

**APPLICATION NOTE**

# WaveLogic Ai: Laying the Foundation for the Autonomous Optical Network

## Today's networking challenges

Network operators know it all too well: streaming video, cloud computing, the Internet of Things (IoT), and the evolution to 5G are putting massive pressure on today's networks, requiring capacity increases by orders of magnitude and the ability to respond to even greater unpredictability in traffic patterns.

The optical network sits at the heart of communications, interconnecting people, data centers, and an increasing number of devices across any distance, from across the street to across the ocean. Yet, for all the critical functions and agility they need to provide to meet today's web-scale demands, most networks are weighed down with manual processes and hardware inflexibility.

Operators are working to keep up with bandwidth demands by deploying, managing, and sparing different hardware for different areas of the network using cost-optimized solutions per specific application. They select their hardware based on upfront link engineering determined with best-guess fiber characterization data. Lack of network visibility and little hardware flexibility limit network efficiency, forcing operators to operate at suboptimal capacity, leaving revenue on the table and resulting in costly network overbuilds. With the speed at which technology shifts are occurring in the industry, using this operating model is no longer an option.

New technologies promise to drive discontinuity in both cost and power reduction. Higher baud rate, programmable, coherent technology can reduce transport costs and put operators within reach of their business goals. But if operators cannot get accurate, real-time link data from the network to determine the right channel capacity rate at any point in time, they cannot take advantage of the savings associated with the new technology.

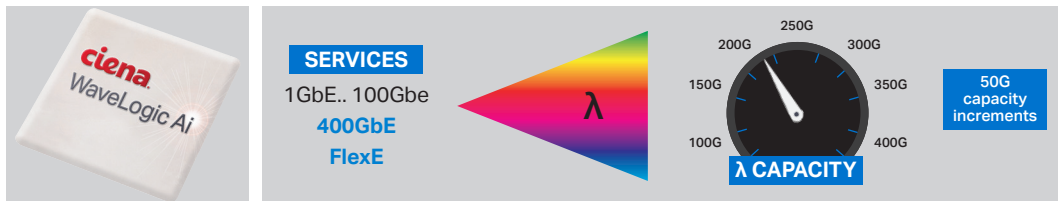
What if the network could self-monitor and adapt to application demands in real time, adjusting capacity across paths as needed based on traffic requirements and system margin? Evolving to such an autonomous network would drive new levels of efficiencies and speed in achieving business goals.

## Benefits

- Provides real-time optical networking performance data as well as the tunability required to build on-demand, programmable networks
- Changes transport economics radically by driving double the capacity per channel, three times the distance at the equivalent capacity, and four times the service density
- Maximizes channel capacity for all applications with tunability from 100G to 400G in 50G increments
- Delivers new levels of visibility and the ability to accurately engineer the network for optimal capacity and maximum efficiency

Network insights: WaveLogic Ai  
Learn more





## ADJUST CAPACITY FOR ANY APPLICATION

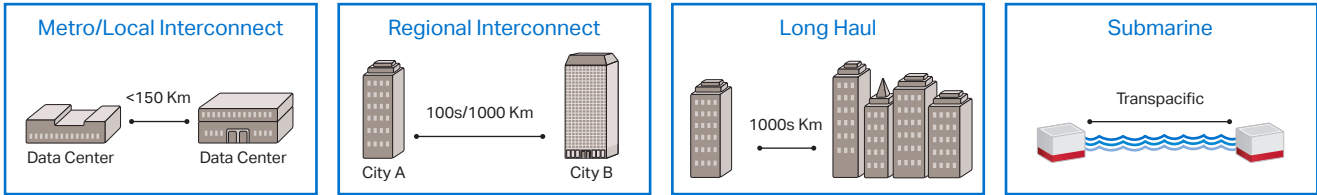


Figure 1. Unmatched programmability

### Introducing WaveLogic Ai

Having pioneered coherent optical solutions with deployments since 2008, Ciena has unique, systems-level expertise and insights into the challenges network operators face in scaling their networks. Using this knowledge, Ciena is integrating new capabilities into its next-generation WaveLogic coherent technology, WaveLogic Ai, that fundamentally changes how optical networks are built and managed moving forward.

WaveLogic Ai provides unprecedented systems intelligence and programmability to address the increasingly dynamic service requirements of today's on-demand networks. It exposes a tremendous amount of data through open interfaces that enable automated, programmable networks.

Introducing a new paradigm for optical networks, WaveLogic Ai provides operators with new visibility into and control over the efficiency of their networks. For the first time in optical networks, users will be able to access real-time link monitoring information to determine the optimal capacity for each channel—across any path, for any network fill—and tune to match that capacity with a single technology that can address any application, from metro Data Center Interconnect (DCI) to trans-Pacific submarine.

WaveLogic Ai builds upon the best-in-class performance of WaveLogic 3 and uses an advanced, 400G-optimized engine to significantly improve transport economics: driving twice the capacity per channel, three times the distance at equivalent capacity, and four times the service density, all at less than half the power.

### Unprecedented programmability

Ciena's WaveLogic Ai technology platform operates at a selectable baud rate of 35Gbaud or 56Gbaud, giving users the ability to trade channel throughput for optical performance and spectrum usage while delivering power and space efficiency benefits over both fixed and flexible grid photonic line systems. At 56Gbaud, the higher level of serial integration, coupled with higher-complexity signal constellations enables a modem that provides the lowest cost and lowest power per bit per km, leveraging fewer components by using only one laser, modulator, and receiver.

WaveLogic Ai | Watch video

WaveLogic Ai is the industry's first coherent modem that can provide the ability to tune capacity from single carrier 100G to 400G in 50G increments. The full range of capacities are available at 56Gbaud, with 100G to 250G channel capacities available at 35Gbaud. This allows network operators, and content and cloud providers to better match capacity to system margin, all with a single technology that can address any application, from high capacity, short-reach metro to ultra-long-haul and submarine. With Ciena's best-in-class soft-decision Forward Error Correction (FEC) and DSP algorithms, operators can deploy higher capacity channels over longer reaches and eliminate regens from the network.

WaveLogic Ai uses advanced high-performance, multi-dimensional modulation to implement 400G on a single carrier supporting short reach applications capable of reaching 300km distances. At the other extreme, WaveLogic Ai can operate a single-carrier 100G

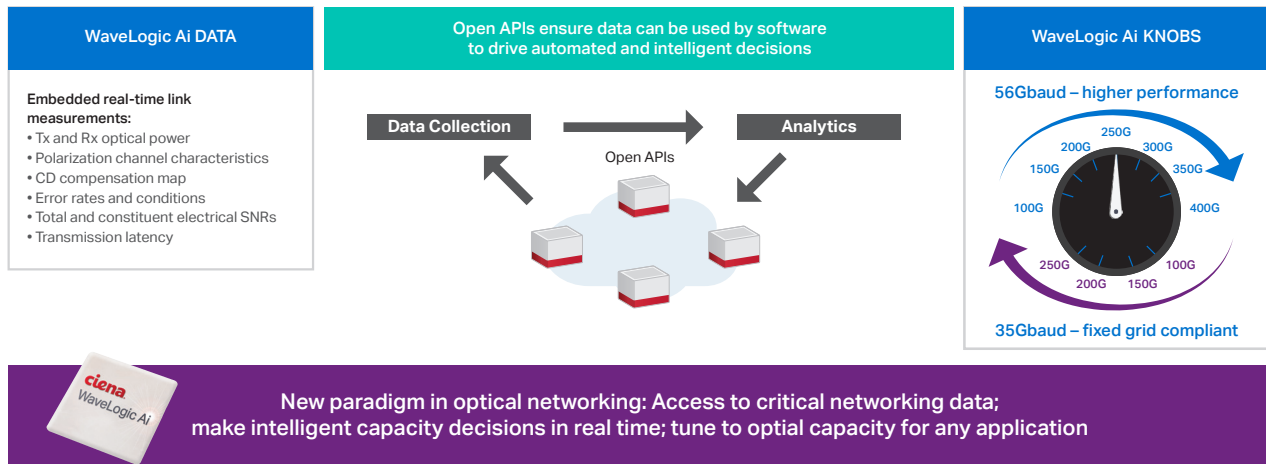


Figure 2. Laying the foundation for the autonomous optical network

over 7,000-kilometer terrestrial distances without regeneration, or equally across the Pacific for submarine applications. Operators can match capacity for applications with reaches that fall between these examples using 150G, 200G, 250G, 300G, or 350G channels.

### Previously unattainable network monitoring and efficiencies

For the operator to be able to optimize network capacity, the system itself must be able to monitor and gather critical information in real time. Using deep systems-level expertise, Ciena has embedded unique, real-time link monitoring capabilities, never before available, into WaveLogic Ai. Operators can now understand exactly how much margin is currently present in the network, as well as the optimal capacity they can deploy.

With the embedded instrumentation in WaveLogic Ai, a comprehensive photonic network monitor can now be realized. Combined with Software-Defined Networking (SDN) analytics, applications such as predictive link failure now become possible, allowing operators to pre-empt outages with scheduled maintenance activities.

The embedded link measurement capabilities of WaveLogic Ai enable operators to extract the most efficiency out of their network at any point in the network's life. Users can access the following comprehensive real-time measurements, which are updated every 10ms, from WaveLogic Ai:

- Transmit and Receive optical powers
- Polarization channel characteristics
- Electronic chromatic dispersion compensation map
- State of polarization and its dynamics

- Error rates and conditions
- Total and constituent electrical Signal-to-Noise Ratios (SNRs)
- Transmission latency

Open interfaces on Ciena's products ensure this data can be put to use by software to drive automated and intelligent decisions to ensure maximum efficiencies and reduce network overbuilds.

### Ready for the future

In order to realize the full cost and efficiency benefits associated with variable line capacity, flexible client service support is required so that the system can efficiently match the service throughput to the line bandwidth. This requirement is already built into the WaveLogic Ai technology platform. Ciena has integrated common client logic inside the modem itself, eliminating dependency on peripheral components for high-capacity applications, including 400GbE and Flex Ethernet. This additional level of integration results in higher service density, lower power, and more compact footprint solutions ready for the SDN world.

### Enabling the autonomous network

WaveLogic Ai lays the foundation for tomorrow's self-driving, autonomous networks. With WaveLogic Ai, operators can take advantage of improved transport economics, gain new insights and control into the efficiencies of their network, and use new levels of automation to compete and win in the new on-demand economy.

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