BNP Best Practices and Procedures
Using the RGB BNP*2xr*

A guideline to better BNP Design and Installation Practices

Version 7.1

This document was designed for BNP Software Version 3.0 or higher.
Customers using versions less than 3.0 should consider upgrading.

DOCUMENT SUMMARY

The goal of this document is help RGB Sales, Third Party Vendors and End User Customers design a sound network using the RGB Broadcast Network Processor (BNP). This document will guide the reader through proper stat Mux design; IP addressing and network design of a BNP or in many cases with any other Statistical Multiplexer.

BNP DESCRIPTION

The BNP is a type of Statistical Remultiplexer. A Statistical Remultiplexer, is also known as a "Transrater" or a "Rate Shaper" and typically has the ability to perform other functions such as Digital Program (or Ad) Insertion (DPI), Muxing HDTV and SDTV services together, clamping of services, Switched Digital Video (SDV), inserting graphical and text overlays over existing Digital services, selective PID grooming and more.

Statistical Remultiplexing involves the use of two functions

1. Statistical Remultiplexing allows a Cable Operator to pick and choose only the services (or Elementary Streams) he desires from multiple MPTSs (Multiple Program Transport Streams) or SPTSs (Single Program Transport Streams) and create a brand new MPTS or SPTS with the new service(s) chosen.
2. Since most services are VBR (variable Bit Rate), the Bit Rate is constantly changing. However, the Transport Stream each service rides in is always CBR (often 27 or 38.8 Mbps), so the Statistical Remultiplexer must "manage the Bit Rate of each service to avoid total Bit Rates which exceed the Transport Stream bandwidth."

Managing service Bit Rates (Transrating/Rate Shaping) is done through several methods

- Stripping out null padding from encoder generated Constant Bit Rate (CBR) Streams or through other Mux related stuffing. This method does not affect picture quality.
- Time shifting. Because Transport Streams are buffered, recreating a Mux allows the opportunity to manage these Data Transmission Buffers to ensure no two services peak in Bit Rate at the same moment in time. This method does not affect picture quality.
- Re-quantizing the video as required. This is achieved through proprietary algorithms and can slowly degrade video quality as larger Bit Rate reductions are required.

These methods can often achieve a 25% or more reduction of Bit Rate without significant loss in quality, depending on the original content. It is never recommended to Transrate more than 40% using any Statistical Remultiplexer on the market today unless the original content has excessive null padding or lends itself easily to heavy Rate Shaping. An example of a service which may include excessive null padding would be certain Local Encoders, if not optimally configured.

BNP FEATURE SUMMARY

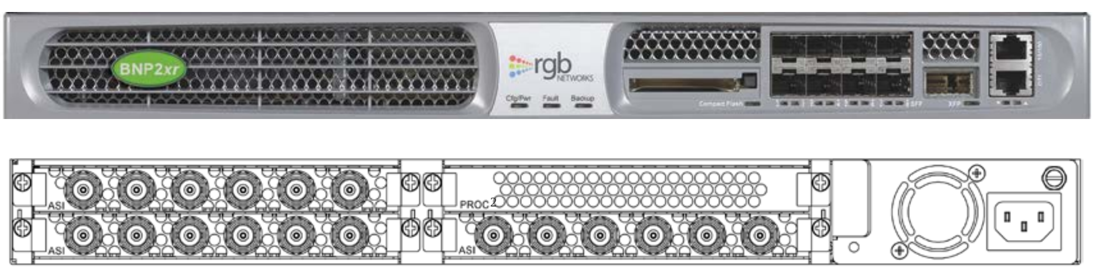
- Transrating & Statistical multiplexing 576 SDTV services in a single Rack Unit (RU)
- Transrating & Statistical multiplexing 36 256 QAM Transport Streams in one RU
- The above data is calculated using a BNP's total Output Processing limit of 1.44 Gbps
- VBR & CBR Switched Broadcast capable
- Supports Bit Rate clamping across all services
- VBR or CBR input and output
- MPTS or SPTS input and output
- 4 Configurable slots
- 8 Gigabit Ethernet ports available with no licenses required
- SCTE 30/35 based Digital Ad-insertion (deployed w/ C-cor, Seachange, Adtec)
- Up to 18 configurable ASI input and/or outputs available
- 1:1 Redundancy options
- Service (Program) level redundancy options with no additional license required
- Single screen configuration and grooming for ease of use
- Scheduled grooming capability
- Full HDTV Transrating and PSIP support with no additional licenses required
- Web/Java based Graphical user interface and SNMP for management and monitoring
- IGMPv2 and IGMPv3 Support
- Bit Rate monitoring and analysis of inputs and outputs simultaneously
- Digital (SCTE-18 based) EAS crawl capability across many services
- Graphical and text overlay capability for targeted advertising

BNP CAPACITIES IN DETAIL

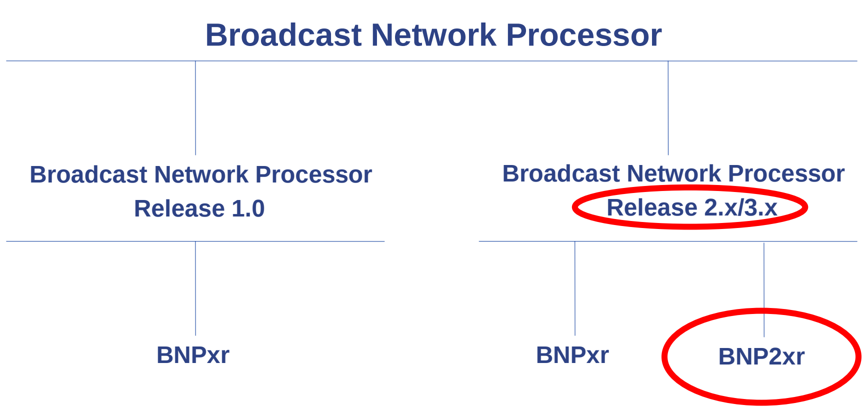
Many BNP hardware components in the field today are known collectively as the BNP*xr* platform. The BNP*xr* platform is no longer being sold. A newer BNP*2xr* platform is now available. The primary differences between the BNP*xr* and the BNP*2xr* are the replacement of the rear Processor cards, known as PROCs, with a new Processor Board called the PROC-2 and the replacement of the front Board, known as the GBP. Other than a higher overall capacity, the two platforms are very similar and both will continue to be supported.

RGB has also recently introduced new versions of our software with many additional features. As these new features are added, the capacity per rear Processor board (PROC) may decrease, depending on hardware. RGB Support will be available for hardware audits to determine if additional hardware is required by call 877-RGB-NETW. The new releases support the addition of a third PROC card in the 2xr, and 4th PROC card in the 3xr. If an upgrade over-subscribes your current hardware, depending on the number of existing Transport Streams, it may not require an additional chassis. Below are the hardware capacities for each version of hardware and software. All BNP*2xr* Hardware should be running on 3.x software as of Q1 of 2010.

BNP*2xr* Hardware Illustration



BNP*2xr* Hardware versus Software compatibility



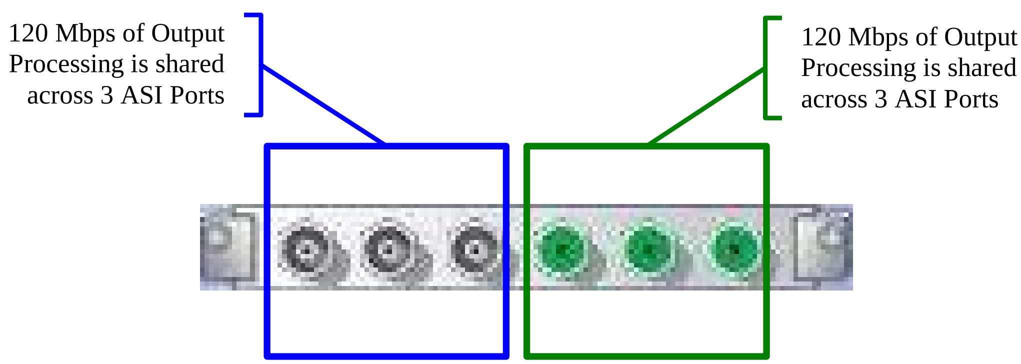
BNP*2xr* HW Capacity using BNP Software 3.x +

Number of PROC Cards	Max 40 Mbps TSs	Max BW (Mbps)	Max MPTS SD Programs	Max 4 Mbps SPTSs
1 PROC	12	480	192	120
2 PROCs	24	960	384	240
3 PROCs	36	1440	576	360

ASI Board Specifications compatibility

Each ASI Board comes with 6 available ASI Ports. Each of the 6 ASI Ports is separately configurable as an Input or Output. Input data rates up to the **ASI spec of 213 Mbps 188 byte ASI packet format** are supported. However, the Output ASI Port design does limit full rate availability. There are two versions of the ASI Board, known as ASI and ASI-2. A BNP must be running software version 1.22 or greater in order to support an ASI-2 Board.

The ASI output data rate on the BNP is dependent on the number of ports configured for outbound processing and the features used on the BNP. ASI ports are assigned into Port Group A (ASI Ports 1, 2, 3 on a module) and Port Group B (ASI Ports 4, 5, 6 on a module). Each ASI Port Group has an outbound aggregate throughput of 120Mbps. This means that if 1 ASI port in a Port Group is configured for outbound communications, a full 120 Mbps bandwidth is available. If 2 ASI ports in a Port Group are configured for outbound communications, 60 Mbps bandwidth per port is available. If 3 ASI ports in a Port Group are configured for outbound communications, 40 Mbps bandwidth per port is available. The Bit Rate does not have to be equal on each port and each port can use any desired Bit Rate, as long as the total does not exceed 120 Mbps. See the diagram below.



TRANSPORT STREAM DESIGN CONSIDERATIONS

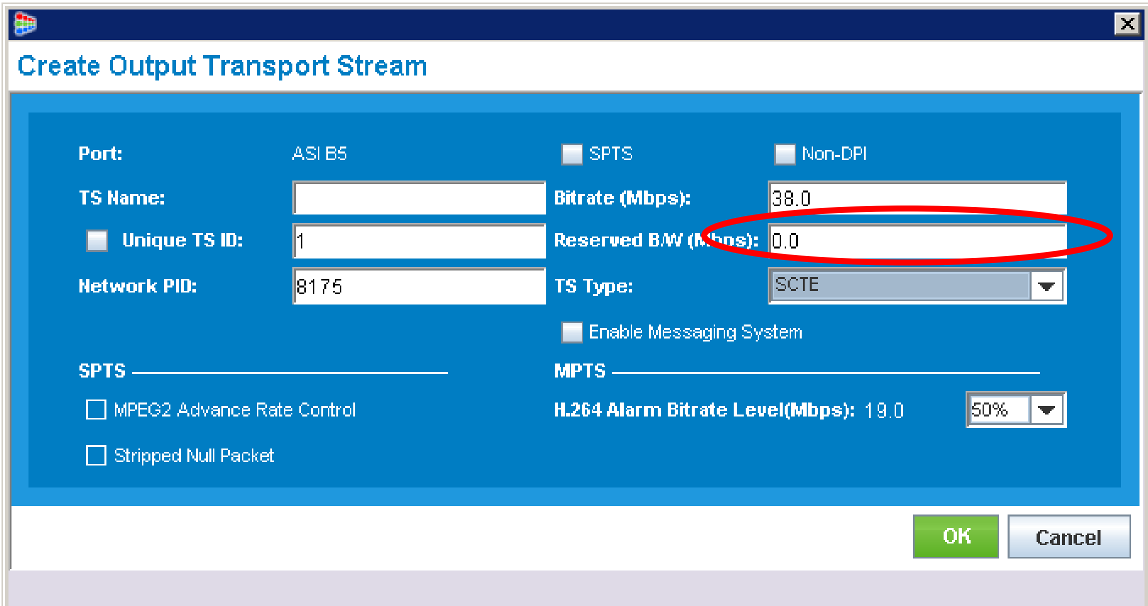
In most instances, Transport Streams created on the output of a BNP will be formatted to be sent to a QAM. While both 64 QAM Modulators and 256 QAM Modulators are prevalent in the North American Operator space, any new QAMs entered into a plant are usually at 256 QAM. The defined Bit Rate of 256 QAM is 38.77 Mbps. For reference, the defined Bit Rate for 64 QAM is 26.97 Mbps. This section will focus on 256 QAM.

Transport Stream Bandwidth

The default Bit Rate for building a new Transport Stream in a BNP is 38 Mbps. This parameter is editable upon Transport Stream creation. While the full bandwidth of 256 QAM is 38.77 Mbps, encryption of digital services after the BNP requires the addition of several new tables and corresponding data in the Transport Stream at the encrypting QAM Modulator. So a properly designed BNP Transport Stream will leave room for this additional data. 38 Mbps is a very conservative reserve of bandwidth, but may always safely be used. In general, the encryption of each service requires an additional 35-50 Kbps per service. However, this could change as new encryption protocols and technologies emerge. Assuming a maximum of 14 encrypted services (not recommended as detailed below); the maximum Bit Rate ever used in a BNP should be 38.07 Mbps. Less encryption may allow for more Transport Stream Bandwidth. Obviously, the more bandwidth available for a BNP to use, the less Transrating (rate shaping) will be required. Not reserving enough bandwidth will cause picture tiling and breakup at a QAM, so 38 Mbps is always a safer bet.

Starting with Release 2.2 +, a second option exists for reserving Bandwidth for downstream Encryption Devices. In addition to building a Transport Stream at a Bit Rate that is less than the total capacity of 38.77 Mbps, with Software Version 2.2 +, a User may build a Transport Stream at 38.77 Mbps and use a new field called “Reserved Bandwidth”. By adding a value in this field, the BNP will automatically cap all Transport Stream Data (Video, audio, Data Packets) at the predefined TS Bandwidth minus the Reserved Bandwidth Field (if populated) and fill the remaining space with Null Packets. This allows end devices to remove these Nulls and replace them with necessary Encryption Bandwidth.

With BNP 3.3.0 release, there is a new feature called Stripped Null Packet. This feature strips the null packets on an SPTS basis from the TS. When using the Stripped Null Packet feature: PCR Repetition value is global for all modes including DVB and MPEG-2, and the output TS is non-DVB compliant.



Number of SD Programs per Transport Stream

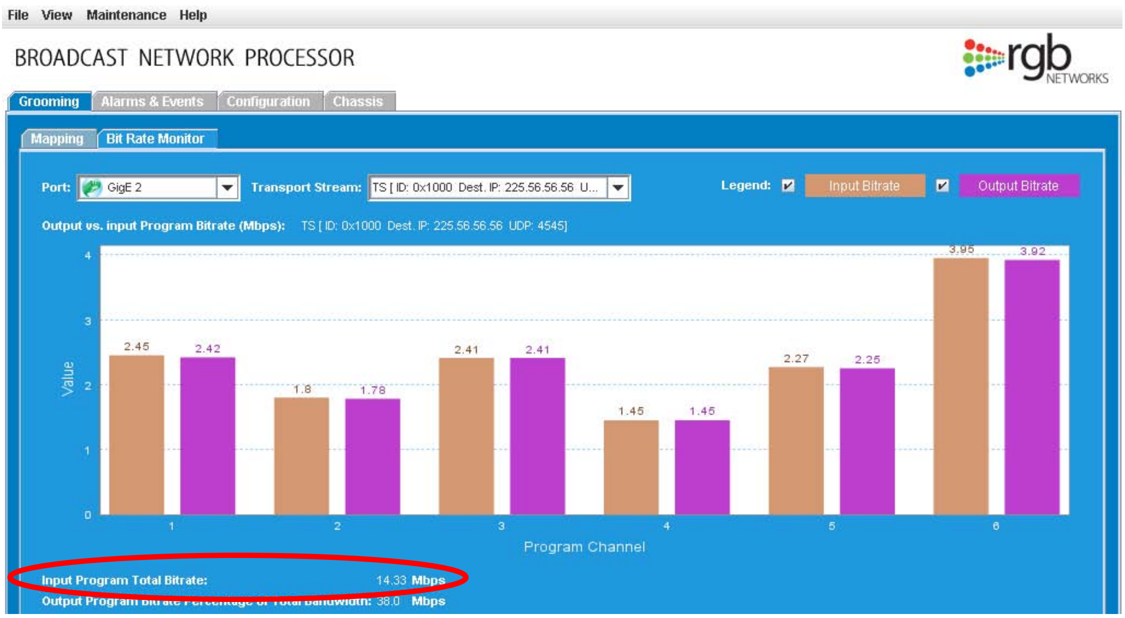
One of the most frequently asked questions by Operators is how many SD or HD services per Mux. Unfortunately, there is no easy answer. First we will address SDTV services. Rule of thumb says no more than 12 – 13 services per Mux. Here is why. Most services in a Statistical Mux are coming from satellite, which provides each service as VBR (Variable Bit Rate). This means that the Bit Rate is constantly changing based on scene complexity and the type of programming. So the average Bit Rate of a service over one hour (or even one day) can be significantly different than another day. The BNP has the ability to look at the Bit Rates of incoming services for Mux planning, but due to the statement above, this is not always an accurate depiction. Experience has told us that in general (though there are exceptions) the following is a basic guideline:

- Digicipher encrypted satellite services often have an average Bit Rate of about 3.5 Mbps
- Powervue encrypted satellite services often have an average Bit Rate of about 4 Mbps
- Sports programming typically has a non-game Bit Rate of 3.5 Mbps and a game Bit Rate of 5 Mbps
- Programming originating from Canada typically has an average Bit Rate of 6 Mbps
- HITS programming typically has an average Bit Rate of 3 Mbps
- CBR (Constant Bit Rate) locally encoded services have a Bit Rate of 3-6 Mbps, config dependant.
- VBR locally encoded services (Closed Loop) tend to have an average Bit Rate of 3.25 Mbps

The key to a good Transport Stream Mux is never to exceed a 25% reduction of Bit Rate from input to output of the aggregate overall Bit Rate. While we support reductions as high as 40%, the further the reduction, the more noticeable the artifacts may be. If minor background artifacts are not a concern, further reductions are permitted. BNP Version 2.0 has an Input Service Bit

Rate Monitor that helps Operators verify the percentage of Bit Rate reduction from Input to Output without actually building an Output Transport Stream.

We know we are starting with 38 Mbps. A 25% increase in Bandwidth would mean 47.5 Mbps. So ideally, we do not want the average aggregate input Bit Rate to exceed 47 Mbps. Occasional peaks above 47 Mbps are fully ok and that is what the BNP does best is handle these peaks. The goal is to keep the average aggregate input Bit Rate at around 47 Mbps. Once a Mux is created in the BNP with all services groomed, the BNP's Bit Rate Monitor will actually give you the real-time aggregate input Bit Rate, which makes verifying the health of a Mux easy to do.



We know that an output Mux total bandwidth is 38 Mbps. We know the average aggregate input Bit Rate should be around 47 Mbps. What we are missing is the average Bit Rate of an "average" service. As you saw above, the average Bit Rate depends on the service. However, we do know a few key things. 60-70% of all satellite services are Digicipher. Sports programming is not high at all times. Conversely, Powervue services sometimes dip well below 4 Mbps. CBR based locally encoded services may have a high Bit Rate, but most of that Bit Rate is in null packets, packets which can be removed from the service without affecting quality.

SD Program mixes

To build a good Mux, never add more than 2 sports related services into a single Mux. Always mix locally encoded services with satellite services, when available. If possible, avoid Muxes consisting only of Powervue services. Once the above is followed, use 3.75 Mbps as your (assumed) per service average Bit Rate. Using the formula 48 Mbps (total aggregate input Bit Rate) / 3.75 Mbps (average Bit Rate of an average service); you will get a result of 12.8 services. So…12 – 14 services per Mux becomes a good number to use when designing a healthy Mux. If all HIT services are used, you may be able to add as many as 15 – 16 services. If you must use all sports services, Canadian services or other Bit Rate intensive services, you may want to use less than 12 services.

Number of HD Programs per Transport Stream

Due to the nature of HD content, the bit rates of HD services can vary greatly. Some HD Services will be constantly around 18 Mbps. Other HD Services may be as low as 11 Mbps. Because of this, building a Mux with HD can be complex. It is very helpful to know average Bit Rates for each HD service you hope to Mux. Once known, low Bit Rate Services can be matched with high Bit Rate services. But rule of thumb (using the above formulas and guidelines) is that the BNP can comfortably handle 3:1 HD Muxes, provided that the average Bit Rate of all 3 HD Programs does not exceed our recommended 25% Input Bit Rate threshold. This means the maximum Bit Rate should not be greater than 47.5 Mbps on average. For example, muxing HDs with average bit rates of 19 Mbps, 12 Mbps and 15 Mbps (46 Mbps) should produce a high quality result. However, 3 HDs at 19 Mbps (57 Mbps) is never recommended.

By nature, a Statistical Multiplexer is most efficient when a large number of services exist. Because of this, RGB recommends mixing HD and SD to produce a larger number of services, per Mux, as long as the above Bit Rate guidelines are followed.

Bandwidth per GigE Port

Finally, it is important to discuss "Per Port" GigE Bandwidth. The BNP was designed to support a full 1 Gbps of Bandwidth. However, this does not mean that output Transport Streams should be added on the input or output until the full 1 Gbps is achieved. When building transport Streams, the GUI is only concerned with the Transport Stream Bandwidth. Additional overhead should always be assumed for traffic through the Network. In addition, other traffic will exist such as ARPs, Multicast requests, etc. Finally, many switches while supporting 1 Gbps, base that spec on data traffic, where real-time delivery is less important.

Given all of this, RGB recommends a 15% overhead when adding input or output services to a GigE Port. This would mean a capacity of 850 Mbps after adding up the bandwidth of the input or output Transport Streams.

In addition, RGB only recommends using each GigE Port as an input or output port in setup of the BNP. While bi-directional capability is available in the BNP, RGB does not recommend such a configuration. Below are the tested capacities, should bi-directional support still be planned in a network design.

GigE Capacity Notes	
The preferred design approach is to separate Input and Output traffic on different GigE ports. Using the same port for in/out CAN cause issues.	
GigE Ingress	850 Mbps recommended per GigE Port
GigE Egress	850 Mbps recommended per GigE Port
Maximum tested Ingress/Egress capacity	853+582=1.44 Gbps
Maximum tested Egress/Ingress capacity	760+584=1.344 Gbps

Ingress & Egress on the same GigE Port	Estimated 1.344 Gbps Maximum supported per GigE Port

Important Guidelines concerning Music Only Services

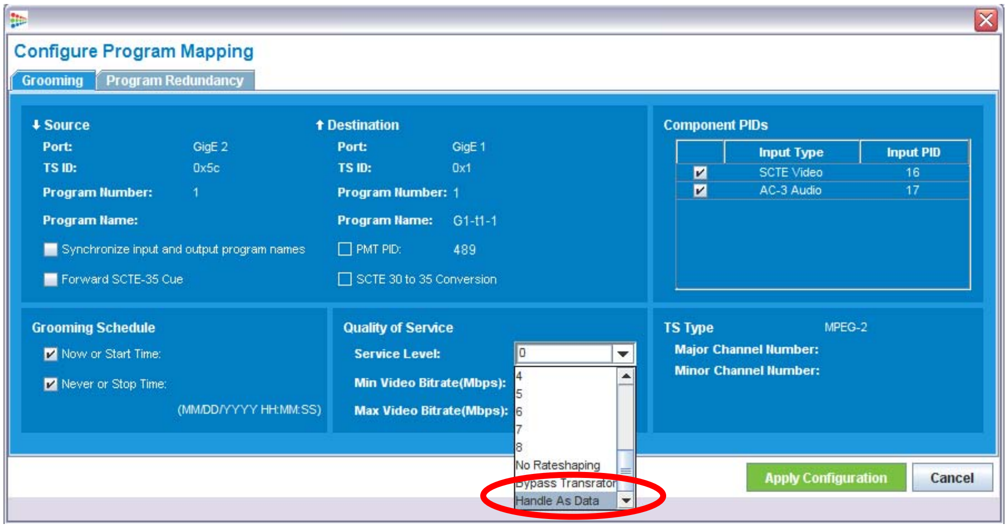
When adding Audio Only channels with Data PIDs into a BNP output Transport Stream or Data only Services, very strict guidelines must be followed to avoid additional issues. Audio Only services with Data PIDs include Music Choice, DMX and Urge. An Audio Only service is defined as any service which is primarily used for listening to music or other audio content. An Audio Only service does not contain full motion video, with the exception of simple barkers and graphics like Music Choice, DMX and Urge. Finally, a Music Only service will typically be less than 500 Kbps per service.

There are two guidelines that must be followed when grooming Music only or Data only services, depending on your BNP Software Version. First is the number of services supported per 38 Mbps TS. The second is the grooming process required.

When grooming Audio only services using BNP Version 1.x, the BNP only supports 5 Mbps total of Audio Only services per 38 Mbps Transport Stream when Transrating occurs. The bit rate monitor in the BNP GUI does not show audio bit rates, so it cannot be used to determine this number. Only an MPEG Analyzer can confirm the bit rates of the Audio Only services being groomed. However, since an MPEG Analyzer is not always available, the total number of services can be estimated, based on current information. Since most Audio Only Services are less than 500 Kbps (aggregate), the total number of Audio Only services typically supported per Output Transport Stream is 10 services. Adding more than 10 services per output Transport Stream can affect the video integrity of other services in the same Transport Stream. The addition of other programs to a Transport Stream with Data Elementary Stream PIDs contained within can further reduce this number. This limitation does not exist in 3.x BNP Software.

In addition to the 10 Audio Only service limitation, the “QOS” (Quality of Service) setting for any Audio Only Service must be configured as “Handle as Data” on both BNP Software Version 1.x and Software version 3.x. If this setting does not exist, please contact RGB Support at 877-RGB-NETW for instructions on obtaining a BNP Software Upgrade package. The QOS window can be found within the Grooming Dialog when initially dragging an Audio Only Input program to an Output Transport Stream. See below.

Important Note: If the Audio Only service has already been groomed to the output TS, do not regroom it with the new QOS setting. You must delete the existing output service (program), then groom it back to the output TS, again.



LOCALLY ENCODED PROGRAM RECOMMENDATIONS

Programs (also known as services) provided from Satellite will be consistently formatted across all sites in a region. Changing this content is not possible without a decode/re-encode scenario. Therefore, the BNP will be expected to be compatible with all input programs provided from Satellite Receivers.

However, many Operators choose to decode/re-encode Satellite content. This is done for several reasons including greater control over the content’s audio, to reduce program bit rates, changing video resolutions (common also when changing Off-Air HD Services into SD Services for Analog Plant distribution via Edge Processors) and to mux it with other programs using closed loop encoder/multiplexer systems. In addition, some programs are still provided as analog over satellite and must be encoded locally.

Most Local Encoders will work immediately out of the box when feeding BNPs using default settings. However, some Local Encoders have the capability of playing with many of these settings, which can cause issues for many devices downstream, including BNPs, if an Operator is not aware of the risks posed by each setting. Below are a few options to consider.

Video GOP Size Recommendations

By default, most encoders will use a GOP (Group Of Pictures) size of anywhere between 11-15 frames. A GOP is an I-Frame and all of the associated B and P Frames which are inter-dependent upon each other as reference points. (A frame is a complete picture, 30 (29.97) of which are broadcast in a second of time giving the illusion of motion. An I-Frame is a frame in which all of the data required to create it is sent via the Elementary Stream Packets. This is compared to B and P Frames, in which only some of the data is sent and the rest is inferred by referencing past and future frames. For more information, please call RGB or contact your Salesperson regarding our VIA Course, a course taught by RGB, that explains MPEG in detail).

Using a GOP size of 11-15 Frames ensures full compatibility with all downstream devices and is the recommended setting by RGB Networks for input programs feeding a BNP. In addition, some Encoders can choose a Fixed GOP length or a variable GOP length, where the frame size varies from GOP to GOP. For best compatibility, RGB also recommends using a fixed GOP length. These recommendations mirror the settings of all known Satellite Provider Programs and the default settings of most Local Encoders.

Issues with increased GOP Lengths

Increasing GOP size can cause a number of unexpected issues. As GOP size increases, Set Top channel change times will increase. Setting GOP sizes beyond 30 Frames can create multi-second channel change times, as Set Tops wait for an I-Frame to begin full decoding and output of program video. This often leads to customer complaints and Set Top swapouts for a non Set Top related issue.

In addition, longer GOP sizes can create DPI issues with Ad Splicers including, but not limited to the BNP. The logic behind this is simple. Without clean reference I-Frames, Local Commercial splice point delays can be expected, as well as possible DPI failures.

Picture quality is another important factor to consider when increasing GOP size. As GOP Size increases, overall quality of the video will begin to degrade. Higher end Encoders will limit this degradation, but with lack of consistent I-Frames, degradation will still occur. More importantly, all Statistical Remultiplexers (Rate Shapers), including the BNP and each of its competitors will make this degradation more pronounced. Each Rate Shaper will exhibit the artifacts differently creating artifacts such as “pulsing” details in the background, color changes, flickering details in the background and more.

Compatibility is another issue to consider. For example, certain Motorola DVR Set Tops will exhibit issues when fast forwarding or rewinding stored programs. Other picture issues are also possible. Because of this, Motorola’s last known recommendation for Local Encoders is a 15 Frame GOP size (Fixed) or a 30 Second GOP size (Fixed) with all other larger GOP sizes not supported. For changes to this policy or other recommendations, RGB would suggest contacting Motorola directly. In addition, most TVs currently being sold have QAM Tuners (and in some cases TV Card slots for encrypted content). Since the number of TV models are too numerous to test all of them, using non-standard GOP sizes may cause unexpected issues with certain TVs, which were optimized for 11-15 Frame GOP Sizes.

Lastly, the benefits to larger GOP sizes are too few to typically consider when noting the above issues. The primary reason for larger GOP sizes is to allow a Local Encoder to encode video at a lower Bit Rate then typical, while maintaining a reasonable quality. This is most often the case with Closed Loop Decode/re-encode Set Ups. However, the efficiency gained is typically only 3-4 %, depending on the increased GOP size. In a classic 38.8 Mbps 256 QAM Transport Stream, this equates to only about 1-2 Mbps of additional efficiency, which can easily be achieved by any Statistical Remultiplexer (Rate Shaper) with no loss in quality and no changes to the GOP structure.

AC-3 versus MPEG Audio

RGB recommends using AC-3 as the audio choice for Local Encoders. The BNP supports both AC-3 and MPEG Audio. However, most legacy Motorola Set Tops do not support MPEG Audio. Instead, they require AC-3 Audio. Therefore, downstream issues are minimized by using AC-3 Audio. Further, most Local Ads are encoded with AC-3 Audio. If the program being encoded is a DPI channel, this ensures no abrupt changes in audio type when DPI splices occur.

Audio Sampling Rates

RGB recommends always using an Audio Sampling Rate of 48 KHz. Many downstream devices do not support an Audio Sampling rate of 44.1 KHz; therefore this option should be avoided. Incompatible devices include certain Set Tops and the SEP 48.

Assigning the PCR PID

By default, most Local Encoders assign the Video PID as the PCR PID. RGB also recommends this option. By assigning a dedicated PID or and Audio PID as the PCR PID, compatibility issues may arise in certain Set Tops. Also, the BNP does not support standalone or other PIDs as PCR PIDs in any BNP Software version 1.xx. Support for this does exist in the 2.xx BNP Software.

IP ADDRESSING CONSIDERATIONS

IP Addressing can be a confusing topic, since we are dealing with physical IP Addresses, virtual IP Addresses, multicast IP Addresses and possibly even Unicast Transport Streams. Below is RGB's attempt to help an End User with IP Addressing Guidelines.

Any physical port which touches a data network must have a physical IP Address assigned to it. This is required and you cannot even build an output Mux without first assigning one. There are 9 IP Addresses required on a BNP, if all 8 GigE ports are used. Less GigE ports used require less IP Addresses. Redundancy requires the addition of more IP Address per port. See the section on Redundancy for details. Each physical IP Address must have a Subnet Mask and many will have a Gateway. For more information on IP in general, enquire about the RGB Training Course "Understanding Simulcast Technologies" for a detailed lesson on IP.

Management Port Practices

We will start with the Management port. This is the port used to access the GUI (Graphical user Interface) of the BNP. All BNPs are shipped with a default Management IP Address of 10.1.1.1 with a subnet of 255.255.255.0. To access a new BNP, simply change the IP Address of your computer to any other Address on this network (10.1.1.2 – 10.1.1.254). Once you access the GUI, you may change this IP Address to one on your existing network. Changing the

Management Address in a BNP requires a reboot. Don't forget to change your computer's IP Address and Subnet after the reboot to reflect the changes in the BNP.

Warning: The subnet used for the management port MUST be a separate Subnet Network than any of the 8 GigE ports. This means that if you were to leave the management port at 10.1.1.1, you cannot use any IP Address in the range of 10.1.1.2 – 10.1.1.255 for a GigE port IP address. For more information on Subnets, enquire about the RGB Training Course "Understanding Simulcast Technologies" for a detailed lesson on IP.

GigE Port Practices

It is strongly recommended by RGB Networks that each GigE port resides on its own Subnet. While setting every GigE port on the same Subnet Network will typically work, the lack of segmentation in a network will make troubleshooting for RGB personnel difficult and may cause unexpected issues. While this configuration typically works, it is not a supported configuration by RGB Networks.

Some End Users may see a need to design their GigE networks as a "flat" network using the same Subnet for all video traffic. It is possible to segment networks in the BNP while still keeping a flat network. As long as the Subnet created in the network switch/router encompasses all GigE IP Addresses, you may create smaller Subnets at the BNP GigE interfaces which no not interfere with each other. Since each BNP GigE port is part of the larger switch network, you may still ping the interface at the switch, provided it resides in the GigE port's Subnet.

For example, if the flat switch network is at 192.168.100.0 with Subnet of 255.255.255.0, it has the ability to talk to any computer from 192.168.100.1 – 192.168.100.254. You can segment each BNP GigE port into smaller subnets with only 4 IP Addresses.

GigE1 on the BNP may have the following settings:
GigE 1
IP Address=192.168.100.14
Subnet=255.255.255.252
Gateway=192.168.100.13 (This would be the IP Address of the Switch Interface Port).

GigE 2 on the BNP may have the following settings:
GigE 2
IP Address=192.168.100.22
Subnet=255.255.255.252
Gateway=192.168.100.21(This would be the IP Address of the Switch Interface Port).

Multicast Addressing Practices

A Multicast address is an IP Address not associated with any physical adapter. It is an Address any device can point to in order to join the flow of traffic coming from the Source IP Address configured behind this IP Address. Multicast IP Addresses are determined by the range of IP Addresses used. Below are all available Multicast IP Addresses:

- Link scope: 224.0.0.0—224.0.0.255
  Reserved and should not be used.

- Global scope: 224.0.1.0 – 238.255.255.255
  Can be delivered (routed) to the Internet. Useful if the video is planned to ever be publicly routed.

- Administrative scope: 239.0.0.0 – 239.255.255.255
  Not forwarded beyond an organization's network. Perfect for a Headend Network.

Netfilters

The BNP has a restriction on the number of Multicast Addresses you may use to join services at an Input GigE port. The process is based on a concept known as Netfilters (NF). The NetFilter process provides the mechanism for determining what inbound IP network packets are addressed for the BNP. The NF consists of entries for IP address and UDP port number pairs in determining what IP network traffic to receive. This in effect provides a network traffic filter to only receive the proper IP packets. The NF consists of a combination of IP address and UDP port entries based on the following guidelines.

BNP Version 2.x Input Multicast Address Guidelines

With BNP 3.3.0 BNP Network Filter supports 512 entries: User can configure up to 512 TSs having unique IP addresses, an additional 1527 input transport streams can be created internally having unique IP address.

For all other software up to 3.2.1, no more than 120 unique input Multicast IP Addresses may be used, as part of the NetFilter design. No such restriction exists with output Transport Streams. The number of consecutive UDP Ports permitted depends on the number of Multicast IP Addresses used in conjunction with them. You may use up to 1920 consecutive UDP ports with a single Multicast IP Address, so there is rarely a limitation to the number of input Transport Streams you can join, only a limitation on how they are addressed. The BNP Input Multicast Architecture revolves around blocks of 16 UDP Ports each (Netfilters), with each block having the flexibility to be assigned to its own Multicast Address. Using UDP Ports which are not consecutive and outside of the 16 UDP Port Block, would require another block of UDP Ports to be used. There are a total of 120 16-Port UDP Port Blocks. This means that if 2 Multicast IP Addresses are used on input Transport Streams, the number of available UDP Ports is split between each Multicast IP Address, allowing 960 consecutive UDP Port combinations per each of the 2 Multicast IP Addresses. When all 120 Multicast IP addresses are used, only 16 UDP Ports may be used per Multicast IP Address, again allowing the join of over 120 Multicast Addresses. Unicast Transport Streams would not have any restrictions, since an IP Address is not used, but with the exception of VOD Streams, Unicast is never recommended for building a flexible and efficient Transport Streams. For more information on IP in general, enquire about the RGB Training Course "Understanding Simulcast Technologies" for a detailed lesson on IP.

IP-1	UDP-X
	…
IP-1	UDP-X+15

… up to 120 NF entries …

IP-120	UDP-X
	…
IP-120	UDP-X+15

Helpful Multicast/UDP Addressing tips

How you choose Multicast IP Addresses often helps determine how easy it is to troubleshoot a network. Unless the video network in your Headend may someday be forwarded to remote WAN networks, it is always recommended to use Multicast IP Addresses in the range of 239.0.0.0 – 239.255.255.255. Generally, the third octet (number) in the IP Address is an excellent way to identify a particular site. The second octet may be used for identifying inputs versus outputs or perhaps to identify Multicasts from specific types of sources. For outputs, it may be a good idea to use a single Multicast Address for the output Transport Streams destined to a specific device (i.e. QAM) with different UDP Ports to distinguish Transport Streams. Others choose to add one digit to the forth octet of the Multicast IP address and the UDP Port simultaneously for every Output Transport Stream. The theory behind this approach is to avoid accidentally mistyping the wrong IP address or UDP Port, resulting in Adult services in the clear at a QAM. A non-matching IP address and UDP port will simply result in no pictures at all. Below is an example in practice of the above paragraph.

Bob's Cable Company
(Not related to any real or known Cable Company.).

Brownstown Headend
Second octet of 1= an Input service from a local encoder
Second octet of 2= an output from a BNP
Third octet of 1= Brownstown Headend
239.1.1.100 / UDP Port=100 references Sci-Fi channel from a local encoder going to a BNP

Wyandotte Headend
Second octet of 1= an Input service from a local encoder
Second octet of 2= an output from a BNP
Third octet of 5= Wyandotte Headend
239.2.5.21 / UDP Port=10021 references a Transport Stream with Sci-Fi from a BNP to a QAM

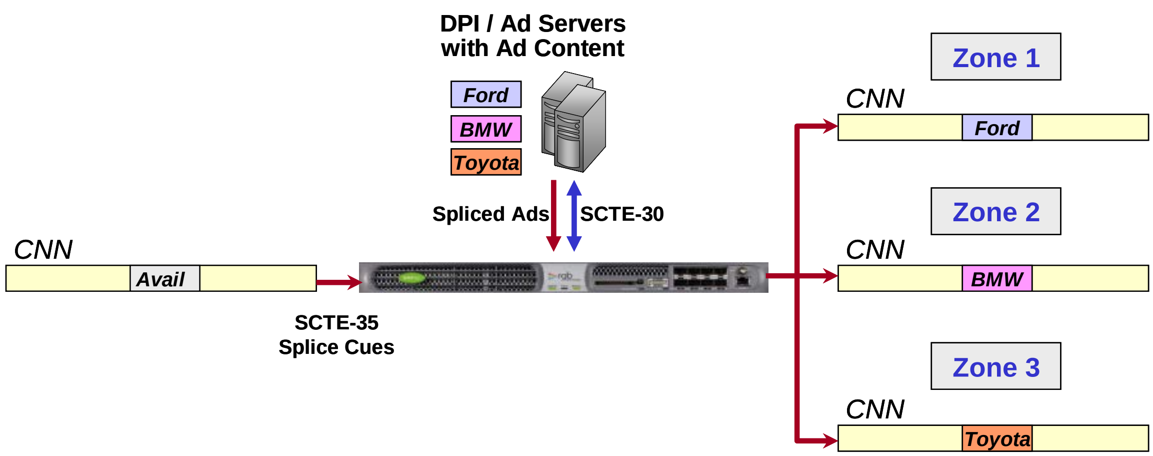
AD INSERTION CONSIDERATIONS

The BNP supports industry standards critical to digital program insertion (DPI) applications, such as those prominently used in the cable industry for localized ad insertion into a primary broadcast program. The BNP is already fully compliant with SCTE 30 and SCTE 35 standards and is interoperable with leading DPI ad servers from SeaChange, Arris and Adtec.

SCTE 30 is the standard that is used as the message protocol between a DPI Splicer such as the BNP and a content storage management system such as an Ad Server to coordinate the precise timing required for a regional ad splice into the primary video feed.

SCTE 35 is an embedded message in an input Transport Stream Program, identified as a PID in the PMT, which acts much like Analog Cue Tones notifying the System that an Ad Avail spot is about to become available.

A common DPI / ad insertion application deployment using SCTE 30 and 35 may be represented by the following regional ad zone insertion illustration:



The splicing function in a BNP is designed to open an active session and insert a Digital Ad into a primary programming channel or a group of channels. This is API driven, based on SCTE-35 compliant cue-tone messages and communication from the Ad Server about when and what to splice. A TCP/IP socket connection exists between an Ad Server and the BNP Splicer for transferring API messages. This messaging occurs on the BNP's management port. SCTE-30 allows an Ad Server and a Splicer to communicate in a standard way.

BNP Ad Insertion Specifications include:

- Complies with SCTE-30 and SCTE-35 standards for ad-insertion and communicating with ad-servers
- Is able to translate SCTE-30 messages to SCTE-35 cue injection messages on a per program level basis.
- Provides selection of cue forwarding or cue not forwarding through GUI configuration.
- Is capable of seamlessly splicing any input streams into any other input streams in real time at any I- or P-frame from Gigabit Ethernet Programs or DVB-ASI Programs.
- Supports concurrent ad insertions for up to 120 SD programs concurrent or 40 HD programs concurrent where 1HD = 3SD, in a BNP with three PROC modules.
- Supports from 1 to a maximum of 10 back-back ads.
- Supports rate shaping on inserted ad channels.
- Supports audio rate changes between the network streams and the ad-insert streams.
- Supports Network and ad stream language matching.
- DPI with Post black will play a duration determined by Ad server.

• Type of Ad Capable Programs	Number of Ad Capable Programs per BNP Chassis
SD Only (no HD programs are present)	**120 maximum**
HD Only (no SD programs are present)	**40 maximum**
Mixed n x SD and m x HD programs	n + 3m=<120

There are very few configuration parameters necessary in a BNP to set up Ad Insertion. The two main configuration parameters required in the BNP are the configuration of the same NTP Server IP Address used by the Ad Server for accurate time synchronization and naming the output program exactly the same way as configured in the Ad Server. No Ad Insertion Licenses are required in the BNP and the functionality is automatically included, if all-inclusive licensing is purchased (optionally, a BNP can be purchased with no Ad Insertion licenses). However, there are several considerations that must be taken into account when designing and building a DPI BNP. Below are some of these considerations.

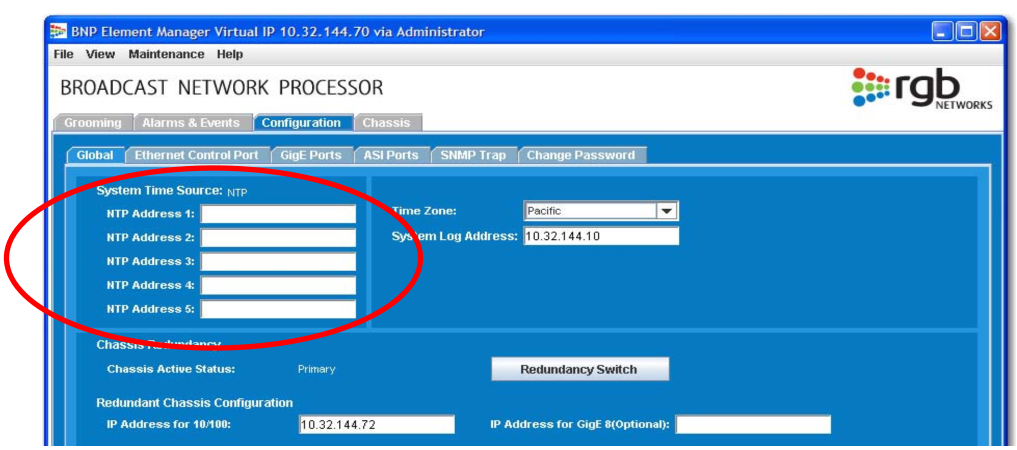
Currently, the BNP supports the configuration of 240 Ad Capable channels. This is not the number of simultaneous or concurrent ads, but in fact the number of channels configured for ads.

When designing an Ad Insertion Network, a selection must be made for how to direct the Ad Video from the Ad Server into the BNP. The BNP supports ASI based Ad Video Inputs. A separate ASI Board must be purchased as the BNP does not include ASI ports by default. The BNP also supports providing Ad Video via GigE. While the BNP can handle Input Ad Video on GigE Ports with other input or output services present, RGB recommends using a dedicated GigE Port for Ad Video from an Ad Server. Depending on other design parameters and customer conditions, RGB reserves the right to not support some installations without a dedicated GigE Port for Ad Insertion Video. Several Ad Server Vendors require a completely isolated Network as part of their requirements, as well. By dedicating a GigE Port to Ad Video, it creates a cleaner environment. It also makes troubleshooting easier and allows you to take down or replace cables, etc on that port without affecting live video. Finally, the Bit Rates from Video feeding the BNP for Ad purposes will constantly fluctuate, depending on the number of current ads being played. By dedicating a GigE Port, you are ensuring these fluctuations will never exceed the capacity of the GigE pipe when combined with other real-time input services.

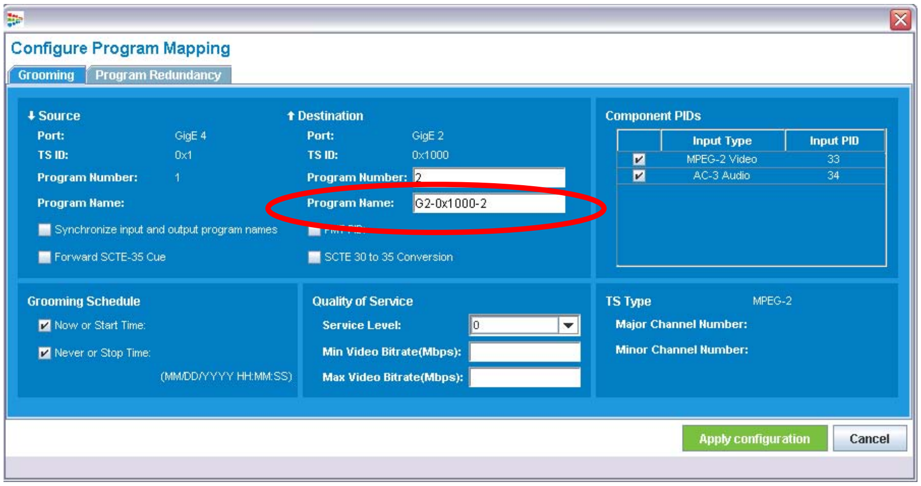
Technically, the BNP can support 12 or more ad insertion services per 256 QAM Transport Stream. This is not recommended, though. Bit Rate considerations should always be taken into account. Most ads today are encoded at a standard Bit Rate of 3.75 Mbps. However, this number is not guaranteed in every system. The risk in adding too many ad insertion services per Transport Stream comes in the danger of all services playing ads with a large Bit Rate concurrently. This can dramatically increase the input Bit Rate, thus forcing heavy Transrating in the BNP. Heavy Transrating can lower the video quality of all services in the Transport Stream. If a site is confident that all ads are encoded at a Bit Rate of 3.75 Mbps or lower, this condition should never occur. However, in the interest of designing a good Transport Stream, RGB strongly encourages never to design more than 10 ad insertion services per Transport Stream. Ideally, it is good to mix non-ad insertion services with ad insertion services for an average of 8 ad insertion services per Transport Stream. The advantage of this design isn't just to manage overall Bit Rates, but also to avoid the loss of too many revenue generating ad insertion services at once per Output Multicast, in the event of switch issues or end device issues specific to a single Multicast Address.

NTP (Network Time Protocol) is a protocol which allows the transmission of sync packets over a network to help assure that all devices on the network are locked to identical timing within +/- 15 ms. In an Ad Insertion environment, perfect time synchronization is the most important parameter and most commonly the reason for ad failures. When configuring NTP, it is absolutely crucial to use a reliable NTP source as your NTP Server. RGB strongly advises against use of any Windows based Ad Server as an NTP source of timing for synchronization of the Ad Server to the BNP. This would include Seachange Servers. Most Headends already have stand-alone NTP servers which are used for synchronizing time at a DAC or DNCS. Another option is to use a Cisco Switch as your NTP source, if configuration is possible in the switch.

You can add an NTP Server Address into the BNP by logging into the GUI and going to Configuration → Global settings.



The next step is to name the Output Program. The name of the Output Program must EXACTLY match the name in the Ad Server. This can be done at the time of grooming. When you drag an Input Program to the Output Transport Stream, the name field will be one of your choices, as referenced below.



You will also notice two other advanced features in the grooming dialog above related to Ad Insertion. These two parameters are “SCTE 30 to 35 Conversion” and “Forward SCTE-35 Cue Tone”. The purpose of these two features is as follows:

SCTE 30 to 35 Conversion

Many satellite Streams still do not have embedded SCTE 35 “cue tones”. An SCTE 30 to 35 Conversion is used at an Upstream BNP coupled with an Ad Server to inject SCTE 35 cue messages into a program which currently does not have embedded SCTE 35 cue messages. Then, Downstream BNPs can become Ad Splicers using this SCTE 35 cue message. This is accomplished through the Ad Server sending an SCTE 30 message to the BNP, which then converts this message into an SCTE 35 cue message. To use this feature, configuration is required in the Ad Server. Simply leave this option unchecked to avoid use of this feature. It’s important to note that SCTE-30 to 35 conversion and splicing on the same program simultaneously is currently not supported through our BNP GUI.

Forward SCTE-35 Cue

This option forwards the SCTE 35 cue messages on an Input Program to the groomed Output Program. Since additional bandwidth is used and this feature is only required if ad splicing is expected Downstream from the BNP, this option is off by default.

Setting up an Ad Server:

An Ad server must be configured with a minimum set of parameters for DPI sessions to successfully occur. The basic set of parameters includes the following:

- **NTP server-** Ad server and BNP must be synchronized on timing to accurately perform DPI functions
- **Splicer IP Address-** The BNP IP address the Ad server connects to.
- **Insertion Channel Name / Program Name-** This name identifies an insertion channel on BNP output programs, this is where the ad will be inserted for this channel
- **Connection Parameters-** You must identify the Ad Splicer Port where the Ad Server will be sending the commercial content.

The BNP supports both GigE and ASI connections, as previously discussed. The tables below list the connection parameters used in an Ad Server GUI or CLI configuration for both types of hardware connections.

ASI Insertion:

Chassis	0
Card	Slot A (1), Slot B (2), Slot C(3), Slot D(4)
Port	ASI port number (1-6)

Gigabit Ethernet Insertion:

Chassis	0
Card	5
Port	Gigabit Ethernet port number (1-8)

There are other more advanced parameters, which will fine tune the insertion parameters for the DPI session. Below is recommended values for the SeaChange DPI server and Arris DPI server.

SeaChange DPI Server Tuning DPI Parameters

- ***DvsPlayAdjust: 450ms***
  - This key is not available from the GUI, so it must be changed in the registry. Each TC (Task Controller) needs to be changed.
  - After the key value is changed, restart the TCs or reboot the server.
  - This key adjusts the time that the SC server will start streaming before the splice time.

- ***Splice Point Adjustment: 0ms***
  - This key is available from the GUI.
  - This key is per channel based.
  - After the key value is changed, restart the TCs or reboot the server.

  - This key adjusts the splice point. A negative number produces an earlier Ad Splice, and a positive number delays the Ad Splice.

- ***Trigger Delay: This parameter ignored in the BNP by default***
  (RGB Support can assist in activating support in the BNP for this parameter, as needed)
  - This key is available from the GUI.
  - This key is per channel based.
  - After the key value is changed, restart the TCs or reboot the server.
  - This key presents the time in millisecond the system will wait after a start tone is received before it starts playing the next insertion event. The system uses this value because there is a delay between the time a tone arrives and when the next insertion event should start playing. If you set the Trigger Delay to a number that is too small, the next insertion event will start playing early, which will cut off the network transmission. If you set the Trigger Delay to a number that is too large, the next insertion event to play will finish late, and cut off the beginning of the next segment of network transmission. The value you choose for Trigger Delay depends on each network channel. (Each channel determines how long to wait between sending a tone and starting to play ads.) Typically, a reasonable range of values is 5000 - 8000 milliseconds, if the default ignore behavior in the BNP has been over-ridden.

Arris (C-COR) DPI Server Tuning DPI Parameters

- ***InsertionChanStartTime: 450ms***
  - This value can be set in the GUI under each Splicer. This value is applied to the entire BNP.
  - After the value is changed, restart the ACM service or reboot the server.
  - This key adjusts the time that the Arris server will start streaming before the splice time.

Guidelines for Encoding Ads

For a seamless and accurate ad insertion, the ad itself has to be encoded in such a way that it conforms to some requirements. Below is a recommended guideline for the ad encoding process.

- First transport packet carrying the first video of each Ad should have PCR (if video PID carries the PCR), and PES header with PTS as well as DTS.
- First video frame of Ad must be an I Frame.
- PCR transport packet should be transmitted by DPI server before any other packet of any PID carrying PTS.
- First video Ad frame should be preceded by a GOP header and Sequence header with the GOP being a CLOSED GOP
- Last video frame of the Ad should end with “End of Sequence” code. EOS should be the last bytes of the last video transport packet to detect successful completion of the Ad video sequence

- Preferable GOP size of the network stream should be around 15 frames or less around the splice points. Higher GOP size results in fewer access points for splicing back into the network from Ad. BNP has around 1 second latency and buffering capacity.
- Encoded audio duration should be equal or more than the encoded video frame duration to ensure that the both video and audio plays for the requested duration. In some cases when audio encoded duration is less, this might result in audio mute. This is not really compliant and is not a good practice as it is putting the burden on the Splicer to cover up this gap as opposed to encoders.
- Audio frame should begin with PES header with PTS.
- Ad server should play the stream in compliance with SCTE specs.
- Cue tone time stamp should accurately point to the PTS of exit frame in the network stream. Any inaccuracies result in early or late splice.
- It is advisable to have some black frames in the network channel around the splice points (going into Ad and coming back into network) to make entry and exit smooth and avoid abrupt or sudden transition to Ad and vice versa. This is more likely for cases when national Ad needs to be replaced by local Ad, which allows some margin.
- To avoid audio pops, Ad should not have loud noise/sound in the very first frame of audio or the very last frame.
- As of BNP 3.2.1: Network Cue forwarding during DPI. While an ad is playing network cues are forwarded to the output.
- When transitioning from the end of an ad back to the network, certain Motorola STB will display visual artifacts due to video resolution change and the ad ending with a P-frame. Try to have ads encoded that do not end in a P frame.

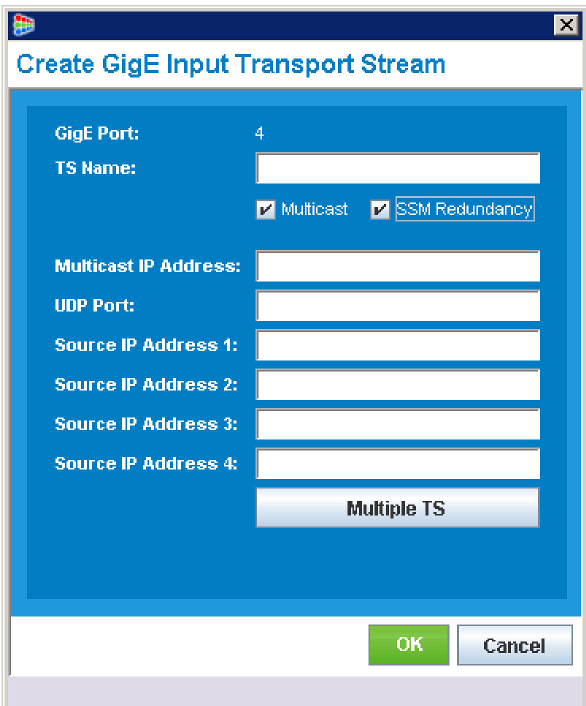
MPEG 2	H.264	FEATURE
	X	SPLICE ON I FRAME
X	X	SPLICE ON IDR FRAME
X		TRANSRATING
X		OPERATOR TEXT CRAWL / GRAPHIC OVERLAY
X	X	STRIPPED NULL PACKET
X	X	DPI
	X	FIELD BASED ENCODING

REDUNDANCY CONSIDERATIONS

There are two types of redundancy in the BNP, “Program Level” redundancy and “Chassis” redundancy. Each will be explained here. We will start with Program Level redundancy.

IGMPv3 Input Source Redundancy

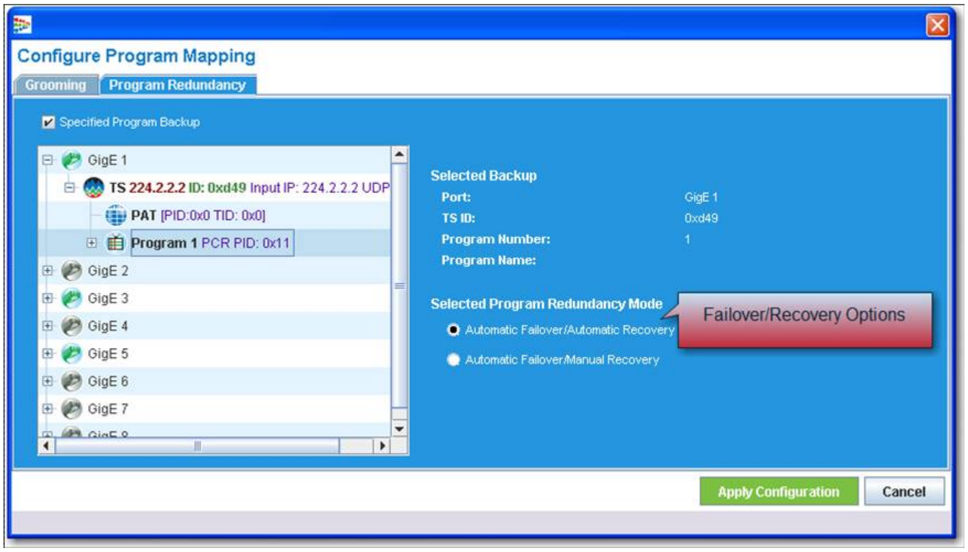
As of BNP 3.3.0, the user can configure up to 4 unique IPs for redundancy for each Multicast join. Source redundancy cannot be mixed with program redundancy. Source redundancy joins the first source and waits 2 seconds for the PAT. After 2 seconds the BNP will join with the next configured source and so on, until a PAT is available.



Program Redundancy

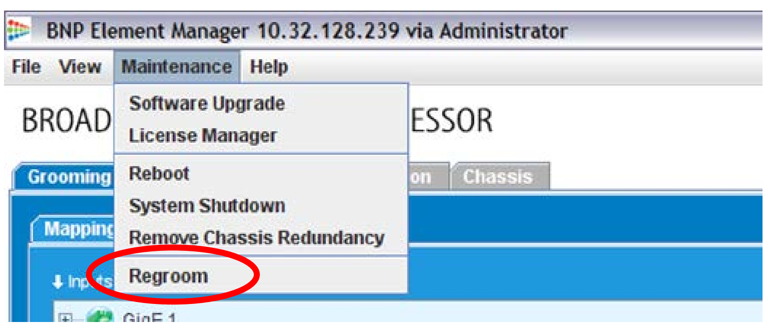
With Program Level redundancy, an operator can point to a second Input Program from any GigE port or ASI Port during grooming, in the event that the primary Input Program disappears in the BNP. If an Operator chooses a secondary Input Program as a redundancy option through grooming, the BNP will automatically fail over to this Secondary Input Program upon loss of PAT/PMT or other issues on the Primary Input Program.

There are two options when configuring Program Redundancy: Automatic Failover/Automatic Recovery and Automatic Failover/Manual Recovery. See the diagram below.



If Manual Switch-back is chosen, the BNP will continue grooming the secondary Program, even if the Primary Program returns. An Alarm will become active in the GUI and on the Front Panel of the BNP. Once the Primary's integrity has been confirmed, the Operator can manually switch back to the Primary Program. In the event that many programs switch over to the secondary, due to Switch issues, etc., you can force all programs back to the primary at once by choosing MAINTENANCE-->REGROOM from the top menu in the GUI. Automatic Failover/Automatic/Recovery is helpful for Operators concerned about the "bouncing of services" from Primary to Secondary due to intermittent issues. No licenses are required for this feature.

Regrooming all Secondary Program back to Primary at once



When choosing Automatic Failover/Automatic Recovery, the BNP will remain on the Secondary Input Program until the BNP determines that a reliable Primary Input Program reappears. The BNP will then immediately switch back to the Primary Input Program. This option is helpful for Operators who do not want to manually intervene in the event of a switchover to secondary. If the Secondary fails while active, the BNP will first attempt to switch back to the Primary Input Program. If both the Primary and Secondary are missing, the BNP will continue to look for a valid video on the Primary. No licenses are required for this feature.

Chassis Redundancy

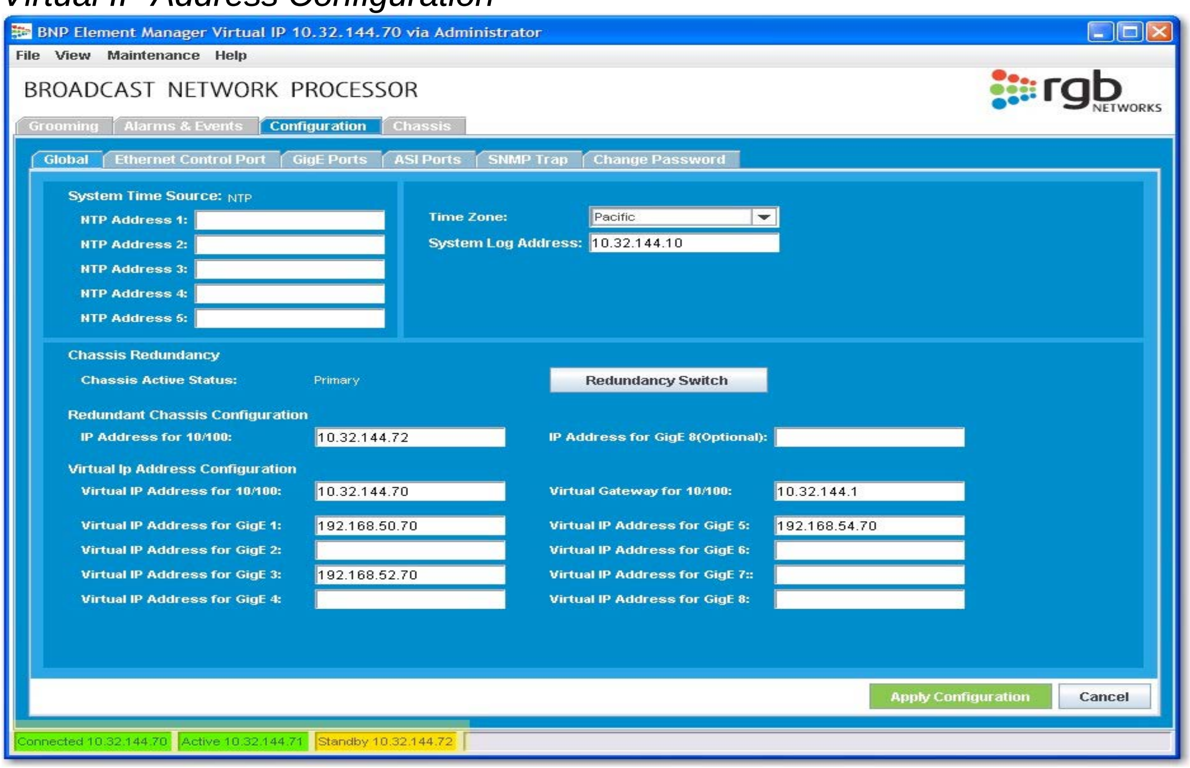
With Chassis redundancy, a BNP will automatically switch to a secondary BNP in the event of a lost GigE Input Port or other serious Network interruption or due to any kind of Hardware failure on the primary BNP. Both BNPs will join all Input Multicast Streams when booted up. This is known as a “Hot Standby”. Each BNP will have a physical IP Address assigned to every GigE Port and Management port. In Addition, the GUI allows for a third “virtual” IP Address to be set for each GigE port and Management port.

Any Unicast Transport Streams should always use the Virtual IP Address as its destination to the BNP. The primary BNP’s MAC Address will be used for this Virtual IP Address. Upon failover, the Virtual IP Address will now use the secondary BNP MAC Address and the switch will update its tables through arping.

The output of the secondary BNP will be muted until a failover. This will allow an Operator to use the same switch for both BNPs. Once a switch to a secondary BNP happens, all outputs will immediately become unmated.

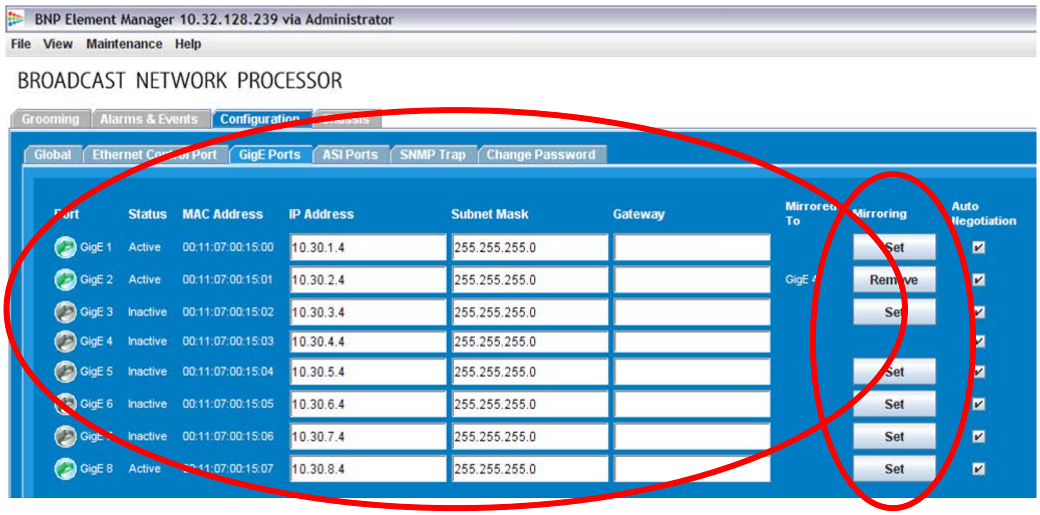
Please note that the procedure for initially setting up Redundancy can result in a lost configuration, if the steps are not followed carefully. Please follow the User Manual carefully. Also, it is prudent to check with RGB Support on whether any additional updated Tech Notes exist on setting up redundancy. Most importantly, never power down any BNP during the process by simply pulling the power cord. Before pulling the power cord, it is critical to choose MAINTENANCE --> SYSTEM SHUTDOWN through the GUI.

Virtual IP Address Configuration



Output Port Mirroring

BNP Version 2.0 also supports Output Port Mirroring. With Output Port Mirroring, the user has the ability to select a second mirrored GigE Port for any one of the 8 GigE Ports. Any Output Transport Streams configured on the first GigE Port will automatically be duplicated on the second GigE Port. This means the output of both BNPs can ALSO feed a second GigE switch or second blade in a single GigE Switch, giving the most powerful redundancy play available.



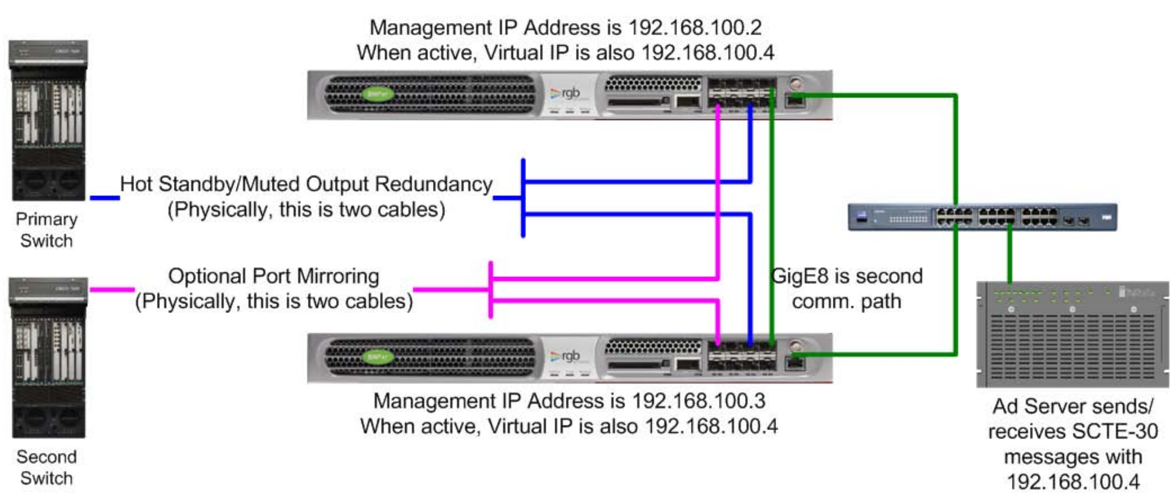
Examples of various redundancy architectures

This configuration illustrates Redundancy Options using Virtual IP Addresses for DPI.

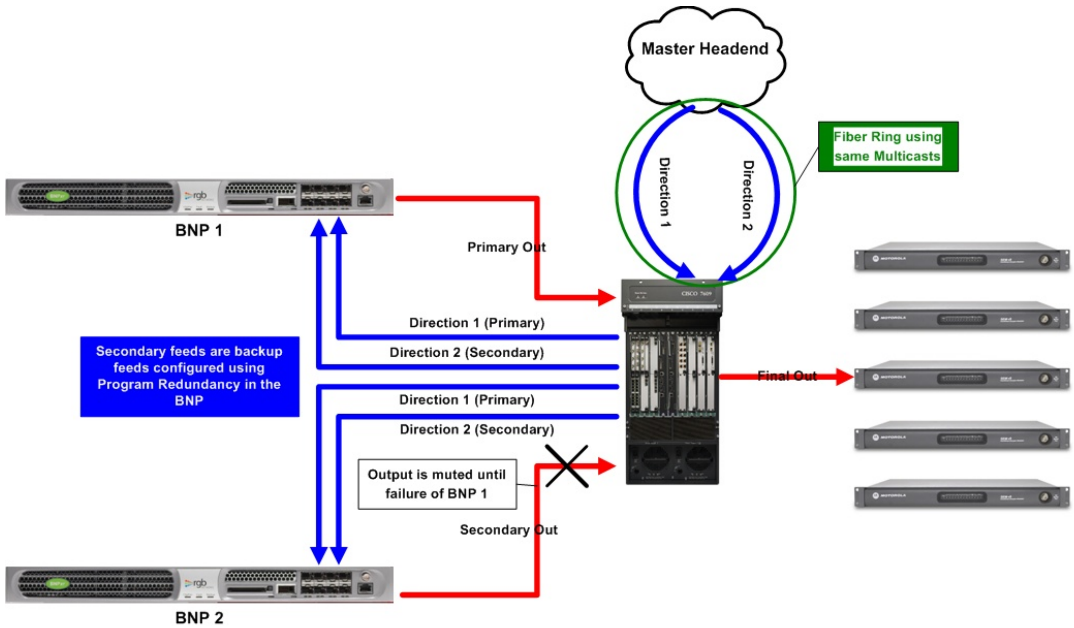
The BNP Employs Hot Standby/Muted Output redundancy. This means that only one BNP will output services at a time, but both will always be joined to the input Multicast Streams.

If feeding a second Switch is desired for additional network redundancy, Port Mirroring can be activated, which allows all output services built on one GigE port to also be mirrored on a second GigE Port.

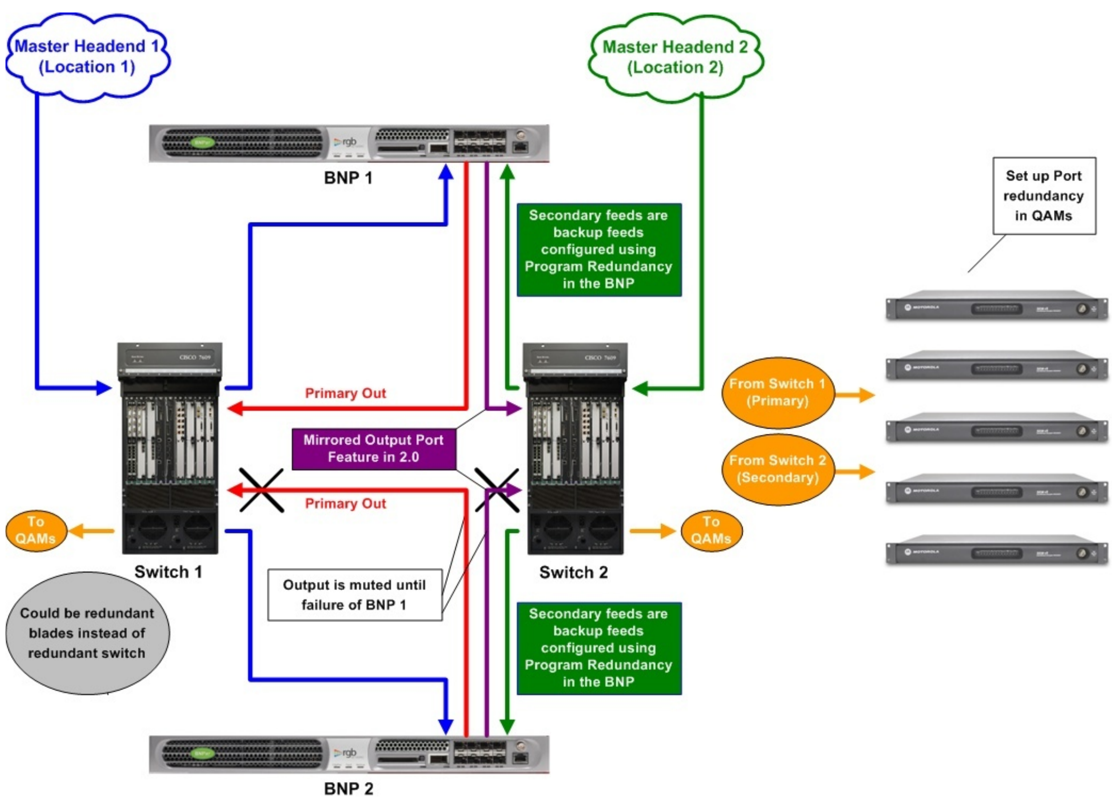
For Input Network Redundancy, Program Level Redundancy should be used during Grooming to select a backup program from a second GigE Port for each Program.



This configuration illustrates a single Headend with one Switch using Fiber Ring Redundancy.



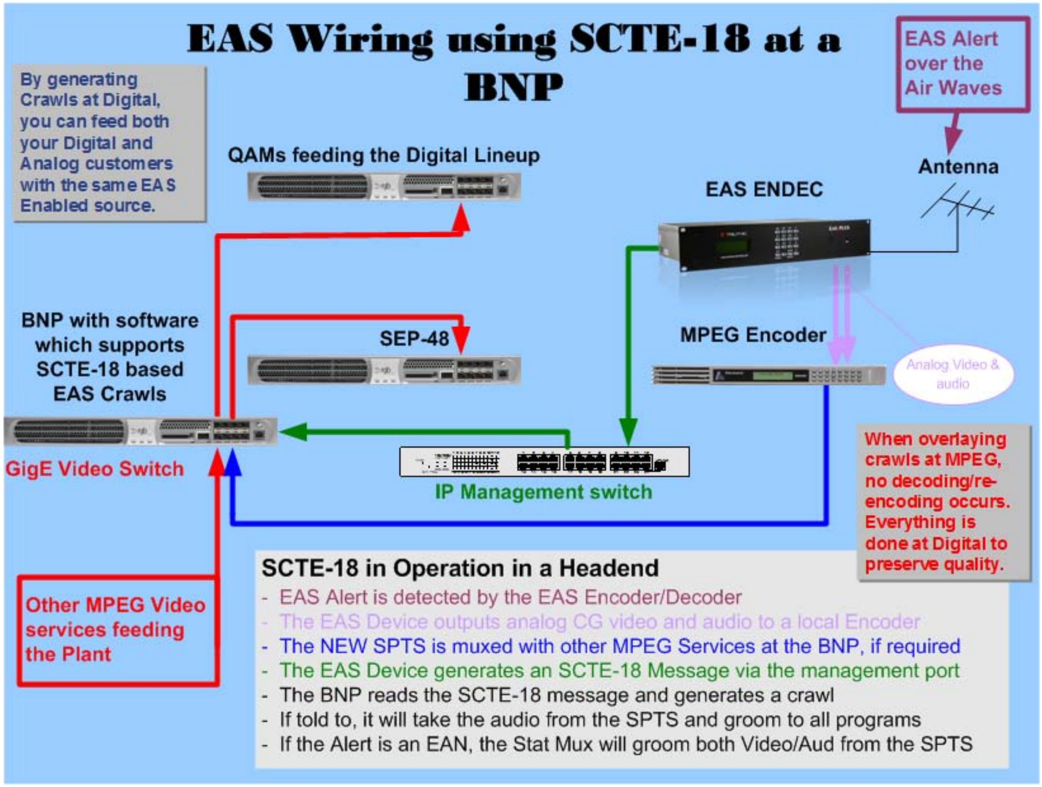
This configuration illustrates dual Headends & dual Switches with many levels of Redundancy.



MESSAGING SYSTEM CONSIDERATIONS

Digital EAS Crawls in BNP Version 3.0 and higher mirrors the configuration found in the RGB SEP 48. In addition, BNP Version 3.0 + also includes the unique ability to send targeted crawls on one or more channels through the GUI and generate logo or graphic overlays at any position desired on the screen. BNP Version 1.x does not support this Messaging System feature. For full instructions on how to use and configure the Messaging System, it is suggested that the User Manual be carefully read, given its detailed configuration parameters. This section will deal primarily with the Specifications and limitations of the Messaging System.

In order to trigger EAS Crawls in the BNP, an EAS Encoder/Decoder which supports SCTE-18 is required. When an EAS Alert is triggered, UDP Packet(s) are sent to the BNP (typically on Port 5050 for the first EAS Zone). The BNP uses the embedded text to generate an EAS crawl. Since SCTE-18 does not support audio generation, the BNP will groom the audio portion of an encoded version of the EAS video and audio output from the EAS triggering (Encoder/Decoder) device. Because of this, it is important to have an MPEG encoder connected to the EAS Encoder/Decoder for the EAS Source video and audio. Some EAS Source devices offer built-in MPEG Encoders. Monroe One-Net is an example of this type of device. While RGB is willing to work with any EAS vendor which supports SCTE-18, RGB has deployed many sites across the U.S. using EAS Solutions from Trilithic and Monroe and would be comfortable recommending either solution.



When a Messaging System License is installed, the overall Mux capacity of the BNP2xr will drop to accommodate the addition processing. The level of droppage depends on the type of programs in each Transport Stream.

In addition, transrating and messaging is not recommended on the same BNP. Given the capacity differences, RGB recommends a dedicated BNP for use with the messaging system feature. A BNP can be purchased specifically for messaging, which can be placed in front of an existing multiplexer. An RGB Salesperson can provide a part number and pricing for a messaging only BNP. The capacity of the messaging BNP is as follows.

BNP 3.0 TS & Program Guidelines when using Messaging		
No (or very minimal) Transrating must occur on BNPs using a Messaging license. Therefore,		
a dedicated BNP is recommended with an SPTS configuration of SDs @ 5 Mbps & HDs @ 20 Mbps		
Parameters	Masking (Transparency) Turned off	Masking (Transparency) Turned on- 80/40 advanced rgbTuning parameter must be enabled
Number of SD Programs per PROC (5 Mbps SPTS)	64 SD Programs per PROC @ 5 Mbps each [320 Mbps total]	48 SD Programs per PROC @ 5 Mbps each [240 Mbps total]
Number of HD Programs per PROC (20 Mbps SPTS)	16 HD Programs per PROC @ 20 Mbps each [320 Mbps total]	12 HD Programs per PROC @ 20 Mbps each [240 Mbps total]
HD to SD tradeoff Ratios	4:1- Subtract 4 SDs for every HD added	6:1- Subtract 6 SDs for every HD added

SCTE-21 TO SCTE-20 CONVERSION

As many Operators have discovered, North American HDTV Off-Air Broadcasters are migrating exclusively to SCTE-21 based Closed Captioning encoding as part of their HDTV MPEG Transport Streams. Originally scheduled for February 2009, but now delayed until June of 2009, all Broadcasters will be turning down their analog feeds. This means the only access to Off-Air SD content Operators will have is via these HDTV Transport Streams.

An immediate issue faced by US cable operators is that many legacy Set Top Boxes are not able to support SCTE-21, including the Motorola DCT models 1000, 1200 and 2000. In order to support Closed Captioning using SCTE-21, the Operator is forced with a painful choice of replacing all legacy Set Tops at a cost of potentially Millions of Dollars or decoding and re-encoding all Off-Air services, which is both costly and disruptive to the original video quality of these programs.

RGB has created an alternative to these two options, which is more cost effective and preserves the original content quality. By simply purchasing a new BNP or using an existing BNP in the Headend, then upgrading the BNP to version 2.x or higher, the BNP will provide support for conversion of SCTE-21 to SCTE-20 based Closed Captioning for all Off-Air SD Programs as part of each HDTV Transport Stream. Note, most legacy Set Tops do not support HD Profiles, so the issue only pertains to SD content in the Off-Air Broadcast. Legacy Set Tops have always supported SCTE-20 based Closed Captioning, there by solving the issue.

BNP SCTE-21 to SCTE-20 conversion feature details

- Provides the ability to receive SCTE-21 and/or SCTE-20 Close Captioned Input Transport Streams.
- Converts SCTE-21 to SCTE-20 within any MPEG2 SD video user_data() field containing SCTE-21 only.
- Passes through SCTE-20 for any MPEG2 SD video user_data() field containing SCTE-20 only.
- Passes through no Closed Caption services if neither SCTE-21 or 20 are received for MPEG2 SD video user_data() field.
- Passes through SCTE-21 for any other video (MPEG2 HD, H.264).