The Converged Optical Network

Key to Enabling Today's Digital Experiences in High-Traffic Developments

CORNING

Authors:
Robert Basile, Solution Architect, ONE™ Market Development
R. Todd Christner, Director, ONE™ Market Development
Jason Greene, Director of Solution Architecture, ONE™ Market Development
Corning Optical Communications

Executive Summary

Mobility. Cloud-based services. Software as a service. Location-based services. The Internet of Things.

These technological advancements are changing ***how*** we work, shop, and play. They also are some of the biggest challenges for those who develop and manage ***where*** people work, shop, and play.

It is a particular problem for those developing and managing high-density and high-traffic areas such as urban and suburban town centers, large corporate campuses, and mixed-use shopping and entertainment complexes.

These high-traffic venues are the most in-demand and fastest-growing commercial developments in America today. But their network infrastructure must support:

- A consumer base averaging 11.5 billion by 2019 or 1.5 mobile devices per capita and counting;
- A workforce of which nearly two-thirds (63%) is reliant on cloud-based services;
- E-commerce models dependent upon things like rich media, mobile gaming, location-based marketing, and promotion;
- Corporate and consumer applications reliant on seamless and immediate streaming of audio and video content; and
- Building infrastructures where everything from lighting to environmental controls is organized around the Internet of Things.

That is just for today. There are also the demands of tomorrow.

Today, it would not be an overstatement to say that for large commercial buildings or high-density developments, the ability to effectively meet connectivity demands of mobility, cloud-based services, and the Internet of Things is as important as the land the buildings occupy.

Unfortunately, many high-traffic and high-density developments can't enable and support the digital experiences in demand today, much less be ready for the future.

In fact, according to a 2015 report by Gartner, four-in-five (80%) of wireless LANs are "obsolete."

As the number of connected devices skyrockets, interoperability is often dependent on outdated and expensive to maintain copper-based local area networks (LANs). These copper-based LANs were designed for the antiquated world of the computer desktop. They can barely keep pace with normal connectivity and bandwidth demands, much less "talk to" and integrate across new and emerging IP-based systems.

It is not just a technology problem. It is increasingly a competitive problem. Again, according to Gartner, mobility is "inextricably linked with business innovation" and that failure to adapt will expose "lagging organizations to negative consequences."

Enter optical fiber and the Corning® Optical Network Evolution (ONE™) solution.

Fiber is proven to be the most scalable, cost-effective, and fastest way to move data. Moreover, fiber-based converged optical networks are cheaper and easier to install, take up less space, use less energy, and are simpler to manage. They can provide high-density developments unlimited access to bandwidth through the tremendous capacity of fiber optic communications.

There are several options available today, but only ***one*** has the ability to meet the bandwidth demands both today and also in the future, all while controlling costs. That ***one*** is Corning ONE.

Corning invented the fiber optic technology that revolutionized long-haul communications. Today, Corning is using that same technology – along with other Corning innovations – to revolutionize networks inside of buildings, campuses, and sports stadiums.

The ONE converged infrastructure is the only fiber-centric solution that:

- Takes full advantage of fiber technology, driving it deep into the network;
- Has the flexible architecture and design to be technology, plug-in, and device agnostic; and
- Provides for maximum "capacity steering," or traffic management, enabling network managers to optimize signals, connections, and performance.

... for large commercial buildings or high-density developments, the ability to meet connectivity demands ... is as important as the land the buildings occupy ...

Put simply, old network infrastructures in most buildings, town centers, and other large building complexes don't have the capacity to support our new digital environment.

In the following pages, we outline the growing role that high-density and high-traffic venues play in today's society.

We also show how copper-centric legacy networks inside these venues are ill-equipped to efficiently support a mobile society, which is increasingly dependent on cloud-based services and the Internet of Things.

Finally we'll outline why only one solution – the Corning® ONE™ solution – has the ability to not only meet those needs today, but also those of tomorrow.

Today, access to bandwidth determines our productivity, preferences, and even our overall "experiences" whatever we're doing, wherever we are.

The opportunity and challenge of high-density development

The town center. The corporate headquarters. The college campus. The medical complex. The stadium. These high-traffic, mixed-use venues support all sorts of human activity – business, entertainment, education, and research.

They are the heart of both urban and suburban life and are some of the fastest-growing segments in real estate development.

High-density, mixed-used developments are booming. According to Rosemary Feenan, director of global research for JLL, *"**Good density will mark out the next generation of winning cities.** Norms and ingrained behaviors are slowly changing, moving away from car-centric sprawling planning towards more environmentally focused, high-density developments."*[1]

These high-density developments are particularly attractive to millennials who make up approximately 40 percent of the population. But it is not just millennials who are flocking to high-density, mixed-use developments. Aging boomers are also warming to the advantages of mixed-use properties and their easy access to stores, healthcare, and other daily needs.[2]

In fact, according to a recent study by the Urban Land Institute, 62 percent of all Americans who plan to move in the next five years say their preference would be a high-density, mixed-use development.[3]

[1] "Why density is not a dirty word in city development," Rhian Nicholson, JLL, 6 July 2015. http://bit.ly/1Um4UBH

[2] "Global trends in mixed use development: the new paradigm in urban placemaking," Sarah Horsefield, director, Urban Insights, 1 July 2015. http://bit.ly/2mclwnP

[3] "RESTORE: Commercial and Mixed-Use Development Trends In The Rocky Mountain West," The Sonoran Institute. http://bit.ly/1Um5P51

High-density development, connectivity, and business strategy

The move to more densely populated locations has triggered an even greater network demand for digital services.

Today, connectivity and bandwidth determine our productivity, preferences, and even our overall "experiences," whatever we are doing and wherever we are. Digital experiences are becoming the norm whether you are in a business complex, a hospital, or a sports stadium.

Perhaps no high-density venue is changing faster than the athletic stadium. According to Scott Radecic, senior architect for the largest sports architecture firm, Populous, the stadium of the future will enable visitors to go beyond being spectators and through interactive virtual-reality be participants. According to Radecic, sporting stadiums will likely have fewer seats and more digital-based experiences. Indeed, an astounding 166 TB of mobile data was used during college football games in the 2015 season.

Indeed, connectivity has become inextricably linked to business competitiveness and innovation.

By 2017, nearly two-thirds (63%) of business workloads will operate in "the cloud. " And by the end of the decade, the growth in information managed by the enterprise will grow fifty-fold.[4]

Those who operate businesses need connectivity and bandwidth to support high-definition displays. Employees need access to high-speed data and video services. Researchers need high-definition imaging and video conferencing services.

On top of that, there is the growth in demand for mobility. More than half of all IP traffic is expected to come from mobile devices by 2019.[5] According to Gartner:

> *"Mobility has moved beyond devices and is now inextricably linked with business innovation ... Pervasive mobile expectations will expose lagging organizations to negative consequences such as customer dissatisfaction, employee resignations and lower productivity."*

In addition to satiating the ever-increasing personal connectivity and bandwidth demands of high-density locations, there is the need to accommodate emerging smart building technologies and the Internet of Things. Not only do networks have to accommodate people, they need to support communications between materials and products.

Addressing today's connectivity and bandwidth demands are difficult. It's even more challenging for businesses and developers to do so in ways that are reliable, easy to manage, and most of all, affordable.

In addition to satiating the ever-increasing bandwidth demands of high-density locations, there's a need to accommodate emerging smart building technologies and the Internet of Things.

[4] From Corning PPT

[5] From Corning PPT

On top of that, there are the people who visit and flow through a sports stadium, hospital, or college campus. They get information and navigate their way through the complex using public touchscreens. They check in and out across campus or commercial centers using an app on their smartphone. All the time, expecting to be able to instantly check on products and services through streaming content on a mobile device.

And we're not talking just a few people, but in the case of medical centers or entertainment venues, this could be tens of thousands of individuals at once.

When asked about the three most important factors in real estate, British real estate tycoon Lord Harold Samuel coined the phrase "location, location, location." Today he might say the three most important factors in real estate development are "connectivity, connectivity, connectivity."

The copper roadblock

The biggest roadblock for the CIO or CTO seeking to effectively and efficiently manage a network to support these high-density, high-traffic environments is copper — specifically, the copper-centric network design.

Legacy copper-centric LANs were built for traditional desktop computer and phone system infrastructures. They are expensive, difficult to install, and require constant upgrading as technology advances. Further, copper-centric network designs limit those who work and play in high-density developments of new ways of doing business. It is an architecture no longer effective in today's mobile, cloud-based digital environment.

Not only does the antiquated copper-centric network rob those who work and play in high-density developments of new ways to do business, they are expensive and difficult to install, maintain, and upgrade.

Put simply, today's new digital experiences either don't work well or can't work at all on an old, copper-based legacy network.

Today we need universal multiservice networks, capable of efficiently transmitting information of any kind, including data, voice, and video.

Copper- and Ethernet-based configurations can't meet that standard. They are not equipped to manage today's large flows of traffic onto a wide area network in a secure, smart, and sustainable way. Here are just a few of their downsides:

Copper-centric systems are bulky and expensive to install: For example, four inches of copper cables are required to carry the same amount of bandwidth that a single strand of optical fiber that is one-tenth the width of a human hair. The sheer weight and bulk of copper systems add to building costs in everything from installation to storage to infrastructure.

Copper-centric systems are expensive to maintain: A traditional copper-switched-based architecture uses multiple tiers of electronics and switches. As a result, it is a system with a short life cycle. When updated, the copper cabling actually has to be replaced. Adding new devices requires long runs of copper at significant costs.

Copper-centric systems are prone to EMI: Long runs of copper also create the problem of potential electronic magnetic interference. That can degrade network performance, particularly when those networks are stacked close together. Optical networks significantly limit EMI risk.

Convergence and the Corning® ONE™ infrastructure

Today's technologies put CIOs and CTOs at the crossroads in the evolution of the local area network.

It is similar to the evolution of Ethernet, FDDI, and token ring. That evolution was characterized by significant differences between the length and the quality of communications links, the complexity of the data transmission methods, data exchange rates, the range of provided services, and scalability.

Today's high-density, high-traffic environment needs next-generation network design — a design that addresses the convergence of three modern-day realities: (a) the need for constant connectivity; (b) the demand for unlimited bandwidth; and (c) the inexorable growth of technology complexity.

That next-generation design is the **Corning ONE solution**. ONE is a converged network that is fiber-centric, not copper-centric. It is based on the same optical fiber technology invented by Corning that revolutionized long-distance communications.

ONE maximizes the advantages of optical fiber-based networks and enables the CIO or CTO to do three things:

1. Improve overall performance by pushing fiber to the extreme edge of the network.
2. Make the network more adaptable by simplifying device connectivity.
3. Make the network more efficient and easier to manage by maximizing "capacity steering" or traffic management.

Improving performance by pushing fiber to the extreme edge of the network

Fiber is the most scalable, cost-effective, and future-ready way to transmit data.

The Corning ONE converged infrastructure uses its own distributed antenna systems to push fiber connectivity deep into the infrastructure and far beyond a building's IT closets. This innovation enables the convergence of multiple disparate networks onto a single fiber-based infrastructure.

The performance-enhancing features include:

- Enabling independent single-mode fibers for each network application to be converged into a large-fiber-count cable assembly and distributed to aggregation points around the campus or venue.
- Ensuring cellular connectivity, regardless of provider and assuring that mobile devices have the same service levels as other business-critical networks.
- Providing a common headend location for cellular, Wi-Fi, security, BMS, core routers, and VoIP.
- Eliminating the legacy copper distance limitations requiring IDF closets to support the maximum copper length of 300 feet.

Simplify device connectivity

Fiber is a near-universal media and practically bandwidth unlimited. The Corning® ONE™ solution maximizes this advantage by being device and connection neutral. In place of IDF or telephone closets consuming valuable real estate and resources, ONE uses a fiber-based, point-to-multipoint architecture that is simpler to develop and maintain. This makes plug-ins and add-ons simpler, easier, and more economical.

First, because the active gear is connected directly to fiber, there is lower latency and more bandwidth available. That translates into a greatly improved user experience.

Second, by pushing multiple strands of fiber and power closer to the person using it, you typically lower the cost and time usually associated with changing or adding new technologies. It is much more "plug and play."

Finally, it simplifies upgrades. Advancements in technologies require active equipment to be upgraded or changed to new or different manufacturers. ONE allows system owners to simply replace elements at the core and edge of the network, leaving the fiber cabling infrastructure in place.

Maximize capacity steering or traffic management

The converged architecture of Corning ONE allows networks to seamlessly aggregate and manage traffic flow within 12 miles of a single headend for each network application. What does that mean? That you can much more efficiently manage multiple communication modes in a single network. It provides a level of convenience and flexibility that is simply not possible with the typically siloed legacy network architecture.

First, because ONE has a one-to-one fiber connection between the cellular signal source and the antenna, you can do something called capacity steering. Capacity steering is the ability to move cellular capacity to specific areas for large events and reallocate to others later. A good example is being able to move capacity from the hotel rooms during the day down to the convention floor in the afternoon and then back into the towers during the evening.

Corning® ONE™ also enables something called "data center and BTS hoteling." The fiber-centric design enables other technologies to provide a single headend and WAN connection to multiple locations around a campus. It supports a single main distribution frame (MDF), data center, or BTS location while providing the required connectivity for mobility and cloud-based services.

The performance and innovation advantage of Corning® ONE™ infrastructure

These three design elements make the Corning ONE converged fiber-based infrastructure uniquely suited to not only meet current connectivity demands, but also provide a single platform that can support the new types of enterprise, commerce, and entertainment of the future.

Specific benefits include:

Improved performance and network management: Managing old networks is messy business. It ranges from provisioning desktops to seemingly endless upgrades and patches. With ONE, you eliminate the complexity and cost of switches and access layers, enabling a building to have "five nines" reliability at a reduced cost.

Floor space savings: Old legacy networks have something called floor-level switching. ONE eliminates the need for multiple switch closets and, by our estimate, can reduce floor space needs by 69 percent. This could mean huge savings for a large campus development with multiple floors and buildings.

Power and cooling savings: Legacy networks need a lot of energy to run and give off a lot of heat. That may not sound like a big deal, but it can add up to real money. Because of the simple, fiber-based architecture, ONE networks consume less power and can reduce costs related to cooling by 74 percent.

Construction savings: With a ONE fiber cable infrastructure, there are fewer cables to install, and the configuring and wiring structure is much simpler. The savings could be considerable in a high-cost labor market.

Greater security: With a Corning ONE converged infrastructure, data will be more secure than it is in traditional copper-based networks. Fiber isn't subject to cross talk, radio frequency interference (RFI), or electromagnetic pulse (EMP). Passive optical LANs meet the federal government's most secure Layer 1 requirements for secret IP networks.

Assured bandwidth: Finally, and perhaps most importantly, ONE is a future-ready upgrade path to safer, greener, higher security, and higher bandwidth over the same fiber infrastructure.

Corning ONE eliminates the need for multiple switch closets and, by our estimate, can reduce floor space needs by 69 percent ... ONE networks consume less power and can reduce costs related to cooling by 74 percent.

	Optical Fiber	Copper
CapEx cost	< $300,000	> $1,000,000
Life cycle	30-50 years	5 years
Distance	12 miles	300 ft
Weight	4 lbs	30 lbs
Energy consumed	2 watts per user	More than 10 watts per user
Max bandwidth	69 Tbps	10 Gbps

Why Corning® ONE™ converged fiber-based infrastructure?

Mobility and access to cloud-based services are the drivers behind today's connected user. The demand to be connected, regardless of the environment or network, requires venue owners, businesses, and carriers to explore technologies that meet these requirements and control costs. There are several options available today, but only one has the ability to meet current and future bandwidth demands while controlling costs.

That one is Corning ONE.

ONE is revolutionizing the digital experience at large, high-population-density developments just as it did with traditional telecommunications over a generation ago. It is being used in large development projects, on college campuses, and in state-of-the-art entertainment venues.

By taking the inherent advantages of fiber and bringing it out from the IT closet, into and throughout the building and development infrastructure, Corning ONE enables a converged fiber infrastructure for DAS, Wi-Fi, security, BMS, and LAN, and drives down total costs while providing fiber and power connectivity to the edge of the network.

You can prepare your network for tomorrow's challenges today. With ONE as the backbone of your building's network, any high-density, high-traffic development can not only deliver on today's digital experience, but also be ready for the added demands of tomorrow. All this at a fraction of the total cost of ownership compared to legacy, copper-based networks.

Are You Corning Connected?

www.corning.com/one-wireless

CORNING

Corning Optical Communications LLC • PO Box 489 • Hickory, NC 28603-0489 USA
800-743-2675 • FAX: 828-325-5060 • International: +1-828-901-5000 • www.corning.com/opcomm

Corning Optical Communications reserves the right to improve, enhance, and modify the features and specifications of Corning Optical Communications products without prior notification. A complete listing of the trademarks of Corning Optical Communications is available at www.corning.com/opcomm/trademarks. All other trademarks are the properties of their respective owners. Corning Optical Communications is ISO 9001 certified. © 2017 Corning Optical Communications. All rights reserved. CMA-533-AEN / February 2017