

APPLICATION NOTE

Craving Bandwidth? Investigate New Ways to Expand Capacity.

Ciena's Waveserver® leverages current infrastructure to keep pace with rising bandwidth demands

Networks are experiencing explosive bandwidth growth, which is exhausting capacity on highly utilized links. For Research and Education, in particular, widespread mobile device use, streaming media, evolving educational tools, and the growing volume of exchanged research files are driving up bandwidth demand across campuses and R&E networks. In addition, limited bandwidth availability directly influences which applications and functions educators can use in the classroom and online, often limiting their ability to use the cloud for managing files or hosting curricula, materials, and other data storage.

The challenges involved in providing sufficient bandwidth manifests in specific network locations, including between data centers, from various locations to the data center, within a campus environment, and between branch or campus locations. In each case, bandwidth must be increased along high-utilization paths while leveraging existing infrastructure as much as possible to minimize budget impact.

Addressing bandwidth demand using traditional LAN/WAN expansion methods requires the deployment of larger ports on Layer 2/Layer 3 switches and routers. This approach adds complexity and is not the most cost-effective way to keep pace with rising bandwidth demands. To resolve these challenges, network operators can rip out and replace existing infrastructure using newer equipment, a solution that requires significant financial investment and increases the risk of service interruptions.

There is another alternative, however, using new, cost-efficient bandwidth expansion equipment inserted into the network without disrupting existing infrastructures or network architectures. Ciena's Waveserver family of products—Waveserver and Waveserver Ai—enables network operators to rapidly scale capacity across point-to-point links that are experiencing exhaust to due high traffic demands. They are high-density, compact devices that can increase capacity using a 'server-like' rack-and-stack deployment model to facilitate installation and provisioning in minutes, not days. With a full suite of industry-standard open APIs, the Waveserver family is fully programmable, enabling integration into virtually any pre-existing network environment.

Benefits

- Features best-in-class coherent optical technology
- Drives the highest possible capacity, regardless of distance, through flexible modulation formats
- Enables higher density and greater fiber capacity, and reduces power costs
- Offers industry-standard open APIs, and operates across non-Ciena line systems as an alien wavelength to leverage existing infrastructure
- Provides DevOps test and development environment for creating, testing, and fine-tuning customized applications

The ability to efficiently expand bandwidth capacity while leveraging existing network infrastructure makes the Waveserver family an attractive option to help R&E network operators keep pace with increasing capacity demands. By deploying Waveserver platforms instead of costly DWDM optics on routing/switching devices, network operators can save up to 50 percent of CAPEX/OPEX costs compared to the cost of upgrading current router-based networks.

Chalk Talk: Waveserver Ai
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Waveserver Benefits

The primary benefits of deploying Ciena's Waveserver family include:

1. Best-in-class coherent optical technology (coherent optical processors increase transport capacity) combined with scalable IT functionality. Waveserver platforms can be quickly and easily deployed out of the box to expand bandwidth and extend network performance beyond traditional local and/or regional limits.
2. By supporting flexible modulation formats, Waveserver products drive the highest possible capacity, regardless of distance, so network operators can quickly bring new locations onto the network, or increase performance on the most congested network links.
3. By leveraging advances in spectral shaping, soft Forward Error Correction, and Ciena's analog-to-digital conversion techniques, the Waveserver family outperforms competitive alternatives. In other words, the use of more bits per wavelength translates to higher density, greater fiber capacity, less hardware, reduced power consumption, and lower costs.
4. Waveserver products advance 'openness.' With industry standard, open APIs, Waveserver and Waveserver Ai can be easily integrated into a network operator's arsenal, or used with new applications or scripts to support unique, individual requirements. Ciena's Waveserver products can operate across non-Ciena line systems as an alien wavelength, allowing operators to upgrade capacity while leveraging their existing photonic infrastructure.
5. Using Ciena's Emulation Cloud™, Waveserver can be emulated in a test and development environment for DevOps testing purposes, or for creation, testing, and fine-tuning of customized applications.

The three unique scenarios highlighted below explain how Ciena's Waveserver platform can be used to alleviate current R&E network capacity challenges while cost-effectively meeting growing bandwidth demands. It is increasingly being used to help simplify everything from planning and ordering to provisioning and maintaining resources in R&E networks.

Rethinking bandwidth demand options

Ciena's Waveserver family has been deployed in a variety of scenarios to provide rapid and long-term bandwidth scale on exhausted network links. The three use cases below—existing fiber optimization, branch or campus expansion, and data center interconnect—are especially relevant to the R&E community.

1. **Existing fiber optimization** – Many network operators who own fiber infrastructure still face budget challenges when they seek to increase bandwidth capacity for their customers. They have found that Ciena's Waveserver can be a cost-effective option to scale any 10G network to meet growing capacity demands without impacting current networks. With pay-as-you-go pricing, Waveserver can be used to help enable less-expensive use of the fiber optics on existing routers. A single Waveserver can be used to carry a mix of 10GE, 40GE, and 100GE over dark fiber or existing DWDM line systems, making planning and sparing as simple as possible.

Figure 1 highlights an example in which a network operator sought to upgrade bandwidth on interconnections from 10G to 100G+. Integrating 100G DWDM ports into existing switches and routers was not a cost-effective, feasible solution. Instead, Ciena's Waveserver may be deployed in front of the existing

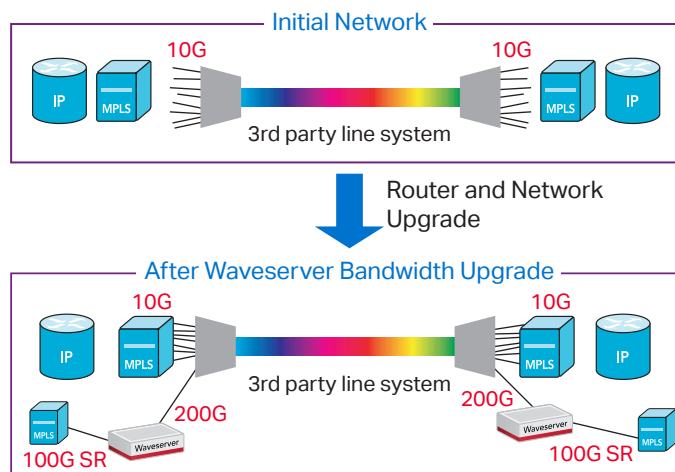


Figure 1. Waveserver optimizes fiber capacity

switching and router infrastructure to enable growth of select circuits to 100G. In this scenario, Waveserver provides the DWDM network interface and enables the use of low-cost, short-reach optics on the routers and switches at a significant cost savings, while also preserving the existing infrastructure.

In R&E environments, this approach can help universities increase bandwidth between campuses, from campuses to regional and long-haul R&E network providers, or across research-specific data paths. Using Waveserver to increase network capacity addresses rising student media demands, enables new learning initiatives, and allows researchers to exchange data, including ever-larger image files and unstructured data for scientific research and analysis—all at a significant cost savings.

2. Branch or campus expansion – Waveserver and

Waveserver Ai may also be deployed to enable modular branch or campus location expansion. Both products provide simple, point-to-point connectivity to backhaul traffic from a spur or branch location. It is much faster and easier to deploy Waveserver platforms than to implement a full ROADM-based, DWDM network solution at each offsite location. This helps network operators get a branch location up and running quickly without requiring lengthy planning and deployment initiatives, as shown in Figure 2.

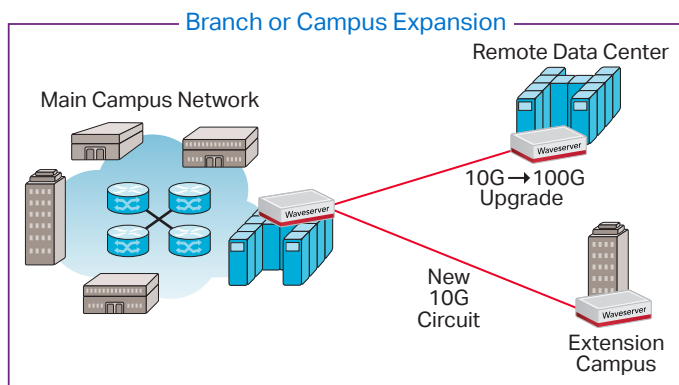


Figure 2. Simple, fast solution for connecting branch locations

Both Waveserver and Waveserver Ai offer a small footprint and low power consumption in an easy-to-install and -manage device. Also, since they are compact, one-Rack Unit (RU) devices, shipping them from one location to another as demand or service requirements shift is easy.

R&E network operators appreciate the ability to extend network privileges to universities and other organizations by deploying Waveserver products at various locations that

will participate in specific research or education projects. Based on bandwidth demand requirements, Waveserver or Waveserver Ai may be shipped and moved to other locations to ensure network accessibility, without the time and expense of implementing a complete Layer 0 (ROADM and DWDM) platform at each location.

Bolstering Higher Ed Networks
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3. Data Center Interconnection (DCI) – Ciena’s Waveserver family was designed to interconnect data centers across metro, regional, and long-haul links while providing a server-like experience for a wide range of high-capacity interconnect uses and applications, as shown in Figure 3.

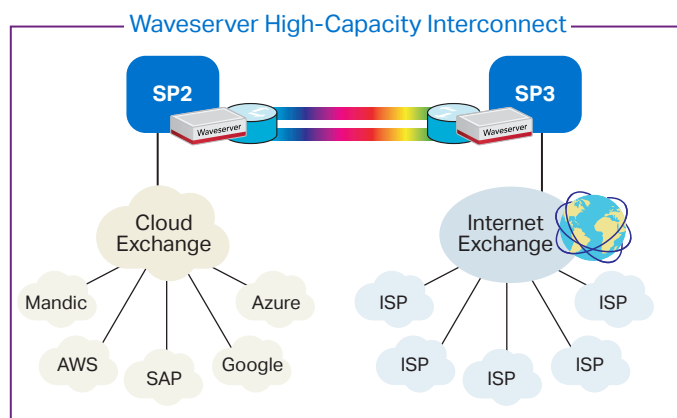


Figure 3. Waveserver provides flexible, scalable DCI

Waveserver and Waveserver Ai products enable simple, scalable DCI in a rack-and-stack 1RU form factor (the smallest rack increment). Flexible modulation and support for multiple line rates enables the Waveserver family to optimize capacity for each application. Depending on how it is configured, Waveserver can support two 100 Gb/s, 150 Gb/s, or 200 Gb/s wavelengths, enabling density of up to 400 Gb/s of line capacity plus 400 Gb/s of client Ethernet ports in a compact, 1RU footprint. It even supports a mix of 10GE, 40GE, and 100GE clients on the same device.

Waveserver Ai provides massive scalability for the largest interconnect requirements, with single-carrier line rates up to 400 Gb/s. Waveserver Ai also provides up to 2.4 Tb/s of line capacity plus 2.4 Tb/s of client Ethernet ports in a single rack unit, with ultra-low power consumption at 0.4 W/Gb.

These scenarios illustrate how R&E network operators can incorporate a few new tools and techniques to rapidly and easily increase bandwidth while leveraging their existing line systems and router/switching hardware to minimize capital expenditure.

The Ciena difference

Ciena has proactively partnered with global R&E organizations for decades, supporting evolving demands for everything from massive data transfers to streaming video and advanced IoT analytics. This is why the world's largest R&E institutions turn to Ciena to meet their high-performance network requirements. Ciena's Waveserver family of interconnect products provides a scalable, flexible, open, high-capacity optical transport platform that can help network operators extend and expand capacity while lowering costs, securely protecting network traffic, and keeping pace with bandwidth demands, now and for the foreseeable future.

Ciena's collaboration with research and academia also drives the company's R&D in optical and packet networking. Ciena is working now to develop network advances that will help R&E networks keep pace with evolving requirements and stay ahead of surging capacity demands. Ciena's packet-optical network solutions lower up-front capital investments while reducing ongoing operational costs by consuming less space and power and simplifying network management. Ciena's open-architected platforms create a highly available and resilient foundation for flexible, software-driven next-generation networks.

Please visit www.ciena.com/researchandeducation or www.ciena.com/insights/data-center-interconnect to learn more or get started.

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