TEXAS INSTRUMENTS

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Driving IPTV Growth:
The Challenges and Perspectives

Introduction

To meet competitive challenges and tap into new growth opportunities, carriers of all kinds are aggressively striving to become Complete Digital Service Providers (CDSP) for their end customers. To achieve that goal, telecommunications service providers are shifting their networks to Broadband Internet Protocol (IP) infrastructures. These networks enable telecommunications operators to provide their customers with IP-based television (IPTV) services and a myriad of next-generation IP-based services that end users are sure to incorporate into their increasingly digital lifestyles.

Telcos must deploy IPTV networks to evolve into CDSPs and ward off advanced services their competitors are beginning to offer, including "triple play" voice, data and video services. By adding IPTV to their service portfolios, telcos are more likely to retain customers who might otherwise turn off landlines and obtain voice, high-speed Internet and television services from cable MSOs, satellite providers or ISPs.

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In addition to customer retention, deploying networks that support IPTV allows telcos to gain market share and streamline business operations. They can use these networks to target the entire customer environment and optimally distribute functionality and intelligence in the form of consumer-friendly services throughout end users' homes. IPTV's flexibility is key, as it will enable telcos to transport multiple services on a single network architecture, mix and match services on a per customer basis and send customers a single bill.

Specifically, IPTV networks with sufficient service management capability will allow service providers to customize services to a customer's preference, including different data rates, channel line-ups and modes of distribution, such as high-definition TV (HDTV), broadcast TV (BTV), video on demand (VOD) and personal video recorder (PVR).

IPTV's flexibility will also enhance the end users' experience, which must include simple set-up and installation, excellent reliability and quality of service (QoS). Service providers' IPTV networks also must deliver:

- End-to-end service management
- Support for multiple devices in the home
- Services integration with customers' home networks and end devices
- Security

IPTV To Date

Early IPTV deployments demonstrate that significant business and technical challenges must be overcome to ensure the application is compelling to end users and competitive with cable and satellite offerings.

Experiences of the past decade have proven "me too" services are unlikely to yield profitable penetration rates. This is especially true in already saturated pay TV markets, or in markets lacking a strong pay TV presence. To steal market share from existing pay TV operators, CDSPs must leverage the technology's unique capabilities—interactivity, personalization and interoperability—to provide service level differentiation.

When deploying IPTV networks, telcos will use expertise gained from delivering digital services over their infrastructures from years past to address several gating technical challenges. First is the fact that their current broadband access networks may not support the extreme demands and dynamic nature of next-generation video services. Upgrades to ADSL2+ or fiber to the node/premises (FTTN/ FTTP) will likely be required. Once access network issues are resolved, in-home wiring at the customer premises can introduce a new bottleneck to high-bandwidth, IP-based services.

Though demand for, and deployment of, the technology is robust, IPTV is a relatively immature technology. Many standards remain under development, and no single vendor is able to provide carriers with interoperable, end-to-end IPTV solutions. Adding to the challenge, many complex networking and service issues will need to be solved during deployment of commercial service, rather than beforehand. This is because intensive testing will not resolve all the possible technical issues that carriers and end users will encounter.

Realizing IPTV is vital to their survival, telcos must address the issues. First, telcos must systematically consider the various sources of differentiation that IPTV provides. Second, they must design a clear service roadmap for deployment, and work through the technology and business implications that arise during the process.

After building field force organizations and provisioning models to enable the profitable delivery of video services, service providers then must prepare their networks, operations support systems (OSS) and employees to meet the fundamentally different demands of the IPTV environment. In most cases, carriers will need to retool back offices to deliver the sophisticated subscriber and session management required to support delivery of high-quality video services.

To succeed in their IPTV efforts, CDSPs must devise a method to measure and meet consumer preferences. According to the McKinsey Group, they can meet consumers' needs by focusing their efforts on the five categories listed:

- *Differentiated content* can be delivered in the form of content that was previously unavailable to customers, such as international or multilingual channels, new formats such as HDTV, exclusive sporting events or movies, and repackaged content.

- *Interactivity* can be fostered in the form of games, virtual storefront or multimedia communications between people and people, people and devices or devices and devices.

- *Interoperability* will manifest itself via multimodal access to the IPTV voice, video and data stream at the customer premises, as well as away from it. The ability to access both personal and public content across multiple types of end devices and other wired and wireless networks is key.

- *Innovative* hardware will include home gateways and set-top boxes (STB) that are integrated with one another and with TV sets, appliances, game consoles, PCs, lap tops, network storage devices, cell phones and a host of devices that do not yet exist. New peripherals such as keyboards, cameras, etc., will be connected or attached to the IPTV in-home network and viewing device. Remote controls that tie multiple devices together and offer enhanced usability of new content and services will add value to the IPTV experience.

- *Personalized* content will proliferate as IPTV matures. It will range from customized channels and services for each end user in the home to advertising targeted at each end user. There also will be growing demand for, and consumption of, micro-market content such as personally produced audio, video or still images targeted at specific communities of interest. Video blogs and PodCasts represent the first wave of this trend.

To date, those service providers that have offered IPTV have found that the application its consumers are most interested in, and willing to pay for, is TV programming. More importantly, they have found IPTV needs to work as well as, or better than, existing TV services. Carriers also have learned that interactive, on-demand services provide a means for differentiation and a way to increase customer loyalty.

However, while bundling of triple play services is a strong weapon in CDSP's arsenals, it can also be their Achilles' heel. Service providers that fail to ensure quality of even one of the bundled elements will experience a 60 percent higher churn rate from affected customers. Simply put, if IPTV service is not stable, customer churn is extremely high.

Other lessons learned include the fact that STB cost is key to a successful and profitable IPTV strategy. The cost is driven by the complexity of the STB's software, the applications, and the hardware specifications. Separating the head-end supplier, the

conditional access system, the STB, and the middleware are key to an open architecture and help to create a low-cost base for future innovation. In addition, content costs and contract subtleties that service providers negotiate have a significant impact on service profitability.

Great Expectations

It is at the customer premises where the access network complexities meet complications of the residential gateway and the multiple end devices and/or home networks connected to it. At the residence, technology must adapt to the home environment rather than the reverse. The home environment may extend to vacation homes, boats, motor homes, etc. This is because consumers will look for access to information, entertainment and communications they have come to rely on at home, even while they are on the road. Mobile consumers should be able to access storage on their residential gateways at a minimum, if not other devices at the customer premises.

Critical to achieving these goals is the IPTV service providers' ability to integrate their access networks and IPTV services into home networks and the growing list of end devices attached to them.

According to TDG Research, in the U.S. there are typically five networked devices per home. Multiply this by 50 million networked homes in 2010 and you have more than 250 million networked devices. Globally, the number of networked households will reach 162 million, with more than 973 million networked devices by 2010.

	2004	2005	2006	2007	2008	2009	2010
# Networked Households (M)	34.7	57.6	75.8	97.3	122.8	142.7	162.3
# Connected Devices (M)	107.6	195.8	288.0	437.9	638.6	799.1	973.8
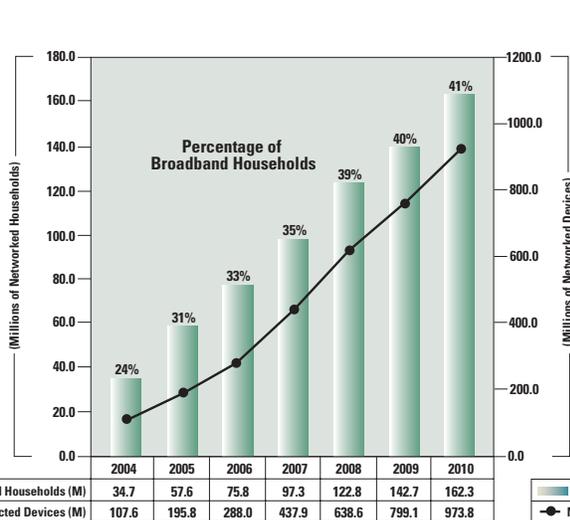
Global Home Network Deployments and Networked Devices
Source: 2005 TDG Research, 6_05 iSuppli

5 Networked Devices per Home x 50 Million Networked Homes = 250 Million Networked Devices

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Networked Households (#M)	6.0	8.7	12.5	18.4	25.2	29.8	34.6	39.5	43.3	47.1
Networked Households (%HH)	5.7%	8.2%	11.7%	17.0%	23.0%	27.0%	31.0%	35.0%	38.0%	41.0%
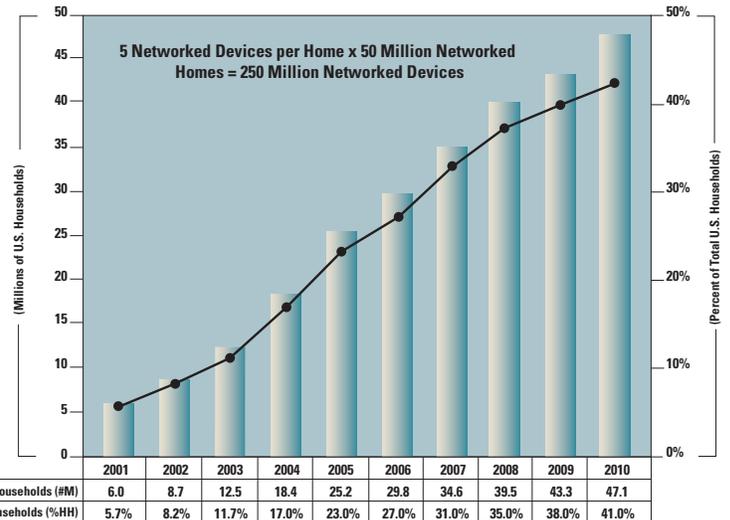
Trends in Network Adoption – U.S.
Source: 2005 TDG Research

For IPTV to flourish, service providers must guarantee quality from end-to-end. This is made more difficult by the variables introduced due to home networks and the numerous devices that are connected within.

What's New?

As mentioned above, telcos are promising, and consumers are expecting something new from IPTV. At the very least, they expect it to support HDTV, VOD, and PVR.

While HDTV and VOD are table stakes, PVR is a capability that CDSPs can use to differentiate themselves. PVR allows end users to time-shift, and perhaps even place-shift their TV viewing. CDSPs can differentiate PVR in terms of programmability and storage capability. First, telcos will decide whether it is in their best interest to store video locally on the residential gateway, on the STB, or on the network. It is important to note that decisions regarding where content can be stored may be influenced by legal restrictions imposed by content providers.

A network storage environment will likely provide more storage than what is available today on existing PVR devices. It will better support time/place-shifted applications, and enable end users to view selected programs at the time and place of their choosing. With network-based storage, when an end user wants to watch an HBO program, he or she can select it from the server and watch on demand, instead of setting a PVR to record, and then queuing the program from the hard drive when ready to watch.

While programmability is rudimentary today, ultimately, the goal is to enable PVRs to be programmed completely based on user preferences. The ability to partition a single PVR for use by multiple members of the household could be of interest as well. Telcos do not want to play a pricing game, so a variety of PVR options would allow them to offer capabilities beyond those that are available today.

Regardless of where PVR storage is ultimately placed, STBs will offer some sort of storage capability. As the need for storage increases, it will likely migrate to the stand-alone storage devices in the home and eventually shift to network-based storage. Home-based personal storage devices will become more and more popular as prices for storage continue to plummet and as consumers accumulate more and more data, photos and videos to archive.

Another challenge at the customer premises is that consumers are looking for content portability. CDSPs must be able to distribute IPTV streams to all TV sets (or any type of viewing device the future may bring) in the home. They also must be able to deliver IP-based services to multiple devices such as PCs, portable MP3 players, video recorders, etc., throughout the home.

This means all the features and functionality offered by IPTV should be available on any TV or device in the home. Service providers can expect end users to connect a growing number of devices to their home networks including cameras, network storage devices, printers, wireless networks, and portable music players. They also can expect in-home networks to increasingly become a network of networks.

Making IPTV delivery throughout the home even more compelling, yet complex at the same time, are "breakthrough" capabilities such as interactivity and personalization. Service providers can expect both to catch on like wildfire with consumers. As soon as one service provider introduces these capabilities, consumers served by the competition will desire and demand them from their IPTV providers.

Because IP enables interactivity, there are more and more applications, such as peer-to-peer gaming applications and voice-over IP (VoIP) phones, coming to market that lend themselves to the two-way flow of information. This means more symmetrical usage of bandwidth on the home network and across the wide area IPTV network.

When service providers give consumers the opportunity to personalize IPTV to meet their individual needs, the service becomes more interesting. Personalization means user programmability, and needless to say, programmability becomes more complex as the home network serves a dynamic and increasing number of individuals. The home network should give each end user the ability to build a personal profile that with personal preferences, and help to record, discard and load content to any devices or personal storage systems of his or her choice. Programmability also enables parental controls to be accessed, sculpted and implemented.

It is worth noting that CDSPs are serving different "technical and cultural IQ's" in each home. For adults still stymied by the blinking VCRs of years past, programmability of the IPTV home network will need to be very user friendly. However, their children and young adults, who are more technologically adept, will be capable of, and less averse to, more complexity when it comes to personalizing and programming their IPTV services and end devices. Operators might well benefit by making it possible to offer a higher level of complexity to those who feel they have the aptitude, enabling them to do more with their services.

No Place Like Home

Currently at the customer premises, IPTV providers rely on a basic two-box solution—a residential gateway and STB. The residential gateway feeds the STB via CAT 5 cable, Ethernet, HPNA, Home Plug or MOCA connections. The connection used is determined by the service providers' end goals.
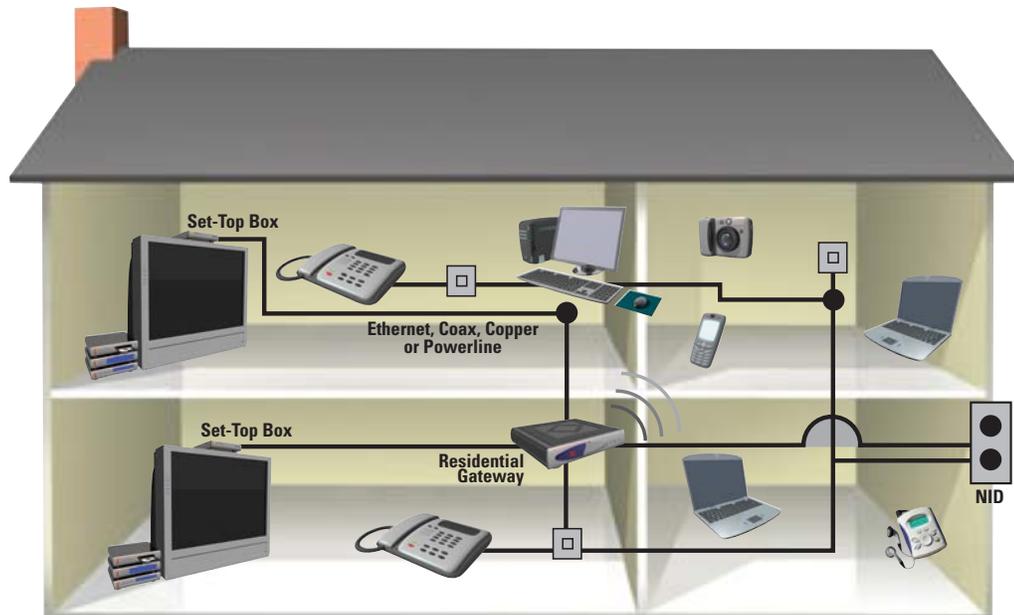
Basic Two-Box Solution

To optimize their IPTV networks' revenue potential CDSPs need a multiroom home networking solution that:

- Enables all TVs in the household to share a common PVR. Differentiation could be established by offering customers partitioning of the PVR or personal/ partitioned PVRs.
- Provides high-quality video reliably and securely to every room in the house and enables parental controls to be enforced throughout the household.
- Provides a quality HDTV signal and an upgrade path to meet the needs of all the potential HDTVs that could be added to the home during several years' time.
- Delivers interactivity and personalization throughout the home. It is likely personalization will need to be portable from room-to-room.

Service providers should factor in installation costs of home networking solutions, and costs to expand throughout the home as families evolve and needs change accordingly. Carriers should keep in mind new services will likely foster new requirements for the home networking solution, so flexibility is key. Therefore, service providers that build remote diagnostic and management controls into their IPTV networks will benefit greatly from their investments.

When developing a home networking strategy, there are many questions that telcos should ask themselves before they deploy their IPTV networks:

- Can the data and video services they plan to offer be delivered on separate networks or can they be combined in the same IP data flow using QoS extensions?
- While "no new wires" home networking solutions offer simplicity, are they robust enough to support QoS for single or multiple video streams?
- Will the home networking solution they operate from a central point of control or will it use peer-to-peer networking to communicate between devices?
- And, as new services are introduced, what is the strategy for adding, monitoring and managing new devices connected to the network over time?

When it comes to content, service providers must ensure content can be transported throughout the home seamlessly and securely. Consumers should be able to access and "play" the content they want, on the device they want, without knowing where the content is located, the format of the content or the playback capabilities of the device they are using. While complexity should be masked from consumers wherever possible, this must be done without sacrificing the consumers' ability to use the content in the manner they choose to use it, share it, send it or store it.

CDSPs can use different methods to deliver programming to end devices. A streaming codec such as RealNetworks or Microsoft® Windows Media® Player can be used, as can an STB connected to a central head-end via a DSL connection. Another method employs a cable STB using a DOCSIS two-way communication path to deliver a compliment of on-demand programming. In the wireless realm, service providers are looking to WiMAX equipment to transport IPTV signals. It is important to consider how different delivery options will fit with home networking solutions.

Semiconductor Building Blocks

The chips used in home network gateways and devices are key to bringing IPTV service definition to fruition. While the IP network is digital, human senses are analog. It is important to remember that the entertainment and information that flows through digital IPTV networks is ultimately consumed by analog senses. Digital signal processing is the best, most cost-effective method of traversing the many analog-to-digital/digital-to-analog conversions that take place along that path without losing integrity on either side or adding cost to the network in the form of additional components.

Using a system on a chip (SoC) approach integrates the necessary hardware into fewer boxes. The SoC enables software to be used to build-in the capabilities and hooks that allow the middleware to deliver programmability, interactivity and personalization that service providers use to differentiate their IPTV services from their competition.

As chip technology matures, the software component on the chip is getting bigger and bigger. Texas Instruments (TI) provides its OEM customers with silicon solutions they can program to suit their particular needs. TI also provides the complete reference platforms that enable OEMs to simulate router, WiFi and video coding/encoding functions.

Aside from the outer shell and LEDs of home networking devices, the semiconductor solution is actually the whole product. It is crucial that chip manufacturers understand the home networking device's system architecture and building blocks to tie them all together to integrate the desired functionality. In addition, the boxes need I/Os to support plug-and-play operation for connection to other devices. The DSL modem/router, wireless router or RF device can be placed on separate chips, or they can be integrated onto a single chip along with the complimentary software. The chip supplier also provides the codecs for the STB.

Using appropriate APIs, the OEMs make the chip's functionality presentable to the end user. The user's name, MAC address and Web security functions are programmed into the Digital Signal Processor (DSP).

System-Level Approach

Modularized DSPs can be built into more complex components for application-specific uses in consumer electronics equipment and other devices. By distributing programmable devices around the IPTV infrastructure, customer premises and mobile environments, software can be used to extend and upgrade the entire networked system without requiring the replacement of dedicated resources over time.

The flexibility of application-specific approaches to chip design requires that designers understand systems at a much higher level than a single component of the system. Systems-level performance is the goal, but it can actually be compromised by the performance of individual components. Therefore, systems-level thinking is critical for today's technology providers. It is no small task to partition a system for maximum performance in today's networks and also provide for software extensions that will be used tomorrow.

To build flexible common architectures that deliver services wherever the consumer resides requires knowledge of the technology deployed in the total IPTV solution. Broad IP portfolios covering all the pieces of these solutions are necessary for the implementation speed and reliability in the ultimate solution.

Service providers will deliver services through all-fiber, or hybrid fiber/copper/coax access wired and wireless architectures to multiple end devices. As complete solutions are developed and introduced, the carriers' ability to mix and match today's technologies is critical to their evolution as CDPS. Service providers and their technology suppliers must

understand this and provide a framework for how their individual approaches to IPTV deployment and service creation will enhance the evolution to a broad-based operator network.

Reaching consumer level price points as quickly as possible is key to IPTV's sooner-rather-than-later uptake by subscribers. Unfortunately, high volume manufacturing is not an option. This is because reaching these price points is not a simple matter of counting chips when digital and analog transmitters meet on the same piece of silicon.

Instead, the manufacturing process is intimately linked with the design of mixed-signal chips. Quality and reliability require a delicate balance between the engineering and manufacturing realms. To extend a given architecture into the future, technology providers must have a clear roadmap that maintains exacting tolerances, and they must be conceptualized and implemented with a holistic view of design and manufacturing, rather than a fragmented view. Quality and reliability control of mixed-signal devices are possible only when designers have full control of each step in the process.

Because the name of the game in IPTV is the introduction of new services, the process of introducing new services must not disrupt or hinder performance of operators' existing network operations. As the number of services increase, compatibility of these services becomes more important. Technology providers must have complete respect for a service providers' infrastructure, including allocated resources to ensure the infrastructures' integrity. They must go beyond simple compliance with industry standards, and be willing to drive new standards, which will enable CDSPs to grow their influence in their customers' digital lifestyles.

While the global consumer market is enormous, it is highly diverse and consists of many cost-sensitive segments. As new services move from trials to mass deployment, cost will be of paramount concern. Therefore, cost leadership is not only limited to the bill of materials (BOM), but also involves operating costs such as maintenance and extensibility. Smart designs, smart business models and economies of scale will enable new cost points, new markets and better margins for cost-focused service providers.

To build, manage and extend new services (i.e., moving storage to the residential gateway and accessing e-mail from any screen in the home), intelligence must be distributed appropriately throughout wide area networks and home networks. Service providers need integrated management tools that enable them to effectively mold IPTV services and technology into their customers' lifestyles, and digital intelligence will allow remote management without compromise.

The 'Anytime, Anywhere' Vision

In the scheme of offering anytime, anywhere communications and entertainment to consumers, IPTV is a given. Service providers that intend to lead by delivering new services to the consumer are now currently making plans to deploy IP networks and use them to deliver IP-based television. Those networks also will deliver emerging IP-based services that offer end users personalization, interactivity and interoperability, and in doing so, make it possible for CDSPs to differentiate their service offerings from one another.

While deploying the access networks that deliver IPTV video services to the customer premises is getting most of the attention today, routing the signal throughout the home to residential gateways, STBs and multiple devices poses a significant challenge to service providers. Home networking will play a critical role in service differentiation.

Truly, customers do not care how the services are delivered to the customer premises. But they do care very much about what happens inside their homes. As a result, service providers are working very hard to develop flexible, feature-rich, high-quality home networking solutions that will enable them to fulfill the anytime, anywhere vision in a way that compels existing customers to remain loyal and, at the same time, beckons new customers to come aboard.

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