Universal connectivity grid design guide

SYSTIMAX® Solutions from CommScope
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Contents

Introduction

The modern workplace is undergoing a rapid transformation toward a more dynamic model. Changing behaviors and usage patterns demand flexibility in the layout of offices, collaboration spaces, conference rooms and other common areas. Wired and wireless technologies are key enablers of this transformation; the efficiency of modern intelligent buildings is becoming highly dependent on an integrated IT and facilities infrastructure to ensure connectivity in all the new ways workplaces require it to be available.

This transformation is driving a transition in telecommunications cabling—from workstation-centric to distributed device-centric, with an increasing number of connectivity points located in or near the ceiling. In addition to the user connectivity requirements at the work area locations, connectivity points in other locations are required to support the growing use of technologies such as:

- Wireless technologies (predominantly Wi-Fi and in-building wireless solutions such as DAS and small cells) that require additional connections in the ceiling for access points throughout the space
- Security and access control systems that are increasingly supported by ceiling connectivity for PoE-powered cameras, controllers and card readers
- Space and energy management systems that rely on distributed sensors throughout the space to optimize space utilization and support occupancy-based energy management via integration with network-controlled LED lights and HVAC systems
- Digital displays that are increasingly being deployed for uses ranging from space and energy monitoring to displaying the location of unoccupied rooms and personnel
- An ever-increasing ecosystem of other various connected devices and services comprising the Internet of Things (IoT)

Given this evolving connectivity landscape, IT and facilities managers must consider new strategies for integrating the growing wireless requirements and the increasing number and types of networked devices into the core network. This involves rethinking how to deploy a uniform, cost-effective, yet flexible cabling infrastructure throughout the facility.

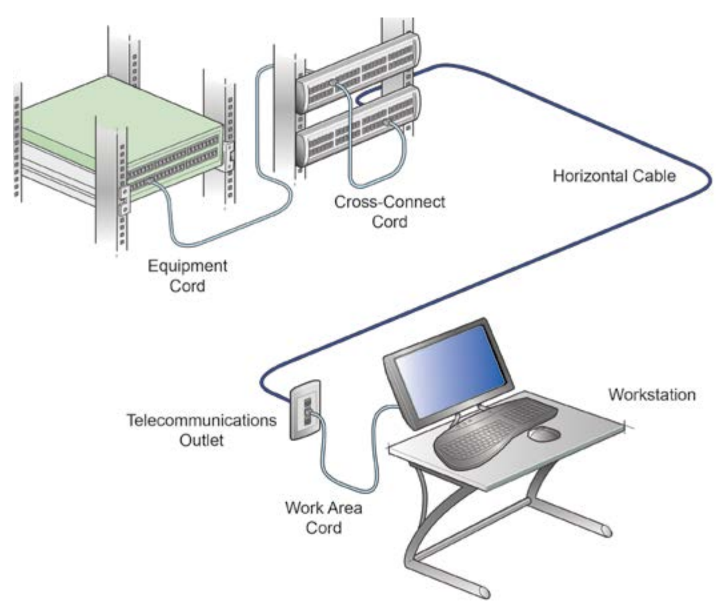
This document explores the emergence of the universal connectivity grid—a zone cabling-based approach created to support a wide range of networked applications through a common infrastructure in commercial buildings—and provides design guidelines and recommendations to facilitate infrastructure planning and deployment.

Commercial building network overview

Within a commercial building, the infrastructure for communications networks consists of two basic segments: the backbone (or riser) and the horizontal. The backbone connects telecommunications rooms (TRs) to a centrally located equipment room (ER). Backbone media is typically OM3, OM4 or OM5 multimode fiber-optic cable to support high-bandwidth applications, although copper cabling may also be deployed for lower bandwidth applications such as building management systems (BMS).

The horizontal section of the network includes the connection between a patch panel in the TR or ER and a telecommunications outlet (TO) or multi-user telecommunications outlet assembly (MUTOA) in the work area, and the connection between the TO or MUTOA to an end device (Figure 1).

The TIA/EIA 568 standard sets 90 meters (295 feet) (plus a total of 10 meters [33 feet] for the patch and equipment cords) as the maximum horizontal channel length to support high-bandwidth applications.



Zone cabling

An alternative horizontal distribution strategy, known as zone cabling, utilizes cable runs from the floor-serving TR to specific building zones or "service areas." A consolidation point (CP) within each service area establishes a permanent intermediate connection, with fixed cabling installed between the TR and CP. Zone cords provide wired connectivity from the CP to the TO for each required service, device or application, as shown in Figure 2.

By deploying a permanent horizontal link between the TR and the CP at the service area, a zone distribution system provides greater flexibility for reconfiguring open office spaces, placing distributed endpoint devices, staging installations, or locating connectivity in easily accessible locations.

While a zone strategy may require greater capital expenditure on connecting hardware as a function of installation over traditional point-to-point cabling, savings can be realized by using common pathways for the diverse systems to be supported. Plus, the additional flexibility it provides for moves, adds and changes can result in long-term operational benefits compared to the traditional approach of deploying separate and independent cabling systems for various applications—particularly in constantly evolving open-office environments.

When designing a zone cabling deployment, standards recommend that the CP be placed at least 15 meters (50 feet) from the TR, while maintaining the maximum 100-meter channel length. In cases where 100 meters is not enough, hybrid fiber-optic cable can be used to power remote devices such as IP cameras over greater distances.

Universal connectivity grid

A newly established design practice called the universal connectivity grid (UCG) evolves the concept of zone cabling by dividing the usable floor space into a grid of evenly sized service areas, or cells. A CP is located within each cell, providing maximum flexibility for connecting, adding and moving devices.

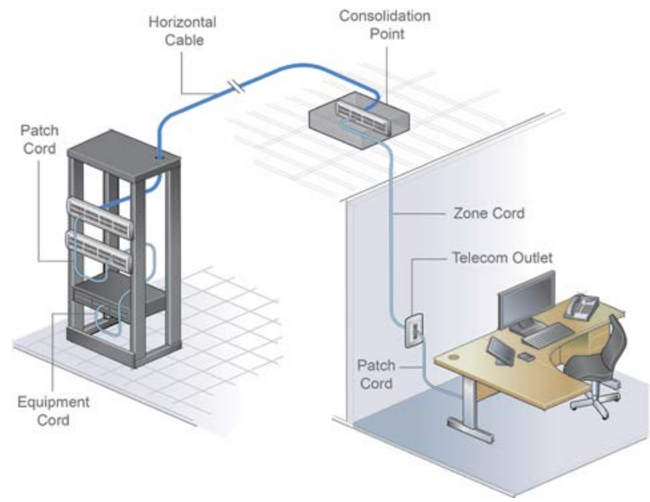


Figure 2: An example of zone cabling and the CP connection to the patch panel

Both new construction and retrofits are ideal opportunities for deploying a uniform infrastructure like the UCG. Adoption of the UCG approach means that moves, adds, changes and upgrades are greatly simplified—requiring less material and labor and reducing OpEx over the life of the installation. In addition, these modifications require less disruption of the workspace, minimizing negative impact on employee productivity when deploying or reconfiguring services.

By integrating all services into one architecture and leveraging low-voltage technologies, installation and ongoing operational costs can be reduced.

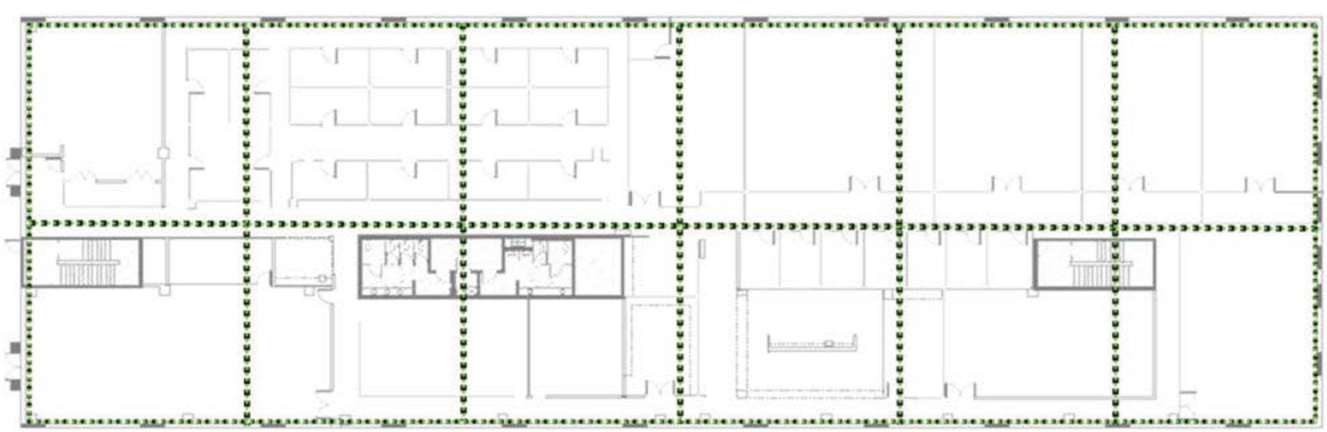


Figure 3: Floor space of office divided into evenly spaced cells

UCG cell size

The maximum recommended cell size for UCG is 60 feet by 60 feet (18.3 meters by 18.3 meters), based on the TIA-162-A recommendations for a grid of evenly spaced cells designed to support easy deployment and upgrades of wireless access points (WAPs) as shown in Figure 4 (similar recommendations exist in ISO/IEC TR 24704, which are shown in Figure 5). Smaller 40-foot x 40-foot (12.2 meter x 12.2 meter) cells should be considered when Wi-Fi is expected to be used as a primary network access method, or in high-user-density areas.

By defining UCG cells based on wireless coverage areas, UCG is ideally suited to support a diverse set of wireless applications (Figure 6), but can also be deployed as an overlay to the traditionally wired LAN architecture to specifically support all ceiling-based applications (Figure 7). In more robust designs, UCG can be used as a common architecture for both ceiling-based applications and workstation cabling (Figure 8).

In order to serve increasingly demanding applications in the building, including Wi-Fi, in-building wireless, and Power over Ethernet (PoE), Category 6A is the recommended cable media for the permanent cabling from the TR to each zone in the UCG.

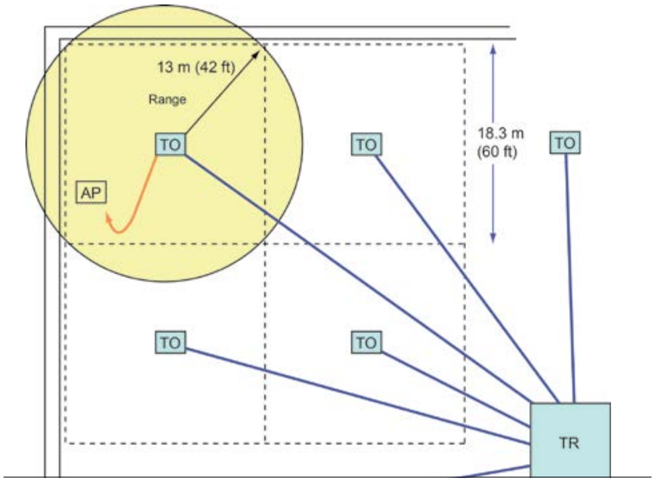


Figure 4: TIA TSB-162-A recommended cell for wireless local area networks (WLANs)

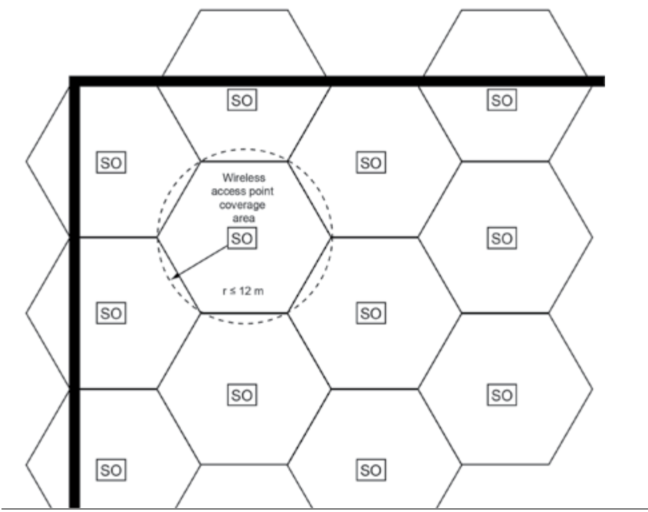


Figure 5: ISO/IEC TR 24704 recommended cell for 802.11

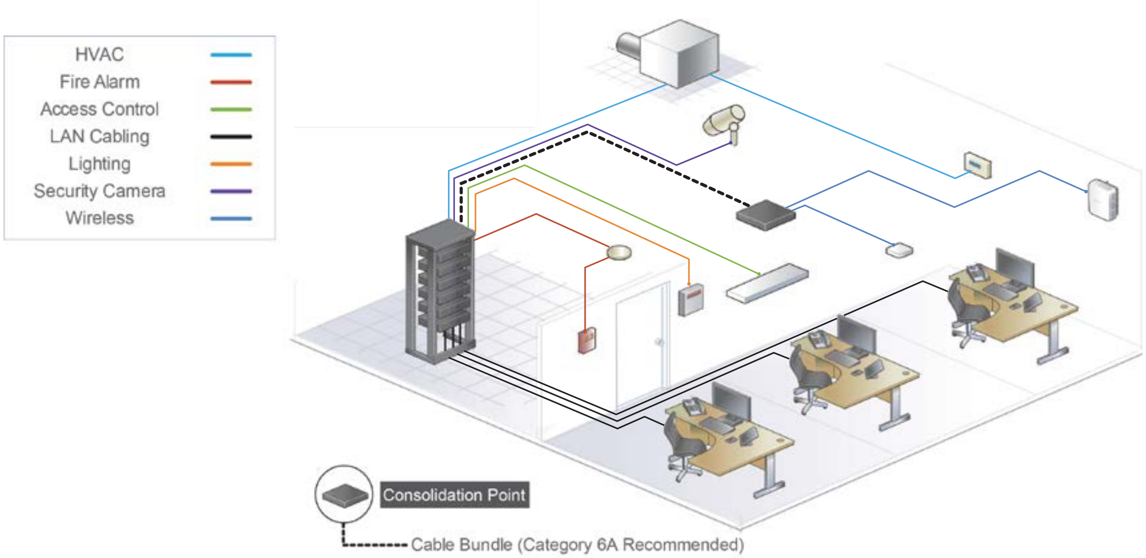


Figure 6: The Universal Connectivity Grid supporting only wireless access points, with other ceiling-based and workstation applications supported by point-to-point cabling

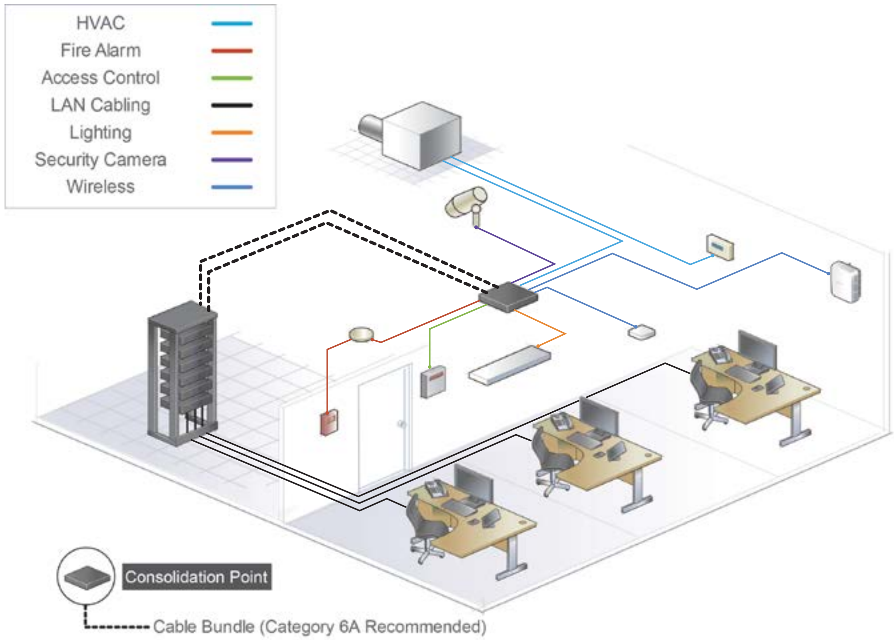


Figure 7: The Universal Connectivity Grid uniting all ceiling-based application cabling through a consolidation point with work station cabling deployed in a conventional star topology separately through a raised floor

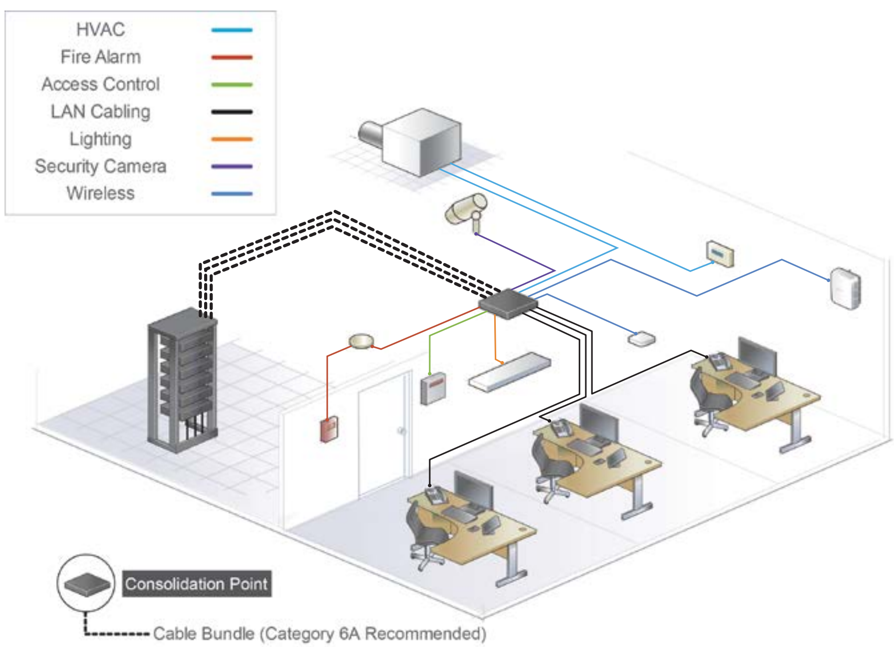


Figure 8: The Universal Connectivity Grid uniting all work station and ceiling-based application cabling through a consolidation point

UCG horizontal cabling

The horizontal channel design for the UCG is based on the standard 100-meter, four-connection channel, as illustrated in Figure 9. This will commonly be used for workstation cabling or connecting IP devices such as projectors or digital displays that may require a wall-mounted outlet. For runs longer than 100 meters, powered hybrid fiber-optic cable makes it possible to connect more remote devices, such as IP cameras or remote Wi-Fi access points.

In other scenarios, however, ceiling-mounted devices—such as occupancy sensors, wireless access points or security cameras—may use the CP as a static termination point, and not require installation of an additional outlet. In these cases, the endpoint device will not use a zone cord, but will be connected directly to the CP with a patch cord, as in Figure 10.

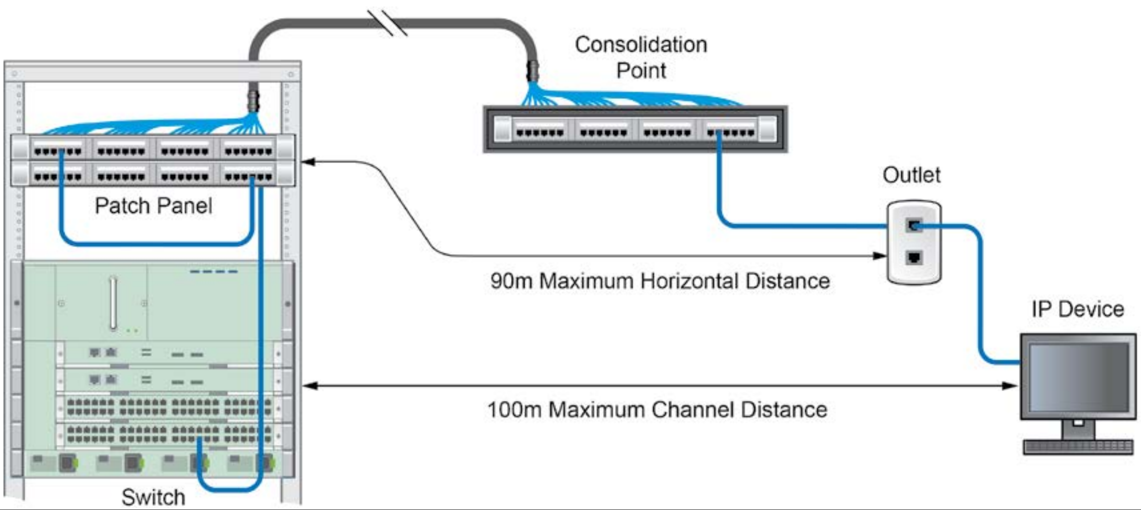


Figure 9: Structured cabling channel with a zone cord from CP to TO

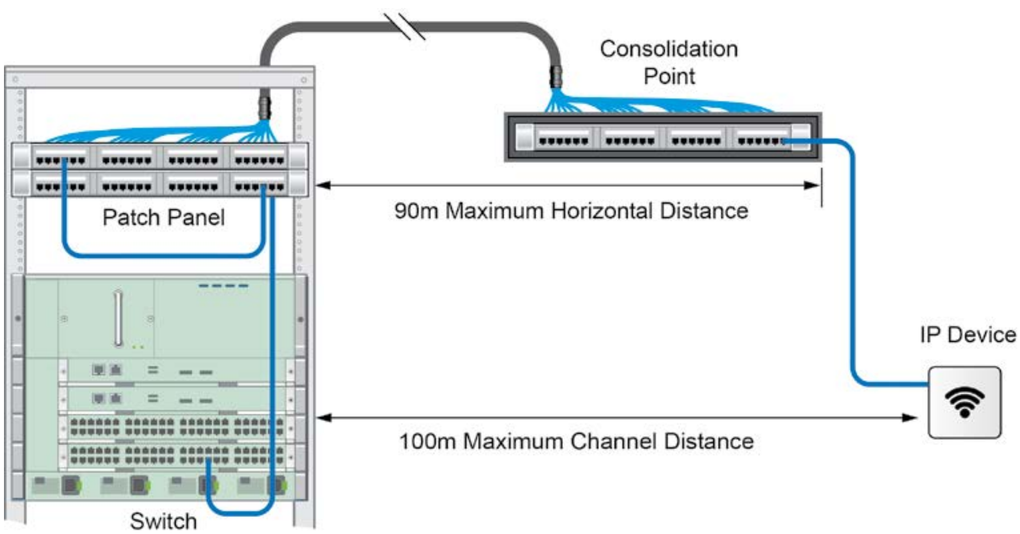


Figure 10: Structured cabling channel with a patch cord from CP to device

Ceiling connector assemblies provide a flexible way to add connected devices with the simple use of insulation-displacement connection (IDC) technology and factory-terminated patch cords. Ceiling connector assemblies remove the need to perform problematic and time-consuming modular plug field terminations—a procedure complicated by tight quarters when working inside the ceiling. The use of a ceiling connector assembly to connect a Wi-Fi access point is shown in Figure 11.

When designing channels for UCG, the maximum horizontal distance must take into account the expected length of the zone cords to the outlet at the work area. When the length of cordage (including equipment cords, zone cords and cross-connect cords) exceeds 10 meters, the maximum channel length should be calculated according to the formula:

Total cord length in meters ≤ (102-horizontal)/1.2
Horizontal length in meters ≤ 102 - 1.2 (total cord length)

One must also take into account the higher attenuation allowed by standards for flexible cordage, including the expected type and length of the zone cords to the outlet at the work area. For cases when the total length of cordage (including equipment cords, zone cords and cross-connect cords) exceeds 10 meters, cabling standards specify that the maximum channel length should be calculated as follows:

TIA calculation (for cordage with 20 percent higher attenuation):

Total cord length in meters ≤ (102-horizontal)/1.2
Horizontal length in meters ≤ 102 - 1.2 (total cord length)

ISO/IEC calculation (for cordage with 50 percent higher attenuation):

Total cord length in meters ≤ (105-horizontal)/1.5
Horizontal length in meters ≤ 105 - 1.5 (total cord length)

When the UCG is intended to support workstation applications in a 60-foot x 60-foot grid, a conservative estimate of 23 meters for the zone cords can be established by estimating a 15-meter radius in the ceiling to the farthest point where cables would run down a wall or pole, and adding eight meters for routing of the cable to the TOs. Using the TIA formula above—and assuming an additional 10 meters of cross-connect and equipment cords with 20 percent higher attenuation than cable—the maximum horizontal distance for this configuration is 62 meters, as shown in Figure 12.

When the UCG is intended to support workstation applications in a 40-foot x 40-foot grid, a conservative estimate of 20 meters for the zone cords can be established by estimating a 12-meter radius in the ceiling to the farthest point where cables would run down a wall or pole, and adding eight meters for routing of the cable to the TOs. Using the TIA formula above—and assuming an additional 10 meters of cross-connect and equipment cords with 20 percent higher attenuation than cable—the maximum horizontal distance for this configuration is 66 meters.

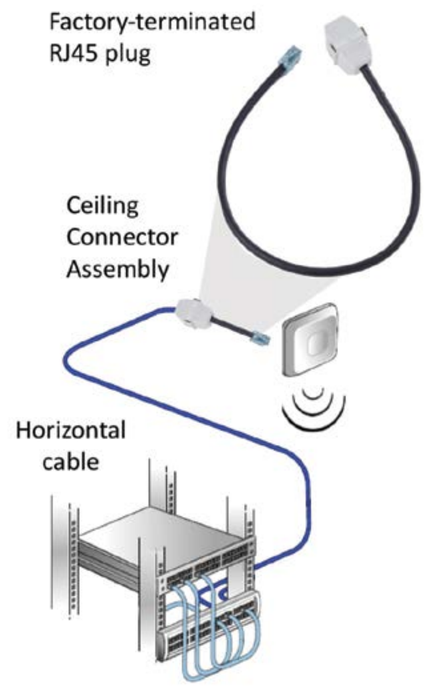


Figure 11: Ceiling connector assembly application

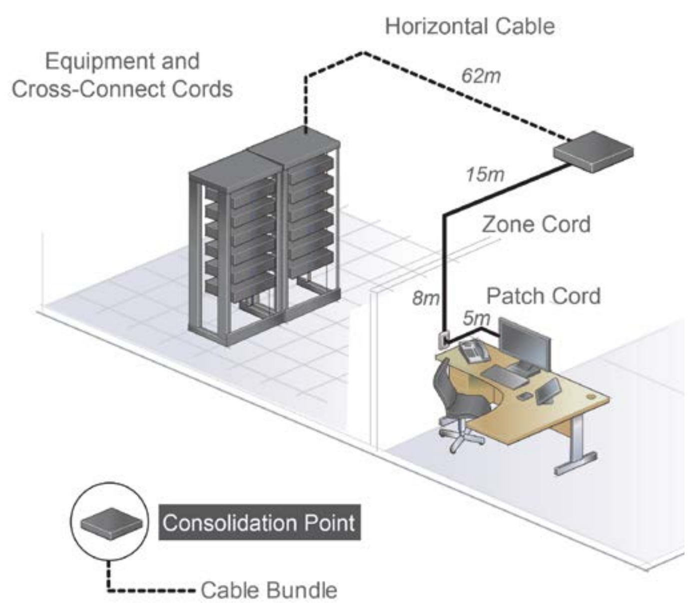


Figure 12: Example UCG channel distance for supporting work station cabling in a 60 foot x 60 foot cell

Integrating building systems with unique architectures into UCG

While optimal flexibility comes from using IP connectivity for as many endpoints as possible, some systems may also require a gateway to integrate non-IP devices onto the network (Figure 13), or a unique type of non-category cable (Figure 14). For these systems, the category cabling must comply with horizontal distance requirements for the structured cabling channel. Note also that there may be additional requirements specific to the system being installed.

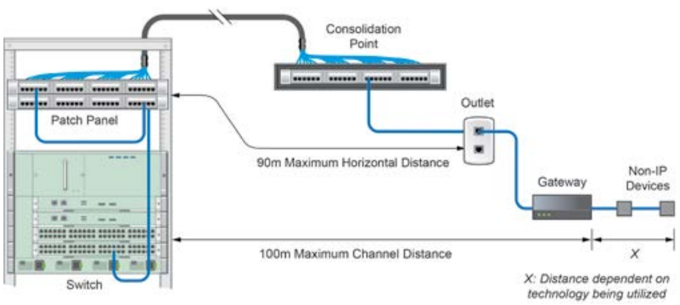


Figure 13: UCG channel for systems requiring gateway for non-IP devices

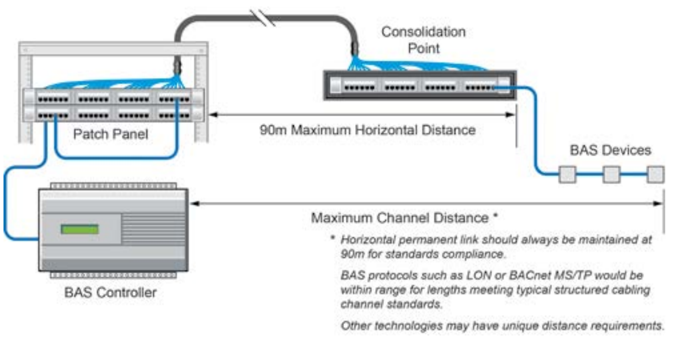


Figure 14: UCG channel for BAS system, which may use non-category cabling for endpoint connections

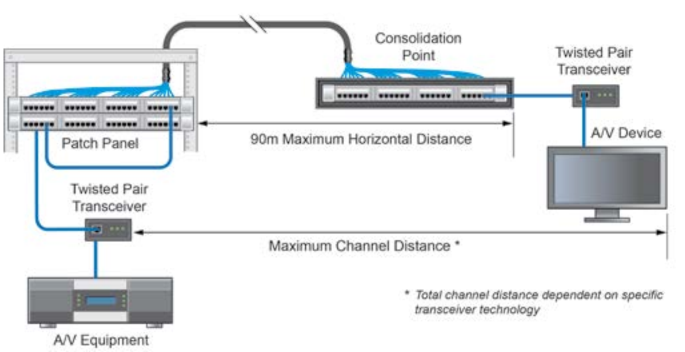


Figure 15: UCG channel for A/V system requiring transceivers

While some A/V systems utilize standard category cabling, others may require the use of transceivers or other conversion devices as shown in Figure 15.

Consolidation points (CPs)

Determining the type and size of CPs utilized for each cell depends on the number of devices intended to be served; ease of accessibility requirements; whether the CP will also house gateways or other active components; and building code requirements.

CPs should be sized to accommodate the amount of cabling needed per UCG cell plus spare capacity for future additions. The section "Planning connectivity for UCG cells" includes recommendations for the number of ports that should be planned for different applications. As a general guideline, though, planning in 20 to 50 percent spare capacity provides sufficient flexibility for future growth.

Some nontypical cabling needs, such as IP gateways, may require active electronics. In this case, power will be needed at the zone. There are two options for this scenario:

1. Provide a zone enclosure that accommodates power. The outlet will need to be provided in the enclosure to meet code requirements and space in the enclosure shall be provided to accommodate the electronics power cabling.

2. Provide an enclosure adjacent to the zone enclosure that will house the electronics and power outlet and meet all the space's UL and plenum requirements.

Systems that require support for active electronics may include A/V systems with media converters or transceivers, BAS or lighting control systems with media gateways, PON systems with distributed ONT devices, or audio paging or sound masking systems with local distributed repeaters and amplifiers.

Planning connectivity for UCG cells

The number of CPs needed per UCG cell will vary depending on the specific type and quantities of systems deployed, as well as environmental factors such as furniture layout and the configuration of walls and corridors. The following recommendations are intended to serve as general guidelines and considerations for predesign planning of port counts to support common building systems in an open office environment.

Tables 1 and 2 provide recommended port counts for planning systems that are consistently deployed throughout open office spaces with 60-foot x 60-foot or 40-foot x 40-foot cells. Table 3 provides recommended port counts and considerations for planning systems that may be less consistently deployed throughout the building or have potentially wide-ranging port counts.

Application	Ports per endpoint	Notes/Additional considerations	Ports per cell
Work Station	Two ports per desk	Assumes 36 workstations per 60 foot x 60 foot cell	72 ports
Wi-Fi	Two ports per WAP	Plan for two access points per cell to accommodate future capacity increases	4 ports
In-building wireless	Two ports per AP	Plan one spare port to accommodate future needs	2 ports
Paging and sound masking	One to four ports per system	System architectures vary. Reference manufacturer's requirements.	1-4 ports
Low-voltage lighting with integrated occupancy sensors	One port per fixture and wall switch	Assumes 9.5-foot ceiling height with connections for wall switches or sensors in common areas	40-48 ports
Occupancy sensors	One port per sensor	Plan one sensor per desk, with additional sensors in hallways and other common areas spaced roughly 10 feet to 15 feet apart	36-48 ports

Table 1: Recommended port counts for planning 60 foot x 60 foot UCG deployments in open office spaces

Application	Ports per endpoint	Notes/Additional considerations	Ports per cell
Work Station	Two ports per desk	Assumes 16 workstations per 40 feet x 40 feet cell	32 ports
Wi-Fi	Two ports per WAP	Plan for two access points per cell to accommodate future capacity increases	4 ports
In-building wireless	Two ports per AP	Plan one spare port to accommodate future needs	2 ports
Paging and sound masking	One to four ports per system	System architectures vary. Reference manufacturer's requirements.	1-4 ports
Low-voltage lighting with integrated occupancy sensors	One port per fixture and wall switch	Assumes 9.5-foot ceiling height with connections for wall switches or sensors in common areas	20-25 ports
Occupancy sensors	One port per sensor	Plan one sensor per desk, with additional sensors in hallways and other common areas spaced roughly 10 feet to 15 feet apart	16-24 ports

Table 2: Recommended port counts for planning 40 foot x 40 foot UCG deployments in open office spaces

Some systems commonly deployed in buildings include widely-distributed endpoint devices, which are less consistent in placement. As a practical matter, such devices should be located independently of the grid, but mapped to the appropriate CP within the cell they reside. The following table provides considerations and recommendations for planning ports per device for these systems.

Application	Ports per endpoint	Notes/Additional considerations
Digital displays	One to two ports per display	Total port counts for digital displays may vary greatly depending on location and application. When planning for digital signage, consider building directories, dashboards, interactive kiosks, security desks, IPTVs, presentation systems and conference room reservation displays.
Building automation systems	One to two ports per controller or IP endpoint	As a rough planning guideline, ANSI/TIA/EIA-862 suggests planning for three BAS devices per BAS coverage area (25 square meters for most enterprise environments), but the number of devices will vary depending on the specific systems being deployed.
Security cameras	One to two ports per camera	The number and location of security cameras will vary depending on the type of space and desired coverage (wide vs. detailed), as well as building features that may obstruct the view of certain locations.
Access control	One to four ports per entry	Access control systems may be deployed at main building entries, as well as throughout the building for controlling access to different floors via stairways. Additionally, consider requirements for securing individual spaces such as conference rooms, private offices, labs or fitness rooms. When planning ports for access control, consider door sensors, exit buttons, keypads and badge readers.

Table 3: Recommended port counts for other systems

Port counts and space usage

An additional factor influencing port counts is the type and intended usage of each space. The following considerations provide general guidelines for planning applications to be deployed within common types of building spaces.

Open office spaces should adhere to the grid for all ceiling connectivity, and, optionally, adhere to grid for workstation cabling.

- Within each cell, plan cabling for workstations, Wi-Fi access points, in-building wireless, low-voltage lighting and/or occupancy sensors.
- In select cells, plan cabling for security cameras, BAS devices and miscellaneous networked peripherals (such as printers).

Open transitional spaces (lobbies, atria, waiting areas, connecting corridors) should adhere to the grid for all ceiling connectivity, and may be utilized for providing connectivity to hard-walled offices (see below).

- Within each cell, plan cabling for Wi-Fi access points, in-building wireless, BAS devices, low-voltage lighting and/or occupancy sensors.
- In select cells, plan cabling for security cameras, access control systems (card readers, number keypads, exit buttons) and digital displays.

Hard-walled offices may utilize the nearest CP or be treated as individual cells depending on size and overall layout. When accessibility of connectivity for maintenance is a concern, it may be preferable to locate CPs in an adjacent open transitional space.

- Within each office, plan cabling for workstations, BAS devices, low-voltage lighting and/or occupancy sensors.
- In select hard-walled offices, BAS devices, security cameras or wireless access points (Wi-Fi or in-building wireless) may be required.

Small conference rooms may utilize the nearest CP or be treated as individual cells depending on size and overall layout. When accessibility of connectivity for maintenance is a concern, it may be preferable to locate CPs in an adjacent open transitional space.

- Within each small conference room, plan cabling for VoIP phone and/or PC, Wi-Fi access points, in-building wireless, projector or digital display (for presentations and/or room scheduling systems), low-voltage lighting and/or occupancy sensors.

Large conference rooms should adhere to the grid for all ceiling connectivity. When accessibility of the zone connectivity for maintenance is a concern, it may be preferable to locate CPs in an adjacent open transitional space.

- Within each large conference room, plan cabling for VoIP phone and/or PC, Wi-Fi access points, in-building wireless, BAS devices, projector or digital displays (for presentations and/or room scheduling systems), low-voltage lighting and/or occupancy sensors.

Auditoria and large meeting spaces should adhere to the grid for all ceiling connectivity.

- Within each cell, plan cabling for Wi-Fi access points, in-building wireless, BAS devices, low-voltage lighting and/or occupancy sensors.
- In select cells, plan cabling for VOIP phone and/or PC, A/V systems and security cameras.

The UCG: An intuitive solution for today's networks

Commercial and enterprise spaces continue to evolve in their function, forcing a corresponding evolution in their form. More connected devices, more mobile employees and more IoT devices and services create an environment where a preplanned, forward-thinking infrastructure approach is the only one that makes sense.

The UCG, properly deployed, can provide flexible, scalable performance to users, devices and applications across an entire building, ensuring that power and connectivity will be where they are needed, backed by the speeds and bandwidth that emerging applications and devices will require. For this reason, the UCG is an intuitive solution for today's—and tomorrow's—high-performance networks.

Contact your CommScope representative today to learn more about how the UCG can add value to your next new deployment or retrofit.

Contact CommScope

Additional information

CommScope provides additional information on cabling design for commercial spaces at CommScope.com. These documents include:

- Enterprise design guide
- General design guide for building automation systems (BAS)
- Honeywell controls enterprise buildings Integrator system over CommScope cabling
- Johnson Controls Metasys system over CommScope SYSTIMAX® cabling
  - LonWorks® design guide
  - SYSTIMAX cabling design and installation guidelines for the ION®-E Solution
- Implementation considerations for HDBaseT networks

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