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An Eye on the Future

Headend Designs for New Applications

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Digital television is changing the way people watch television. Its popularity is driving a shift from the analogue environment to a digital entertainment world where new applications are being introduced regularly to meet consumer demand. As the viewing options increase, the complexity of managing this growing number of video streams places heavy burdens on the operator's headend. Decisions are needed continually on what application needs to be implemented, in what time-frame and on what scale. As a result, operators need new technology that can go beyond the limited capabilities of traditional multiplexers to help them manage the increasing number of video streams. To create the headend of the future, operators need new "content manager" technology to increase processing capabilities, create new revenue opportunities and continue to deliver secure, reliable, high-quality service to their customers. This paper describes the new applications that are increasing the demand for increased processing power, defines the capabilities of content manager technology and outlines the future-friendly solution for headends that content manager technology can help provide.

Content drives future applications

Generally speaking, there is a well-defined set of applications that is on the wish-list of just about every operator.

- More programs
- Video on Demand (VOD)
- High-Definition Television (HDTV)
- Ad insertion
- Increased security

Increase the number of programs available to the end-user

The number of digital programs that are offered on the network is increasing rapidly. This is partly driven by competition, but also to increase the ARPU (Average Revenue per User). Since people are moving continually, they are willing to pay for local channels that originate in the region they recently left, or if they move beyond borders, they want to watch the major broadcasters from the country they originally lived in.

This increase of services on the network drives the need for expanded, powerful service management. This ever-shifting demand for varied content creates the need to have the flexibility to quickly and seamlessly alter the channel line-up. A headend that can manage and implement these changes very easily can help control operational expenses while increasing customer satisfaction.

Video on Demand

The success and popularity of Video on Demand, also called content on demand, is increasing rapidly. This is not limited to movies on demand only, but includes subscription on demand, after-broadcast on demand, news on demand and a lot more.

VOD also brings with it a new challenge: security. This is done using pre-scrambling or session based scrambling.

Pre-scrambling is problematic with delayed broadcasting and cannot be implement with some video servers. Pre-scrambling's server incompatibility limits the operator's choices for video servers, as well as IP-QAM modulators, reducing the flexibility of the headend.

A typical VOD system's headend includes the video servers as well as the Conditional Access (CA) system for session-based scrambling. The IP-QAM modulators are located in the modulation sites, many times connected to the main headends over an IP based network.

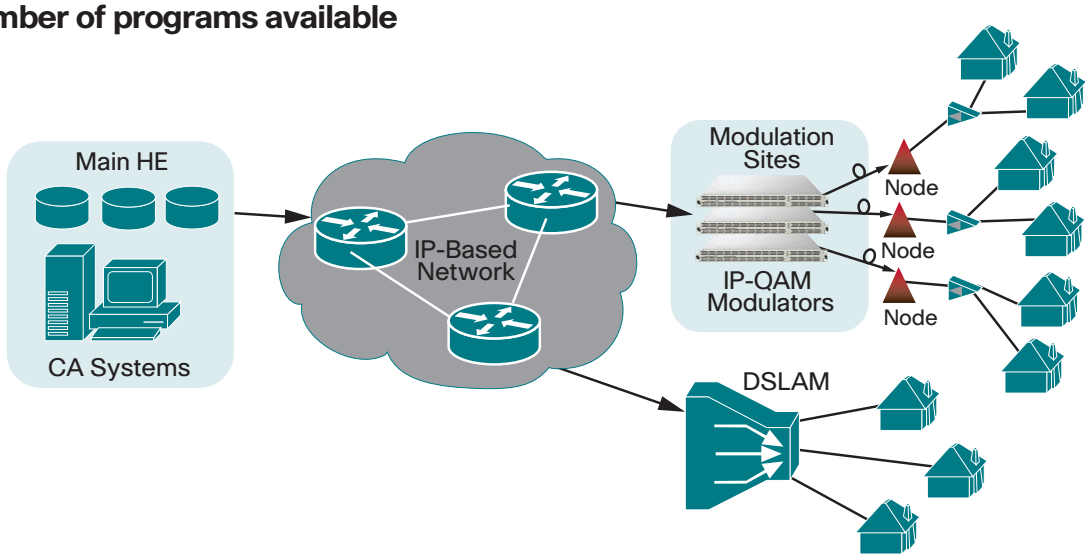

Diagram 1: A Typical Video-on-Demand System

Session-based scrambling in the IP-QAM modulator has some future limitations:

- **An unsecured connection to the CA system**
  The keys of the scrambling algorithm, the Control Words (CW), are distributed to the CA system over an IP backbone. Although the backbone might be private, and this distribution might be allowed today, will it be legally allowed by the CA vendors in the future? It might become mandatory that control words are only distributed over a private connection from the CA system directly to the session-based scrambler. At that moment an open IP backbone cannot be used anymore.

- **What about new video standards?**
  When video streams are encoded using Advanced Video Compression (AVC), the bandwidth needed is reduced by about 50 percent compared to MPEG-2, enabling operators to nearly double the number of programs they can deliver. With an eye on the future, operators should have an AVC deployment plan in place since next-generation set-tops will be capable of supporting AVC.

- **Session-based scrambling for Off-Net IP projects**
  When IP set-tops are introduced in the system (over xDSL or FTTx), the processing and scrambling of the services should happen in exactly the same way as for RF set-tops. This produces savings in both time and money since the back office functions can be identical for IP and RF deployments. But, if the session-based scrambling is performed in the IP-QAM, the cost- and time-saving replications of back-office functions becomes impossible. Taking session-based scrambling out of the QAM modulator will allow this application in the future.

- **Video streams transported in the clear over the network**
  Today, this is not considered a problem, but will the content providers still allow this in the future? As digital television becomes more and more popular, the number of hackers will grow with its popularity. Operators need to be ready if content providers implement new security measures.

The Bottom Line: Flexibility and good headend design to manage VOD content are "must haves" because a lot of the requirements might change over time.

High Definition Television

The technology is available, the content is available and 2006 will be the year HDTV is introduced in the digital domain in Europe.

As mentioned earlier, expanded programming options, especially HD programs, add to the complexity of operations. Ongoing changes to the channel lineup, competition and the goal to increase ARPU only intensify the demand for a content manager that can dynamically and very easily manage all the content that becomes available.

The second HD operational challenge is bandwidth. As more programs are introduced on the network, the available bandwidth becomes more valuable. As HDTV grows in popularity, it will require more bandwidth. The operator's challenge will be to meet the bandwidth requirements of expanded HD service without jeopardizing the picture quality that existing VOD customers are accustomed to receiving.

The best way to solve the bandwidth problem is upgrading the hybrid- fiber-coax (HFC) network to a 1GHz network. Finding the time and funding for this solution may not be practical for all operators. As a result, content management becomes the solution to managing the bandwidth and the dynamically changing channel line-up.

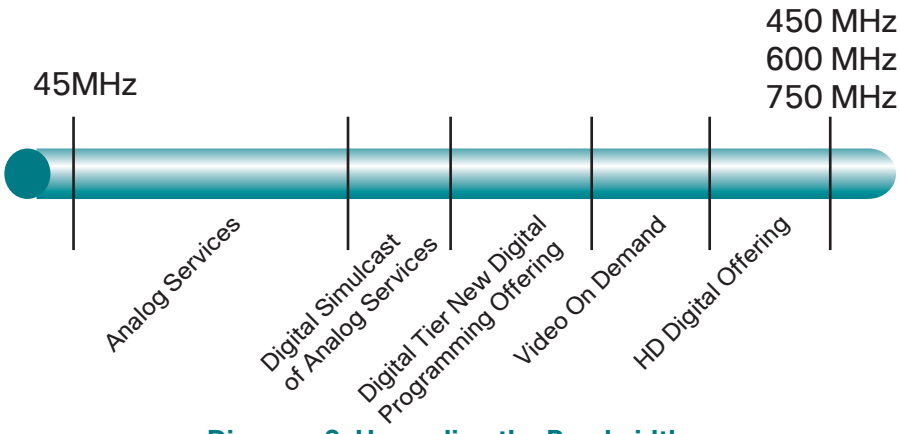

Diagram 2: Upgrading the Bandwidth

Advertisement Insertion

As more digital set-tops are installed in the field, local ad insertion becomes more important. Before ad insertion can actually be deployed, there are a variety of commercial hurdles to overcome. This may result in yet-to-be-defined timing for implementation of ad insertion, but this should not have a huge impact on the installed headend with the proper content management technology in place. Adding an ad server and some licenses should be all it takes to be ready to implement revenue-generating ad insertion capabilities.

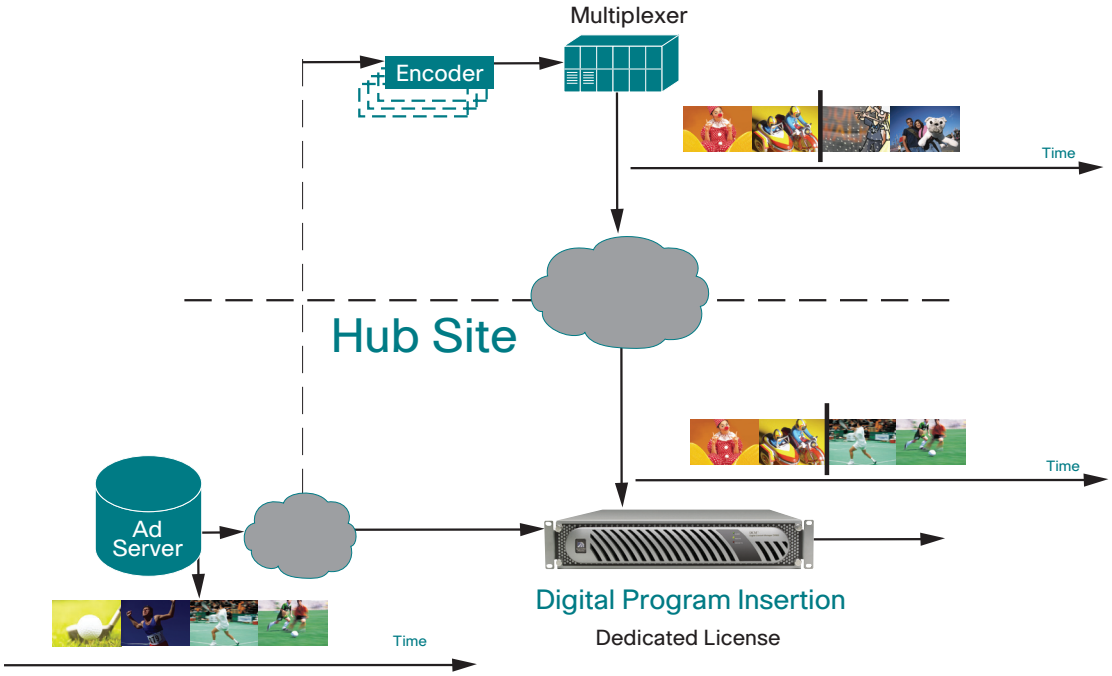

Diagram 3: Advertisement Insertion

Increased Security

In the analogue world, one failing device resulted in one service being unavailable for a certain region. With multiple services being processed with one device, a failing device becomes more critical. Switching times are very critical in order to minimize down-time.

The popularity of digital television is leading many operators to implement a second master headend, also called redundant or security headend. This second headend is in a different location and contains all or a subset of the services available in the master headend. This redundant approach to security also requires a flexible content management solution to help provide a secure system that minimizes downtime and delivers a satisfactory entertainment experience for customers.

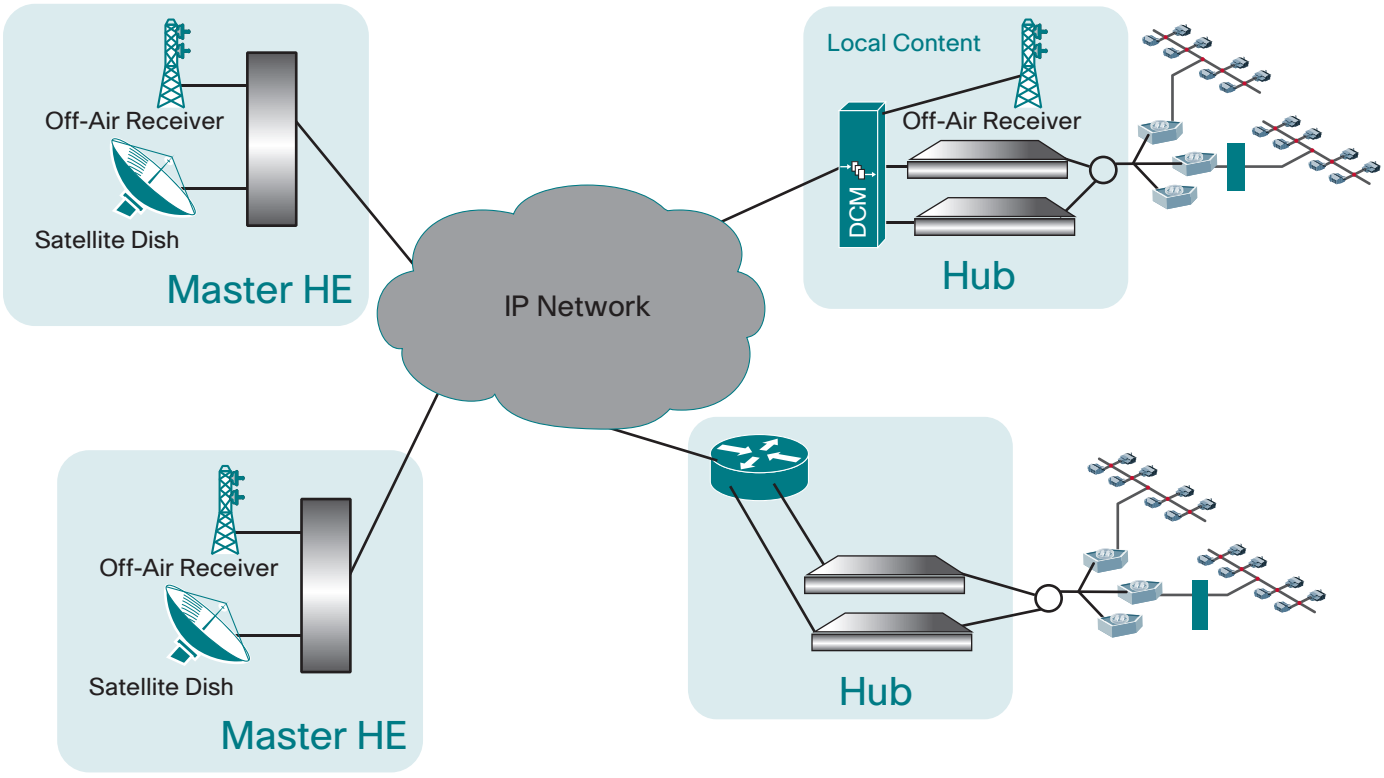

Diagram 4: Second Master Headend for Increased Security

Overview – Content Manager

The functionality of a digital headend has not changed over time. The complexity of the functions it delivers are markedly different from just a few years ago, and will only increase in the future.

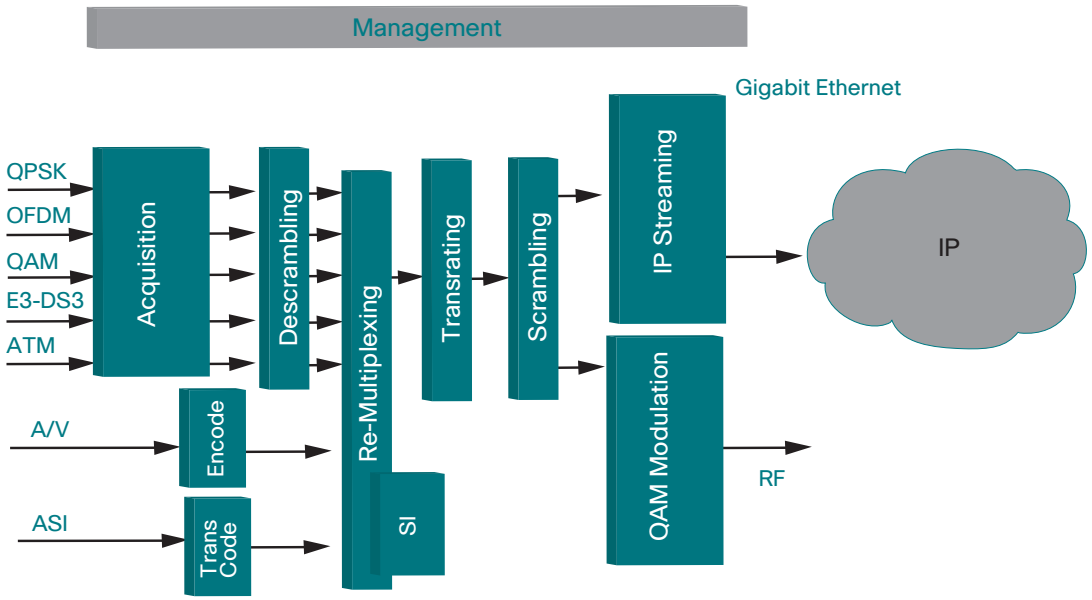

Diagram 5: Content Management

These functionalities are:

- **Acquisition** — Services are acquired in the headend in a variety of ways - from satellite (DVB-S), Terrestrial (DVB-T), IP, ATM, etc.
- **Descrambling** — Scrambled services that will be used need to be descrambled.
- **Re-Multiplexing** — New Transport Streams (TS) are generated using the different services acquired in the network.
- **Transrating** — To make sure the TS does not overflow and to include more services in a TS, transrating is needed.
- **Scrambling** — Connection to a CA system is required to do this
- **IP Streaming** — Streaming the services to an IP network to the Hub sites or to an IP-STB
- **QAM modulation**
- **Management** — Managing the complete system, from acquisition in the master headend over QAM modulation in the hub sites to the HFC equipment.

Prior to the advent of content manager technology every function was performed with one device, now multiple functionalities are combined in one content manager.

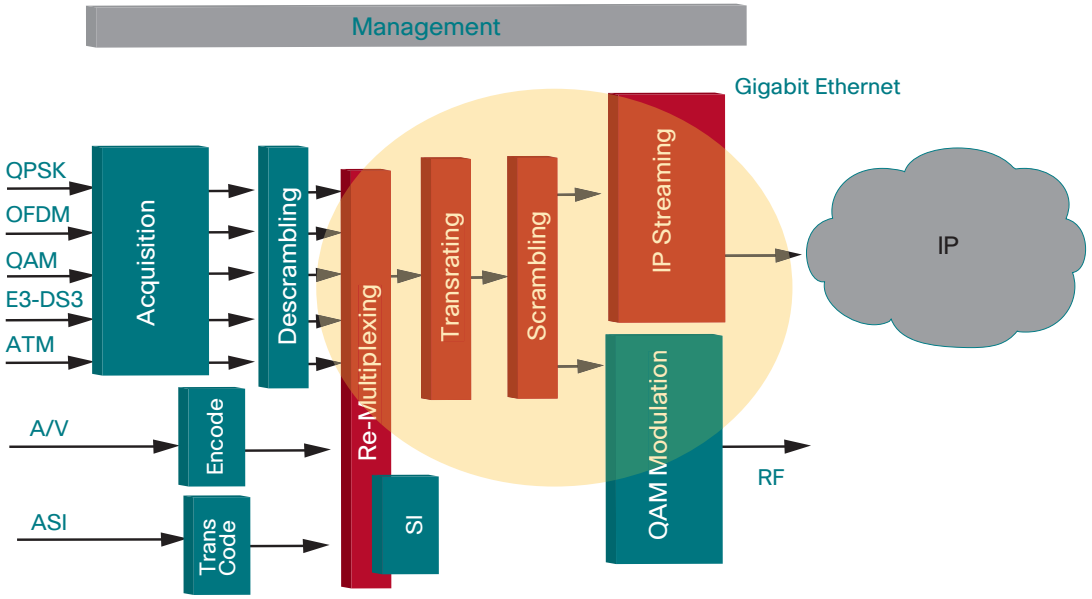

Diagram 6: Content Management With Every Functionality Combined in One Device

This new content manager can manage the complete content from the moment it passes the acquisition step (including descrambling) to the moment it has to be sent out to the network or to a QAM modulator.

These content managers can manage all the content across the complete headend, both in the master headend as well as in the hub sites.

With the latest available hardware components, it is possible to process thousands of services within 2RU. This opens new opportunities in headend designs.

The Content Manager's role in future-friendly designs

Using such a Content Manager allows headend designs to be future-friendly. This means:

- **Extra applications** can be easily added without a complete re-design of the complete headend
- **Adding services or changing the channel line-up** can be done very easily without a re-installation of the system
- **Redundancy** (1:1 redundancy on the equipment and headend redundancy) can be added with limited impact to the installed system.

A headend incorporating a Content Manager could be designed as shown in Diagram 7.

With this design, it's very simple to add current or future applications:

- **Conditional Access**
  The content manager can communicate over a private Ethernet connector to the CA system. In this way, scrambling is added with no design changes.
- **Ad insertion** (Digital Program Insertion)
  The communication to the ad server is done over IP. Ad insertion is implemented by connecting a server to the content manager which matches the correct program with the desired ad to be inserted.
- **Off-Net project: including IP-set-tops**
  Playing out a Single Program Transport Stream (SPTS) requires minor management changes, so playing out to an IP-set-top can be easily done.
- **Changing channel line-up**
  The different services are running over the content manager, making channel line-up changes simple.

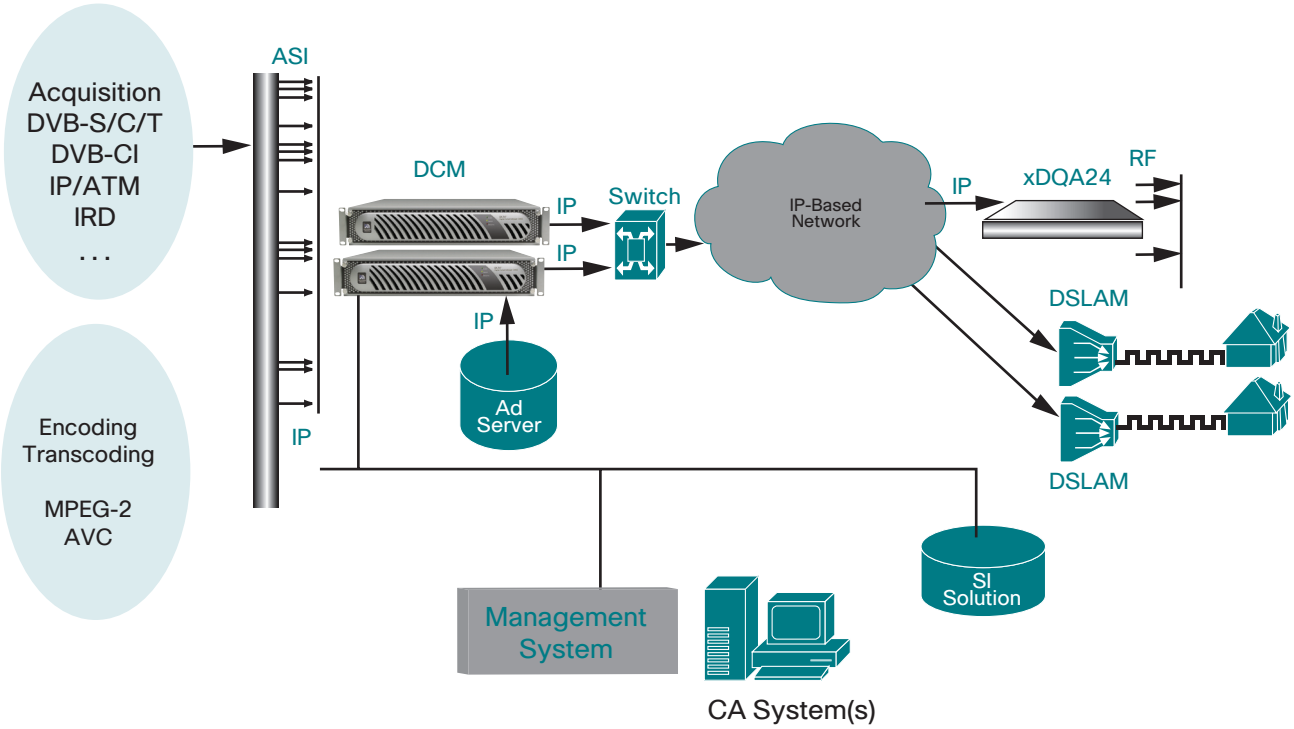

Diagram 7: A Future-Friendly Headend Design

As shown in Diagram 8, extra security can also be provided by having multiple master headends.

All or a subset of the services are being played out from the primary and backup headends. In the hub site, the content manager automatically decides what service to use. If a service disappears, it can be inserted from the redundant feed to continue to provide reliable service to customers. This is called service redundancy.

In a VOD situation, in Diagram 9, the content manager takes care of the session-based scrambling. It can be put in both the modulation site as well as locally in the main headend. This provides flexibility for the operator to enable seamless, rapid response to technology- or legal-based security changes. In the main headend, the content manager secures the video by scrambling it directly after the video servers. As a result, the content manager is directly connected to the CA system (closed network), the content is scrambled over the IP based network and the scrambled content can go to either an RF set-top (after an IP-QAM modulator) as well as to an IP set-top

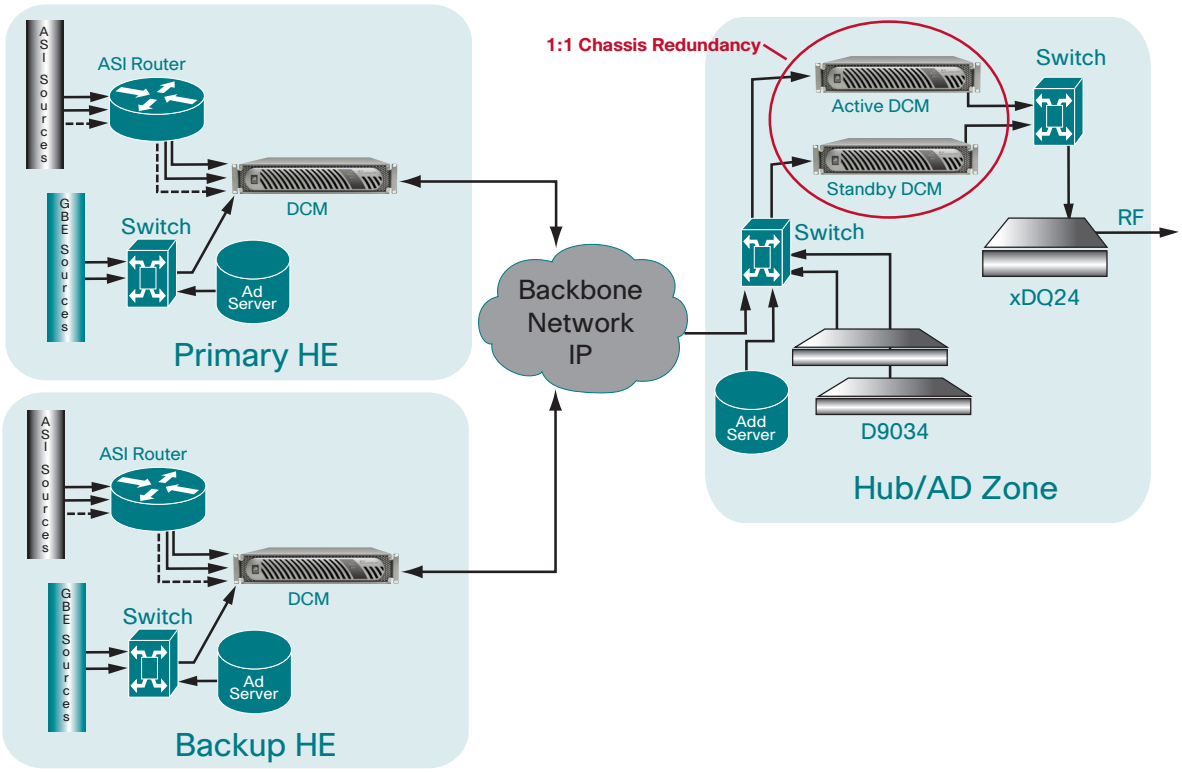

Diagram 8: Adding Extra Security to a Future-Friendly Headend Design

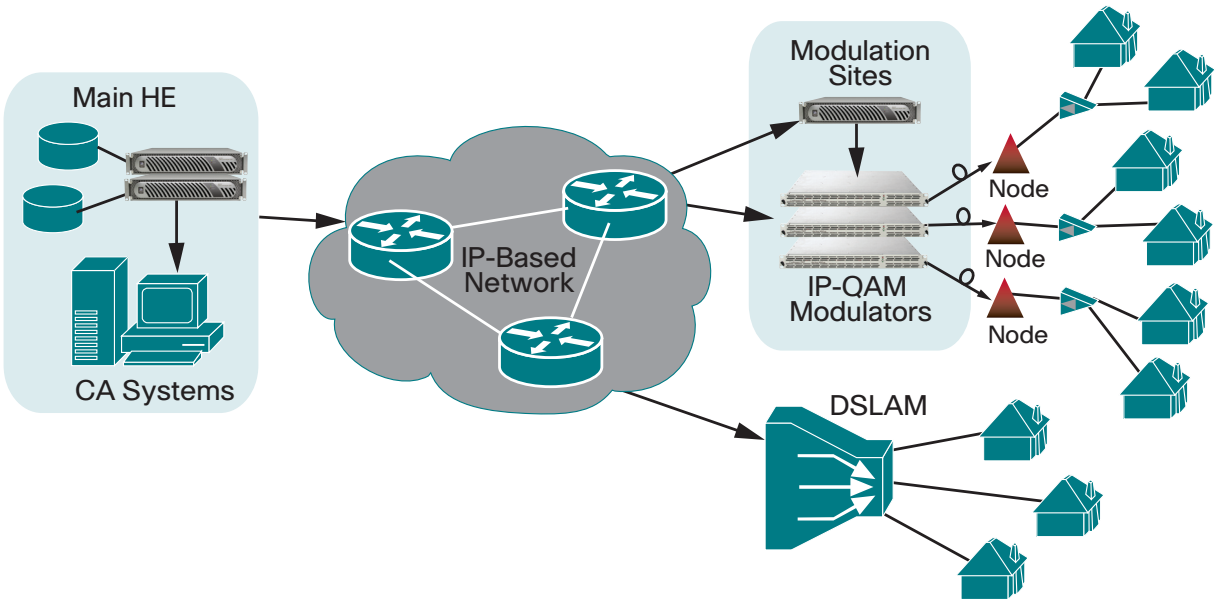

Diagram 9: A VOD Headend Design

Conclusion

The growing demand for digital content presents both opportunities and challenges for operators. With an eye of the future, operators need to begin plans for using new content manager technology to expand digital program lineups, launch more HD services, generate new revenue streams with ad insertion capabilities and protect content from piracy. The processing power of a content manager meets many of these needs and enables the operators to extract more performance from existing bandwidth. Coupled with AVC encoding, a digital content manager can provide the future-friendly environment needed for today's operator to create and deliver the digital services of the future.

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