Innovation, Automation and the Path to Network Transformation

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Innovation is a top priority for organizations all over the globe and most are in various states of digital transformation—telecoms, cable and mobile network operators are no exception.

In its Top Ten Predictions for the Future of Digital Innovation, the research firm IDC predicts that "By 2026, 75 percent of market leaders will have systemic, structured digital innovation programs and investments that support ongoing iterative innovation, enabling growth, scale, agility and resilience." In addition, data-driven insights will be key to this innovation, with 85 percent of CEOs of the G2000 demanding that senior leaders deliver data-driven insight into innovation activity including developer efficiency and business outcomes by 2025. And the pressure is on communications service providers (CSPs) to use innovation to meet top priorities, including positive customer experience, overall customer satisfaction, operational efficiency, sustainability, cost savings, agility and business resilience, according to a July 2022 IDC survey of enterprise spending.

For today's CSPs, transformation is a process that includes addressing complexity, streamlining processes and driving efficiencies through intelligent automation using a mix of tools and technologies—cloud-native infrastructure and serverless, container technologies—that can automate their networks and provide observability across their varied and complex infrastructures and operations. In this article, *Pipeline* delves into insights from the recent SCTE Cable-Tec Expo on innovation, automation, and network transformation.

The urgency of cable network transformation

Cable service providers are deeply enmeshed in this network transformation journey, driven by an array of factors: competition from fixed and mobile service providers; pandemic-induced demand pressure for higher speeds and more symmetrical bandwidth for video streaming, videoconferencing and other applications; the availability of billions of dollars in government funding from the U.S. infrastructure bill to fund broadband expansion and upgrades; the push for fixed-mobile network convergence for seamless connectivity; and the need for better OpEx and TCO, among others.

Looking beyond the value of the network itself, however, CSPs are also seeking to identify more revenue-generating services, and to improve service and deliver experiences that create customer loyalty.

Leaders are recognizing an accelerated pace for industry innovation. At the Expo late last year, Phil McKinney, CEO of CableLabs said, "It is beyond anything I've ever experienced," he said, noting that innovation used to take up to 10 years to get broad adoption. "It's no longer decades or years. In some cases, for applications, it can be months or even weeks."

CableLabs, the industry's chief R&D organization, defines the path to network transformation as the [10G Initiative](#). It envisions infrastructure that is access network agnostic, delivers multi-gigabit speeds, lower latency and more robust security, cuts space and power needs and reduces operational costs while increasing new product development and service deployment velocity. Over the longer term, it also aims to bring the convergence of fixed and wireless networks into tighter focus for operations over a single converged core.

Cable operators are investing significant time, money and human resources to update and expand their infrastructure to accomplish these goals and remake their platforms and operations to manage and optimize the pace of innovation. They're accomplishing this with IT systems, tools and technologies that add virtualization, open, cloud-native software, containerization, and automation to enable better control, visibility, telemetry, and testing and reporting, among other capabilities.

Liberty Global embodies one example of the variability of cable infrastructure—it owns and operates Virgin Media-02 in the UK, VodafoneZiggo in The Netherlands, Telenet in Belgium, Sunrise in Switzerland, Virgin Media in Ireland and UPC in Slovakia with 85 million fixed line and mobile customers across nine countries in Europe. EVP and CTO Enrique Rodriguez has publicly emphasized the need for automation, given the different types of networks both within and across its footprint: "I don't believe we've seen even 10 percent of the benefits that we're going to get from automation," he noted at the Cable-Tec Expo technology leadership panel last year.

In EMEA markets for example, Liberty Global is already moving along with its version of FMC with Wi-Fi playing an increasingly important role in its value proposition to customers. Rodriguez noted that in mid-September, Liberty Global launched a Wi-Fi Guarantee, combining Wi-Fi and mobile network connectivity for a seamless end-to-end user experience.

The enterprise market is also part of cable operator fixed-mobile convergence (FMC) targets. Most of Liberty Global's B2B customers take both mobile and fixed connectivity services, using wireless access as a backup/failover connection option, which is of critical importance to business operations. MNOs like Liberty with deep fiber networks are connecting mobile-based stations to their fixed fiber infrastructure for better network efficiency and improved operational costs. It's part of what cable hopes will be a step closer to the ideal of one single converged network core.

The wireless play

Cable companies are also grappling with the realities of explosive growth in connected devices. Charter Communications, for example, reports that its networks are averaging 15 connected devices per household—phones, laptops, gaming devices, printers, smart devices and so on—using the in-home Wi-Fi network. In effect, Wi-Fi and home networks are becoming increasingly important to cable's residential strategy, with upgrades to Wi-Fi 6E and eventually Wi-Fi 7 expected to become the backbone of the residential strategy and a way to add value to residential and business customers.

By pursuing the FMC strategy over the next four to six years, and with the addition of CBRS spectrum, cable operators will be able to offload some of the MVNO workload to this converged network. "We're already doing a great job with Wi-Fi. And now that we're moving towards this converged solution, you'll be able to actually roll out services across all of these networks at the same time," commented CableLabs Vice President Mark Bridges, part of the Future Infrastructure Group.

Cable's next-gen platforms

Cable networks combine various flavors of the broadband access technologies, with the cable modem standard known as DOCSIS (3.1, and two different versions of next-gen DOCSIS 4.0), as well as fiber and next-gen PON, advanced digital optical technologies and wireless technologies including Wi-Fi and CBRS.

Network digitization often involves disaggregation of certain network elements. For cable, this includes distributed access architecture (DAA), which moves certain functions typically resident at cable headends or hubs closer to the user, thus reducing the amount of hardware housed at these locations and creating efficiencies in speed, reliability, latency and security in support of 10G.

DAA is part of the larger network evolution strategy that decentralizes and virtualizes headend and network functions, and the move to deeper fiber architectures with digital service nodes that use digital optics and Ethernet transport. Jeff Heynen, Vice President, Broadband Access and Home Networking, Dell'Oro Group, told Pipeline that shipments of DAA nodes are expected to reach nearly 80,000 units in 2022 with global shipments of 112,000 DAA units forecast for 2023, skewing heavily toward North America. According to Dell'Oro Group data, worldwide shipments

of remote OLT ports are expected to reach 55,189 units through the end of 2024—more than doubling from 2022 to 2024 on the expectation of more fiber deployments by operators.
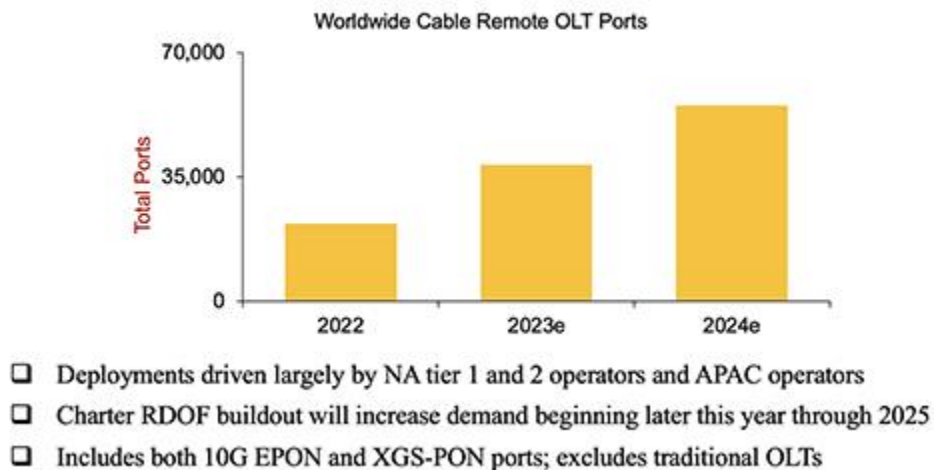
Cable FTTH Deployments Increasing

Worldwide Cable Remote OLT Ports

❑ Deployments driven largely by NA tier 1 and 2 operators and APAC operators
❑ Charter RDOF buildout will increase demand beginning later this year through 2025
❑ Includes both 10G EPON and XGS-PON ports; excludes traditional OLTs

**Figure 1: 2022 to 2024 FTTH Deployments. Courtesy of Dell'Oro Group.**
click to enlarge

"While the numbers are relatively small compared with total homes passed, the takeaway is that cable operators are gradually becoming true Multi-System Operators (MSOs) with multiple, physical layer technologies being used for residential broadband access. Part of what makes that available is the deployment of virtual CMTS (vCMTS) or Access Controllers that can abstract and virtualize hardware functionality and manage the modems and ONTs in the same manner, all the while masking some of the underlying technical differences between the technologies and vendor implementations," said Heynen.

Companies like Harmonic and Casa Systems are among the top suppliers for vCMTS solutions to global operators. Casa, for example, has showcased a convergence use case demonstration using a 5G core, virtual Broadband Network Gateway and their vCMTS to show how operators can give customers the ability to boost their speeds for limited periods of time or for specific applications implementing virtualized solutions and software running on COTS servers at the push of a button. Harmonic, inparticular, started early along the virtualization path and expects to reap the rewards as cable upgrades to the various version of DOCSIS and fiber technologies over the next several years. Harmonic's solution (CableOS) has been widely deployed and now serves over 10 million homes. As noted during the annual Analyst Day in 3Q2022, Nimrod Ben-Natan, SVP & GM of Harmonic's Cable Access division, said that the company has been able to build a strategic and foundational differentiation through development of a "true virtualized cloud-native software platform" that took very complex network functions such as cable modem management in the CMTS, traditionally implemented as a hardware, and moved it to a software-based approach "that can scale out horizontally with micro services."

This has enabled "multi-tenancy" within their solution, which he described as a CapEx-efficient solution that supports both DOCSIS and fiber within the same network implementation. The

platform includes analytics that can provide instant visibility into networks, letting customers see changes or anomalies within minutes and hours and monitor the trends impacting their customers. The software incorporates tools to automate responses to these changes.
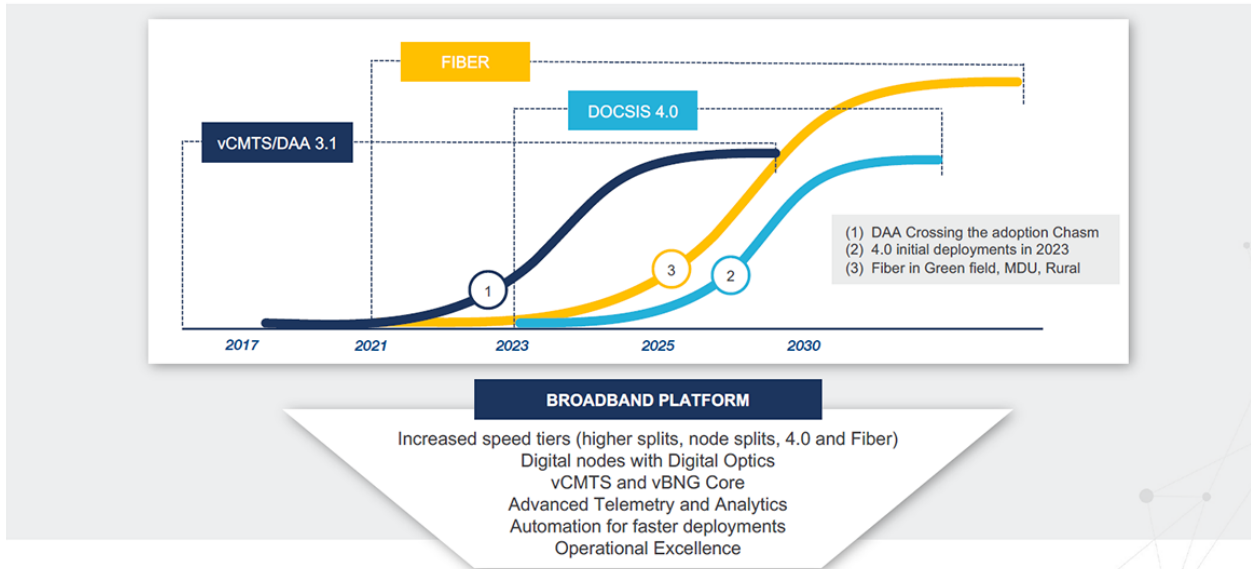
Figure 2: Planned pace of upgrades
[click to enlarge](#)

Network convergence and network as a platform

The prevalence of bundled service offerings for cable service providers increasingly includes a mobile or wireless component and is expected to be a big driver for converged networks. In North America most cable operators resell wireless services as mobile virtual network operators (MVNOs), while globally, they're more likely to own and operate wireless networks directly as mobile network operators (MNOs). These networks all use different access technologies— DOCSIS, PON, 4G/5G, Wi-Fi—with independent network cores and their own specialized (custom) hardware and embedded software. It's often a complicated mix to manage efficiently and from which to develop and launch new services across an entire service footprint.

In a [recent article](#) and in a whitepaper "The Road to Wireline-Wireless Convergence," CableLabs presented cable's vision of fixed-mobile convergence: a single converged core consisting of a common platform and back-end infrastructure using common-off-the-shelf (COTS) servers and software.

This single converged core is agnostic to the underlying access network (DOCSIS, PON, fiber, mobile) and enables cable operators to roll out services more quickly and efficiently across all networks at the same time, from a single point of deployment and enforcement, with better management tools, simplified billing, and so on. It also promises to deliver operational, CapEx,

and OpEx benefits, as well as support sustainability goals. End user customers can expect a more pervasive, consistent and seamless user experience no matter the underlying access technology.

CableLabs has mapped out this migration to a converged single core into at least three stages, with a lot of variability by operator and region, over a three- to eight-year timeline. RedHat was involved in a proof of concept shown at the SCTE Cable-Tec Expo, and CableLabs is currently working with partners on the next iteration. CableLabs and vendor ecosystem partners Casa Systems, HPE and Intel were also involved in a proof of concept for the FMC project.

While CableLabs stressed that estimated timelines for deployment by members will extend out to 2028 and beyond, the industry will need to develop specifications and vendor implementations will also need to be developed prior to any deployment. Non-standards-based vendor deployments may potentially lead the way to standards development.

CableLabs experts Mark Bridges, Vice President, and Randy Levensalor, Principal Architect, both of the Future Infrastructure Group, explained in a conversation with *Pipeline* the work that they are doing on the wireline-wireless convergence project both

in the labs and in field trials with vendor partners. According to Levensalor, "Network as a Platform has the potential to manage E2E connectivity for customers using a network with the same servers, switch fabric and container platform" and that has the ability to "ramp up services quickly, do upgrades footprint-wide at the flip of a switch, troubleshoot problems faster and more easily, and be more energy efficient."

Bridges noted that "with a converged solution, you'll be able to actually roll out services across all types of networks at the same time without having to worry whether it's XPON or 10G, DOCSIS or 5G," said Bridges. "We're running all these on the same infrastructure, using the same servers, switch fabric, and container platform, and this synergy allows things to work really well and will let operators focus on the important pieces," like rolling out competitive new service offerings.

Cable operators have invested in CBRS spectrum in the 3.5 gigahertz band, which is expected to be a key element in a more comprehensive mobile strategy. Bridges described it as initially supporting general coverage but eventually being used for private LTE and 5G deployments for enterprise applications.

Evolving networks, managing legacy infrastructure

The converged network vision is a compelling one with potential for lots of stops and starts along the way. Thuy Nguyen, Cable Segment Manager for Intel, described the process of upgrading cable operator network infrastructure while also managing legacy systems this way: "It's like fixing the car while it's still running."

Cable's existing network infrastructure is not likely to change overnight and will likely be around for some time to come, but the next cycle of network evolution will focus on automating the network to better manage complexity, simplify operations, and enable service velocity.

Convergence Deployment Roadmap
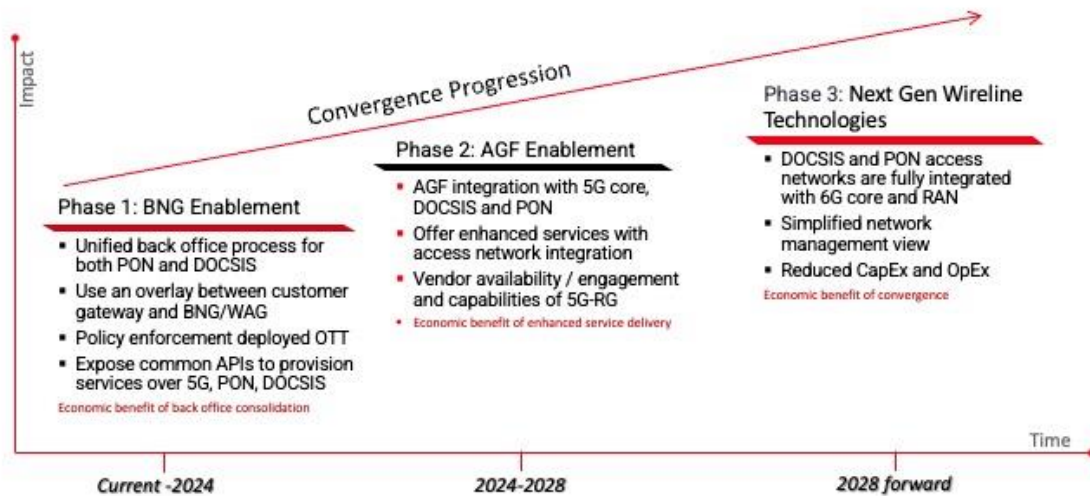
Figure 3: CableLabs - Convergence Deployment Roadmap
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Comcast is already leading the way on the network automation part of this journey. Comcast Fellow Bob Gaydos, who leads the Enterprise Architecture team for Comcast Connect and is responsible for technical strategy for core and access network, shared that by using its CI/CD process, Comcast was able to deploy and upgrade 16,000 hosts with a new version of Linux with a push button while operators were asleep, and in another instance, upgraded 50,000 digital optical nodes overnight. "In the past, cable operators were never able to achieve the level of proficiency in upgrading its legacy, purpose-built chassis with that kind of speed, accuracy and ability to test out the telemetry," said Gaydos, speaking at an industry session on "vCMTS Scale & Sustainability."

Automation is allowing Comcast to find and fix problems faster than ever before, and with the expected migration to a "mid-split" network configuration for more bandwidth in the upstream path, and roll-out of multi-gigabit symmetrical services using Full Duplex DOCSIS (FDX) on the road to 10G, it's going to need all the power that automation tools can deliver to keep up with the required volume of changes and fixes.

The end game is the same

To get to that kind of proficiency, however, service providers are going to have to shrink the variability in their network designs, both within and across operators, and move toward infrastructure that allows easy support by software vendors in order to write applications on common platforms.

Ultimately, however, it's the same end point for cable service providers as for their telco rivals—more bandwidth, more convergence, more virtualization, more automation on cloud-native, containerized platforms that provide faster and easier ways to turn up new services and to centrally monitor, manage and update networks without requiring truck rolls—using less energy, delivering better TCO, and ensuring happier customers.