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SUMMER 2003 | VOLUME 3e
CORNING

# Glass Houses . . . and Apartments . . . and Office Buildings

*Fiber-optic enterprise networks on the rise in Asia's metropolises*

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It is estimated that 80 percent of all the construction cranes in the world are located in Asia. And 80 percent of *those* cranes are located in the rapidly growing People's Republic of China. Nearly all of this growth is happening in Asia's densely populated cities. Yet more than 63 percent of Asia's total population is still rural (though becoming urbanized) — compare that with about 20 percent of the United States' population.

In most of Asia's metropolises, there is little room to expand outward, forcing their citizens ever upward. Corporate headquarters, learning centers, hotels and apartment buildings scrape the sky, with construction cranes towering over them all in a quest to build even more, even higher.

And many of them are densely threaded with glass fiber, creating short-distance, high-bandwidth infrastructures for Asia's millions of broadband and Ethernet users, business and residential alike. Premises networks, which encompass both traditional local area networks (LANs) as well as storage access networks (SANs) and high-speed parallel interconnects (HSPIs), are climbing in Asia right along with the high-rise buildings.

The penetration of fixed-line telephony is about 17.5 percent in China, with mobile phone density at about 16.2 percent. While much attention has been given to China's national communications infrastructure via long-haul and provincial fiber-optic network builds — the construction boom in China's cities has had a major impact on short-distance fiber deployment. Bandwidth demand in local networks is booming in China apace with construction.

"What is interesting to note is that this demand is not solely driven by growth in the number of new businesses or new network users," said Hu Zhang, Greater China market development manager, Corning Optical Fiber. "The growth is also driven, certainly, by the demand of existing users for additional bandwidth. Carriers in China strongly promote broadband connectivity and content. Urban network users are very familiar with broadband applications and seek out broadband content."

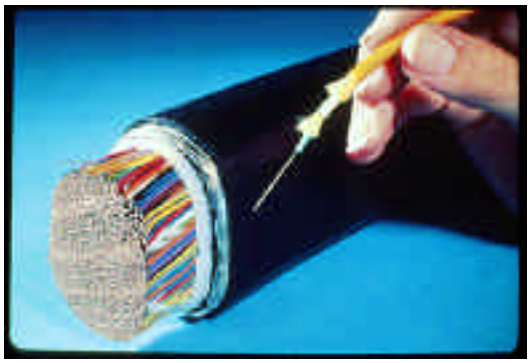
According to China's Ministry of Information Industry (MII), there were more than 6.6 million broadband subscribers in China as of 2002, and Ethernet subscribers in China are expected to grow from 132,000 subscribers in 2001 to 3.85 million subscribers by 2006, according to the International Data Corporation (IDC).

Similar tales can be told for the remainder of Asia, where broadband use is among the highest in the world. Japan has about 5.7 million broadband subscribers, and the remaining 14 Asian countries are expected to have about 21.8 million subscribers this year, up 31 percent from last year. Korea leads the world in per capita broadband, with 6.5 million subscribers in 2002 — about half of its Internet users.

In the rest of Asia, much like China, growth is spurred not solely by new users, but by the drive of users to new, bandwidth-hungry applications. In particular, online gaming, especially online role-playing games, has become such a standard of entertainment — in South Korea, it has a huge and enthusiastic fan base not unlike most nations' sports teams — that demand is often driven by these bandwidth-intensive gaming applications. Teleworking is also becoming a critical driver of bandwidth demand.

Related significantly to telework, in the Asia-Pacific region wireless LAN (WLAN) has spurred premises network growth, as it is a useful technology for difficult-to-wire older buildings, for building-to-building connectivity with short lines of sight, and, commonly now, within public areas like hotels and restaurants. Rather than cannibalizing optical fiber demand, WLAN and wireline premises technologies have proven to be complementary within premises networks in Asia. Many enterprises have chosen to offer WLAN technologies as a supplemental access technology for their wired networks to maximize efficiencies. Mobile workers, for example, can connect via WLAN technology from a convenient access point (their home, a hotel, the airport) and, via a secure tunnel connection to their wired corporate network, they perform increasingly complex and bandwidth-intensive tasks.

With such growth in short-distance networks in Asia's urban centers, local area network planners have embraced international Gigabit Ethernet (GbE) and 10 Gigabit Ethernet (10 GbE) standards and are making a dramatic shift away from copper technologies. Optical fiber, particularly multimode fiber, has proven to be a more cost-effective and high-capacity solution for local area networks, offering more bandwidth capacity than copper wire, and with more flexible and user-friendly installation. And multimode fiber networks, which take advantage of less expensive 850 nm equipment, offer additional cost savings compared to single-mode fiber networks, which offer greater reach but require more costly 1300 nm equipment. Multimode fiber has become particularly applicable in Asia's urban networks, given the very



**Bigger is not better**. The slender design of optical fiber cables, compared with bulky copper cables with the same bandwidth capacity, is yet another reason optical fiber is the best solution for typically space-limited Asian urban construction. (*Photograph by Corning Incorporated.)*

short reach requirements of its densely constructed cities. [For more information about the advantages of optical fiber compared with copper, please see the Return Signal feature in this issue of GuideLines® Online.]

**Laser sources and 50-micron fibers: why they matter**

Over the past few years, much has changed in premises data technology, particularly with regard to data rate, and given the relatively new conversion to multi-gigabit speeds for Asian premises networks, many network operators are only now becoming familiar with the new technologies available to them.

While light emitting diode (LED) sources have been the technology of choice for traditional premises networks, the commercialization of first GbE, and then 10 GbE, drove the industry's enterprise technology toward vertical cavity surface emitting lasers (VCSELs), laser sources better suited to gigabit transmission rates. This similarly drove a change in the preferred operational wavelength of multimode fiber systems, which had traditionally operated — with their LED sources — in the 1300 nm window to the more economically advantaged 850 nm window. VCSELs, as low-cost laser sources, are designed to operate in the 850 nm window and provide a more cost-effective transmission solution. More than 95 percent of Gigabit Ethernet applications use 850 nm laser sources, though more costly 1300 nm lasers are available (and generally used with longer-distance single-mode systems).

Therefore, the legacy LED specification of 500 Mhz•km overfilled launch (OFL) bandwidth at 1300 nm, while adequate for Mb/s speeds, is no longer relevant for networks requiring an upgrade path to gigabit speeds. The logical way to future-proof a system is to provide an upgrade path to gigabit protocols, and these laser-based gigabit protocols require fibers optimized for laser performance. Corning's InfiniCor® fibers were the industry's first multimode fibers optimized for laser transmission and, today, continue to set the standard for comprehensively measured and proven multimode fiber in high-speed premises networks.

This move to the 850 nm region and faster transmission speeds has also led Asian network designers to embrace 50-micron multimode fiber as their preferred network base, moving away from larger-cored 62.5 µm multimode fibers. (Of course, Japan has historically always preferred 50-micron fiber.) The difference between 50 µm and 62.5 µm multimode fibers is subtle in design, but hefty in network impact. The two fibers have a different core (light-carrying region of the fiber) diameter, 50 microns v. 62.5 microns. In all other respects, their attributes are virtually the same — tensile strength, minimum bend radius, and cabled and bare fiber attenuation.

However, 50 µm multimode fiber offers 10 times more bandwidth (2000 MHz-km) compared with 62.5 µm (200 MHz-km) at 850 nm. As mentioned previously, the 850 nm region offers a more cost-effective transmission alternative with VCSELs. In fact, all major standards bodies worldwide have adopted 50-micron multimode fiber specifications due to its clear advantages for high-bandwidth networks.

**Why trusted suppliers and thorough measurements matter**

Fortunately, network operators throughout Asia can call on the trusted Corning name and are doing so. Corning, the trusted leader worldwide in fiber optics, offers a complete line of high-quality, laser-optimized 50-micron fibers. Corning uses the outside vapor deposition (OVD) manufacturing process, which was developed and patented by Corning, to manufacture all of its fiber.

Why does this matter? Corning, which first used vapor deposition to create optical fiber (vapor deposition is the foundation of all modern fiber manufacturing done today), has found that the OVD process creates significantly smoother index profiles within the fiber compared with other processes and reduces the chances of centerline imperfections. Those small flaws in the glass — dips and peaks and roughness in the refractive index profile near the fiber's center — may dramatically and negatively affect laser performance.

Additionally, Corning offers the most thoroughly measured multimode fibers in the industry. Corning provides calculated effective modal bandwidth (EMBc) for its most advanced, highest speed InfiniCor® SX+ and SX*i* optical fibers. EMBc is a differential mode delay (DMD)-based bandwidth value that best predicts multimode system performance in high-bandwidth 10 Gb/s and 1 Gb/s systems. Corning was the first to offer EMBc bandwidth measurements for its high-bandwidth, laser-optimized multimode fibers, giving customers increased confidence in their performance.

**Multimode fiber modal bandwidth measurement at a glance**

Overfilled launch (OFL) bandwidth

- Designed for LEDs, not lasers
- Power distributed in 100% of the fiber core, like LEDs
- Perturbations in index profile undetected
- For data rates < 622 Mb/s

Restricted mode launch (RML) bandwidth

- Power distributed in narrow center region of the fiber core
- Simulates VCSEL launch
- Provides more accurate indicator of functional performance in laser-based systems
- For 1Gb/s data rates < 600 m in length

Calculated effective modal bandwidth (EMBc)

- Most accurate indicator of bandwidth; approved by TIA and IEC
- Employs power weighting provided in raw data to determine expected bandwidth
- Offered first by Corning for high-performance multimode fibers
- For high-bandwidth 10 Gb/s data rates

Corning also provides restricted mode launch (RML) bandwidth measurements for InfiniCor 300, 600 and CL1000 optical fibers. RML bandwidth is the most accurate measurement of a fiber's bandwidth performance in lower-bandwidth 1 Gb/s laser-based systems less than 600 m in length. Corning also was the first to offer RML bandwidth measurements for its multimode fibers.

In fact, Corning is so confident in the performance of its InfiniCor® fibers that, working with cabler warranty programs, they guarantee their performance in laser-based systems, thus ensuring reliable, high-speed performance for Asia's premises networks, networks that are seeing enormous growth in both users and broadband content demand.

**GuideLines Online Work Saver:**
Let us save you time and effort — we did the work for you! Here are related links and additional data we found while researching this article.

- Corning White Paper: 50-Micron Optical Fiber Q&A
- Economic Growth Center Collection — Asia, at the Yale University Library Online
- Fiber 101 — Learning About Fiber from a Trusted Leader in Fiber Optics