BUILDING LOW COST AND HIGH VALUE METROPOLITAN NETWORKS WITH PROVISIONING FLEXIBILITY AND SIMPLIFIED UPGRADABILITY

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Service providers in today's metropolitan network environment face a litany of challenges. The ability to offer a broad selection of services to accommodate the burgeoning bandwidth demands of the marketplace is crucial. As customer demands evolve and the appetite for bandwidth remains insatiable, networks must guarantee flexibility and the ability to provision new services. Critical above nearly all else in the metropolitan space is the drive to reduce network installation and operational costs with minimal design and management complexity. The Astral Point ON 5000 Optical Services Node works in concert with Corning® MetroCor™ optical fiber to enable service providers to build low-cost yet high-value metro networks.

THE FOUNDATION FOR THE NEXT-GENERATION METRO OPTICAL NETWORK

Astral Point Communications has developed a portfolio of carrier-class products – the ON 5000 Optical Services Node and ON 7000 Integrated Optical Transport Node -- designed to fully support the demands of the next-generation metro optical network. Astral Point's products deliver a range of low-speed to light-speed services, combining the intelligence and switching capability of a data network with the reliability and protection performance of SONET.

Astral Point has focused on delivering restoration schemes and provisioning models to support the accelerated demand for broadband services, Ethernet services, OCn and optical transport services, and carrier-class IP services, while also allowing customers to maintain the revenue stream provided by traditional T1 and DS3 private line services.

OPTICAL FIBER OPTIMIZED FOR THE CHANGING METRO NETWORK

A primary factor in the complexity of designing a metropolitan network is the presence of chromatic dispersion and the resultant deterioration of optical signals as a function of distance. In standard single-mode optical fiber, signals from directly modulated lasers operating at OC-48 (and comparable) rates typically limit system transmission capabilities to less than 100 kilometers. Due to the optimization of MetroCor fiber's dispersion profile to exploit the otherwise disadvantaged characteristics of directly

modulated transmitters, these same systems have shown error-free transmission in excess of 400 kilometers. At higher data rates such as OC-192, which is becoming the obvious migration path for many growing metropolitan networks, the effects of dispersion are more significant. Due to this, system vendors typically employ higher performance externally modulated transmitters. Nevertheless, standard single-mode fiber limits the signal transmission distance to less than 100 kilometers before some means must be employed to compensate for the signal degradation. MetroCor fiber advantages externally modulated transmitter types as well, displaying error-free transmission at 10 Gbps data rates beyond 200 kilometers.

For metropolitan networks of reasonable size, the implementation of optics in the 1550 nanometer (nm) wavelength region is an obvious choice in comparison to transmission at 1310 nm. With significantly reduced attenuation in all single-mode optical fibers at the higher wavelengths, longer spans can be constructed before signal regeneration or amplification is required. In addition, the availability of erbium doped fiber amplifiers (EDFAs) at wavelengths from 1530-1620 nm allows for simultaneous optical amplification of multiple channels without costly optical to electrical to optical (O-E-O) conversions, enabling economically viable dense wavelength division multiplexed (DWDM) systems. The disadvantage to operating within the EDFA window is that the dispersion in standard single-mode fiber is considerably larger than at 1310 nm. MetroCor fiber mitigates the effects of dispersion through optimized design, effecting a small amount of negative dispersion across the EDFA window. The dispersion curves for standard single-mode fiber and MetroCor fiber are illustrated in Figure 1.

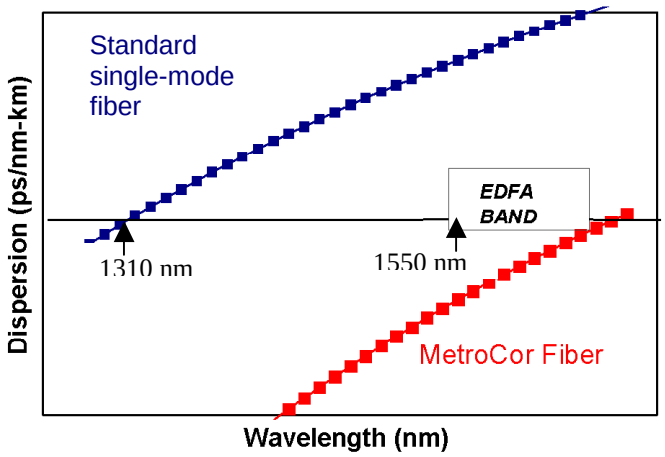

Figure 1.
Dispersion as a function of wavelength for both positive (Standard Single-Mode Fiber) and negative (MetroCor™ fiber) dispersion fibers. MetroCor fiber is a non-zero dispersion shifted fiber, optimized for the 1550 nm EDFA window.

Historically, the economic advantage of using low-cost directly modulated lasers at OC-48 rates has come at the cost of accepting a high degree of optical frequency chirp, where the central wavelength of an optical pulse varies from beginning to end due to instabilities in the laser as the drive current through it changes. As chromatic dispersion in fiber increases, variations in wavelength over the duration of the pulse translate into pulse degradation and reduced system performance. With transmitters characterized by positive transient chirp, pulses sent over standard single-mode fiber are degraded such that systems are typically not specified for transmission distances beyond 100 kilometers. However, if MetroCor fiber is installed, the behavior of a positively chirped source is balanced by the fiber's negative dispersion characteristics such that signals can travel in excess of 400 kilometers.

At higher data rates such as OC-192 (10 Gbps), dispersion effects are significant enough to necessitate higher cost externally modulated transmitters that can be tuned to have lower levels of frequency chirp. Still, standard single-mode fiber limits the transmission performance to less than 100 kilometers before either signal regeneration or dispersion compensation is required. With MetroCor fiber, the reduced magnitude of dispersion enables uncompensated error-free performance over twice the distance allowed by standard single-mode fiber.

The ability of MetroCor fiber to significantly extend transmission distances at both OC-48 and OC-192 data rates enables service providers to reduce or, in some cases, completely eliminate the need for dispersion compensation. Additionally, optical amplification with EDFAs can take the place of electrical regeneration sites that would otherwise be needed to reconstruct degraded signals. Network costs are thereby decreased, with reduced system complexity and a simplified path for future upgrades.

ASTRAL POINT – CORNING SYSTEM PERFORMANCE

Testing performed at Astral Point validates the performance advantage of MetroCor fiber when combined with the ON 5000 Optical Services Node. When testing with MetroCor fiber, Astral Point demonstrated error-free transmission in excess of 400 kilometers, which reflected nearly a fourfold increase in performance compared to standard single-mode fiber transmission. Further, transmission over MetroCor fiber allows for relaxed requirements on receiver sensitivity, allowing for lower minimum received power to accomplish equivalent bit error rate performance. The minimum required receiver power for transmission over both fibers is shown in Figure 2. At OC-192 rates using externally modulated transmitters, Astral Point testing shows allowable transmission distances over MetroCor fiber that exceed those over standard single-mode fiber by 50 to 100%.

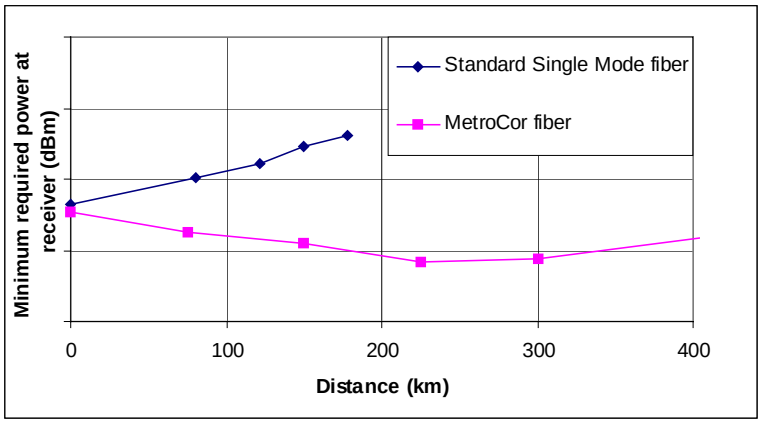

Figure 2.
Minimum required power at receiver as a function of distance for 2.5 Gbps directly modulated transmitters. MetroCor fiber allows for lower minimum requirements on received power to accomplish equivalent or better performance than standard single-mode fiber.

Astral Point's ON 5000 optical transport platform allow service providers to increase the flexibility of their networks, with maximum scalability across services and data rates. With optimized dispersion characteristics tailored to the metropolitan network market, Corning MetroCor fiber allows providers to reduce system costs and complexity. Joint testing between Astral Point and Corning demonstrates the benefits of building a total network solution with multiple service flexibility and a clear path for future upgrades.

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