

# Avvio Networks™

## A1040 Example Application – Optical Transport

App Note AN04-A1040 (1)

This application note illustrates the use of the A1040 multiplexer to shift wavelengths and its use as a repeater to re-time, re-shape and re-generate optical signals.

### Introduction

This application note describes typical configurations where the Avvio Networks A1040 multiplexer can be used to carry the optical data over 1310, 1550 and or WDM links, with optional redundant connections. Avvio Networks' innovative optical networking products support configurations using a single pair of attached devices and/or multiple attached devices. Diagrams are provided with each sample configuration for clarity.

The configurations described are not an exhaustive listing of the configurations supported by the A1040. A wide variety of networks can be developed based on the user's specific requirements.

#### A1040

Avvio Networks' A1040 OC-48 to OC-192 multiplexer is an optical edge device that multiplexes up to four OC-48 data streams onto an OC-192. The OC-192 data stream may be a 1310nm, 1550nm or DWDM ITU optical interface. The A1040 is well suited to leverage existing 1310nm equipment onto DWDM wavelengths at a fraction of the cost of adding new fiber. It is ideally suited for use in low-density applications that require a low-cost solution.

The A1040 provides economical short and intermediate reach interfaces on the OC-48 ports, however, long reach interfaces are available.

Optical power is a constraining factor in optical data transmission, so the length of the optical fiber between A1040s, as with any optical device, is restricted. The maximum recommended fiber length between A1040s is 80 km<sup>1</sup> excluding loss from any other optical components. The general power budget from one A1040 to the next A1040 is approximately 22dBm. If more precise calculations are required, please contact Avvio Networks.

Two other Avvio Networks products are used in this application note. They are briefly described below.

#### A1020

The A1020 is a 10Gigabit optical repeater/regenerator. This application note illustrates its use as a SONET regenerator, however, it can also be configured as an Ethernet repeater with or without G.709 encapsulation. The A1020 is a bi-directional regenerator; each side is clocked independently from the other.

It can also be used as a wavelength shifter for 1310-1550 (or DWDM) applications.

#### A2010

The A2010 is an OC-3/12 to OC-48 multiplexer. It multiplexes up to 16 OC-3s or up to 4 OC12s to an OC-48. It is capable of multiplexing a mix of OC-3 and OC-12 data streams. The A2010 supports 1310, 1550, or DWDM interfaces on the OC-48 side, as well as 1310 or 1550 interfaces on the OC3/12 side.

#### A1504

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<sup>1</sup> Depending on the type of fiber and loss from other devices; contact Avvio Networks for more information

The A1504<sup>2</sup> is a passive optical shelf with 4 optical add/drop ports. These ports are used to multiplex and demultiplex DWDM channels to and from a single fiber. The A1504 DWDM ports are located on the ITU grid; it may be used with any ITU-compliant devices.

When used with A1040s, the A1504 allows a user to share a single fiber between multiple A1040s instead of running a separate fiber for each A1040 pair. The cost savings due to the reduction in fiber cable can be significant when there are long distances between the attached devices. Some example configurations using the A1504 are shown in Figures XX and XX.

Each A1504 contains six pairs of optical connections. All ports support OC-192 data rates. Four pairs are used to interface to up to four A1040s, and the fifth pair is used as a 1310 interface. The sixth port interfaces to the DWDM fiber. Except for their wavelength, the ports are identical. In normal operation, each of the ports interfaces to an A1040 or other device operating on the same optical wavelength.

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<sup>2</sup> Note that the 15XX is available with a number of port count and wavelength options. The 1504 model is used in this application note for clarity.

# Configurations

## Simple OC-48 Multiplex Configuration

Figure 1 illustrates a simple configuration where the A1040 multiplexes four OC-48 devices interfaces to an OC-192 optical link, allowing all four devices to share a single pair of fibers. In this example, The A1040s are wired point-to-point, as are the devices feeding them.

A2010 A is fed by an OC-12 CPE device. The A2010 can support up as many as 16 OC-3 devices, 4 OC-12 devices, or a mix of OC-3 and OC-12 devices. The data is then multiplexed into an OC-48 data stream to the A1040. The data is then multiplexed into an OC-192 data stream and received by the other A1040, where it is de-multiplexed into an OC48 data stream and sent to A2010 B. A2010 B demultiplexes the data to an OC-12 data stream and feeds the CPE device.

In a similar fashion, data from CPE devices A, B, and C are connected the CPE devices D, E, and F.

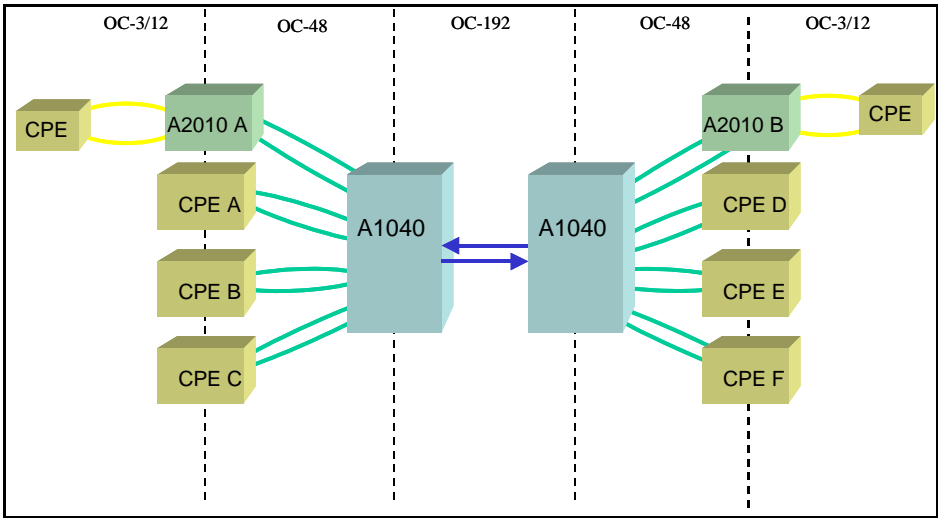
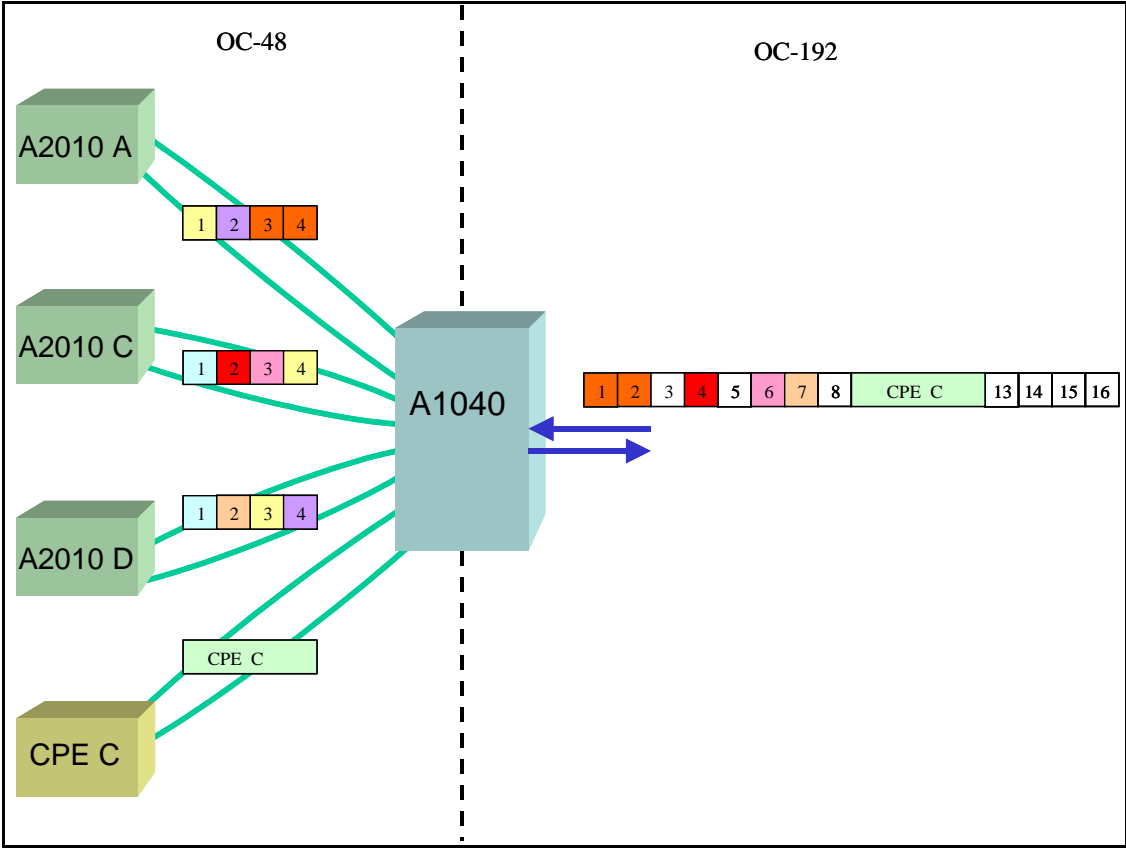


Figure 1: OC-48 Multiplex Configuration

In a slightly more complex network, the A1040 has a non-blocking TSI allowing hair-pinning and re-distribution of the incoming traffic. The figure below illustrates an A1040's TSI capability.



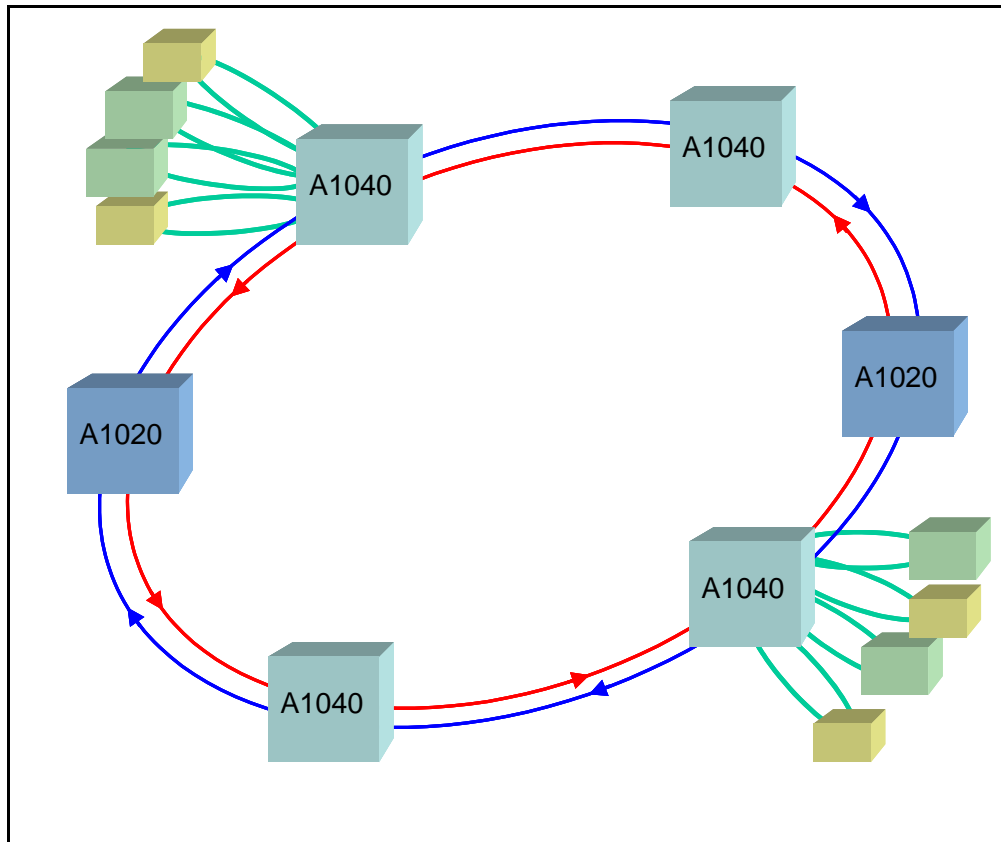
**Figure 2: A1040 TSI capability**

Although the A1040’s TSI works down to the STS-1 level, in Figure 2 above data is shown as blocks of OC-12 data, except for CPE C, which is shown as an OC-48 block. This is done strictly for clarity.

Data block 1 from A2010 A is broadcast data the A1040 re-sends out to A2010 C (block 4) and A2010 D (block 3). Data block 2 from A2010 A is also turned around by the A1040 and sent to A2010 D (block 4). Finally, data blocks 3 and 4 are sent through the A1040 across the OC192 network

This capability is used in one of the more common uses of the A1040, a ring configuration.

In the UPSR ring configuration illustrated in Figure 3, two A1020 SONET regenerators were added due to the size of the ring. Note that some of the A1040’s tributaries were omitted for clarity. An Avvio Networks A2010 or other SONET device can be used to feed the A1040’s OC-48 Rings. Note that the OC-48 rings feeding the A1040 can either be point-to-point connections or rings.



**Figure 3: A1040 in a Ring Configuration**

The A1040 can also be ordered with a DWDM OC192 interface. In this case, an OADM such as the A1504 is used to add and drop the data streams. Any ITU compliant ADM may be used.

One interesting use of the A1040 here is the 1310 ring may be a SONET ring, while the overlaid network could be any other protocol, for example, Ethernet.

## Summary

In this Application Note we have shown a variety of ways in which the Avvio Networks A1040 Multiplexer can be used to create an end-to-end optical network. The A1040 can significantly reduce equipment and fiber cost in either a greenfield or upgrade situation. Avvio Networks' innovative optical networking products support configurations allowing virtually limitless growth with minimal capital expenditure.

For additional information please contact Avvio Networks by telephone at (978) 453-5200 or by email at [sales@avvionetworks.com](mailto:sales@avvionetworks.com).

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