Streaming IP Media And Its Impact On The Digital Set-Top

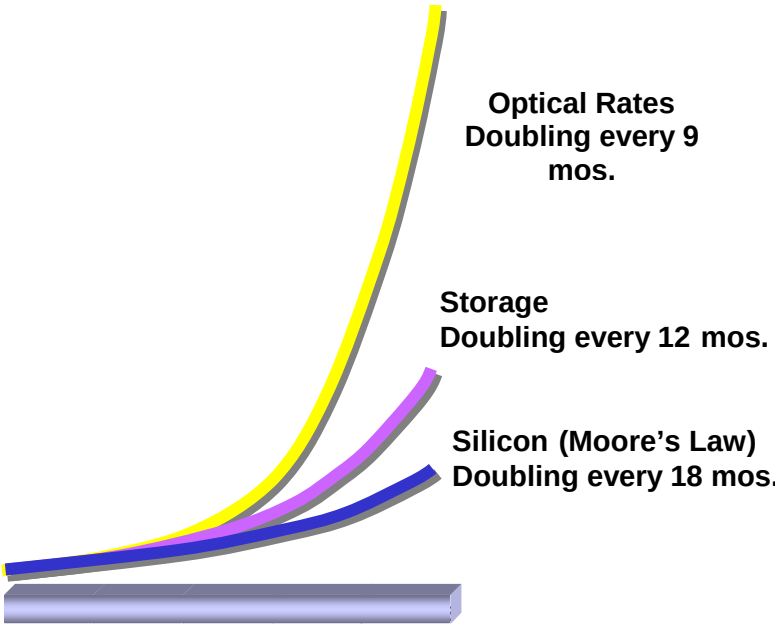
William E. Wall
Scientific-Atlanta Subscriber Sector

It's now clear that packet-based communications — using the global MPEG transport standard for downstream video transport and IP for data transport and interactive communications — will be the fundamental enabler of multiple communications media (video, data and voice) by a single broadband delivery network. This combination of bandwidth and open technology gives cable operators an unmatched competitive advantage, creating a network which is, in essence, a giant "hard drive" loaded with executable applications, all ready to be called at any time by any connected set top.

Bandwidth Explosion

What has been the catalyst behind packet's rapid emergence? For 20 years, the industry has been part of a rapidly escalating technology revolution, culminating in a "bandwidth explosion" that has altered forever the types of services we can now offer to our customers. Just consider the reductions in size and cost of computer chips that have occurred; with the corresponding exponential improvements in memory, processing and graphics power.

Together, these innovations have caused a huge "pull" from client side because all this power is creating demand for new bandwidth-intensive applications and services. So too has there been a "push" from the backbone side. Network servers have become much more affordable and powerful. Fiber is now deployed throughout the network, and it too has increased dramatically in capacity. All in all, the broadband pipeline today is truly primed to handle the flow.



Source: Lucent

Up to this point the bottleneck has occurred within the access portion of network — the last mile and the set-top at the home. However, with the lower cost of silicon, added memory, advent of hard disk drives, network capabilities, etc, that too is changing. Today it is not only possible, but essential for the set-top to be well connected to the IP network

Streaming Media Applications

We are really just beginning to develop a large category of applications that are going to proliferate and require streaming IP to the set top:

***-Internet TV*:** E-mail, Chat, Web browsing, Personalized Services (e.g. AOL TV), Walled Garden, Watch n' Surf, E-Commerce

-Home Gateway: MP3, PDA, Printer, Digital Camera, Web Pad, PC, Home Networks

-Communications: Voice, Videophone, Messaging

-Games: Interactive, Multi-player, Integrated with video

IP Delivery Mechanisms

Three basic mechanisms for delivering IP data to the set top have been developed and will be available either as standard or optional within the next generation digital set-tops — Out-of-Band IP, DOCSIS and In-Band IP. These technologies are not mutually exclusive, but in fact are very complementary and can be employed in the same network, running on the same set- tops. Each one however, does possess unique advantages and disadvantages, making it better suited for certain operators, running certain applications at certain times.

(See Figure 1)

Out of Band IP Protocol (OOB IP)

The oldest of the technologies, OOB IP is available on all set tops utilizing the DAVIC protocol. Early on a need was determined for a permanent connection available for signaling, conditional access, and other system related usage, regardless of whether the tuner was tuned to analog, digital, or data channels. Using the DAVIC channel, OOB IP is a relatively low-bandwidth channel (compared to 27 Mbps) delivering a payload of 1.2 Mbps. System usage consumes About 300 - 400 kbps, leaving about 800 -900 kbps of IP bandwidth available for other applications. That may not seem like a lot, but keep in mind that until now, most people connect to the Internet at rates

below 56kbps. Thus, OOB IP falls into the niche of very good for relatively low-bandwidth applications that need to be always connected, like e-mail, limited web browsing, and instant messaging services.

DOCSIS

Originally developed as a standard for cable modems, it's incorporation into digital the set top has been the most recent. The advantage of DOCSIS is high speed — with 27 or 38 Mbps bandwidth available downstream, and up to 10 Mbps upstream, depending on network capacity and quality of the digital plant it is installed in. Typical data rates used in the field are 4 mbps upstream.

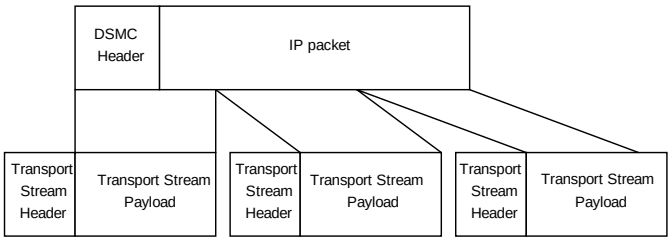
DOCSIS enjoys enhanced bandwidth over OOB IP but in many ways emulates the same sort of functioning of an always-on, always-connected service. DOCSIS can be used by operators who want constant high-speed connectivity to the Internet and for transporting telephony services, video conferencing, downloading MP3 audio or video clips. One disadvantage of DOCSIS is that is does require an additional 6 MHz tuner and additional hardware within the set-top to support the DOCSIS channel. The second disadvantage, which is also true of OOB IP, is that they are fixed services on a single channel that all set-tops in that portion of the network are connected to. And once that channel's bandwidth is all used up, operators will have to add equipment or subdivide the network to obtain more capacity.

In-Band IP (IP Gateway)

A relatively new implementation developed as a way to extend the bandwidth limitations of OOB IP, In-Band IP uses standard multiprotocol encapsulation of IP data into MPEG transport along with video and other types of services. As such, a portion of or an entire 6 MHz channel, or more can be dedicated to IP services. And it does this while making use of the existing tuner in the set-top eliminating the additional tuner cost that DOCSIS requires.

In-Band IP delivery is based on international signaling and encapsulation standards that are being implemented in networks today. Protocols enabling the setup of client/server data sessions over the QAM channels plus the use of broadcast data carousels in the network are established according to standards under Digital Storage Media-Command and Control (DSM-CC) MPEG Part 6 (ISO/IEC 13818-6).

International Standards
Encapsulation



DSM-CC Header contains destination MAC

Digital video and audio services are broadcast directly in MPEG transport. In hybrid video and data networks, IP may be encapsulated in MPEG transport packets using the protocols standardized in DSM-CC for routing over the HFC network. These multiprotocol encapsulation standards also have been adopted by ATSC and DVB, and are in use by various satellite and cable data delivery systems worldwide.

Frequency agility is a big advantage of In-Band IP. This allows an operator to dynamically switch IP connections from one frequency to another and reassign bandwidth virtually on the fly. As such, In-Band IP offers true on-demand functionality, with the ability to match bandwidth devoted to IP traffic to actual demand at the moment (e.g. traffic heavier at night) without having to re-engineer the plant.

Another potential advantage of frequency agility is with Open Access issues, where multiple ISPs are going to be allowed onto the network. Under this scenario, it will be advantageous to be able to assign certain amount of bandwidth on demand to a particular ISP for a duration or time. In-Band IP's User to Network DSM-CC signaling allows you to assign blocks of bandwidth to ISP's for short or long periods of time. An operator can know how much bandwidth an ISP is using, as well as being able to guarantee the service will not be interrupted by bursty traffic. With OOB IP and DOCSIS, ISPs can be allowed in to share bandwidth, but there are not control mechanisms to determine how much bandwidth they are utilizing.

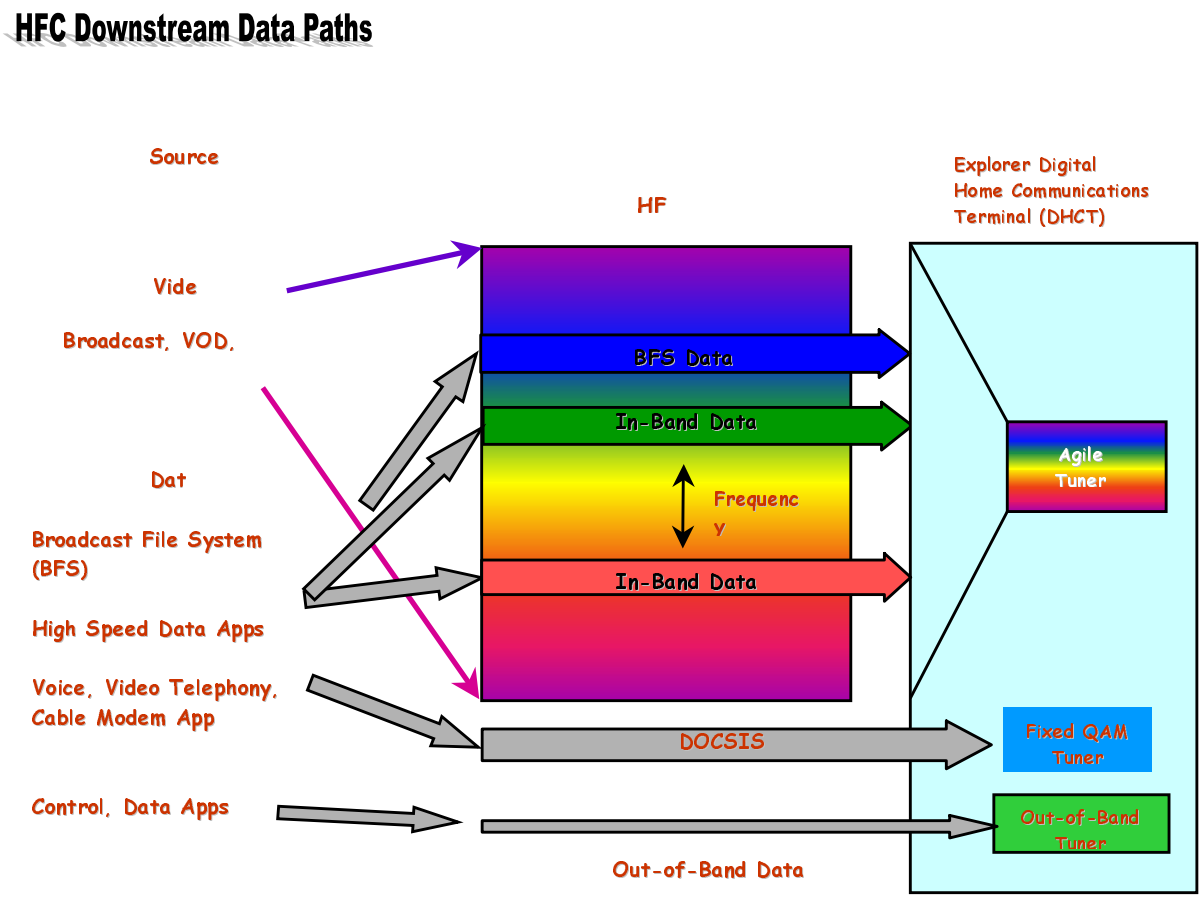
In-Band IP not only allows you to share bandwidth, but also share common equipment as well. QAM modulators, for example can be used for either VOD or IP services. Depending on the instantaneous demand on the system, the system can dynamically switch the content on a QAM modulator, (x percentage of IP, y percentage of VOD) to share and balance peak loads.

SUMMARY

In Band delivery of IP data to set-tops tops provides an attractive alternative to DOCSIS and complements OOB IP delivery mechanisms. By utilizing multiprotocol encapsulation and DSM-CC signaling, In-Band

IP provides operators with an inherently guaranteed quality of service, while allowing them to dynamically reassign bandwidth on the fly to match system demands, and to share bandwidth with other targeted services, making for high equipment efficiency. No extensive system reconfiguration or re-engineering will be necessary to implement In-Band IP, as it works through software download to the existing base of interactive digital set-tops which are already deployed throughout networks today.

Figure 1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HF
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Home Communications
Terminal (DHCT)
Vide
Broadcast, VOD,
Dat
Broadcast File System
(BFS)
High Speed Data Apps
Voice, Video Telephony,
Cable Modem App
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