Generic framing has the smarts

Services can be individually switched and transported over hundreds of kilometres to different cities and customer sites, writes ***Ross Halgren****.*

In the past few years, photonics has migrated from dumb Bragg grating filters and inefficient single service per wavelength multiplexing to wavelength selective switches (WSS) and multi-protocol sub-lambda multiplexing Standards such as generic framing procedure (GFP).

Following this trend, smart photonics cabling solutions employ a mix of configurable optics, programmable electronics and clever thermal designs to enable remotely managed capacity and service upgrades from 100Mbs to 2.5Gbps without the need for a truck roll.

From the late 1980s, there were large telecomms infra-structure upgrades involving the pulling and burying of multi-core optical fibre cables. Councils and utilities followed this trend by running fibre cables around cities, between buildings and along right-of-ways. By the mid to late 1990s, the expansion of the Internet and the need for more private data services consumed most of this installed fibre – hence the dawn of the wavelength division multiplexing (WDM) era promoted under the new generic term 'photonics'.

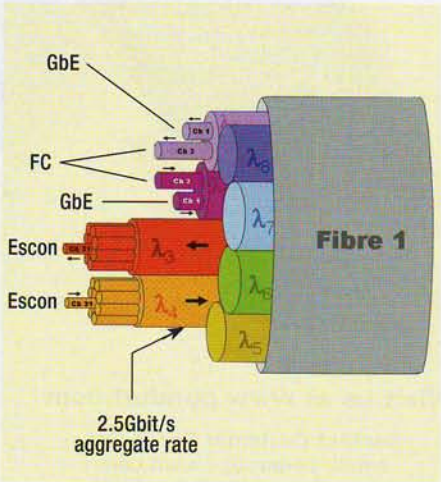

Figure 1: Sub-lambda WDM channels.

Notwithstanding the clever new name, the first WDM systems rolled out were quite dumb, doing little more than providing 'fibre pair-gain' at very high cost (albeit cheaper than pulling and buying more fibre cables).

Ten years down the track, the hype of the photonics era has been dampened by a dose of commercial reality after the telecomms downturn in 2001. Many survivors of this downturn focused on low-cost, smart photonics solutions that add value to the installed base of fibre cables rather than just offering dumb pair-gain solutions to fibre exhaust problems.

An example of smart, low-cost photonics is a wavelength selective switch (WSS) used for reconfigurable optical add/drop multiplex (ROADM) and optical cross connect applications.

However, the WSS is beyond the scope of this article. More relevant to smart photonic cabling solutions are the following complementary technologies, Standards and products.

Small form factor pluggable (SFP) fibre-optic transceivers embody the essentials of coloured (WDM) and non-coloured (850nm/1310nm) fibre-optic interfaces with integrated electronic drivers, receivers and signal-quality monitoring.

The standardisation of SFP footprints and interfaces, and volume production in Asia, drove down the cost of photonics interfaces by a factor of 10. SFPs are now widely available, and some variants support configurable data rates from 100Mbs to 4Gbps, enabling 1310nm client interface upgrades without the need for a truck roll.

Following the success of SFPs, new XFP fibre-optic transceivers are available that support 8-12Gbps data rates. Furthermore, SFPs have evolved to support standard electrical client interfaces such as 100BASET/1000BASET Ethernet, DVB-ASI, SDI / HD-SDI video and more recently pseudo-wire E1/T1.

How these electrical SFPs fit into a photonics network is explained next with reference to RBN's 2330 product.

Generic framing procedure (GFP) is a long-awaited data multiplexing Standard that enables SDH, SONET and OTN optical networks to transport multiple data protocols and rates with the same transparency as a bare optical fibre. However, it has the smarts needed to enable performance monitoring for service level agreements, distance-independent sub-lambda multiplexing and switching between telecomms exchanges and other telecomms and enterprise sites.

RBN has combined the above-mentioned SFP based WDM and GFP photonics technologies and Standards into its GigaEdge 2330 optical platform to provide value-added lambda and sub-lambda multiplexing, switching and performance monitoring for telecomms and enterprise bandwidth-management applications.

To further increase the value of the 2330 product at low increment cost, RBN has combined other programmable electronics, mechanical and thermal technologies and open Unix-based software to remotely program, configure and monitor the product.

The result is a low-cost, fully programmable optical transport and switching platform that offers the same transparency as previous WDM pair-gain solutions but with the following value-added features. (These offer the common benefit that a GigaEdge 2330 can be deployed then remotely managed throughout its service life without the need for costly truck rolls for feature upgrades and optical interface changes.)

- Programmable electronics using large FPGAs (field programmable gate arrays) include all GFP data and SONET/SDH multiplexing, performance monitoring and switching functions.
- Incremental feature upgrades such as fractional rate DVB-ASI and major transport upgrades such as carrier Ethernet can be downloaded to a remote location avoiding truck rolls and extensive downtime.
- Configurable electronics in a single FPGA program and software download, combined with multi-protocol and multi-rate clock data recovery (CDR) devices and multi-protocol/multi-rate SFPs, enables any protocol on any client port at any time. Standard protocols supported include: STM-1/OC-3; STM-4/OC-12; STM-16/OC-48; Fast Ethernet (FE); gigabit Ethernet (GE); DVB-ASI; ESCON; 1Gbps fibre channel (FC) and 2Gbps FC. As a result, clients can upgrade their equipment interfaces attached to the 2330 from STM-1 to GE, for example, without any changes to the 2330 itself.

Configuring high-speed 2.5Gbps interfaces on any or all ports, combined with FPGA-based switching, supports the stacking of 2330s where the multiplexing capacity is port limited rather than client protocol/rate limited. By stacking 2330s, up to 16 x FE or a lesser mix of FE and other client protocols can be multiplexed into a single lambda.

Product stackability offers the benefit to customers of low first-in cost and low incremental cost.

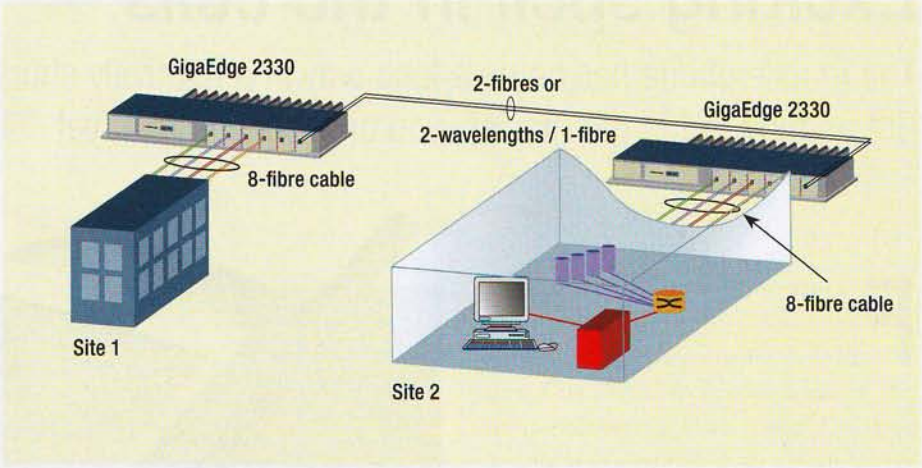

Fig 2: Typical point-to-point application of GigaEdge 2330.

Building on RBN's patented mechanical and thermal design technologies for its GigaEdge 8200 outside plant CWDM ROADM, the GigaEdge 2330 uses low-power electronics and conductive rather than convective cooling to eliminate all fans and air filters. Thus there is no need for a truck roll to replace a dirty air filter or a faulty fan unit.

Further to the above features and benefits, a mix of lambda transponders and sub-lambda multiplexers is supported by the GigaEdge 2330 with either coarse WDM (CWDM) or dense WDM (DWDM) SFPs. RBN offers its GigaEdge 6000 range of optical filter modules to support mixed WDM configurations.

Fig 1 illustrates a mix of lambda and sub-lambda multiplexing of multiple bi-directional services over a single optical fibre strand, offering a lower-cost solution for customers who must lease fibre for their networks.

The 2330 also exploits the availability of new electrical SFPs, enabling electrical to optical conversion using its transponder or sub-lambda multiplexer capabilities.

All of RBN's products (8200, 2330 and 6000) have another common feature, being that they occupy only one rack unit of shelf space. This has the benefit of easy slotting into an equipment rack and it minimises the lease cost in co-location applications.

Fig 2 illustrates a typical point-to-point application of the GigaEdge 2330. In this example, four different services that normally require eight fibres – such as GE for Internet data, FC for financial data, DVB-ASI for broadcast video and STM-1 for ADSL data and telephony – are monitored and transported between two sites using a single fibre and only two wavelengths.

As further evidence that the GigaEdge 2330 provides more than just a fibre pair-gain solution, its support for additional SDH/SONET Standards such as 'virtual concatenation' enables the 2330 book-end to be eliminated altogether at a central office exchange and the fibre carrying the above four services to be connected directly to a core cross-connect switch.

In doing so, these four services can then be individually switched and transported over hundreds of kilometres to different cities and customer sites. Furthermore, the cost of the access network is halved due to elimination of the GigaEdge 2330 book-end. ■

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