Residential Broadband for Internet Service Providers and Regional Service Providers

Internet Service Providers (ISPs) and Regional Service Providers (RSPs) have been major drivers of broadband infrastructure growth across the globe. With a commitment to developing the communities they serve, they face the challenges of connecting geographically large, lower-density areas but with a tight business case. To sustain a high Quality of Experience (QoE)—while remaining profitable and enduring both technology and demand evolution—they require a smarter, more flexible broadband infrastructure.

Broadband network investments face unprecedented momentum. Technological and behavioral shifts in the spheres of work, education, and entertainment have radically accelerated, making high-performance broadband connectivity essential to everyday life—and a highly coveted resource. This expectation for ubiquitous connectivity has been met by a surge in private funding, coupled with massive public stimulus. The convergence of exploding demand and abundant capital has created an extraordinary opportunity for Fiber-to-the-Home (FTTH) expansion. ISPs and RSPs have been at the forefront of this movement, advancing new infrastructure, services, and capabilities to areas previously unserved or underserved, where often lower household density makes the business case particularly challenging for network expansion and/or modernization.

These service providers are critical to the communities they serve, where they often have strong local ties. They help bridge the digital divide and, by enabling high-quality broadband internet access, promote tangible economic and social development—ultimately integrating and connecting society. It is a noble mission, but not an easy one.

Delivering a high QoE at competitive prices over large areas of sparse and uneven demand requires an extremely flexible infrastructure, capable of adapting to the reality of each location and scaling as needed. But even in challenging and previously underserved areas, laying fiber and offering superior technology is no guarantee of evading competition. From alternative technologies to new entrants, even remote regions are likely to see some level of broadband competition, as Fixed Wireless Access (FWA) may become a viable alternative in some locations and new satellite networks promise to deliver reasonable performance at competitive prices with nearly unlimited reach. This competitive scenario leaves little to no room for

Highlights

- ISPs and RSPs play a critical role in their communities, helping bridge the digital divide, promote economic development, and integrate and connect society.

- Uneven and hard-to-predict subscriber demand requires a flexible and modular broadband infrastructure that can start small and efficiently scale when needed.

- To continue delivering great QoE as technologies and demand evolve, providers must embrace open and scalable architectures that can easily adapt to future requirements.

- To sustain business profitability, network monetization is crucial. This can be achieved through converged platforms capable of seamlessly supporting business and wholesale services.

- Once-in-a-generation private and public funding has created a unique opportunity to modernize residential networks and address the digital divide.

inefficiencies and the sustained success of ISPs and RSPs depends on seizing every opportunity to monetize investments and keep competitors in check.

> ### 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, affordable, automated residential broadband network that scales dynamically so providers can deliver on customer expectations to ensure quality services and quickly achieve a high adoption rate through the MaaS program[1]

The ideal next-generation residential broadband architecture

Unfortunately, the legacy approaches of incumbent vendors force ISP and RSPs 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 ISP/RSPs are starting to look for a more modern and sustainable option to implement their residential broadband networks—moving away from a closed, chassis-based approach towards a more automated, modular, and flexible architecture.

There is a new and smarter way to build broadband networks based on openness, modularity, scalability, and convergence.

This innovative approach leverages routing platforms embedded with XGS-PON micro Optical Line Terminal (µOLT) pluggables, supporting symmetrical 10GbE connectivity over shared fiber—enabling symmetrical access capacity from 100 Mb/s to multiple Gb/s in the most efficient way possible. Unlike legacy chassis-based architectures, it is highly modular, so providers can start with a single µOLT and grow up to 32 µOLTs per Rack Unit (RU)—which can support over two thousand subscribers. And, whenever higher density is necessary, additional 1-RU host platforms can stack up to a total of eight per system. It is a no-compromise path that allows providers to start small and invest as needed, all while optimizing space and power consumption so both CAPEX and OPEX are balanced.

But broadband services are not just about the access. Providers must never neglect the critical role aggregation networks play in the end-customers' QoE. As soon as gigabit per second access speeds are deployed in the last mile, the data flow bottleneck moves to the middle mile—the metro aggregation of a broadband network. A 'right-sized' middle mile and carefully planned oversubscription rates are crucial to making customers feel they are getting what they are paying for. A study by analyst firm ACG Research[2] indicates that average household peak-hour bandwidth demand is growing at 12 percent per year, which combined with typical subscriber growth rates creates the need for middle-mile expansion above 30 percent per year. Many legacy architectures offer very limited aggregation capacity, capped at 40 Gb/s or 100 Gb/s, which will not support growing demand. The study also showed that, even in small- to medium-size deployments, aggregate bandwidths must be capable of scaling to 100, 200, and 400 Gb/s in the next few years to support new applications and growing user demand.

In the next-generation broadband architecture, the host routing platforms are equipped with multiple 100, 200, or 400GbE Network-to-Network Interfaces (NNIs). This allows for much higher aggregation scalability, assuring that providers can keep up with subscribers' bandwidth demand, delivering the best QoE without the need to upgrade or replace platforms.

This architecture is open, which means providers can integrate compatible third-party Broadband Network Gateways (BNGs), Optical Network Units (ONUs), and other open software and hardware components as desired. The freedom to integrate network components from different vendors maximizes innovation and minimizes costs, paving the way for sustained business success.

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1 The Ciena Partner Network's Marketing as a Service (MaaS) is currently only available in the Americas Region. The products and services described here are available only to participants in the Ciena Partner Network (CPN). For more information about CPN, visit www.ciena.com/partners.
2 Ciena and ACG Research, "Middle-Mile Networks Capacity Requirements for Fixed Broadband", 2021
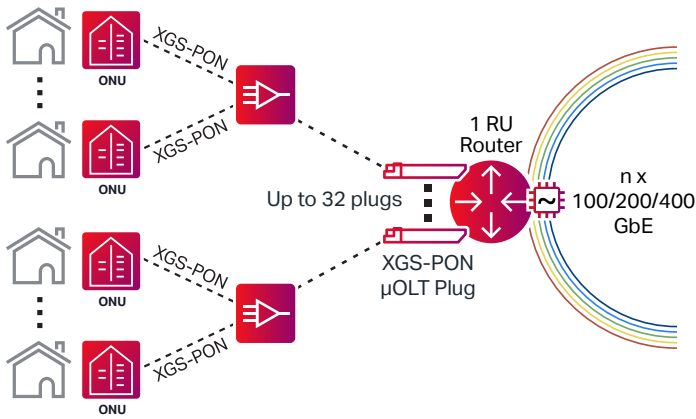
Figure 1. The ideal next-generation broadband solution

Broadband network planning, infrastructure commissioning, service fulfillment, and service assurance turn more complex as the network grows, and Operations, Administration, and Management (OAM) network tools become critical to running the network efficiently while sustaining a high level of customer experience. A carrier-class PON OAM with open APIs supporting gNMI and NETCONF/YANG, as well as streaming telemetry over Secure Shell (SSH), is highly recommended to complement this new broadband architecture.

Ciena's Residential Broadband Solution for ISPs and RSPs

Ciena's Residential Broadband Solution is designed to enable the next-generation residential broadband network architecture—simply and cost-effectively—for ISPs and RSPs.

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.

Ciena's routing platforms provide unmatched scalability by aggregating FTTH and middle-mile traffic using multiple 100, 200, or 400GbE NNIs, powered by market-leading WaveLogic™ 5 Nano coherent optical pluggables to support both existing and future bandwidth requirements.

This solution can converge last/middle-mile or FTTH/metro aggregation functionality by integrating XGS-PON µOLT plugs on Ciena's routing platforms, offering shared fiber broadband services for residential as well as Small and Medium Enterprises (SMEs). These platforms offer high SFP+ port density (accommodating up to 32 XGS-PON µOLTs per RU) with low energy consumption per port, in a modular approach that allows ISPs and RSPs to start small by deploying only the OLTs required for their short-term plans and investing as they grow. As application requirements evolve, Ciena's routing platforms are ready to support 25G PON pluggables when they are available in the future.

Ciena offers a highly scalable solution that can easily ramp from tens to hundreds of XGS-PON ports without sacrificing previous platform investments, replacing existing network equipment, or requiring significant upfront costs. This solution leverages Ciena's Universal Aggregation (UA) and access capabilities to support multiple service options in addition to residential broadband, enabling new revenue streams. It also allows providers to offer enterprise business services over IP or dedicated Ethernet and mobile wholesale services with 4G/5G xHaul transport capabilities. Moreover, it provides a
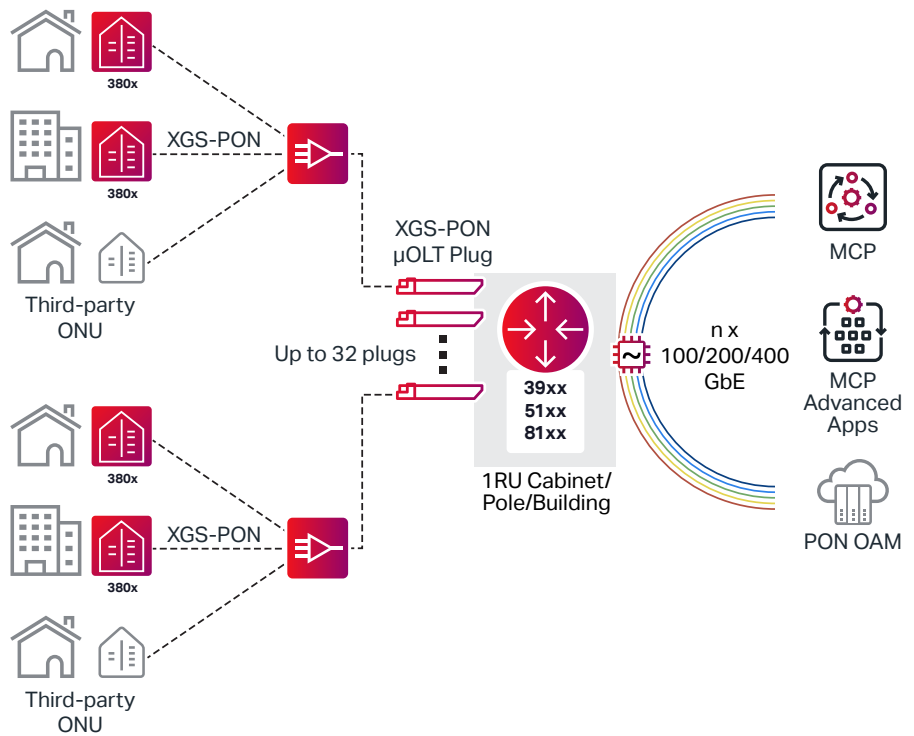

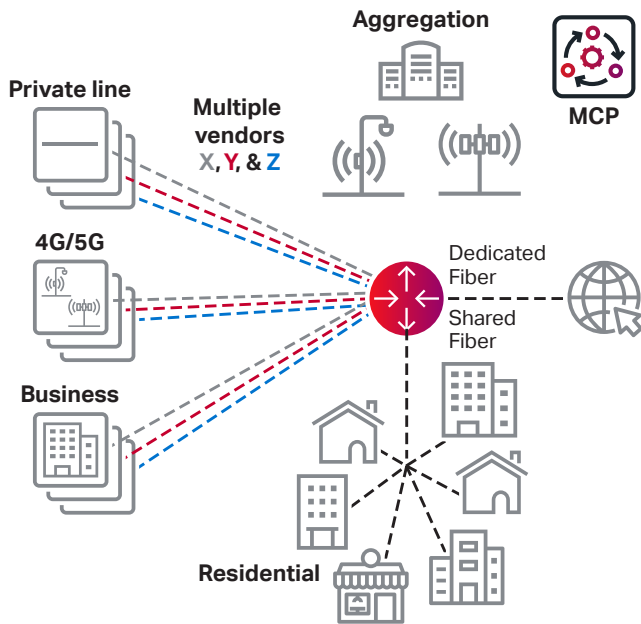Figure 2. Ciena's Residential Broadband Solution for ISPs and RSPs

Figure 3. Ciena's Universal Aggregation capabilites

highly-optimized footprint that reduces energy and space requirements to expand the addressable market and revenue opportunities. Hardened and weatherproof platforms provide additional flexibility, with the ability to move OLTs closer to end-users for improved performance.

Ciena's Universal Aggregation
and access approach
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From the customer side, Ciena's Residential Broadband Solution offers a family of ONUs, such as Ciena's 3801, 3802, and 3805, allowing end-users to benefit from high-performance and cost-efficient multi-Gb/s connectivity while being open to support other vendors' ONUs to provide technology choice and further flexibility.

Ciena's solution is open by design, providing the freedom to select best-of-breed network components that meet service providers' unique needs without limiting solutions to any single vendor's innovation cycle. It also gives better control over the procurement process, eliminating vendor lock-in. If providers need help accelerating and de-risking a multi-vendor architecture, Ciena's System Integration Service helps streamline the design, integration, validation, and implementation of a best-of-breed multi-vendor infrastructure.

Broadband beyond the infrastructure

To deliver the best QoE at a competitive price, service providers not only need the right infrastructure, but also an efficient operational model. Broadband network planning, infrastructure commissioning, service fulfillment, and service assurance can become challenging as networks grow. Ciena's PON OAM software makes network and service management simple and effective. Its carrier-class management and control provide northbound API support for gNMI, NETCONF/YANG, and streaming telemetry over SSH. The software can be cost-effectively hosted on an external x86 server or internally on Ciena's platforms.

Ciena's Residential Broadband Solution also leverages Ciena's Manage, Control and Plan (MCP) domain controller, which allows operators to simplify and automate their network operations. It gives the ability to manage and orchestrate multi-layer networks from end to end, including middle mile, last mile, and Customer Premises Equipment (CPE) when delivering broadband, enterprise, or mobile wholesale services using a common and integrated platform.

To further enable multi-vendor interoperability and third-party ONU integration, Ciena's Residential Broadband Solution supports both ONU Management Control Interface (OMCI) and Ethernet OAM in-band management. With rich carrier-class OAM and Provisioning (OAMP) software, providers can store configurations, provide Performance Monitoring (PM) data collection, monitor faults, and manage firmware images.

Additional support for business success

Not all service providers necessarily have the staff or experience to navigate the complex nuances of residential broadband network deployments. Ciena Services' extensive experience and industry best practice processes can assure a successful rollout. Depending on the provider needs, Ciena can support initial planning and design, systems integration, implementation to network optimization, support, and management. Ciena also offers an extensive library of learning courses and labs to enhance employee knowledge. Ciena Services are designed to be flexible and can be consumed individually or as a packaged solution.

Ciena Services
Learn more ⊝→

Ciena's solution goes beyond just a network solution, as it also includes the Ciena Partner Network's Marketing as a Service (MaaS) program. This award-winning marketing support service helps providers go to market faster and more efficiently through collaborative engagement, execution, and dedicated marketing experts. Ciena stands by our customers, supporting the development and execution of their go-to-market strategies, winning business together.

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.[3]

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.

Maximize community impact. Boost business outcomes.

ISPs and RSPs are moving away from closed, chassis-based approaches that simply cannot offer the capacity, efficiency, and adaptability required to succeed in the rapidly evolving broadband market. Ciena's next-generation solution has been proven by multiple rural small-scale operators—as well as by some of the largest service providers in the world—to provide a flexible, cost-effective, and sustainable solution to expand and modernize residential broadband networks. With Ciena, ISPs and regional and rural providers can build a better next-generation broadband infrastructure with the scalability, openness, and modularity needed to close the digital divide and transform communities.

(?) Was this content useful?   Yes   No

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

ciena.