An Introduction To IPTV

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Television is changing

Over the last decade, the growth of satellite service, the rise of digital cable, and the birth of HDTV have all left their mark on the television landscape. Now, a new delivery method threatens to shake things up even more powerfully. Internet Protocol Television (IPTV) has arrived, and backed by the deep pockets of the telecommunications industry, it's poised to offer more interactivity and bring a hefty dose of competition to the business of selling TV.

IPTV describes a system capable of receiving and displaying a video stream encoded as a series of Internet Protocol packets. If you've ever watched a video clip on your computer, you've used an IPTV system in its broadest sense. When most people discuss IPTV, though, they're talking about watching traditional channels on your television, where people demand a smooth, high-resolution, lag-free picture, and it's the telcos (telecommunication companies) that are jumping headfirst into this market. Once known only as phone companies, the telcos now want to turn a "triple play" of voice, data, and video that will retire the side and put them securely in the batter's box.

In this primer, we'll explain how IPTV works and what the future holds for the technology. Though IP can (and will) be used to deliver video over all sorts of networks, including cable systems, we'll focus in this article on the telcos, which are the most aggressive players in the game. They're pumping billions into new fiber rollouts and backend infrastructure (AT&T alone inked a US$400 million deal for Microsoft's IPTV Edition software last year, for instance, and a US$1.7 billion deal with hardware maker Alcatel). Why the sudden enthusiasm for the TV business? Because the telcos see that the stakes are far higher than just some television: companies that offer the triple play want to become your household's sole communications link, and IPTV is a major part of that strategy.

How it works

First things first: the venerable set-top box, on its way out in the cable world, will make a resurgence in IPTV systems. The box will connect to the home DSL line and is responsible for reassembling the packets into a coherent video stream and then decoding the contents. Your computer could do the same job, but most people still don't have an always-on PC sitting beside the TV, so the box will make a comeback. Where will the box pull its picture from? To answer that question, let's start at the source.

Most video enters the system at the telco's national headend, where network feeds are pulled from satellites and encoded if necessary (often in MPEG-2, though H.264 and Windows Media are also possibilities). The video stream is broken up into IP packets and dumped into the telco's core network, which is a massive IP network that handles all sorts of other traffic (data, voice, etc.) in addition to the video. Here the advantages

of owning the entire network from stem to stern (as the telcos do) really come into play, since quality of service (QoS) tools can prioritize the video traffic to prevent delay or fragmentation of the signal. Without control of the network, this would be dicey, since QoS requests are not often recognized between operators. With end-to-end control, the telcos can guarantee enough bandwidth for their signal at all times, which is key to providing the "just works" reliability consumers have come to expect from their television sets.

The video streams are received by a local office, which has the job of getting them out to the folks on the couch. This office is the place that local content (such as TV stations, advertising, and video on demand) is added to the mix, but it's also the spot where the IPTV middleware is housed. This software stack handles user authentication, channel change requests, billing, VoD requests, etc.—basically, all of the boring but necessary infrastructure.

All the channels in the lineup are multicast from the national headend to local offices at the same time, but at the local office, a bottleneck becomes apparent. That bottleneck is the local DSL loop, which has nowhere near the capacity to stream all of the channels at once. Cable systems can do this, since their bandwidth can be in the neighborhood of 4.5Gbps, but even the newest ADSL2+ technology tops out at around 25Mbps (and this speed drops quickly as distance from the DSLAM [DSL Access Multiplier] grows).

So how do you send hundreds of channels out to an IPTV subscriber with a DSL line? Simple: you only send a few at a time. When a user changes the channel on their set-top box, the box does not "tune" a channel like a cable system. (There is in fact no such thing as "tuning" anymore—the box is simply an IP receiver.) What happens instead is that the box switches channels by using the IP Group Membership Protocol (IGMP) v2 to join a new multicast group. When the local office receives this request, it checks to make sure that the user is authorized to view the new channel, then directs the routers in the local office to add that particular user to the channel's distribution list. In this way, only signals that are currently being watched are actually being sent from the local office to the DSLAM and on to the user.

No matter how well-designed a network may be or how rigorous its QoS controls are, there is always the possibility of errors creeping into the video stream. For unicast streams, this is less of an issue; the set-top box can simply request that the server resend lost or corrupted packets. With multicast streams, it is much more important to ensure that the network is well-engineered from beginning to end, as the user's set-top box only subscribes to the stream—it can make no requests for additional information. To overcome this problem, multicast streams incorporate a variety of error correction measures such as forward error correction (FEC), in which redundant packets are transmitted as part of the stream. Again, this is a case where owning the entire network is important since it allows a company to do everything in its power to guarantee the safe delivery of streams from one end of the network to the other without relying on third parties or the public Internet.

Though multicast technology provides the answer to the problem of pumping the same content out to millions of subscribers at the same time, it does not help with features such as video on demand, which require a unique stream to the user's home. To support VoD and other services, the local office can also generate a unicast stream that targets a particular home and draws from the content on the local VoD server. This stream is typically controlled by the Real Time Streaming Protocol (RTSP), which enables DVD-style control over a multimedia stream and allows users to play, pause, and stop the program they are watching.

The actual number of simultaneous video streams sent from the local office to the consumer varies by network, but is rarely more than four. The reason is bandwidth. A Windows Media-encoded stream, for instance, takes up 1.0 to 1.5Mbps for SDTV, which is no problem; ten channels could be sent at once with bandwidth left over for voice and data. But when HDTV enters the picture, it's a different story, and the 20-25Mbps capacity of the line gets eaten up fast. At 1080i, HDTV bit rates using Windows Media are in the 7 to 8 Mbps range (rates for H.264 are similar). A quick calculation tells you that a couple of channels are all that can be supported.

The bandwidth situation is even worse when you consider MPEG-2, which has lower compression ratios. MPEG-2 streams will require almost twice the space (3.5 Mbps for SDTV, 18-20 Mbps for HDTV), and the increased compression found in the newer codecs is one reason that AT&T will not use MPEG-2 in the rollout of its IPTV service dubbed "U-verse."

Simultaneous delivery of channels is necessary to keep IPTV competitive with cable. Obviously, multiple streams are needed to support picture-in-picture, but they're also needed by DVRs, which can record one show while a user is watching another. For IPTV to become a viable whole-house solution, it will also need to support enough simultaneous channels to allow televisions in different rooms to display different content, and juggling resulting bandwidth issues is one of the trickiest parts of implementing an IPTV network that will be attractive to consumers.

What's in it for me?

If IPTV was simply a way for telcos to enter the video delivery game, it would be an attractive service just for the increased competition. A recent FCC study showed that cable rates increased at more than 3.5 times the rate of inflation between 1998 and 2003—but in the few places where cable faces competition from another wireline provider, prices are substantially lower than the average. The increased competition provided by the telcos will no doubt drive prices down further, as has already happened in Texas (where several telco TV projects are undergoing trials).

Apart from the effect on the competitive landscape, though, IPTV has the potential to deliver more interactivity than cable. An all-IP solution is switched digital by nature, does not depend on shared bandwidth, and uses well-known Internet technology, which should make for some interesting applications. Expect to see caller ID information displayed on the screen when your phone rings, for instance, or alerts when you receive new e-mail. Because IPTV does not require expensive tuners, multiple picture-in-picture applications will become a reality, and DVRs will be able to record multiple shows at once without upping the cost of the unit (the main constraint will be bandwidth). An interactive program guide, pay-per-view functionality, and video on demand will all be standard features, and channel changes should be much quicker.

Because the set-top boxes will use Ethernet and IP, they should be simple to integrate into the existing home network, which includes a user's computer. STBs will be able to pull video and pictures from a home PC and display them on the television, and will also be able to easily network with other STBs on other televisions throughout the house. This will allow a user to own a single DVR that can be controlled from any set in any room.

IPTV: here at last

The promise of IPTV has been, well, *promised* for some time now, but it really is just around the corner. In the US, AT&T (formerly SBC) is in the midst of its Project Lightspeed, a 40,000-mile fiber rollout. The company is dropping US$4 billion on upgrading its network, though unlike Version's FiOS service, the fiber will generally not run all the way to the home. As the rollout continues, the company will introduce its U-verse IPTV service, which is currently undergoing live trials in Texas.

Speaking of Verizon, they already offer 300+ channels of television service. It's not delivered over DSL, but by fiber strung directly to the home. They are also in the process of a multi-billion dollar network upgrade and have the jump on AT&T, having already laid fiber to three million homes at the end of 2005. Running fiber to the home gives them incredible bandwidth and allows them to stream all channels at once; out of the 4.5Gbps available on the fiber, only 3.5Gbps are taken up with TV. (Though they plan to transition to a full-IP network in the future, FiOS TV is currently RF [radio frequency] based, except for video on demand, which uses IP.)

Prior to being acquired by AT&T, BellSouth had jumped on the fiber train early and has already rolled out more than five million miles of the stuff while preparing its own IPTV trials. Like both AT&T and Verizon, BellSouth was testing Microsoft's IPTV software; with AT&T swallowing up BellSouth, it looks as though the software giant may become the main provider of IPTV backend software in the US.

One potential roadblock to these rollouts could be franchise agreements, the licenses that most companies need from a municipality to offer television service. Cable companies have had decades of negotiating practice with cities, but it's a new world for the telcos, who have found the process to be excruciatingly slow (and costly). Verizon, for instance, calls the agreements "a major barrier to entering the video market on a wide scale" and claims that the cable industry has done its best to use franchise agreements to trip up the telcos.

The telcos have lobbied both the FCC and state legislatures to make changes to the rules governing these agreements, and it appears that some states, at least, are cooperating. Texas recently passed a law allowing the telcos to negotiate a franchise agreement with the entire state at once instead of with every separate community, and Verizon told the FCC that this had provided extra incentive for the company to conduct some trials in the state. AT&T, for its part, has publicly taken the stance that they don't actually need a franchise license since they are essentially delivering an IP-based data service, not a video signal, and thus are not subject to the franchising rules. This could be a costly decision if the FCC thinks differently, but it could also save them a lot to time, money, and energy if their strategy gets an official thumbs-up.

The big loser here could be satellite, which has been providing the video portion of the telcos' offerings for nearly a decade. With the telcos going into the TV business for themselves, satellite will need to find a compelling way to offer both VoIP and data services along with its traditional video signal in order to remain competitive. (DirectTV, in particular, has been mulling a move to WiMAX technology to remain competitive.) Fortunately for them, satellite companies currently control just over 30 percent of the pay TV market, which should give them some breathing room when the telcos deploy IPTV systems in force.

Another approach to IP-based video comes from web companies who do not necessarily own the complete network infrastructure, but who plan to offer IPTV services over the public Internet. AOL has already

announced its plan for a service dubbed In2TV that will stream ad-supported programming to users over the 'Net, and companies like Apple and Google already offer what are essentially IP-based video on demand services. Though such efforts typically rely on a computer to display the content, it would definitely be possible to roll out set-top boxes so that consumers could watch the programming on their own televisions. The idea's not quite as crazy as it sounds—Atlanta-based Dave.tv is currently in the process of producing its own box and plans to offer TV services right over the Internet. Such a move could leapfrog the traditional networks, but it faces problems.

The obvious challenge to this business model comes from being a "broadcaster" without a network, which means that users need to bring their own access and that content is delivered over networks owned by the telcos or cable providers (in most cases). Both groups have begun making noise about "tiered pricing" schemes, and you can expect them to push the idea even harder as increased amounts of video stream through "their pipes." Any company serious about providing their own IPTV service would no doubt ante up, since consumers are unlikely to subscribe to a TV service that suffers from bandwidth bottlenecks or other inconsistencies.

Time for a triple play

How big will the IPTV market be? Multimedia Research Group estimates that IPTV subscribers will balloon from 3.7 million in 2005 to 36.9 million by 2009 (worldwide), with Europe leading the market. The industry's revenues could reach nearly US$10 billion by that time—no small chunk of change. Still, the battle is for more than just your television; it's a struggle for the single entry point into your home.

The so-called "triple play" of voice, video, and data is currently a holy grail for the telcos, who need to compete with the cable companies, which already offer all three services. With both telcos and cable providers offering the triple play, it's likely that consumers will soon need only a single data pipe flowing into their home (and bundle discounts will ensure that this is the cheapest way to do things). Whichever pipe that turns out to be—cable or telephone line—will mean big money for the company that owns it.

IPTV provides the missing piece that the telcos need, but the cable companies, for their part, are talking tough. "AT&T is spending years and billions of dollars to imitate a network that Comcast has already built," said spokesman Andrew Johnson. "We've seen nothing... that we can't exceed." Despite the posturing, both industries see this as an important transition time during which they need to sell customers on the merits of one-stop shopping for their communication and entertainment needs. Hopefully, the battle of words will soon give way to the price war that satellite could not fully spark, in which case IPTV, if it does nothing else, will have succeeded.