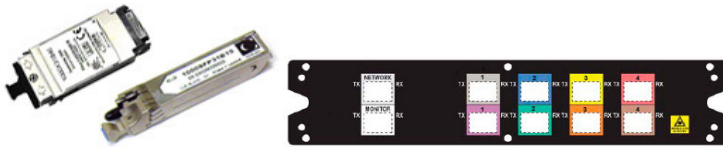


### Single Fiber Transceivers and Single Fiber WDM Passives

Champion ONE offers single fiber GBICs and SFPs that run up 80KM on single mode fiber. Single fiber passives provide multiple protocol/speed independent channels on a single fiber strand, and allow for both CWDM and DWDM channel configurations, increasing bandwidth even more.

Rather than add additional fibers to your existing fiber plant, or having to lease pairs of fiber for each non-multiplexed service, single fiber transceivers allow single strands to be deployed for point-to-point scenarios where fiber is scarce, expensive, difficult to design around, or in any way non cost-effective. No additional filters are needed when utilizing single fiber transceivers and no specialty cables are required. In addition, the transceivers (which achieve single fiber operation by using matched wavelength pairs depending on the distance required) are available in GBIC and SFP form factors, in 20km, 40km, and 80km rated distances, and are meant to be direct replacements for existing LX, EX (LX40), and ZX optics.



### Single Fiber Transceiver Applications

- Direct replacement of dual fiber LX (10km), LX40 (40km), ZX (80km) transceivers
- Single strand leasing versus dual strand
- Reclamation of strands in cases of initial dual-fiber links
- Backhaul and enterprise/business services
- Ability to grow from single fiber, single service to multiple services over a strand of fiber (WDM)
- Fiber plant build out/rebuild avoidance (put off adding additional fiber in the ground for longer)

### Fiber Optimization Evolution Overview

Single fiber transceivers allow for optimization of your existing or leased fiber plant and also allow for more flexibility in designing fiber deployments. They can be the 'jumping off point' for future growth as well, and allow for future single fiber (bidirectional) WDM (wave division multiplexing) deployments – adding additional links and mixing of protocols and data rates without adding fiber.

When the capacity allowed with single fiber WDM (4 services over 8 wavelengths for CWDM and 8 services over 16 wavelengths for DWDM) is saturated, dual fiber WDM is a way to grow to up to 40 services of up to 10Gbps each over a pair of fibers. While using a pair of fibers in this instance, it allows for a maximized amount of time in pushing out dual fiber deployment and fiber lease and build-out costs.

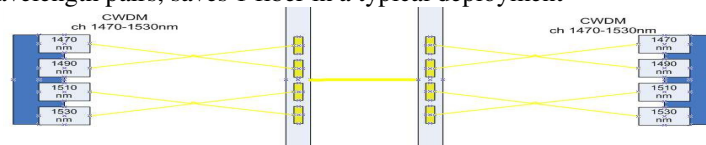
The key arguments for single fiber transceiver deployment may vary in different use cases, but the utilization of such a growth path has proven itself to be a way to remain competitive and flexible in the offering and design of data connections over fiber when fiber itself is a costly and/or limited commodity.

**Fiber Optimization Evolution - Highlights**



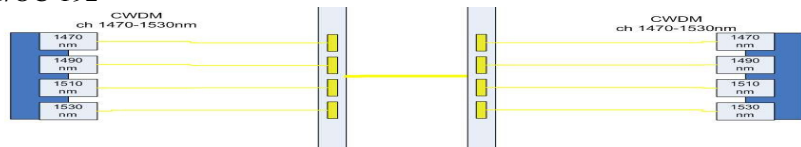
**1. Single Fiber Transceivers**

- a. For point-to-point deployments
  - i. Ethernet
    - 1. Fast Ethernet and Gigabit Ethernet
  - ii. SONET/SDH
    - 1. OC-3, OC-12, OC-48
- b. Matched wavelength pairs, saves 1 fiber in a typical deployment



**2. Single Fiber WDM**

- a. Matched wavelength pairs, saves 1 fiber in a typical deployment
  - i. CWDM - up to 4 services on a strand of fiber
    - 1. 2 wavelengths per service, 8 wavelengths used
      - a. The pairing of wavelengths is arbitrary but usually 'neighbor pairs'
  - ii. DWDM - up to 8 services on a strand of fiber
    - 1. 2 wavelengths per service, 16 wavelengths used
      - a. The pairing of wavelengths is arbitrary but usually 'neighbor pairs'
  - iii. Support for OADM and other topologies (point to point, bus, ring, etc.)
    - 1. Single fiber OADMs in various configurations available
- b. Mixed protocols allowed
  - i. CWDM - up to 10G/OC-192
  - ii. DWDM - up to 10G/OC-192



**3. Single Fiber, Single lambda WDM**

- a. Specialized WDM transceivers able to 'face' the same wavelength over the same strand of fiber
  - i. CWDM - up to 8 services over a strand of fiber, 8 wavelengths used.
  - ii. APC connectors must be used on receptacle of WDM transceiver
    - 1. Due to matched wavelengths, back reflections must be minimized.
  - iii. Initial technology utilized short pigtails fused to transceivers...receptacle version eliminates jumper distance limitations.
  - iv. Support for OADM and other topologies (point to point, bus, ring, etc.)

**4. Dual Fiber WDM**

- a. Individual Wavelengths used for each service - 2 fibers used
- b. Multiplexed signals over a pair of fibers
- c. mixed protocols allowed
- d. CWDM - up to 8 services on a pair of fiber
  - i. Up to OC-48 data rates
- e. DWDM - up to 40 services on a pair of fiber
  - i. Up to 10G/OC-192 data rates

**Conclusion**

In closing, single fiber transceivers allow for fiber build-out and fiber leasing avoidance in non-ILEC regions of a network, where either option comes at considerable cost and/or time. CAPEX and OPEX savings can be realized in weeks rather than months or years by avoiding these associated costs in the fiber plant.

The planning of service deployment around a strand of fiber - while not a standard approach - does not limit design options, but instead allows for future WDM utilization. This in turn allows for mixed protocols and data rates over the same strand, as well as the redeployment of single channel bidirectional (single fiber) transceivers in new service areas, further improving the value of such a component in one's design offering.