APPLICATION NOTE

Residential Broadband for Communications Service Providers

The pandemic left much of the global population with no choice but to shift dramatically to work, learn, and play from home. In 2020 and the years following, millions worldwide traded classrooms, offices, and conference rooms for at-home screens—but many were left stranded by inadequate or unaffordable access to internet connectivity. From remote communities with little to no broadband connectivity to poorer urban areas with affordability challenges, the digital divide remains an overwhelming obstacle for many individuals and communities at large.

Compounding the challenge is that fact that developers and content providers are constantly investing in bringing new applications and technologies to the consumer market. An example of emerging technology for the coming years is the Metaverse. This new ecosystem of applications will significantly raise the bar for acceptable broadband service performance, even when compared to most bandwidth-consuming 4K video streaming services of today. This will create additional challenges for service providers.

Communications Service Providers (CSPs) are not new to the residential broadband market. They have invested, developed, and implemented a mature residential broadband infrastructure and associated services for decades, historically focusing on the more lucrative urban and densely populated areas. But while their profound experience and market penetration puts them in an advantageous position, they must rethink their broadband network strategy to stay ahead of new application and customer demands while continuing to enable digital inclusion.

A closed, legacy approach will not equip CSPs to succeed

As new application and market dynamics are significantly changing residential broadband service requirements, many CSPs are still using solutions based on legacy technologies, like xDSL or G-PON, which simply cannot provide the performance and cost-efficiencies required. In addition to using aging technologies, these legacy solutions are closed by design, limiting the ability for CSPs to take a best-of-breed approach to modernizing their residential network infrastructure. As a result, CSPs have limited ability to capitalize on new network innovations to improve service affordability and the end-customer experience.

Highlights

- The strong adoption of home-based activities, like remote working and learning, has changed broadband service requirements related to bandwidth, latency, availability, and symmetry
- Supporting new applications by providing a better Quality of Experience (QoE) while improving broadband affordability are the main challenges for CSPs in the coming years
- Existing Gigabit Passive Optical Network (G-PON) and Digital Subscriber Line (xDSL) technologies do not have the scalability, performance, and symmetry new applications require
- Multiple governmental subsidies and stimulus programs will change the CSP marketplace creating opportunities and increasing competition
- CSPs must rethink their residential broadband networks to make them more open, modular, and scalable
- Unlike incumbent vendors with closed, legacy approaches, Ciena helps operators build a sustainable residential broadband network without compromise

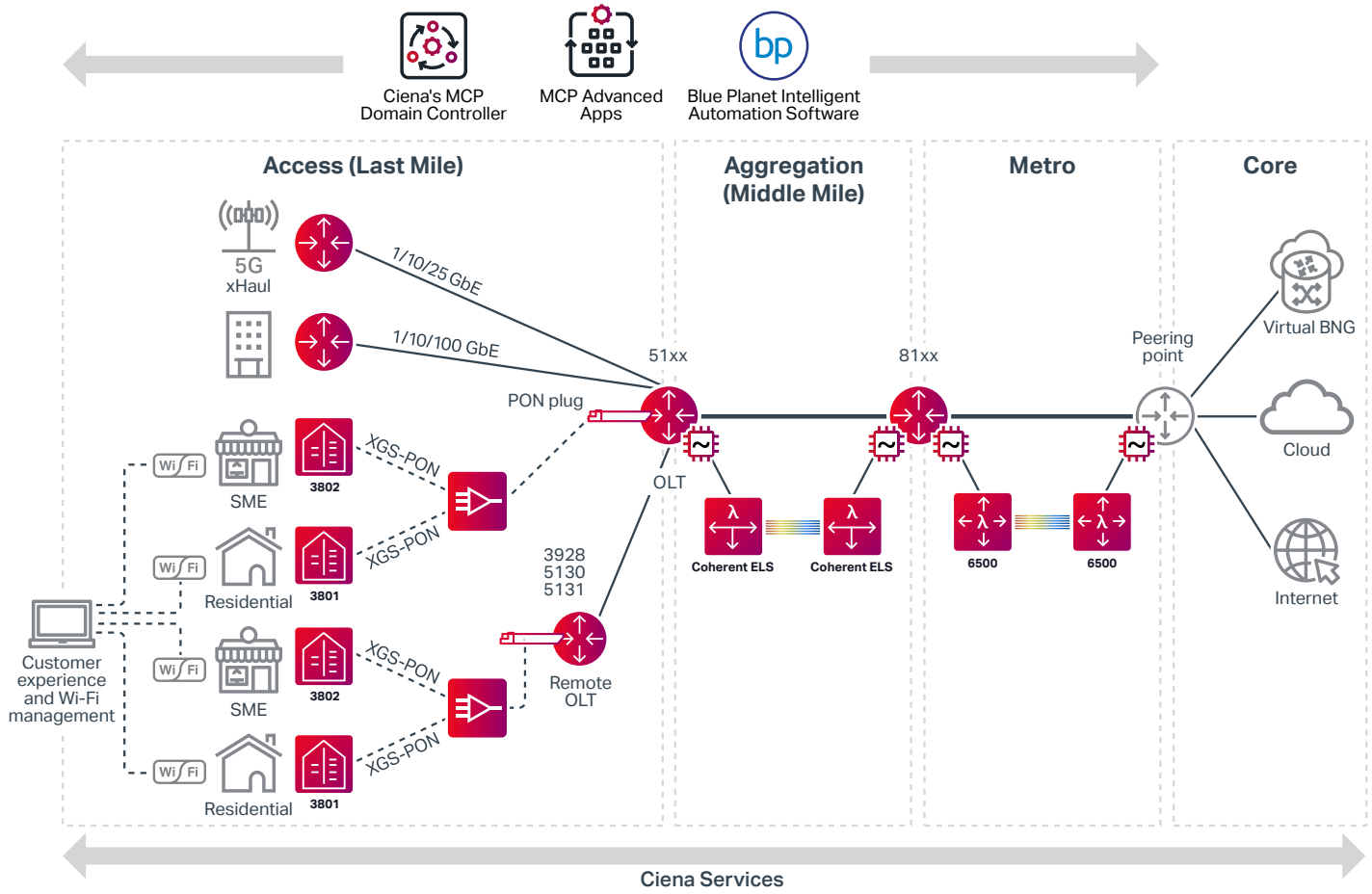

Figure 1. Ciena's Residential Broadband Solution

Unfortunately, the legacy approaches of incumbent vendors force CSPs to compromise on the basic functionality of their residential broadband networks. They shouldn't have to choose between:

- Overspending on their initial deployment or limiting their ability to grow
- Supporting only broadband or implementing multiple devices to support multiple services
- Optimizing OPEX or delivering great QoE
- Sustainability or scalability

The mission to create a digital future for all is too important for service providers to compromise. It's not surprising then that CSPs are starting to rethink their residential broadband networks—moving away from closed, chassis-based approach towards a more automated, modular, and flexible architecture.

Ciena's Residential Broadband Solution

Ciena's solution for residential broadband is designed to deliver the scalability, openness, and modularity CSPs need to remain competitive, protect their network investment, and maintain a competitive edge—while enabling digital inclusion for all.

This solution leverages the power of Ciena's portfolio, including Routing and Switching platforms with XGS-PON pluggable technology, market-leading optical networking technology, Ciena's Manage, Control and Plan (MCP) domain controller, Blue Planet® Intelligent Automation Software, and Ciena Services.

This solution allows end-customers to access applications for working from home, telemedicine, remote learning, cloud gaming, Ultra-High Definition (UHD) video streaming, and enables CSPs to upgrade their service portfolio features and capabilities when required by Metaverse and Augmented Reality/Virtual Reality (AR/VR) applications—without the need to rip and replace existing network infrastructure.

Ciena's Residential Broadband Solution allows the convergence of aggregation and Fiber-to-the-Home (FTTH) access functionality by integrating XGS-PON micro Optical Line Terminal (µOLT) pluggables in Ciena's Routing and Switching Platforms, offering shared fiber broadband services for residential as well as Small and Medium Enterprises (SMEs). Ciena offers the best XGS-PON port density per Rack Unit (RU) and the lowest energy consumption per port for typical deployments while allowing customers to buy only the necessary XGS-PON plugs, when required, in a modular business model. As the market evolves, Ciena's Routing and Switching Platforms are ready to support 25G PON pluggables when they are available in the future.

Universal Aggregation and access over 10G PON transceivers
Learn more

Ciena offers a highly scalable and modular solution that allows network operators to sustainably go from tens to hundreds of XGS-PON ports without losing sunk platform investments, replacing existing network infrastructure, or needing significant upfront costs.

Ciena's Universal Aggregation (UA) and access capabilities support multiple service options in addition to XGS-PON. With solution modularity, CSPs can offer enterprise business services over IP or dedicated Ethernet and mobile wholesale services with xHaul transport capabilities. Moreover, they can have a highly-optimized footprint that reduces energy and space requirements to expand addressable market and revenue opportunities. Hardened and weatherproof platforms provide network operators with maximum flexibility and the ability to move their OLTs closer to end-users for improved performance.

Ciena's Universal Aggregation Solution
Get insights

By aggregating and supporting multiple services, Ciena's Routing and Switching Platforms deliver unmatched scalability and flexibility by providing traffic using multiple 100, 200, or 400GbE Network-to-Network Interfaces (NNI).

Ciena's Residential Broadband Solution offers a family of Optical Network Units (ONUs), allowing end-users to benefit from multi-Gb/s connectivity while being open to support other vendors' ONUs to provide increased choice.

Ciena's solution is open by design—allowing CSPs to create the best possible network infrastructure by choosing preferred vendors that complement Ciena's network elements. This helps operators protect their competitive edge by not limiting their solution to a specific vendor's innovation cycle. This also allows operators to maintain better control over their procurement processes to minimize, and outright eliminate, vendor lock-in.

Deploying broadband is much more than just deploying network elements

CSPs are looking to deliver the best QoE to their customers while increasing operational efficiencies. Broadband network planning, infrastructure commissioning, service fulfillment, and service assurance can be complex as networks have grown. Ciena's PON Operations, Administration, and Maintenance (OAM) software makes network and service management simpler. PON OAM gives carrier-class management and control to provide Northbound IP API support for gNMI,

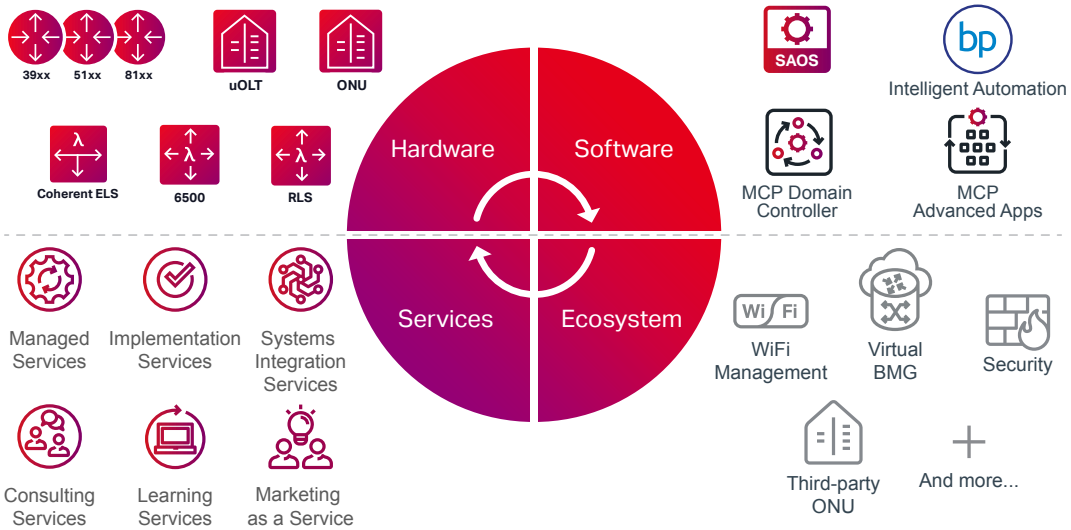

Figure 2. Ciena's Residential Broadband Solution components

NETCONF/YANG, and streaming telemetry over Secure Shell (SSH). PON OAM can be cost-effectively hosted on an external x86 server or internally on Ciena's UA platforms.

Ciena's Residential Broadband Solution also leverages Ciena's MCP domain controller which allows operators to scale the network—simplifying operations, reducing cost, and delivering the agility and resiliency that customers expect. It provides CSPs the ability to manage and orchestrate their multi-layered network from end to end—including headend, hubs, and Customer Premises Equipment (CPE)—when delivering broadband, enterprise, or mobile wholesale services using a common and integrated platform.

Supporting multi-vendor interop or third-party ONU integration, Ciena's solution avoids vendor lock-in by supporting both ONU Management Control Interface (OMCI) and Ethernet OAM in-band management. With rich, carrier-class OAM and Provisioning (OAMP) software, operators can persistently store configurations, provide Performance Monitoring (PM) data collection, perform fault monitoring, and manage firmware images.

Level up network control
Ciena's MCP

The scale and complexity of residential broadband networks require end-to-end automation. The Blue Planet Intelligent Automation Software automates service lifecycle management—from service design and resource reservation to orchestration and assurance—and provides real-time end-to-end service control and visibility across multi-domain, multi-layer networks. This helps CSPs improve customer experience, increase service agility, reduce OPEX, and streamline their strategic digital transformation initiatives.

Blue Planet Intelligent Automation Software
Learn more

To ignite a digital future for all requires planning, deployment, management, and support for implementing the latest broadband technologies—and requires specialized skillsets, tools, and deep institutional knowledge. While some network operators may have the requisite capabilities, others may not. Ciena offers a full suite of professional services, as well as learning and marketing services, to assure success. Ciena Services are designed to be flexible—they are available individually or as a packaged solution—and consist of Consulting, Implementation, Systems Integration, Maintenance, Managed Services, Optimization, and Learning.

Ciena Services
Learn more

Sustainability cannot be an afterthought

Investing in infrastructure to close the digital divide without considering all relevant environmental and economic sustainability aspects can negatively impact any service provider's long-term financial viability.

At Ciena, we continue to invest in the sustainability of all critical network elements by converging the access infrastructure with best-in-class routers, WaveLogic™ coherent optics, and innovative uOLTs and corresponding ONUs.

Sustainability models show we have already helped our customers avoid more than 550,000 metric tons of CO2e over an eight-year period (2014–2021) with our Routing and Switching Platforms—helping our customers' production networks achieve 23 percent savings in power consumption, equaling 96,000,000 kWh saved which resulted in $12 million per year OPEX savings.[1]

Through our WaveLogic coherent optic investments, we introduced the industry's first 400 Gb/s transceiver in 2017 and are delivering the pluggable version five years later at one fifth the power, one tenth the space, and with improved industry-leading systems performance.

Combining Ciena's routing, optical, and PON innovations together offers significant improvements in footprint and power savings to enable more efficient and sustainable networks for our customers—and the planet at large. For example, evolving from a traditional pure PON chassis-based, multi-boxed solution to Ciena's converged access with XGS-PON and routing in a single platform results in a 67 percent reduction in footprint and 63 percent reduction in power consumption. This is just one example and, when applied to 100,000 homes passed at 50 percent market share (12 sites) using a 64 OLT split, can avoid 84,400 kWh annually, resulting in 59.8 metric tons of CO2e avoided. A higher market share rate or homes passed would yield much larger sustainability results.

1 Ciena's Routing and Switching Sustainability Model to Quantify Equivalent CO2 Emissions Avoided: 2014-2021

Leverage the latest in open, modular, and scalable broadband technologies

CSPs need to implement a flexible and future-proof residential broadband solution that will enable them to stay competitive. Ciena's solution has been designed with these goals in mind.

With once-in-a-generation broadband investments, the opportunity is now for CSPs to rethink their residential network to realize greater sustainability and create a digital future for all—without compromise.

Why Ciena for residential broadband

- **Open:** Protects future growth by enabling providers to focus on quality customer experiences while containing cost and offering services at affordable prices
- **Modular:** Allows providers to start small and expand networks where and when residential, business, and institutional customers need it—streamlining operations and ensuring financial sustainability
- **Scalable:** Helps build a high-capacity, automated residential broadband network that scales dynamically to deliver on customer expectations, protect existing revenue streams, and capture new ones