

# AgilePorts over DWDM for long distance 40GbE

## Inside

### AgilePorts

Arista AgilePorts allows four 10GbE SFP+ to be combined into a single 40GbE interface for easy migration to 40GbE

### DWDM Extension

Extending 40GbE is a simple cost-effective application of AgilePorts

- Reach up to 80km with DWDM SFP+ and passive solution
- Extended up to 150km with DWDM semi-passive solution

### SmartOptics

Low cost, power efficient and simple to operate passive multiplexer solutions for extending 10G and 40G up to 150km

## Introduction

Existing 40GbE solutions are limited to 10km and require costly upgrades to DWDM systems to enable long haul extensions. The AgilePorts feature enables groups of adjacent SFP+ ports to be configured for 40Gb operation using 10Gb transceivers and cables providing maximum port flexibility and a seamless migration from 10Gb to 40Gb. This enables the use of inexpensive and simple 10Gb DWDM systems to extend a 40GbE service.

Cost effective 40GbE solutions are a key enabler for delivering support for higher bandwidth flows, lower latency and deterministic load sharing. These solutions are critical for High Performance Compute (HPC), Financial and Cloud Services environments where the traditional approach of aggregating multiple 10G links fails to enable individual flows to be over 10Gb. As the growth in both processing power and server virtualization increases the density and performance of servers, widespread adoption of 10Gb Ethernet as the host interface technology of choice has accelerated the migration to 40GbE for both uplinks from leaf switches and for interconnecting spine-nodes and other core network devices which in turn is has put pressure on data center interconnects to expand beyond 10Gb.

This rapid growth in bandwidth from the servers places Network Architects in a transition period between 10GbE and 40GbE technologies for both leaf-spine and core network connections. With the introduction of AgilePorts, Arista meets the current 10GbE demands while ensuring an upgrade path to 40GbE avoiding the need for new hardware, replace existing optics, or for an entirely new cabling infrastructure, providing a significant investment protection.

When connecting data centers over longer distances or where fiber availability is limited, network operators often leverage Wavelength Division Multiplexing (WDM) to extend distance and to multiplex multiple connections on a single fiber path.

Arista's AgilePorts technology enables the combination of four 10GbE SFP+ interfaces into a single 40GbE interface leveraging the parallel lane technology present in the 40GBASE-CR4 and 40GBASE-SR4 standards. With AgilePorts, each 10GbE interface emulates one of the four parallel lanes, which are then driven by a 40GbE scheduler. Unlike traditional Ethernet port-channel/link-aggregation techniques or other link bundling technologies, which use Layer 2/3/4 information to hash traffic over links on a per flow basis, potentially resulting in uneven utilization between links, AgilePorts leverages 40GbE's bit striping to ensure perfectly even load distribution across all four 10GbE lanes, achieving true 40Gbps line rate rather than a theoretical maximum based on flow based hashes.

In addition to the investment protection associated with the reuse of existing optics, this technology offers data center operators significant design flexibility. It avoids the limitations enforced by the current generation of 40GbE optics, allowing network and infrastructure designers to choose from the much wider range of 10GbE single-mode and multi-mode optics. This is achieved over an existing cable infrastructure avoiding the immediate need to invest in new parallel fiber plant based on MTP/MPO standards.

This 10GbE transceiver and fiber reuse becomes particularly beneficial when the need arises to have a long-range 40GbE inter-connection as currently the options to extend beyond 10km are limited without the deployment of premium optical transport equipment.

#### Connecting Data Centers Using WDM and AgilePorts

When connecting data centers over longer distances or where fiber availability is limited, network operators often leverage Wavelength Division Multiplexing (WDM) to extend distance and to multiplex multiple connections on a single fiber path. WDM uses multiple wavelengths to provide separate parallel circuits within a single fiber pair. 1- and 10GbE solutions are commonly deployed while native 40GbE solutions are also becoming more prevalent, although typically at a significantly higher price point.

WDM solutions typically fall into two categories – simpler passive solutions and more complex active DWDM systems.

To leverage passive WDM systems, the end devices must be capable of supplying independent wavelengths (colors, or lambdas) which the WDM device combines optically onto a single fiber pair. This requires end devices to support xWDM transceivers and is normally range limited by the availability of transceivers (e.g. 80km). Enhanced solutions, such as the SmartOptics m:series exist which enable ranges up to 150km. Passive WDM requires no Optical-Electrical-Optical (OEO) conversion and as such is highly reliable, introduces little latency and requires minimal ongoing maintenance.

Active WDM solutions are required where connected devices deliver 'gray' light, typically using cost effective 850nm transceivers (e.g. 10G-BASE-SRL or 10GBASE-SR). The WDM shelf terminates a number of 'gray' connections regenerating each onto its own wavelength before combining all wavelengths on to the transmit fiber link.

Arista 40G Switch + 40G Capable Active DWDM System



Figure 1: Arista 40G Switch with a 40G Active DWDM System

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Active DWDM platforms provide extended range but may add significant additional cost and complexity, requiring specialized skills and ongoing operational management. This makes passive solutions particularly appealing for circuits of less than 150km.

While 1- and 10-GbE transceivers are available in 40km (ER) and 80km (ZR) variants, 40GbE single mode solutions are not available for distances longer than 10km. As there are no current WDM specific 40G transceivers expensive and complex active DWDM solutions are required for even modest distances, or any time multiple 40G circuits need to be delivered over a single fiber pair.

Arista Networks' AgilePorts solution solves this issue by supporting the use of 10GbE WDM reach for 40GbE circuits. Where 40GbE solutions leverage 4x10G multi-lane technology through a QSFP+ format transceiver, AgilePorts enables the same 4 parallel lanes to be delivered through 10Gb SFP+ components, which offers long haul WDM support to 80km. As a result this enables the extension of native 40GbE over existing 10GbE WDM equipment, using existing cost effective 10GbE optics and cabling.

Combining the SmartOptics selection of passive and semi-passive solutions it becomes simple and cost-effective to deliver native 40GbE circuits over long distances, saving significant power, space and operational costs when compared to fully active WDM:

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Distance	DWDM Platform	Solution
Up to 80km	Passive WDM	DWDM SFP+ transceivers connect to passive multiplexer/de-multiplexer
Up to 150km	Semi-Passive WDM	DWDM SFP+ to m:series 1U distance extension platform

#### Arista and SmartOptics DCI Solutions for 40G

The transmission of 40GbE over long distances using WDM technology introduces highly stringent requirements to maintain end-to-end integrity and timing accuracy. Arista and SmartOptics have jointly developed and tested a set of solutions that leverages SmartOptics' market leading passive and semi passive devices to deliver a variety of long-haul solutions offering native 40GbE connectivity up to 150km reach today, without the need for an active DWDM system and in a considerably smaller form factor as show below.

This solution also provides a straightforward, path to increase capacity from 10GbE connectivity to 40GbE simply by adding further interfaces with no requirement to replace optics, ports or the Arista switches.

### Arista with SmartOptics 10GbE + 40GbE WDM Solution

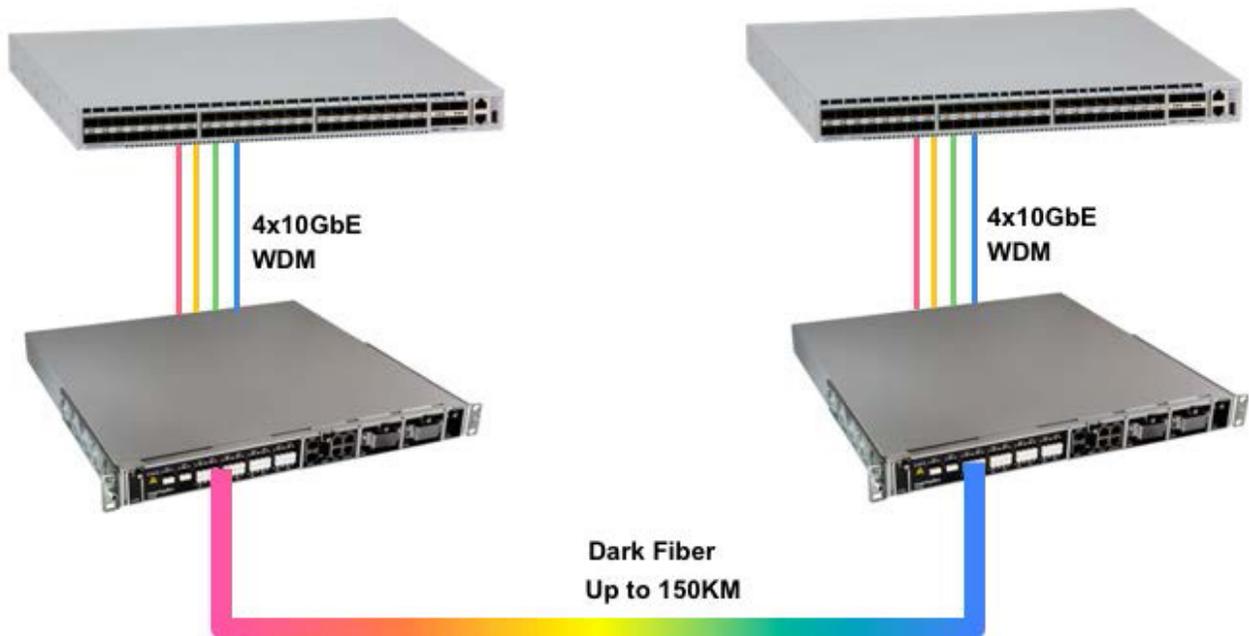


Figure 2: Arista 10G/40G Switches with a 10G and 40G WDM Solution

- 40GbE over 4x10G links multiplexed over one pair of single mode fiber, using a SmartOptics passive DWDM MUX and DWDM SFP+, offering a range of up to 75 km.
- 40GbE over 4x10G links multiplexed over one pair of single mode fiber with a reach of 150 km using DWDM SFP+ in conjunction with the SmartOptics m:series (pictured above).

Network architects no longer need to delay the expansion of capacity with the Arista Networks 40GbE solutions, due to cost prohibitive active WDM.

#### Summary

Arista Networks AgilePorts feature in combination with SmartOptics advanced optical solutions enables organizations to leverage native 40GbE for high capacity, low latency long distance interconnects. Network architects no longer need to delay the expansion of capacity with the Arista Networks 40GbE solutions, due to cost prohibitive active WDM. The Arista and SmartOptics' innovative solutions provide customers with a path to better fiber efficiency by using existing WDM technology, and enabling coexistence of 10GbE and 40GbE applications on the same link for distances up to 150km.

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