



What's Next in Broadband Provisioning?

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Introduction

As a label, next-generation may have lost some of its edge through overuse, but there is nothing wrong with asking, "What's next?" It cuts to the heart of any sound strategic analysis.

Answering that question about the provisioning of next-generation broadband services begs another one, namely: What kind of services are we talking about? Possible answers—including direct fiber, wireless broadband and IPTV—point to existing opportunities for today's broadband cable operators.

The opportunities are straightforward:

- Direct fiber is largely a case of following the money, given that one business customer can generate more revenue than scores of residential customers.
- Wireless broadband is a matter of meeting customer demand for mobility.
- With IPTV, operators can simultaneously offer an enhanced video experience and gain efficiencies by converging all services onto a single IP platform.

These services have their own challenges, but in each case, provisioning is one of the weak links. Succeeding today calls for systems that navigate multiple access networks, harvest more information at the network edge and embrace standards that may lie outside traditional industry borders.

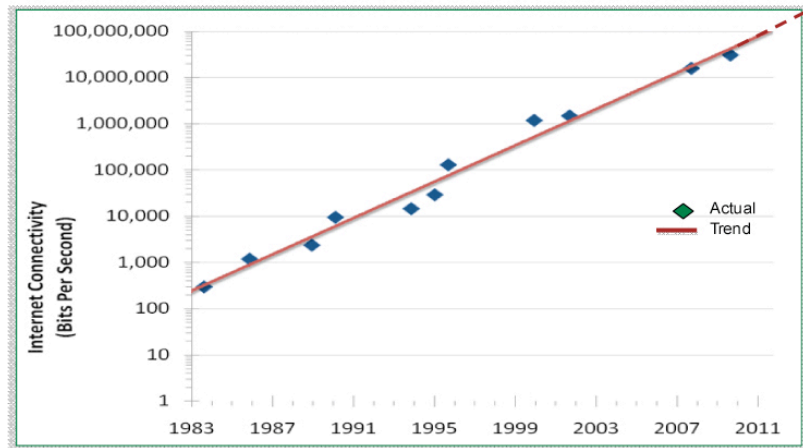
Broadband Enters the Next Phase

The telcos and cable operators that are morphing into next-generation service providers are characterized by the speeds of their broadband platforms and growing portfolios of services.

Faster speeds are an obvious point, but they underscore the industry's growing technical capacity and basic market dynamics. The so-called Nielsen's Law neatly summarizes this trend.

A former Sun Microsystems Distinguished Engineer and admittedly high-end data user, Jakob Nielsen stated in 1998 that broadband speeds grow at 50 percent per year. Supporting his eponymous law was a plot of seven speeds with which he had personally been connected to the Internet, beginning with an early acoustic 300 bps modem in 1984. The points represented constant exponential growth of 50 percent. Four subsequent points confirmed the trend, the latest being a 31 Mbps cable modem in 2010. (See figure 1.)

Figure 1. Nielsen's Law¹
 Applying Nielsen's Law To Broadband Usage Forecasts
 Historical UK broadband Availability Rate Samples Map Directly to Nielsen's law



Source: <http://www.useit.com/alertbox/980405.html>

By themselves, faster speeds simply made it easier to access the kinds of web sites that Nielsen himself was renowned for optimizing. But two decades into his logarithmic scale, those speeds has helped transform the broadband business by enabling the delivery of voice. These services included facilities-based telephony using standards such as PacketCable, as well competitive VoIP offerings that used smart endpoints to ride over-the-top (OTT) of high-speed data networks.

So what's next? Fiber and wireless technologies are diversifying product mixes, but many industry players are bracing for an era of Internet video. And as service providers leverage their high-speed data infrastructures for the delivery of video and IPTV, they come closer to the model of an all-IP network envisioned for years by strategists and standards bodies, including the International Telecommunications Union (ITU).

¹ Mike Cookish, "Provisioning – What's Next." (presentation, Incognito Global User Conference, Las Vegas, NV. June 11 2010)

NGN and MSOs

Affiliated with the United Nations, the ITU is a public-private partnership with more than 900 members. Governments comprise one-fifth of ITU membership, and the balance is divided between vendors and telcos. The service provider members from the U.S. are AT&T and Verizon.

What does the ITU have to do with the cable industry? While certainly closer to telcos than multiple system operators (MSOs), the ITU is a standards body engaged in work that transcends traditional lines. In 2004, the ITU- Telecommunications Standardization Sector (T) framed this definition of next generation networks (NGNs), which still stands as a reference point for ongoing architectural evolution:

"A Next Generation Network (NGN) is a packet-based network able to provide services including Telecommunication Services and able to make use of multiple, broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies."²

In essence, an NGN is an all-IP (packet-based) service network with separable transport and service layers. The ITU-T's definition furthermore calls for "unrestricted access" and "generalized mobility." Standards supporting the ITU-T's efforts range from fixed to wireless. This work is ongoing, with a gathering of groups under the NGN global standards initiative (GSI) slated in Geneva for September 2010. Among the technologies under discussion is IP Multimedia Subsystem (IMS), a standardized NGN framework defined by the European Telecommunications Standards Institute (ETSI) and the 3rd Generation Partnership Project (3GPP).

Affected by the same business and technology drivers as many ITU members, the cable industry itself is open to similar evolutionary change. For instance, the cable modem termination system (CMTS), the industry's broadband platform, is the focus of an ongoing next-generation optimization effort.

The CMTS has been part of the high-speed success story. But some MSOs are anticipating constraints, especially concerning the quadrature amplitude modulation (QAM) channels used to carry MPEG video and high-speed data. Already MSOs are using large numbers of QAM channels for video-on-demand (VOD) and switched digital video (SDV). In addition, MSOs have been allocating growing numbers of QAM channels for DOCSIS 3.0 channel bonding. These numbers have increased as serving group sizes, for operational efficiencies, have decreased.

Add to those factors the industry's desire to support Internet video and eventually IPTV, to traverse multiple access networks, such as

² For the ITU's NGN working group definition, see: http://www.itu.int/ITU-T/studygroups/com13/ngn2004/working_definition.html

PON and wireless, and to improve subscriber management. The upshot is growing consensus around specifications for a flexible, ultra-dense CMTS that falls under the rubric of a next-generation access architecture (NGAA).³

The Next Provisioning Challenge

The physical density alone of a next-gen platform bakes in significant efficiencies of space, power and heat. These savings are critical because of the demands posed by scaling up the number of QAM channels.

The dilemma is equally clear regarding software. As broadband networks deliver more services to a larger number and variety of devices over increasingly complex and integrated network systems, the need also rises for highly effective provisioning and management architectures and solutions.

The industry's IP and software experts, of course, have solved provisioning challenges in the past. The obvious cases in point are solutions that have helped to build the multi-billion dollar data and voice businesses. But to expand upon one of the opportunities and related challenges mentioned up front: Putting direct fiber into a customer today means leaving CableLabs provisioning standards behind. What then?

Is it cost-effective to send out a technician who has to be specifically trained to configure an IP router because of a direct fiber connection? Or is it even possible for network operations staff at a help desk to answer a request from a commercial customer without access to the same surveillance data or the ability to reboot the device from that customer's connection?

Going forward, manual configurations and "non-supportive" customer support will be non-starters. Solutions that do work, such as those associated with DOCSIS, have enabled centralized management and provisioning. They succeeded because they became mass market, cost-effective and easy to roll out and were tried and tested over many years of deployment.

Regardless of when the converged, access-agnostic CMTS platform emerges, the industry needs automated solutions for direct fiber, wireless, and other new services. Provisioning technologies exist. But finding them means being open to standards "not built here." It means using CableLabs, but also borrowing from the Internet Engineering Task Force (IETF), which has defined the dynamic host configuration protocol (DHCP), from the Broadband Forum and its work covering Ethernet terminals, and from ITU and ETSI. The goal

³ Comcast engineering executives Jorge Salinger and John Leddy presented a paper titled, "Proposed Next Generation Cable Access Network Architecture," at the 2009 SCTE Conference on Emerging Technologies. At the 2010 Spring Technical Forum, Salinger outlined the proposed next-gen CMTS platform in a paper titled, "Converged Multiservice Access Platform."

is standards that can tie the edge of the network identification to the subscriber service.

The need is critical. Efficiencies to be gained through converged platform engineering designs are promising. But without mature and automated provisioning, the total cost of ownership of the broadband service provider network will skyrocket.

Provisioning over Multiple Access Networks

“Network agnostic” is a popular expression, if not as common as “next generation network” (Google search results: 1.2 million and 28.9 million, respectively.⁴)

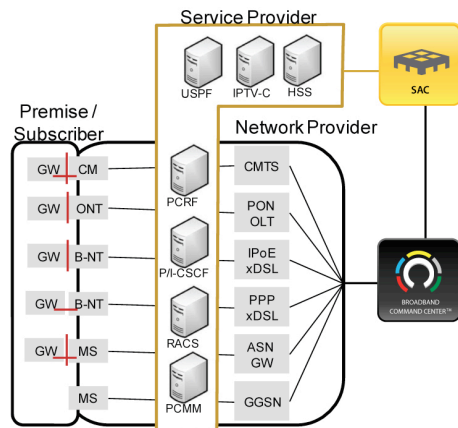
The idea of being non-partial or open to all access networks, however, is a more precise formula. It rules out the long haul or metro and focuses on the so-called last mile, that leg of the network tied to the premise or subscriber. It is also more politically loaded, as it evokes the ITU-T’s distinction between transport technologies and service-related functions, along with its appeal to “unrestricted access.”

The idea of traversing disparate access networks is not new. An earlier packaging of it fell under the fixed-mobile convergence (FMC) rubric, one of the first applications associated with IMS. If and when the IMS core architecture gains momentum, the implications to provisioning could be significant.

Technology Lineup

From a provisioning perspective, being access network-agnostic means that subscriber activation and provisioning happen above, beside or alongside device provisioning concerns. The concept of multiple access networks allows one to draw a service provider line across all of the edge. (See figure 2.)

Figure 2. Access Network Agnostic Provisioning⁵



⁴ For purposes of comparison, DSL generates 43.3 million hits and DOCSIS, 900,000.

⁵ Chris Busch. “Provisioning – What’s Next.” (presentation, Incognito Global User Conference, Las Vegas, NV. June 11 2010)

Unifying subscriber awareness is a matter of associating service activation with a service provider's relevant network elements, such as user server profile function (USPF), IPTV control function (C) or IMS home subscriber server (HSS). (See icons at the top of figure 2.)

With subscriber and device provisioning converged, a service provider can treat a subscriber as a subscriber regardless of access network. In practice, this means an operator can have customers accessing services across a range of access platforms, including:

- CMTS, whether legacy or next generation
- Optical line terminal (OLT), whether GPON or EPON
- Digital subscriber line access multiplexer (DSLAM)
- Broadband remote access server (BRAS), or DSLAM aggregator
- Access service network (ASN) gateway, for WiMAX traffic
- Gateway GPRS support node (GGSN); GPRS = general packet radio service for 2G, GSM and 3G

In each of these cases, the relevant QoS elements serve as a bridge between the premise and service provider management. (See vertical icons in figure 2.). These elements would include the policy and charging rules function (PCRF), proxy/interrogating call session control function (P/I CSCF), remote access control server (RACS) and PacketCable Multimedia (PCMM) server.

The upshot is that whether a subscriber uses a DOCSIS cable modem at home and a WiMAX broadband device or 3G smart phone there or elsewhere, a next-generation provisioning system can establish the concept of customer uniqueness in any of these platforms. It achieves this by reaching into relevant authentication, authorization and accounting (AAA) elements. In the case of wireless customers, that typically means leveraging Remote Authentication Dial In User Service (RADIUS). In the ITU (and IMS) framework, there is the Network Attachment Subsystem (NASS). For DOCSIS, it means adding the concept of the cable-based device into a provisioning system.

In any of these cases, once a client class of service is established, inherited processing then takes over.

What about IMS?

The practice of associating IMS and NGN is well established. As mentioned, IMS implementation is among the topics being assessed in NGN-GSI standards groups. There is even an industry association and sponsor of interoperability events that uses both labels.⁶

⁶ See the NGN Forum and IMS Forum, <http://www.imsforum.org/about>.

Both NGN and IMS share the concept of NASS, but the underlying reason for congruence is that within the notion of an IMS core, everything is unified. That includes IP applications, including presence, and services delivery. The reality, however, is that after many years of talk, one has yet to see the IMS architecture fully deployed.

There may be a future where a provisioning system interacts with a central authority for all subscriber data. If the vision for an IMS core network does come about, it no longer becomes necessary, for instance, to add data into RADIUS, forward data to device provisioning systems or add data into specific mediation platforms.

In such a scenario, the data instead would go to an IMS core network, which has the concept of the HSS, the one location for all subscriber profile information. In that case, the vendors of all the systems just mentioned simply need to build interfaces to hook into that server. Incoming requests from edge of network (whatever the edge) would then query the HSS for information on whether to pass traffic on a particular port, to provision a particular device, and so forth.

For now, that remains a future conversation about the collapse of the back office, the flattening of layers, and operations support systems (OSS) simplification.

Standards, Information and Relay

Meanwhile, network-agnostic provisioning today is a matter of interworking centralized DHCP with mature, deployed technologies. That could include CableLabs device provisioning for DOCSIS data and PacketCable voice services and Broadband Forum device provisioning for IP over Ethernet, DSL as well as wireless mobile.

As far as the ITU-defined NASS, given a sufficiently robust DHCP system, it is not necessary to leave RADIUS to establish the concept of the unique subscriber. By interworking with RADIUS requests, a system can allow those authentication and authorization messages to influence its DHCP processing.

Getting into that RADIUS control plane can be very useful for gaining additional visibility and processing. The relevant principle here is relay sub-option data, a mechanism that CableLabs has used extensively over the years.⁷ Having made relay sub-option core to the NASS concept (implicitly endorsing the CableLabs efforts), the ITU has begun requesting that access edge vendors embed additional information on a per-logical or per-physical identifier.

⁷ See for instance, RFC 3256, "The DOCSIS Device Class DHCP Relay Agent Information Sub-option," D. Jones, YAS Corporation and R. Woundy, AT&T Broadband, April 2002; and RFC 3993, "Subscriber-ID Suboption for the DHCP Relay Agent Option," R. Johnson, T. Palaniappan, M. Stapp, Cisco Systems, March 2005.

As indicated, CableLabs already makes use of DOCSIS Relay. In the Broadband Forum, there is TR101 Relay. In ETSI's Telecoms & Internet Converged Services & Protocols for Advanced Network (TISPAN), one finds references to Relay 82.1, 82.2 and Option 77 and 120. The IETF's Protocol for Carrying Authentication for Network Access (PANA) and even DHCP Authentication also can make these identifiers available.

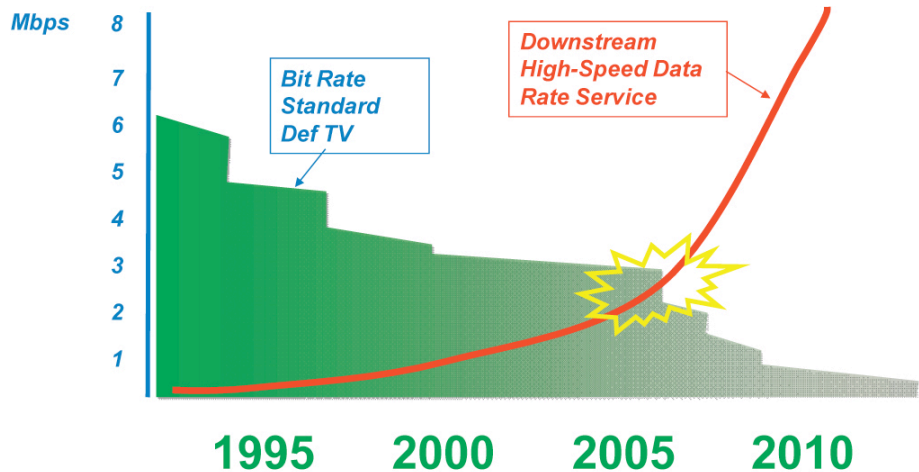
The idea is that when the first DHCP packet begins to flow, the additional data are shimmed in such that network-agnostic auto-provisioning then can take over. The end result is an inventory or activation system that is able to add in those data to the distant edge of a network.

All IP Means IPTV

Much of the momentum behind NGN discussions in recent years derives from the addition of video to a service provider's IP portfolio. Without video, one simply cannot be an "all-IP" services provider.

Technology is driving this shift. As video compression algorithms reduced the bit-rate for standard definition television from 6 Mbps to less than 1 Mbps, increasingly fast downstream speeds turned the Internet into a viable means for delivery of television programming. (See figure 3.)

Figure 3. The Internet is Viable for TV Content⁸

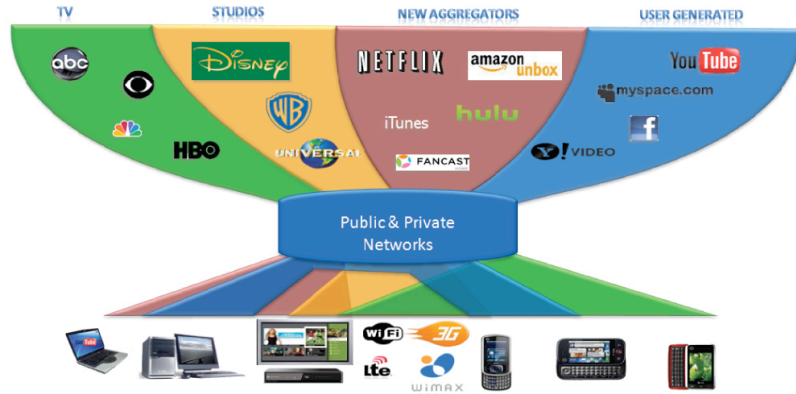


Video thus has become both driver and battleground for this next phase in the evolution of public and private IP networks. The landscape now includes not only traditional broadcasters and cable programmers but also new aggregators and hosts who aim OTT

⁸ Mike Cookish, "Provisioning – What's Next." (presentation, Incognito Global User Conference, Las Vegas, NV. June 11 2010)

services toward the ever-expanding lineup of IP-enabled devices. (See figure 4.)

Figure 4. Delivery, Provisioning & Management Challenges Escalating⁹



Until recently, the cable industry has been mostly an observer in the move toward IPTV. That is changing. CMTS supplier Motorola, for instance, envisions its forthcoming high-density CMTS as a “video services platform.” The platform’s flexible use of QAM channels would enable a gradual change from MPEG video to IP video. But additional features fleshing out that vision include fast channel change for IPTV; integration with video caching for targeted ads; next-gen and legacy encryptions; and AAA for mobility and subscriber management purposes.

First-gen IPTV

While the cable industry has been watching, other service providers have adopted IPTV. A review of a typical early solution, however, suggests that the first movers have inherited several disadvantages.

In a traditional DSL implementation of IPTV, a service provider generally engineered the access plant for performance characteristics in terms of loop lengths and throughput to support a desired, simultaneous number of SD and HD channels to a customer. The provider took a hard QoS-engineered approach to guarantee traffic classification through the network. Stranded IPTV middleware from one vendor would have required custom integration to extract subscriber information. A system typically used Internet Group Management Protocol (IGMP) for channel changing, multicast for moving broadcast content around and Real

⁹ Mike Cookish, “Provisioning – What’s Next.” (presentation, Incognito Global User Conference, Las Vegas, NV. June 11 2010)

Time Streaming Protocol (RTSP) for delivering unicast on-demand assets. As a closed application, it had no access to OTT content.

Provisioning challenges could be vexing. Terminals with no sense of provisioning provide only limited subscriber information. And an access network limited in its ability to communicate information about a set-top box and its subscriber makes it difficult, if not impossible, to associate a subscriber to a service, much less to a device. Never mind that the early devices did not comply with any standard form of provisioning.

IP Service Model

Going forward, there appears to be two schools of thought on how to build an IP service model: either with or without IMS.

For some, it is a foregone conclusion that session initiation protocol (SIP) would serve as the control plane in an IMS framework, video simply being another "session." Others argue that an IMS core is not necessary. What is needed is a well-defined set of standards and subsystems that conforms to the knowledge of the IPTV middleware platform, manages subscriber data profile, and enables some control-plane conversation. Instead of SIP, it could be HTTP RESTful XML.

Either way, however, there will be several constants, including the following:

- A standard, defined approach to subscriber data, relative to an IP service, called TV
- A control plane related to getting in and out of a terminal that customers are using to access that IP service in the network
- A terminal compliant, more often than not, to Broadband Forum device provisioning (TR 135 for IPTV set-top provisioning, control and surveillance)

When those elements are in place, several other things happen. The access network complies with the emerging NASS specification, enabling an operator to figure out where on the edge of that network—whether cable or wire-line or mobile—the set-top box resides. The use of Broadband Forum removes any concern over what kind of network needed to be traversed to provision that device. The network itself identified that customer edge as a customer.

Using DHCP alone or DHCP tied together with RADIUS, either in the control plane or not, a provisioning system can authorize a port to open and pass traffic. With the right sense of IP connectivity, the device-provisioning standard then takes over, coordinates with the access control server and enables the device to come on line and channel guides to be populated, whether over RESTful or SIP.

This is a compelling vision: A service model that entails no hard engineering apart from delivering sufficient throughput. After the bandwidth arrives, the applications take care of themselves.

Conclusion

It can be risky to ask, "What's next?" The answer may be relatively clear, or may not. (No one is perfectly clairvoyant.) "What's next" could take years to arrive, if it ever does, or it could be today's version of a "next" thing that was just deployed.

For broadband service providers, video is one of the next things. It is important not to misstate that point. Media measurement company Nielsen reported that in Q1 2010, Americans across all demographics watched a record 35 ½ hours of traditional television per week, between 50 and 100 times as much time spent viewing video online.¹⁰ In other words, the computer monitor has not replaced the television set.

How to convert traditional television into efficient and enhanced IPTV is the strategic challenge. As with lucrative business services opportunities, such as fiber connects and moves into the competitive broadband wireless market, one of the big challenges with IPTV is provisioning. What will not fly very far in any of these cases are manual and boxed implementations with little reference to the types of standards that support mature, centralized and information-rich deployments.

Successful provisioning of next-generation broadband services, on the other hand, will navigate IP, mobile, fixed and other access networks, leverage sufficient information at the network edge and embrace standards that may lie outside traditional industry borders.

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¹⁰ See "Nielsen Three Screen Report, Q1 2010," http://en-us.nielsen.com/content/nielsen/en_us/insights/nielsen_a2m2_three.html. The range (between 50x and 100x) results from looking at their data for both monthly or weekly data viewing.