

## “IPTV(InternetProtocolTelevision)”

**IPTV( InternetProtocolTelevision )** is a system where a digital television service is delivered using Internet Protocol over a network infrastructure, which may include delivery by a broadband connection. A general definition of IPTV is television content that, instead of being delivered through traditional broadcast and cable formats, is received by the viewer through the technologies used for computer networks.

For residential users, IPTV is often provided in conjunction with Video on Demand and may be bundled with Internet services such as Web access and VoIP. The commercial bundling of IPTV, VoIP and Internet access is referred to as "Triple Play" service (when these three are offered with mobility, the service is referred to as "Quadruple Play"). IPTV is typically supplied by a service provider using a closed network infrastructure. This closed network approach is in competition with the delivery of TV content over the public Internet, called Internet Television. In businesses, IPTV may be used to deliver television content over corporate LANs.

In 1994, ABC's World News Now was the first television show to be broadcast over the Internet, using the CU-SeeMe videoconferencing software.

The term IPTV first appeared in 1995 with the founding of Precept Software by Judith Estrin and Bill Carrico. Precept designed and built an internet video product named "IP/TV". IP/TV was an MBONE compatible Windows

and Unix based application that moved single and multi-source audio/video traffic, ranging from low to DVD quality, using both unicast and IP multicast RTP/RTCP. The software was written primarily by Steve Casner, Karl Auerbach, and Cha Chee Kuan. Precept was acquired by Cisco Systems in 1998. Cisco retains the "IP/TV" trademark.

Internet radio company AudioNet started the first continuous live webcasts with content from WFAA-TV in January, 1998 and KCTU-TV-LP on January 10, 1998.

Kingston Communications, a regional telecommunications operator in UK, launched KIT (Kingston Interactive Television), an IPTV over DSL broadband interactive TV service in September 1999 after conducting various TV and VoD trials. The operator added additional VoD service in October 2001 with Yes TV, a provider VoD content. Kingston was one of the first companies in the world to introduce IPTV and IPVoD over ADSL.

In 2006, AT&T launched its U-Verse IPTV service, comprising a national head end and regional video-serving offices. AT&T offered over 300 channels in 11 cities with more to be added in 2007 and beyond. While using IP protocols, AT&T has built a private IP network exclusively for video transport.

## **Future**

In the past, this technology has been restricted by low broadband penetration. In the coming years, however, residential IPTV is expected to grow at a brisk pace as broadband was available to more than 200 million households worldwide in the year 2005, projected to grow to 400 million by

the year 2010. Many of the world's major telecommunications providers are exploring IPTV as a new revenue opportunity from their existing markets and as a defensive measure against encroachment from more conventional Cable Television services.

Also, there is a growing number of IPTV installations within schools, universities, corporations and local institutions.

## **IPTV Regulation**

Historically Broadcast TV has been regulated differently than Telecom and Internet. As IPTV allows TV and VOD to be transmitted over IP networks new regulatory issues arise.

## **Definition**

It is important to note that historically there have been many different definitions of "IPTV" including elementary streams over IP networks, transport streams over IP networks and a number of proprietary systems. Although (in Mid 2007) it is premature to say that there is a full consensus of exactly what IPTV should mean, there is no doubt that the most widely used definition today is for single or multiple program transport streams (MPTS) which are sourced by the same network operator or that owns or directly controls the "Final Mile" to the consumer's premises. This control over delivery enables a guaranteed quality of service, and also allows the service provider to offer an enhanced user experience such as a better program guide, interactive services etc.

The official definition approved by the International Telecommunication Union focuses on IPTV (ITU-T FG IPTV) as follows:

*"IPTV is defined as multimedia services such as television/video/audio/text/graphics/data delivered over IP based networks managed to provide the required level of quality of service and experience, security, interactivity and reliability."*

## **Markets**

While all major western countries and most developed economies have IPTV deployments, the world's leading markets for IPTV for now are France (led by Free, then Orange, then Neuf Cegetel; total of over 4 million subscriptions), South Korea (1.8 million subscriptions), Hong Kong, Japan, Italy, Spain, Belgium, China, Switzerland and Portugal. Services have also been launched in Slovenia, Croatia, Serbia, Montenegro, Scandinavia and, with two competing players, Iceland. The United Kingdom launched IPTV early but has been slow to grow. IPTV is just beginning to grow in Central and Eastern Europe, now it is growing in South Asian countries such as Sri Lanka and especially India. -but significant plans exist in countries such as Poland and Russia.

The first IPTV service to launch on the Chinese mainland sells under the "BesTV" brand and is currently available in the cities of Shanghai and Harbin.

## IPTV and Internet TV

A telco IPTV service is usually delivered over a complex and investment heavy walled garden network, which is carefully engineered to ensure bandwidth efficient delivery of vast amounts of multicast video traffic. The high network quality also enables easy delivery of high quality SD or HD TV content to subscribers' homes. This makes IPTV by default the preferred delivery platform for premium content. However the investment for a telco to build an end-to-end IPTV service can be substantial.

By contrast "Internet TV" generally refers to transport streams sent over IP networks (normally the Internet) from outside the network that connects to the users premises. An Internet TV provider has no control over the final delivery and so broadcasts on a "best effort" basis. Elementary stream over IP networks and proprietary variants as used by web sites such as YouTube are now rarely considered to be IPTV services.

Compared to telco IPTV, Internet TV is a quick-to-market and relatively low investment service. Internet TV rides on existing infrastructure including broadband, ADSL, Wi-Fi, cable and satellite which makes it a valuable tool for a wide variety of service providers and content owners looking for new revenue streams. However, due to the fact that IPTV is always delivered over low cost IP STBs, which have limited computing power, the capability for IPTV operators to provide diverse multimedia services is limited. This is where Internet TV has an advantage as it is delivered to a subscriber's (generally) powerful PC.

The relative ease of establishing an Internet TV service seems at first a threat to telco IPTV operators' multimillion-dollar investment, but both services do not necessarily compete for the same customers and there are some synergies between the two such as a common technology platform in the form of web-based technologies for content storage and delivery.

Broadcast IPTV has two major architecture forms: free and fee based. As of June 2006, there are over 1,300 free IPTV channels available. This sector is growing rapidly and major television broadcasters worldwide are transmitting their broadcast signal over the Internet. These free IPTV channels require only an Internet connection and an Internet-enabled device such as a personal computer, HDTV connected to a computer or even a 3G cell/mobile phone to watch the IPTV broadcasts. Various Web portals offer access to these free IPTV channels. Some cite the ad-sponsored availability of TV series such as *Lost* as indicators that IPTV will become more prevalent.

Because IPTV uses standard networking protocols, it promises lower costs for operators and lower prices for users. Using set-top boxes with broadband Internet connections, video can be streamed to households more efficiently than current coaxial cable. ISPs are upgrading their networks to bring higher speeds and to allow multiple High Definition TV channels.

IPTV uses a two-way digital broadcast signal sent through a switched telephone or cable network by way of a broadband connection and a set-top box programmed with software (much like a cable or DSS box) that can handle viewer requests to access to many available media sources.

Local IPTV, as used by businesses for Audio Visual (AV) distribution on their company networks is typically based on a mixture of : a) Conventional TV reception equipment and IPTV encoders b) IPTV Gateways that take broadcast MPEG channels and IP wrap them to create multicast streams.

## **Architecture of IPTV**

### **Architecture of a Video Server Network**

Depending on the network architecture of the Service Provider, there are two main types of Video Server architectures that can be considered for IPTV deployment, Centralized, and Distributed.

The Centralized Architecture model is a relatively simple and easy to manage solution. For example, as all contents are stored in Centralized servers, it does not require a comprehensive content distribution system. Centralized Architecture is generally good for a network that provides relatively small VOD service deployment, has adequate core and edge bandwidth and has an efficient Content Delivery Network (CDN).

A Distributed Architecture is just as scalable as the Centralized model, however it has bandwidth usage advantages and inherent system management features that are essential for managing a larger server network. Operators who plan to deploy a relatively large system should therefore consider implementing a Distributed Architecture model right from the start. Distributed Architecture requires intelligent and sophisticated content distribution technologies to augment effective delivery of multimedia contents over service provider's network.

### **Key Areas of an End-to-End IPTV Technology Solution**

When considering deploying a telco IPTV service, understanding the technical implications of delivering the solution should be of paramount

importance. Within the overall technical parameters of an IPTV service rollout, there are four key areas that need to be addressed to ensure a robust and scalable service delivery: content distribution, middleware, transport infrastructure and customer premise equipment.

The content distribution module contains live encoding platforms, video file repository and IPTV video servers which are the key elements enabling video feeds for an IPTV service.

In general, content distribution (in the headend), processing and adaptation are all part of the functions of a TV headend.

While the live video encoder and IPTV video server are conceptually considered to be part of the TV [headend], they not necessarily need to be placed at the same physical location. Multicast video sources are usually located at the top level of the core network for better bandwidth efficiency, whereas unicast IPTV video sources are commonly installed at the local PoP level to minimize core bandwidth usage.

## **IMS Architecture for IPTV**

There is a growing standardization effort on the use of the 3GPP IP Multimedia Subsystem (IMS) as an architecture for supporting IPTV services in carriers networks. Both ITU-T and ETSI are working on so-called "IMS-based IPTV" standards (see e.g. ETSI TS 182 027). The benefits of this approach are obvious. Carriers will be able to offer both voice and IPTV services over the same core infrastructure and the implementation of services combining conventional TV services with

telephony features (e.g. caller ID on the TV screen ) will become straightforward.

## **Protocols**

IPTV covers both live TV (multicasting) as well as stored video (Video on Demand VOD). The playback of IPTV requires either a personal computer or a set-top box connected to a TV. Video content is typically compressed using either a MPEG-2 or a MPEG-4 codec and then sent in an MPEG transport stream delivered via IP Multicast in case of live TV or via IP Unicast in case of Video on Demand. IP Multicast is a method in which information can be sent to multiple computers at the same time. The newly released (MPEG-4) H.264 codec is increasingly used to replace the older MPEG-2 codec.

In standards-based IPTV systems, the primary underlying protocols used are:

- Live TV uses IGMP version 2 for IPv4 for connecting to a multicast stream (TV channel) and for changing from one multicast stream to another (TV channel change).
- VOD is using the Real Time Streaming Protocol (RTSP).
- N-PVR (Network-based Personal Video Recorder) is also using the Real Time Streaming Protocol (RTSP).

Network Personal Video Recording is a consumer service where real-time broadcast television is captured in the network on a server allowing the end

user to access the recorded programs on the schedule of their choice, rather than being tied to the broadcast schedule. The NPVR system provides time-shifted viewing of broadcast programs, allowing subscribers to record and watch programs at their convenience, without the requirement of a truly personal PVR device. It could be compared as a "PVR that is built into the network" -- however that would be slightly misleading unless the word "Personal" is, of course, changed to "Public" for this context.

Subscribers can choose from the programmes available in the network-based library, when they want, without needing yet another device or remote control. However, many people would still prefer to have their own PVR device, as it would allow them to choose exactly what they want to record. This bypasses the strict copyright and licensing regulations, as well as other limitations, that often prevent the network itself from providing "on demand" access to certain programmes.

In Greece, On Telecoms offers an NPVR service to all subscribers in their basic package with all the programming of all major national Greek TV channels for the last 72 hours. The user has to sign in their contract that they agree that the company will record national programming of the last 72 hours FOR them so that they can come around any legal implications as this service would work like a personal PVR.

Currently, the only alternatives to IPTV are traditional TV distribution technologies such as terrestrial, satellite and cable. However, cable can be upgraded to two-way capability and can thus also carry IPTV.

## **Advantages**

The IP-based platform offers significant advantages, including the ability to integrate television with other IP-based services like high speed Internet access and VoIP.

A switched IP network also allows for the delivery of significantly more content and functionality. In a typical TV or satellite network, using broadcast video technology, all the content constantly flows downstream to each customer, and the customer switches the content at the set-top box. The customer can select from as many choices as the telcomms, cable or satellite company can stuff into the “pipe” flowing into the home. A switched IP network works differently. Content remains in the network, and only the content the customer selects is sent into the customer’s home. That frees up bandwidth, and the customer’s choice is less restricted by the size of the “pipe” into the home. This also implies that the customer’s privacy could be compromised to a greater extent than is possible with traditional TV or satellite networks. It may also provide a means to hack into, or at least disrupt the private network.

## **Interactivity**

An IP-based platform also allows significant opportunities to make the TV viewing experience more interactive and personalized. The supplier may, for example, include an interactive program guide that allows viewers to search for content by title or actor’s name, or a picture-in-picture functionality that allows them to “channel surf” without leaving the program they’re rewatching. Viewers may be able to look up a player’s stats while watching a sports

game, or control the camera angle. They also may be able to access photos or music from their PC on their television, use a wireless phone to schedule a recording of their favorite show, or even adjust parental controls so their child can watch a documentary for a school report, while they're away from home.

Not that this is all possible, to some degree, with existing digital terrestrial, satellite and cable networks in tandem with modern set-top boxes.

## VoD

VoD stands for Video on Demand. VoD permits a customer to browse an online programme or film catalogue, to watch trailers and to then select a selected recording for playback. The playout of the selected movie starts nearly instantaneously on the customer's TV or PC.

Technically, when the customer selects the movie, a point-to-point unicast connection is set up between the customer's decoder (Set Top Box or PC) and the delivering streaming server. The signalling for the trick play functionality (pause, slow-motion, wind/rewind etc.) is assured by RTSP (Real Time Streaming Protocol).

The most common codecs used for VoD are MPEG-2, MPEG-4 and VC-1.

In an attempt to avoid content piracy, the VoD content is usually encrypted. Whilst encryption of satellite and cable TV broadcasts is an old practice, with IPTV technology it can effectively be thought of as a form of Digital Rights Management. A film that is chosen, for example, may be playable for 24 hours following payment, after which time it becomes unavailable.

## **IPTVbasedConvergedServices**

Another advantage of an IP-based network is the opportunity for integration and convergence. This opportunity is amplified when using IMS-based solutions. Converged services implies interaction of existing services in a seamless manner to create new value added services. One good example is On-Screen Caller ID, getting Caller ID on your TV and the ability to handle it (send it to voicemail, etc). IP-based services will help to enable efforts to provide consumers anytime-anywhere access to content over their televisions, PCs and cell phones, and to integrate services and content to tie them together. Within businesses and institutions, IPTV eliminates the need to run a parallel infrastructure to deliver live and stored video services.

## **Limitations**

Because IPTV requires real-time data transmission and uses the Internet Protocol, it is sensitive to packet loss and delays if the streamed data is unreliable. Also exist some problems of delays when the user decides to switch the channel (zap time). If the IPTV connection is not fast enough, picture break-up or loss may occur. This problem has proved particularly troublesome when attempting to stream IPTV across wireless links. Improvements in wireless technology are now starting to provide equipment to solve the problem. Because of its high latency satellite Internet Access is not ideal for IPTV. This is due to the long distance the data has to travel from the sender, to the satellite and then back to earth. A cable, DSL, or FiOS internet connection more suitable for IPTV.

## Vendors

A small number of companies supply most current IPTV systems. Some, such as Imagenio, were formed by telecoms operators themselves, to minimise external costs, a tactic also used by PCCW of Hong Kong. Some major telecoms vendors are also active in this space, notably Alcatel-Lucent (sometimes working with Imagenio), Ericsson (notably since acquiring Tandberg Television), NEC, Thomson, Logic Innovations, and ZTE, as are some IT houses, led by Microsoft. California-based UTStarcom, Inc., Tennessee-based Worley Consulting and Tokyo-based The New Media Group also offer end-to-end networking infrastructure for IPTV-based services, and Hong Kong-based BNS Ltd. provides turnkey open platform IPTV technology solutions. Global sales of IPTV systems exceeded 2 billion USD in 2007.

Many of these IPTV solution vendors participated in the biennial Global MSF Interoperability 2008 (GMI) event which was coordinated by the MultiService Forum (MSF) at five sites worldwide from 20- to 31-October 2008. Test equipment vendors including Empirix, Ixia, Mu Dynamics and Spirent joined solution vendors such as the companies listed above in one of the largest IPTV proving grounds ever deployed.