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PRODUCT BRIEF

Middle Mile Made Modern

Empowering High-Performance Broadband for Today and Tomorrow

June 2024

Unleashing High-Performance Broadband with Flexible Middle Mile Solutions

Broadband providers face a constant battle: staying ahead of ever-increasing bandwidth demands. From work-from-home tools and high-definition streaming, to the burgeoning Internet of Things (IoT), data usage continues to skyrocket. The future holds even more bandwidth-intensive applications, like 8K streaming, immersive learning experiences, and augmented reality powered by artificial intelligence.

Bridging the digital divide, while crucial, only addresses part of the equation. Users in underserved areas have the same expectations for performance and bandwidth as their urban counterparts. While deploying the latest PON (Passive Optical Network) and wireless technologies can deliver faster speeds, a critical element often gets overlooked - the middle mile.

Traditional middle mile deployment methods lack the agility and flexibility needed to handle the exponential growth in data traffic. This creates a bottleneck, negating investments in last-mile technologies.

The Equation:

More Users on the Network + Higher Bandwidth Applications + Future Capacity Needs = Middle Mile Stress

Network operators are struggling to meet demands with traditional solutions.

Today's network operators need to:	Traditional networks suffer from:
Rapidly grow middle mile capacity to keep up with aggregate traffic demands.	Slow capacity deployment with existing solutions creating bandwidth bottlenecks and limiting agility.
Future-proof flexible network infrastructure.	Vendor lock-in and lack of compatibility with proprietary solutions, which limits options.
Reduce operational costs, make better use of space and lower power consumption.	Poor TCO driven by prohibitively expensive licensing models, support costs, as well as equipment's space and power requirements.
Decrease lead times for network deployments and expansions.	Proprietary solutions frequently encounter significant lead time delays, often exceeding 12 months, which severely hinder timely network expansion.
Use best-of-breed technology including networking hardware and optics to ensure top performance and reliability.	Limited technology choices due to closed network architectures create vendor lock-in.
Deliver operational visibility and management simplicity.	Complex operational environment creates delays in operational processes.

IP Infusion Has the Solution:

A Modern Approach to Middle Mile Deployment for Broadband Operators

IP Infusion open networking solution powered by Ciena ZR+ optics empower operators to innovate on their own terms. Our converged packet/optical solution, combining the proven strength of IP Infusion's carrier-grade OcNOS network operating system with Ciena's cutting-edge WaveLogic 5 Nano 400G ZR/ZR+ coherent optics, and interoperable white boxes from Edgecore, UfiSpace and Celestica, delivers the performance, scalability, and cost-efficiency needed to make high-speed broadband a reality for everyone.

IP Infusion Delivers

Limitless Customizability at Every Stage	Single Vendor Simplicity	Better Middle Mile Performance
OcNOS Field Proven Network Operating System	■ Easy network expansion ■ Unprecedented customizability ■ Best-of-breed compatibility ■ Clear Accountability ■ Single 24/7 expert support for all software, hardware, and optics	■ Future-proof technology ■ Lower TCO ■ Faster scaling ■ Greatly reduced lead times ■ Integration and Management Simplicity ■ Advanced support for ZR+ with transceiver tunning through OcNOS Future-proof technology
ROUTING EQUIPMENT Choose from more than 50 qualified white boxes.		
TRANSPORT EQUIPMENT Featuring Ciena's WaveLogic 5 Nano (WL5n) 400G ZR/ZR+		

Get The Best-of-Breed Solution That Work Best at EVERY Layer:

ZR+ Transceiver Configuration on OcNOS using OpenConfig and CMIS

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NOS

Enjoy OcNOS's complete feature stack and integrate with a large selection of whitebox switch suppliers.

Streamlined Operations

- ✓ **Fast & Easy:** Reduce engineer training and simplify deployments with familiar and intuitive industry standard CLI.
- ✓ **Cost-Effective:** Simple perpetual licensing model.
- ✓ **Advanced ZR+ Support** Streamline operations and eliminate external tools with comprehensive transceiver tuning directly from the command line.

Stay Ahead

- ✓ Stay flexible so you can seize the next opportunity and adapt.
- ✓ Gain immediate access to cutting-edge technologies like advanced fabric architectures (EVPN, VxLAN) and protocols (SR-MPLS, Segment Routing, BGP unnumbered, SR P2MP, FlexAlgo and more),

No Vendor Lock-in

- ✓ Get the freedom to choose components from the widest range of white box routing and transport solutions.

Routing

Choose from a wide selection of access, aggregation and edge routers.

- ✓ **Devices**

  The widest range of supported white box routing and switching hardware with over 50 qualified devices.

- ✓ **Vendors:**
  - Edgecore
  - UfiSpace
  - Celestica
- ✓ **Post Speeds**
  - 100M to 400G
- ✓ **Switching Capacities**
  - 32Gbps to 14,400Gbps

See the full list here (link)

Simple, transparent licensing of OcNOS with the freedom to select the ideal combination of hardware components from leading vendors.

Future-proofed network tailored to your unique requirements and budget.

Optical Transport

Get best-of-breed 400G ZR+ pluggable technology with Ciena's WaveLogic 5 Nano.

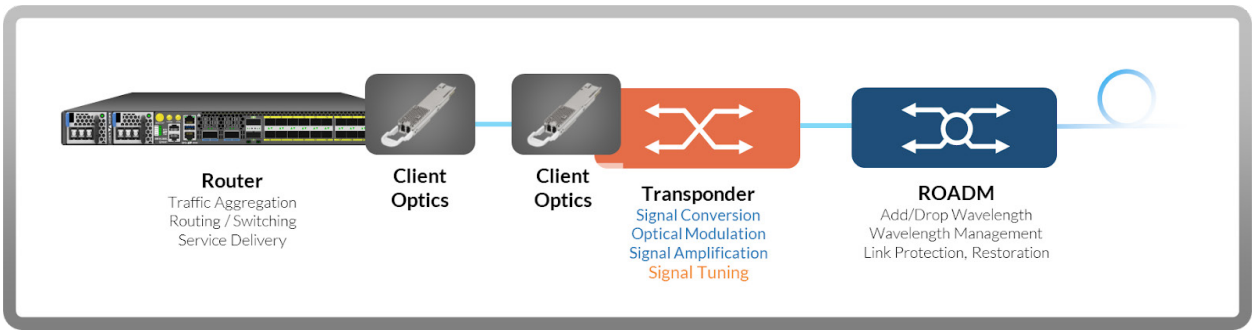
Ciena's ZR+ technology revolutionizes optical transport by simplifying network architectures and reducing costs.

By working with **Ciena's WL5n 400G ZR/ZR+,** which requires less power and needs less space to operate, you can:

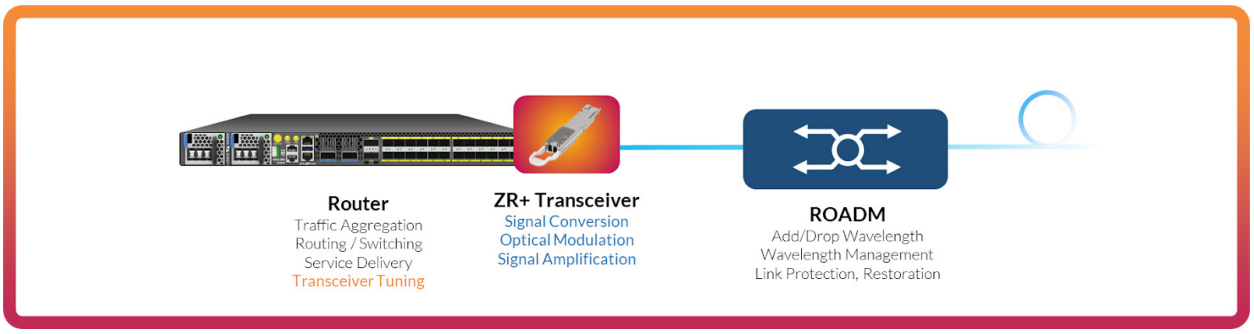
- **Keep Up with Growing User Demand:** ZR+ optics enable high capacity 400G transmission over long distances, making it ideal for connecting remote and underserved areas. This is particularly beneficial for initiatives like BEAD, where extending broadband to rural communities is a priority.
- **Maximize your network investment:** Leverage advanced modulation techniques to maximize the capacity of existing fiber optic infrastructure.
- **Deliver the best experience for users:** IP/Optical convergence simplifies the signal path, resulting in lower latency, which is crucial for applications like online gaming, video conferencing, and other real-time services.

Reducing your transport equipment and operational costs:

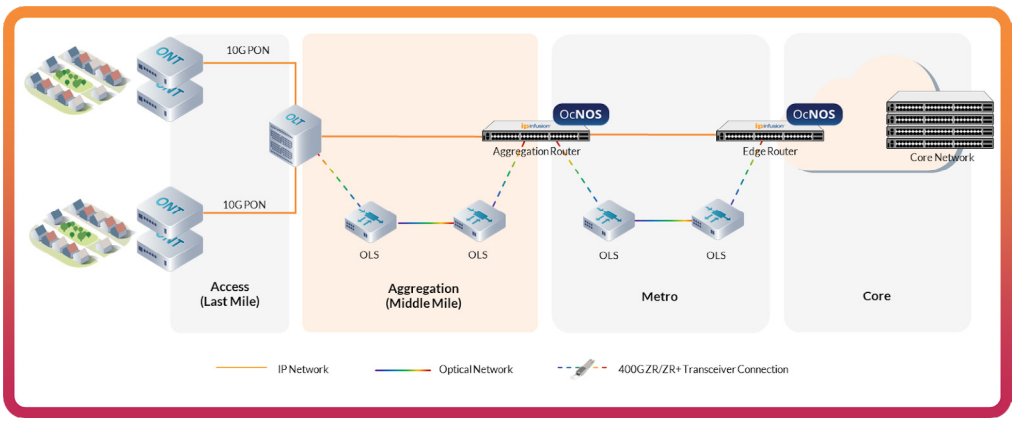
ZR+ optics integrate multiple functions traditionally performed by optical transponder directly into the pluggable module. This eliminates the need for expensive and power-hungry transponders.



Before. Traditional OLS with Transponders and Client Optics



After. ZR+ Enabled OLS with ZR+ Transceivers



Reference Architecture of Middle Mile Network With ZR+ Transceivers

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Qualified Ciena 400G Pluggables

Transceiver Model	400G Modes	Power Output	Application	Status As of May, 2024
176-3530-901	400ZR	-13dBm to -9dBm	Single span DCI – 120km	✓ Qualified
176-3580-900	400ZR, 400ZR+	-13dBm to -9dBm	Longer reach / better perf. vs. ZR Router-optimized application Limited span/ROADM support	✓ Qualified
176-3590-900	400ZR, 400ZR+, PKT-MAX	-13dBm to -9dBm	Supports interop modes plus longer reach/better perf. vs. ZR+	Coming Soon
176-3360-900	400ZR, 400ZR+, PKT-MAX	-7dBm to +4dBm	Longer reach/better perf. vs. ZR Router-optimized application +4dBm Tx, any type of line system	Coming Soon
176-3370-900	400ZR, 400ZR+, PKT-MAX, OTN-MAX	-7dBm to +4dBm	Support for all modes – interop and high performance +4dBm Tx, any type of line system	Coming Soon

OcNOS Qualified Ciena 400G ZR/ZR+ Transceivers

A Seamless Open Networking Solution

Backed by 25 Years of Trusted Network Leadership

Simplify your network management and expansion:

IP Infusion's **Open Networking Solution** delivers a seamless one-stop shopping experience combining OcNOS network operating system with the best-of-breed routing and transport technology. Whether you're adding middle mile capacity or deploying a new system, you can significantly reduce install times – and get a lower TCO by deploying a sustainable solution that requires less space and consumes less power.

- **We're the industry leader:** 25+ years of experience in networking solutions.
- **We built the foundation of modern NOS:** Many leading Network Operating Systems (NOS) in the market today are built upon our technology.
- **We're trusted all over the world:** Over 600 global deployments in carrier networks, including numerous U.S. broadband customers.
- **You get *comprehensive* functionality:** Complete, field-proven solutions, unlike unproven and niche market alternatives.

At IP Infusion, we understand navigating complex projects with multiple vendors can be overwhelming. That's why we take the burden off your shoulders. We manage all aspects, ensuring seamless integration across software, hardware, and optics.

Our commitment extends beyond implementation. Our agile support team provides comprehensive maintenance, giving you peace of mind and a single point of contact for all your needs.

Contact Us Today

Contact IP Infusion to learn how our network solutions can facilitate and accelerate your Middle Mile initiatives.

ABOUT CIENA

Ciena is a global leader in networking systems, services, and software. We build the most adaptive networks in the industry, enabling customers to anticipate and meet ever-increasing digital demands. For three-plus decades, Ciena has brought our humanity to our relentless pursuit of innovation. Prioritizing collaborative relationships with our customers, partners, and communities, we create flexible, open, and sustainable networks that better serve all users—today and into the future.

Web | www.ciena.com

ABOUT IP INFUSION

IP Infusion is a leading provider of open network software and solutions for carriers, service providers and data center operators. Our solutions enable network operators to disaggregate their networks to accelerate innovation, streamline operations, and reduce Total Cost of Ownership (TCO). Network OEMs may also disaggregate network devices to expedite time to market, offer comprehensive services, and achieve carrier grade robustness. IP Infusion network software platforms have a proven track record in carrier-grade open networking with over 500 customers and over 10,000 deployments. IP Infusion is headquartered in Santa Clara, Calif., and is a wholly owned and independently operated subsidiary of ACCESS CO., LTD. Additional information can be found at **http://www.ipinfusion.com**

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