A check mark indicates that the provisioning defined in the line is enabled.
Output TS	Specifies the output transport stream where the service to be scrambled belongs. Range: 1 – 48 *Note: Only output transport streams that are configured as SimulCrypt enabled can be used to define a scramble provisioning.*
All Svcs	A check mark indicates that all services transmitted through the specified output transport stream *must be scrambled.*
Single SCG	A check mark indicates that only one scrambling group will be created (one single connection with each ECMG, for example) so that all the services within the specified output transport stream share the same control word. *Note: This option is only available if the All Svcs checkbox is marked.*
Svc ID	Identifies the service that has to be scrambled within the specified output transport stream (1 – 65535). *Note: This option is only available if the All Svcs checkbox is not marked.*
SuperCAS list	Each column appears referring to one of the SuperCAS configured (CAS_id/subsystem_id). A check mark in any of the columns indicates that the corresponding SuperCAS must be contacted to perform scrambling for the specified services in that output transport stream.

Access Criteria Configuration

To configure which access criteria to use when requesting ECMs from a specific SuperCAS ECMG entity, click **AC Define** in the EIS Configuration screen.

The AC Definition screen displays:

Figure 10-8 — AC Definition window



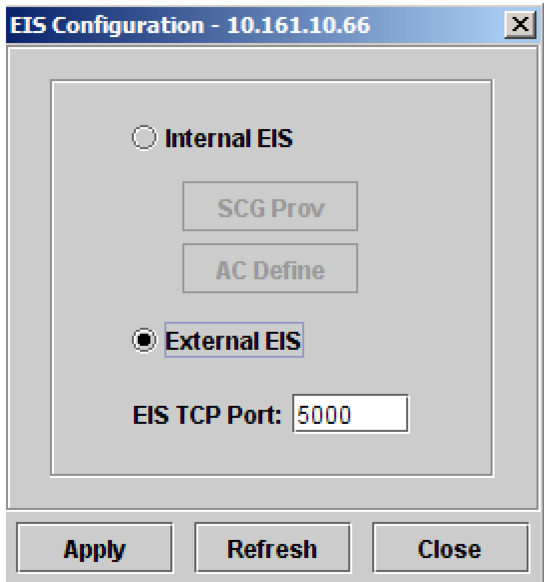
AC Definition window field definitions

Item	Definition/Range
SuperCAS	Specifies the SuperCAS identifier. *Note: Each line will appear referring to one of the SuperCAS configured (CAS_id/subsystem_id).*
Access Criteria	Specifies the Access Criteria to be used when contacting an ECMG configured with the specified SuperCAS to request an ECM. Range: String of up to 256 hexadecimal values

External EIS Configuration

Select this mode to configure the connectivity for the existing device in the SimulCrypt network, acting as the EIS entity and performing the scrambling provisioning.

Figure 10-9 — External EIS Configuration



Note: You must the must reboot APEX for an EIS mode change to take effect.

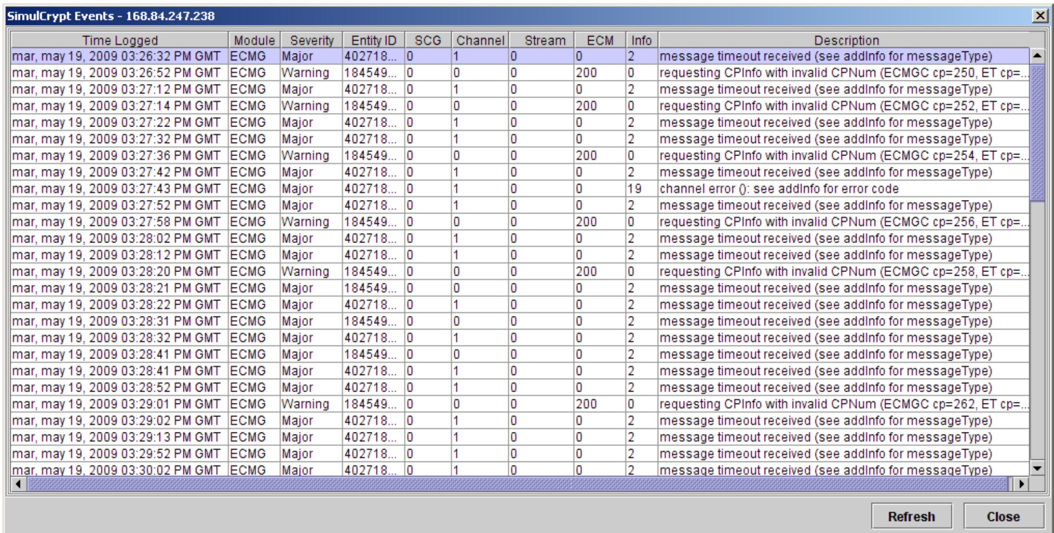
External EIS Configuration window field definitions

Item	Definition/Range
EIS TCP Port	Specifies the local TCP server port to be used to communicate with the event scheduler entity (EIS).

SimulCrypt Events

This window provides information about different errors or conditions happening in the SimulCrypt network. For access, select **SimulCrypt > SimulCrypt Events**:

Figure 10-10 — SimulCrypt Events



The following table provides (read-only) SimulCrypt Events screen field definitions:

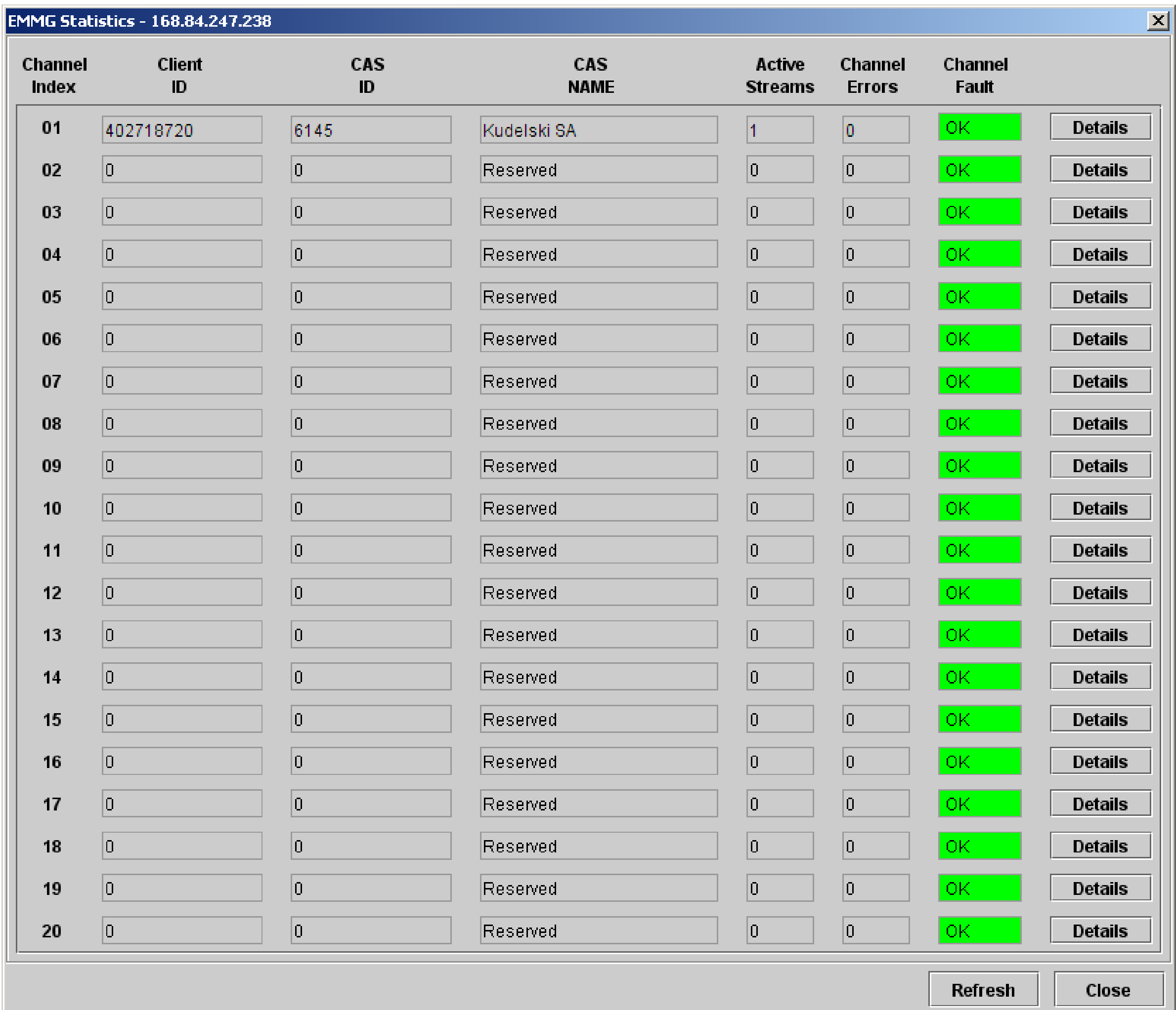
Item	Definition/Range
Time Logged	Shows the system time when the error or condition was logged.
Module	Entity type impacted: • **ECMG** • **EMMG**
Severity	Indicates the severity level of the event.
Entity ID	Identifies the affected entity.
SCG	Identifies the affected Scrambling Group if the event is SCG-related.
Channel	Identifies the affected channel if the event is Channel Level-related.
Stream	Identifies the affected stream if the event is Stream Level-related.
ECM	Identifies the affected ECM identifier if the event is ECM Level-related. ECM_id is allocated by the head-end and uniquely identifies an ECM stream for a Super_CAS_id.
Info	Provides additional information to help identify the error condition (SimulCrypt error code).
Description	Provides a text description of the error or condition logged.

EMMG Statistics

This window provides information on the status of EMM streams currently active in the SimulCrypt network.

For access, select **SimulCrypt > EMMG Statistics**:

Figure 10-11 — EMMG Statistics



EMMG Statistics - 168.84.247.238

Channel Index	Client ID	CAS ID	CAS NAME	Active Streams	Channel Errors	Channel Fault	
01	402718720	6145	Kudelski SA	1	0	OK	Details
02	0	0	Reserved	0	0	OK	Details
03	0	0	Reserved	0	0	OK	Details
04	0	0	Reserved	0	0	OK	Details
05	0	0	Reserved	0	0	OK	Details
06	0	0	Reserved	0	0	OK	Details
07	0	0	Reserved	0	0	OK	Details
08	0	0	Reserved	0	0	OK	Details
09	0	0	Reserved	0	0	OK	Details
10	0	0	Reserved	0	0	OK	Details
11	0	0	Reserved	0	0	OK	Details
12	0	0	Reserved	0	0	OK	Details
13	0	0	Reserved	0	0	OK	Details
14	0	0	Reserved	0	0	OK	Details
15	0	0	Reserved	0	0	OK	Details
16	0	0	Reserved	0	0	OK	Details
17	0	0	Reserved	0	0	OK	Details
18	0	0	Reserved	0	0	OK	Details
19	0	0	Reserved	0	0	OK	Details
20	0	0	Reserved	0	0	OK	Details

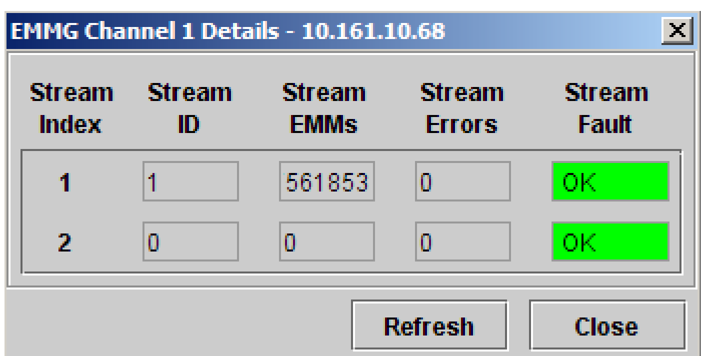
Refresh Close

Note: All values in this window are read-only.

EMMG Statistics screen field definitions

Item	Definition/Range
Channel Index	Identifies the window line item.
Client ID	Shows the identifier of the EMMG entity.
CAS ID	Shows the code officially assigned to the conditional access system or EMMG vendor.
CAS Name	Shows the conditional access system or vendor name officially assigned to the corresponding CAS identifier. Only vendors currently certified by the APEX1000 are identified. The complete list of CAS names is available in ETSI-ETR162 standard document.
Active Streams	Shows the number of streams active per EMMG channel.
Channel Errors	Counter for the channel errors detected for the corresponding EMMG channel.
Channel Fault	EMMG Channel status. Values are: • **ok** • **indeterminate** • **warning** • **minor** • **major** • **critical**
Details	Opens the EMMG Channel Details window.

EMMG Channel Details Window



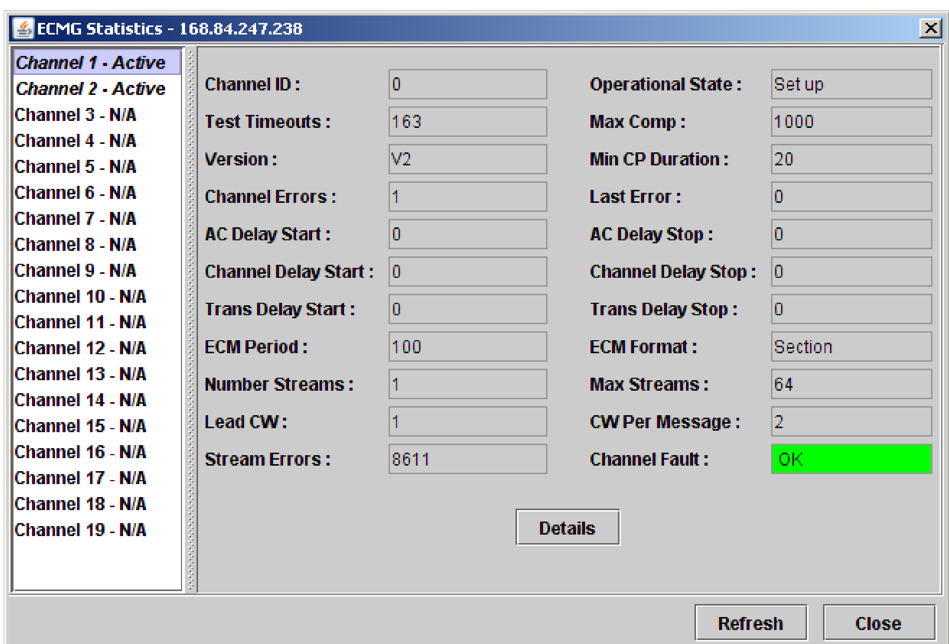
EMMG Channel Details window definitions

Item	Definition/Range
Stream Index	Identifies the window line item.
Stream ID	Shows the identifier of the EMM stream.
Stream EMMs	Counter for the number of EMM provision messages received within the corresponding EMM stream.
Stream Errors	Counter for the errors detected for the corresponding EMM stream.
Stream Fault	Displays EMM Stream status. Values are: • **ok** • **indeterminate** • **warning** • **minor** • **major** • **critical**

ECMG Statistics

This window provides information on the status of ECM streams currently active in the SimulCrypt network. For access, select **SimulCrypt > ECMG Statistics**:

Figure 10-12 — ECMG Statistics



Note: All values in this window are read-only.

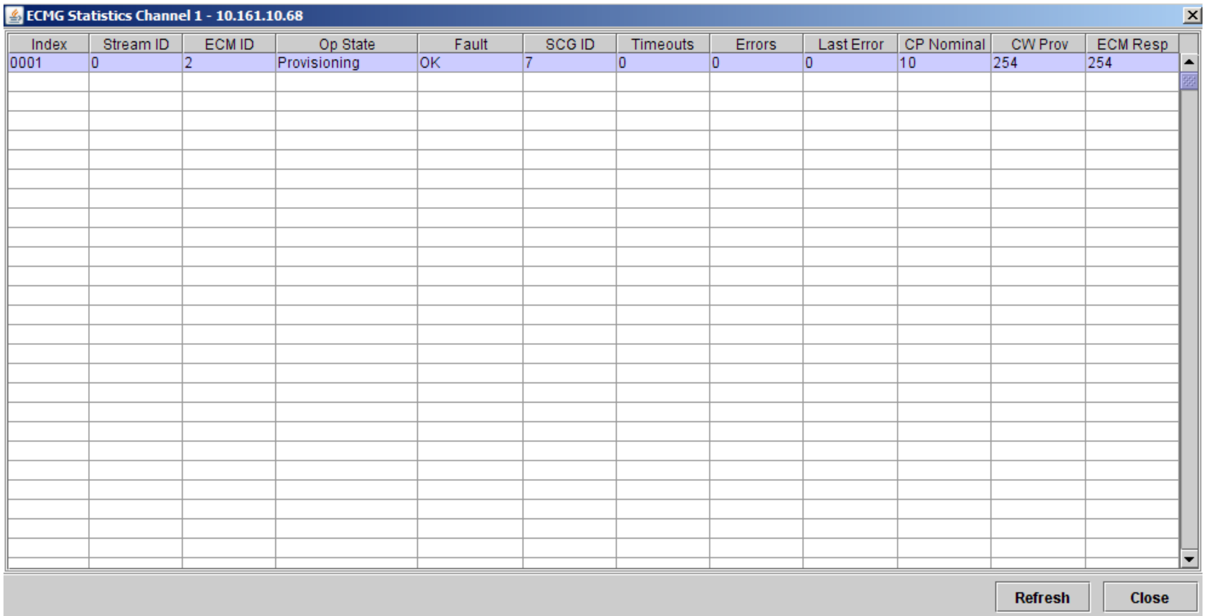
ECMG Statistics screen field definitions

Item	Definition/Range
Channel ID	Identifies the connection with ECMG entities.
Test Timeouts	Counter for the number of times the channel test procedure has failed.
Version	Displays the SimulCrypt version reported by the ECMG entity.
Channel Errors	Counter for the channel errors detected for the corresponding ECMG connection.
AC Delay Start	Displays (in milliseconds) the SimulCrypt Timing parameter reported by the ECMG entity. This value represents the amount of time between the start of a Crypto Period and the start of the broadcasting of the ECM attached to this period for the first Crypto Period following a change in Access Criteria.
Channel Delay Start	Displays (in milliseconds) the SimulCrypt Timing parameter reported by the ECMG entity. This value represents the amount of time between the start of a Crypto Period and the start of the broadcasting of the ECM attached to this period.
Trans Delay Start	Displays (in milliseconds) the SimulCrypt Timing parameter reported by the ECMG entity. This value represents the amount of time between the start of a Crypto Period and the start of the broadcasting of the ECM attached to this period for the first Crypto Period following a *clear to scrambled* transition.
ECM Period	Shows (in milliseconds) the periodicity for the repetition of data for the corresponding ECMG channel.
Number Streams	Shows the number of streams active per ECMG channel.
Lead CW	Displays the number of control words required in advance to build an ECM as reported by the corresponding ECMG entity.
Streams Errors	Counter for the stream errors detected for the corresponding ECMG.
Operational State	ECMG channel operational status. Values are: • **notApplicable** • **idle** • **connecting** • **settingUp** • **setup** • **closing** • **closingStreams**
Max Comp	Displays (in milliseconds) the SimulCrypt Timing parameter reported by the ECMG entity. This value indicates the worst case time needed by an ECMG to compute an ECM.

Item	Definition/Range
Min CP Duration	Displays (in hundreds of milliseconds) the SimulCrypt Timing parameter reported by the ECMG entity. This value represents the minimum supported amount of time a control word will be active before it can be changed.
Last Error	Displays the error code for the last error situation detected by the APEX for the corresponding ECMG channel.
AC Delay Stop	Displays the SimulCrypt Timing parameter reported by the ECMG entity. This value represents (in milliseconds) the amount of time between the end of a Crypto Period and the end of the broadcasting of the ECM attached to this period for the last Crypto Period preceding a change in Access Criteria.
Channel Delay Stop	Displays the SimulCrypt Timing parameter reported by the ECMG entity. This value represents (in milliseconds) the amount of time between the end of a Crypto Period and the end of the broadcasting of the ECM attached to this period.
Trans Delay Stop	Displays the SimulCrypt Timing parameter reported by the ECMG entity. This value represents (in milliseconds) the amount of time between the end of a Crypto Period, and the end of the broadcasting of the ECM attached to this period for the last crypto period preceding a scrambled to clear transition.
ECM Format	Shows the format expected for ECM received from ECMG entity. Values are: • **Section** • **Packet**
Max Streams	Displays the number of ECM streams supported by the corresponding ECMG entity as reported at channel connection.
CW Per Message	Displays the number of control words needed by the ECMG per control word provision message as reported by the corresponding ECMG entity.
Channel Fault	ECMG channel status. Values are: • **ok** • **indeterminate** • **warning** • **minor** • **major** • **critical**
Details	Opens the ECMG Statistics Details window.

ECMG Statistics Details Window

To access this feature, click **Details** in the **ECMG Statistics** window:



EMMG Statistics Details window definitions

Item	Definition/Range
Index	Identifies the window line item.
Stream ID	Indicates the ECM stream within the ECMG channel.
ECM ID	Identifies the ECM allocated by the headend to the ECM stream.
Op State	Shows the ECM stream operational status. Values are: • **notApplicable** • **idle** • **settingUp** • **setup** • **provisioning** • **closing**

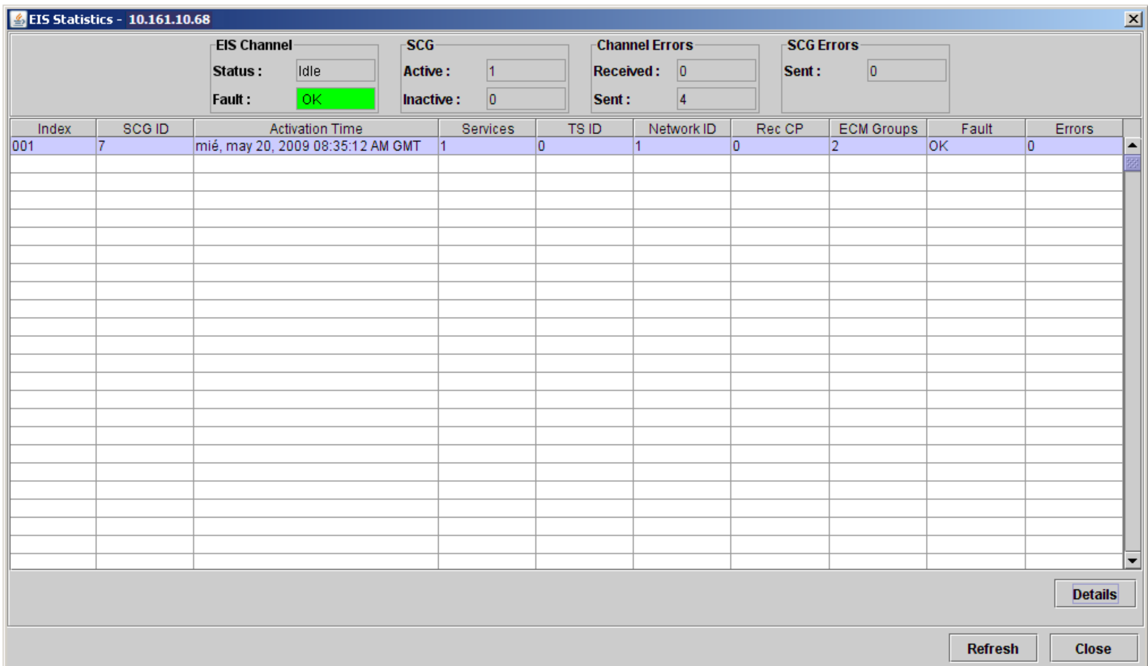
Item	Definition/Range
Fault	Shows the ECM stream status. Values are: • **ok** • **indeterminate** • **warning** • **minor** • **major** • **critical**
SCG ID	Identifies the scrambling group linked to the ECM stream.
Timeouts	Shows the number of times the ECMG has not provided an ECM on-time over this ECM stream.
Errors	Counter for the number of errors detected for the corresponding ECM stream.
Last Error	Displays the error code for the last error situation detected by the APEX for the corresponding ECM stream.
CP Nominal	Displays (in seconds) the Crypto Period duration for the corresponding ECM stream.
CW Prov	Counter for the number of ECMs requested to the ECMG over this ECM stream.
ECM Resp	Counter for the number of valid ECMs received from the ECMG over this ECM stream.

EIS Statistics

This window provides information on the status of connectivity with *EISentity* in the SimulCrypt network.

For access, select **SimulCrypt > EIS Statistics**:

Figure 10-13 — EIS Statistics



Note: All values in this window are read-only.

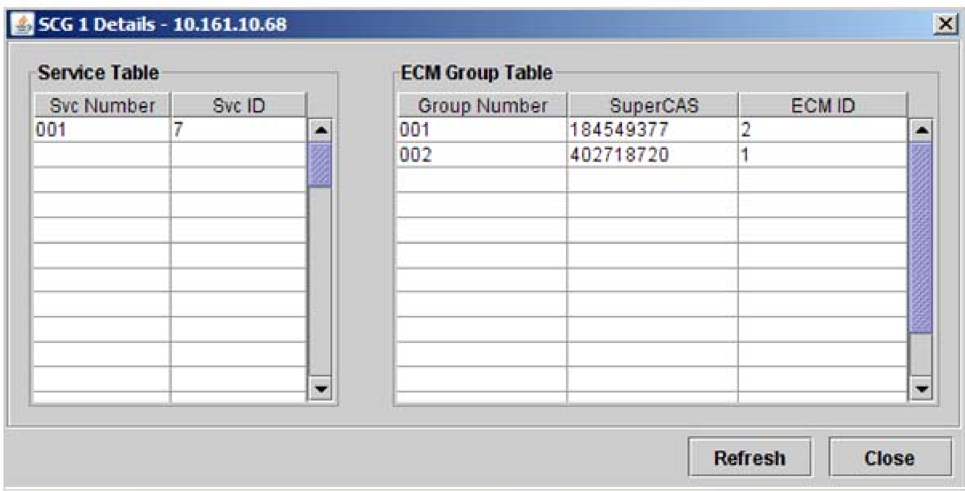
EIS Statistics window field definitions

Item	Definition/Range	
EIS Channel	**Status**	Shows the EIS connectivity operational status. Values are: • **notApplicable** • **idle** • **setup** • **close**
	Fault	Shows the EIS connectivity status. Values are: • **ok** • **indeterminate** • **warning** • **minor** • **major** • **critical**
SCG	**Active**	Displays the number of scrambling groups currently active.
	Inactive	Displays the number of scrambling groups currently provisioned but not active.
Channel Errors	**Received**	Counter for the channel errors received from the EIS entity.
	Sent	Counter for the channel errors reported to the EIS entity.
SCG Errors	**Sent**	Counter for the scrambling group specific errors reported to the EIS entity.
Index	Identifies the window line item.	
SCG ID	Identifies a specific scrambling group.	
Activation Time	Indicates the time for activation of the specific scrambling group. If the scrambling group is provisioned but not yet active, the activation time indicates a moment in the future.	
Services	Number of services belonging to the specific scrambling group.	
TS ID	Transport Stream linked to the specific scrambling group. This value identifies one of the 48 output QAM channels existing in the APEX (referenced with values 0 to 47 instead of 1 to 48).	
Network ID	Identifier for the Network linked to the specific scrambling group.	
Rec CP	Displays the recommended Crypto Period duration proposed by the EIS entity for the specific scrambling group.	
ECM Groups	Number of ECM groups belonging to the specific scrambling group.	

Item	Definition/Range
Fault	Shows the scrambling group status. Values are: • **ok** • **indeterminate** • **warning** • **minor** • **major** • **critical**
Errors	Counter for the number of specific errors detected for the specific scrambling group.
Details	Opens the SCG Details window.

SCG Details Window

For access, click **Details** in the *EIS Statistics* window:



EIS Statistics Details window definitions

Item	Definition/Range	
Service Table	**Svc Number**	Identifies the window line item.
	Svc ID	Identifies an specific service within the scrambling group selected.
ECM Group Table	**Group Number**	Identifies the window line item.
	SuperCAS	Identifies an specific SuperCAS (combination of conditional access code and entity number, identifying a specific ECMG entity in the SimulCrypt network) within the scrambling group selected.
	ECM ID	Shows the identifier allocated by the head-end to the an specific ECM stream within the scrambling group selected.

11 DEPI – MPT Mode

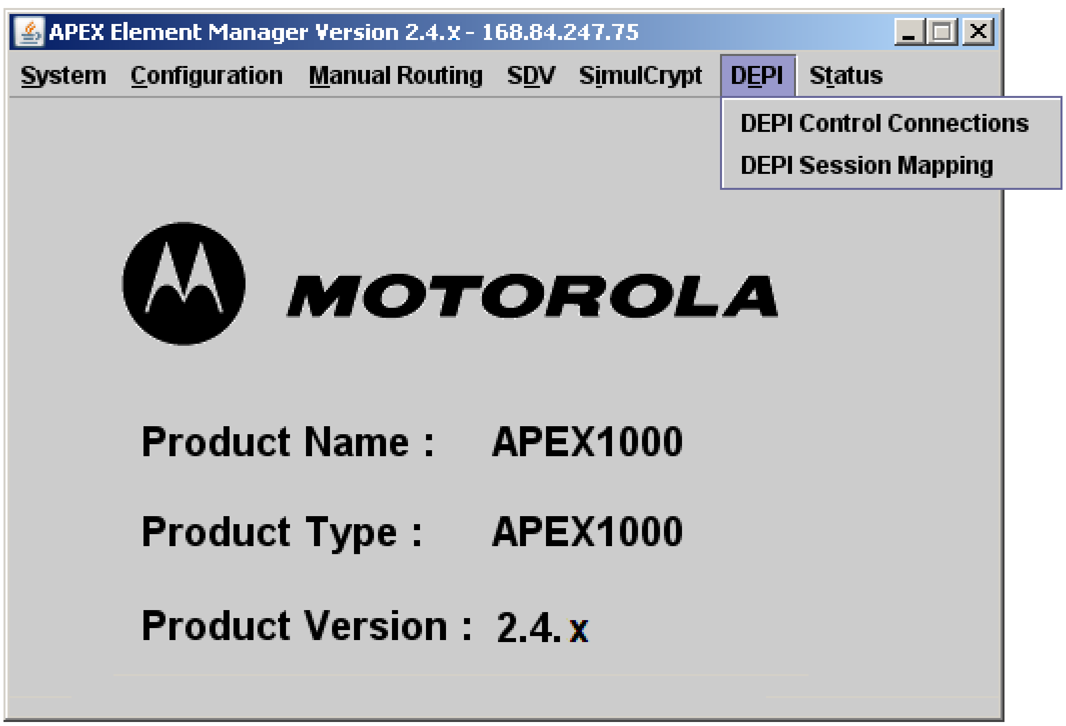
Overview

APEX1000 release 2.4.x includes support for Modular CMTS. The APEX M-CMTS architecture allows merging video delivery and high speed data applications, providing support for services such as Voice Over- IP (VoIP), email, gaming, and video telephony.

DEPI Modes

There are two M-CMTS transmission modes:

- **MPT** – In this mode, the M-CMTS core performs transmission convergence and generates the DOCSIS SYNC messages
- **PSP** – In this mode, the EQAM performs transmission convergence and generates the DOCSIS SYNC messages



*Note: Version 2.4.x only supports **MPT** mode. **PSP** flow mode will be supported in a future version of the APEX1000.*

M-CMTS Architecture

The M-CMTS architecture includes the following components:

- A DEPI interface to configure DOCSIS data to be broadcasted by APEX output transport streams
- A DTI interface to receive a common time reference for DOCSIS data within the whole head end
- An ERMI interface* to register and allow reservation of QAM channels within the EQAM entity

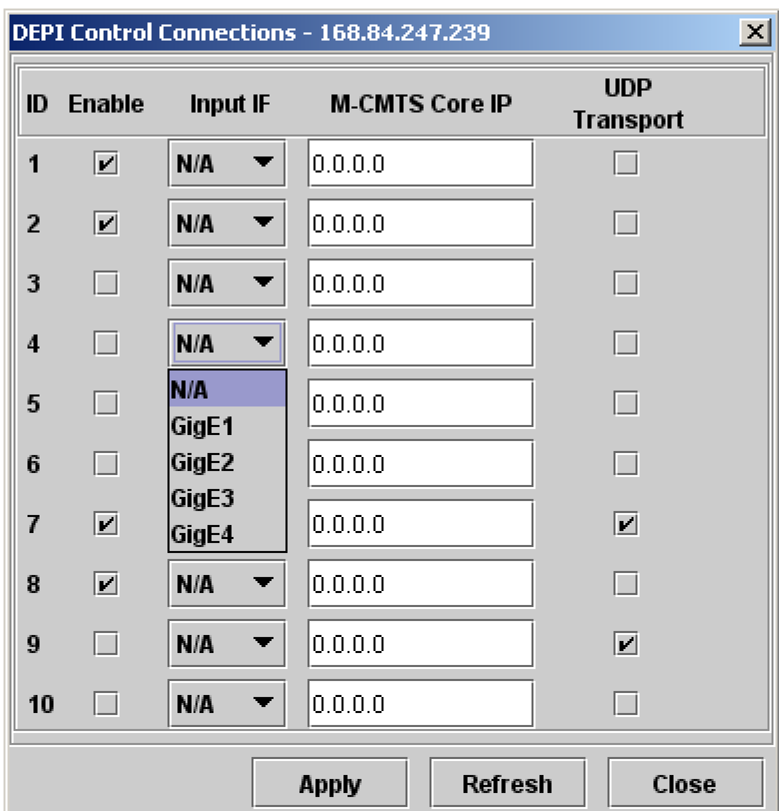
These interfaces allow an external Edge QAM to provide the downstream path for the DOCSIS data and MAC messages being sent to the Cable Modems.

**Note:* *Version 2.4.x does not support ERMI functionality; control connections / sessions for DEPI interface are configured statically. This feature will be supported in a future release.*

DEPI Control Connections

Use this window to define the parameters which control the delivery of DOCSIS frames from the M-CMTS core to the EQAM devices:

Figure 11-1 — DEPI Control Connections window



DEPI Control Connection Configuration

This feature allows you to configure the control connection identification information such as the M-CMTS Core IP address. (The APEX supports a total of ten control connections to ten different cores simultaneously.)

Note: This configuration also allows you to configure the DEPI control connection using UDP transport or native IP support.

DEPI Control Connections window definitions

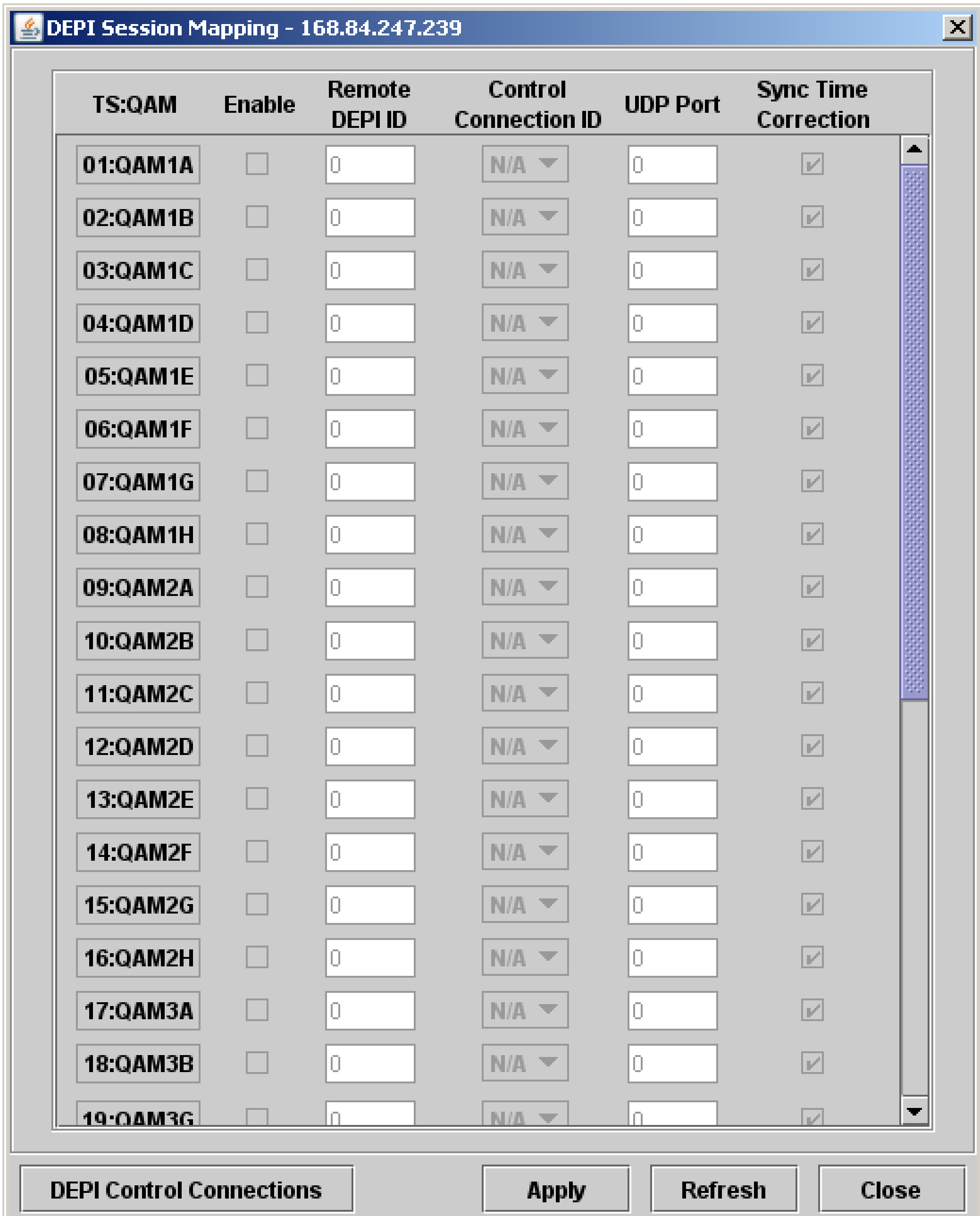
Item	Definition/Range
ID	Identifies the Control Connection.
Enable	Select this checkbox to enable connectivity with the corresponding M-CMTS Core entity.
Input IF	Incoming GigE interface for connectivity with corresponding M-CMTS Core entity.
M-CTMS Core IP	IP address for the M-CMTS Core entity allowed to connect *Note: The IP address must be a unicast address as it refers to an originating device.*
UDP Transport	Select this checkbox if DEPI connectivity with specific M-CMTS Core entity is done over UDP.

CAUTION *You cannot modify the control connection configuration information if there is an active session setup with the corresponding M-CMTS core entity.*

DEPI Session Mapping

Use this window to define mapping parameters, such as the set of UDP ports to be used for session data transfer in the DEPI interface:

Figure 11-2 — DEPI Session Mapping window



DEPI Session Mapping window definitions

Item	Definition/Range
TS: QAM	Identifies the Output Transport Stream.
Enable	Select this checkbox to enable the corresponding session.
Remote DEPI ID	Logical identification (Remote End ID) for the DEPI session assigned to the corresponding output transport stream. Because sessions are configured statically, this parameter will be used as the session identifier for data messages received from the M-CMTS core entity.
Control Connection ID	Identifies the control connection where this session belongs.
UDP Port	If the corresponding control connection has been configured to run DEPI over UDP, this parameter indicates the incoming UDP port allocated to this session. Range: 61696 – 65535 This value should only be modified if not impacting any existing session. *Note: Only Active if connection is defined as UDP. Must be unique.*
Sync Time Correction	Select this checkbox if correction of timestamp value in incoming SYNC message is required.
DEPI Control Connections	Opens the DEPI Control Connections configuration window.

Notes:

*1. You can also access DEPI Session Mapping by selecting **Output TS Configuration > DEPI Session Mapping**.*

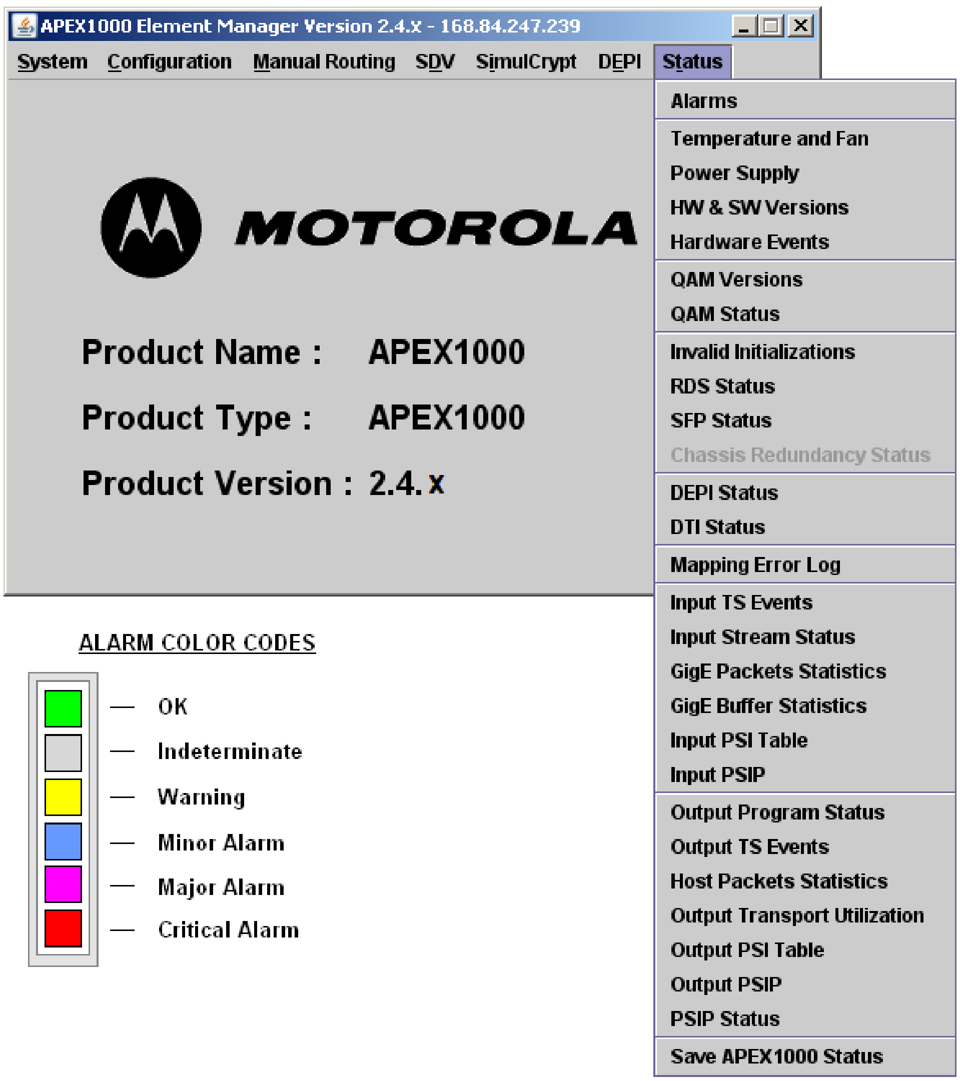
*2. You can monitor the health of various aspects of DEPI control connections and sessions by accessing **Status > DEPI Status** and **Status > DTI Status**.*

3. You cannot modify the session-specific information (Remote DEPI ID, UDP port) if the corresponding session is active (enabled).

12 Status

Reports

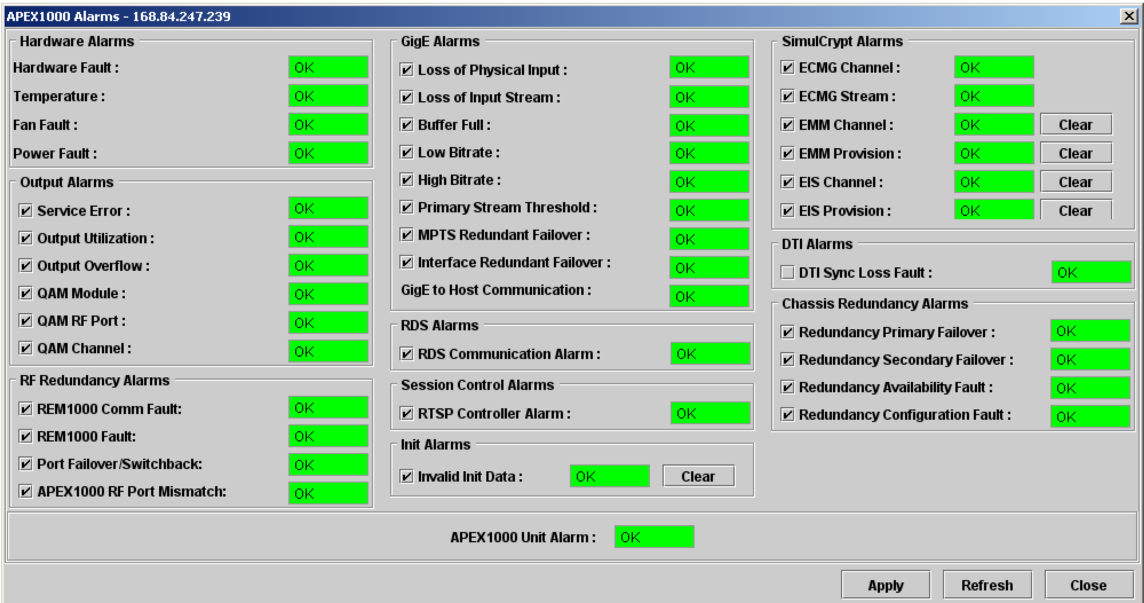
To display the drop-down list of available reports, click **Status** on the APEX1000 EM menu bar. Please note that a *Critical* alarm prevents the APEX1000 from performing operational requirements, while *Warning, Minor,* and *Major* alarms allow uninterrupted operation, and allow corrections to take place at a later time.



Alarms

The Alarms window represents a software panel of monitored conditions in the APEX1000. Although not applicable to all alarm conditions, the six status levels are listed in the preceding graphic.

Figure 12-1 — APEX Alarms



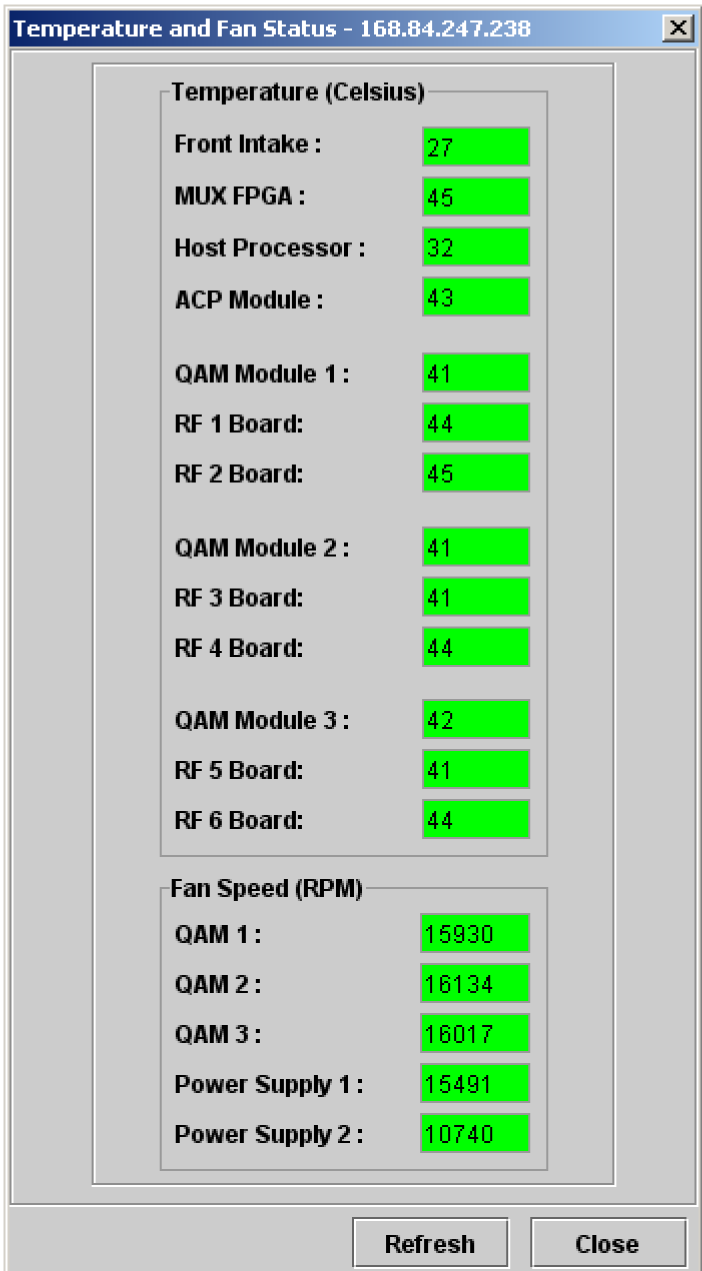
*Note: All alarms are enabled by default. To disable any enabled alarm, un-click the check box and click **Apply**. (Items without a checkbox cannot be disabled through the APEX-EM.)*

For a complete listing of all alarm conditions, reference Alarms Window Field Definitions.

Temperature and Fan

The Temperature and Fan Status window provides Celsius readings (in revolutions per minute) of the two temperature sensors and speeds of the three fans:

Figure 12-2 — Temperature and Fan Status



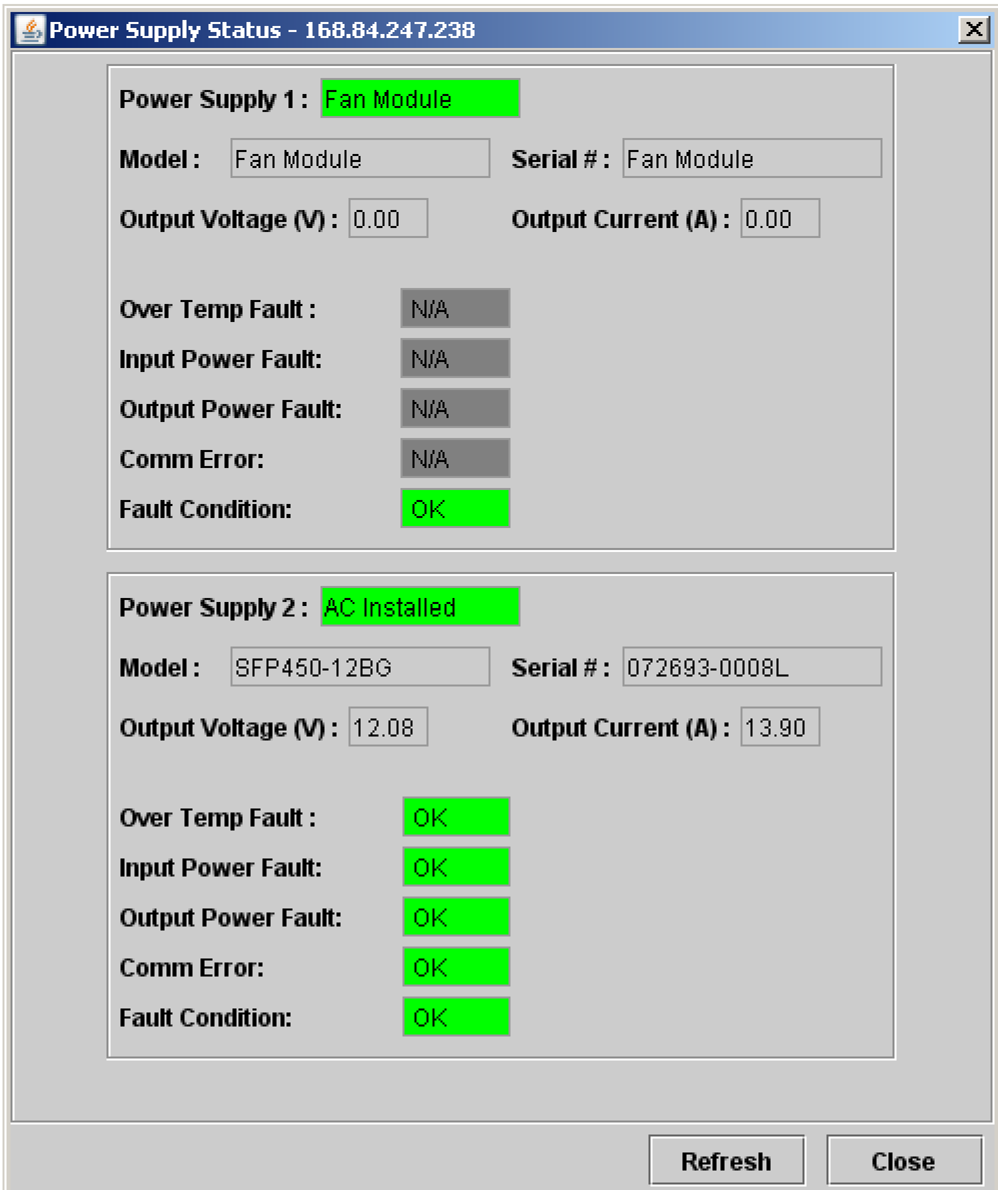
Temperature and Fan Status window field definitions

Item	Definition
	TEMPERATURE (Celsius)
Front Intake	Ambient temperature at the front intake.
MUX FPGA	Ambient temperature at the MUX field-programmable gate array.
Host Processor	Ambient temperature at the host processor.
ACP Module	Ambient temperature at the installed ACP module.
QAM Modules 1 – 3	Ambient temperature at specific QAM Module slot. The numbering (1 – 3) corresponds to QAM modules from left to right when facing the back of the unit. *Note: This area also displays the temperature from a Fan Only module in a QAM slot.*
RF Boards 1 – 6	Plate temperature of RF boards. RF boards are sub-assemblies of a QAM Module. The numbering (1 – 6) corresponds to the RF output connectors from left to right when facing the unit.
	FAN SPEED (RPM)
QAM Modules 1 – 3	Fan speed reading in revolutions per minute of the specified Fan. The numbering (1 – 3) corresponds to QAM modules from left to right when facing the back of the unit.
Power Supply 1 – 2	Fan speed reading in revolutions per minute of the specified power supply. The numbering (1 – 2) corresponds to power supply modules from left to right when facing the back of the unit.

Power Supply

This window provides status readings of the available power supply units and fan modules:

Figure 12-3 — Power Supply Status



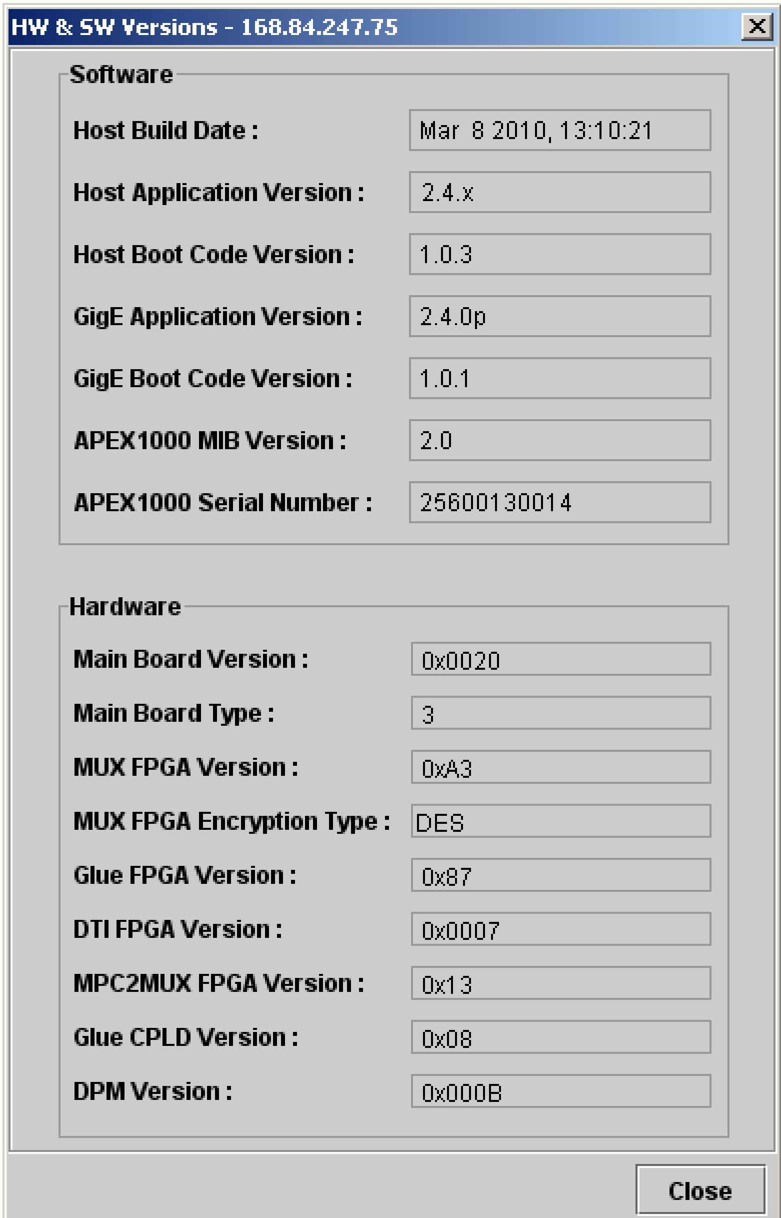
Power Supply Status window field definitions

Item	Definition	
Power Supply, Model, Serial	Displays the type of installed power supply or module, model, and serial number.	
Output Voltage (V)	Displays the output voltage (in Volts).	
Output Current (A)	Displays the output current (in Amperes).	
Fault Type	During a fault, the following items may display: • **Over Temp** • **Input Power** • **Output Power** • **Comm Error** • **Fault Condition**	Each item displays the current status in the corresponding alarm color: • **OK (green)** • **Indeterminate (gray)** • **Warning (yellow)** • **Minor alarm (blue)** • **Major alarm (magenta)** • **Critical alarm (red)**

HW and SW Versions

This window provides read-only information regarding APEX1000 hardware and software:

Figure 12-4 — HW/SW Versions



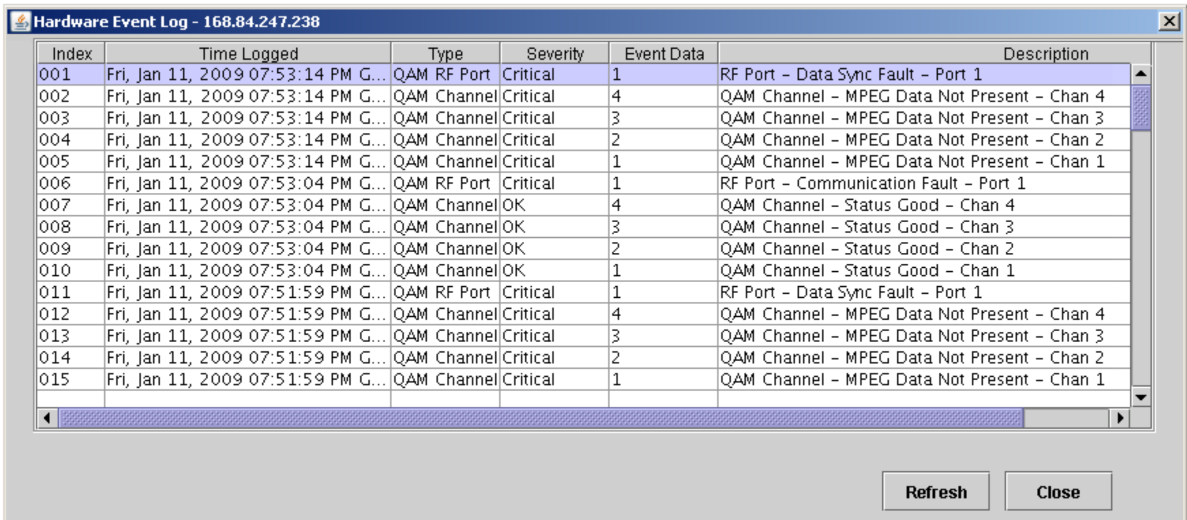
HW and SW Versions window field definitions

Item	Definition
SOFTWARE	
Host Build Date	Shows the date when all of the software was linked into executable object code.
Host Application Version	Host processor application creation date.
Host Boot Code Version	Host processor boot code version.
GigE Application Version	APEX1000 Gigabit Ethernet processor application code version.
GigE Boot Code Version	APEX1000 Gigabit Ethernet processor boot code version.
APEX MIB Version	APEX1000 Management Information Base version.
APEX Serial Number	APEX1000 Serial Number.
HARDWARE	
Main Board Version	Identifies the APEX1000 main board version.
Main Board Type	Identifies the APEX1000 main board type.
MUX FPGA Version	Identifies the APEX1000 MUX FPGA version.
MUX FPGA Encryption Type	Identifies the APEX1000 MUX FPGA encryption type.
Glue FPGA Version	Identifies the Glue field-programmable gate array (FPGA) version.
DTI FPGA Version	Identifies the DTI field-programmable gate array (FPGA) version.
MPC2MUX FPGA Version	Identifies the MPC2MUX field-programmable gate array (FPGA) version.
Glue CPLD Version	Identifies the Glue CPLD Version.
DPM Version	Displays the current Data Protection Manager (DPM) Version.

Hardware Events

The Hardware Event Log window provides a read-only table of hardware errors:

Figure 12-5 — Hardware Event Log



Hardware Event Log - 168.84.247.238

Index	Time Logged	Type	Severity	Event Data	Description
001	Fri, Jan 11, 2009 07:53:14 PM G...	QAM RF Port	Critical	1	RF Port – Data Sync Fault – Port 1
002	Fri, Jan 11, 2009 07:53:14 PM G...	QAM Channel	Critical	4	QAM Channel – MPEG Data Not Present – Chan 4
003	Fri, Jan 11, 2009 07:53:14 PM G...	QAM Channel	Critical	3	QAM Channel – MPEG Data Not Present – Chan 3
004	Fri, Jan 11, 2009 07:53:14 PM G...	QAM Channel	Critical	2	QAM Channel – MPEG Data Not Present – Chan 2
005	Fri, Jan 11, 2009 07:53:14 PM G...	QAM Channel	Critical	1	QAM Channel – MPEG Data Not Present – Chan 1
006	Fri, Jan 11, 2009 07:53:04 PM G...	QAM RF Port	Critical	1	RF Port – Communication Fault – Port 1
007	Fri, Jan 11, 2009 07:53:04 PM G...	QAM Channel	OK	4	QAM Channel – Status Good – Chan 4
008	Fri, Jan 11, 2009 07:53:04 PM G...	QAM Channel	OK	3	QAM Channel – Status Good – Chan 3
009	Fri, Jan 11, 2009 07:53:04 PM G...	QAM Channel	OK	2	QAM Channel – Status Good – Chan 2
010	Fri, Jan 11, 2009 07:53:04 PM G...	QAM Channel	OK	1	QAM Channel – Status Good – Chan 1
011	Fri, Jan 11, 2009 07:51:59 PM G...	QAM RF Port	Critical	1	RF Port – Data Sync Fault – Port 1
012	Fri, Jan 11, 2009 07:51:59 PM G...	QAM Channel	Critical	4	QAM Channel – MPEG Data Not Present – Chan 4
013	Fri, Jan 11, 2009 07:51:59 PM G...	QAM Channel	Critical	3	QAM Channel – MPEG Data Not Present – Chan 3
014	Fri, Jan 11, 2009 07:51:59 PM G...	QAM Channel	Critical	2	QAM Channel – MPEG Data Not Present – Chan 2
015	Fri, Jan 11, 2009 07:51:59 PM G...	QAM Channel	Critical	1	QAM Channel – MPEG Data Not Present – Chan 1

Refresh Close

Note: A maximum of 100 errors can be recorded and displayed.

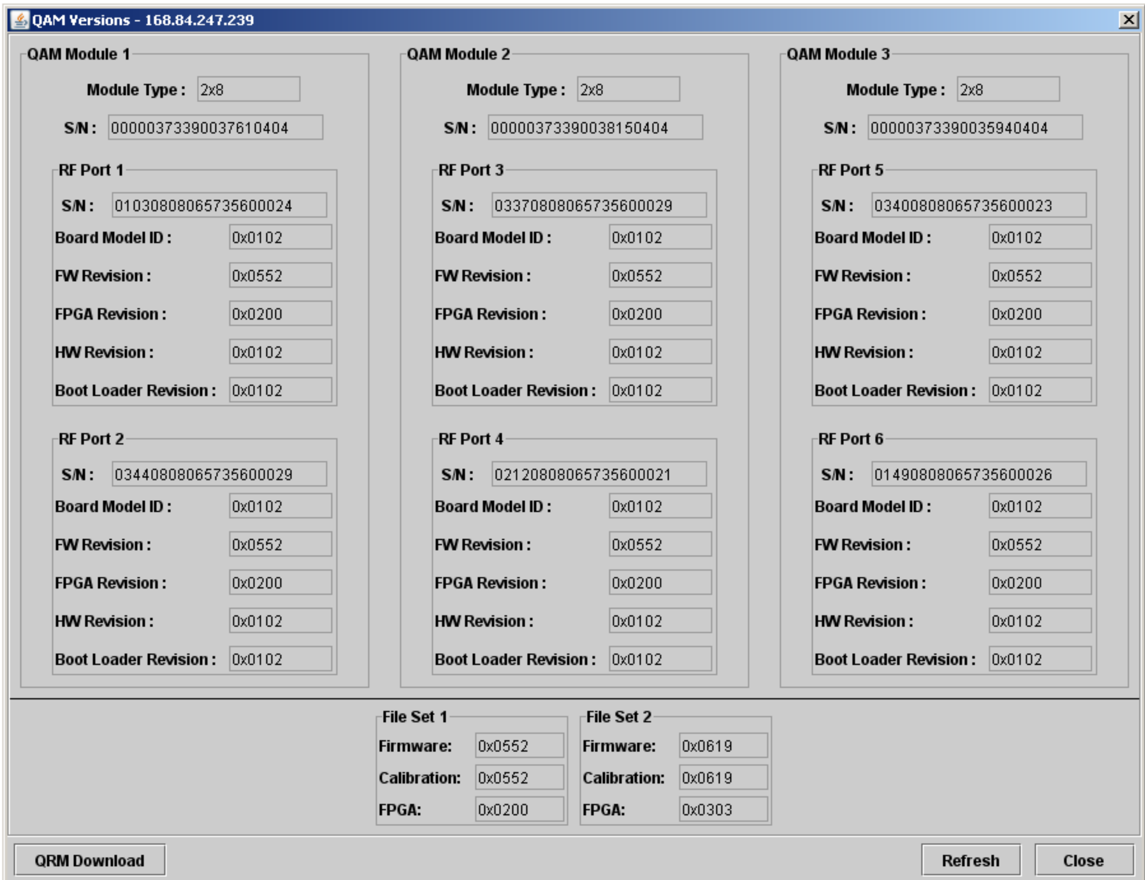
Hardware Event Log window field definitions

Item	Definition
Index	Index of hardware error table entry.
Time Logged	Shows system up time when the error was logged. A zero demonstrates that the error occurred at startup.
Type	Indicates the type of hardware event.
Severity	Indicates the level of severity of the event.
Event Data	Applicable to errors that are issued for multiple inputs, outputs, output transport streams, etc. Also used to indicate the input port, output port, or output transport stream to which the error applies. A zero in this area indicates that: • The error does not use this parameter *or* • The APEX1000 cannot determine the port or stream number for the error *or* • The APEX1000 is not supporting this parameter for the error
Description	Provides a text description of the error.

QAM Versions

This window provides read-only information about each QAM module and its associated RF ports:

Figure 12-6 — QAM Versions



QAM Versions window field definitions

Item	Definition
QAM Module #	Shows the QAM Number, Type, and Serial Number.
RF Port #	
Serial Number	Shows the RF Port Serial number.
Board Model ID	Shows the Board Model ID number.
FW Revision	Shows the FW Revision number.
FPGA Revision	Shows the FPGA Revision number.

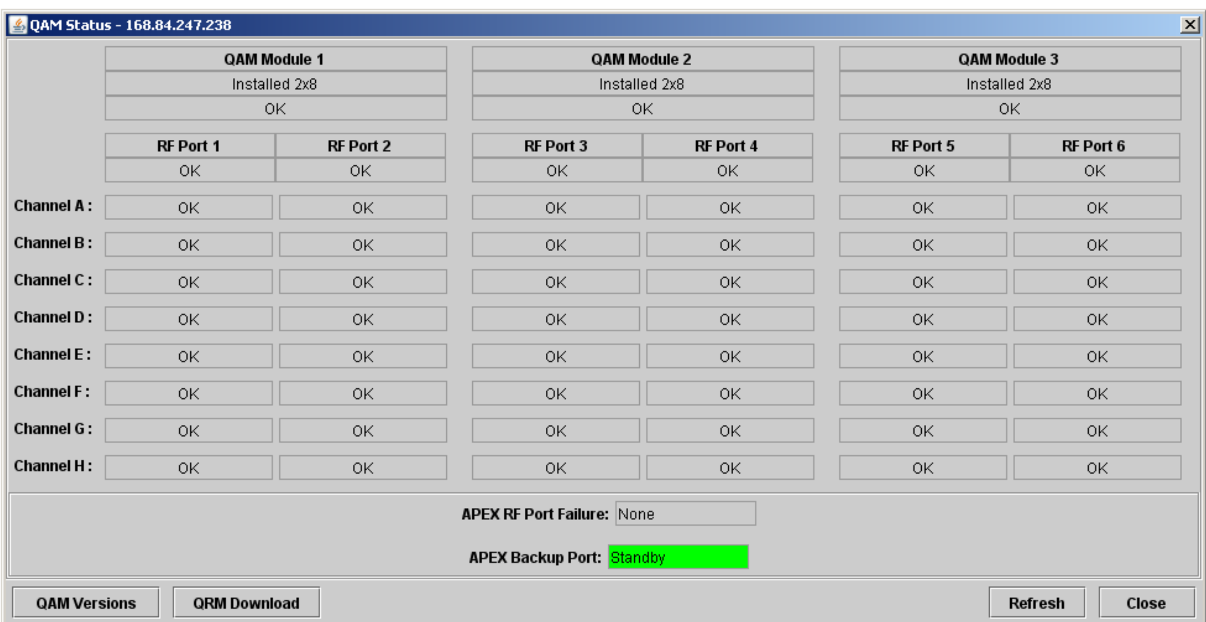
Item	Definition
HW Revision	Shows the HW Revision number.
Boot Loader Revision	Shows the Boot Loader Revision number.
File Set 1 and 2	
Firmware	Shows the FW Revision number for the file set.
Calibration	Shows the Calibration number for the file set.
FPGA	Shows the FPGA Revision number for the file set.
QRM Download	Displays the QRM Download progress window.

QAM Status

The QAM Status window provides a snapshot of the current status of the QAM Modules, RF Ports, and QAM Channels.

This window displays the current installed and error status for each QAM module and the current error status for each RF Port and QAM Channel. When there are errors present, the status box will be colored for the severity of the error, as shown in the example below:

Figure 12-7 — QAM Status



Note: As illustrated below, allowing the cursor to temporarily hover over any channel box displays the information for that particular QAM:

QAM Status window button definitions

Button	Definition
QAM Versions	Displays the QAM Versions window.
QRM Download	Displays the QRM Download Progress window.
APEX RF Port Failure	Indicates that the RF Port has failed over to backup (The value of *0* indicates no failover). Values: None (0), 1, 2, 3, 4, 5
APEX Backup Port	Shows the current state of APEX RF Port #6. Values are: • **Disabled** • **Standby** • **Active** • **Failed** • **Removed**

QRM Download Window

Use this window to initiate and monitor the progress of manual QRM downloads.

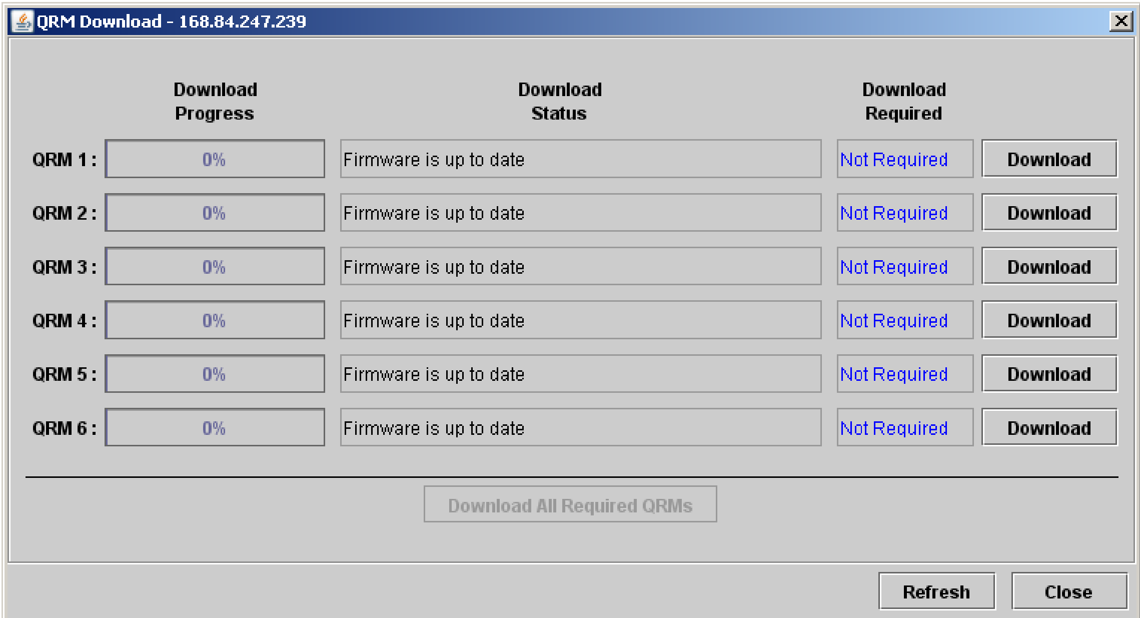
QRM FW downloads will automatically occur at bootup, but only if the QRM has an **older** version of FW or FPGA.

1. To monitor the progress of a download, click **Download**.

   The QRM Download window displays, to show progress of any downloads.

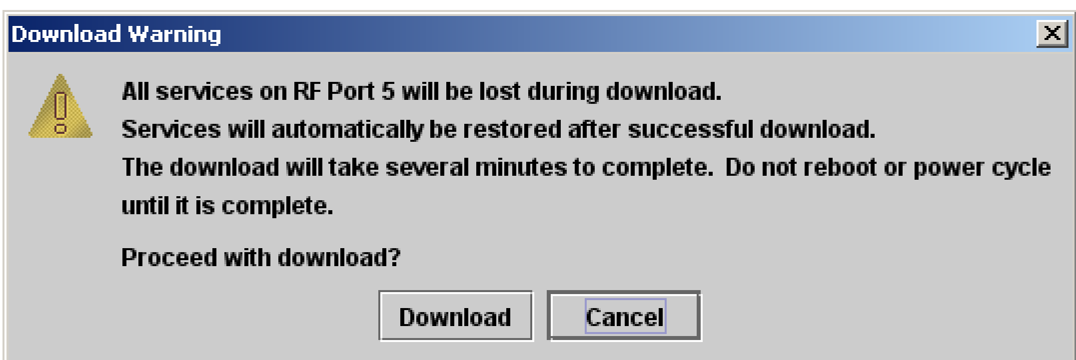
CAUTION *The download of a single QAM module (two QRMs) takes approximately five (5) minutes. During a download, the QAM channels are inactive and cannot be used.*

Figure 12-8 — QRM Download window



2. This screen will automatically refresh on a periodic basis. To update the progress between automatic updates, click **Refresh**.
3. To initiate download to a QRM, click **Download** for that QRM.

   The following pop-up displays:

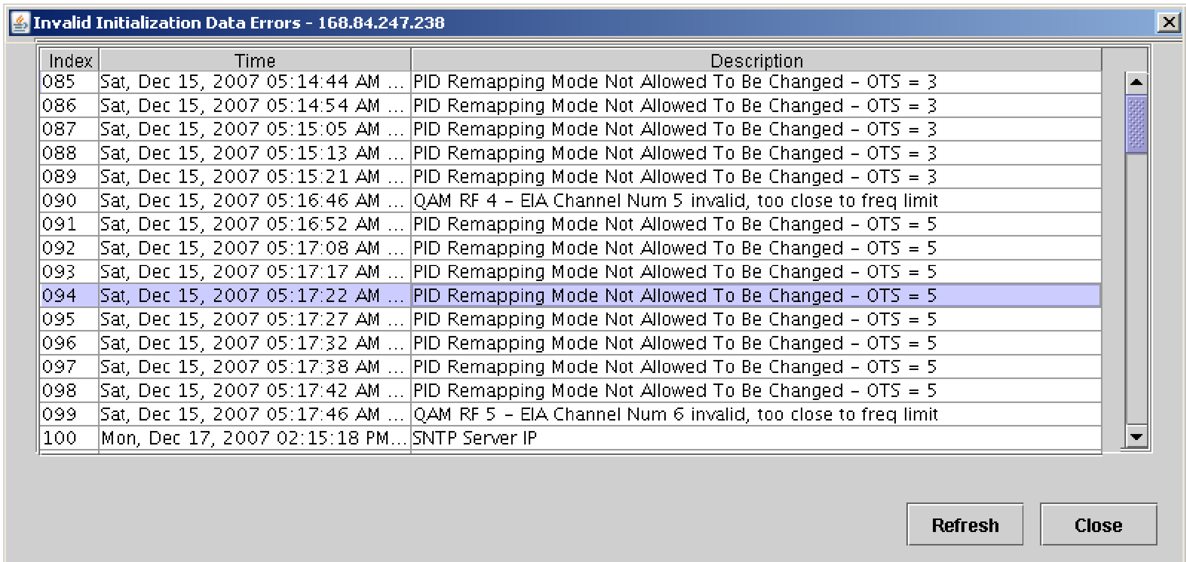


4. Click **Download** to continue, or **Cancel** to exit.
5. Use the QRM Download window to monitor progress.
6. To close the QRM Download window and exit after the procedure is complete, click **Close**. (Do not click **Close** while the download is in progress.)

Invalid Initializations

This window provides a read-only table of invalid initialization data errors:

Figure 12-9 — Invalid Initialization Data Errors



Index	Time	Description
085	Sat, Dec 15, 2007 05:14:44 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 3
086	Sat, Dec 15, 2007 05:14:54 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 3
087	Sat, Dec 15, 2007 05:15:05 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 3
088	Sat, Dec 15, 2007 05:15:13 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 3
089	Sat, Dec 15, 2007 05:15:21 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 3
090	Sat, Dec 15, 2007 05:16:46 AM ...	QAM RF 4 - EIA Channel Num 5 invalid, too close to freq limit
091	Sat, Dec 15, 2007 05:16:52 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
092	Sat, Dec 15, 2007 05:17:08 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
093	Sat, Dec 15, 2007 05:17:17 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
094	Sat, Dec 15, 2007 05:17:22 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
095	Sat, Dec 15, 2007 05:17:27 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
096	Sat, Dec 15, 2007 05:17:32 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
097	Sat, Dec 15, 2007 05:17:38 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
098	Sat, Dec 15, 2007 05:17:42 AM ...	PID Remapping Mode Not Allowed To Be Changed - OTS = 5
099	Sat, Dec 15, 2007 05:17:46 AM ...	QAM RF 5 - EIA Channel Num 6 invalid, too close to freq limit
100	Mon, Dec 17, 2007 02:15:18 PM...	SNTP Server IP

Note: A maximum of 100 errors can be recorded and displayed.

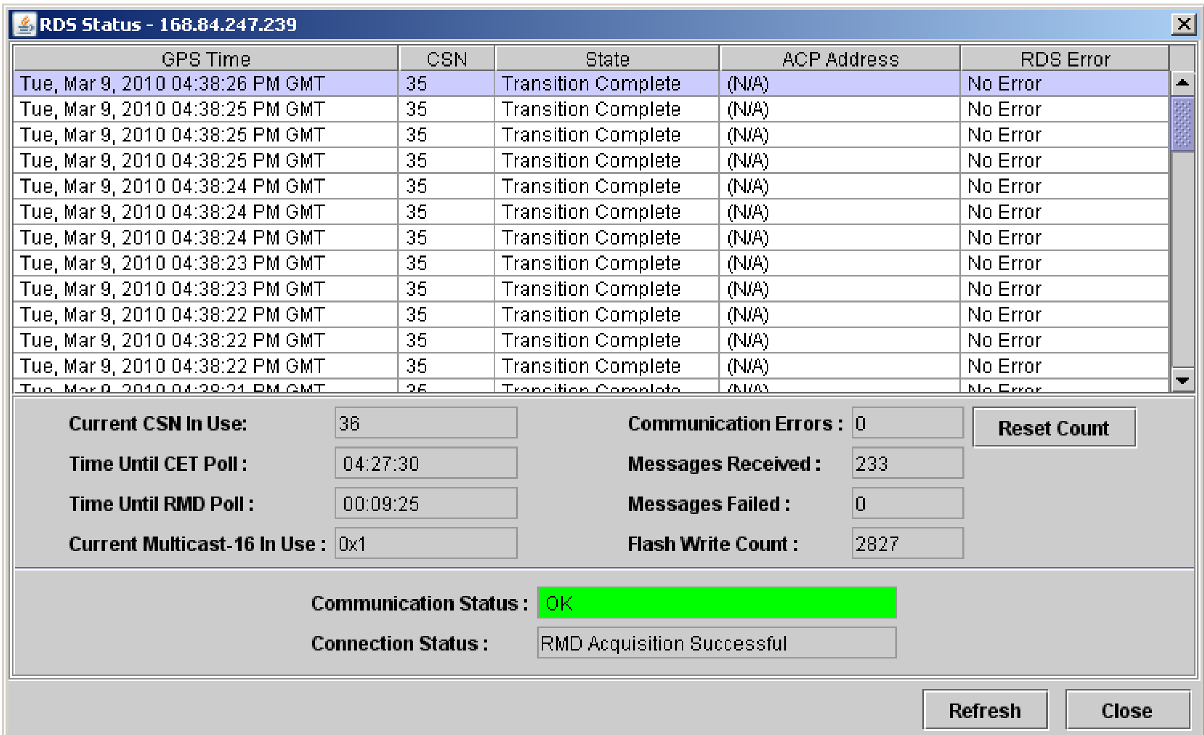
Invalid Initializations Data Errors window field definitions

Item	Definition
Index	Index to invalid initialization data table entry.
Time	Text string of the MIB variable name of the data item or table.
Description	Shows the table leaf to which the error pertains (when the data item is part of a table).

RDS Status

The RDS Status window displays information about the current and past encryption modes, as well as the current program epoch:

Figure 12-10 — RDS Status



RDS Status window field definitions

Item	Definition/Range
GPS Time	Shows the GPS time of the state transition.
CSN	Displays the current server CSN (Category Sequence Number) in use.
State	Shows the current state of the transition. Values are: • **Transition Complete** • **Transition Start** • **Start of New Epoch**
ACP Address	This is the address of the Access Control Processor (ACP) associated with the error reported by the Rights Data Server in the RDS Error column. *Note: If no address is contained in this entry, the error reported applies to all ACPs or to the entire APEX1000.*

Item	Definition/Range
RDS Error	RDS Communication Error – Cannot communicate with the RDS after three (3) polling attempts. *Alarm – Major. Clears when communication is successfully restored.*
Current CSN In Use (0-255)	This is the current Category Sequence Number (CSN) that the APEX is using for encrypting all programs. When the last poll indicates that the RDS server is starting or that it has completed a category epoch transition, the current CSN in use is one larger than the last CSN reported by the RDS server. Otherwise, the current CSN in use is equal to the last CSN reported by the RDS server.
Time Until CET Polls	Shows the time remaining until the next CET poll.
Time Until RMD Polls	Shows the time remaining until the next RMD poll.
Current Multicast-16 In Use	Displays the 16-bit address used for building PRKs (Program Rekey Messages).
Communication Errors	The number of times that the APEX was unable to establish communications with the Rights Data Server. A communication is considered to be in error after all user configurable RDS Polling Retry Counts have been exhausted. *This count resets at system boot. You can also manually reset it using the adjacent **Reset Counts** button.*
Reset Counts	Resets RDS communication error counts.
Messages Received	Shows the number of successful ServiceEncrypt Messages received in the last 15 minutes.
Messages Failed	Shows the number of failed ServiceEncrypt Messages received in the last 15 minutes.
Flash Write Count	Shows the running count of the number of Flash Memory erasures/writes.
Communication Status	Current communication status with RDS. Error state is set after the configured number of retries is reached. **OK** (1) **Error** (2)
Connection Status	State of communications with the DAC RDS for the purpose of retrieving EMMs or RMD. States can vary depending on the condition of the connection, and can include: • **Not Connected – In Initial Hold-off Period** • **Not Connected – No RDS IP Address Configured** • **CSN Acquisition Successful** • **EMM Acquisition Successful** • **Service List Acquisition Successful** • **RMD Acquisition Successful** • **CSN Acquisition Failed** • **EMM Acquisition Failed** • **Service List Acquisition Failed** • **RMD Acquisition Failed**

SFP Status

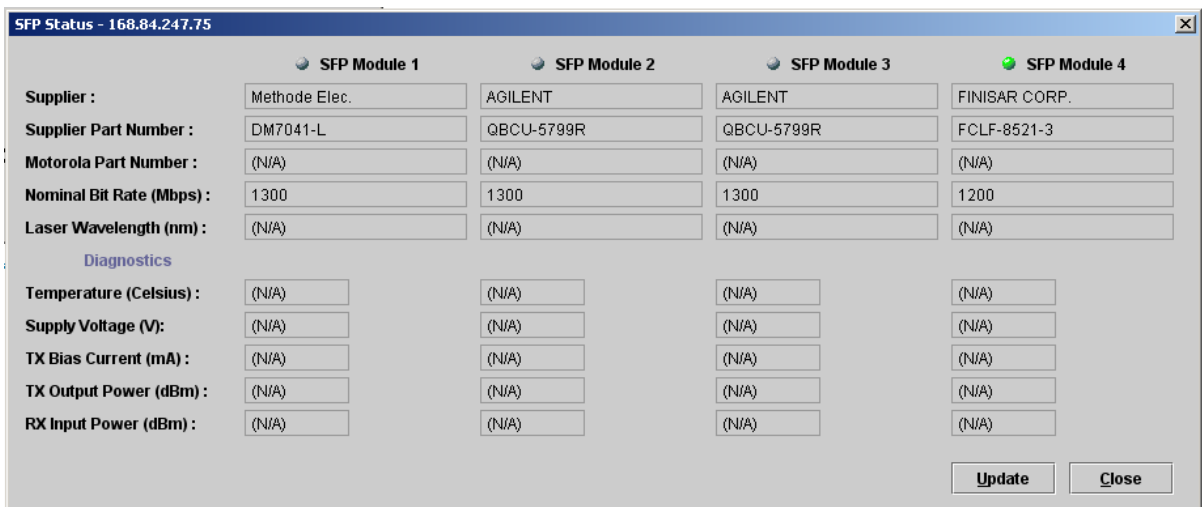
The APEX1000 can retrieve SFP configuration from the SFP memory. When a Motorola-certified SFP is inserted into the APEX chassis, the APEX1000 can read the SFP memory to obtain SFP company name, Motorola part number, and SFP revision.

The following table lists the four Motorola-certified SFPs which can be used with the APEX1000:

Wavelength	MOT part #	Manufacturer
850 nm	551742-002-00	Finisar
1310nm	551755-001-00	Finisar
1550nm	551767-001-00	Finisar
1000bT	551771-002-00	Methode

To display SFP status and diagnostic information, select **Status > SFP Status**:

Figure 12-11 — SFP Status



SFP Status window field definitions

Item	Definition
	Physical Data
Supplier	Displays the name of the SFP supplier.
Supplier Part Number	SFP supplier's part number.
Motorola Part Number	Motorola's part number.
Nominal Bit Rate (Mbps)	Nominal signaling rate to nearest 100 Mbps.
Laser Wavelength (nm)	Shows the device's laser wavelength.
	Diagnostics
Temperature (Celsius)	Shows the internally measured module temperature.
Supply Voltage (V)	Shows the internally measured supply voltage.
TX Bias Current (mA)	Shows the internally measured TX bias current.
TX Output Power (dBm)	Shows the measured TX output power.
RX Input Power (dBm)	Shows the measured RX input power.
Update	Click to refresh the information on the screen.

SFP configuration information is polled after boot-up or after communication is established with the module. The wavelength, vendor name, vendor part number, and vendor revision are then displayed on the EM screen. The other parameters become available on the APEX1000 MIB, and are recorded during a *status capture*.

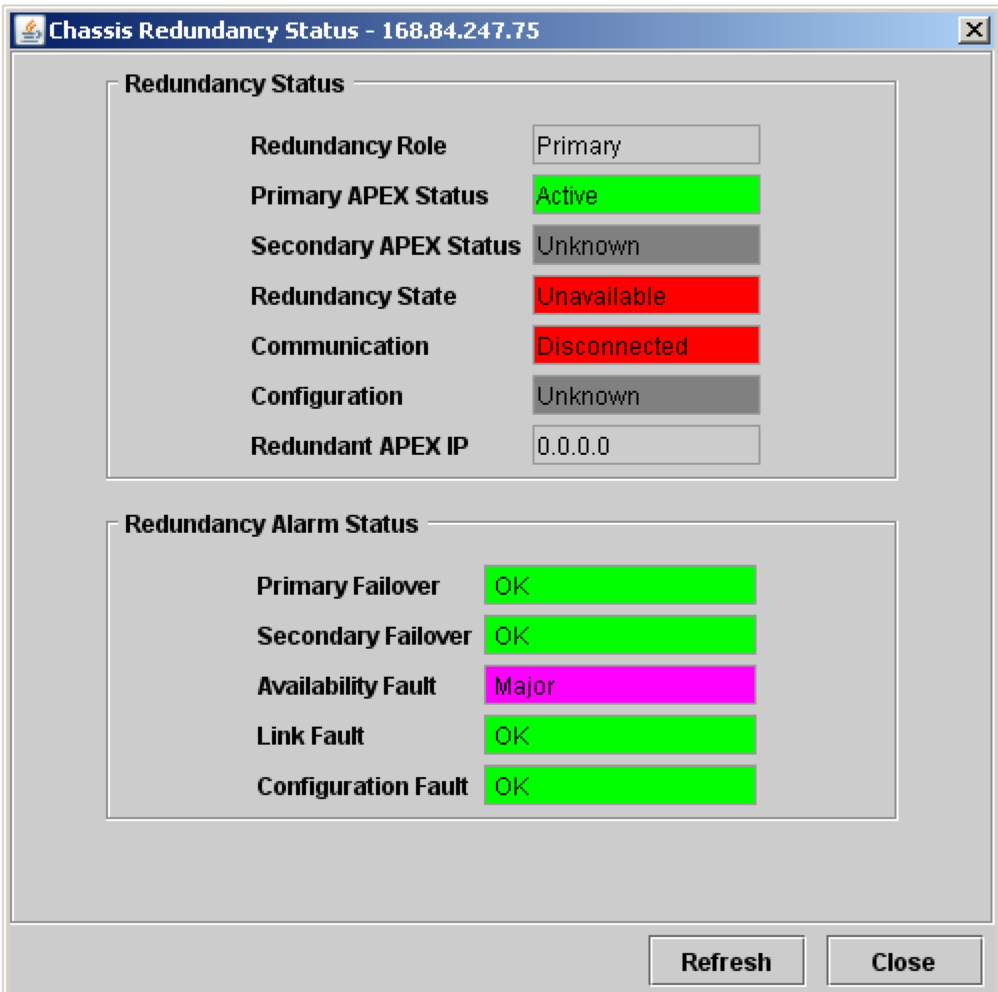
Note: Diagnostic parameters are updated once per second. Alarms and warnings set when measurements exceed vendor specified limits.

Chassis Redundancy Status

Redundancy status information is gathered from heartbeat message exchanged between the APEXs.

The graphic below illustrates a sample of the Chassis Redundancy Status screen:

Figure 12-12 — Chassis Redundancy Status



Chassis Redundancy Status window parameters

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td colspan="2">Redundancy Status</td></tr>
<tr><td>Redundancy Role</td><td>Describes the functional role of the designated APEX.
Values are:
• Primary – The APEX which is typically active
• Secondary – The APEX which is typically standing by</td></tr>
<tr><td>Primary APEX Status</td><td>Describes the functional state of the primary APEX. Values are:
• Unknown – State of the Primary is not known. (Heartbeat not received)
• Active – Primary RF outputs are active
• Standby – Primary RF outputs are muted. Waiting to become active
• Fault – The Primary has experienced a fault
• Suspended – User has enabled Suspend on the Primary APEX
The default is Standby.</td></tr>
<tr><td>Secondary APEX Status</td><td>Describes the functional state of the secondary APEX. Values are:
• Unknown – State of the Secondary is not known. (Heartbeat not received)
• Active – Secondary RF outputs are active
• Standby – Secondary RF outputs are muted. Waiting to become active
• Fault – Fault on the Secondary
• Suspended – User has enabled Suspend on the Secondary APEX
The default is Unknown.</td></tr>
<tr><td>Redundancy State/Availability</td><td>Shows the availability state of the 1:1 redundancy system.
Values are:
<table>
<tr><td>Available</td><td>1. Primary in active state received heartbeat from Secondary in standby state or
2. Secondary in active state received heartbeat from primary in standby state
• Configurations are synchronized
• No critical faults</td></tr>
<tr><td>Protected</td><td>1. Primary in fault state received heartbeat from Secondary in active state or
2. Secondary in fault state received heartbeat from Primary in active state
• Configurations are synchronized</td></tr>
<tr><td>Unavailable</td><td>• Timeout waiting for heartbeat from other APEX in redundancy pair
• Configuration not synchronized
• Primary or Secondary APEX in fault or suspend state</td></tr>
<tr><td>Synchronizing</td><td>• Synchronizing configuration between active and standby APEXs</td></tr>
</table>
</td></tr>
</table>

Parameter	Description
Communication	Values are: • **Disconnected** – No heartbeats have been received from secondary or communication timed out • **Connected** – Heartbeat has been received and communication has not timed out The default is Disconnected.
Configuration	Values are: • **Unknown** – State of secondary configuration is not applicable, or secondary not connected • **Synchronized** – Secondary has same configuration as primary (except for QAM outputs) • **Out of Sync** – Secondary configuration is not in sync with primary The default is Unknown.
Redundant APEX IP	Shows the IP address of the heartbeat interface in the redundancy pair.
Redundancy Alarm Status	
• **Primary Failover** • **Secondary Failover** • **Availability Fault** • **Link Fault** • **Configuration Fault**	Shows the current alarm state of these redundancy functions. This section of the window duplicates a portion of the APEX Alarms window.

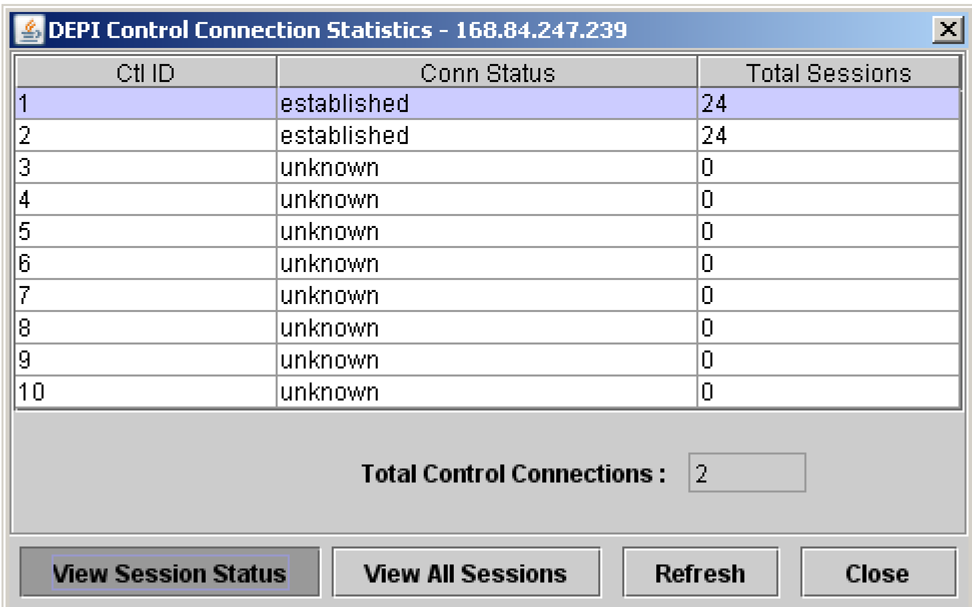
For further Redundancy Alarm Status details, reference Alarms Window Field Definitions.

DEPI Status

This window displays information on the status of the DEPI connections which are currently active in the system.

For access, select **Status > DEPI Status**.

Figure 12-13 — DEPI Status window



DEPI Status window field definitions

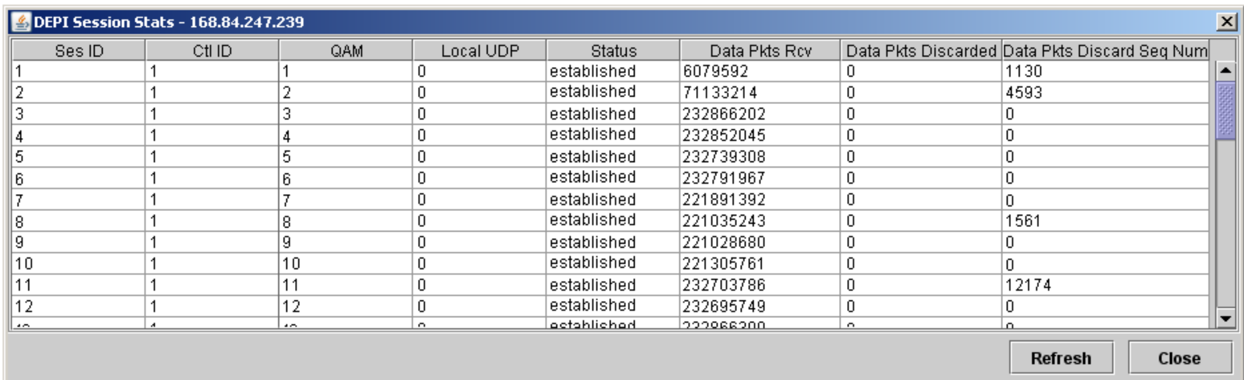
Item	Definition/Range
Ctl ID	Identifies the Control Connection.
Conn Status	Operational state for the connection, such as *Established* or *Unknown*.
Total Sessions	Counter for the number of DEPI sessions active within the corresponding control connection.
Total Control Connections	Counter for the number of control connections (independent connection to an M-CMTS Core entity) which are *active*.
View Session Status	Opens the DEPI Session Stats window to display status information specific for active sessions within the highlighted control connection.
View All Sessions	Opens the DEPI Session Stats window to display status information for *all* active sessions.

DEPI Session Stats Window

Use this window to displays information on the status of the DEPI sessions currently active in the system.

For access, select **View Session Status** in the DEPI Status window, to display status specific for a given control connection; alternatively, select **View All Sessions** to display status for all active sessions in the system:

Figure 12-14 — DEPI Session Stats window



Ses ID	Ctl ID	QAM	Local UDP	Status	Data Pkts Rcv	Data Pkts Discarded	Data Pkts Discard Seq Num
1	1	1	0	established	6079592	0	1130
2	1	2	0	established	71133214	0	4593
3	1	3	0	established	232866202	0	0
4	1	4	0	established	232852045	0	0
5	1	5	0	established	232739308	0	0
6	1	6	0	established	232791967	0	0
7	1	7	0	established	221891392	0	0
8	1	8	0	established	221035243	0	1561
9	1	9	0	established	221028680	0	0
10	1	10	0	established	221305761	0	0
11	1	11	0	established	232703786	0	12174
12	1	12	0	established	232695749	0	0

DEPI Session Stats window field definitions

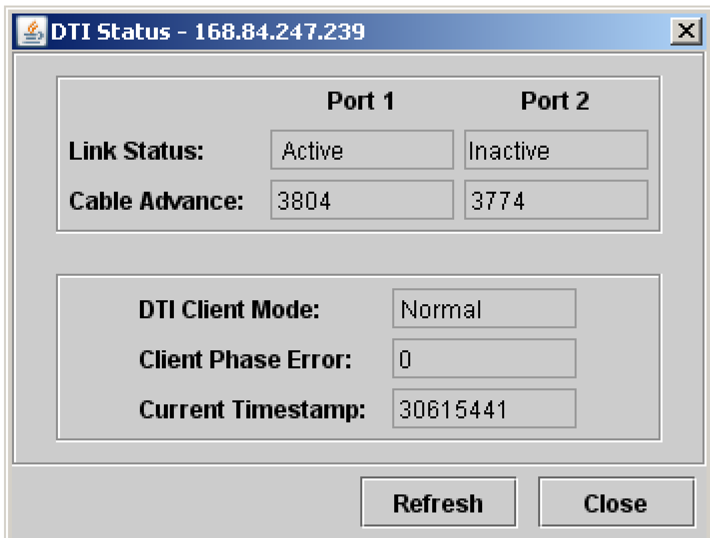
Item	Definition/Range
Ses ID	Identifies the DEPI session.
Ctl ID	Identifies the Control Connection.
QAM	Identifies the output transport stream linked to the specific DEPI session.
Local UDP	Identifies the incoming UDP port linked to the specific DEPI session. *This value is only meaningful if the session is configured to run over UDP.*
Status	Operational state for the connection, such as *Established* or *Unknown*.
Data Pkts Rcv	Number of data packets received belonging to the specific DEPI session.
Data Pkts Discarded	Number of data packets discarded in the specific DEPI session.
Data Pkts Discard Seq Num	Number of Data packets discarded due to a sequence number discontinuity in the specific DEPI session.

DTI Status

Use this window to displays information on the status of the DOCSIS Timing Interface parameters in the system. The DTI (DOCSIS Timing Interface) is the interface between the DOCSIS time server (DTI Server) and each DTI client, providing DOCSIS Time Stamps containing the 10.24 MHz Master Clock reference from an external time server.

For access, select **Status > DTI Status**:

Figure 12-15 — DTI Status window



Note: In the M-CMTS architecture, both the M-CMTS core and the EQAM are considered DTI clients.

DTI Status window field definitions

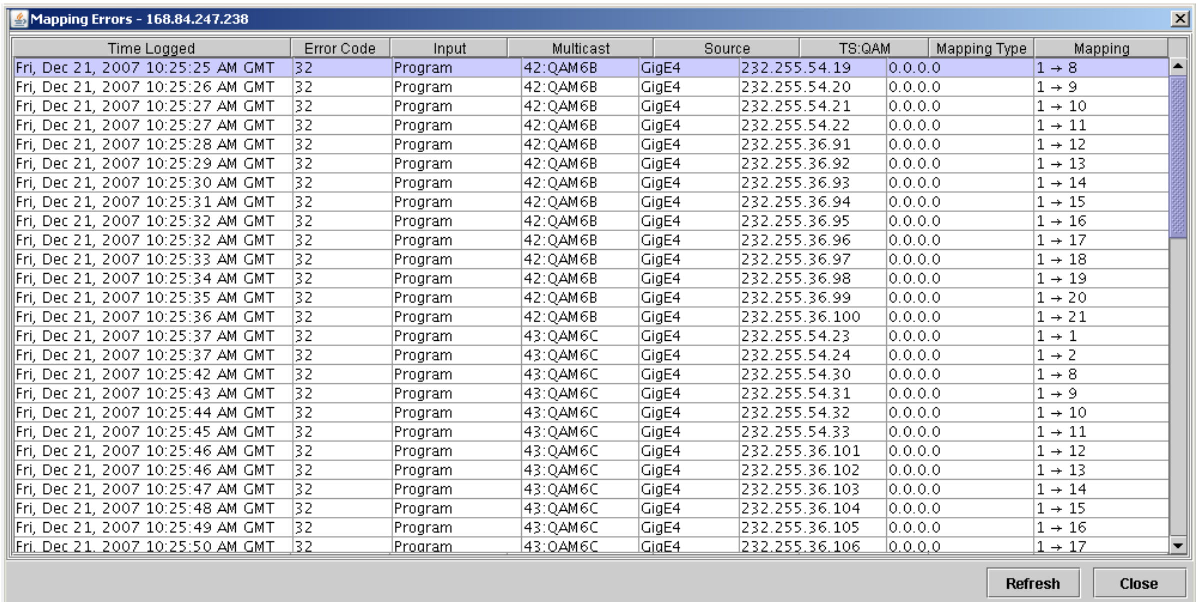
Item	Definition/Range
Link Status	Indicates the DTI link status for each of the DTI ports in the APEX.
Cable Advance	Indicates the current Cable Advance value last reported by the DTI server for each of the DTI ports in the APEX.
DTI Client Mode	Current DTI mode (such as *Free-run* or *Normal*) for the DTI client in the APEX.
Client Phase Error	Current Phase error value for DTI client in APEX. This value represents the error of its local clock with respect to the delay-corrected server frame clock.
Current Timestamp	Current Timestamp value for DTI client in APEX. This value represents the accurate timing value to be inserted in SYNC messages when required by specific DEPI session configuration.

Note: DTI clients may reside in M-CMTS devices, Edge QAM (EQAM) devices or Upstream Receivers.

Mapping Error Log

All Program Mappings and Ancillary PID Remapping errors are registered in the Mapping Errors log window:

Figure 12-16 — Mapping Errors window



Mapping Errors - 168.84.247.238

Time Logged	Error Code	Input	Multicast	Source	TS:QAM	Mapping Type	Mapping
Fri, Dec 21, 2007 10:25:25 AM GMT	32	Program	42:QAM6B	GigE4	232.255.54.19	0.0.0.0	1 → 8
Fri, Dec 21, 2007 10:25:26 AM GMT	32	Program	42:QAM6B	GigE4	232.255.54.20	0.0.0.0	1 → 9
Fri, Dec 21, 2007 10:25:27 AM GMT	32	Program	42:QAM6B	GigE4	232.255.54.21	0.0.0.0	1 → 10
Fri, Dec 21, 2007 10:25:27 AM GMT	32	Program	42:QAM6B	GigE4	232.255.54.22	0.0.0.0	1 → 11
Fri, Dec 21, 2007 10:25:28 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.91	0.0.0.0	1 → 12
Fri, Dec 21, 2007 10:25:29 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.92	0.0.0.0	1 → 13
Fri, Dec 21, 2007 10:25:30 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.93	0.0.0.0	1 → 14
Fri, Dec 21, 2007 10:25:31 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.94	0.0.0.0	1 → 15
Fri, Dec 21, 2007 10:25:32 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.95	0.0.0.0	1 → 16
Fri, Dec 21, 2007 10:25:32 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.96	0.0.0.0	1 → 17
Fri, Dec 21, 2007 10:25:33 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.97	0.0.0.0	1 → 18
Fri, Dec 21, 2007 10:25:34 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.98	0.0.0.0	1 → 19
Fri, Dec 21, 2007 10:25:35 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.99	0.0.0.0	1 → 20
Fri, Dec 21, 2007 10:25:36 AM GMT	32	Program	42:QAM6B	GigE4	232.255.36.100	0.0.0.0	1 → 21
Fri, Dec 21, 2007 10:25:37 AM GMT	32	Program	43:QAM6C	GigE4	232.255.54.23	0.0.0.0	1 → 1
Fri, Dec 21, 2007 10:25:37 AM GMT	32	Program	43:QAM6C	GigE4	232.255.54.24	0.0.0.0	1 → 2
Fri, Dec 21, 2007 10:25:42 AM GMT	32	Program	43:QAM6C	GigE4	232.255.54.30	0.0.0.0	1 → 8
Fri, Dec 21, 2007 10:25:43 AM GMT	32	Program	43:QAM6C	GigE4	232.255.54.31	0.0.0.0	1 → 9
Fri, Dec 21, 2007 10:25:44 AM GMT	32	Program	43:QAM6C	GigE4	232.255.54.32	0.0.0.0	1 → 10
Fri, Dec 21, 2007 10:25:45 AM GMT	32	Program	43:QAM6C	GigE4	232.255.54.33	0.0.0.0	1 → 11
Fri, Dec 21, 2007 10:25:46 AM GMT	32	Program	43:QAM6C	GigE4	232.255.36.101	0.0.0.0	1 → 12
Fri, Dec 21, 2007 10:25:46 AM GMT	32	Program	43:QAM6C	GigE4	232.255.36.102	0.0.0.0	1 → 13
Fri, Dec 21, 2007 10:25:47 AM GMT	32	Program	43:QAM6C	GigE4	232.255.36.103	0.0.0.0	1 → 14
Fri, Dec 21, 2007 10:25:48 AM GMT	32	Program	43:QAM6C	GigE4	232.255.36.104	0.0.0.0	1 → 15
Fri, Dec 21, 2007 10:25:49 AM GMT	32	Program	43:QAM6C	GigE4	232.255.36.105	0.0.0.0	1 → 16
Fri, Dec 21, 2007 10:25:50 AM GMT	32	Program	43:QAM6C	GigE4	232.255.36.106	0.0.0.0	1 → 17

Refresh Close

Mapping Errors window field definitions

Item	Definition
Time Logged	Displays the date, time, and the time zone that the error was logged.
Error Code	Displays a numerical value error code that corresponds to the fault condition. See Mapping Error Codes for a complete listing of possible error conditions.
Mapping Type	Displays the mapping type. Types: Program, Ancillary PID
TS:QAM	The Output Transport Stream numbers (1 – 16, 17 – 32, 33 – 48) and Output QAM channel.
Input	Number of the input type from which to obtain data (GigE 1 – 4 or Host 1 – 2).
Multicast	The Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Source	This is the IP address of the source device for multicast reception.
Mapping	Displays the mapping range *in->out*.

Mapping Error Codes

Error Code Reference Number	Error Description
1	OTS number out of range
2	OTS already pass-thru mapping
3	OTS already PID or Service mapping
4	Max service mappings on OTS reached
5	Max service mappings supported reached
6	Max PID mappings supported reached
7	MR mapping invalid – OTS not in MR mode
8	Output stream is not active, mappings not allowed
9	Invalid GigE UDP Port
10	Input Not Enabled - mappings not allowed
11	Input IF Port out of range for type
12	Input Type not supported
13	Invalid MC IP Address (reserved MC or invalid range)
14	Invalid Source IP Address (not Class A, B, or C)
15	Maximum number GigE input streams reached
16	Maximum number Host input streams reached
17	Primary input TS is already a Secondary TS
18	Primary Number of Source IPs per MC IP exceeded (4)
19	Secondary Number of Source IPs per MC IP exceeded (4)
20	Secondary on a Primary is already in use when adding sec
21	Secondary found on another Primary input TS when adding sec
22	Secondary is not enabled
23	Secondary is already in use as a Primary input stream
24	Secondary is already in use on another Primary input
25	Secondary is exact same stream as Primary

Error Code Reference Number	Error Description
26	Primary is already in use for a different type of routing
27	Pass Thru Enable set to invalid value
28	Service Enable set to invalid value
29	PID Enable set to invalid value
30	Source Specific IP cannot be assigned to this MC IP
31	Source Specific IP already assigned, non-zero Src IP not allowed
32	Output is not in required operating mode for usage
33	Invalid pre-encryption setting
34	Invalid input program number
35	Invalid output program number
36	Input program number 0 cannot be mapped, already mapping from input
37	Input program number already mapped to output
38	Input program number 0 is mapped from input, no other mappings allowed
39	Output program number is already in use (already mapped)
40	Invalid input PID number
41	Invalid output PID number
42	Output PID already in use
43	Duplicate output PID mapping
44	Duplicate input PID mapping
45	Output PID not in valid range (PID remapping only)
46	CAT PID can only be remapped to CAT PID value
47	Input and output PIDs not the same (PID remapping disabled)
48	Input PID already in use (mapped to same output)
49	Primary interface port number out of range
50	Primary interface port not enabled
51	Primary UDP port is invalid
52	Primary MC invalid

Error Code Reference Number	Error Description
53	Primary Source IP invalid
54	Primary low bit rate out of range
55	Primary high bit rate out of range
56	Rate Compare type invalid
57	Redundancy enable field invalid
58	Redundancy threshold invalid
59	Redundancy suspend invalid
60	Secondary interface port number out of range
61	Secondary interface port not enabled
62	Primary UDP port is invalid
63	Secondary MC invalid
64	Secondary Source IP invalid
65	Secondary low bit rate out of range
66	Secondary high bit rate out of range
67	MC Join setting invalid (currently not used)
68	Primary is already in use (duplicate row)
69	Primary is in use as a secondary already
70	Secondary is in use as a primary already
71	Secondary is already in use (duplicate row)
72	Secondary is already in use for a different type of routing
73	Primary and Secondary are not a pair
74	Invalid number of programs requested
75	Invalid starting program number requested
76	Invalid TS Offset
77	Invalid mode bits
78	Invalid Host FE UDP Port
79	FE UDP Port already assigned to another MC group/Source

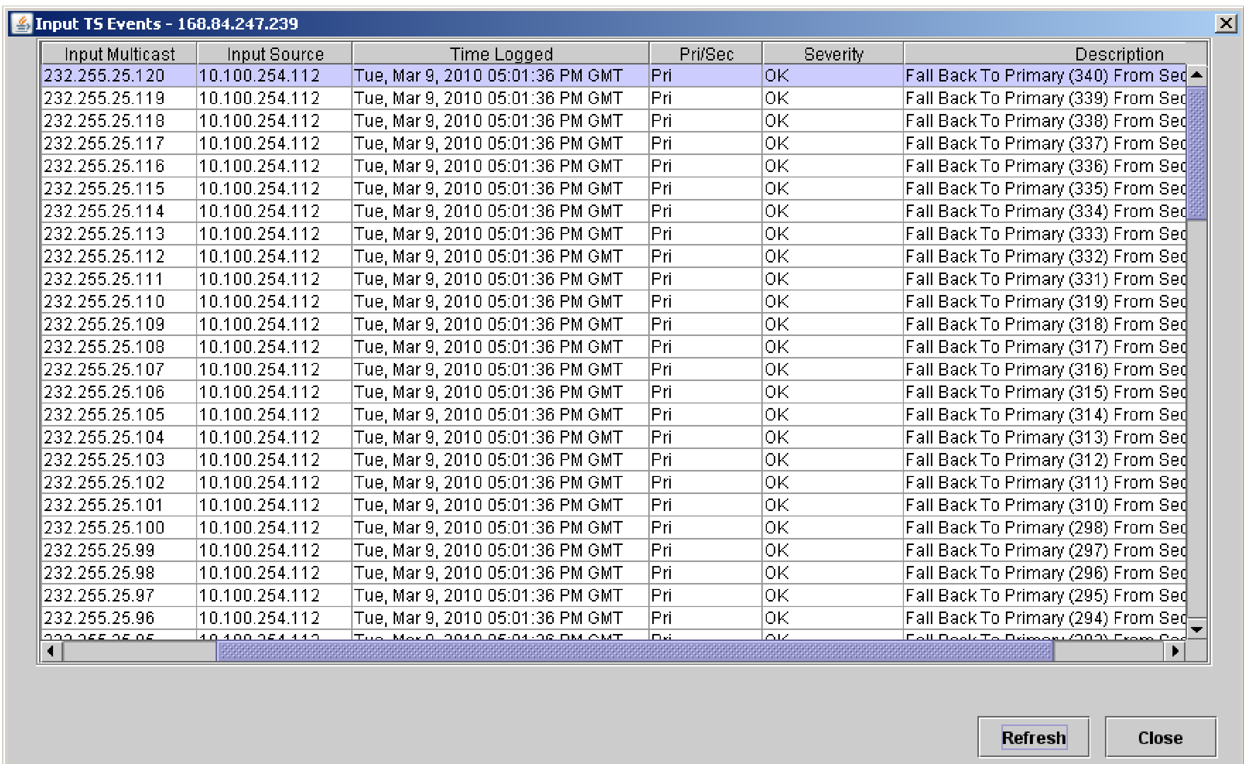
Error Code Reference Number	Error Description
80	FE Multicast IP is already in use on other interface
81	Invalid Provider ID
82	Invalid Source ID
83	Port in use for redundancy
84	Primary GigE interface not reported to ERM
85	Primary and Secondary input program numbers do not match
86	Multicast and Unicast counts invalid or unsupported
87	GigE input TS is assigned, no configuration changes allowed
88	GigE configuration entry is invalid (out of range)
89	GigE configuration – Duplicate IP Address
90	Output stream is in backup, mappings not allowed
91	Program Based output program number range exceeded
92	Invalid UDP Multicast Enable setting
93	Duplicate UDP Mapping Multicast Table entry
94	Unsupported change for UDP Multicast entry
95	Invalid data TS enable setting
96	Duplicate GigE Input Data TS entry
97	Invalid DEPI Control Map Enabled setting
98	DEPI Control configuration - Invalid DEPI Control ID
99	Cannot configure while CMTS connection established
100	Invalid DEPI Session Map Enabled setting
101	Cannot configure while CMTS data session established
102	DEPI Session(s) still assigned to Control ID
103	Duplicate DEPI TSID
104	DEPI UDP port out of range
105	DEPI Keepalive Timeout out of range
106	GigE Interface Redundancy is enabled

Error Code Reference Number	Error Description
107	Primary already opened with different redundancy type

Input TS Events

All Input Transport Stream events are registered in the Input TS Events window:

Figure 12-17 — Input TS Events window



Input Multicast	Input Source	Time Logged	Pri/Sec	Severity	Description
232.255.25.120	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (340) From Sec
232.255.25.119	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (339) From Sec
232.255.25.118	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (338) From Sec
232.255.25.117	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (337) From Sec
232.255.25.116	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (336) From Sec
232.255.25.115	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (335) From Sec
232.255.25.114	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (334) From Sec
232.255.25.113	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (333) From Sec
232.255.25.112	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (332) From Sec
232.255.25.111	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (331) From Sec
232.255.25.110	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (319) From Sec
232.255.25.109	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (318) From Sec
232.255.25.108	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (317) From Sec
232.255.25.107	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (316) From Sec
232.255.25.106	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (315) From Sec
232.255.25.105	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (314) From Sec
232.255.25.104	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (313) From Sec
232.255.25.103	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (312) From Sec
232.255.25.102	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (311) From Sec
232.255.25.101	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (310) From Sec
232.255.25.100	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (298) From Sec
232.255.25.99	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (297) From Sec
232.255.25.98	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (296) From Sec
232.255.25.97	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (295) From Sec
232.255.25.96	10.100.254.112	Tue, Mar 9, 2010 05:01:36 PM GMT	Pri	OK	Fall Back To Primary (294) From Sec

Input TS Events window field definitions

Item	Definition
Input IF	Specifies a GigE port (1 – 4) as the input interface.
Input UDP	The Gigabit Ethernet Input UDP Port. Range: 0 – 65535
Input Multicast	The Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0

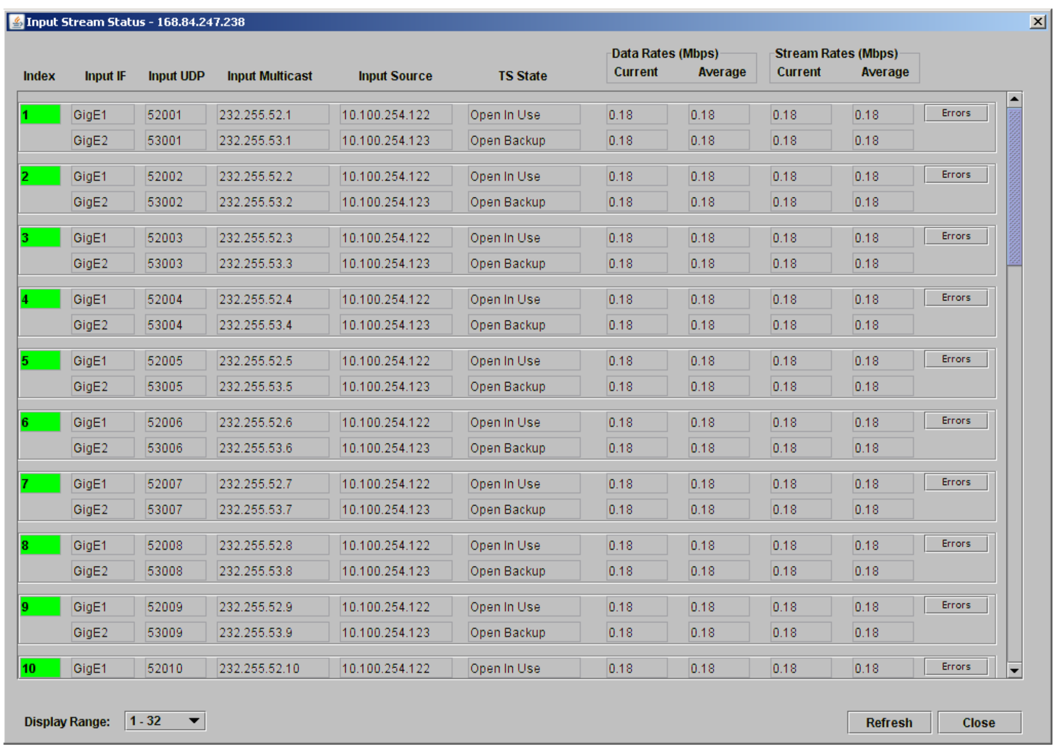
Item	Definition
Input Source	This is the IP address of the source device for multicast reception. *The source IP address must be a valid singlecast address.*
Time Logged	Displays the time when the event was logged.
Pri/Sec	Specifies if the event involves the Primary or Secondary TS.
Severity	Indicates the severity of the event.
Description	Provides a text description of the event, as shown in the example below: Fall Back To Primary (205) From Secondary (973) Primary TS (205) Above Threshold (90)

Input Stream Status

The Input Stream Status window can help you determine where GigE ports are used, by reporting the input UDP port data and/or stream rate of all GigE input streams in use.

The input stream rate is calculated by counting the number of MPEG packets received over a five second status period. The rate is then calculated by converting the MPEG packet counts into Megabits per second (Mbps).

Figure 12-18 — Input Stream Status

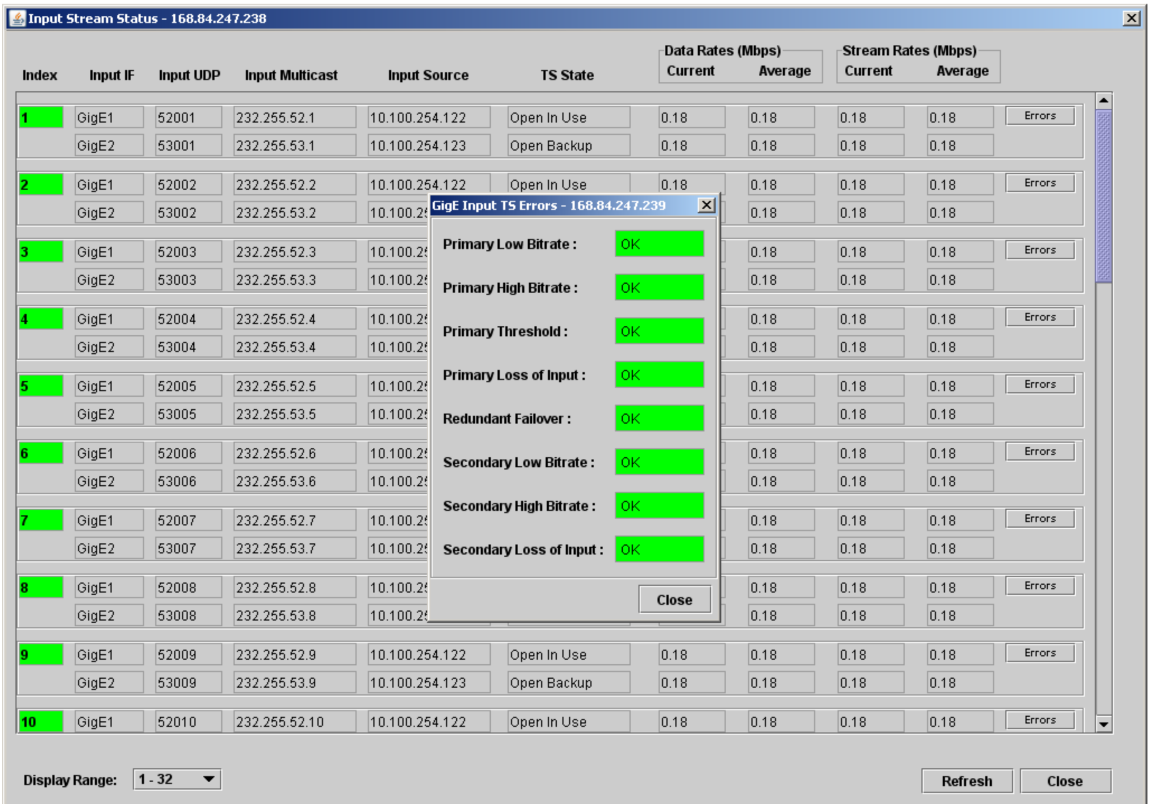


Input Stream Status window field definitions

Item	Definition
Index	Identifies the window line item. Range: 1 – 784 *Caution: Number series 769 – 784 is reserved for FastE Stream Status.*
Input Interface	Specifies a GigE port (1 – 4) or Host port (1 – 2) as the input interface.
Input UDP	Shows the Input UDP Port.
Input Multicast	The Multicast receive IP address: • Valid Range: 224.0.1.0 – 239.255.255.255 • Reserved: 224.0.0.0 – 224.0.0.255 • Not used: 0.0.0.0
Input Source	This is the IP address of the source device for multicast reception. The source IP address must be a valid singlecast address.
TS State	Displays the transport stream state: • **Open in use** • **Open Backup** • **Closed**
***Data Rates (Mbps) — Current**	Current data rate of the most recently taken sample. (1 – 16 Mbps, depending on the number of streams being monitored.)
***Data Rates (Mbps) — Average**	Average utilization over this sampling interval in bps. This is the average data rate over the last 15 minutes (sampling interval is a sliding 15 minute interval).
***Stream Rates (Mbps) — Current**	Stream rate of the most recent sample in Mbps.
***Stream Rates (Mbps) — Average**	Average stream rate over the sampling period in Mbps.
Errors button	Displays the Input TS Errors pop-up window.
Display Range	Allows user to select which group of 32 input streams (out of 784 available) to display in the Input Stream Status window.
Refresh	Click to update the information on the screen.

Input TS Errors Pop-up Window

Clicking any of the **Errors** buttons in the Input Stream Status window displays a corresponding pop-up, which indicates current conditions for that particular line item:



GigE MPTS Alarms and Traps

There are three alarms and traps associated with GigE MPTS redundancy and input stream monitoring. These alarms and traps inform you whenever a threshold event, a Primary to Secondary failover event, or a GigE input stream low bit rate event occurs.

- The **Threshold** alarm is set to Critical whenever any Primary input stream falls below the specified threshold percentage. The alarm clears when all Primary input streams are above the threshold level. A trap is issued for the *first* threshold event.
- The **Primary Failover to Backup** alarm is set to Critical whenever any Primary input stream fails over to the backup (secondary) stream. The alarm clears when all redundant pairs fallback to the Primary input stream. A trap is issued for the *first* failover event.

- The **Low Bit Rate Alarm** is set to Critical whenever any GigE input stream falls below the specified input data rate. For MPTS Redundancy, this alarm's purpose is to alert users that the Secondary stream *is no longer available*. However, this alarm can also indicate a low Primary input rate, in the event that the data rate drops *at the same time* for both the Primary and Secondary input streams. The alarm clears when all input streams are above the specific low bit rate.

Low Bit Rate Alarm

You can configure any GigE input stream to have the input rate monitored for a low bit rate by using the same window as redundancy is configured, but you only need to select a low bit rate and a comparison type (data rate or stream rate). The APEX1000 will then set an alarm and issue a trap whenever any GigE input stream falls below the specified low bit rate.

- An overall alarm is maintained to indicate the status of all input streams being monitored.
- Traps are issued for each input stream when the alarm condition for that input stream changes.

Low Bit Rate Error Factor

The low bit rate checking uses a five percent error factor based on the input rate you enter. In view of the fact that the input GigE packet counts are done *prior* to network de-jittering (due to fluctuations in the network), the low bit rate needs to allow for variations in the actual rate. The APEX1000 takes the rate you enter and multiplies this by 95% to calculate the actual rate that will be used for comparison against the actual input rate. This five percent error factor allows for enough deviation to prevent unwanted alarms, while at the same time allowing for the alarming of *real* low bit rate streams.

The five percent error factoring is done internally by the APEX1000, rather than requiring a user to know what a specific input rate should be. Typically, for an input stream rate of 38.81, various users would enter this low bit rate as 38.8, 38.8107, 38.0, etc. This error factor also removes this issue from the user, thereby preventing unintentional alarms.

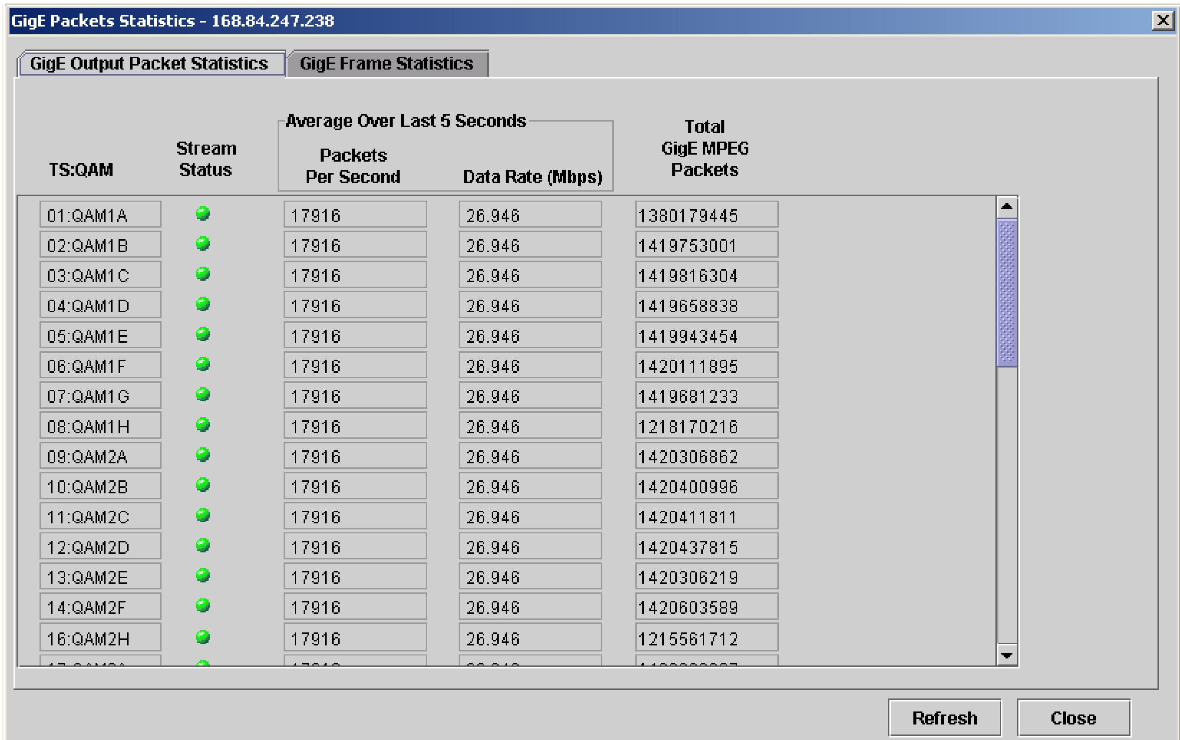
For example, factors for the rates listed above would yield the following low bit rate alarm levels:

1. — 38.8 Mbps = 36.86 Mbps
2. — 38.81 Mbps = 36.8695 Mbps
3. — 38.0 Mbps = 36.1 Mbps

GigE Packet Statistics

The GigE Output Packet Statistics screen provides information on the amount of data received through a GigE input and routed to specific output streams:

Figure 12-19 — GigE Output Packet Statistics



The data rates shown in the preceding graphic are based on the amount of non-null MPEG packets received by the GigE and routed to an output stream. This window is useful in determining the amount of MPEG data received by the GigE and routed to each output transport stream.

Note: This number does not include PSI insertion, such as PATs, PMTs, ECMs, etc..

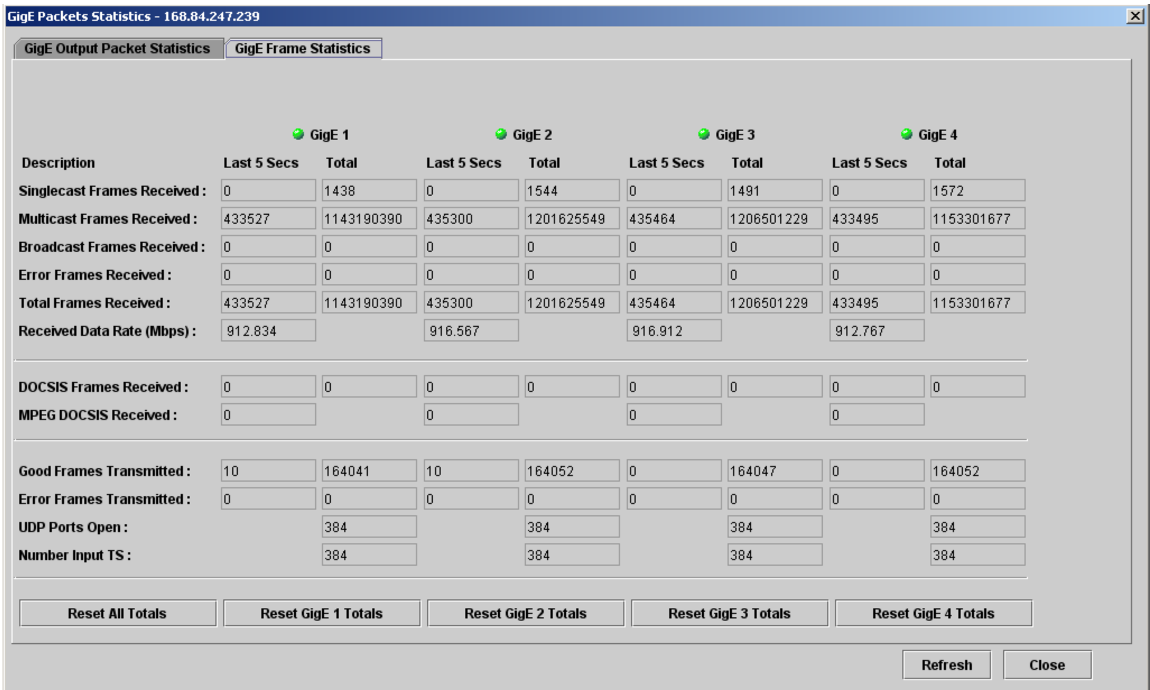
GigE Output Packet Statistics screen field definitions

Item	Definition
TS:QAM	The Output Transport Stream number and Output QAM channel.
Stream Status	Summary of the possible alarms associated with an output stream, such as: • Output Stream Overflow • Output Stream Threshold • Output Stream Host IP Overflow • QAM Fault • Upconverter Fault The highest current fault is indicated by each LED. The alarm indications are as follows: • **Green** – no alarm • **Gray** – cause of alarm is indeterminate • **Yellow** – warning • **Blue** – minor • **Magenta** – major • **Red** – critical If an LED alarm indication is active, display the Alarms window to determine which of the above Output Transport Stream alarms is causing the event.
***Packets Per Second**	Number of GigE MPEG packets routed from GigE input to an output stream in the last second.
***Data Rate (Mbps)**	Data rate of GigE MPEG packets routed from GigE input to an output stream.
***Total GigE MPEG Packets**	Total number of GigE MPEG packets routed from GigE input to an output stream.
Refresh	Click to update the information on the screen.
**Average is taken over the preceding five seconds.*	

GigE Frame Statistics

The GigE Frame Statistics screen provides five second interval and total frame counter statistics:

Figure 12-20 — GigE Frame Statistics



GigE Frame Statistics screen field definitions

Item	Definition	
Frames Received	• **Singlecast** • **Multicast** • **Broadcast** • **Error** • **Total**	**Last 5 Secs** – shows the number of singlecast frames received during the last status checking interval (five seconds). **Total** – shows the total number of singlecast frames received since last reset.
Received Data Rate (Mbps)	Received date rate in Mbps during the last status checking interval (five seconds).	
Frames Received	• **DOCSIS** • **MPEG DOCSIS**	**Last 5 Secs** – shows the number of singlecast frames received during the last status checking interval (five seconds). **Total** – shows the total number of singlecast frames received since last reset.

Item	Definition
• **Good Frames Transmitted** • **Error Frames Transmitted**	**Last 5 Secs** – shows the number of good frames transmitted during the last status checking interval (five seconds). **Total** – shows the total number of good frames transmitted since last reset.
UDP Ports Open	**Total** – shows the total number of UDP ports currently open.
Number Input TS	**Total** – shows the total number of Input TSs currently open.
Reset buttons	Use to *Reset All* (or each individual GigE 1 – 4) totals.

GigE Buffer Statistics

The APEX1000 uses the GigE frame buffer to hold frames while its de-jittering algorithm performs time-based recovery. This algorithm attempts to correct the timing errors on the incoming MPEG streams, principally caused by the following factors:

- **PCR Jitter** — program clock reference
- **Clock Skew** — the relative difference in clock accuracy of devices in the processing chain that either creates or alters the PCRs
- **Network Jitter** — a variation in delay of received packets

The de-jittering algorithm will attempt to determine the intended rate of the incoming transport stream. The GigE will then de-jitter this stream and make the necessary PCR corrections in the stream before it is transmitted as an output stream. The de-jittering algorithm uses incoming PCRs as a variable in the calculation of the intended incoming stream rate.

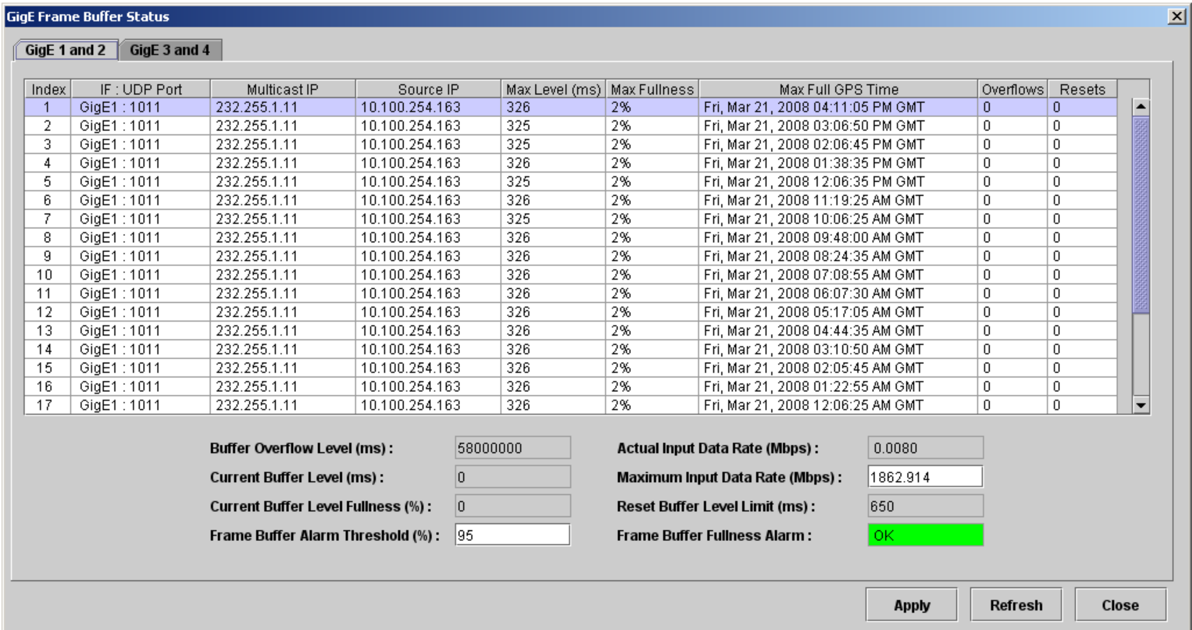
Note: If incoming PCRs are incorrect, the de-jittering algorithm will calculate the wrong stream rate, and the associated frames will be taken out of the buffer at the wrong rate.

- The *initial frame buffer level* is configured by the user based on the nominal buffer level setting. The default nominal buffer level is designed to prevent under runs, as well as be low enough to prevent frame buffer overflows.
- The *input data rate setting* helps to define the overflow and reset level of each input buffer. The default input data rate setting is designed to allow for the maximum amount of MPEG data to be received and buffer each input stream for up to 650ms.

CAUTION *The default configuration settings have been carefully selected to prevent both under runs and overflows of the GigE frame buffers. Motorola recommends that you do not change these settings.*

The GigE Frame Buffer Status window (illustrated in Figure 12-21) shows information on the current GigE frame buffer level and input data rates. This window also logs the maximum values from the last 24 hours.

Figure 12-21 — GigE Frame Buffer Status



Index	IF : UDP Port	Multicast IP	Source IP	Max Level (ms)	Max Fullness	Max Full GPS Time	Overflows	Resets
1	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 04:11:05 PM GMT	0	0
2	GigE1 : 1011	232.255.1.11	10.100.254.163	325	2%	Fri, Mar 21, 2008 03:06:50 PM GMT	0	0
3	GigE1 : 1011	232.255.1.11	10.100.254.163	325	2%	Fri, Mar 21, 2008 02:06:45 PM GMT	0	0
4	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 01:38:35 PM GMT	0	0
5	GigE1 : 1011	232.255.1.11	10.100.254.163	325	2%	Fri, Mar 21, 2008 12:06:35 PM GMT	0	0
6	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 11:19:25 AM GMT	0	0
7	GigE1 : 1011	232.255.1.11	10.100.254.163	325	2%	Fri, Mar 21, 2008 10:06:25 AM GMT	0	0
8	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 09:48:00 AM GMT	0	0
9	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 08:24:35 AM GMT	0	0
10	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 07:08:55 AM GMT	0	0
11	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 06:07:30 AM GMT	0	0
12	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 05:17:05 AM GMT	0	0
13	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 04:44:35 AM GMT	0	0
14	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 03:10:50 AM GMT	0	0
15	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 02:05:45 AM GMT	0	0
16	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 01:22:55 AM GMT	0	0
17	GigE1 : 1011	232.255.1.11	10.100.254.163	326	2%	Fri, Mar 21, 2008 12:06:25 AM GMT	0	0

GigE Frame Buffer Status window field definitions

Item	Definition
Index	Identifies the window line item.
Interface: UDP Port	Shows the GigE interface and UDP port that experienced the highest buffer level for the hour.
Multicast IP	Shows the multicast IP address.
Source IP	Shows the source IP address.
Max Level (ms)	Displays the maximum GigE frame buffer level (in milliseconds) recorded for the hour.
Max Fullness	Displays the maximum GigE frame buffer level (as a percentage of Buffer Overflow Level) recorded for the hour.
Max Full GPS Time	Displays the GPS time when this table entry was last updated.

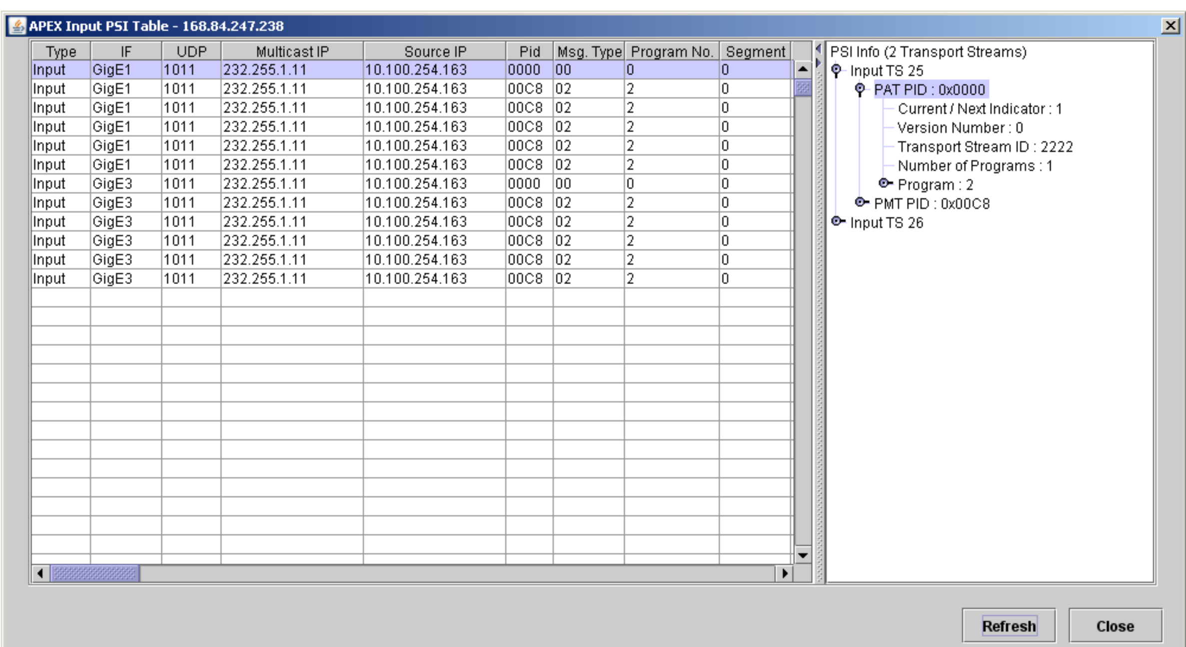
Item	Definition
Overflows	Displays the number of GigE frame buffer overflows recorded for the hour. The count of overflows is calculated based on the actual input data rate and the configured buffer level. It is assumed that if the input data rate exceeds the calculated buffer level, then the input has overflowed one or more GigE buffers. The APEX1000 is designed to reset a GigE frame buffer prior to overflowing. The maximum input data rate and nominal buffer settings are used to calculate the size of the GigE frame buffers. If an overflow occurs prior to a reset, then the APEX1000 has been incorrectly configured the (input data rate setting is incorrect).
Resets	Displays the number of frame buffer resets reported by the GigE processor for the hour. A reset of a buffer indicates that a number of GigE frames have been dropped, likely resulting in visible tiling or glitching. *Note: Any tiling or glitching should appear only momentarily, as it will take some time before the GigE buffers become full enough to reset.* Resets of the GigE frame buffers are not normal and indicate the APEX1000 is incorrectly configured and/or the input data rate exceeds the maximum recommended rate. Additionally, erratic or incorrect PCR values may also cause resets, due to forcing the APEX1000 to increase the buffer level based on the incorrect PCR values.
Buffer Overflow Level (ms)	This is the point (in milliseconds) at which the GigE frame buffer will overflow. This value is based on the number of received frames per second for all interfaces.
Current Buffer Level (ms)	Current highest GigE frame buffer level (in milliseconds).
Current Buffer Level Fullness (%)	Current highest GigE frame buffer level as a percentage of Buffer Overflow Level.
Frame Buffer Alarm Threshold (%)	User defined threshold representing a percentage of Buffer Overflow level. If this threshold is exceeded, a Gigabit Ethernet Frame Buffer Fullness alarm will be issued.
Actual Input Data Rate (Mbps)	Gigabit Ethernet MPEG input data rate (in Mbps). This is the total amount of MPEG data currently being received by all Gigabit Ethernet interfaces.
Maximum Input Data Rate (Mbps)	Maximum Gigabit Ethernet MPEG input data rate (in Mbps). This is the total amount of MPEG data expected to be received by all Gigabit Ethernet interfaces. This data rate is used to determine the Reset Buffer Level Limit. *Caution: The default setting of 1.8 Gbps is the maximum recommended data rate for all GigE inputs. Exceeding this rate may cause the GigE frame buffers to overflow or reset, resulting in dropped packets (glitching and/or tiling).*

Item	Definition
Reset Buffer Level Limit (ms)	Level at which the GigE frame buffer will be reset (in milliseconds). This value is based on the Maximum Input Data Rate. The APEX1000 calculates this level using the input data rate and the total number of GigE frame buffers. This limit is calculated to force a reset to prevent a GigE frame buffer overflow. *Note: A reset of the GigE frame buffers will result in a momentary glitch; however, this is preferred, instead of a buffer overflow that will cause glitching until the level drops or the buffer is reset.* In normal operation, it is expected that this level will never be reached or exceeded. Exceeding this level indicates that the APEX1000 is either incorrectly configured (incorrect input data rate) and/or the input to the APEX1000 exceeds the maximum recommended data rate.
Frame Buffer Fullness Alarm	**Major** – Current Buffer Level Fullness has exceeded the Frame Buffer Alarm Threshold. **Critical** – Current Buffer Level has exceeded the Buffer Overflow Level.
Refresh	Click **Refresh** to update the information on the screen.

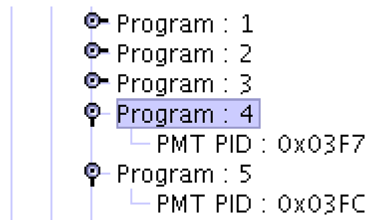
Input PSI Table

The following table contains a list of program-specific information messages that are extracted from the APEX1000 inputs. All messages extracted from APEX1000 inputs that are being used by the APEX1000 are displayed (PATs, PMTs, and PITs):

Figure 12-22 — Input PSI Table



Note: Clicking on a row in the left pane will highlight and expand the appropriate node in the right pane's tree, as shown below:



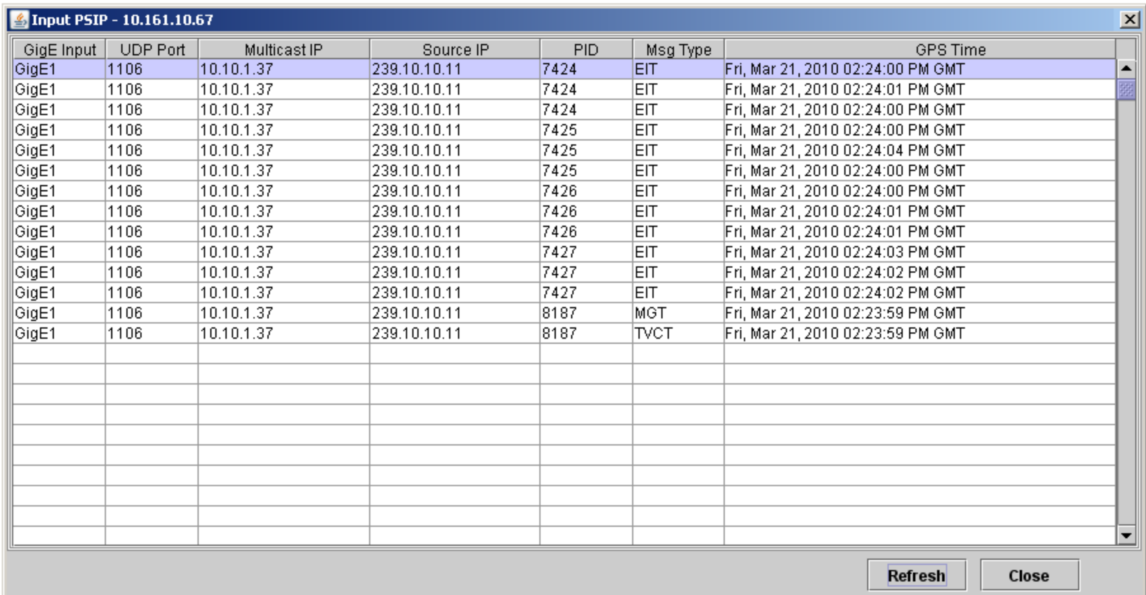
Input PSI Table window field definitions

Item	Definition
Type	Indicates whether this message comes from an APEX1000 input or output, or if the source is unknown.
IF	Indicates the input interface (GigE 1 – 4 or Enet 1 – 2) port ID for which this message applies.
UDP	Displays the Gigabit Ethernet Input UDP Port (User Datagram Protocol). Range: 0 – 65535
Multicast IP	Shows the Gigabit Ethernet Receive Multicast IP Address.
Source IP	Shows the Gigabit Ethernet Source IP Address.
PID	Shows the input PID Number.
Msg. Type	Displays the *message type* of the message being inserted.
Program No.	Indicates the program number in the input transport stream. When the message is related to a program, it indicates the program number. *If the message is not related specifically to a program, this value is zero.*
Segment	Indicates the segment number of this message, which is useful for PAT messages.
Part	The 1024 bytes of a message can be divided into parts, which are indexed with this field.
Time	Displays the time the message was logged.
Message	Displays raw data stream of the message.
In TS	Shows the input TS number.

Input PSIP

The following table contains a list of messages that are extracted from the APEX1000 input PSIP:

Figure 12-23 — Input PSIP window



GigE Input	UDP Port	Multicast IP	Source IP	PID	Msg Type	GPS Time
GigE1	1106	10.10.1.37	239.10.10.11	7424	EIT	Fri, Mar 21, 2010 02:24:00 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7424	EIT	Fri, Mar 21, 2010 02:24:01 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7424	EIT	Fri, Mar 21, 2010 02:24:00 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7425	EIT	Fri, Mar 21, 2010 02:24:00 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7425	EIT	Fri, Mar 21, 2010 02:24:04 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7425	EIT	Fri, Mar 21, 2010 02:24:00 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7426	EIT	Fri, Mar 21, 2010 02:24:00 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7426	EIT	Fri, Mar 21, 2010 02:24:01 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7426	EIT	Fri, Mar 21, 2010 02:24:01 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7427	EIT	Fri, Mar 21, 2010 02:24:03 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7427	EIT	Fri, Mar 21, 2010 02:24:02 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	7427	EIT	Fri, Mar 21, 2010 02:24:02 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	8187	MGT	Fri, Mar 21, 2010 02:23:59 PM GMT
GigE1	1106	10.10.1.37	239.10.10.11	8187	TVCT	Fri, Mar 21, 2010 02:23:59 PM GMT

Input PSIP window field definitions

Item	Definition
GigE Input	Shows the number of GigE input for this PSIP message.
UDP Port	Shows the UDP Port for this PSIP message.
Multicast IP	Shows the Multicast IP address for this PSIP message.
Source IP	Indicates the Source ID of EIT tables. *Note: When a message is not specifically related to a program, this value is 0.*
PID	Indicates the PID in which this message is contained.
Msg Type	Indicates the PSIP message type: • **199** – MGT • **200** – TVCT • **201** – CVCT • **203** – EIT • **202** – RRT • **205** – ST
GPS Time	The GPS time when the PSIP message was added to the table.

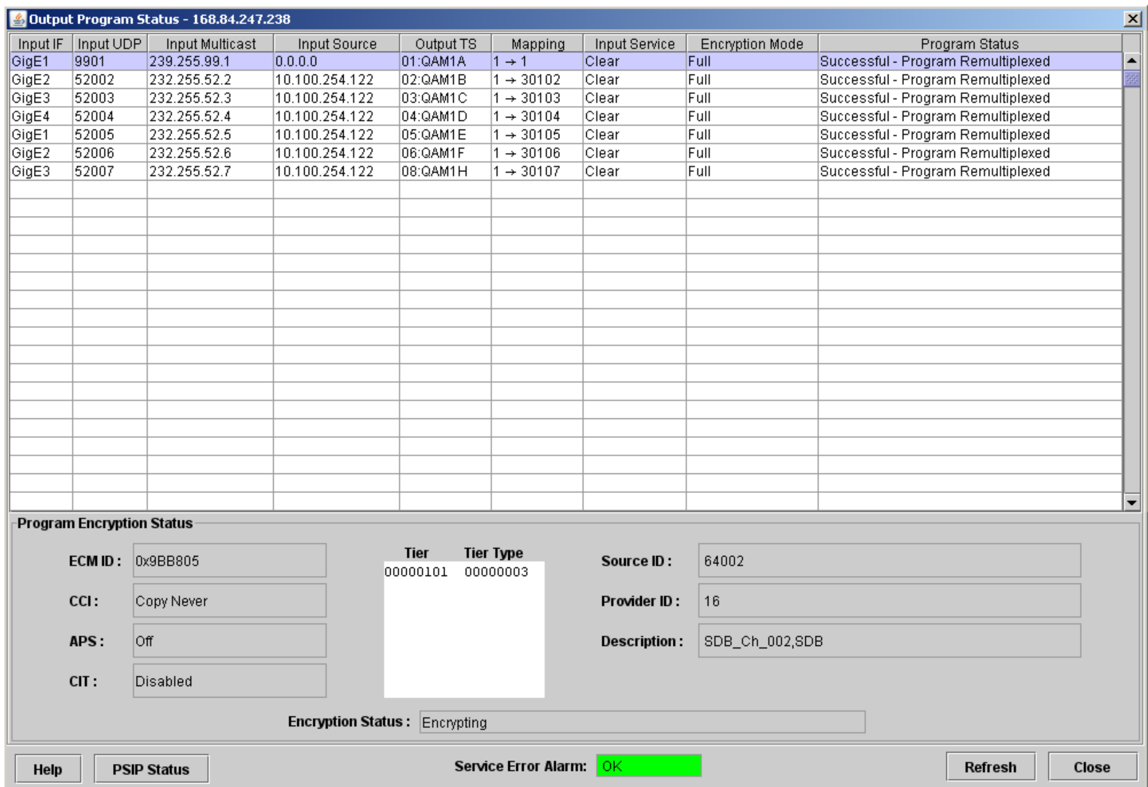
Output Program Status

This window can help you determine the status of all mapped programs. The APEX1000 maps input programs to output streams in the same manner, regardless of the Operating mode. The Output Program Status window shows the programs that are being remapped to a particular output stream.

The Output Program Status window also shows:

- The current encryption mode (if any)
- The current encryption status of each program

Figure 12-24 — Output Program Status



Each input program is mapped to an output stream, as follows:

1. Input PAT is extracted.
2. Using the input PAT, the corresponding input program number is used to find the input PMT PID.
3. Using the input PMT PID, the input PMT is extracted.
4. Using the input PMT, the component PIDs and PCR PID are identified and remapped or remultiplexed to the specified output. The PID values are changed depending on the PID Remapping configuration parameter.

5. If the input program is pre-encrypted, and pre-encryption has been selected, then the ECM PID is also remapped or remultiplexed to the specified output stream. Additionally, the PIT PID is extracted and reinserted into the output stream (the output program number in the PIT is updated).
6. If the output program is being encrypted (input program is not pre-encrypted), then the APEX1000 will mark the component PIDs with the appropriate scrambled control bit settings and encrypt the payload of the component PIDs. Additionally, ECM messages such as the PRK and WKE are inserted.
7. The output PAT and PMT are updated and inserted to contain the appropriate PID and program number references.

Output Program Status window field definitions

Item	Definition
Input Interface	Specifies a GigE port (1 – 4) or Enet port (1 – 2) as the input interface.
Input UDP	Identifies the input UDP port for a service (UDP port opened to receive service).
Input Multicast	Shows the Receive Multicast IP Address.
Input Source	Shows the Source IP Address.
Output TS	This column replicates the transport stream-to-output interface selections made in the APEX1000 Output Transport Stream Configuration window. *This is the output stream that the input program is being mapped to.*
Input Service	Indicates the input service as *clear or pre-encrypted*. Only applicable when the program mapping has been configured to check for pre-encryption.
Encryption Mode	Encryption mode of the program. This is the configured encryption mode based on either the user-configured CTE encryption mode, or the RMD information received for Broadcast encrypted services. • **Full** • **FWK** • **FPK** • **Unencrypted/Clear** • **Clear** • **Pre-Encrypted**

Item	Definition
Program Status	Output program status fields are as follows: • **Program Undefined** • **Program Mapping Defined – Inactive** • **Successful – Program Remultiplexed** • **Program Remultiplexing Stopped** • **Waiting For Input PAT** • **PAT Error – Program Number Not Found** • **PAT OK – Waiting For Input PMT** • **PMT Error – Output PMT Unavailable** • **PMT Error – Shared PID Violation** • **PMT Error – Max PIDs Exceeded** • **PMT Error – PCR PID Unsupported** • **PMT Error – ES PIDs Unsupported** • **PMT Error – ECM PID Unsupported** • **PMT Error – PMT Invalid (Parsing Error)** • **Encryption Error – Waiting for RMD** • **Encryption Error – Waiting for Rights Meta Data** • **Encryption Error – Unable to Start Encryption** • **Encryption Error – Unable to Encrypt PIDs** • **Encryption Error – Unauthorized for Encryption** See below for more information on Program Mapping Status field values.

The following table provides field definitions for the Program Encryption Status section of the window:

Item	Definition
ECM ID	Displays the current Entitlement Control Message ID. This is a unique ID used internally by the APEX for generating ECM messages.
CCI	Displays the current Copy Control Information level.
APS	Displays the current Analog Protection System level.
CIT	Displays the current Constrained Image Trigger setting.
Tier/Tier Type	Displays the tier, and the tier type.
Source ID	Displays the user configured Source ID.
Provider ID	Displays the user configured Provider ID.
Description	Displays the service information based on the Source ID and Provider ID. This is to allow easier identification of Broadcast encrypted programs.
Encryption Status	Displays the current encryption status.
PSIP Status	Displays the PSIP Status window.
APEX Service Error Alarms	Provides an immediate alert to a new mapping that is in error.

Program Status Summary

For each program mapped, the current status is displayed. This status indicates whether the program has successfully been mapped, successfully been encrypted, or if there is an error.

The following bullets describe the program status fields in more detail:

- **Program Undefined** — This is the default state for any program, and indicates no mapping; therefore, should not be seen by the user.
- **Program Mapping Defined – Inactive** — Indicates a program mapping has been defined, but is now inactive. Inactive program mappings can only occur when after a mapping has been created and the output stream becomes inactive (such as when a QAM module is removed from the APEX1000). The program will automatically reactivate whenever the output channel becomes active.
- **Successful – Program Remultiplexed** — Indicates the mapping is successful and the program is being mapped from an input to the output stream. No errors.
- **Program Remultiplexing Stopped** — This is a temporary state indicating the mapping is being stopped. Either the mapping has been deleted or is transitioning from active to inactive.

Program Status Error Conditions

- **Waiting For Input PAT** — Program is waiting for the input PAT to be extracted. Either the input source is missing or the input is not connected. Check cable connections, router/switch status, and validate the input source specified (interface, UDP, multicast, and source IP).
- **PAT Error – Program Number Not Found** — PAT has been extracted, but the input program number specified by the user was not found in the PAT. Verify the input program of the mapping.
- **PAT OK – Waiting For Input PMT** — PAT has been extracted and input program number was found. Waiting for PMT to be extracted.
- **PMT Error – Output PMT Unavailable** — Output PMT PID is not available. This can only occur when the output stream is configured with PID Remapping disabled. This indicates that two programs are sharing the same PMT PID, or that the PMT PID is in use by another mapping as a component PID.
- **PMT Error – Shared PID Violation** — There are one or more component PIDs that are being shared with other programs. The APEX does NOT support programs that share component PIDs. This condition can also indicate that the ECM PID is being shared when the input program is pre-encrypted (also not supported).
- **PMT Error – Max PIDs Exceeded** — Indicates that the maximum number of PIDs supported per program is exceeded.
- **PMT Error – PCR PID Unsupported** — PCR PID is a value that is not supported.
- **PMT Error – ES PIDs Unsupported** — One or more Elementary stream PIDs are invalid.

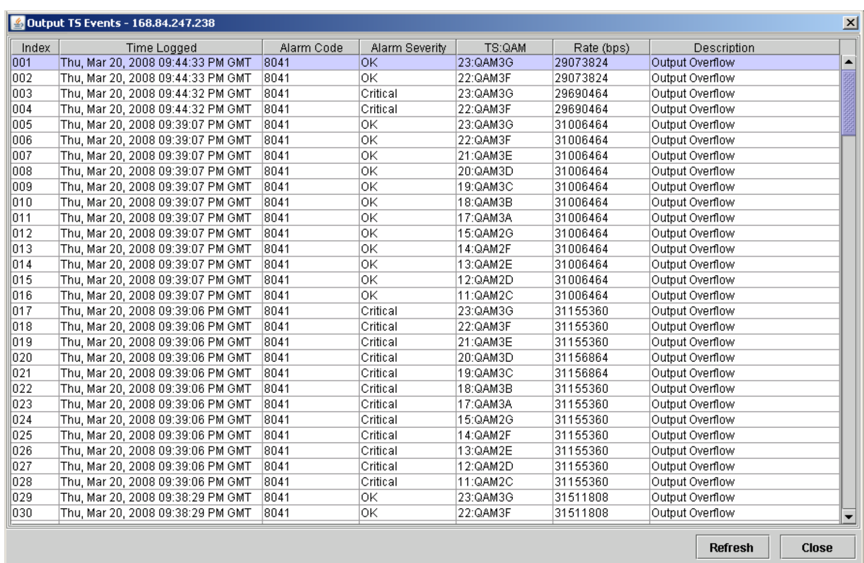
- **PMT Error — ECM PID Unsupported** — ECM PID value is unsupported. Pre-encrypted input streams must have the PMT and ECM PID on separate PIDs.
- **PMT Error — PMT Invalid (Parsing Error)** — PMT is invalid (indicates a malformed input PMT message).
- **Encryption Error — Waiting for Rights Meta Data** — Broadcast encrypted program only. Indicates the Source ID and Provider ID specified by the user are invalid. The APEX has not received an update from the RDS with a matching Source ID and Provider ID.
- **Encryption Error — Unable to Start Encryption** — Indicates some type of internal HW or FW error during encryption.
- **Encryption Error — Unable to Encrypt PIDs** — Indicates some type of internal HW or FW error during encryption.
- **Encryption Error — Unauthorized for Encryption** — Indicates the APEX has not been properly configured for encryption. This can occur if the APEX has not received the proper EMMs from the DAC or the wrong DAC Category Sequence Number (CSN) was received by the APEX.

Output TS Events

Events such as Time Logged, Alarm Code, Severity, and other components are registered in the Output TS Events status window.

When you first open this window, this log displays in reverse chronological order. It can only contain a limited number of entries. If the log fills, the oldest entries are deleted to make room for new entries. To use this log, select a column header to sort and display the list based on the entries in that column.

Figure 12-25 — Output TS Events



Index	Time Logged	Alarm Code	Alarm Severity	TS:QAM	Rate (bps)	Description
001	Thu, Mar 20, 2008 09:44:33 PM GMT	8041	OK	23:QAM3G	29073824	Output Overflow
002	Thu, Mar 20, 2008 09:44:33 PM GMT	8041	OK	22:QAM3F	29073824	Output Overflow
003	Thu, Mar 20, 2008 09:44:32 PM GMT	8041	Critical	23:QAM3G	29690464	Output Overflow
004	Thu, Mar 20, 2008 09:44:32 PM GMT	8041	Critical	22:QAM3F	29690464	Output Overflow
005	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	23:QAM3G	31006464	Output Overflow
006	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	22:QAM3F	31006464	Output Overflow
007	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	21:QAM3E	31006464	Output Overflow
008	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	20:QAM3D	31006464	Output Overflow
009	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	19:QAM3C	31006464	Output Overflow
010	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	18:QAM3B	31006464	Output Overflow
011	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	17:QAM3A	31006464	Output Overflow
012	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	15:QAM2G	31006464	Output Overflow
013	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	14:QAM2F	31006464	Output Overflow
014	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	13:QAM2E	31006464	Output Overflow
015	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	12:QAM2D	31006464	Output Overflow
016	Thu, Mar 20, 2008 09:39:07 PM GMT	8041	OK	11:QAM2C	31006464	Output Overflow
017	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	23:QAM3G	31155360	Output Overflow
018	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	22:QAM3F	31155360	Output Overflow
019	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	21:QAM3E	31155360	Output Overflow
020	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	20:QAM3D	31156864	Output Overflow
021	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	19:QAM3C	31156864	Output Overflow
022	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	18:QAM3B	31155360	Output Overflow
023	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	17:QAM3A	31155360	Output Overflow
024	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	15:QAM2G	31155360	Output Overflow
025	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	14:QAM2F	31155360	Output Overflow
026	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	13:QAM2E	31155360	Output Overflow
027	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	12:QAM2D	31155360	Output Overflow
028	Thu, Mar 20, 2008 09:39:06 PM GMT	8041	Critical	11:QAM2C	31155360	Output Overflow
029	Thu, Mar 20, 2008 09:38:29 PM GMT	8041	OK	23:QAM3G	31511808	Output Overflow
030	Thu, Mar 20, 2008 09:38:29 PM GMT	8041	OK	22:QAM3F	31511808	Output Overflow

Output TS Events window field definitions

Item	Definition
Index	Identifies the window line item.
Time Logged	Shows the time when the event was logged.
Alarm Code	The event code specifies which error occurred for this entry in the error log. Examples of current error codes are: • **8040** – Output Utilization Threshold Exceeded • **8041** – Output Overflow
Alarm Severity	Shows the alarm severity level of this event.
TS:QAM	Shows the Output Transport Stream number and the Output QAM channel.
Rate	This field can be Data Rate or TS Rate.
Description	Provides a text description of the event. Possible events are: • **Output Utilization Threshold** — Indicates that the output stream rate exceeded the user-specified threshold percentage. This does not necessarily mean an overflow has occurred, but that the rate is over the user- specified maximum rate, based on threshold percentage. • **Output Overflow** — Output stream has overflowed (output rate exceeded). This is possibly due to improperly mapping input streams to the same output or input streams that have not been properly rate-shaped.

Host Packet Statistics

This window offers three menu tab choices:

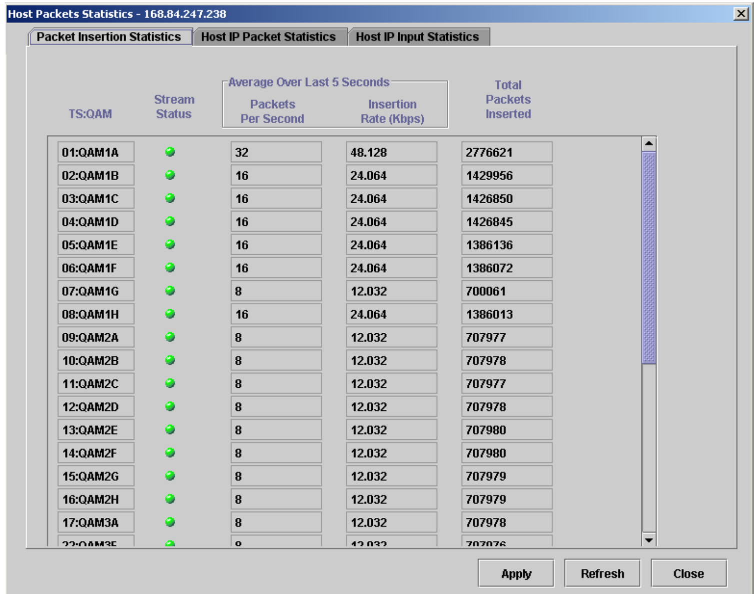
- Packet Insertion Statistics
- Host IP Packet Statistics
- Host IP Input Statistics

Packet Insertion Statistics

Shows the read-only average number of packets inserted per second, the insertion rate, and the total number of packets inserted for a specified time interval (for example, five seconds) for each interface output port by service number (1 – 48).

A section of the Packet Insertion Statistics window is illustrated below:

Figure 12-26 — Packet Insertion Statistics



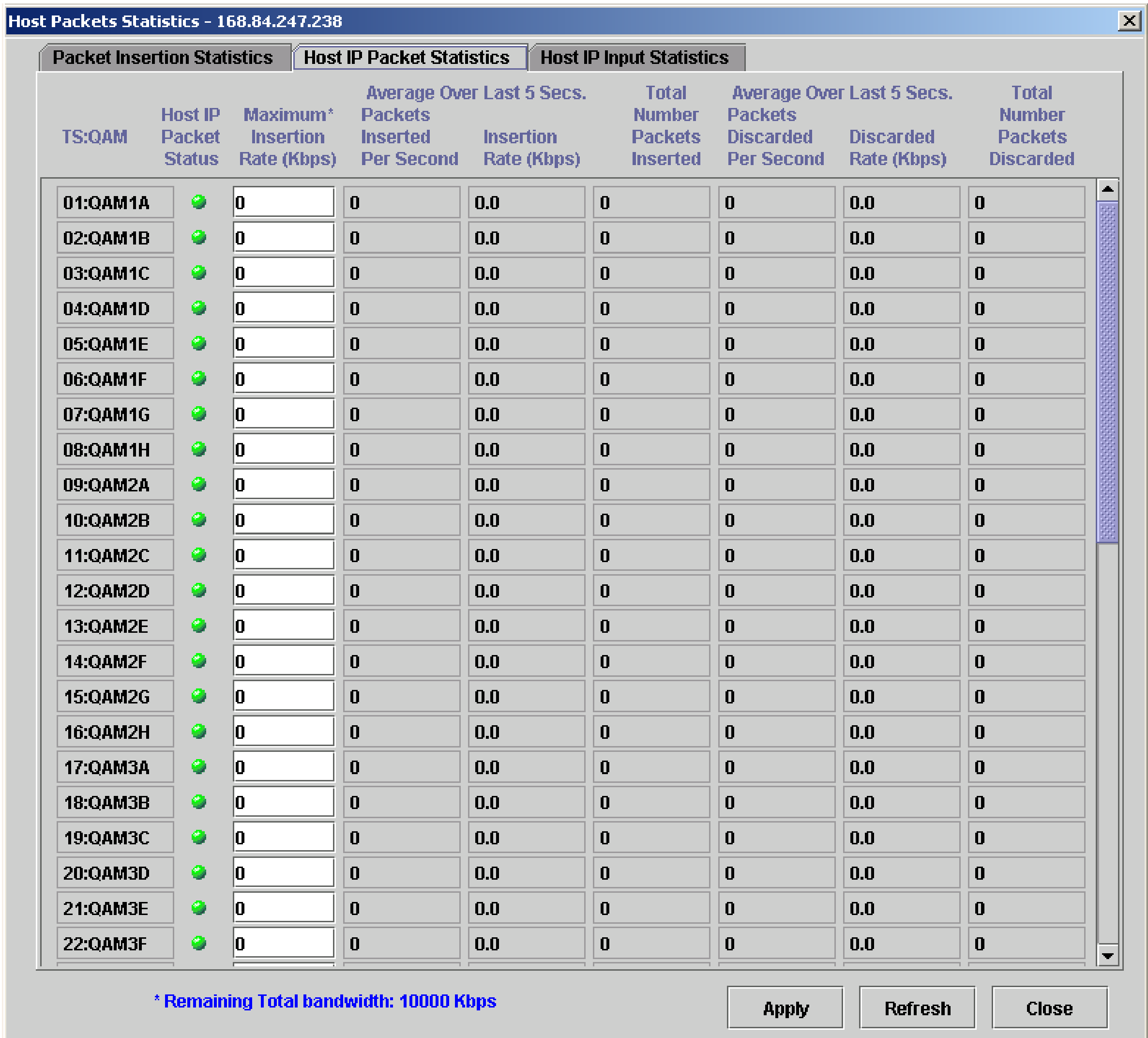
Packet Insertion Statistics screen field definitions

Item	Definition
TS:QAM	The Output Transport Stream number and Output QAM channel.
Stream Status	Summary of the possible alarms associated with an output stream, such as: • **Output Utilization Threshold** • **Output Overflow** The highest current fault is indicated by each LED. The alarm indications are as follows: • **Green** – no alarm • **Gray** – cause of alarm is indeterminate • **Yellow** – warning • **Blue** – minor • **Magenta** – major • **Red** – critical *If an LED alarm indication is active, display the Alarms window to determine which of the above Output Transport Stream alarms is causing the event.*
Packets Per Second	Shows the average number of packets inserted per second during the last monitoring period (five-second monitoring period).
Insertion Rate (Kbps)	Shows the insertion rates of the MPEG interface output ports during the last monitoring period.
Total Packets Inserted	Displays the total number of packets inserted by the MPEG interface output ports.

Host IP Packet Statistics

The Host IP Packet Statistics window shows the read-only average number of packets inserted and discarded per second, the insertion rate, the discarded rate, and total number of packets discarded:

Figure 12-27 — Host IP Packet Statistics



TS:QAM	Host IP Packet Status	Maximum* Insertion Rate (Kbps)	Average Over Last 5 Secs. Packets Inserted Per Second	Insertion Rate (Kbps)	Total Number Packets Inserted	Average Over Last 5 Secs. Packets Discarded Per Second	Discarded Rate (Kbps)	Total Number Packets Discarded
01:QAM1A		0	0	0.0	0	0	0.0	0
02:QAM1B		0	0	0.0	0	0	0.0	0
03:QAM1C		0	0	0.0	0	0	0.0	0
04:QAM1D		0	0	0.0	0	0	0.0	0
05:QAM1E		0	0	0.0	0	0	0.0	0
06:QAM1F		0	0	0.0	0	0	0.0	0
07:QAM1G		0	0	0.0	0	0	0.0	0
08:QAM1H		0	0	0.0	0	0	0.0	0
09:QAM2A		0	0	0.0	0	0	0.0	0
10:QAM2B		0	0	0.0	0	0	0.0	0
11:QAM2C		0	0	0.0	0	0	0.0	0
12:QAM2D		0	0	0.0	0	0	0.0	0
13:QAM2E		0	0	0.0	0	0	0.0	0
14:QAM2F		0	0	0.0	0	0	0.0	0
15:QAM2G		0	0	0.0	0	0	0.0	0
16:QAM2H		0	0	0.0	0	0	0.0	0
17:QAM3A		0	0	0.0	0	0	0.0	0
18:QAM3B		0	0	0.0	0	0	0.0	0
19:QAM3C		0	0	0.0	0	0	0.0	0
20:QAM3D		0	0	0.0	0	0	0.0	0
21:QAM3E		0	0	0.0	0	0	0.0	0
22:QAM3F		0	0	0.0	0	0	0.0	0

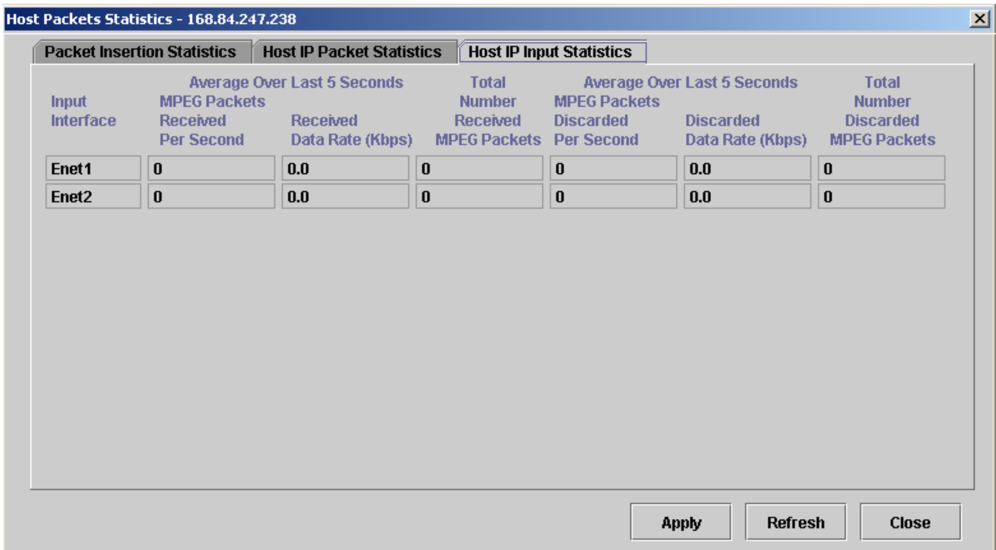
Host IP Packet Statistics screen field definitions

Item	Definition
TS:QAM	The Output Transport Stream number and Output QAM channel.
Host IP Packet Status	Summary of the possible alarms associated with an output stream, such as: • **Output Utilization Threshold** • **Output Overflow** The highest current fault is indicated by each LED. The alarm indications are as follows: • **Green** – no alarm • **Gray** – cause of alarm is indeterminate • **Yellow** – warning • **Blue** – minor • **Magenta** – major • **Red** – critical *If an LED alarm indication is active, display the Alarms window to determine which of the above Output Transport Stream alarms is causing the event.*
Maximum Insertion Rate (Kbps)	User-configured maximum insertion rate for an output stream. This determines the maximum amount of Enet 1 or 2 data that will be inserted into an output stream every second. This is used to throttle the ENET1 or ENET2 input streams. The maximum is 2500Kbps per output stream with a total of 10Mbps across all 48 QAM output streams.
Packets Inserted Per Second	Average number of packets inserted per second during the last monitoring period (five-second monitoring period).
Insertion Rate (Kbps)	Insertion rates of the MPEG interface output ports during the last monitoring period.
Total Number Packets Inserted	Total number of packets inserted by the MPEG interface output ports.
Packets Discarded Per Second	Average number of packets discarded per second during the last monitoring period (five-second monitoring period).
Discarded Rate (Kbps)	Discarded rates of the MPEG interface output ports during the last monitoring period.
Total Number Packets Discarded	Total number of packets discarded by the MPEG interface output ports.

Host IP Input Statistics

This window provides a read-only record of the input interface, average number of MPEG packets inserted per second, the received data rate, the total number of MPEG packets received/discarded, and the discarded data rate:

Figure 12-28 — Host IP Input Statistics



Host IP Input Statistics screen field definitions

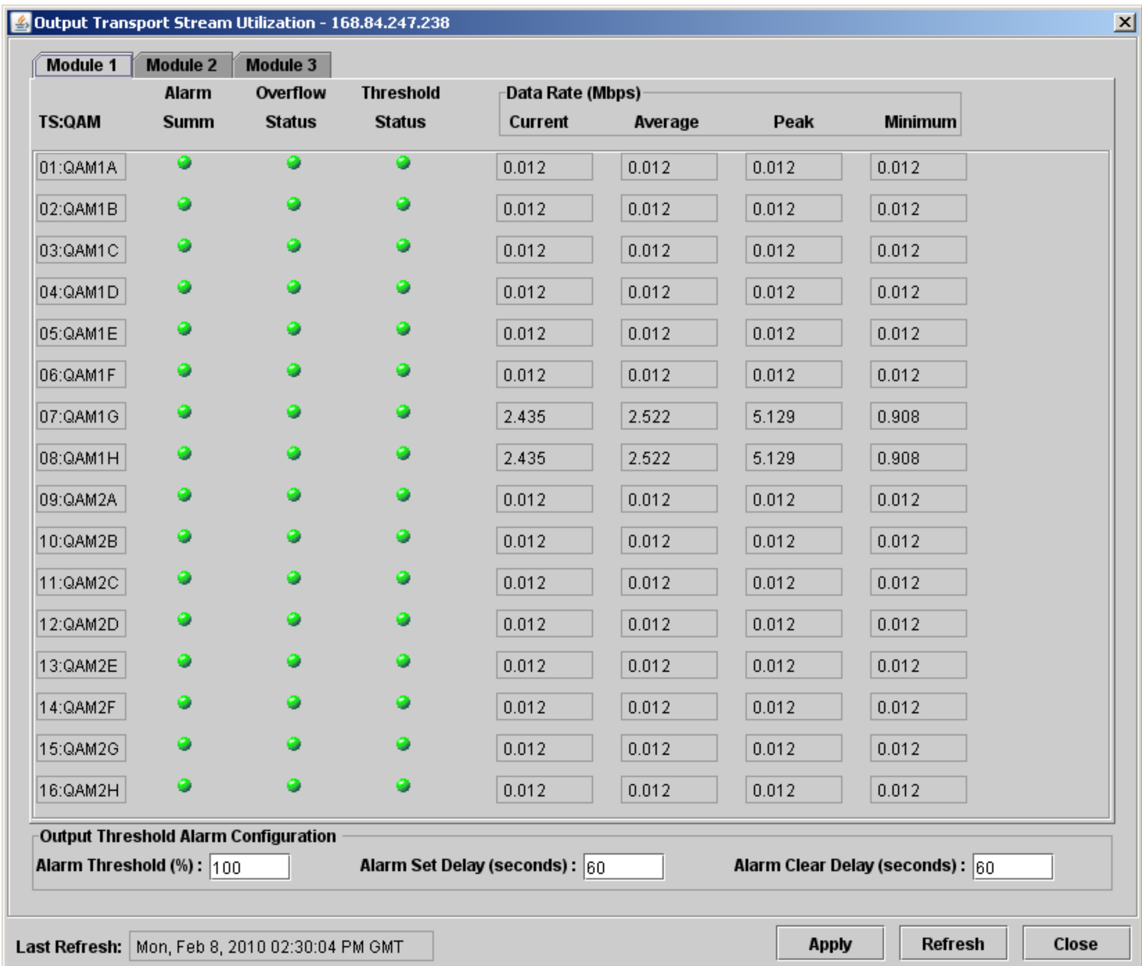
Item	Definition
Input Interface	Displays data associated with a particular OAM&P and Application network interface (ENET1/ENET2).
MPEG Packets Received Per Second	Shows the average number of packets received per second during the last monitoring period (5 second monitoring period).
Received Data Rate (Kbps)	Received data rate of the MPEG interface output ports during the last monitoring period.
Total Number Received MPEG Packets	Displays the total number of packets received by the MPEG interface output ports.
MPEG Packets Discarded Per Second	Displays the total number of packets discarded by the MPEG interface output ports.
Discarded Data Rate (Kbps)	Displays the discarded data rate of the MPEG interface output ports during the last monitoring period.
Total Number Discarded MPEG Packets	Displays the total number of packets discarded by the MPEG interface output ports.

Output Transport Utilization

The Output Transport Stream Utilization window provides a data rate summary presentation within a sampled time frame.

Note: To determine the output data rate, each output transport stream is monitored once per second.

Figure 12-29 — Output Transport Utilization



Output Transport Stream Utilization window field definitions

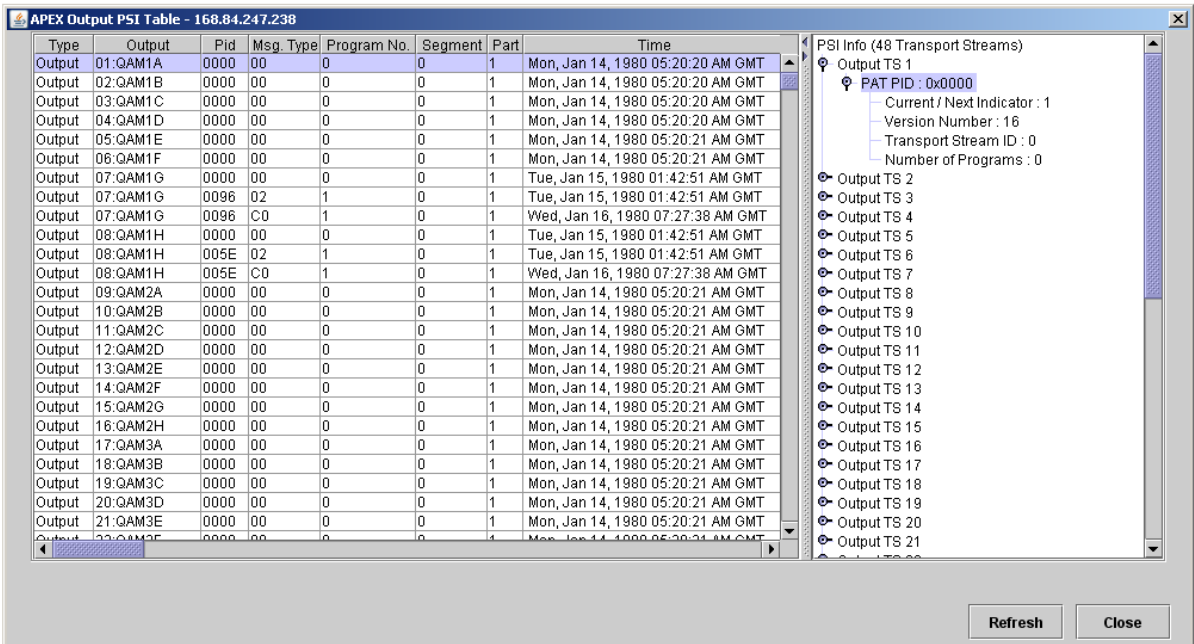
Item	Definition
Output Transport Stream	The transport stream number associated to an output interface port.
Output Stream Status	Summary of the possible alarms associated with an output stream, such as: • **Output Utilization Threshold** • **Output Overflow** The highest current fault is indicated by each LED. The alarm indications are as follows: • **Green** – no alarm • **Gray** – cause of alarm is indeterminate • **Yellow** – warning • **Blue** – minor • **Magenta** – major • **Red** – critical *If an LED alarm indication is active, display the Alarms window to determine which of the above Output Transport Stream alarms is causing the event.*
Output Overflow Status	• This LED is red if an overflow error occurred at least once during this sampling interval. • When green, it indicates no output overflow error occurred. An output overflow indicates that the input stream data rate is either greater than the output stream data rate, or the input stream has had a sudden burst (a sudden increase in the input data rate). *Caution: Input streams that are bursty can cause the APEX1000 to overflow and will result in the dropping of output packets.*
Output Threshold Status	This LED is red if a Threshold Reached Error occurred at least once during this sampling interval. When green, it indicates *No Threshold Reached* error occurred.
Data Rate (Mbps) – Current	Current data rate of most recently taken sample (1 – 16 seconds depending on the number of streams being monitored).
Data Rate (Mbps) – Average	Average utilization over this sampling interval (in bps). This is the average data rate over the last 15 minutes (sampling interval is a sliding 15 minute interval).
Data Rate (Mbps) – Peak	Peak utilization for a sample during this sampling interval (in bps). This is the peak data rate over the last 15 minutes (sampling interval is a sliding 15 minute interval).
Data Rate (Mbps) – Minimum	Minimum utilization for a sample during this sampling interval (in bps). This is the minimum data rate over the last 15 minutes (sampling interval is a sliding 15 minute interval).

Item	Definition
Time Recorded	Time in GPS seconds that this table row was saved. When GPS time is not available to the APEX1000, the internal APEX1000 clock is used. This clock starts at GPS time zero when the APEX1000 is booted. (The APEX1000 uses real GPS time when available.) When the APEX1000 time source is internal (no GPS time source available), you can select PC time from the System Configuration window. This allows the APEX1000 to use the current PC time of the APEX1000 EM for logging purposes.
Alarm Threshold (%)	This threshold, which is a percentage of usable bandwidth, monitors output transport stream bandwidth utilization and produces an alarm for the following conditions: • **Minor Alarm** – If the threshold is met or exceeded for the time specified in Alarm Set Delay. The minor alarm clears after remaining below the threshold for the time specified in Alarm Clear Delay. Setting Alarm threshold to 0 or 100 disables the minor alarm. • **Critical Alarm** – If the rate reaches 100% (overflow). The alarm returns to minor if the level is no longer at overflow but above the threshold for the time specified in Alarm Clear Delay. The critical alarm cannot be disabled, even if the Alarm Threshold is set at 0 or 100.
Alarm Set Delay (seconds)	This is the time (in seconds) that the output transport stream bandwidth utilization exceeds the Alarm Threshold percentage before alarming. This parameter takes immediate effect.
Alarm Clear Delay (seconds)	This is the time (in seconds) that output transport stream bandwidth utilization must remain below the Alarm Threshold percentage before clearing the alarm.
Last Refresh	This read-only area displays the last time the window was updated by clicking **Refresh**.

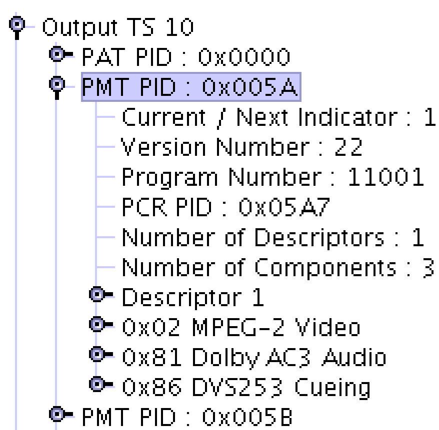
Output PSI Table

The following table contains a list of messages that are inserted into the APEX1000 outputs. For the APEX1000 outputs, only PATs and PMTs are shown:

Figure 12-30 — Output PSI Table status window



Note: Clicking on a row in the left pane will highlight and expand the appropriate node in the right pane's tree, as shown below:

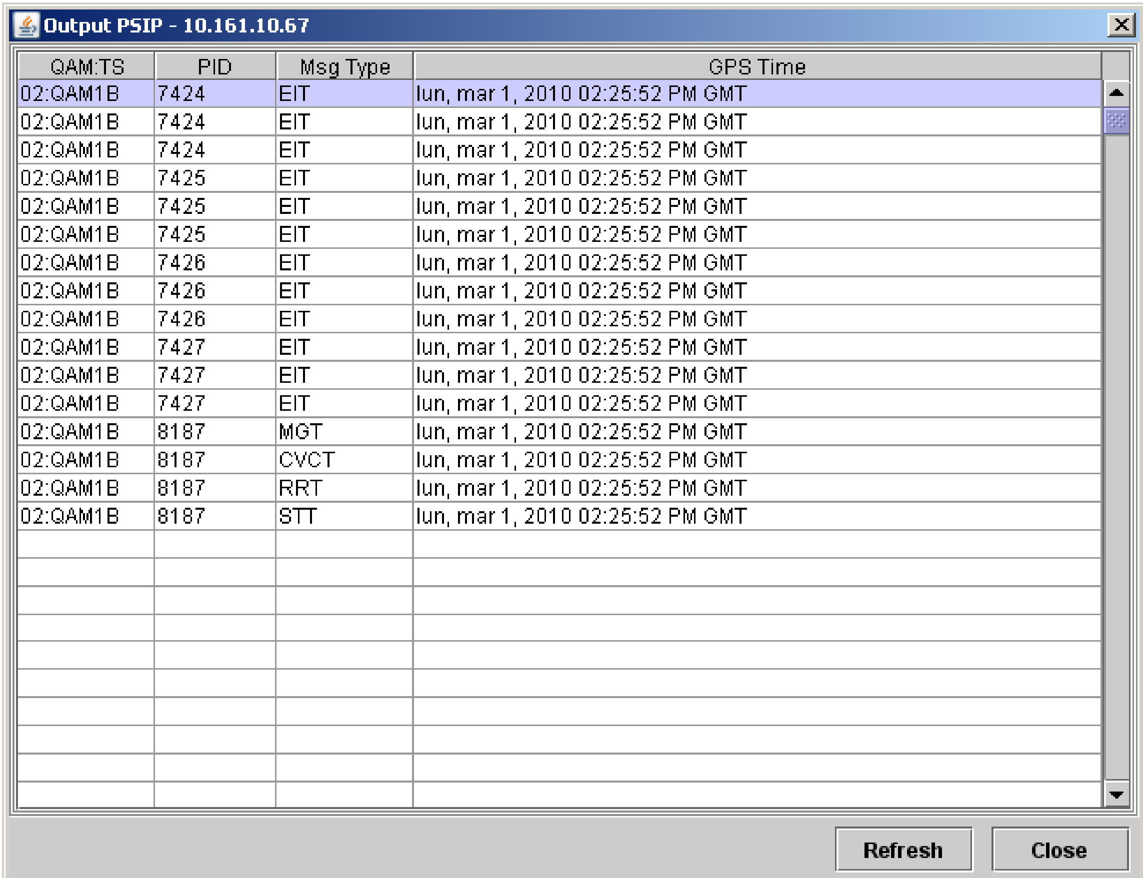


Output PSI Table window field definitions

Item	Definition
Type	Indicates whether this message comes from an APEX1000 input or output, or if the source is unknown.
Output	This column replicates the transport stream-to-output interface selections made in the APEX1000 Output Transport Stream Configuration window. This is the output stream to which the input program is mapped.
PID	Indicates the PID that contains this message.
Msg. Type	Shows the *message type* of the message being inserted.
Program No.	When the message is related to a program, indicates the program number. If the message is not specifically related to a program, this value is zero.
Segment	Indicates the segment number of this message, which is useful for PAT messages.
Part	The 1024 bytes of a message can be divided into parts, which are indexed with this field.
Time	Indicates the time the message was logged.
Message	Displays the raw data stream of the message.

Output PSIP

Figure 12-31 — Output PSIP window



QAM:TS	PID	Msg Type	GPS Time
02:QAM1B	7424	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7424	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7424	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7425	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7425	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7425	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7426	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7426	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7426	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7427	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7427	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	7427	EIT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	8187	MGT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	8187	CVCT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	8187	RRT	lun, mar 1, 2010 02:25:52 PM GMT
02:QAM1B	8187	STT	lun, mar 1, 2010 02:25:52 PM GMT

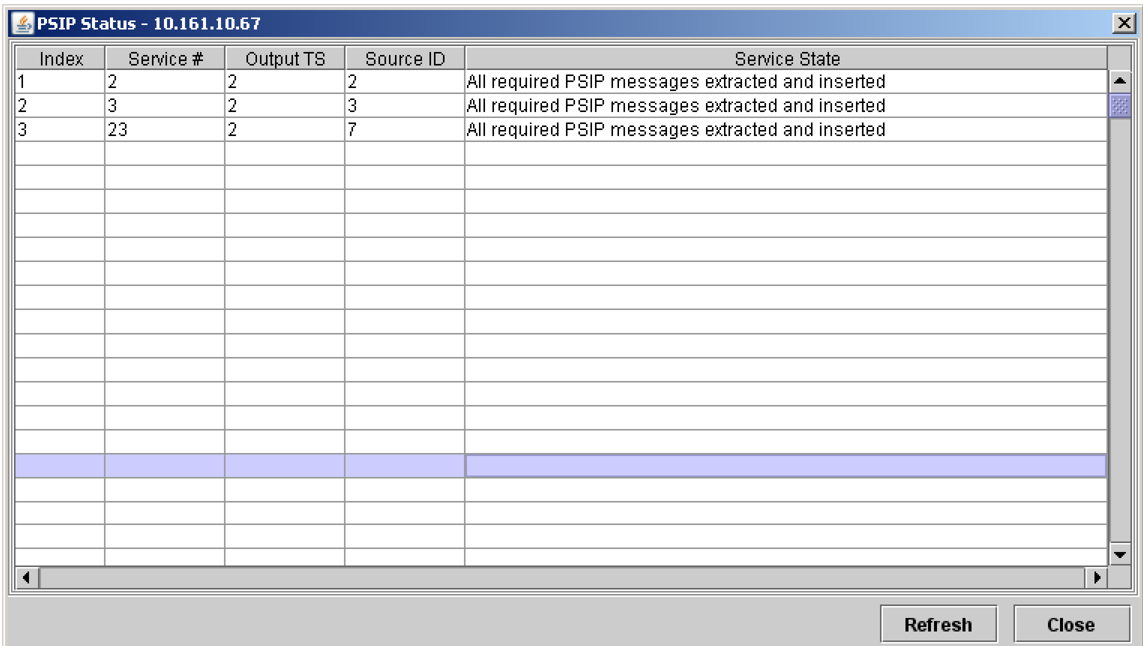
Output PSIP window field definitions

Item	Definition
QAM:TS	Indicates the Output index for which this message applies. *Note; This is the Output Transport Stream number (1…48)*
PID	Indicates the PID in which this message is contained.
Msg Type	Indicates the PSIP message type. • **199** - MGT • **200** - TVCT • **201** - CVCT • **203** - EIT • **202** - RRT • **205** - STT
GPS Time	The GPS time when the PSIP message was added to the table.

PSIP Status

The following table shows the PSIP status per service. For each service, the service number, the Output Transport Stream number, its PSIP state and its source id are shown in the current entry.

Figure 12-32 — PSIP Status



Note: Due to the table's reception rates defined by users, and the internal process in the EQAM, these statistics may take up to two minutes (given that PSIP is enabled until all the parameters displayed are updated).

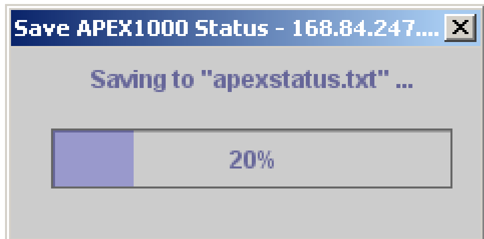
PSIP Status window field definitions

Item	Definition
Index	Output Program Table Index.
Service #	Current Output Service Number.
Output TS	Current Output Transport Stream of this service.
Source ID	Current PSIP Program Source Id.
Service State	Current program PSIP state.

Save APEX1000 Status

This feature saves all of the current status to the `apexstatus.txt` file, located in the same directory as the `apex.jar` file.

Figure 12-33 — Save APEX1000 Status



12 Troubleshooting

Contacting the TAC

If you need assistance with your Motorola product, contact the Motorola Technical Assistance Center (TAC):

- Toll free: **1–888–944–HELP (1–888–944–4357)**
- Direct: **1–847–725–4011**
- Motorola Online: http://businessonline.motorola.com

The TAC is on call 24 hours a day, 7 days a week. In addition, Motorola Online offers a searchable solutions database, technical documentation, and low-priority issue creation and tracking. For specific toll-free numbers when calling from outside the United States, please refer to your product manual or our Web page.

APEX1000 LED Color Scheme

Colors used for status and alarms are:

- **Green** – OK
- **Gray** – Indeterminate
- **Yellow** – Warning
- **Blue** – Minor
- **Magenta** – Major
- **Red** – Critical (or *Error* in the case of a field that has only two possible states)

Error Checking and Ranges

The APEX1000 EM will check the validity of the data in most fields. Some common ranges it checks are:

- Percentages (0 – 100)
- Multicast addresses (224.0.1.0 – 239.255.255.255)
- IP addresses (0.0.0.0 – 223.255.255.255)
- UDP ports (GigE: 0 – 65535, Host: 1024 – 65535)
- MAC addresses (00:00:00:00:00:00 – FF:FF:FF:FF:FF:FF)
- Output Transport Stream numbers/QAM Channels (1 – 48)
- Input Program Numbers (0 – 65535)
- Output Program Numbers (1 – 65535)

LED/Error Indications

The table below contains LED/Error Conditions data for quickly resolving problems you may encounter using the APEX1000:

LED/Error Condition	Possible Cause or Indication	Corrective Action
Status LED not illuminated	No power or faulty LED.	• No power connection – check. • Faulty power supply – replace.
Status APEX1000 solid yellow (warning or minor alarm)	**Invalid Initialization Data** – invalid initialization data was encountered in the config.ini at system startup.	• Look at the Invalid Initialization Data Errors table to determine which data is incorrect. • Change to a valid configuration.
	Output Utilization Fault – the data rate specified for the output transport stream exceeded the limit.	Reduce the amount of services to the output transport stream.
	GigE Redundancy Threshold Exceeded – the threshold was exceeded on the in-use GigE port. *Only applicable when the GigE is in redundant mode.*	Verify GigE connections and server status.
	GigE Redundancy Fail Over Fault – the threshold was exceeded on the in-use GigE port and a fail over to the other GigE port occurred. *Only applicable when the GigE is in redundant mode.*	Verify GigE connections and server status.
Status LED solid Red (major or critical alarm)	**Service In Error** – Indicates a service command is currently in error (unable to fully continue processing). The alarm is set after one or more service commands is in error for more than 60 seconds. *Not applicable when the APEX1000 is internally controlled.*	Verify input connections and service is present and content is supported by APEX1000.
	Temperature Fault – temperature of the APEX1000 exceeded the maximum allowed for three or more consecutive reads.	• Check that the front air inlets are not blocked. • Check that the fan outlets are not blocked. • Check that the rack ambient temperature is within specifications. • Check fan operation. If failure is noted, replace fan.
	Fan Fault – one or more fans dropped below the allowed RPM level.	Check fans; reference Fan Field Replacement Procedure for instructions on replacing a failed fan.

LED/Error Condition	Possible Cause or Indication	Corrective Action
	Loss of Input – loss of the SPTS or MPTS that are configured for the current window of time.	Inspect and secure the connectors to the input ports.
	Hardware Failure – the host processor detected a problem with the ACP module, QAM module, or GigE processor.	Replace the APEX1000.
	Output Buffer Overflow – the aggregate information rate of the input services/PID streams being routed to the output transport stream exceeds the configured output information rate.	Reduce the input rate of the APEX1000 by removing one or more programs or increase the alarm threshold.
GigE1 - 4 LEDs solid red	Faulty or failed optical interface.	Replace optical interface module.
ENET1 - 2 LEDS alternating green-yellow	Collision detected (if in half-duplex mode, 10/100Base-T only). LED activates for 100 msec after detection of collision. *During high collisions, LED alternates green-yellow.*	Duplicate IP addresses may be on network.
APEX1000 powers up but fails to initialize	BOOTP/TFTP configuration.	Check the BOOTP configuration and all file paths and names on the server.
	Flash memory corrupted.	Reload memory from the BOOTP server.
BOOTP unsuccessful	BOOTP reply not received.	• Verify that the MAC address is correct. • Verify Ethernet connectivity.

Appendix A

A

Specifications

Physical Dimensions

Item/Parameter	Description
Dimensions	
Overall depth from front panel to end of fan studs	24.9 inches (632 mm)
Depth from mounting ears to rear panel	23.5 inches (597 mm)
Width	19 inches (483 mm)
Height	1.72 inches (43.4 mm)
Approximate Weight	23 lbs (10.4 Kgs)
Mounting	Rack mount

Electrical Specifications for AC Inputs

Parameter	Description
Voltage, AC	100 through 240 VAC
Line frequency, AC	50 through 60 Hz
Power (@ 115 VAC)	
Typical	230 W
Maximum	280 W

Electrical Specifications for DC Inputs

Parameter	Description
Voltage, DC	–40 through –60 VDC
Nominal, DC	–48 VDC
Power (@ –48 VDC)	

Parameter	Description
Typical	230 W
Maximum	280 W

Operating Environment

Parameter	Description
Ambient temperature	32 °F to 104 °F (0 °C to +40 °C)
Operating humidity	5% to 95% Relative Humidity (non condensing)
Storage temperature	–40 °F to 158 °F (–40 °C to +70 °C)
Cooling	Five fans
Altitude	–200 feet to 10, 000 feet

ASI Monitor Port

Parameter	Description
MPEG input	ASI front panel BNC connector
ASI impedance	75 Ohms
ASI Data Rate	
Line rate	270 Mbps
Output data rate	Variable: 1 Mbps to 206 Mbps
Output format	188 mode only
Voltage range	800 mVpp ±10%

- The maximum MPEG throughput across a single GigE interface pair is 931 Mbps, assuming 24 QAMs active with a 38.81 Mbps data rate.
- The maximum MPEG throughput across the APEX1000 is 1.863 Gbps, assuming 48 QAMs active with a 38.81 Mbps data rate.
- Including headers, the maximum data rate at GigE inputs is 1.976 Gbps (3.952 Gbps assuming input redundancy).

OAM&P and IP Data 10/100Base T Ethernet Interfaces

Item/Parameter	Description
Network data rate	10/100 Mbps maximum
Interface	IEEE 802.3
Impedance	120 Ohms
Cable	Shielded twisted pair
Output format	188 mode only
Connector	RJ 45
Application Protocols*	UDP, TCP/IP, ICMP, ARP, IGMP, SNMP, BOOTP, TFTP, SNTP, HTTP, Auto negotiation full and half duplex modes
** IP data supports a subset of these protocols.*	

GigE Interface

Wavelengths are 850 nm, 1310 nm, and 1550 nm. Electrical GigE interface modules are also supported using high-quality CAT-5e or CAT-6 cable.

SFP Specifications

The APEX1000 GigE interface requires SFP transceivers. Each of the four GbE interfaces can accept any one of a variety of Small Form Factor Pluggable (SFP) modules, including 1000 Base SX (850 nm), 1000 Base LX (1310 nm), and 1000 Base ZX (1550 nm) fiber based modules, or 1000 Base T Electrical based modules.

Note: The Gigabit Ethernet interfaces are full-duplex interfaces with respect to standard L2/L3 Ethernet traffic. This includes ARP Responses to ARP Requests, ICMP Echo Responses to ICMP Echo Requests, IGMP Joins, IGMP Host Membership Reports in response to IGMP Queries, etc..

RF Interface

Parameter	Specification
QAM frequency range	54 to 1003MHz
Carrier frequency step size	250 kHz
Carrier frequency accuracy	±5 ppm
Channel spacing	1 to 8 MHz
Symbol Rate	
Annex B DC II 64 QAM	5.056942 Msym/sec

<table>
<tr><th>Parameter</th><th colspan="2">Specification</th></tr>
<tr><td>Annex B DC II 256 QAM</td><td colspan="2">5.360537 Msym/sec</td></tr>
<tr><td>Annex A DVB</td><td colspan="2">0.8 to 6.98 Msym/sec</td></tr>
<tr><td>Annex C</td><td colspan="2">0.8 to 5.31 Msym/sec</td></tr>
<tr><td>QAM carriers per output</td><td colspan="2">Six outputs, each RF output contains up to eight adjacent QAM channels.</td></tr>
<tr><td rowspan="6">Output level adjustment range</td><td>Channels</td><td>RF Level Range [nominal] (dBmV/Channel)</td></tr>
<tr><td>1</td><td>52 – 63 [60]</td></tr>
<tr><td>2</td><td>48 – 59 [56]</td></tr>
<tr><td>4</td><td>44 – 55 [52]</td></tr>
<tr><td>6</td><td>42 – 53 [50]</td></tr>
<tr><td>8</td><td>41 – 52 [49]</td></tr>
<tr><td>Output level step size</td><td colspan="2">0.5 dB</td></tr>
<tr><td>Output impedance</td><td colspan="2">75 Ohms</td></tr>
<tr><td>Output return loss</td><td colspan="2">• >14 dB within an active output channel block anywhere within 57 MHz to 750 MHz
• >13 dB within an active output channel block anywhere within 750 MHz to 870 MHz
• >12 dB within an active output channel, from 870 MHz to 1002 MHz
• >12 dB in every inactive channel from 54 MHz to 870 MHz
• >10 dB in every inactive channel from 870 MHz to 1002 MHz</td></tr>
<tr><td>QAM constellations</td><td colspan="2">64 QAM or 256 QAM</td></tr>
<tr><td>QAM FEC encoding modes</td><td colspan="2">ITU T J.83 Annex A, B
Both Annex A and B are supported; Annex A is supported with the following constraints):
• 81 – 1003 MHz frequency range
• 8 MHz channel width (fixed)
• 6.952 Msps symbol rate (fixed)</td></tr>
<tr><td>MER equalized</td><td colspan="2">> 43 dB</td></tr>
<tr><td>1 kHz to 10 kHz</td><td colspan="2">< –35 dBc</td></tr>
<tr><td>10 kHz to 50 kHz</td><td colspan="2">< –54 dBc</td></tr>
<tr><td>50 kHz to 3 MHz</td><td colspan="2">< –56 dBc</td></tr>
</table>

Notes:

1. Adjusting the RF Level such that it exceeds the nominal RF level when measured at the APEX RF Connector may degrade RF performance.

2. For proper function of the internal RF Power Level detector, RF Outputs must be TERMINATED with 75 Ohms. Unterminated RF Outputs may cause an RF Low Alarm to be generated.

Alpha values for Annex A and B are as follows:

FEC Mode	Modulation Mode	Alpha	Ch Spacing/ Symbol Rate	Typical Ch Spacing	Typical Symbol Rate
Annex A DVB	64 QAM	15%	1.15	8 MHz	<6.952 Msps
Annex A DVB	256 QAM	15%	1.15	8 MHz	<6.952 Msps
Annex B DCII	64 QAM	18%	1.18	6 MHz	5.06 Msps
Annex B DCII	256 QAM	12%	1.12	6 MHz	5.36 Msps
Annex C*	64 QAM	12%	1.12	6 MHz	<5.31 Msps
Annex C*	256 QAM	12%	1.12	6 MHz	<5.31 Msps

**Annex C specifies Alpha = 13%. The APEX utilizes 12% for Annex C, which results in a QAM signal skirt bandwidth that is slightly below the normal value for Annex C.*

Cabling Specifications

This section provides 10Base-T, 100Base-T, RS 232, and RF cabling specifications, as well as a list of approved GigE SFP transceivers vendors.

Ethernet 10/100Base-T Interface Cabling

Item/Parameter	Specification
Connector type	RJ-45 connector
Cable type	Shielded Twisted Pair CAT5
Maximum cable length	300 feet

Ethernet 10Base-T Interface Connector Pin Out

Pin Number	Signal	Direction	Description
1	TX+	out	transmit data +
2	TX–	out	transmit data –
3	RX+	in	receive data +

Pin Number	Signal	Direction	Description
4 and 5			no connection
6	RX–	in	receive data –
7 and 8			no connection

CAUTION *To fully comply with applicable Electromagnetic Compatibility (EMC) standards, high quality shielded twisted pair cable must be used.*

RS-232 Interface Cabling

Item	Specification
Connector type	DB9 male shielded connector with screw locks
Cable type	9 conductor shielded

RS-232 Interface Connector Pin Out

Pin Number	Signal	Direction	Description
2	TX	Out	Transmit data
3	RX	In	Receive data
5	Ground	Ground	Ground
1, 4, 6, 7, 8, 9			Not connected

RF Cabling

Item	Specification
Connector type	F type
Cable type	CommScope F59 HEC T/CU Headend Cable or equivalent 75 Ohm 100% shielded coax cable

DTI Client RJ45 Interconnect Scheme

RJ45 Pin Number	Signal
1	SIG+
2	SIG+
3,4,5,6,7,8	NC

DTI Client RJ45 Interconnect Scheme

RJ45 Pin Number	Signal
1	GND
2	10.24 MHz +
3	10.24 MHz -
4	GND
5	NC10 kHz frame clock
6	Serialized Data (client only)
7	GND

Certified SFP Transceiver Vendors

The GigE requires Small Form Factor Pluggable (SFP) transceivers. The APEX1000 is product– and certification–approved, based on the following Multi-Source Agreement (MSA) compliant SFP transceiver vendors:

Type	Description	Supplier	Supplier Part Number	Motorola Part Number	Connector
Optical	850nm SX, RoHS	Avago Technologies	AFBR-5710LZ	N/A	LC
		Finisar	FTLF8519P2BNL	N/A	
		Finisar	N/A	551742-002-00	
Optical	1310nm LX, RoHS	Avago Technologies	AFCT-5710LZ	N/A	LC
		Finisar	FTLF1319P1BTL	N/A	
		Finisar	N/A	551755-001-00	
Optical	1550nm ZX, RoHS	OCP	TRXAG1YXHBYM5	N/A	LC
		Finisar	FTLF1519P1xCL	N/A	
		Finisar	N/A	551767-001-00	
Copper	1000bT, RoHS	Methode Electronics	DM7041-R-L	N/A	RJ-45
		Methode Electronics	N/A	551771-002-00	

Note: Items with a Motorola part number are orderable directly from Motorola. Items that do not have a Motorola part number are supported, but must be ordered direct from the SFP manufacturer (supplier part number provided).

B

Appendix B

Alarms Window Field Definitions

Condition	Description	Event or Alarm (Severity Level)	Data Included in Alarm or Event Trap	Notes
		Hardware Alarms		
Hardware Fault	HW fault alarm: • Failure during boot up • Failure getting HW status (MUX) • GigE not responding • HW communication issue • TFTP File download • Input Power Failure to all installed Power Supplies	Alarm • Critical	HW Error Code	1. Cannot be disabled 2. Trap sent per instance
Temperature	Over temperature detected	Alarm • Critical	None	1. Cannot be disabled 2. Overall alarm – one alarm for all temperature sensors
Fan Fault	One or more fans have failed	Alarm • Major	None	1. Cannot be disabled 2. Overall alarm – one alarm for all fans
Power Fault	Indicates one or both power supplies at fault • Warning indicates PS not compatible • Major indicates input power fault, output power fault communications fault, or no module installed • Critical indicates Over Temperature fault	Alarms • Warning • Major • Critical	PS Slot # (1,2), PS Error Code	1. Cannot be disabled 2. Trap sent on a Power Supply basis

Condition	Description	Event or Alarm (Severity Level)	Data Included in Alarm or Event Trap	Notes
		GigE Alarms		
Loss of Physical Input	Loss of physical input on a GigE interface	Alarm • Major	GigE Interface	1. Can be disabled 2. Trap sent per instance
Buffer Full	• Buffer fullness threshold exceeded or full • Major indicates threshold exceeded • Critical indicates buffer is full	Alarms • Major • Critical	GigE Processor # (0, 1)	1. Can be disabled 2. Trap sent on a GigE Processor basis
Low Bitrate	Input stream is below the user-defined bit rate	Alarm • Major	None	1. Can be disabled 2. Overall alarm – one alarm for all input streams
High Bitrate	Input stream is above below user-defined bit rate	Alarm • Major	None	1. Can be disabled 2. Overall alarm – one alarm for all input streams
Primary Stream Threshold	Primary input stream is below user-defined threshold as compared to secondary	Alarm • Major	None	1. Can be disabled 2. Overall alarm – one alarm for all input streams
TS Redundancy Failover	Input stream has failed over from primary to secondary input stream	Alarm • Major	None	1. Can be disabled 2. Overall alarm – one alarm for all input streams
Redundant Interface Failover	Primary GigE interface has lost link. APEX will failover to backup GigE interface, which will assume the same IP address as the primary	Alarm • Major	GigE Interface #	
GigE to Host Communication alarm	Host processor has lost communication with the GigE processor	Alarm • Major	GigE Interface #	
		Output Alarms		
Service Error	One or more services is in error. Indicates mapped service is waiting for extraction (PAT or PMT), or is unable to process input PAT or PMT and cannot output program as mapped	Alarm • Major	None	1. Can be disabled 2. Overall alarm – one alarm for all input streams

Condition	Description	Event or Alarm (Severity Level)	Data Included in Alarm or Event Trap	Notes
Output Utilization	Output stream is above user defined utilization threshold	Alarm • Minor	Output TS #	1. Can be disabled 2. Trap sent on an Output Transport basis
Output Overflow	Output stream has overflowed (packets have been dropped)	Alarm • Critical	Output TS #	1. Can be disabled 2. Trap sent on an Output Transport basis
QAM Module	QAM Module Fault detected (QAM Module removed, unsupported module installed, no module installed, power fault, module offline) • Major indicates QAM channels were not active when QAM Module first entered a fault condition • Critical indicates QAM Channels were active when QAM module first entered a fault condition	Alarms • Major • Critical	Module Slot # (1,2,3)	1. Can be disabled 2. Trap sent on a QAM Module basis
QAM RF Port	QAM Port Fault detected • Major indicates power voltage or output RF level • Critical indicates clock, PLL, or data sync	Alarms • Major • Critical	RF Port # (1,2,3,4,5,6)	1. Can be disabled 2. Trap sent on a RF Port basis
QAM Channel	QAM Channel Fault detected Critical, indicates data fault	Alarm • Critical	Output TS #	1. Can be disabled 2. Trap sent on a QAM Channel basis
		RDS Alarms		
RDS Communication Alarm	Problem communicating with RDS after three (3) polling attempts	Alarm • Major	Affected output TS and/or SN	Clears upon successful communication
		Session Control Alarms		
RTSP Controller Alarm	Failure to communicate with RTSP controller	Alarm • Major	None	Can be disabled
		Init Alarms		

Condition	Description	Event or Alarm (Severity Level)	Data Included in Alarm or Event Trap	Notes
Invalid Init Data	Invalid configuration data on initialization *Occurs only at APEX bootup*	Alarm • Warning	None	1. Indicates that the APEX is not properly configured 2. Can be disabled 3. Can be cleared 4. Overall alarm - 1 alarm for all invalid data
		RF Redundancy Alarms		
REM1000 Comm Fault	REM Communication Fault Major when experiencing an REM communication fault	Alarm • Major	N/A	1. Can be disabled 2. Clears when REM connection is restored
REM1000 Fault	REM Fault Major when error received from REM or REM is reporting incorrect switch configuration	Alarm • Major		1. Can be disabled 2. Clears when REM errors clear
Port Failover/Switchback	QAM RF Redundancy Failover Alarm Major when the backup QAM RF Port status is active Occurs when a primary QAM RF Port has failed over to the backup RF Port or the user has forced a primary to the backup	Alarm • Major		1. Clears when the backup QAM RF Port status returns to 'standby' 2. Can be disabled
APEX RF Port Mismatch	QAM RF Redundancy Mismatch Alarm Warning when channels could be lost on QAM RF Fail Over to backup or on Switch Back to primary	Alarm • Warning		1. Clears when mismatch condition is corrected 2. Can be disabled
		SimulCrypt Alarms		
ECMG Channel	• Minor when Active ECMG Channel is not setup but a Backup ECMG Channel is configured and setup • Major when both Active and Backup ECMG Channels are not setup	Alarms • Minor • Major	Event generated identifying the Impacted ECMG channel	1. Can be disabled 2. Clears automatically when all configured ECMG Channels are setup or if Channel is Disabled by user 3. Overall alarm – 1 alarm for all ECMG channels

Condition	Description	Event or Alarm (Severity Level)	Data Included in Alarm or Event Trap	Notes
ECMG Stream	• Minor when Active ECMG Stream is not setup, but Backup Stream is setup • Major when both Active and Backup ECMG Streams are not setup	Alarms • Minor • Major	Event generated identifying the Impacted ECMG stream	1. Can be disabled 2. Clears automatically when all EIS-requested ECMG Streams are setup 3. Overall alarm – 1 alarm for all ECMG Streams
EMM Channel	Indicates that an EMMG connection has been lost	Alarm • Warning	Event generated identifying the Impacted EMMG channel	1. Can be disabled 2. Clears automatically when failing EMMG is reconnected 3. Overall alarm – 1 alarm for all EMMG Channels
EMM Provision	Indicates that some incoming EMM could not be processed properly	Alarm • Warning	Event generated identifying the Impacted EMMG stream	1. Can be disabled 2. Clears automatically when there are no EMM streams receiving invalid data 3. Overall alarm – only *one* trap sent for the first problem found
EIS Channel	Indicates that the EIS Channel is down	Alarm • Major	None	1. Can be disabled 2. Clears automatically when EIS channel is connected
EIS Provision	• Warning for minor issues like inconsistency between APEX config and EIS (getting SCG Provision for a service not yet mapped in APEX) • Major when received SCG Provision is incorrect	Alarms • Warning • Major	Event generated identifying the Impacted scrambling group.	1. Can be disabled 2. Warning clears automatically when APEX config is corrected 3. Major must be manually cleared 4. Overall alarm – only *one* trap sent for the first error found

Condition	Description	Event or Alarm (Severity Level)	Data Included in Alarm or Event Trap	Notes
		DTI Alarms		
DTI Sync Loss Fault	This alarm indicates that the APEX DTI client has lost synchronization with the DTI server	Alarm • Major	None	1. Can be disabled (Disabled by default to support use cases where no M-CMTS configuration is required, therefore no need to report any sync failure.) 2. Alarm clears when the synchronization with DTI server is recovered.
		Chassis Redundancy Alarms		
Redundancy Primary Failover	This alarm is raised when primary APEX fails over to secondary		N/A	Alarm clears when redundancy is disabled or when primary becomes active and secondary in standby state
Redundancy Secondary Failover	The APEX designated as the "secondary" APEX in the 1:1 chassis redundancy system has experienced a fault and will failover to the "primary" APEX in the redundancy system	• Major, when failing over due to a fault • Warning, when failing over due to operator command	N/A	
Redundancy Availability Fault	This alarm is generated when APEX redundancy is not available because of either APEX configurations not synchronized or Secondary is in Fault state		N/A	Alarm clears when redundancy status becomes available or redundancy is disabled
Redundancy Configuration Fault	This alarm is generated when primary APEX received heartbeat message from another APEX		N/A	Alarm clears when primary APEX contention is cleared
APEX Unit Alarm	Highest alarm within the APEX Major error received	Alarms • Major • Critical	N/A	N/A

C

Appendix C

Initialization Information

During power up or reset, the APEX1000 undergoes an automatic initialization process during which it loads the executable software and parameter settings that control its operation. The APEX1000 performs initialization either by self booting from *internal*, non-volatile memory or *externally* booting from another device. External initialization is performed by downloading information from a LAN-connected BOOTP server.

Some initialization information can also be loaded externally from a device connected to the APEX1000 front panel RS-232 Console Port interface. Reference RS-232 Test/Console Port for more information.

Self boot APEX1000 initialization enables it to operate:

- Without connecting it to the headend LAN
- In a headend LAN that does not include a BOOTP server

External APEX1000 initialization enables it to:

- Modify the setup of an installed APEX1000 to accommodate system configuration changes
- Load upgraded executable software into an installed APEX1000

Self Boot Initialization

The APEX1000 begins initialization by determining the type of boot operation: BOOTP or None (Self boot). If BOOTP is selected, it begins broadcasting BOOTP requests over its ENET1 Ethernet port.

Self boot initialization occurs when the APEX1000 times out waiting for a reply and then initializes itself from the information stored in its non volatile memory.

External Initialization from a LAN Resident BOOTP Server

For external initialization to occur from a BOOTP server:

- The APEX1000 must be connected to the system Ethernet LAN on ENET1
- A BOOTP server must be present on the LAN
- The BOOTP server must have the APEX1000 MAC address

The APEX1000 begins initialization by broadcasting BOOTP requests over its ENET1 Ethernet port. The BOOTP server receives the APEX1000 BOOTP requests and provides a BOOTP response packet containing the assigned IP addresses and bootfile entries, from which the APEX1000 initializes itself.

CAUTION *The response packet may also contain a gateway if the BOOTP server is on a different network segment than the APEX1000 Ethernet interface.*

Upon receipt of the BOOTP reply, the APEX1000 obtains the FOF filename (apex1000.fof) and path. It then downloads it from the BOOTP server. The APEX1000 then parses the FOF and compares the listed source files in the FOF with those maintained in the APEX1000 local copy of the previously used version.

- If any listed source filename or path has changed, or if there is a force download flag for any listed files (an **F** is shown at the end of the line listing the file), the listed file is then downloaded to the APEX1000.
- If a downloaded FOF and the APEX1000 local copy are the same and a force download flag does not exist in that FOF, the APEX1000 does not download any additional files. It continues booting using the values stored in non volatile memory.
- An FOF and other downloaded files are transferred through Trivial File Transfer Protocol (TFTP).
- Initialization is complete when the APEX1000 finishes loading the executable software and operating parameters, either from a new download or from memory.

Configuration Modes

The APEX1000 can be configured to use either a BOOTP or a no BOOTP request. Typically, the APEX1000 is configured to perform a BOOTP request (this is the factory default).

*Note: When configured to **not** issue a BOOTP request, the APEX1000 must already contain all files it needs in non-volatile memory. Motorola recommends that you only configure the APEX1000 in this manner after it has been initially installed and loaded.*

Configuring the APEX1000 to *not* issue a BOOTP request will eliminate the chance that on a reboot, the APEX1000 will download an unwanted configuration file. This typically occurs when the user added a Force flag to a line in the file of files and forgot to remove the Force flag.

The APEX1000 will reboot approximately ten seconds faster.

CAUTION *During the download process, undetected transmission errors can cause initialization failure. Always retry the initialization at least once before searching for a specific fault.*

BOOTP Request and Reply Format

BOOTP request and reply messages use the same packet format. The BOOTP packet includes multiple fields divided into the following areas:

Packet Area	Description
Standard Area	Contains fields for specifying basic BOOTP message information, including: • Message type (request or reply) • MAC address of requesting device • IP address assignment of requesting device • Boot file name for the requesting device • Values for some standard fields must be specified and others are optional, depending on whether the BOOTP message is a request or reply
Vendor-Specific Area	Contains fields for use as defined by the vendor for example, to set values for operating parameters.

BOOTP Request

In the BOOTP request, the APEX1000 includes:

- A value indicating that the message is a BOOTP request
- A MAC address

BOOTP Server Reply

In the BOOTP reply to the APEX1000, the BOOTP server includes:

- A value indicating that the message is a BOOTP reply
- The IP address of the boot server
- The IP address assigned to that APEX1000 Ethernet port
- The file of files (FOF) name for the APEX1000 (apex.fof)
- The path for the FOF
- The network mask

Note: Both BOOTP Request and Reply are transferred using UDP.

Typical APEX1000 BOOTP Packet Files

The BOOTP packet file mix is not fixed, as files are added/removed consistent with APEX1000 functionality enhancements.

The following table shows a typical list of files:

Filename	Purpose
Apex1000.fof	(File of files) Contains three field columns: source path, destination path, and force flag. *Do not change the symbolic name of the APEX1000 in the second field, as it can cause an initialization failure.*
apex.cod	Host application code for main APEX1000 processor.
apex.ini	Contains APEX1000 configuration settings for application firmware.
apexbcmr.ini	Remapping configuration settings — holds configuration settings when the APEX1000 is internally controlled (for example, Manual Routing, UDP Mapping).
mux.rbf	Field programming gate array personality file for Mux.
gigeapp.bin	Executable code for GigE processor.
apex.jar	Executable APEX1000-EM Java based application.

APEX1000 File of Files

```
#-----------------------------------------------------------
---------
# APEX1000 Software File-Of-Files
#
# DESCRIPTION:
#   APEX File-of-Files.
#
# FORMAT:
#   ---------SOURCE--------- -------DESTINATION------- -
FLAGS---
#   <boot server file name and path>  <unit file name and
path>
#  <flags>
#
#   Note: File names must be in the standard DOS 8.3
format, i.e.,
#   the “xxxxxxxx.xxx” format. The full path and file name
must be
#   stated explicitly without the use of wildcards.
#-----------------------------------------------------------
---------
# APEX Application Image File
```

```
#-----------------------------------------------------------
--------
/bootdir/apex/02_00.001/apex.cod
/appcode/kernel.img
#-----------------------------------------------------------
---------
# Dynamic Configuration Files
#-----------------------------------------------------------
---------
/bootdir/apex/02_00.001/apex1000.ini
/config1/config.ini
/bootdir/apex/02_00.001/apexbcmr.ini
/config2/bcmr.ini
/bootdir/apex/02_00.001/apexred.ini
/config2/gige_red.ini
/bootdir/apex/02_00.001/apexsdv.ini        /config3/sdv.ini
#-----------------------------------------------------------
---------
# Element Manager Files
#-----------------------------------------------------------
---------
/bootdir/apex/02_00.001/apexem.jar
/emgui/apexem.jar
/bootdir/apex/02_00.001/logomot.gif
/emgui/logomot.gif
/bootdir/apex/02_00.001/default.htm
/emgui/default.htm
#-----------------------------------------------------------
---------
# FPGA Files (Non-DOS File Systems)
#-----------------------------------------------------------
---------
/bootdir/apex/02_00.001/mux_des.rbf
/muxfpga1/mux_des.img
/bootdir/apex/02_00.001/mpc2mux.rbf
/mpc2mux/mpc2mux.img
/bootdir/apex/02_00.001/mpc2gx60.rbf
/mpc2gx60/mpc2gx60.img
/bootdir/apex/02_00.001/dtifpga.bin
/dtifpga/dtifpga.img
/bootdir/apex/02_00.001/gluefpga.rbf
/gluefpga/gluefpga.img
#/bootdir/apex/02_00.001/qrmimage.rbf
/qrmimage/qrmimage.img
#-----------------------------------------------------------
---------
# GigE Files (Non-DOS File Systems)
```

```
#------------------------------------------------------------
---------
/bootdir/apex/02_00.001/gigeapp.bin
/gigeapp/Gigeapp.img
/bootdir/apex/02_00.001/gigeboot.bin
/gigeboot/Gigeboot.img
```

Reference Specifications

To support BOOTP, the APEX1000 conforms to the following RFC specifications:

- Dynamic Host Configuration Protocol, RFC 2131
- DHCP Options and BOOTP Vendor Extensions, RFC 2132
- Bootstrap Protocol, RFC 951
- Clarifications and Extensions for the Bootstrap Protocol, RFC 1542

Refer to these specifications for complete information on the BOOTP packet format and field descriptions.

D

Appendix D

Fan Field Replacement Procedure

The APEX1000 is factory-equipped with one fan for each of the hot-swappable QAM modules, and one fan located inside each power supply unit, for a maximum total of five (5) fans per unit. Each PS incorporates a single 12V Fan for internal cooling. (The airflow direction and cooling is from front to back with respect to the chassis.)

Note: This procedure applies only to QAM module fans; power supply cooling fans are not field-replaceable.

A fan failure is indicated with a solid red STATUS LED on the APEX1000's front panel. When a QAM module fan fails, you must immediately replace it to ensure proper airflow and cooling within the APEX1000. Fan replacement does not require powering down the unit, as each fan plug can be disconnected from its power connector on the APEX1000's rear panel.

Warning! Removal and replacement procedures include removing the fan cover. Keep hands away from fan blades, and do not insert or drop objects into exposed fan blades.

Fan Removal

In a rack of APEX1000s, it is a good idea to identify any marginal fans and guarantee the availability of adequate spares.

To remove a fan:

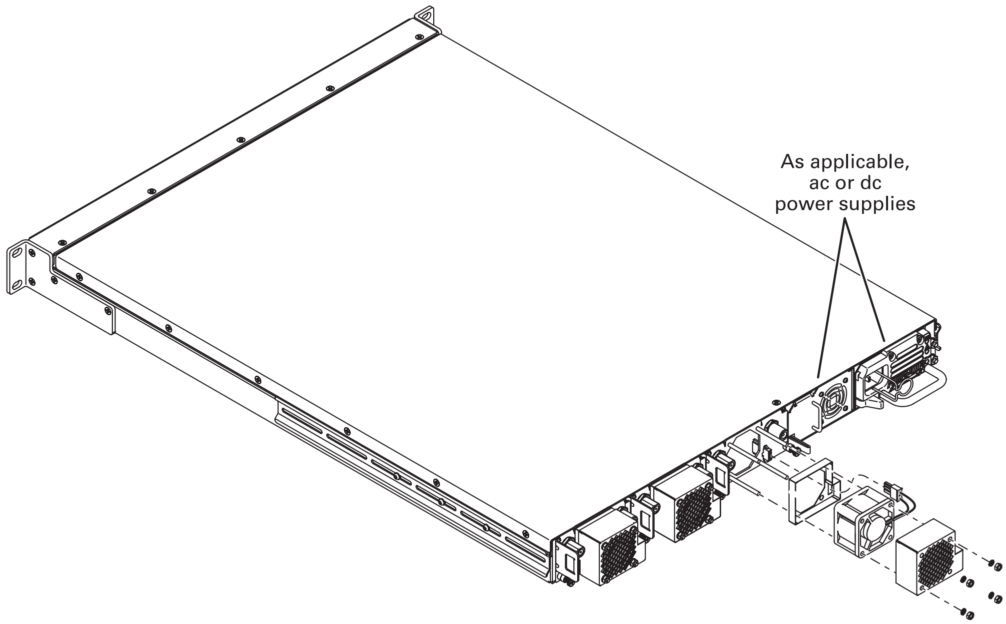
1. Identify the failing fan whose blade is not turning on the rear panel of the APEX1000.

   Note: A failing fan blade does not turn, whereas a marginal fan may have a rasping sound that is definitely a pitch off, and also surges in volume from the steady hum of other fans.

2. Remove the four hex nuts and washers securing the fan cover to the fan. Save these, as they must be re installed on the new fan.
3. Slide the fan cover off of the four stand offs.
4. Unplug the fan power cable from its connector. Note the orientation of the fan cable. The fan blades face toward the APEX1000 and the rear of the fan motor faces away from the APEX1000.
5. Slide the fan off of the four stand offs.

CAUTION *Do not slide the base of the fan cover off of the stand offs.*

The diagram below details field fan removal and replacement steps:



Replacement Fan Kit Assemblies

The Motorola part number for an APEX1000 replacement fan kit assembly (one fan) is 492898-002. (The PS cooling fan **is not** field replaceable.) Motorola part numbers for APEX1000 replacement power supply assemblies are:

- PS Module — AC Power PS Module (AC Power): 540272-001
- PS Module — DC Power PS Module (DC Power): 540271-001

Fan Replacement

To install a fan:

1. Rotate the fan motor so that the cable is properly aligned with the connector, and slide it onto the four standoffs. The fan blades should face toward the APEX1000; the rear of the fan motor should face away from the APEX1000.
2. Connect the fan power cable to the connector.
3. Slide the fan cover over the body. The four stand offs should pass through holes on the fan cover.
4. Secure the fan cover in place with the four washers and hex nuts.
5. Make certain that the replacement fan blade is turning.
6. Verify that the front panel status led is NOT solid red.

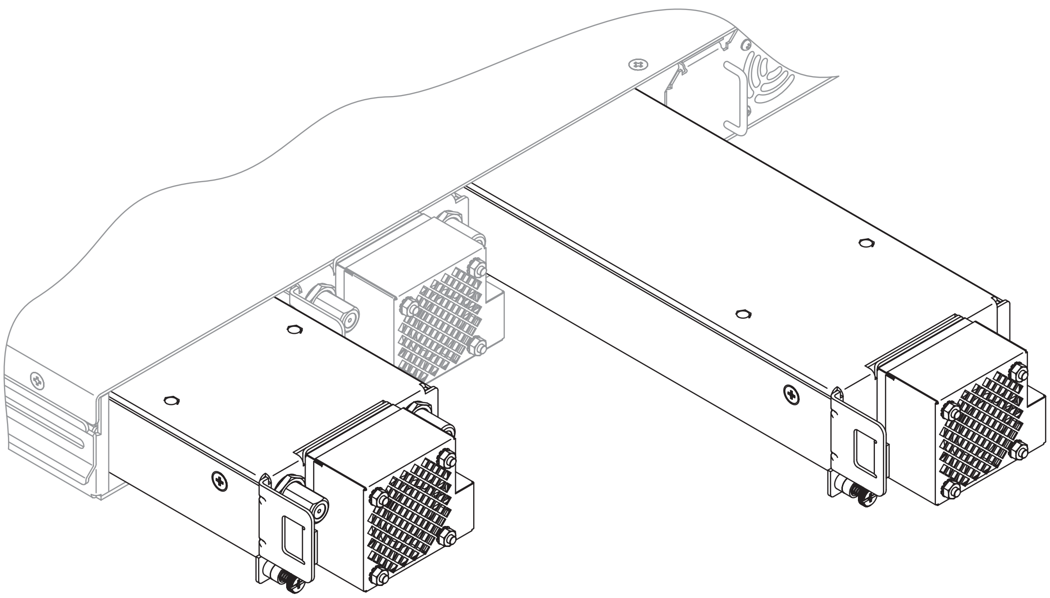
Appendix E

E

RFPM and Power Supply Modules

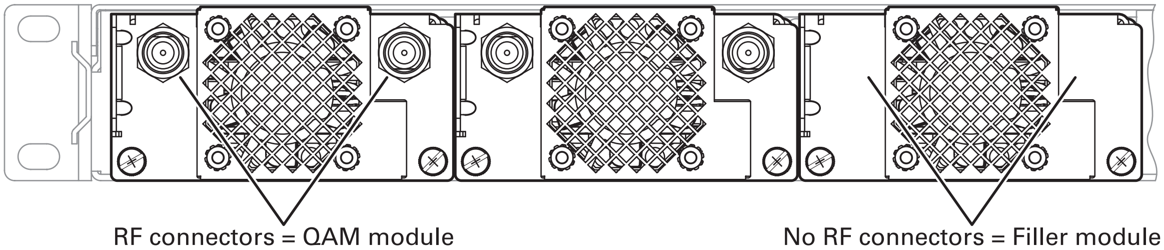
The APEX1000's three RF Plug-in Modules (RFPM) are hot-swappable, and are plugged into the chassis from the rear of the chassis.

The modules slide onto rails and mate with a high-speed docking connector on the main board, as shown below:



Identifying an RFPM or Filler Module

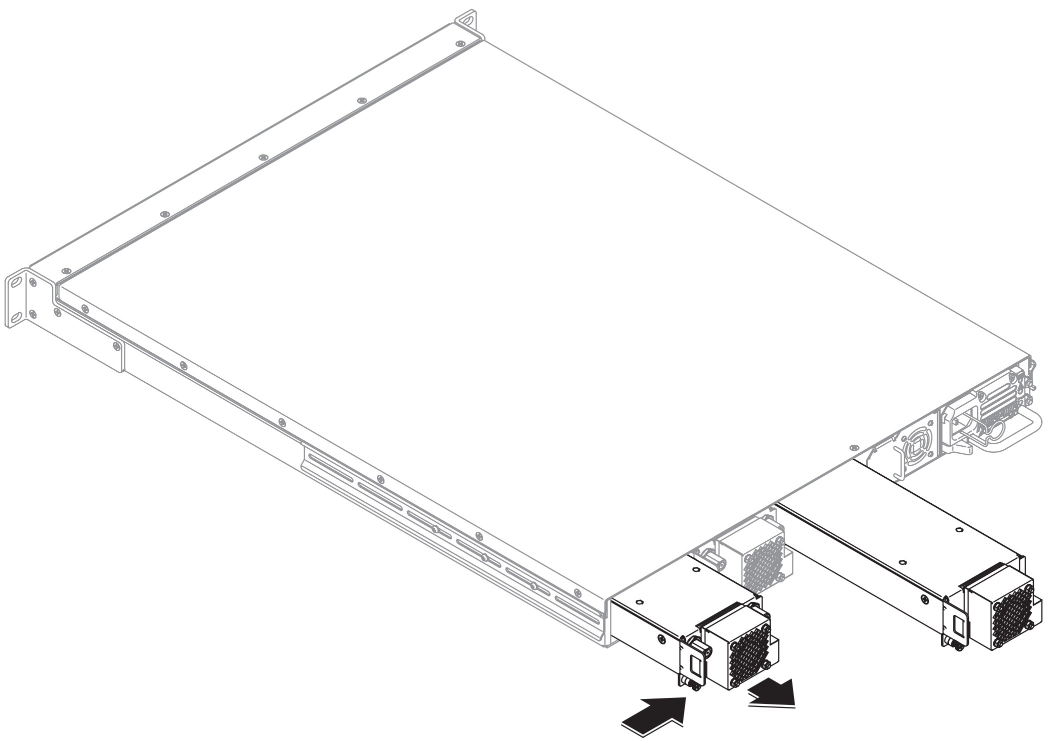
As shown below, active RFPM modules include two RF connectors each, while RFPM filler modules only include the cooling fan:



Note: When viewed from the back of the unit, #1 is the left QAM module, #2 is located in the middle, and #3 is located on the right.

Removing an RFPM or Filler Module

1. Identify the RFPM or filler module to be removed.
2. Loosen the two captive screws that hold the module to the chassis.
3. Carefully slide the unit out completely.



Installing an RFPM or Filler Module

1. Identify the slot where the RFPM or filler module is to be installed.

2. Position the module in the slot with the two captive screws located at the lower half of the unit.
3. Carefully slide unit into the empty slot until flush with other units.
4. Tighten the two captive screws to secure the module to the chassis.

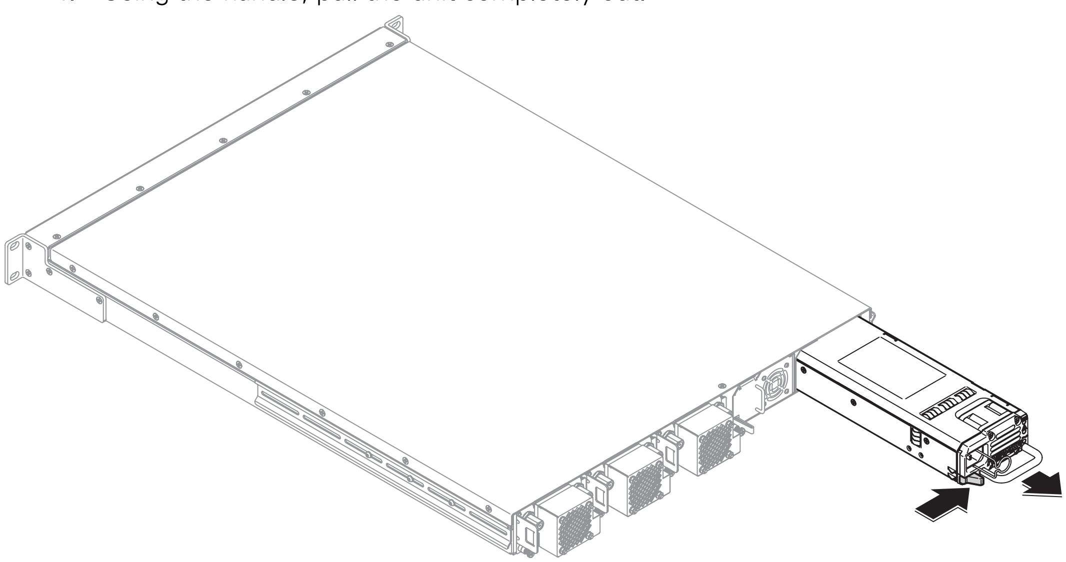
AC/DC Power Redundancy

The APEX1000 supports up to two dual hot-swappable redundant load sharing power supplies (the system can operate with either one or two); supports two AC, two DC, or one AC *or* one DC. In redundant mode, each power supply must be connected to an independent power source that is attached to a dedicated circuit breaker. This circuit breaker must comply with local building and electrical safety codes.

CAUTION *Before removing and replacing a PS unit, certify that the APEX1000 is in full redundancy; operating in non-redundant power will require a complete system shutdown while removing and inserting a power supply module.*

Removing a Power Supply or Filler Module

1. Identify the power supply (or filler) module to be removed.
2. Detach the power cord.
3. Depress locking tab located on the lower left of the unit, as shown in the figure below.
4. Using the handle, pull the unit completely out.



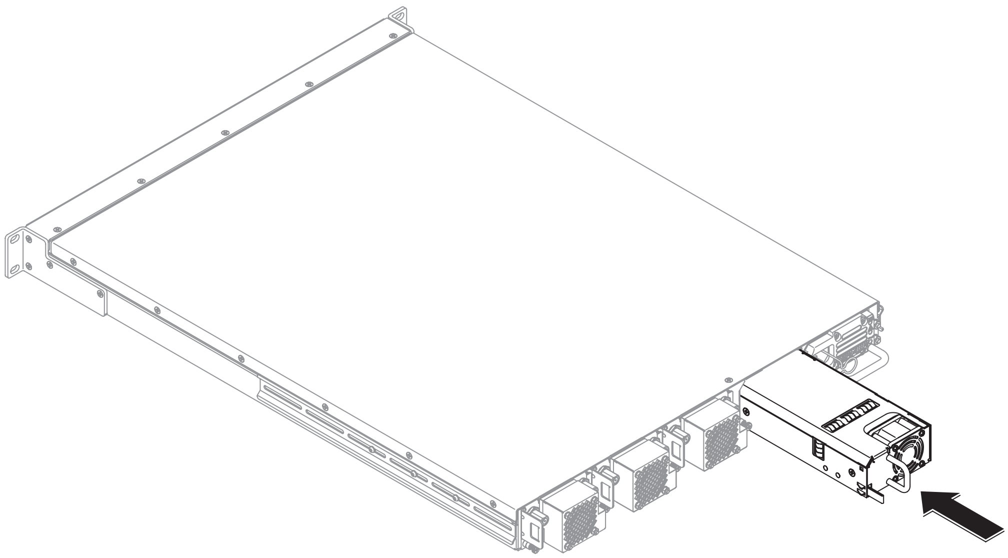
Installing a Power Supply Module

1. Identify the PS unit slot to be installed.

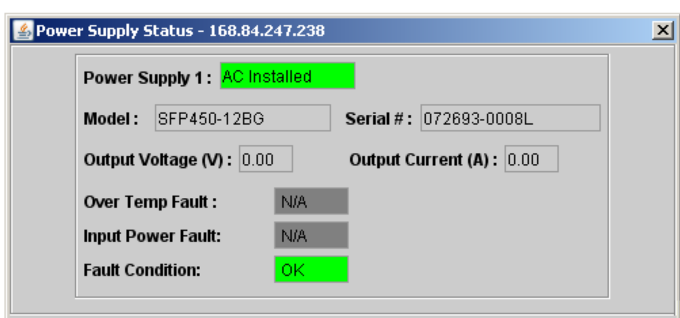
2. Position unit so that slotted top left corner matches the profile of the insertion well. (This is to prevent incorrect insertion and potential damage to unit and chassis.)
3. Slide the module in until you hear a clicking sound and it is flush with the other units.
4. Re-attach the power cord.
5. Verify successful installation by accessing the Power Supply Status window.

Installing a Power Supply Filler Module

1. Identify the slot where the filler module is to be installed.
2. Position unit so that slotted top left corner matches the profile of the insertion well. (This is to prevent incorrect insertion and potential damage to unit and chassis.)
3. Slide the module in until you hear a clicking sound and it is flush with the other units.
4. The fan is powered from the rear connectors; you should hear the fan running to indicate a successful installation.



5. Confirm a successful installation by accessing the Power Supply Status window:



F

Appendix F

RS-232 Test Console Port

The RS-232 Test/Console Port includes a menu-driven interface available by means of any *terminal emulation* program. The primary purpose of the menu is to configure the Internet Protocol (IP) address of the Ethernet 1 network interface.

Properly setting the IP address is a prerequisite to using the APEX1000 EM. After the IP address has been properly assigned, the APEX1000 EM should be used for all subsequent configuration changes.

Console Port Connection

The RS-232 Test/Console Port has a standard nine-pin connector that accepts a nine-pin straight through cable.

CAUTION *Do not use a null modem cable that swaps transmit and receive.*

Establishing Communication with a PC

To initiate a port session with the APEX1000:

1. On the PC connected to the APEX1000, open a terminal emulation program (HyperTerminal, for example).
2. Display the Communications Port window and select the following values:

Parameter	Value
Bits per second:	9600
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None

3. Click **OK** to close the window.
4. Press **ENTER**.

   The User Console Root Menu displays.

Menu General Operations

To access a menu, type the menu number and press **ENTER**. Menu items that display sub-menu items are marked with a **->** designator. Menu items that are not marked are *action* items. Some action items require confirmation prior to proceeding. When confirmation is required, the word yes in all lowercase must be provided; any other response is considered negative.

For convenience, the options **Save Changes** and **Reboot Now** are available on several menus as well as the root menu. They work exactly the same regardless of the menu from which they are called, and are only repeated to minimize required navigation steps.

Menu Selections

The figure below is a summary illustration of menu selections 1 through 3:

```
User Console Root Menu
[0] Exit user console
[1] Show Enet1 Parameters
[2] Enet1 IP Setup (Fixed Config) ->
[3] Enet1 IP Setup (via boot protocols) ->
[4] Destructive Purge ->
[5] Reset APEX EM Admin Username and Password
[6] Save Changes
[7] Reboot Now
Enter a selection 0-7: _
```

Select 1

```
Eth1 IP Parameter Display
Configuration Method: IP configuration via Bootp.
MAC address:          00:1c:11:b5:40:ae
Default IP address:   192.168.32.151
Default Subnet Mask:  255.255.255.0
Default Gateway:      192.168.32.254
```

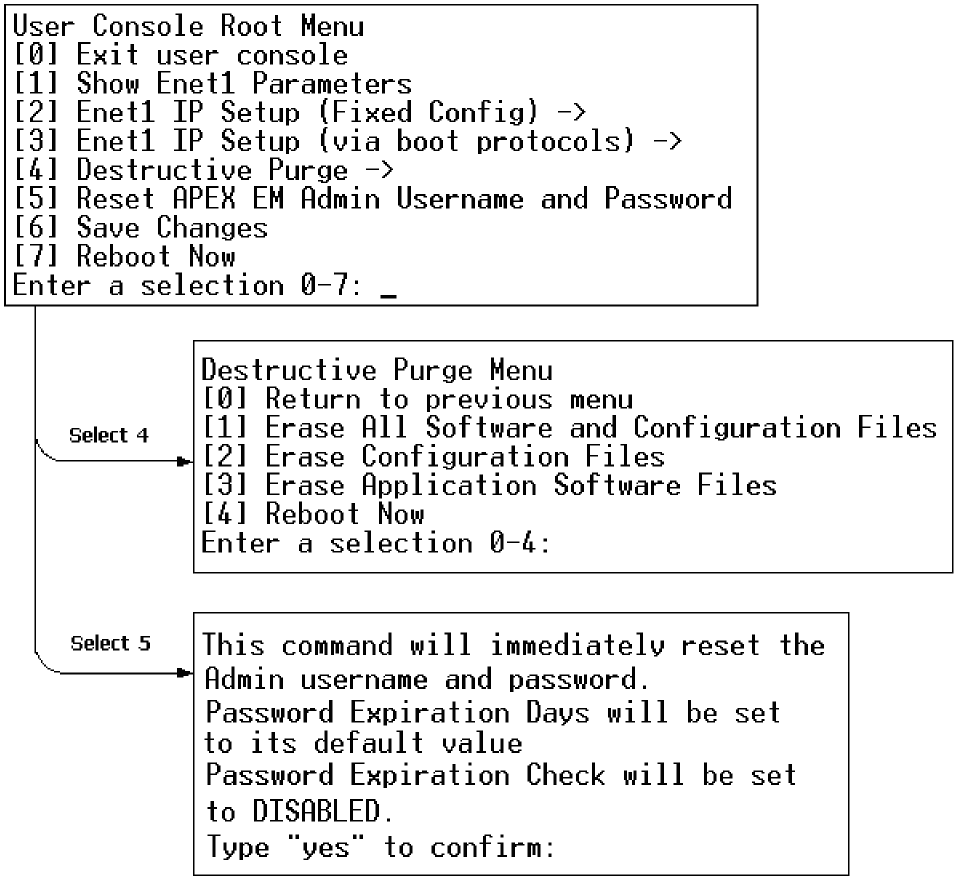
Select 2

```
Enet1 IP Setup (Fixed Config) Menu
[0] Return to previous menu
[1] Set IP address
[2] Set Subnet Mask
[3] Set Gateway IP
[4] Save Changes
[5] Reboot Now
Enter a selection 0-5: _
```

Select 3

```
Enet1 IP Setup (via boot protocols) Menu
[0] Return to previous menu
[1] Do not use boot protocols
[2]
[3]
[4]
[5] Save Changes
[6] Reboot Now
Enter a selection 0-6: _
```

The figure below is a summary illustration of menu selections 4 through 5:



User Console Root Menu

From the User Console Root Menu, you can access:

- **Show Enet1 Parameters** — A quick access display for the APEX1000 MAC address and ENET1 parameters (IP, Subnet Mask, and Gateway addresses).
- **Enet1 IP Setup (Fixed Config)** — Provides access to the fixed IP configuration Setup Menu.
- **Enet1 IP Setup (via boot protocols)** — Provides access to the dynamic IP configuration Setup Menu.
- **Destructive Purge** — Provides access to the destructive purge submenu.

  Entering this menu is not recommended, as it is not necessary for configuration (under normal circumstances). It is only provided for extreme circumstances where normal configuration fails due to unrecoverable errors.

- **Reset APEX1000 EM Username and Password** — Provides the ability to reset the current username and password to the factory default values.
- **Save Changes** — Preserves changes from RAM to flash. This allows the changes to take effect on the next reboot.
- **Reboot Now** — Causes the APEX1000 to reboot immediately; changes in RAM not persisted to flash are discarded.

Show Enet1 Parameters Menu (Root.1)

Provides immediate display of the APEX1000 MAC address and ENET1 parameters.

Note: The actual addresses displayed are network dependent.

`Eth1 IP Parameter Display`
`Configuration Method: IP configuration via BOOTP protocol`
`Default IP address: 168.84.247.109`
`Default Subnet Mask: 255.255.0.0`
`Default Gateway: 168.84.247.1`

Enet1 IP Setup (Fixed Config) Menu (Root.2)

This menu allows you to configure ENET1 with a fixed IP address and configuration. From this menu you can access:

- **Set IP address** — specifies the IP address for ENET1.
- **Set Subnet Mask** — specifies the subnet mask for the network to which ENET1 is attached.
- **Set Gateway IP** — specifies a computer/server that will act as a gateway to other network segments.
- **Save Changes** — preserves changes from RAM to flash. This allows the changes to take effect on the next reboot.
- **Reboot Now** — causes the APEX1000 to reboot immediately; changes in RAM not persisted to flash are discarded.

Enet1 IP Setup (via boot protocols) Menu (Root.3)

This menu allows you to select a boot protocol, which is used to obtain an IP address and configuration at boot time. From this menu you can access:

- **Do not use boot protocols** — Causes the APEX1000 to use the fixed IP configuration specified in the previous menu. This selection cannot be made if the APEX1000 configuration files or application files have been purged.
- **Use Bootp to obtain config** — Causes the APEX1000 to send a BOOTP request at boot. If a BOOTP reply is received, the APEX1000 will use the IP configuration assigned by the BOOTP server.

- **Save Changes** — Preserves changes from RAM to flash. This allows the changes to take effect on the next reboot.
- **Reboot Now** — Causes the APEX1000 to reboot immediately; changes in RAM not persisted to flash are discarded.

Destructive Purge Menu (Root.4)

You should only use this menu as a last resort, preferably under the direction of Motorola BCS technical support. Indiscriminant use of this menu may cause the APEX1000 to become non-operational.

You must manually select the APEX1000 to be rebooted after selecting any of the options below. From this menu you can access:

- **Erase All Software and Configuration Files** — Destroys flash file system. This includes all configuration files as well as the application software itself. Only the boot ROM firmware is left intact. The boot ROM firmware will rebuild the file system at the next reboot provided there is a BOOTP server that will provide the correct configuration and application software files. This selection cannot be made if the boot method was previously set to **None**.
- **Erase Configuration Files** — Erases the APEX1000 configuration files, including manual mapping files. This should only be done when a new set of known configuration files are to be loaded onto the APEX1000. This selection cannot be made if the boot method was previously set to **None**.
- **Erase Application Software Files** — Erases all application files. This should only be done when loading the APEX1000 with new firmware. This selection cannot be made if the boot method was previously set to **None**.
- **Erase All Commands Stored in NVRAM and Reboot** — This feature deletes all stored Load APEX1000 commands (commands from an external controller such as a DAC 6000) and all other internal APEX1000 configuration settings. Erasing commands has no effect on the operation of the APEX1000 when the APEX1000 is internally controlled (any of the VOD operating modes).

  The APEX1000 will be immediately rebooted after accepting/entering **yes**.

Warning! Selection of any of the purge options may render the APEX1000 inoperable.

- Except for the erasing of NVRAM, a BOOTP server must be available to reload the APEX1000 after the configuration files and/or application software files have been erased.

*Warning! Selection [5], **Erase All Commands Stored in NVRAM** will cause all external controller commands in NVRAM to be erased on the next reboot of the APEX1000. When externally controlled, the APEX1000 will have to be reloaded with commands before services or PIDs will be remultiplexed.*

Reset APEX-EM User Name and Password Menu (Root.5)

This menu option allows you to reset the APEX1000 EM username and password to the factory default values (`root, password`). This menu is useful in the event a user forgets the username and/or password previously defined for an APEX1000. (The APEX1000 does not require a reboot for the username and password to be reset.)

Typical Scenarios

Setup for BOOTP Client Configuration

To use boot protocols like BOOTP to automatically obtain the IP configuration at boot time:

1. Install a BOOTP server on your network. (Server configuration is beyond the scope of this document. There are many Linux®/UNIX®/Windows solutions available.)
2. Add an entry into the BOOTP server's database so that it will respond to your APEX1000. The servers use the MAC address of the requester to identify them. You can obtain the MAC address of your APEX1000 by selecting the Root.1 menu (or from the label on the bottom of the unit).
3. From the Root menu, select [3] **`Enter the Enet1 IP Setup (via boot protocols)`**
4. Select the appropriate protocol for your server. Save the changes, and then reboot the APEX1000.
5. Verify that the APEX1000 is using the IP configuration from the BOOTP server's database.

Fixed IP Configuration

If using automatic protocols to manage the IP configurations is not desirable, the APEX1000 can be configured to run using a static configuration as follows:

1. From the Root menu, select [3] **`Enet1 IP Setup (via boot protocols)`**
2. From the protocol setup menu, select [1]: **`Do not use boot protocols`**
3. Select [0] **`Return to previous menu`** to thread back to the Root menu.
4. From the Root menu, select [2] **`Enet1 IP Setup (Fixed Config)`**
5. Enter the following information items: IP Address, Subnet Mask, Gateway IP. These are network topology dependent; therefore, in house IT support may have to provide these values.
6. Select [4] **`Save Changes`**, then select [5] **`Reboot Now`**.

G Glossary

Abbreviations and Acronyms

Acronym	Description
APEX1000	All-Purpose Edge QAM
ARP	Address Resolution Protocol
ASI	Asynchronous Serial Interface
AVP	Attribute-Value Pair
BNC	Bayonet, N-type, C-size connector
BOOTP	Bootstrap Protocol
CPU	Central Processing Unit
CSA	Common Scrambling Algorithm
CTE	Common Tier Encryption
CWG	Control Word Generator
DAC 6000	Digital Addressable Controller 6000
DEPI	Downstream External PHY Interface
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data Over Cable Service Interface Specification
DVB	Digital Video Broadcast
ECM	Entitlement Control Message
ECMG	Entitlement Control Message Generator
EM	Element Manager
EMM	Entitlement Management Message
EMMG	Entitlement Management Message Generator
ERM	Edge Resource Manager
FPGA	Field Programmable Gate Array
GigE	Gigabit Ethernet

Acronym	Description
HTTP	Hypertext Transfer Protocol
I/O	Input/Output
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
IPPV	Impulse Pay-Per-View
JRE	JAVA® Runtime Environment
MAC	Media Access Control
MC	MediaCipher
MCAS	MediaCipher Conditional Access System
M-CMTS	Modular Cable Modem Termination System
MHA	Modular Headend Architecture
MIB	Management Information Base
MPEG-2	Motion Picture Expert Group–2
MPTS	Multi-Program Transport Stream
MSB	Media Stream Broadcast
MSP	Message Stream Protocol
MUX	Multiplex
NMS	Network Management System
NTP	Network Time Protocol
NVMEM	Non-Volatile Memory
NVRAM	Non-Volatile Random-Access Memory
OAM&P	Operation, Administration, Maintenance, And Provisioning (Ethernet port)
OM 1000	Out-of-Band Modulator 1000
PAT	Program Association Table
PCR	Program Clock Reference
PID	Packet Identifier
PMT	Program Map Table

Acronym	Description
PRKM	Program Rekey Message
PSI	Program-Specific Information
PSIG	Program Specific Information Generator
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RADIUS	Remote Authentication Dial-In User Service
REMUX	Remultiplexer
RF	Radio Frequency
RSA	Return for Service Authorization
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
RU	Rack Unit
SDV	Switched Digital Video
SFP	Small Form Factor Pluggable
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SPTS	Single Program Transport Stream
SVM	Switched Video Manager
SVOM	Switched Video Operations Manager
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TS	Transport Stream
UDP	User Datagram Protocol
UDP/IP	User Datagram Protocol/Internet Protocol
URL	Universal Resource Locator
UTP	Unshielded Twisted Pair
VOD	Video on Demand
WK	Working Key

Acronym	Description
WKEM	Working Key Epoch Message
XML	eXtensible Markup Language

Definitions of Terms

Term	Definition
Boot File	This is the file referenced in the BOOTFILE field of the BOOTP reply message. A boot file provides configuration information for a network device either by containing an executable code image for the device or by listing the names of other files that contain the code image and other configuration information.
Boot Image	The configuration information delivered as the result of the boot process. Includes all information derived from the BOOTP reply, boot file, and associated hosts, services, and code files.
BOOTP	Boot protocol. The communication protocol used to transfer initialization information between digital headend network elements and a central server. At power up, network elements issue a BOOTP request. The BOOTP server receives the request and responds with a BOOTP reply that specifies startup information and operating parameters for the requesting device.
BOOTP Reply	Single-packet, multi-field boot protocol message transmitted in UDP by a BOOTP server to provide a boot image to a network device (BOOTP client).
BOOTP Request	Single-packet, multi-field boot protocol message transmitted in UDP by a network device (BOOTP client) to request a boot from a BOOTP server.
Conditional Access Table (CAT)	A table carried in the PID1 stream of a transport multiplex that lists the PID numbers of all EMM streams in a transport multiplex, and indexes each EMM stream to an EMM provider ID.
Entitlement Management Message (EMM)	This message type enables digital set-tops to decrypt a service. The MPEG-2-formatted messages carry system-wide information, such as Category Keys to specific set-tops, as well as authorization privileges and related access control information to specific or a group of set-tops. The RADD 6000 inserts these messages into the EMM data stream that is distributed out-of-band.
Internet Protocol (IP) Address	This public standard address is used for packet- and connection-type communications.
JAVA-Enabled Console	A remote configuration tool that uses a multiplatform, object-oriented programming language.
Local Area Network (LAN)	A data communications network within a given area, such as a control room, office, specific workplace, building, or building cluster up to six miles wide (10 kilometers), but not using a common carrier.

Term	Definition
MAC address	Media Access Control address. A proprietary address used for upstream/downstream communications. This is the lower sub-layer of the Data Link layer in the OSI model and is used to describe the mechanisms used to arbitrate access to a shared medium.
MPEG-2 (MPEG-II)	An international standard (ISO/IEC 13818) for delivering compressed digital video. MPEG-2 is broadcast quality at 704x480 pixels at 30 frames per second (fps) in North America and 704x576 pixels at 25 fps in Europe. MPEG-2 is typically compressed at higher than 5Mbs and intended for higher quality broadcast uses.
OAM&P	A telephone industry acronym referring to operations, administration, maintenance, and provisioning. The term refers to software required to generate the reports and commands needed to control all network equipment. The OAM&P port is a network (Ethernet) port through which a device communicates with the headend network. The OAM&P port is assigned a hardware (MAC) address at the factory; this MAC address is used for communication with the BOOTP server before the network (IP) address is assigned to the port.
Packet Identifier (PID)	A number assigned to MPEG transport packets to identify the information stream to which they belong. The PID number is assigned in the packet header, and all packets from the same stream have the same PID number. A 13-bit number included in MPEG-2 transport packet headers.
PSI (Program Specific Information)	PSI information is required by the Host to determine the services contained within each transport stream, and the component PID streams making up each service to be encrypted. Knowledge of the component PID values is also required to perform PID re-mapping. The APEX1000 must also detect version number changes within these messages in order to respond to changes.
Quadrature Amplitude Modulation (QAM)	A data modulation technique used to convert digital program information for delivery in cable TV systems over in-band frequencies (a form of double sideband modulation). The data stream is split into two half-rate streams. One of the data streams modulates a sine wave carrier, the other a cosine carrier at the same frequency. The resultant signal resembles a vestigial sideband signal with no pilot carrier present.
Transmission Control Protocol/Internet Protocol (TCP/IP)	The basic communication protocol of the Internet. TCP/IP is a two-layered protocol: • The TCP layer breaks a data packet into smaller packets that are transmitted over the Internet and received by another TCP layer that reassembles the packets into the original message. • The IP layer ensures that each packet has the sender’s and the receiver’s Internet address and will get to the right destination.
User Datagram Protocol (UDP)	A transmission protocol that uses an IP address to identify the destination host and a port number to identify the destination application.

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