Optical Network Evolution (ONE™) Solutions

Convergence Design Guide

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Introduction

The arrival of virtual desktops, managed services, cloud-based computers, wireless applications, hosted data centers, and a myriad of IP-enabled devices has widely advanced communications and led the way for enterprises to redefine networks. These underlying technologies can make businesses more efficient, advanced, and connected. However, with the advent of new technologies, IT professionals are also finding challenges to support them. While keeping up with business enablement typically requires being at the cusp of the latest and greatest innovations, corporate and IT managers are being asked to do more with less. They are challenged to have ever-evolving networks to support big data analytics and software-enabled solutions, in addition to more devices and more applications.

Over time, enterprises have deployed copper-based LAN networks that were designed originally to support a layered, hierarchical infrastructure with point-to-point/peer-to-peer connections. As transmission speeds have evolved and wireless has become a more prevalent in-building need, copper-based networks have been ripped and replaced, augmented, and significantly upgraded. In order to respond to this new environment, a different infrastructure approach is needed to make the migration from local user traffic to traffic that flows onto the WAN in a secure, scalable, smart, and more sustainable way.

In the 1980s and 1990s, optical communications revolutionized long-haul transmission. Today, continents are interconnected with undersea fiber optic cables. Across each continent there are terrestrial fiber optic cables forming the communications backbone nationally and regionally, in almost every country. Fiber optic technology has shown to be vastly superior to copper in terms of bandwidth, range, consumed power, longevity, security, and reliability. Recent advances in the manufacturing and commercialization of passive and active optical components are extending these capabilities into the horizontal portion of the network, i.e. network edge, within enterprise networks. Power can now be delivered over composite cable, and pervasive wireless can economically reach every section of a facility. Enterprise networks now have a cost-effective way to use fiber closer to the edge of the network with numerous benefits to the end user. For example, reduced network infrastructure footprint, reduced cost, reduced power requirements, future-proof bandwidth, environmentally friendly, increased security, and increased reliability. As the need for connectivity is ever-increasing, the only requirement moving at a faster rate is the need for mobility. The Corning® Optical Network Evolution (ONE™) Solutions address these needs head-on with the converged network of tomorrow.

This guide will provide useful information to assist designers, end users, IT personnel, and other technical groups that are involved with designing data and wireless networks. It is important to understand different fiber-based solutions that can be implemented in corporate and public facilities prior to diving straight into architecture and material examples. The next few sections of this document will provide a high-level overview of:

1. Extended Access Switching
2. Passive Optical LAN
3. Distributed Antenna System (DAS) Networks

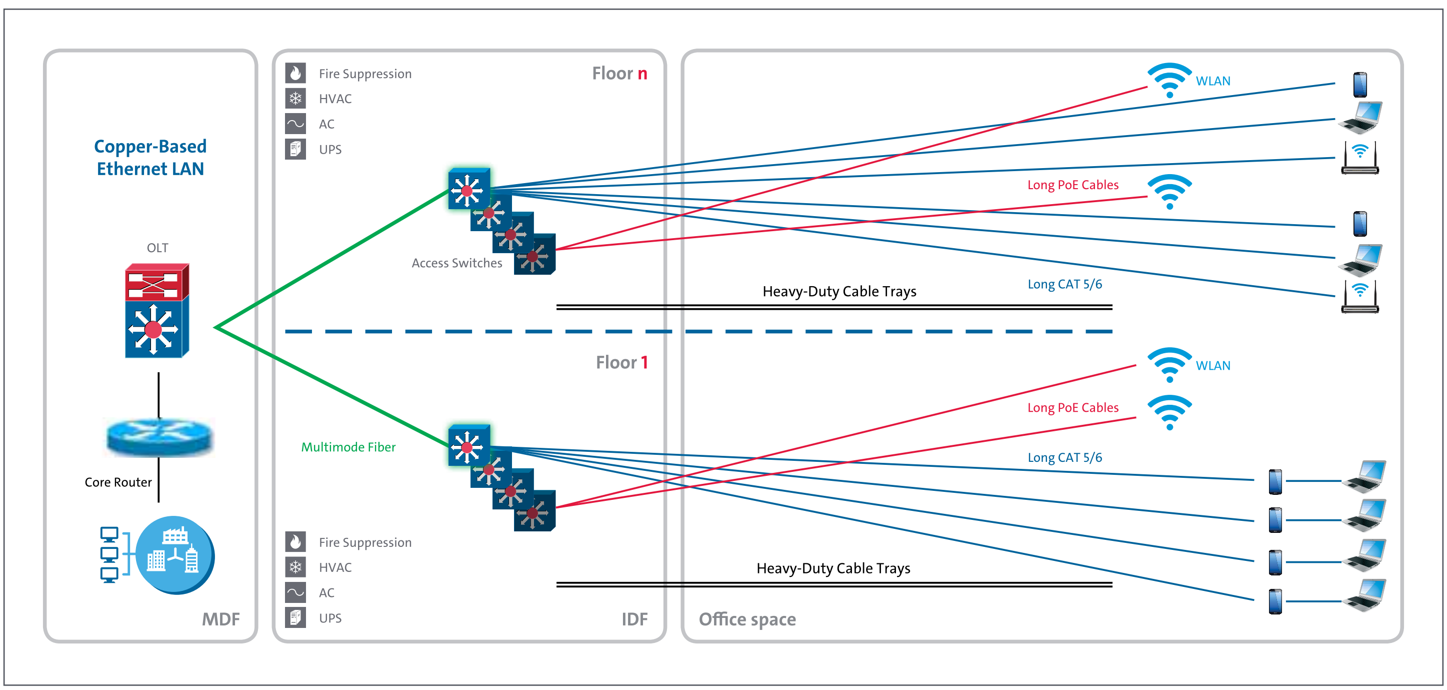
The remainder of the document will focus on how to integrate these network types under the Corning® Optical Network Evolution (ONE™) fiber-based solutions. This answer is the Corning ONE solutions.

Switching Overview

Traditional switched networks are found in nearly every building type and enterprise vertical. Typically there is a main distribution frame (MDF) where the main services are aggregated through a core and router and then distributed up to individual distribution frames (IDFs) or telco rooms (TRs) around the building or facility. Those TRs can house access switches and patch panels to provide a connection to individual category cabling (twisted-pair copper) that is installed to endpoints or directly to IP-based components. Power over Ethernet (PoE) is a critical solution in this switched architecture, providing DC power to end devices such as IP phones or wireless access points. These are devices that don't always have an AC outlet nearby, or they are critical to day-to-day operations and require power backup from the TR closet.

See the diagram below of a traditional switched network:

Traditional Switched Network Diagram:



Extended Access Switching Overview

Networks today have continued to evolve around changing traffic flow. The original port dense access switches are referred to as Work Group Switches because they were designed to connect a group of users transferring files between them. As networks have evolved, they have rapidly transitioned toward wireless and media delivery. Over 60 percent of traffic flows are moving to a centralized location or the cloud. As this transition happens, traffic is no longer moving mostly East to West (between users), but more so South/North. Networks today have an "Access" vs. "Control" issue where all users demand access to information and the network owner is tasked with protecting the integrity of their network without being too restrictive. The change in traffic flow to a common aggregation point such as a group of routers, firewalls, or AP controllers allows the security of a network to be maintained, but the additional layers create stress on the network topology and infrastructure. Latency becomes the critical factor to overcome allowing users to quickly get on and off the network as they make many requests.

In addition, these networks have continued to evolve due to higher bandwidth demand, and switching components including cabling have had to change in order to meet these needs. In the core, the switch to low latency, optical-based switches has been a growing trend. On the access side, there are multiple reasons to push switch components further into the network. The "Internet of Things" (IoT) is requiring more connections out on the floor at the user level through wireless or wired connectivity. This includes different applications such as lighting, HVAC sensors, video surveillance, building access, digital signage, Wi-Fi APs, and small cell technology. Many networks are finding that space is a challenge in their remote closet such as telecommunication rooms (TRs) or intermediate distribution frames (IDFs) and are looking for ways to provide this connectivity in a space never designed for it. Adding new TRs to an existing building that is already struggling with space can be difficult. IT managers have in many cases standardized on a switched network vendor, and when adding new facilities to their campus, they want to stay consistent with switch OEM and management.

Moving to an Extended Access Solution creates the opportunity to continue deploying a trusted vendor while moving to a new fiber-deep topology for these new high-density applications. In doing this, enterprises see the advantage of pushing fiber further out to the edge. Fiber allows you to extend access deeper into the environment.

There are multiple scenarios where extended access switching can benefit the enterprise:

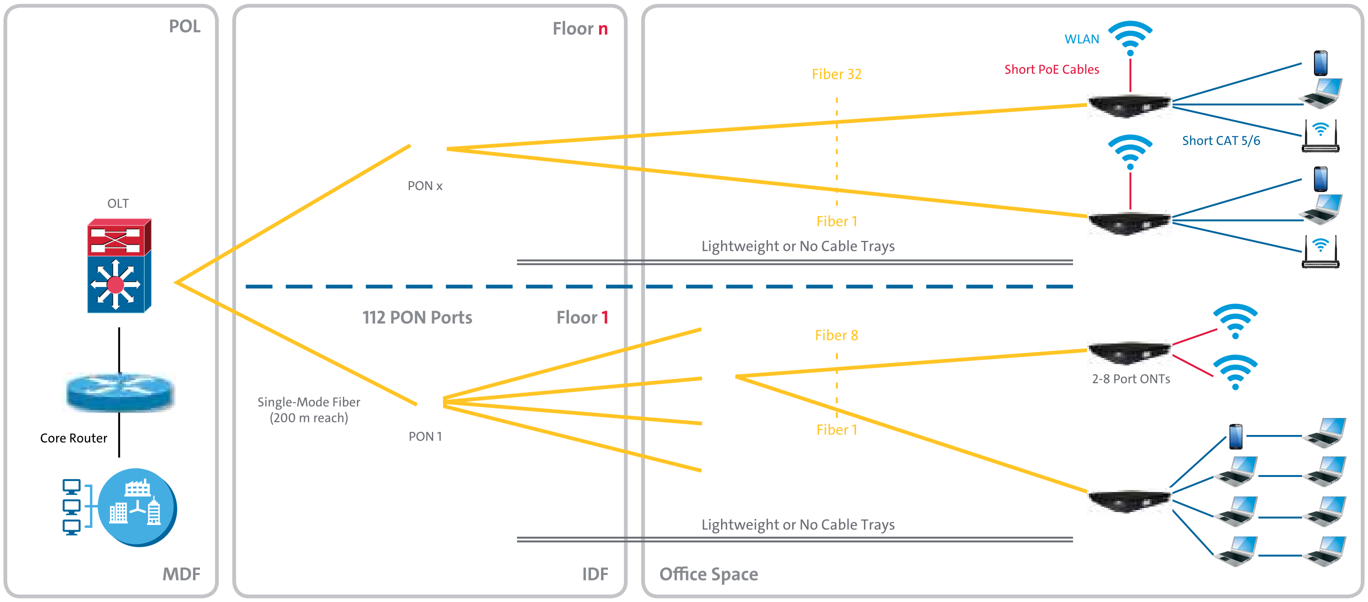
- Conference rooms or ad-hoc training centers that require an immediate need for port access
- Dense Wi-Fi environments utilizing 802.11AC and above
- Rich media applications in the latest formats
- Trade show floors or hotels require multiple connections for every different event
- Stadium press boxes
- Collaborative work spaces
- Hotel rooms/suites with multiple port requirements for connected devices

Placing a switch at the edge with one fiber cable vs. four to eight drops from an existing TR can save on labor and cabling.

Passive Optical LAN (POL) Overview

Passive optical LAN (POL) is passive optical network (PON) technology brought into the enterprise LAN through the enhancement of both software and hardware functionality. In a traditional switch-based architecture, multiple tiers of electronics are used to connect users. Ethernet switches in the equipment room are connected via optical fiber to aggregation switches in IDF closets. Individual copper cables extend to each end-user device. In contrast, POL replaces aggregation electronics and associated copper cables with passive optical splitters and single-mode fibers. This creates an infrastructure that is lower in cost to purchase, install, and maintain, and with a far longer life span, than traditional copper infrastructures.

POL is an alternative to the traditional layer-2 copper-based LAN infrastructure that is designed to support multiple services (e.g., voice, video, and data) at Gigabit speeds over single-mode fiber cabling infrastructure. POL overcomes all the limitations found in traditional copper-based Ethernet implementations: the optical fiber cable used in POL can travel for a distance of up to 12-18 miles; the fiber cable structure is much lighter than copper-based cables; the use of bend-insensitive fiber radically diminishes bend radii, therefore diminishing cable tray and pathway requirements; the passive nature of the intermediate splitter eliminates the need of power and cooling; and the single management console provides consolidated access to all devices and network ports in the network.



The above figure shows the corresponding layers in a traditional LAN design. Switches in the access layer and building aggregation layer are replaced by a passive optical splitter, and those two layers do not exist anymore in a POL design. The main components of a POL design are optical network terminals (ONTs), passive splitters, and optical line terminals (OLTs). The ONT connects client devices into the passive optical LAN via the Ethernet ports on the unit.

Electrical signals from the computer devices get converted to an optical signal in the ONT. Optical splitters simply split the light signal multiple ways to ONTs and transmit the multiplexed signal to the OLT. The OLT aggregates all optical signals from the ONTs and converts them back to electrical signals for the core router. The OLT may also have a range of built-in functionalities such as integrated Ethernet bridging, VLAN capability, end-user authentication, and security filtering.

Passive Optical LAN

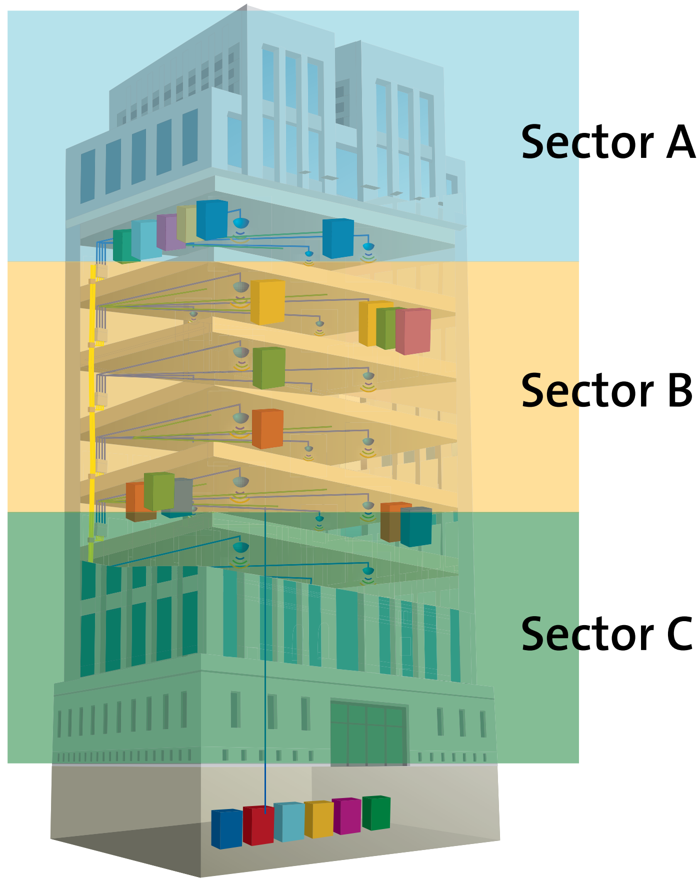
- Passive Optical Network (PON)
  - Optical Line Terminal (OLT)
  - Passive Optical Distribution Splitters
  - Optical Network Terminations (ONT)
- Single-mode fiber converges all building ICT services over single infrastructure

Corning® Optical Network Evolution (ONE™) Solutions Distributed Antenna System

The Corning® ONE™ Solutions provides a flexible in-building RF and network digital coverage solution based on a fiber optic transport backbone.

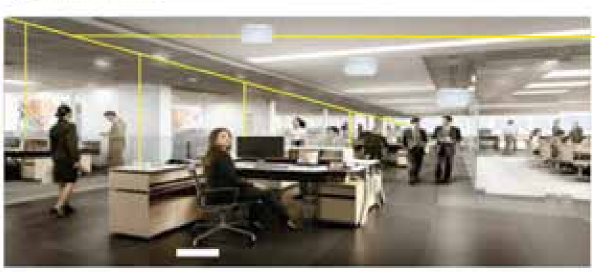
The fiber optics infrastructure is easily deployable via a wide range of preterminated (or one-half preterminated) composite cables and advanced end-to-end equipment. Easy to design, plug-and-play connectors significantly reduce installation cost and deployment time. The ONE solution is an ideal fit for large, high-rise, or campus-style deployments. It generates significant CapEx savings and OpEx savings through the use of user configurable service distribution groups and an infrastructure that is simple to deploy and efficient in usage.

Dynamic service distribution group management allows precise service distribution control to meet changing density needs, and provides further savings by enabling sharing of equipment at various levels for service providers (see figure 1 below). Radio source agnostic remote units can be used as network extenders. Ethernet capability with dedicated fiber link for Wi-Fi offload brings a higher level of granularity and support for devices and applications with very high-speed requirements.

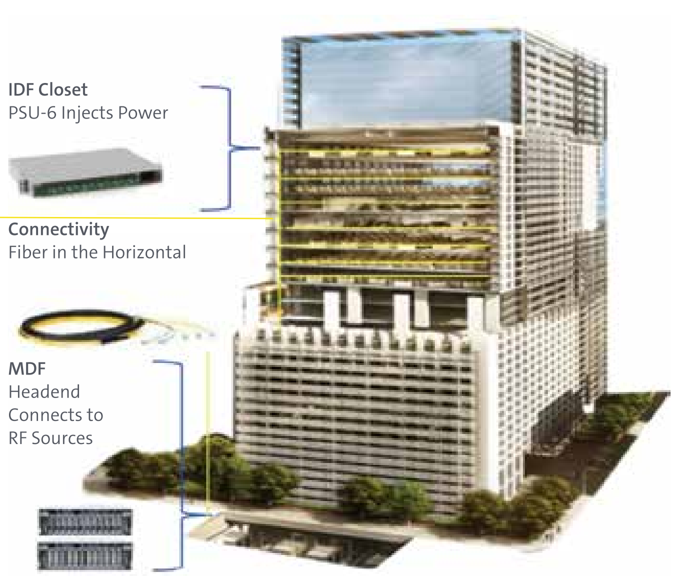


In-building wireless converged solution providing cellular with connectivity for Wi-Fi or other Ethernet backhaul over an **all-optical network**.

Active Antenna
Distribute RF + Ethernet backhaul



Coverage	Convergence	Capacity
Distributed architecture	Cellular + LAN + WLAN + POL	Unlimited bandwidth at the edge



The Corning® Optical Network Evolution (ONE™) Solutions fiber optic infrastructure allows various combinations of SISO and MIMO services to be routed from the headend to specified remote locations of each floor, according to the user-defined configurations via the web management graphical user interface (GUI). This allows optimizing service coverage and provides equipment savings. While the fiber optics infrastructure is common, the services can be routed via service provider shared or dedicated equipment. By default, the system is configured to support a single-service group: all services are transferred to all remote locations. This default configuration can be easily modified according to site requirements.

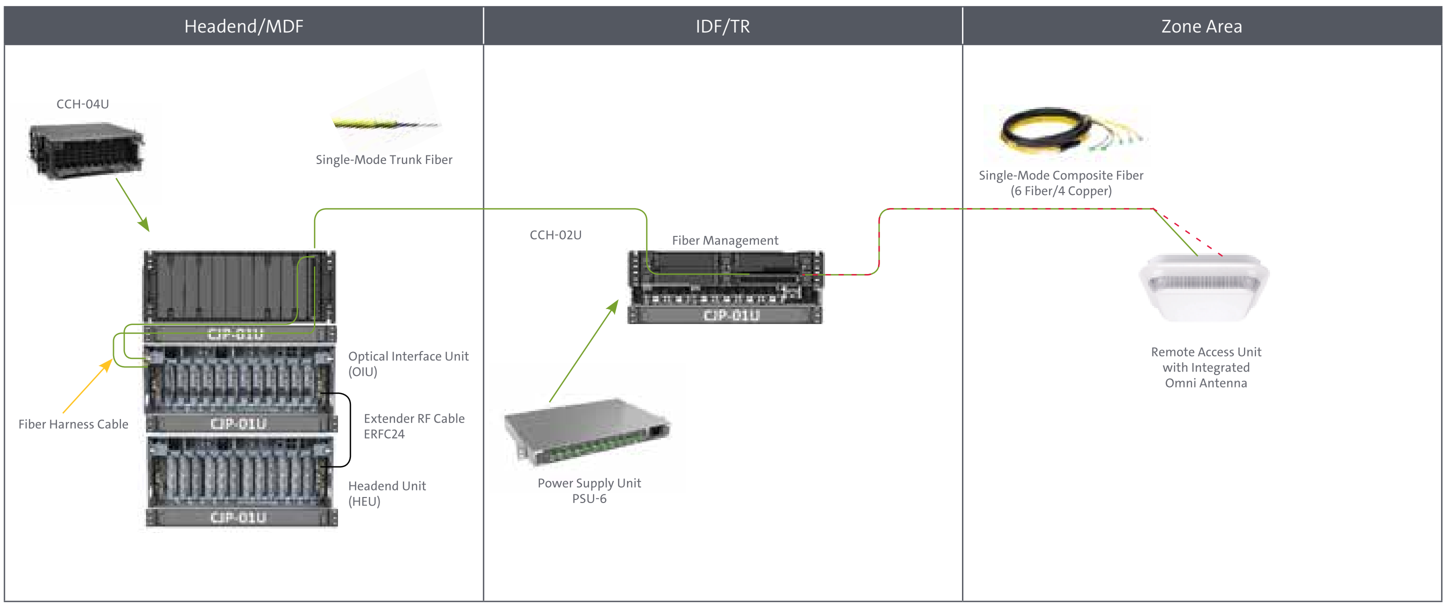
The essential components of the Corning ONE solution all-fiber distributed antenna system consist of the following:

- **Headend Unit (HEU):** Chassis that can house up to 12 RF interface modules (RIMs) used to condition RF signals from RF sources. It also houses the headend control module (HCM). The HCM is the main GUI interface for control and management for the system. The same slot is utilized for other chassis in the same system to house the ACM (auxiliary control module). The HEU chassis holds two slots for PSM (power supply modules, the second is redundant). In addition, the two outside slots (1 and 14) hold RIX cards which are RF expanders modules that are used to connect to other chassis like the OIU.
- **Optical Interface Unit (OIU):** This chassis resembles the HEU but it is used to house 12 optical interface modules (OIMs). The OIM is a wideband RF to F/O (and vice versa) media conversion module. Each OIM can support up to three remote access unit (RAU) connections. The OIU also contains positions for the ACM, two PSM modules, and two optical expander module cards (OIX).
- **Fiber Management:** Fiber harness cables from the OIMs are connected to a fiber management unit. Each OIM connects to six fibers via an MTP®-LC 6-fiber harness cable. The fiber management unit can come from different product families. The Corning CCH or EDGE™ products both work well. The CCH family works well for some converged solutions.
- **Trunk and/or Composite Fiber:** Corning provides multiple single-mode fiber cabling solutions for the Corning ONE platform. The type of trunk and horizontal fiber cabling utilized in the solution depends on the solution requirements.

- **ICU or PSU (Interconnect Unit or Power Supply Unit Chassis):** The main function of the ICU/PSU in the Corning® ONE™ solutions is to provide DC power to the end remote access units and other devices in the zone such as the Corning Gigabit Ethernet module, PON optical network terminals, or remote switches. The ICU/PSU chassis holds either four or six power supply modules (PSM-I). Each PSM-I contain two 100 W ports. The ICU is designed to hold two fiber edge cassettes for fiber management and four PSM-I units. The PSU-6 is designed to hold six PSM-I units and no EDGE™ cassettes.

- **Remote Access Unit (RAU):** The RAU distributes up to five services via internal antennas (external antennas are optional). The RF services received over optic cables and converted for distribution over internal (or via the external option). An RXU (RF expansion unit) can be added to the modular RAU to add two more frequencies as needed.

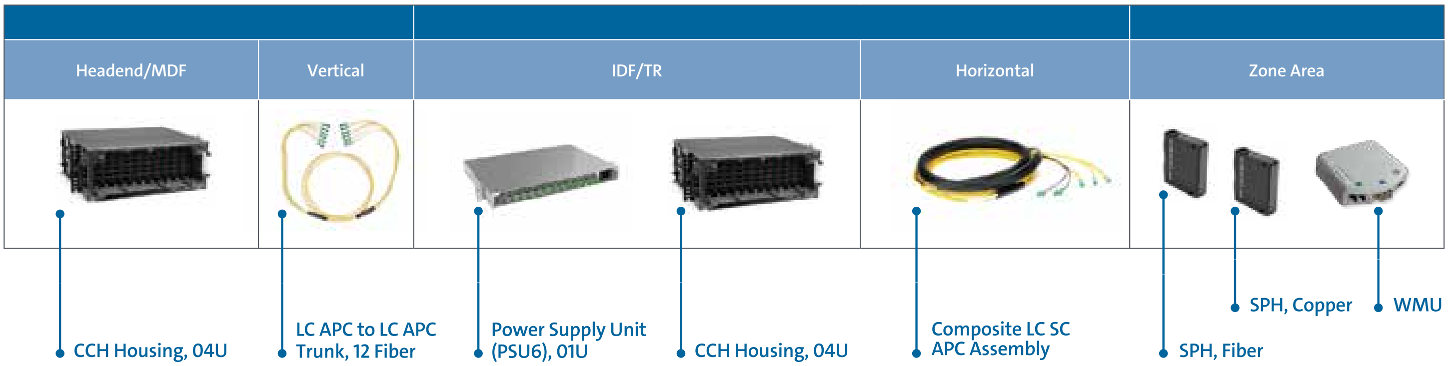
Below is a diagram of the main components of the Corning ONE distributed antenna system.



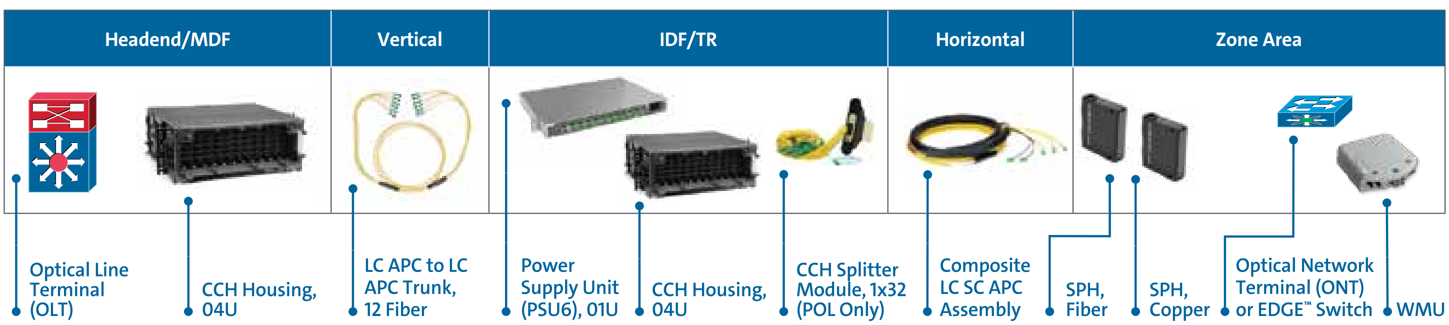
The Convergence Solution On Corning® Optical Network Evolution (ONE™) Solutions

Now that we've discussed three different all-fiber networks (extended access switched networking, passive optical LAN networking, and distributed antenna systems), we can focus on how to merge these solutions together utilizing the same fiber optic infrastructure.

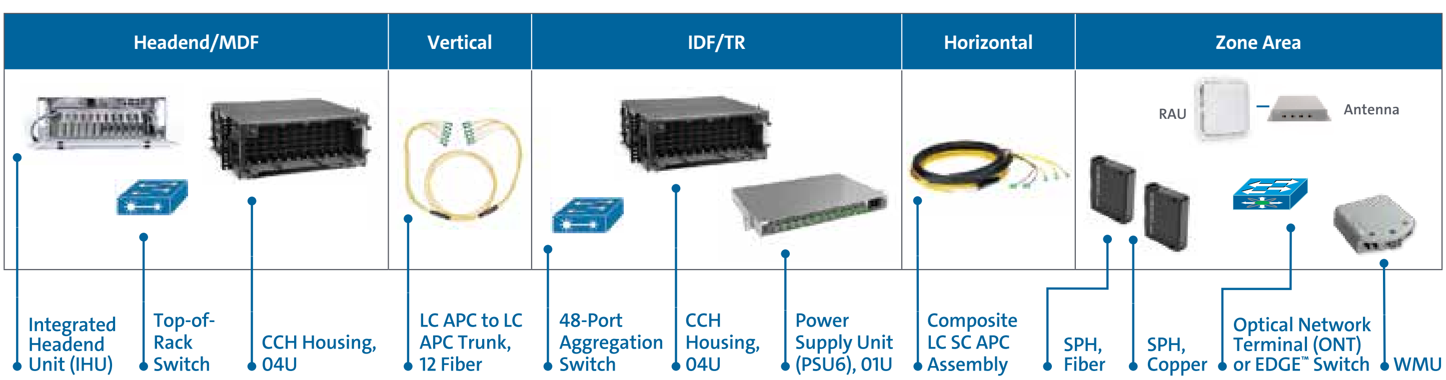
We can break down the infrastructure of the Corning® ONE™ solutions into the following common components:



Once a fiber network is sized to support the active components at the headend and the zone area, connecting the active components is relatively a simple task. Here is a high-level example of the components needed when combining a POL network and Corning's DAS network over the Corning ONE solutions:



Or consider the common components when combining an extended access switch network and Corning's DAS network over the Corning ONE solutions:



Design Considerations:

Before starting a converged design with the Corning® Optical Network Evolution (ONE™) Solutions, it is important to identify the customer requirements for the full solution. In a traditional design, power budgets and bandwidth allocation need to be heavily accounted for. QoS schemes are able to minimize contention, but greatly complicate the network and could depredate performance. There are many ways to design a solution, but designing one with a common infrastructure that supports multiple applications requires a focus on some key points.

1. What applications are required to be connected at the edge of the network?
   - Wi-Fi?
   - IPTV?
   - IP phone?
   - Building management controls?
   - LAN ports?
   - Small cells?
   - Cellular DAS?
   - Location-based services?
   - Security systems?
     - If yes, what is the maximum video stream size in Mbps?
     - Can the camera turn into a multicast source and broadcast its stream to others?
   - Other?

2. Of these applications, what will be the switching network to connect these IP connections back to the data center core in the main distribution frame (MDF)?
   a. Extended access switching?
   b. Passive optical LAN (GPON)?
   c. Gigabit Ethernet modules?

3. Do the end devices require Power over Ethernet (PoE) or local power? If yes to PoE, what are the power requirements in watts per device? This is important to understand the type of active equipment required to provide that Ethernet and PoE connection. This will also help determine the proper gauge of the copper conductors required for the composite cabling.

4. How many active components (either remote switch or GPON ONT) are required per zone? Essentially, how many ports are required per zone area? This will help determine the horizontal fiber count per zone/room.

5. Does the solution require a zone box to be installed in the ceiling? What is the predominant ceiling type? Is there room for a 2-by-2-foot ceiling-mounted zone box that may be up to 12 inches deep?

6. Where are the TR/IDFs located in relation to the zone areas? Are there multiple per floor? Can one TR serve multiple floors? What is the path from the TR to the endpoint location? What are the maximum distances from the MDF/TR (and remote power sources)? What sort of power is available in the TRs?

7. Where is the headend/MDF located in the facility? How is it connected to each TR/IDF? Are there other key network assets, like storage, servers, or telco demarks that should be considered with the overall topology?

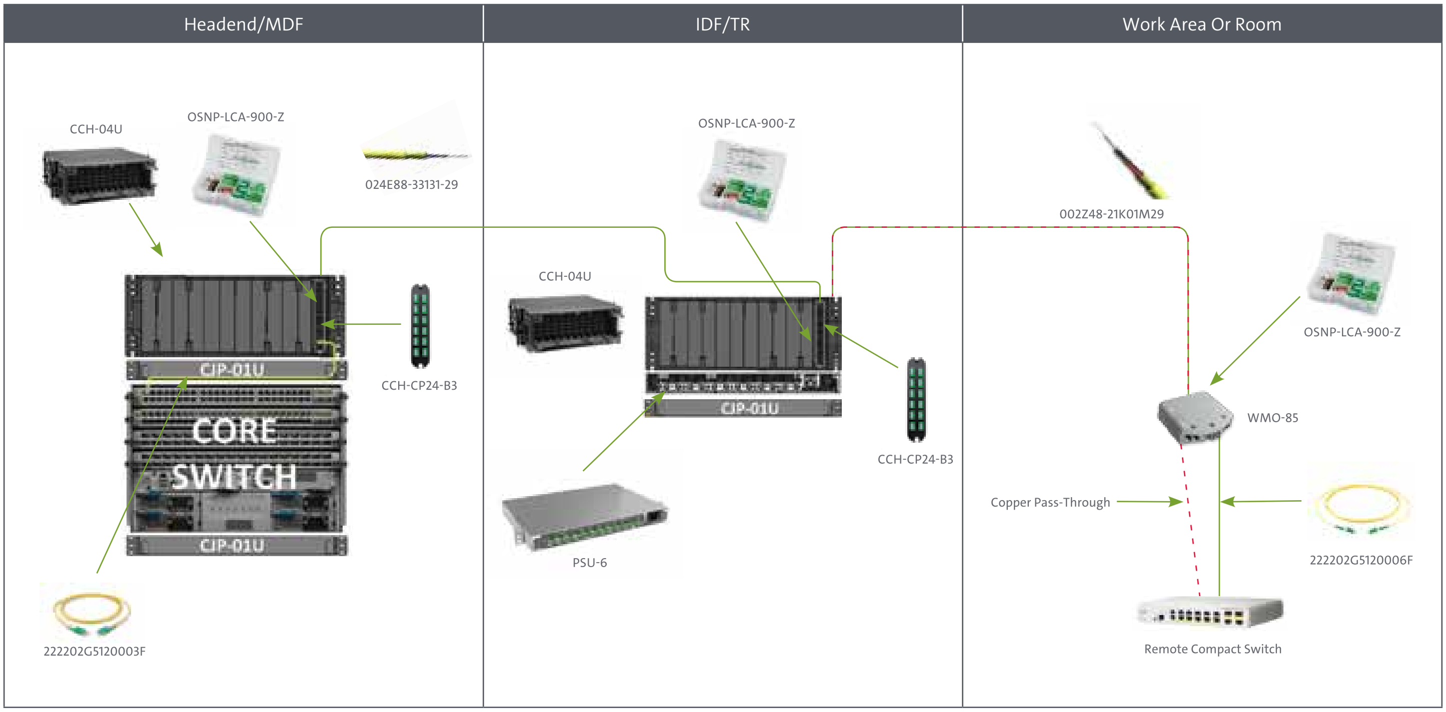
8. Regarding cellular, it is recommended to work with Corning or a Corning VAR directly to ensure proper wireless service provider requirements are gathered. The goal is to understand how many RAUs per floor are required. Many times the RAU count matches up nicely with the zone locations. Sizing the composite fiber cable to serve both the cellular RAUs and the other Ethernet switching components is key to the solution.

   NOTE: Each Corning RAU requires a minimum of one pair of fiber from the RAU back to the OIU in the headend location. It is common practice to plan for at least four fibers per RAU in the horizontal and the vertical when sizing fiber counts. RAU fibers do not pass through optical splitters.

Corning® Optical Network Evolution (ONE™) Solutions Examples of Designs and Sample BOMs:

The following section provides various examples of different solutions that include the Corning parts and descriptions. These examples are essentially to cover a single location in a building and could be scaled accordingly. Fiber counts used in these diagrams are only examples. Appropriate calculations would be required for fiber counts with associated fiber hardware per zone/drop, TR, and trunk fiber back to the MDF.

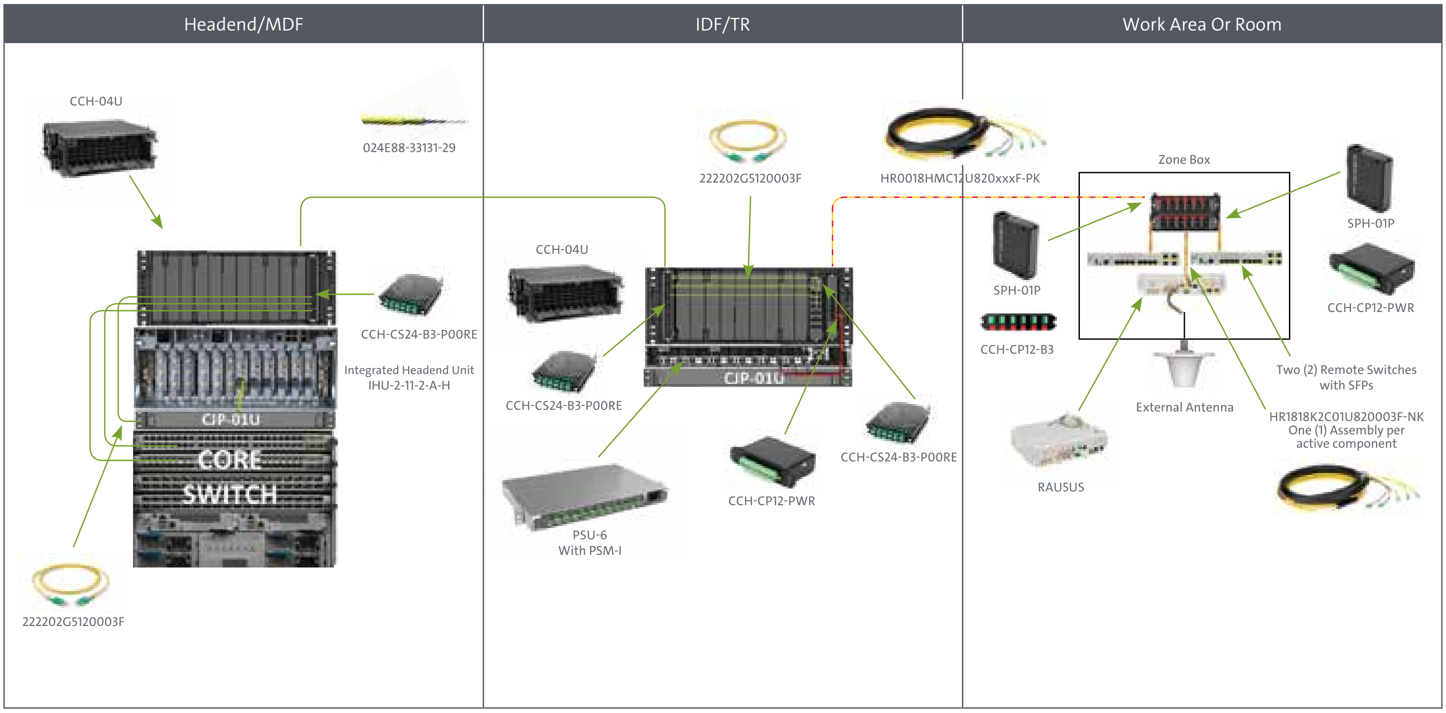
Example of Corning® ONE™ Solutions: Extended Access Switch



Example of Corning® ONE™ Solutions: Extended Access Switch

Location	Type	Part Number	Description	Comments
Headend/MDF	Jumper	222202G512003F	LC APC to LC APC 3-ft Duplex Jumper	One per access switch
	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	Can support up to 144 links/access switches
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	Front and rear access to LC APC connectors
	Jumper Management	CJP-01U	Horizontal Cable Management	Use in between components for wire management
	Riser Fiber Cable	024E88-33131-29	MIC® Tight-Buffered Cable, plenum, 24 F, single-mode (OS2)	Riser fiber count may vary depending on requirements
IDF/TR	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	May reduce to smaller version for less panels
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	Front and rear access to LC APC connectors
	Jumper Management	CJP-01U	Horizontal Cable Management	Use in between components for wire management
	Power Supply Chassis	PSU-6	Corning® ONE™ Power Supply Unit Chassis. Holds up to six PSM-I modules	Up to 12 100 W DC power feeds from one chassis
	Power Supply Module	PSM-I	Power Supply Module: provides two 100 W	Need to understand total power needs for remote switch
	Field Connector	OSNP-LCA-900-Z	OptiSnap® Connector, LC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	
	Horizontal Cable	002Z48-21K01M29	2 F/2Cu Composite Cable 20AWG, bulk cable	2 F/2Cu is minimum cable size recommended
Work Area/Room	Field Connector	OSNP-LCA-900-Z	OptiSnap Connector, LC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	
	Field Connector	WMO-CPO2-B3-85	Workstation Multimedia Outlet (WMO), with duplex LC APC adapter plate	One WMO can hold up to five fiber panels
	Jumper	222202G512003F	LC APC to LC APC 3-ft Duplex Jumper	One jumper per switch

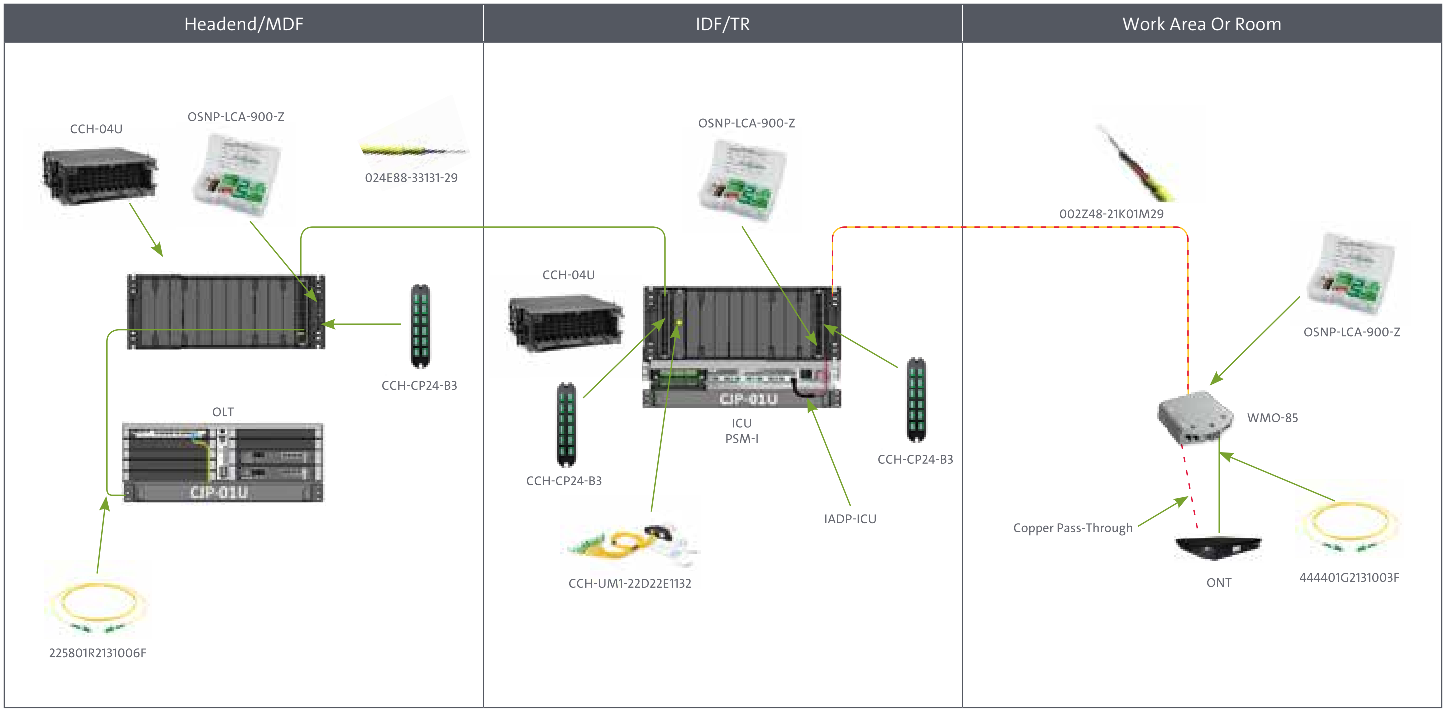
Example of Corning® ONE™ Solutions: Extended Access Switch + Corning ONE Cellular (Zone Architecture)



Example of Corning® ONE™ Solutions: Extended Access Switch + Corning ONE Cellular (Zone Architecture)

Location	Type	Part Number	Description	Comments
Headend/MDF	Jumper	222202G512003F	LC APC to LC APC 3-ft Duplex Jumper	One per access switch
	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	Can support up to 144 links or combo of access switches and RAUs
	DAS Headend	IHU-2-11-2-A-H	IHU Assembly (without RIMs and OIMs), ERFC cable provided, support for one RIX, one OIX, four RIMs, four OIMs, and four additional RIMs/OIMs in combo slots, two PSM-AC modules, and one HCM	The integrated headend unit is a combo unit that houses both RIMs and OIMs. This chassis can be used for single carrier solutions or remote buildings in a campus.
	DAS Headend	RIM-L70	Radio Interface Module for HEU/IHU chassis, LTE 700 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-C85	Radio Interface Module for HEU/IHU chassis, CELL 850 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-P19	Radio Interface Module for HEU/IHU chassis, 1900 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-P17	Radio Interface Module for HEU/IHU chassis, 1700 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	OIM	Optical Interface Module for OIU/IHU Chassis, three optical links. (Ships with OIM 6-F MTP®-LC APC harness cable)	OIMs are scaled based on number of RAUs in a system
	Splice Module	CCH-CS24-B3-P00RE	LC APC Splice Cassette, 24 F	One used per 24-F riser cable
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Trunk Fiber	024E88-33131-29	MIC® Tight-Buffered Cable, plenum, 24 F, single-mode (OS2)	One cable can support six RAUs and six switches
IDF/TR	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	CCH-04U could be reduced to something that holds less panels depending on how many zones are fed from the IDF
	Splice Module	CCH-CS24-B3-P00RE	LC APC Splice Cassette, 24 F	One splice cassette per 24-F cable
	Jumper	222202G512003F	LC APC to LC APC 3-ft Duplex Jumper	One per switch and one per RAU needed
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Power Supply Chassis	PSU-6	Corning® ONE™ Power Supply Unit Chassis. Holds up to six PSM-I modules	Up to 12 100 W DC power feeds from one chassis
	Power Supply Module	PSM-I	Power Supply Module: provides two 100 W	One port for RAU; One port for remote switch
	Splice Module	CCH-CS12-B3-P00RE	LC APC Splice Cassette, 24 F	One splice cassette per 12-F composite cable
	Power Patch Panel	CCH-CP12-PWR	12 Conductor Patch Panel	One power patch panel per 12 conductors
	Horizontal Cable	HR0018HMC12U820xxxF-PK	Composite Assembly, 12 single-mode fiber, and 12 20AWG copper conductors. Half of cable is preterminated with 12 LC APC connectors and 12 copper dinkle conductors.	12 F and 12Cu to the zone box. Number of fibers could vary based on needs in the zone box.
Zone Area	Hardware	SPH-01P	CCH Single-Panel Housing. Houses one CCH panel.	One housing to hold the 12-F patch panel
	Fiber Patch Panel	CCH-CP12-B3	LC APC Panel, 12 F	Connects the 12 fibers
	Hardware	SPH-01P	CCH Single-Panel Housing. Houses one CCH panel.	One housing to hold the 12Cu patch panel
	Copper Patch Panel	CCH-CP12-PWR	12-Position Copper Patch Panel	Connects the 12 copper conductors
	Composite Jumper	HR1818K2C01U820003F-NK	LC APC to LC APC 3-ft Composite Duplex Jumper with two copper conductors	Need one per switch and one per RAU
	DAS Remote	RAU5-US	Remote Access Unit supporting five bands (ESMR 800/CELL 850, LTE 700, AWS 1700, and PCS 1900 (external antenna required)	RAU locations are designed specifically to support wireless carrier requirements and building density

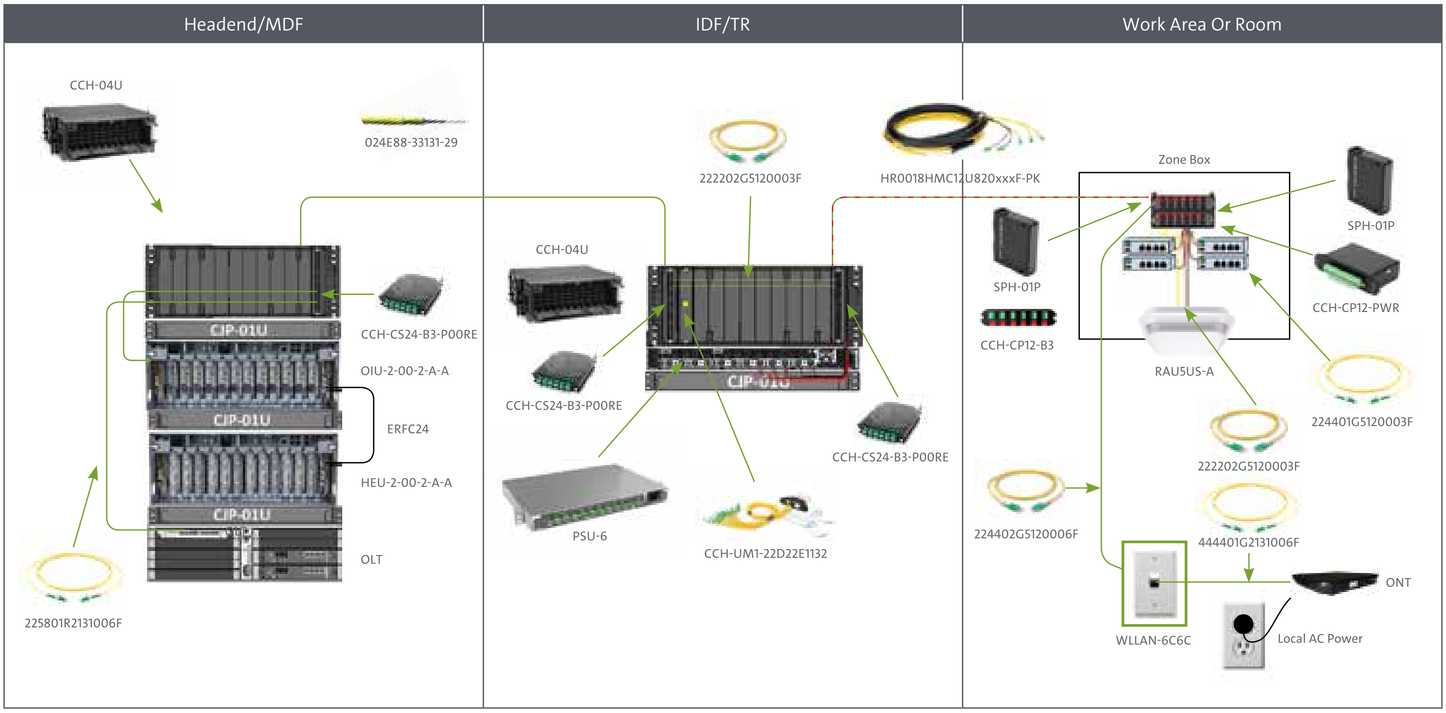
Example of Corning® ONE™ Solutions: Passive Optical LAN (POL)



Example of Corning® ONE™ Solutions: Passive Optical LAN (POL)

Location	Type	Part Number	Description	Comments
Headend/MDF	Jumper	225801R2131006F	LC APC to SC UPC Jumper	Need one jumper per splitter
	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	12 different 24-F riser cables are supported
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	One needed per 24-F riser cable
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Trunk Fiber	024E88-33131-29	MIC® Tight-Buffered Cable, plenum, 24 F, single-mode (OS2)	Size fiber count as needed. PON solutions typically require less fiber in riser due to 1-F feeding a splitter.
IDF/TR	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	Holds patch and splitter panels
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	One per 24-F riser cable
	Splitter	CCH-UM1-22D22E1132	1x32 Optical Splitter with 25-in input and 32 32-in output pigtails (LC APC)	Up to 32 splitter fibers connect to second patch panel. Only one split fiber per ONT. Using 1:24 ratio.
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	Receives the 24 splitter fibers
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Power Supply Chassis	ICU	Corning® ONE™ Interconnect Unit (ICU). Holds up to four PSM-I modules	ICU used in this example
	Power Supply Module	PSM-I	Power Supply Module: provides two 100 W	Need one 100 W port of PSM-I per ONT
	Power Supply Module	IADP-ICU	In-Rush Power Adapter used with the ICU for remote power supplies to ONTs	Need one in-rush adapter if the ICU is used. Future releases (PSU-6) will not need this part.
	Field Connector	OSNP-LCA-900-Z	OptiSnap® Connector, LC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	One per opposite end of horizontal cable. Recommend terminating two.
	Horizontal Cable	002Z48-21K01M29	2-F/2Cu Composite Cable 20AWG , bulk cable	One cable per ONT
Work Area/Room	Field Connector	OSNP-SCA-900-Z	OptiSnap Connector, SC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	One SC connector per ONT needed
	Field Connector	WMO-85	Workstation Multimedia Outlet Housing	One housing per ONT. Could connect multiple fibers if needed.
	Field Connector	WMO-CPO2-66-85	Workstation Multimedia Outlet (WMO), with SC APC adapter plate	One housing per ONT. Could connect multiple fibers if needed.
	Jumper	444401G2131003F	SC APC to SC APC Simplex Jumper, 3-ft	One per ONT

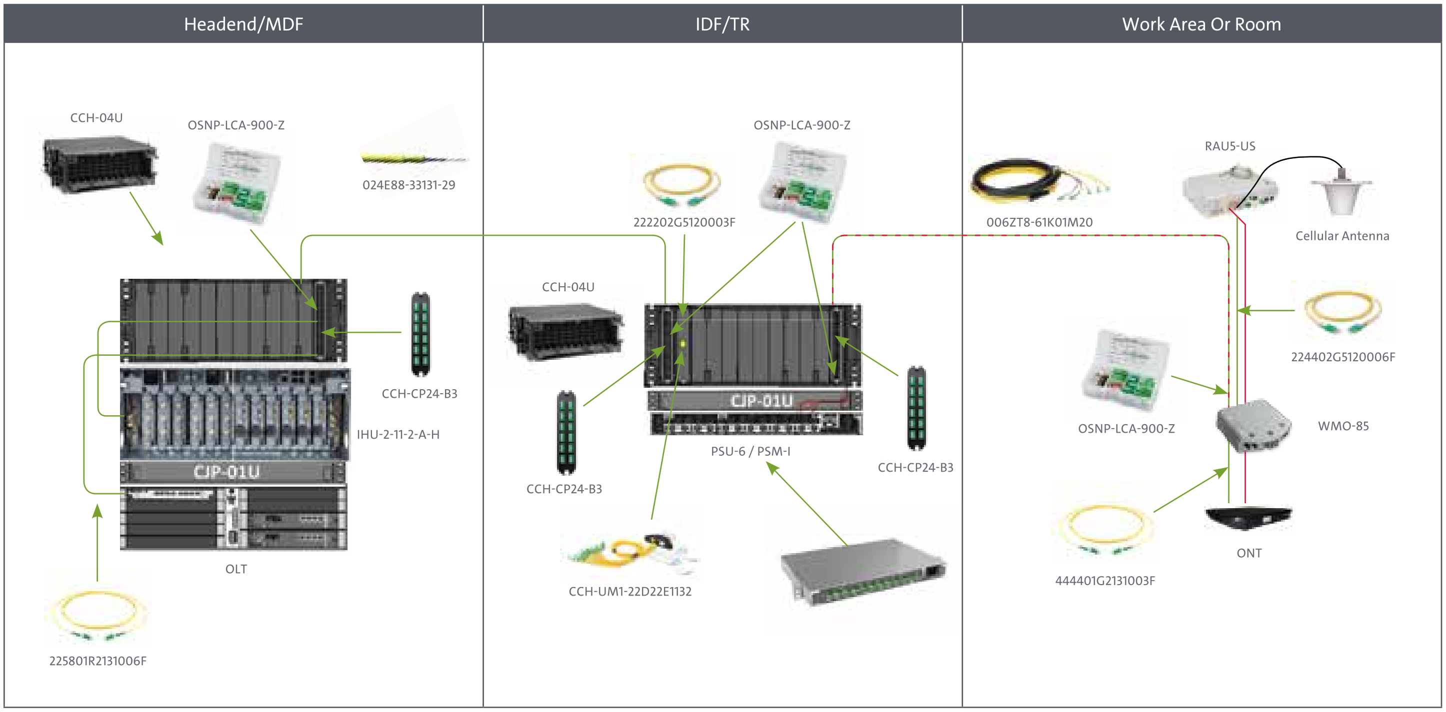
Example of Corning® ONE™ Solutions: Passive Optical LAN (POL) + Corning ONE Cellular (Zone Architecture)



Example of Corning® ONE™ Solutions: Passive Optical LAN (POL) + Corning ONE Cellular (Zone Architecture)

Location	Type	Part Number	Description	Comments
Headend/MDF	Jumper	225801R2131006F	LC APC to SC UPC Jumper	Need one jumper per splitter
	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	12 different 24-F riser cables are supported
	DAS Headend	HEU-2-00-2-A-H	Headend Unit with two RIX, two PSM-AC, and one HCM	Holds up to 12 RIM units
	DAS Headend	RIM-L70	Radio Interface Module for HEU/IHU chassis, LTE 700 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-C85	Radio Interface Module for HEU/IHU chassis, CELL 850 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-P19	Radio Interface Module for HEU/IHU chassis, 1900 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-P17	Radio Interface Module for HEU/IHU chassis, 1700 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	OIU-2-00-2-A-A	Optical Interface Unit with two OIX, two PSM-AC, and one ACM	Holds up to 12 OIM cards
	DAS Headend	OIM	Optical Interface Module for OIU/IHU Chassis, three optical links. (Ships with OIM 6-F MTP® to LC APC harness cable)	OIMs are scaled based on number of RAUs in a system
	DAS Headend	ERFC24	Extender RF Cable, 24-in (Connects HEU to OIU)	One cable needed to connect HEU to OIU (RIX to OIX)
	Splice Module	CCH-CS24-B3-P00RE	LC APC Splice Cassette, 24 F	One used per 24-F riser cable
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Trunk Fiber	024E88-33131-29	MIC® Tight-Buffered Cable, plenum, 24 F, single-mode (OS2)	One cable can support multiple splitters and multiple RAUs.
IDF/TR	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	CCH-04U could be reduced to something that holds less panels depending on how many zones are fed from the IDF
	Splice Module	CCH-CS24-B3-P00RE	LC APC Splice Cassette, 24 F	One per 24-F riser cable
	Jumper	222202G512003F	LC APC to LC APC 3-ft Duplex Jumper	One jumper per RAU is required
	Splitter	CCH-UM1-22D22E1132	1x32 Optical Splitter with 25-in input and 32-in output pigtails (LC APC)	One splitter per 24 ONTs is typical ratio
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Power Supply Chassis	PSU-6	Corning® ONE™ Power Supply Unit Chassis. Holds up to six PSM-I modules	One PSU-6 chassis per 12 devices
	Power Supply Module	PSM-I	Power Supply Module: provides two 100 W	One PSM-I per two devices
	Splice Module	CCH-CS12-B3-P00RE	LC APC Splice Cassette, 12 F	One splice module per 12-F cable
	Horizontal Cable	HR0018HMC12U820xxxF-PK	Composite Assembly, 12 single-mode fiber, and 12 20AWG copper conductors. Half of cable is preterminated with 12 LC APC connectors and 12 copper dinkle conductors.	One 12-F/12Cu cable per zone
Work Area/Room	Hardware	SPH-01P	CCH Single-Panel Housing. Houses one CCH panel.	One housing to hold the 12-F patch panel
	Fiber Patch Panel	CCH-CP12-B3	LC APC Panel, 24 F	Connects the 12 fibers
	Hardware	SPH-01P	CCH Single-Panel Housing. Houses one CCH panel.	One housing to hold the 12Cu patch panel
	Copper Patch Panel	CCH-CP12-PWR	12-Position Copper Patch Panel	Connects the 12 copper conductors
	Jumper	222202G512003F	LC APC to LC APC 3-ft Duplex Jumper	One per RAU
	Jumper	224402G5120006F	SC APC to LC APC Duplex Jumper	One per WLAN-6C6C (wall plate)
	Hardware	WLLAN-6C6C	Wall Plate with two installed Keystone SC APC adapters	One per 2-F wall plate. Supports up to two ONTs. (One shown)
	Jumper	224401G2131006F	SC APC to LC APC Simplex Jumper	One per ONT in zone box
	Jumper	444401G2131006F	SC APC to SC APC Simplex Jumper (connects local AC-powered ONT)	One per AC-powered ONT
	DAS Remote	RAU5US-A	Remote Access Unit supporting five bands (ESMR 800/ CELL 850, LTE 700, AWS 1700, and PCS 1900. Internal omni antenna included. Mid-mount on zone box shown.	RAU locations are designed specifically to support wireless carrier requirements and building density

Example of Corning® ONE™ Solutions: Passive Optical LAN (POL) + Corning ONE Cellular (Home Run Design, aka Hospitality)



Example of Corning® ONE™ Solutions: Passive Optical LAN (POL) + Corning ONE Cellular (Home Run Design, aka Hospitality)

Location	Type	Part Number	Description	Comments
Headend/MDF	Jumper	225801R2131006F	LC APC to SC UPC Jumper	Need one jumper per splitter
	DAS Headend	IHU-2-11-2-A-H	IHU Assembly (without RIMs and OIMs), ERFC cable provided, support for one RIX, one OIX, four RIMs, four OIMs, and four additional RIMs/OIMs in combo slots, two PSM-AC modules, and one HCM	The integrated headend unit is a combo unit that houses both RIMs and OIMs. This chassis can be used for single carrier solutions or remote buildings in a campus.
	DAS Headend	RIM-L70	Radio Interface Module for HEU/IHU chassis, LTE 700 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-C85	Radio Interface Module for HEU/IHU chassis, CELL 850 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-P19	Radio Interface Module for HEU/IHU chassis, 1900 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	RIM-P17	Radio Interface Module for HEU/IHU chassis, 1700 MHz service	Example: frequencies will vary by carrier and market
	DAS Headend	OIM	Optical Interface Module for OIU/IHU Chassis, three optical links. (Ships with OIM 6-F MTP® to LC APC harness cable)	OIMs are scaled based on number of RAUs in a system
	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	CCH-04U can support 12 24-F riser cables
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	One 24-F patch panel per 24-F riser cable
	Field Connector	OSNP-LCA-900-Z	OptiSnap® Connector, LC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	One pair of LC connectors per RAU and one single LC connector per splitter needed
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Trunk Fiber	024E88-33131-29	MIC® Tight-Buffered Cable, plenum, 24 F, single-mode (OS2)	One cable can support multiple splitters and multiple RAUs
IDF/TR	Hardware	CCH-04U	Fiber Zone Box, four rack units, holds 12 CCH panels or modules	CCH-04U could be reduced to something that holds less panels depending on how many zones are fed from the IDF
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	Receives the 24-F riser from MDF. Connects to the 1:32 splitter and jumpers for RAUs.
	Field Connector	OSNP-LCA-900-Z	OptiSnap Connector, LC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	Connects riser fiber to the patch panel
	Splitter	CCH-UM1-22D22E1132	1x32 Optical Splitter with 25-in input and 32-in output pigtails (LC APC)	One splitter per 24 ONTs is typical ratio
	Fiber Patch Panel	CCH-CP24-B3	LC APC Panel, 24 F	Outgoing patch panel that receives the jumpers for the RAUs and the splitter legs
	Jumper	222202G5120003F	LC APC to LC APC Duplex Jumper	One per RAU needed
	Jumper Management	CJP-01U	Horizontal Cable Management	
	Power Supply Chassis	PSU-6	Corning® ONE™ Power Supply Unit Chassis. Holds up to six PSM-I modules	Up to 12 100 W DC power feeds from one chassis
	Power Supply Module	PSM-I	Power Supply Module: provides two 100 W	One port for RAU; one port for remote switch
	Field Connector	OSNP-LCA-900-Z	OptiSnap Connector, LC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	Two LC connectors per RAU. One per ONT.
	Horizontal Cable	006ZT8-61K01M20	6-F/6Cu Composite Cable 20AWG, bulk cable	16-F/6Cu cable per location needing both RAU and ONT
Work Area/Room	DAS Remote	RAU5-US	Remote Access Unit supporting five bands (ESMR 800/ CELL 850, LTE 700, AWS 1700, and PCS 1900)	RAU locations are designed specifically to support wireless carrier requirements and building density
	Jumper	224402G5120006F	SC APC to LC APC Duplex Jumper	One per RAU
	Field Connector	OSNP-SCA-900-Z	OptiSnap Connector, SC APC, single-mode (OS2), ceramic ferrule, organizer pack, green housing, green boot, 25 pack	Terminates bulk fiber into WMO unit: two SC connectors for RAU and one minimum for ONT
	Field Connector	WMO-CPO2-66-85	Workstation Multimedia Outlet (WMO), with SC APC adapter plate	Two SC connectors reserved for RAU and two for ONT (Only 1-F needed for ONT)
	Field Connector	IC107DSBWH	Cu Power Barrel Connector for copper connection (to fit in WMO for RAU)	One for RAU copper patch
	Jumper	444401G2131003F	SC APC to SC APC Simplex Jumper, 3-ft	One per ONT

Links to Key Component Specification Sheets

Jumpers	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/Cable_Assemblies_NAFTA_AEN.pdf
Closet Connect Housing (CCH) Family	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/Closet_Connector_Housings_CCH_NAFTA_AEN.pdf
CCH Splice Cassettes	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/Closet_Connector_Housings_CCH_NAFTA_AEN.pdf
CCH Panels	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/Closet_Connector_Housing_Panels_CCH_CP_NAFTA_AEN.pdf
CCH Splitter Module	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/Closet_Connector_Housing_CCH_Splitter_Module_NAFTA_AEN.pdf
Composite Fiber 6-F/6Cu	http://csmedia.corning.com/opcomm/Resource_Documents/spec_sheets_rl/fo_cable/006UT8-61K01M20_NAFTA_AEN.pdf
24-Strand Trunk Fiber	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/MIC_Tight_Buffered_Cables_Plenum_NAFTA_AEN.pdf
Workstation Multimedia Outlet (WMO)	http://csmedia.corning.com/opcomm/Resource_Documents/product_family_specifications_rl/Workstation_Multimedia_Outlet_WMO_NAFTA_AEN.pdf

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