



# Comparing DWDM Transceiver Technologies

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## Dense Wavelength Division Multiplexing

(DWDM) technologies are ideal for the demands of Remote PHY and other Distributed Access Architectures (DAA). The migration to DAA is pushing digital fiber networks further into the outside plant. On time and under budget DAA deployments will maximize existing fiber infrastructure to minimize new fiber builds. DWDM transceiver technology is the perfect fit for successful DAA deployments. Deploying DWDM at scale presents both practical and technical challenges. Understanding the options available and the associated total cost of ownership is critical to a successful DWDM deployment strategy.

## Understanding the Options

DWDM transceivers are widely available in several configurations across the ITU C-Band (1525nm ~ 1575nm). DWDM transceiver solutions fall into two categories: fixed wavelength and tunable transceivers.

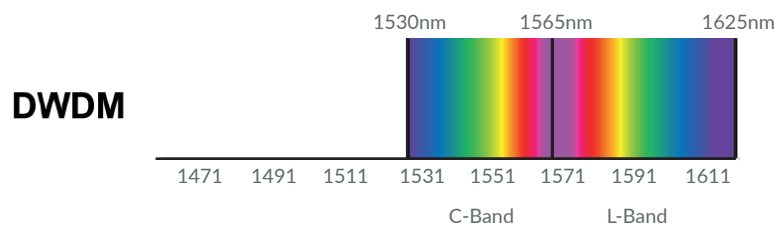
**Fixed wavelength DWDM transceivers** transmit at a single DWDM wavelength (i.e. ITU Channel). Fixed wavelength transceivers can be deployed in any Ethernet switch across multiple of data rates and optical budgets. Fixed wavelength DWDM transceivers offer a lower cost of entry and offer solutions for any DAA deployment challenge.

**Tunable DWDM transceivers** meet the needs of DAA deployments requiring standardization and mass deployment. The tunable DWDM laser can be programmed to transmit at any one of the C-BAND wavelengths, at 50Ghz increments. Tunable transceivers are programmed at the time of installation to the desired wavelength by the network platform or by 3rd-party accessories. Thus, a tunable transceiver can perform the same function as 80 fixed wavelength parts. Service providers are provided by tunable transceivers the benefits of fewer spares and quicker time to market when deploying new Remote PHY services. Tunable DWDM transceivers come at higher purchase cost than fixed wavelength transceivers and require compatible network equipment or a 3rd-party tuning platform to deploy.

## Understanding the Total Cost of Ownership

Evaluating only unit cost or network flexibility does not fully capture the total cost of ownership for network equipment. The total cost of ownership between fixed wavelength and tunable transceivers must consider the factors of equipment compatibility, engineering, and operational considerations.

**Equipment Compatibility** - Fixed wavelength DWDM transceivers are highly adaptable to any network deployment scenario.



Wavelength transceivers are plug-and-play in almost any Ethernet switch or node. The switch or node receives the ethernet handoff from the transceiver without special interaction with the switch.

Standard tunable transceivers are not plug and play. When a tunable transceiver is installed, the switch platform must recognize the tunable transceiver and have the capability to let the user choose the desired wavelength within the switch's operation system or command line interface. In contrast, a switch or node that is not capable of tuning a tunable transceiver must use a third-party tuning appliance to transform the optic into fixed wavelength transceiver.

## Engineering and Operational Considerations

The sheer volume of planned and potential network elements has put network engineering on alert to future proof the network. The C-BAND 50GHz and L-BAND DWDM options are to be considered as the 40 common 100GHz C-Band channels may not be enough to allow DAA networks to be leveraged for business services and for the many wireless opportunities' service providers will encounter. Fixed wavelength DWDM transceivers offer capabilities for any deployment edge case, including 50GHz and L-BAND options. Commercially available tunable transceivers offer solutions for both 100GHz and 50GHz C-BAND wavelengths at 40km and 80km.

With the growth of DWDM in the network, the operational concerns of sparing and the cost of carrying inventory is critical to a successful DAA deployment. Carrying a spare Fixed Wavelength DWDM transceiver for each wavelength used in the network will stress the operational budget. The cost of spare inventory will explode by adding the variables of distance and spectrum (C-BAND 50GHz and L-BAND DWDM channels). Tunable transceivers offer the operational tradeoff of reduce spares and lead times. The flexibility of tunables make them especially valuable for emergency restoration operations. A single tunable transceiver can spare up to 80 fixed wavelength transceivers! Tuning DWDM transceivers within an OEM software interface requires trained network staff for proper provisioning. The costs of training network construction to tune optics through a switch or with a third-party tuning appliance cannot be over looked.

## Total Cost of Ownership

Simply comparing the purchase costs between fixed wavelength and tunable DWDM transceivers does not outline the total cost of ownership. Fixed wavelength and tunable DWDM transceivers offer service providers options to optimize DAA deployments.

	Fixed Wavelength DWDM	Tunable DWDM Transceivers
Form Factors	SFP+, XFP	SFP+, XFP
ITU Grid	C-BAND 100Ghz, 50Ghz, L-BAND	C-BAND 100Ghz, 50Ghz
Distances	10Km, 40Km, 80Km, 100Km	40Km, 80Km
-40C to +85C Options	Yes	Yes

Fixed wavelength DWDM transceivers are the lowest upfront cost, offering variants for any network requirement. Tunable transceivers are more expensive but offer flexibility for inventory and urgent deployment scenarios. Given only basic information there is not a clear total cost of ownership winner- nor does there have to be only one.

## Pulling it all Together

Luckily for service providers, DWDM strategies need not be exclusive of fixed tuned or tunable transceivers. Fixed wavelength transceivers, with a lower per unit cost and installation cost, are ideal for reducing the capital expenditures of upfront project rollouts. Tunable DWDM transceivers excel in reducing both the costs spares and time to deploy.

TCO Factors	Fixed Wavelength	Tunables
Unit Cost	\$	\$\$
Cost of Inventory	\$\$\$	\$
Technical Training		\$
Advantage	???	???



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