IPTV:
The Next Step in the Evolution of Television

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AUDIO VIDEO SYSTEMS

Executive Summary

As the result of a U.S. federal mandate, all television stations will make the transition from analog video transmissions to all-digital transmissions by June 2009. Basically, this means that broadcasters must turn off their analog broadcasts and switch to digital. Fortunately, digital broadcasting allows stations to offer improved picture and sound quality along with a host of other advantages over traditional analog broadcasting. Riding on the digital wave, Internet Protocol Television (IPTV) is an efficient system in which digital television channels are shuttled via internet protocol (IP). However, despite the implication, this digital television content is not actually streaming over the Internet.

The IP in IPTV merely refers to the same method, protocol, or technology that enables access to the Internet. Here, television content simply utilizes the same (IP) technology for delivery to an end user. In other words, IPTV is television content that (instead of transmitting in traditional analog/digital broadcast and cable formats) uses multicast IP services to deliver digital video content to subscribers using the technology of computer networks.

With IPTV, additional infrastructure does not need to be added if existing network is already in place. IPTV boasts very low life cycle operating costs, can be centrally managed, and complies with most security policies and practices. It also offers content and distribution versatility not available with normal analog and digital Advanced Television Systems Committee (ATSC) video signals. IPTV is essentially the next step in the evolution of television as we know it, offering a progressive solution to distribute a tailored selection of video content throughout your facility. Additionally, IPTV is fully scalable to the extent of the network fiber.

Benefits of IPTV

IPTV essentially supports the same digital television content that is offered via traditional transmissions, but boasts several other benefits by using internet protocol. Some of the main benefits of IPTV:

- IPTV can reduce the number of necessary displays in a system. If TV signals can be made available at the desktop, displays can be eliminated in open office areas.
- IPTV reduces necessary infrastructure. Using the network backbone eliminates the need for traditional coaxial copper radio frequency (RF) cabling throughout the building(s) to support television distribution.
- IPTV reduces operating and maintenance costs. IPTV systems do not require attention like traditional coaxial RF analog television distribution systems. With analog systems, the signals need to be amplified and balanced at all segments of the building(s) requiring access to the cabling at all points throughout the building. The use of IP distribution eliminates the need for continuous upkeep of the analog network.
- IPTV improves system-wide availability. IPTV can be made available and accessible to any networked computer. With a standard analog distribution system, coaxial cable must be installed to a specific location, ultimately restricting the installation location and placement of the TV monitor and/or tuner.

General IPTV Design Parameters

The typical IPTV system provides network television, select cable/satellite television, and locally generated channel content at a low bandwidth to any user working on a desktop over the facility's network. IPTV provides a set of selected channels at full bandwidth to be distributed to IPTV displays in public spaces, designated private offices and special facilities on the network. A content management server is employed on the network to manage total bandwidth usage and user access rights to individual channel content.

Primary network channels can be backed up by the availability of multiple sources to provide redundant capability. Redundant capability is available by using a second source for local channels where available (i.e. local channels can originate from off air and satellite sources). Multiple IPTV head-ends (i.e. one Unclassified and one Classified) may be configured to share source content while maintaining appropriate security separation of systems. Although international content is available on the system, it may not be available as high definition content and may not have redundancy due to limited availability from distribution vendors. Redundancy in this context refers to the offering of the same channels by different services (i.e. CNN by way of Comcast Cable as well as by DirectTV). Only the Dish Network International offers international channels to the US at this time.

General IPTV Architecture

A system provider (the entity which supplies the IPTV services and administers/ maintains the system) can support television signals at a facility through an IPTV distribution system. The IPTV distribution system is capable of ingesting full bandwidth content from multiple service providers (satellite or terrestrial) as well as off-air ATSC (digital) content for redundancy; this system is also capable of ingesting locally-generated content. IPTV can distribute and display emergency notification messages, content on demand, military feeds, streaming video sources, RSS feeds, and digital signage feeds. All received content can be encoded into digital bit streams and retransmitted through digital content managers as IP multicast outputs to the network. A content management system can be deployed on the network to control access based on user authentication.

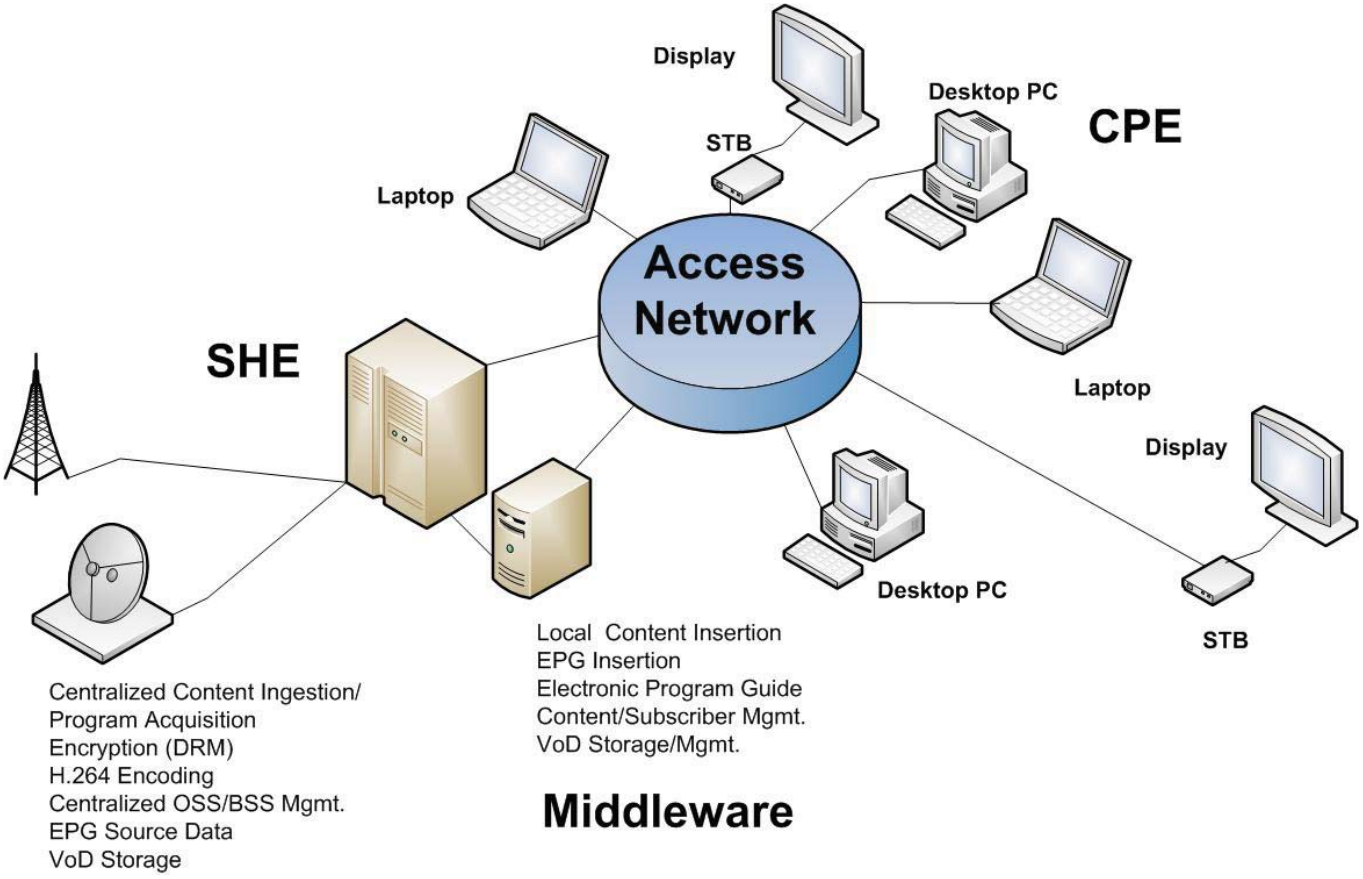

Figure 1 – High Level IPTV Architecture

Super Head End (SHE) - The super head end is the brain of the IPTV system. This is where the national broadcast channels and other content is received and distributed. First, the content is put through a process of ingestion (capture from various sources – satellite, fiber feeds, etc.). Then, the content is encrypted - formatted for compatibility with the chosen set top box (STB). Finally, digital rights management (DRM – see definition on the next page) is applied to protect the content from being pirated prior to delivery to various parts of the network. The main storage for the Video on Demand (VoD) content is also located at the SHE. Other key functions such as service management, subscriber authentication (what content should the subscriber be allowed to access), IP address management and fault/performance management can reside at the SHE or can be managed at the video hub offices.

Customer Premise Equipment (CPE) - The IPTV distribution network is comprised of customer premise equipment combined with the facility network infrastructure wiring. A typical configuration includes a network gateway that connects to the server access network. The network gateway also manages the control requests from each STB on the video distribution network. A STB is connected to each TV and delivers the video and audio programming. The facility network wiring is an important aspect of the facility network and can include Fiber Optic/CAT5/CAT6/Coaxial cable and wireless Ethernet. Although network wiring can be very costly, facilities typically choose to rewire the facility during initial installation in order to avoid potential problems.

IPTV Middleware - IPTV middleware is the software control layer that enables the delivery of the services. Current middleware offerings are provided by multiple vendors, each employing non-standard approaches. Middleware enables channel change control, electronic programming guide browsing, VoD control including browsing and purchasing content, interaction with ad-insertion systems and other customer interface control activities. Companies such as Entone, Kassena, Minerva and Microsoft provide IPTV middleware products.

IPTV Video-on-Demand (VoD) - VoD provides users with the convenience and choice to view the content they want from their own desktop/office. The initial concept of VoD was originally promoted as a premium service by the cable companies to compete with the movie rental companies. However, its expansion to include free content has proven to be an effective operational tool. VoD in a commercial or government environment can be used for training, review of critical operations material, and as a means for presenting live mission-critical material. An important consideration for any service provider is the location the VoD content. Placing all of the content at the super head end impacts the amount of bandwidth required throughout the access network despite possible results of throughput constraints. Placing significant content at the edge of the network increases infrastructure, storage and operations costs. The right mix of centralized and distributed VoD content can improve the overall operation of IPTV while limiting operations costs.

Access Network - The access network typically employs fiber to the node (FTTN). The bandwidth to the end user ranges between 20 Mbps and 50 Mbps depending upon the access technology chosen. New access technologies bond (or combine) the copper cable pairs running to the individual end user locations to increase the bandwidth speed. Although not necessarily part of the architecture, the electronic programming guide (EPG), digital rights management (DRM) and content greatly impact the IPTV network.

Electronic Programming Guide (EPG) - The electronic programming guide presents the subscriber with a robust navigation system to browse the available channels and the on-demand content. An easy to use EPG greatly enhances the end user experience.

Digital Rights Management (DRM) - The protection of content rights is a liability taken on by the service provider through its agreement with the content providers. Digital rights management reduces content piracy and revenue loss and is delivered through a closed access network. The service provider can choose the approach that best meets their network architecture and operations philosophy. Various approaches exist today including encryption and key management.

Content - Content make up within the IPTV services portfolio can be a blur. Clearly, traditional entertainment material such as movies, broadcast channels, specialty channels, live events and various VoD content make up the lion's share of today's content. However, with the advent of user customizable content, the IPTV network becomes a distribution method through which non-traditional content could be distributed while maintaining content rights. An IP-based platform also allows significant opportunities to make the TV viewing experience more interactive and personalized. Converged services are interactive tools available on the IPTV System. The most common examples of converged services are Video on Demand (VoD), Picture-In-Picture (PIP), digital video recorder (DVR) service, or parental controls. These converged services are indicative of the interactive nature of IPTV.

Bandwith Control

Most of the IPTV video content is encoded into MPEG-2 or MPEG-4. If lower bandwidth is required, additional sets of encoders can be used on video content using Windows Media or other proprietary software. The video content transported over the IP networks is often at a lower resolution and requires lower bandwidth across the data network.

- MPEG-2 provides Standard Definition video with audio at about 3 to 7 Mbps
- MPEG-2 High Definition with audio at about 14 to 19 Mbps
- MPEG-4 provides better compression with HD maxing at around 9 to 10 Mbps

There are four distinct ways that bandwidth is managed for IPTV. Rate Shaping and Transport Rendezvous Points are specific to IPTV systems.

Rate Shaping

As the video/audio sources are transported into the head-end system as (MPEG2/4 or IP), they must pass through a level of grooming and statistical remultiplexing. An application platform called a “cherry picker” can be used for grooming and rate shaping. The cherry picker provides rate shaping on the video content to improve bandwidth efficiency. Rate shaping is a process by which system managers distinguish critical video content from non-critical video content and adjust initial bandwidth requirements accordingly. For instance, certain channels that provide critical information, such as news and weather would be determined to be available at maximum bandwidth because they would be necessary for the mission. Whereas, video content available on non-essential channels such as “The History Channel” may only be necessary for viewing on the desktop on a small screen/monitor as they are not mission-critical; non-essential channels can be shaped to only be available in a small window before they get to the distribution system.

Transport Rendezvous Points

A critical part of the network design, transport rendezvous points help manage logical transmission paths. On large networks, it is very important to ensure that video content follows the most logical path on the network to ensure successful delivery. This is a critical aspect of multicast delivery of video content.

Transport Quality of Service (QOS) Implementation

Another critical part of the network design, transport QOS sets the limits for minimum and maximum bandwidth for traffic during times of congestion.

Security

Security issues vary depending on system requirements and engineering design choices. As the IPTV system is designed, engineers should address security at each step and ensure that IPTV will not compromise the networks in any way. In traditional radio frequency (RF) based systems, security risks include the unintentional escape of RF radiation. While security is managed physically by merely separating the head end equipment and not permitting bidirectional content, there are many additional security factors that must be considered in the development of the IPTV system.

Conclusion

IPTV – digital television is received through the same technologies used for computer networks, using Internet Protocol. This technology is expected to transform the way people experience television.

Basically, IPTV can provide new interactive services such as adding the ability for users to interact with scheduled programs or employ interactive options like Video on Demand or Content on Demand, in which users select content items they want to watch at a time of their choosing.

Of course, IPTV can be configured to be integrated with numerous other communication services. For instance, IPTV systems can potentially include options for text messaging by dynamically allowing users to communicate with others online. The IPTV system can be configured to permit users to share information about the content they are watching on TV, or even receive on-screen notifications about incoming audio calls or requests for video calls on the network.

The IPTV network option is a technically efficient solution providing potential cost savings, full security features and bandwidth controls that simply cannot be employed with deployment of a traditional television video system.

About AVS

Audio Video Systems, Inc. (AVS) is a design, engineering and systems integration firm, which provides custom, high-end audiovisual systems, integration services and solutions, ongoing maintenance and on-site support. AVS' core competency and major focus lies in designing, installing and maintaining integrated audio, video and control facilities for a wide variety of environments including classrooms, command and control centers, conference rooms, classrooms and training facilities, SCI Facilities, auditoriums, theaters and more.

AVS, a privately owned Certified Small Business headquartered in Chantilly, Virginia, is dedicated to serving the Department of Defense; Federal, State and Local governments; higher education and commercial enterprise worldwide. Established in 1992, AVS has grown to occupy more than 20,000 square feet of office, engineering and integration space, and employs more than 100 full-time project managers, engineers, certified programmers, integration technicians and support personnel.

AVS is a Diamond Level Solutions Provider under the audiovisual (AV) industry's prestigious AudioVisual Solutions Provider (AVSP) Program. The Diamond designation certifies that 50 percent of all Customer Service, Sales and Technical staff at AVS have and maintain general or advanced CTS certification or InfoComm Academy course completion under InfoComm International's Certified Technology Specialist (CTS) credential program. AVS first obtained the Diamond Level status in 2006 and remains near the top of the industry for having such a high percentage of staff with industry certifications. The award further demonstrates AVS' commitment to continuing education and training for staff at all levels.

Also in 2008, AVS received the "Best Government AV Project (Federal)" award as part of *PRO AV Magazine's* first annual Spotlight Awards program. The Spotlight Awards recognize the best professional audio/video installations designed for corporate, educational, and other non-residential applications. The award was given for the installation at the U.S. Marine Corps Forces Pacific Headquarters Command Operations Center (MARFORPAC COC) in Hawaii, which required technological upgrades to meet its mission.

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