

Beyond Analog A System Comparison

In this session we I will talk about the history and development of cable systems. I will concentrate on the components of an analog television system delivered via standard coaxial cable, digital television services delivered via a standard Radio Frequency coaxial feed, and digital television signals delivered via an IPTV feed.

Although there are other backbone technology options for the delivery of program content, I only want to address basic RF cable distribution, digital into analog distribution, and IPTV distribution. These distribution technology options are what most people in this room will run into.

Let's start by taking a look at how cable television systems started. Then we'll take a look at the type of TV systems we have today.

According to the National Cable & Telecommunications Association, in the late 1940s, Cable television originated in the United States almost simultaneously in Arkansas, Oregon and Pennsylvania as a way to enhance poor reception of over-the-air television signals in mountainous or geographically remote areas. "Community antennas" were erected on mountain tops or other high points, and homes were connected to the antenna towers to receive the broadcast signals.

By 1952, 70 "cable" systems served 14,000 subscribers nationwide.

By 1962, almost 800 cable systems serving 850,000 subscribers were in business.

In the early 1970s, the FCC enacted regulations that limited the ability of cable operators to offer movies, sporting events, and syndicated programming. However, by the end of 1972 a lessening of these restrictions started that would continue throughout the decade. These changes, coupled with cable's pioneering of satellite communications technology, led to a pronounced growth of services to consumers and a substantial increase in cable subscribers.

In 1972, Charles Dolan and Gerald Levin of Sterling Manhattan Cable launched the nation's first pay-TV network, Home Box Office (HBO). This venture led to the creation of a national satellite distribution system that used a newly approved domestic satellite transmission. Satellites changed the business dramatically, paving the way for the explosive growth of program networks.

The second service to use satellite distribution was a local television station in Atlanta that broadcast primarily sports and classic movies. The station, owned by R.E. "Ted" Turner, was distributed by satellite to cable systems nationwide, and soon became known as the first "superstation," WTBS.

By the end of the decade, nearly 16 million households were cable subscribers.

The 1984 Cable Act established a more favorable regulatory framework for the industry, stimulating investment in cable plant and programming on an unprecedented level.

Deregulation provided by the 1984 Act had a strong positive effect on the rapid growth of cable services.

Satellite delivery, combined with the federal government's relaxation of cable's restrictive regulatory structure, allowed the cable industry to become a major force in providing high quality video entertainment and information to consumers. By the end of the decade, nearly 53 million households subscribed to cable, and cable program networks had increased from 28 in 1980 to 79 by 1989.

In an effort to continue to build profit, cable companies wanted to provide more and more services. The strategy of providing Internet services, telephone services, and television services delivered by your local cable company fueled the need for more bandwidth to deliver such services. Since many cable companies did not have enough bandwidth to deliver more services, ways to get more bandwidth had to be considered.

Let's take a look at the concept of bandwidth. Assume that you your program services are being delivered to your home in the same way that water is delivered to your home. That is, it comes through a pipe – for a cable company, the pipe is coaxial cable. Obviously, only so much water can get through any pipe. If you want more water, you have to get a bigger pipe. To get more bandwidth, cable companies decided to get a bigger pipe. They built higher capacity hybrid networks of fiber optics and coaxial cable. Such networks would evolve into the broadband networks that we have today.

For that evolution to occur, cable engineers decided to move beyond the use analog distribution technology. By using digital compression and distribution technology, more information could be delivered using the same amount of bandwidth. In other words, cable engineers started cramming more water into the pipe. Using compression technology, they found ways to more *efficiently* send data in the limited amount of space that was available.

Let's talk about the concept of compression. Compressing video is like sitting on a loaf of bread, you squash it down, you move it from point A to point B, then you put the air back in it and restore it to what it looked like prior to being squashed. It is done by applying a mathematical formula, or algorithm, to take away unneeded space. That space can be put back at a later time. The compressed material is then restored to much of what it originally looked like.

When talking about video, your file sizes get smaller. Which means data is transferred in less space using less time.

Let me illustrate this another way.

Do the paper wad demo.

Compression technology is critical in a broadband network, and during the late 80's and early 90's, most all cable companies started moving toward offering broadband services. Broadband networks could provide multichannel video, two-way voice, high-speed Internet access, and high definition and advanced digital video services all on a single wire into the home.

Putting broadband services in proved to be an expensive undertaking, so most cable companies started raising the rates that they charged their subscribers.

In 1992, Congress responded to rising cable price increases and other market factors with legislation that opened heretofore "exclusive" cable programming to other competitive distribution technologies such as "wireless cable" and the emerging direct satellite broadcast (DBS) business.

By the end of 1995, there were 139 cable programming services available nationwide, in addition to many regional programming networks.

Enactment of the Telecommunications Act of 1996 altered the regulatory and public policy landscape for telecommunications services, spurring new competition and greater choice for consumers.

A generally low-key regulatory environment for cable operating and programming companies enabled the cable industry to accelerate deployment of broadband services, allowing consumers in urban, suburban, and rural areas to entertain more choices in information, communications, and entertainment services.

By the spring of 1998, the number of national cable video networks had grown to 171.

By that time, the average subscriber could choose from a wide selection of quality programming, with more than 57 percent of all subscribers receiving at least 54 channels, up from 47 in 1996. And at the end of the decade, approximately 7 in 10 television households, more than 65 million, had opted to subscribe to cable.

Arrival of the new millennium brought with it hopes and plans for acceleration of advanced services over cable's broadband networks.

As the new millennium got under way, cable companies began pilot testing video services that could change the way people watch television. Among these: video on demand, near video on demand, subscription video on demand, and interactive TV. The industry was proceeding cautiously in these arenas, because the cost of upgrading customer-premise equipment for compatibility with these services was substantial and required new business models that were both expansive and expensive.

In 2001, partly in response to those demands, AT&T agreed to fold its cable systems with those of Comcast Corp., creating the largest ever cable operator with more than 22 million customers.

The lower cost digital set-top boxes that started to become the norm in customer homes in the mid 1990s proved effective in accommodating the launch of many of the new video services. In general, however, more expensive technology would still be required for cable to begin delivery of advances such as high definition television services, being slowly introduced by off-air broadcast stations as well as by cable networks such as HBO, Showtime, Discovery, and ESPN.

By 2002, the cable landscape largely reflected the findings of a study sponsored by the Cable & Telecommunications Association for Marketing (CTAM). The study showed that roughly two of every three U.S. households had access to three cutting-edge communication tools: cable television, cellular phones and personal computers. Digital cable could be found in 18 percent of U.S. television homes, suggesting an overall digital cable penetration among cable customers in the range of 27 percent. As for data services, the research revealed that 20 percent of cable customers with PCs are using high-speed modems today.

Cable operators with upgraded two-way plant have been witnessing dramatic growth in “broadband” data. Cable has quickly become the technology of choice for such services, outpacing rival technologies, such as digital subscriber line (DSL) service, offered by phone companies, by a margin of 2 to 1. Subscribership to high-speed Internet access service via cable modems had grown to more than 10 million by the end of the third quarter of 2002.

As for telephone service using the cable conduit, growth was evident in all the limited market areas where such service was offered. More than 2 million customers were using cable for their phone connections by mid 2002.

To accommodate accelerating demand, cable programmers are rapidly expanding their menu of digital cable offerings. By 2002, about 280 nationally-delivered cable networks were available, with that number growing steadily.

The financial business challenges of 2001 and 2002 affected a number of cable operators, with accounting and financing issues forcing some of the weaker companies into bankruptcy. Increasing competition from alternative providers also was taking a toll, causing overall cable penetration during 2002 to decline.

Nevertheless, projections for increased demand for broadband services has caused most cable systems, including the telephone companies and direct to home satellite service providers, to continue to add more services. In addition, Internet Protocol Television (or IPTV) systems were now being installed in places all over the country.

Now that we have looked at how the cable industry has used new technology to evolve over the years. Let’s look at how the basic cable distribution technologies work. Specifically, let’s take a look at the components of the basic analog cable system, a broadband cable system offering some digital services, and a full digital IPTV system.

Most analog cable systems are delivered as an RF feed over coaxial cable. What is RF feed? RF stands for Radio Frequency. According to CableLabs, Radio Frequency is defined as: Analog electrical signals sent over the cable. Conventional (broadcast) television and radio, as well as cable TV, deliver RF signals to your television/radio. Most of you in this room have an RF coaxial cable system. Let's take a look at what this looks like.

Show analog system diagram.

At the heart of most CATV (cable) systems is the Headend. That is where the reception and processing of broadcast or "off-air" television signals and reception, decryption and modulation of satellite delivered programming in preparation for distribution to cable subscribers takes place.

The broadcast signals routed to the headend are filtered to reject any unwanted signals from adjacent off-air channels and adjusted for proper aural & visual carrier level input. They can be fed to a signal processor or a demodulator / modulator approach can also be used.

In today's cable system, the majority of CATV channels are delivered to the headend via satellite. In this method signals are uplinked to a communications satellite in geosynchronous orbit from an uplink facility. The satellite then retransmits the signal back to earth where it is received by dish shaped antennas which focus the signals. At the dish, an LNB (low noise block converter) amplifies the signals and delivers them to the headend via a coaxial cable. Most satellite signals are scrambled and the satellite receiver in the headend is used to decode the signals. These units may have the ability to decode or decrypt the scrambling of a particular format or type of signal built in (IRD) – That's the Integrated Receiver Demodulator. The satellite receiver typically converts the signal to a baseband audio & video signal. This signal is then modulated onto any desired CATV channel.

The CATV headend uses frequency division multiplexing to combine signals from broadcast TV processors, satellite fed modulators and locally originated system specific channels onto a single feed. The combining process is passive since the signals already occupy discrete frequencies and have been adjusted to the same RF carrier level by their respective processing equipment. Passive combiners simply provide multiple signal ports where different signals are connected and are combined onto a single output containing all of the input signals. A post amplifier, sometimes called a launch or distribution amplifier, then amplifies the signals and provides slope control so that the entire range of carriers can be at the correct RF level for launching to the distribution system.

Now let's take a look at how digital television services can be delivered via a standard Radio Frequency coaxial feed. It is very similar to the basic cable system that we just examined. The difference is that in most cases, these systems do not develop from the ground up. That is, digital services are usually added to existing analog cable systems so as to provide more program services.

Explain how you take away some bandwidth to get more.

Now that we conceptually know how such an analog system with a digital tier works, let's look at the components used in such a system.

Show the diagram and explain.

Now let's take a look at how an IPTV system works. In it's simplest form, and IPTV system can look like this.

Show diagram.

Most IPTV systems will be more sophisticated than what I have proposed in this diagram. They are most likely to look like this.

Show diagram and explain.

An IPTV system has several advantages over a traditional CATV system.

1. It is more cost effective to put in an IPTV system. In fact I have heard that a savings as great as 25% can be achieved over the cost of installing a coax based system.
2. Hardware is easier to maintain and network resources are easier to manage, because much of the equipment is IP addressable. It can be in a local or a remote location, but the management process is the same.
3. Provisioning of services is easier to accomplish. In other words it's easier to decide who gets what.
4. DRM and Conditional Access technology is easier to manage.
5. People can watch programs using a TV or using a PC with special software.
6. Wireless distribution becomes possible.

Conclusion:

After discussing the basics of the three different types of cable TV systems, we have ask ourselves which one is the best. They each have their place. Although all three methods of program distribution are viable, I believe that more and more television systems will be deployed as IPTV systems in the future.