rgb NETWORKS

Digital Program Insertion:

Meeting the Technology and Cost Challenges of Delivering Highly Targeted and Personalized Video Services

Abstract

Cable operators face many challenges today, from the quest for more bandwidth to the pressures of competition. To stay ahead, they must deploy new, personalized services to meet the needs of customers, while delivering highly targeted advertisements to generate revenues from advertisers in an increasingly on-demand environment. In addition, with the cable industry seeing constant growth in the number of programming channels, and particularly in the number of high definition (HD) channels, cable operators face the challenge of managing a rising number of digital MPEG video and audio streams. To meet these demands, MSOs must deploy scalable and flexible solutions that support this growth and the expansion of their programming networks. This paper reviews the various technologies and applications of digital program insertion (DPI) in today's digital video environment. It also spells out the benefits of RGB's high density solution for grooming, transrating, statistical multiplexing and DPI.

The Challenges

Due to increasing competitive pressure in the video delivery business, first from satellite television providers, and now telephone companies, cable operators face serious new challenges. They must look for any opportunities to grow, maintain and protect their customer base. Increasing their revenues and return on investment while reducing their operational and capital expenses will be critical to their success.

Cable operators are seeking solutions that provide greater bandwidth efficiency not just to offer additional services but also to reduce their costs. High-density grooming, digital program insertion (DPI) and transcoding are just some of the key technology solutions that can address these needs.

For the past two decades, local cable advertising has been a steadily growing business for cable operators. Once just a nominal contributor to overall multiple system operator (MSO) revenues, local spots on national, regional and local programming networks now quietly generate roughly $6 billion annually for cable coffers, or about one-third of the industry's entire ad revenues. Indeed, PricewaterhouseCoopers estimates that local cable advertising will generate $6.6 billion in revenues in 2006, up 13% from 2005.

As MSOs make their transition to all-digital systems, local cable advertising is undergoing some dramatic changes. With the number of cable digital video subscribers now surpassing 30 million, or nearly 40% of all cable homes in the U.S., commercials placed on the more established, analog tier cable networks are no longer reaching many of their intended viewers. Plus, cable operators have not been able to fill many of the local ad avails offered by the newer, digital networks.

Largely as a result, cable operators are seeking ways to switch from their old ad traffic systems for analog programming lineups to new digital ad insertion systems that suit digital programming channels. In particular, MSOs are looking to shift to more advanced DPI technology so that they can seamlessly and inexpensively place local digitized spots on digital channels. And they are aiming to carry out this transition as quickly as possible without disrupting their increasingly lucrative local ad sales businesses.

As in cable advertising's pioneering days back in the early 1980s, cable operators also believe that the implementation of DPI will enable them to charge premium rates to advertisers for reaching select, upscale digital video customers with specialty interests. In one prime example, a golf equipment supplier might pay extra to target The Golf Channel's digital subscribers. Or a home-furnishings supplier might spend more to reach digital viewers of HGTV's fare.

Moreover, cable operators increasingly recognize DPI as the basic building block for inserting lucrative spots into high-definition TV (HDTV), video-on-demand (VOD), interactive TV and even network-based personal video recorder (nPVR) programming because the underlying technologies are similar. Cable advertising executives figure that such options will only continue to grow as digital cable's total customer base soars past the 30-million mark. Targeted advertising is one of the hot application areas with an opportunity for exponential revenue growth.

The growing deployment of digital simulcast systems by many MSOs promises to reshape the cable landscape even more dramatically in the near future. With digital simulcast systems, cable operators carry all programming in digital format throughout their entire HFC networks. They then convert the programming back to analog at the edge of the network for their analog customers while simultaneously supplying the content in digital format to their digital subscribers.

In a digital simulcast environment, MSOs can use the same digital ad insertion equipment for all channels because all programming is carried throughout the network in digital form and the ads are inserted in digital format before being converted back to analog for analog subscribers. With the deployment of digital simulcast technology growing, and with the number of digital subscribers rising, cable operators will need to process increasingly greater numbers of programs. Thus, the need for cost-efficient and high density DPI will become even more critical.

This paper explores DPI and grooming across various applications and demonstrates how cable operators can use these techniques to generate incremental revenue. It also spells out how RGB Networks' new Broadcast Network Processor (BNP) can greatly simplify the deployment of advanced video services, boost bandwidth efficiency and reduce operating and capital expenditures.

Defining Technology Terms

Grooming is an essential task that cable operators perform to create customized channel lineups for their subscribers. It consists of taking input programs from multiple satellite feeds or such other sources as regional and local channels and then combining them to create customized programming packages for subscribers.

Transrating, also known as "rate-shaping," is a technique that manipulates the bit rates of groomed input video streams to fit into a constant bit rate (CBR) output multiplex. It allows real-time modification of an encoded digital MPEG-2 video stream. If at any time the total bit rate of all the video streams exceeds the capacity of the output multiplex, it will transrate one or more of the programs and discard information to lower the bit rate. Individual CBR or variable bit rate (VBR) programs are transrated to achieve optimal bit rate. The transrated programs can be CBR or VBR. However to transrate to VBR programs, statistical multiplexing is utilized to achieve better picture quality and more efficient use of the bandwidth of the output multiplex. Transrating is beneficial because it allows more digital programs to be squeezed into the same amount of channel space, freeing up additional bandwidth for the delivery of more services.

Digital program insertion (DPI) is the digital splicing of MPEG programs into other MPEG programs. This process involves the splicing of a single program transport stream—advertisements in most cases—into a broadcast program. Sophisticated digital ad splicers seamlessly insert digitized ads into digital programs. With digital program insertion, MSOs can replace a national advertising slot with a local ad. In most cases, the ads are also transrated to make the most efficient use of bandwidth.

The Society for Cable Telecommunications Engineers (SCTE) has created two standards, SCTE 30 and SCTE 35, that all DPI vendors must meet. SCTE 35, also known as Digital Program Insertion Cueing Message for Cable, supports splicing of MPEG-2 streams—usually ads—for digital program insertion. SCTE 30, or Digital Program Insertion Splicing API, creates a standardized method for communication between ad servers and ad splicers for inserting content into any MPEG-2 program in the splicers. Compliance with these two standards ensures interoperability and interchangeability of ad insertion equipment.

Grooming and DPI Applications

Both DPI and grooming provide benefits for many advanced digital applications and initiatives that cable operators are either implementing or actively considering, ranging from today's digital broadcasts to zoned or targeted advertising. This paper briefly reviews some of the leading applications.

Digital Broadcast

As noted above, digital broadcasting is an increasingly lucrative, steadily growing business for the cable industry. In just the last five years, the digital cable universe has more than doubled from 11 million homes to more than 30 million households. With such increased digital penetration and the emergence of HDTV, MSOs are now delivering hundreds of MPEG programs through their hybrid fiber/coax (HFC) networks. These numbers are expected to grow as cable operators continue to offer additional services by freeing up additional bandwidth through analog reclamation. Such growing video traffic makes the ability to groom and splice channels efficiently an essential requirement for cable systems.

Zoned Ad Insertion

Local ad avails are commercial breaks that programming networks offer to cable operators to override national ads with their own local ad spots. Until recently, MSOs would insert their local ads into analog programming streams through analog ad-switching equipment. But now, with the steady expansion of digital cable, cable operators have begun to use new digital splicing gear to insert digital ads into their growing digital programming streams. As the number of services offered to subscribers increases, so will the number of digitized local ads.

Targeted Advertising

Targeted advertising is the much-desired ability to steer customized commercials to a tightly segmented group of viewers, such as long-term care insurance ads for residents of a senior citizen complex. It's also the ability to target an ad directly to an individual subscriber, which can be done through the use of switched digital video, VOD and nPVR devices. The development of targeted advertising will prompt cable operators to make significantly larger numbers of splices in their digital programming streams, creating the need for cost-efficient splicing equipment that can provide higher ad-splicing densities.

Ad Insertion in the VOD Environment

Over the past few years, there has been significant growth in the distribution of VOD content. Cable operators believe that VOD cuts cable churn by offering digital subscribers a valuable service that can not be easily matched by satellite providers. In particular, MSOs view VOD as a great weapon for gaining a competitive edge over satellite TV providers, who can not offer the same service due to a lack of bandwidth. Satellite providers have a limited number of transponders, hampering their ability to beam programming to individual subscribers on an on-demand basis. Furthermore, satellite operators don't always have a connected and reliable return channel.

Today, an estimated 20 million U.S. homes have access to thousands of hours of VOD content. Comcast alone served up 1.4 billion on-demand programs to its digital subscribers last year. Despite this wide distribution, VOD content offers limited revenue opportunity because up to 95% of the content is provided free of charge to customers. Plus, the delivery of VOD requires significant investment by both cable operators and programmers. There are hefty costs associated with purchasing new equipment, adding additional storage capacity for new content and making the content VOD-ready. Even though VOD may reduce churn, MSO still must find ways to generate additional revenue from this service.

Advertising offers the most significant revenue opportunity for cable VOD. However, growth in VOD advertising revenue will require a new approach in the distribution of ads. VOD advertising is now still in its infancy. In fact, Mediaweek estimates that only $50 million was spent on VOD advertising in 2005. To date, cable operators have felt that subscribers might not tolerate commercials running in on-demand programs, especially when they are already paying for the shows. As a result, most of today's VOD content does not include ads. In the cases where commercials are present, they are baked into on-

demand content anywhere from six to eight weeks prior to air time, which means that the ads are already outdated before they are even viewed by subscribers. Furthermore, the commercials are not changed for that particular program during the show's run, even though it may run for a few months or more. The subscriber views a select number of commercials, usually limited to ads right before and after the programs, which are called "bumper ads." Considered ineffective, this advertising method does not appeal to most advertisers.

A VOD ad insertion method that improves on today's practice of pre-baked ads is known as "playlisting." In this method, the commercials are updated more frequently, possibly on a daily or weekly basis. Primarily, the ads used are bumper ads. An ad could be placed on a piece of VOD content on one day of the week and then be swapped on the same day each week. This model dramatically improves on the pre-baked ad model and opens opportunities for advertisers with more time-sensitive needs. In February 2006, the largest U.S. MSO, Comcast, announced the deployment of digital ad insertion technology that will allow it to insert commercials into on-demand programming by early summer. The plan is to place ads into VOD content on a weekly basis by June. Comcast is the first MSO to roll out this technology. The initial deployment will be limited to a few VOD cable channels. If Comcast's move is any indication, the future of VOD advertising will be a lucrative one for cable operators.

But even the playlisting technique is not ideal because it is difficult to manage and lacks the benefits of real-time ad insertion. Furthermore, the ads are still not targeted to a particular group of viewers or to specific subscribers. To generate major revenue growth in on-demand advertising, cable operators must promote VOD as an attractive avenue for advertising. Dynamic ad insertion—the ability to insert ads on the fly in any piece of VOD content—is an essential requirement.

The Benefits of Dynamic Digital Ad Insertion
Dynamic digital ad insertion in VOD content enables a more effective and relevant form of advertising. Targeted ad insertion is a much more attractive proposition for advertisers because the commercials are more pertinent to the subscriber and, therefore, are more likely to generate product sales.

The VOD ad insertion technology deployed today has nominal revenue prospects for advertisers. The deployment of targeted VOD ads will likely cause the VOD advertising business to explode. Ads could be targeted by cities, neighborhoods and even specific demographics in that area. For example, on-demand content distributed in a college town could have ads aimed at college students. Ads could also be targeted by the time of day (daypart), so that VOD programming running during the day could carry different ads than the same content running in the evening. Targeted and personalized ads will motivate advertisers to increase their advertising budgets. They also promise to create a lucrative market for all parties involved, including advertisers, advertising agencies, cable programmers and MSOs.

Just like the cable networks, the broadcast networks are seriously exploring putting their prime time programs in cable VOD packages. Revenue generation is the main driver for this move. Some broadcasters are reportedly considering an a la carte model, enabling viewers to pay either $1 per show for the ability to fast forward through commercials or 50 cents per show to view a show with ads. This second option offers an opportunity for effective and lucrative targeted advertising. Such companies as Nielsen Media Research and Rentrak are now collecting demographic information on VOD viewership. Among the data that Rentrak collects are: the number of views per VOD-enabled set-top box; the number of VOD-enabled set-tops; and the total number of minutes viewed.

To date, dynamic ad insertion has been technologically prohibitive. Most of today's VOD ads are pre-baked many weeks in advance and are mainly limited to bumper ads. But the future of VOD relies on doing targeted real-time ad insertion. Performing true, dynamic ad insertion requires sophisticated splicing technology that can seamlessly insert ads. In addition to implementing the right technology, deploying a cost-effective solution will be imperative for cable operators. As the number of VOD ads continues to grow, MSOs will be looking for solutions that can handle a large number of ads efficiently. Solutions that can efficiently and cost-effectively process a large number of ad splices with the least amount of equipment will provide a strong value proposition for cable operators.

Switched Digital Video

In a switched digital video environment, subscribers receive certain channels only when they request them by tuning into those channels. In other words, the cable operator sends programming just to those subscribers who tune into the channel, not to all the cable homes in the market. All operations are dynamic and conducted in real time. As a result, switched digital video makes additional bandwidth available by filling precious channel capacity only when the programming has actually been requested for viewing. While a switched digital video architecture can offer network bandwidth savings, it also brings new operational challenges and opportunities. With the shift towards addressable content delivery to each set-top box, in the future cable operators will be able to direct specific ads to each subscriber. Ads can be targeted based on subscribers' viewing habits or unique programming interests. This innovation, however, requires high density ad insertion systems that can serve up a large number of program streams simultaneously.

The current switched digital architecture poses another limitation that reduces the benefit of this technology. Although the goal of the switched digital design is to save network bandwidth, it forces cable operators to convert existing programming to CBR program streams to manage the necessary network bandwidth. Thus, the design requires MSOs to support multiple constant video bit rates based on the complexity of video programs delivered. While the switched nature of the network helps reduce bandwidth, the conversion to constant bit rate and the support for multiple constant bit rates reduce the bandwidth efficiency of the architecture. These requirements also hinder optimum video quality. The switched digital architecture can be enhanced through the application of high density video processing to deliver the programming in the original VBR form. This solution offers further bandwidth reduction as well as better video quality throughout the network.

Bandwidth-Saving Technologies

As the bandwidth requirements of on-demand, HD and new digital linear programming services continue to grow, they are driving cable operators to recapture inefficiently used analog bandwidth through market-by-market conversions to all-digital systems. These increased bandwidth requirements will also prompt MSOs to adopt new and advanced video compression technologies to save precious network bandwidth.

In addition, increasing competition from satellite TV providers and phone companies is putting pressure on cable operators to offer additional services to their subscribers to maintain their business and attract new customers. These additional services will need more bandwidth, especially as subscribers sign up for products like HDTV and VOD in ever-growing numbers. Up to now, MSOs have been using various MPEG-2 statistical multiplexing techniques to boost their bandwidth.

As cable operators search for new ways to increase bandwidth, the use of the MPEG-4 advanced video codec (AVC) is starting to look very attractive. MPEG-4 AVC, also known as ITU-T H.264, is a compression technique that can offer dramatically higher bandwidth efficiencies. In fact, MPEG-4/H.264 uses bandwidth up to twice as efficiently as MPEG-2 without compromising picture quality. Satellite TV providers have already employed MPEG-4 for many of their HD services.

The drawback to MPEG-4 is that many cable operators, especially in the U.S., have invested millions of dollars in MPEG-2 technology devices—namely, the tens of millions of cable set-tops already installed in subscriber homes. Therefore, switching the whole cable plant over to MPEG-4 technology is simply not a feasible task in the foreseeable future. MSOs have instead been looking at introducing advanced codecs when expanding to new markets or upgrading portions of their networks or particular cable systems.

Advanced video processing applications such as video transcoding (MPEG-2 ↔ MPEG-4 conversion) offer a viable option for cable operators. The key advantage of video transcoding is that MSOs can make use of MPEG-4 compression efficiencies and yet still maintain their existing MPEG-2 investments.

Video distribution and storage using advanced video formats also offer tremendous savings in digital transport and storage, even if the end clients are not capable of supporting MPEG-4 AVC. As cable operators migrate to video-over-IP and video-over-DOCSIS solutions, advanced processing techniques will permit the same content to be shared among many client devices. PCs, set-tops and digital TVs can all share the same content as an intelligent video processor makes the appropriate format and transport conversions to meet the needs of the client device.

A device that delivers integrated functionality—transcoding, digital ad insertion and encryption all together—is an especially attractive proposition for the future expansion of MPEG-4 AVC. This type of device will not only provide cable operators with significant bandwidth savings to offer advanced services like HDTV; it will also reduce their capital and operational costs.

RGB's Advanced Video Processing Technology

RGB's Broadcast Network Processor (BNP) delivers the cable industry's highest density solution for grooming, statistical multiplexing, transrating and DPI. Based on RGB's flexible, scalable and modular platform, the BNP simplifies deployments of personalized advanced video services, boosts bandwidth efficiency and cuts operational and capital costs.

The BNP is designed to support a variety of services and applications, including standard definition (SD) and high-definition (HD) digital broadcast, switched digital video, zoned ad and targeted ad insertion, local channel insertion and program substitution. This advanced video processing system can perform grooming, statistical multiplexing, transrating and splicing on more than 500 SD programs through its Gigabit Ethernet or ASI interfaces.

The BNP is fully compliant with SCTE 30 and SCTE 35 standards and is interoperable with the leading DPI ad servers. This flexible product can also perform SCTE 30 to SCTE 35 conversion to support digital program insertion at the cable system hub.

## Applications of RGB's BNP

Digital Broadcast
The high density offered by the BNP makes it an attractive solution for digital broadcast, where cable operators may be providing hundreds of channels to their subscribers. In a centralized architecture, cable

providers can process all of their channel lineups with a single one-rack-unit BNP instead of using multiple devices. Deployment with multiple devices requires purchasing additional equipment which could potentially increase capital investment. It also requires management of multiple systems, additional space and an increase in power requirements, all of which will increase operational costs. Using a single device, as opposed to multiple devices, reduces capital and operational costs and simplifies system management and deployment. In addition, the BNP's simple-to-use graphical user interface allows MSOs to add or drop programs to create customized packages for their subscribers.

Zoned and Targeted Ad Insertion
The BNP is well suited for zoned and targeted ad insertion in both centralized and distributed DPI architectures. The BNP's high density video processing power improves the operation and management of centralized DPI systems by enabling cable operators to direct multiple ad zones from a single, central location.

The ability to support multiple ad zones from a single device simplifies operation, boosts manageability and reduces capital and operational costs. Low density devices would require racking, configuring and managing multiple systems, which not only requires additional capital, but also demands more engineering time and resources to manage the multiple systems. Taking the place of multiple devices, a single BNP can manage the ads in just one rack unit, reducing capital investment and allowing operators to configure and manage a single device. This simpler, centralized management lets cable operators expand and customize their ad zones, thereby generating greater operational revenue.
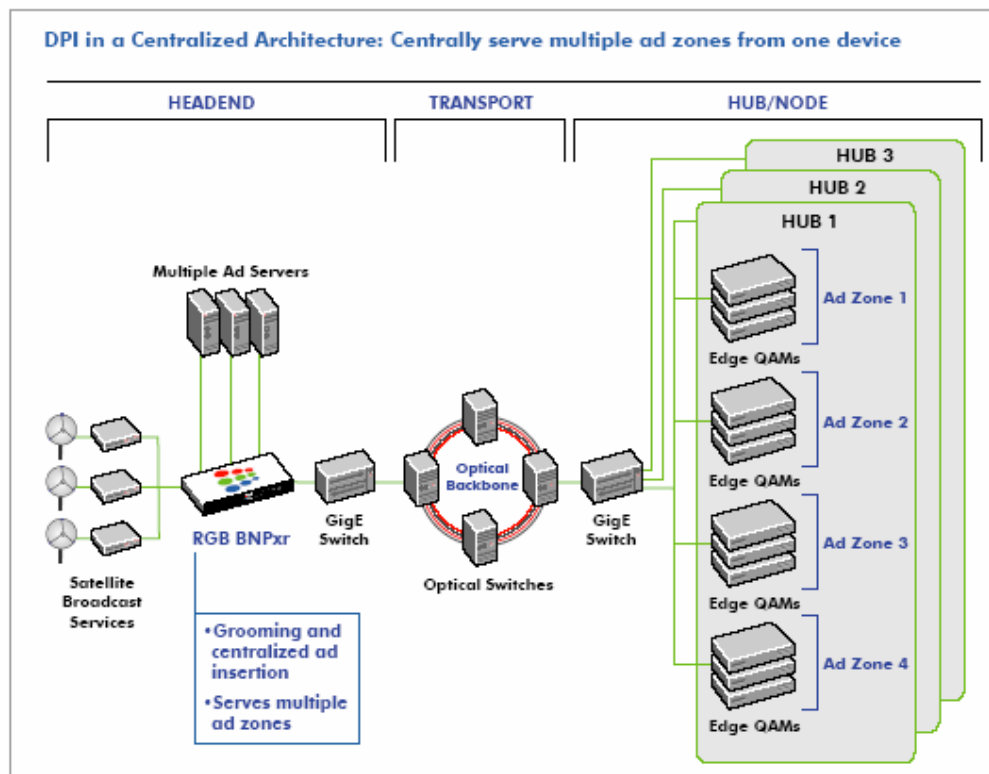
Just as the BNP's high density is an ideal solution in a centralized environment, its scalability offers an equally compelling solution for distributed DPI environments where density requirements may vary. The BNP's programmable architecture allows MSOs to start out at lower densities and scale up as their density requirements increase.
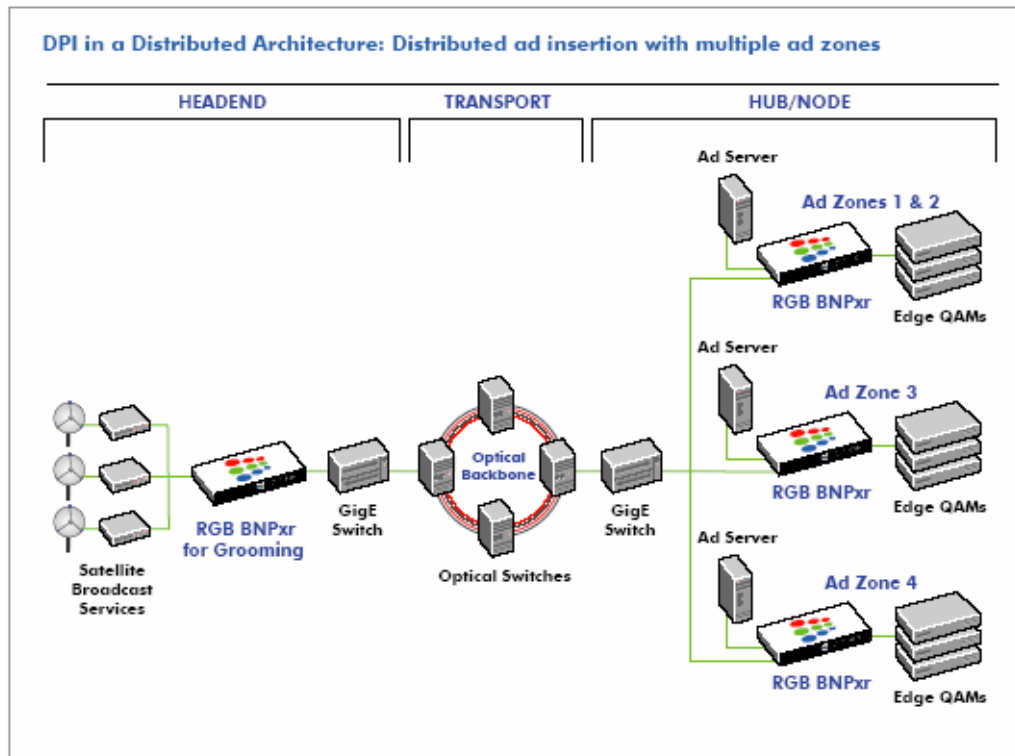
VOD Ad Insertion
With the expansion of the VOD market and the deployment of dynamic ad insertion, cable operators will need solutions that can efficiently manage and process an increasing number of ads. Solutions that can process and splice hundreds of ads in a single device offer a strong value proposition. RGB's BNP is well positioned to meet the future requirements of VOD ad insertion.

Switched Digital Video
Cable operators can use the BNP to deliver video content in variable bit rate streams, instead of having to convert programming to different constant bit rate streams, which reduces bandwidth efficiency. This capability not only increases available bandwidth; it also offers superior video quality.

Bandwidth-Saving Technologies
As cable operators start adopting advanced video codecs like MPEG-4 AVC with DPI and transcoding capabilities, the BNP will provide them with an easier, smoother migration path. The BNP's programmable and upgradeable architecture, combined with its high processing power, will eliminate hardware changes and ease and expedite future deployments of MPEG-4 AVC applications.

Benefits of Deploying the BNP

Simplified Management Reduces Capital and Operational Costs
The BNP's high-density video processing power enables centralized management of the MSO's cable plant. This centralization simplifies operations, eases manageability and cuts capital and operational

costs. The BNP's easy-to-use graphical user interface allows cable operators to configure and manage all these programs, offering further simplification.

Simplified Operation Expedites Deployment
The BNP can concurrently groom, transrate and perform seamless splicing of SD and HD programs. With the capability to groom and insert ads concurrently in a single device, it eliminates the need to dedicate multiple devices for these functions. This capability simplifies installation, wiring and configuration, all of which reduce system deployment time.

Simplified Architecture Provides Upgradeability and Scalability
The BNP's modular and programmable platform provides cable operators with full processing scalability. Plus, it is designed to grow with the MSO's changing environment. The BNP's core processing modules are scalable to support more than 500 programs. The BNP's program density is both software-configurable and upgradeable, allowing cable operators to start at lower densities and upgrade to the full hardware capacity through software licenses as their stream densities and network needs grow.

This scalability reduces capital costs and allows cable operators to allocate their budgets accordingly. By paying for processing on an "as needed basis," MSOs can plan their budgets wisely based on today's requirements and avoid overspending to meet their future needs.

Summary

The future is clearly bright for digital cable. Close to 40% of all cable subscribers today subscribe to digital programming packages and the number is growing each week. With cable customers also signing up in droves for such advanced digital video services as HDTV, VOD and DVRs, digital video delivery is more and more becoming the mainstay of cable programming services.

With the recent launch of digital simulcasting, the cable industry's transition to all-digital systems will likely accelerate even further in the near future. As MSOs convert more cable systems and channels over to digital delivery and more cable customers upgrade to all-digital service, the need for more efficient, higher density processing of all these MPEG video streams will only continue to grow. So will the need to groom programs and channels for customized programming packages and to insert digitized ads into the increasing number of digital programming streams.

RGB's Broadcast Network Processor (BNP) can help with this effort. This advanced video processing platform is designed to simplify cable deployments of advanced video services, boost bandwidth efficiency and cut operational and capital costs across various digital service applications. Scalable and upgradeable, the BNP is the optimal solution for cable operators entering the growing digital advertising market today. It will also provide a smooth migration path as MSOs roll out more complex, bandwidth-consuming services and adopt more advanced video codecs in the near future.