ECI THE ELASTIC NETWORK

NETWORK EVOLUTION

TO 200G WITH APOLLO

HASSLE-FREE NETWORK CAPACITY EXPANSION

As the need for bandwidth continues to increase throughout metro, long haul, and data center interconnect networks, network operators are looking for easy ways to expand capacity without ripping out their entire network infrastructure. 10G networks have been the standard for years, and 100G has become affordable for most networks recently. However, the move beyond 100G is unclear, with most solutions requiring extensive upgrades such as flexgrid support throughout the network.

ECI's Apollo 8QAM and 16QAM 200G solutions are designed to operate in the same 50GHz spacing that is currently deployed for 10G and 100G networks, offering a hassle-free and economical doubling of network capacity. ECI's industry-leading 8QAM solutions offer unprecedented span budget in a fully interoperable, digital CFP2 package.

Fast

Over 24Tbps potential capacity per fiber

Compatible

Operates over existing 50GHz spaced networks

Economical

Optics costs on par with 100G, no network upgrade costs

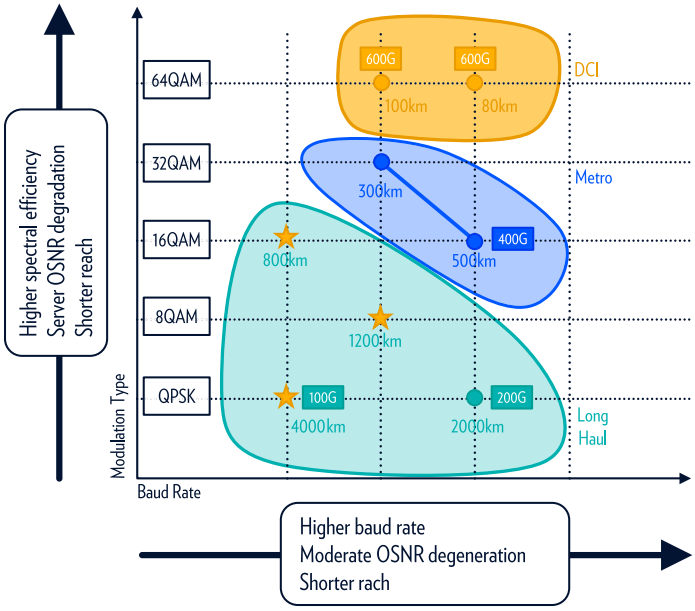
Extended Reach

Over 1200km span with 200G 8QAM

200G

The move to 100G and higher transmission rates has introduced the concept of complex modulation schemes into optical networking. Rather than the simple on-off-keyed (OOK) techniques used in speeds up to 10Gbps, higher speed optical networking signals use multi-level and multi-phase modulation techniques to transmit information. The techniques employed borrow from technologies developed for satellite transmission, such as Quadrature Amplitude Modulation (QAM) and Quadrature Phase Shift Keying (QPSK).

At 100G, the industry coalesced around QPSK as the modulation format, allowing unrepeatered distances of 4000km or more. For higher speeds, a variety of modulation and baud rate options are being considered and developed. Apollo's MSA-based 200G interfaces use 16QAM modulation, allowing distance of up to 800km. The latest offering from ECI, Apollo's digital CFP2-based 200G interfaces, uses 8QAM modulation, which is a less complex modulation scheme, requiring a higher baud rate and allowing longer distance (1200km) operation.

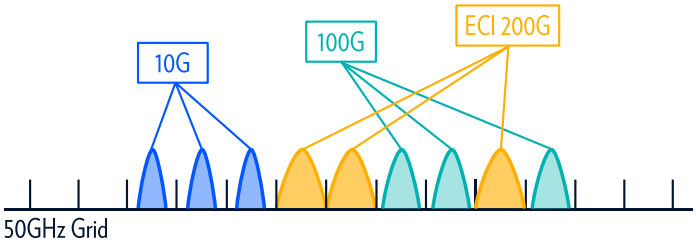


Apollo's 8QAM solution maintains the ability of 16QAM solutions to operate within the 50GHz wavelength grid while offer a larger span budget. The larger span budget is ideal for metro networks with multiple ROADM sites and/or for longer reach networks (1200km versus 800km). By operating within the 50GHz grid, Apollo's 200G solutions that can be deployed on any existing 10G/100G DWDM network. This capability is not available for all 8QAM optical solutions from all vendors. It means that longer reach 200G wavelengths can be added to either an ECI-designed network or as an alien wavelength on any standard-spaced DWDM network.

FLEXGRID VERSUS FIXED GRID

The ability of the Apollo 200G optics to operate within the existing 50GHz wavelength grid is crucial for allowing the simple upgrade of existing DWDM networks. The 50GHz grid was established via ITU standards to ensure compatibility of wavelengths across networks. 50GHz is plenty of room for 10G signals to be spaced far enough apart to avoid interfering with each other. However, the spacing required generally goes up as the bandwidth being transmitted goes up. Advanced modulation techniques like QAM and QPSK reduce the spacing required to transmit higher bandwidth, but eventually, higher speeds will need more than 50GHz to operate.

The more recently defined flexgrid standard allows groups of 12.5GHz spacing to be combined into whatever size is required for transmission. A 10G signal might be allocated only 25GHz of bandwidth while a 100G QPSK signal is allocated 50GHz. In the future, 400G signals might be allocated 75GHz of spectrum by combining six 12.5GHz spaces. Higher speeds like 1T may require even more.



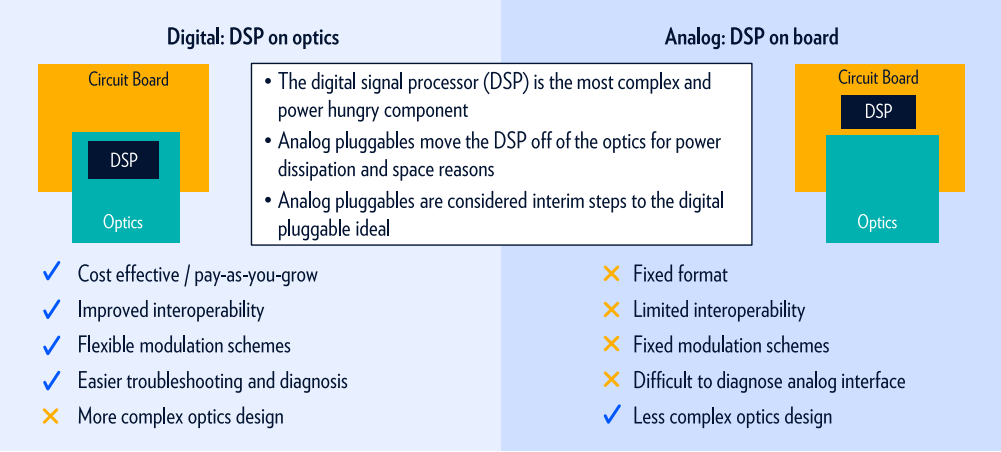
Flexgrid networks are the way that future high-bandwidth networks will be built. Optical innovations will be pushing past 400G wavelengths in an ever-increasing effort to put more bandwidth on fibers. Network operators who are

installing ROADMs and mulitplexers that include grid filters should be encouraged to deploy flexgrid hardware wherever possible. However, it can be expensive and complex to upgrade an existing network to flexgrid, and managing a complex flexgrid network is a challenge that has not yet been fully addressed. Therefore, solutions like Apollo's 200G, which allows existing networks to double their bandwidth without moving to flexgrid, are especially attractive.

DIGITAL VERSUS ANALOG CFP

Apollo's CFP and CFP2 pluggable optics are digital. Digital CFPs incorporate Digital Signal Processing (DSP) on the pluggable optic, while analog CFPs move the DSP to the supporting board.

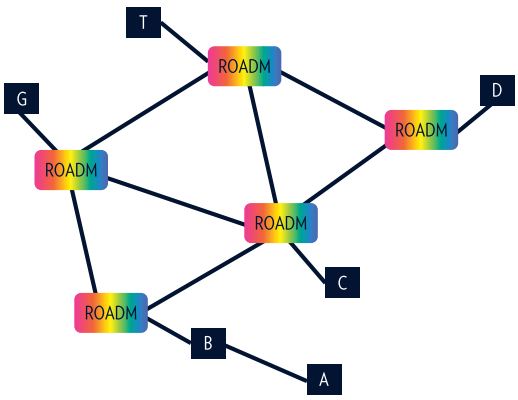
The DSP is the most complex and power-hungry component of high-speed optics, so moving the DSP to the supporting board removes complexity and heat dissipation issues from the optics. However, while the power on the pluggable may be smaller, simplifying cooling requirements on the optics, the additional electronics required for the optics/board interface make the overall solution more power hungry for the end user.



Putting the DSP on the board also greatly limits interoperability between optics, and limits the ability of the programmable optics within the module to be used for different speeds or properties. Also, the analog interface between the optics and the DSP on the board can be difficult to troubleshoot when there are network issues. A digital board/optics interface is much simpler to design, implement, and troubleshoot overall.

In general, analog pluggable optics are considered an interim step towards the digital ideal. In the Apollo platform, all pluggable optics are digital, providing more flexibility, more choice, and higher network reliability.

100G NETWORK UPGRADE TO 200G



In the example below, a network has already been deployed with 100G wavelengths, ROADMs, amplifiers, and DWDM filters. The network operator has determined that some links on the network are near full capacity and need to be upgraded. There are several options available, including adding more fiber on existing routes, adding more fiber routes, upgrading to higher speed signals with a flexgrid network, or using the Apollo 200G optics, which can operate within the existing 50GHz spacing. Adding fiber is almost always the last resort due to installation costs, so the decision comes down to which optics option to choose.

If the route to be upgraded is a simple point to point (A to B), then the operator may choose to upgrade the entire route to flexgrid technology, especially if the route was already scheduled for a capacity upgrade. If the route is more complex (e.g. B to D), upgrading all of the components along the route to flexgrid would be much more costly and intrusive, so the network operator would likely prefer doubling their capacity without extensive hardware replacement.

But the network operator would probably prefer to upgrade the network gradually, even on a point-to-point route, like A to B. Apollo's 200G signals can operate on the same network as existing 10G or 100G signals for up to 1200km. That means that a network operator can add a 200G wavelength to an existing 100G network and either add capacity directly to that wavelength or roll an existing 100G service onto that wavelength. This doubles the capacity without taking up any additional wavelengths. Apollo's 200G optical technology is uniquely designed to allow this sort of in-service network capacity upgrade.

APOLLO 200G OPTIONS

ECI's Apollo platform offers a variety of 200G options for use in whichever network application is appropriate:

- For simple transponder networks, Apollo offers the TR200_2 dual transponder card, providing 400G of capacity in a single-slot card for low-power consumption and high-density 200G solutions.
- For applications where lower-speed signals need to be multiplexed into higher-speed signals, the TM400 muxponder can carry up to 400G of traffic on a single card.
- For networks that require high levels of security, the TM200_EN muxponder offers a unique per-service encryption capability at the service level, with a line speed of up to 200G.
- Finally, ECI offers native 200G interfaces on OTN switching cards, like the HIO500, which is designed to allow OTN switching growth over time.

No matter what your high-speed network needs, ECI has a 200G solution that can fit the bill.

CONCLUSIONS

With the introduction of complex modulation schemes into optical networking, speeds of 100G, 200G, and higher are now available and economical. For each modulation scheme, there are tradeoffs in distance and speed, and many of the new formats will require a network hardware upgrade to flexgrid filters. Apollo's 8QAM 200G optics offer the ability to upgrade an existing 50GHz network to 200G per wavelength, using economical and interoperable digital D-CFP2 optics for spans up to 1200km or more. This capability allows network operators to double their network capacity without requiring an expensive and intrusive network upgrade.

Contact us to find out how our ELASTIC networks can help you grow

ABOUT ECI

ECI is a global provider of ELASTIC network solutions to CSPs, utilities as well as data center operators. Along with its long-standing, industry-proven packet-optical transport, ECI offers a variety of SDN/NFV applications, end-to-end network management, a comprehensive cyber security solution, and a range of professional services. ECI's ELASTIC solutions ensure open, future-proof, and secure communications. With ECI, customers have the luxury of choosing a network that can be tailor-made to their needs today – while being flexible enough to evolve with the changing needs of tomorrow. For more information, visit us at www.ecitele.com