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APPLICATION NOTE

NetShelter CX Cabling Deployment in Office Buildings

by François Durand

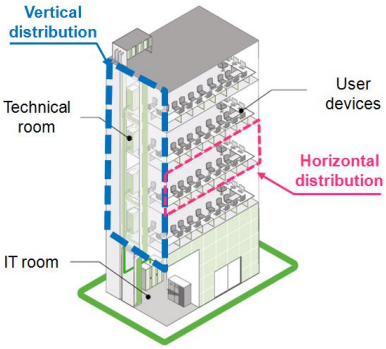
Executive summary

Netshelter CX deployment in Office Building is an alternative to floor distributors, remaining on known star configuration.

This paper shows how that alternative is an opportunity to lower Capex, covering all aspects of such deployment in open spaces.
An explicit example in appendix illustrates those benefits.

Introduction

The first purpose of the LAN network is to distribute the bandwidth available at the entry point of the building to all the users and all equipments that are sharing data inside the building. The very common and standardized architecture is to create an IT room at the building entry point, then to create a vertical distribution from the floor ground to the last highest floor. At each floor, a technical room is the interface between the vertical and the horizontal distributions towards the users and the equipments present at the floor.
The technical room is a dedicated closed and air-conditioned room.



The NetShelter CX is an enclosure, installed in ambient office environment. It leverages the strengths of a standardized architecture, while **saving the dedicated m² of the technical room**. In cities where the pressure on the cost of every square meter is high, it either delivers **significant space monthly cost reduction** or provides **more floor space** for the facility manager. In both cases, no need to build walls any longer.

By being installed in ambient, it also leads to **shorter permanent cable links** with the users or with the equipments. Shorter cables mean **faster installations** and **optimize linear costs**. But shorter cables will also leverage the use of Power over Ethernet. The electrical power which is carried out under PoE has been continuously increasing for the last 12 years. The coming new release of the IEEE 802.3 bt standard in 2017 will support up to 100W of DC power. Shorter links are **more efficient in delivering power** and generate **much less heat**.

This Application Note looks at what needs to be considered when using a NetShelter CX solution.

Netshelter CX solutions

The NetShelter CX being a self-contained cabinet offers a very flexible and portable solution for today's ever changing business needs when deploying network and or server equipment in a SMB or branch office environment. The flexibility allows for relocation within an office or indeed to a different office without the core cost of installing a dedicated network and server room. It also provides an ideal solution for deploying identical systems in a number of branch offices, thus simplifying support and maintenance. In addition, they are also ideally suited for deployment as part of a disaster recovery plan or at summits and major sporting events.

Figure 1

NetShelter CX cabinets (12U – 38U)

AR4000MV (12U)

AR4018A & AR4018IA (18U)

AR4024A & AR40124IA (24U)

AR4038A & AR4038IA (38U)

The NetShelter CX cabinets, as shown in Fig 1, are available in four sizes with 12U, 18U, 24U and 38U of available rack space respectively.

The units each contain one, two or three fan units respectively to pull in cool air and exhaust the warm air. The fan units are the only elements within the cabinets that consume power other than the installed network and server equipment and the associated Uninterruptable Power Supply (UPS) supporting the equipment, so the running costs are minimal. The fan power consumption in each rack is as shown in Table 1 below.

Table 1

NetShelter CX fan power consumption

NetShelter CX	Total fan power consumption
AR4038A & AR4038IA	101 W
AR2024A & AR4024IA	68 W
AR4018A & AR4018IA	39 W
AR4000MV	30 W

Figure 2

NetShelter CX fan module

The AR4000MV uses a fan tray whilst all other models employ a common fan module.

Netshelter CX solutions in office environment

The NetShelter CX solution is essentially a small network / server room with fan-assisted ventilation. Being a self-contained cabinet, that is movable, means it can be easily positioned in an office environment or indeed moved from one location to another if required. The heat generated within the cabinet, by the installed equipment, is exhausted into the local environment. The four different size cabinets each have a maximum thermal loading capacity, for both critical and non-critical loads, as shown in Table 2 below.

Table 2

Maximum thermal loading for critical and non-critical loads

NetShelter CX	Max thermal loading for critical loads	Max thermal loading for non-critical loads
AR4038A & AR4038IA	~1500 W	~3600 W
AR2024A & AR4024IA	~1000 W	~2400 W
AR4018A & AR4018IA	~500 W	~1200 W
AR4000MV	~400 W	~800 W

In many cases the thermal loading limits will equate to the power being drawn by the equipment installed in the cabinet, however, this is not true when Power over Ethernet (PoE) equipment is installed and used, as discussed in the “Power considerations” section later in this document.

The AR4038A and AR4038IA all have three fan modules installed, so in the event of a fan module failure the system can still function, however, the maximum loading should be reduced to 2400W whilst the system is awaiting repair. In the unlikely event of a second fan module failure the loading needs to be reduced further, down to 1200W. Similarly, with the AR4024A and AR4024IA, which all have two fan modules, the failure of one means the loading should be reduced to a maximum of 1200W.

The AR4018A and AR4018IA all have one fan module and the AR4000MV has one fan tray, failure of any of these means the system should be either shutdown or operated on minimum load with the cabinet doors open until the system is repaired.

The size of the office in which the cabinet is deployed, and whether any form of heat removal is available in that room, such as comfort cooling, will also influence the maximum potential loading capabilities of the cabinet. Essentially it is the ability of the room to absorb and dissipate the heat exhausted by the cabinet. The larger the room the more effective it is at absorbing the heat generated and the slower any potential temperature rise in the room as a result. Table 3 below provides general guidelines on the performance in different environments.

Table 3

Guidelines on NetShelter CX performance in different office environ-

Performance	Environment
Best	Large open plan office with air-conditioning
Better	Medium size office with air-conditioning
Good	Large office without air-conditioning
Consult us	Small to medium size office without air-conditioning

In a normal office environment each person generates heat equivalent to approximately 100W, so to put the heat exhausted by the cabinet into perspective, an AR4024A or AR4024IA cabinet supporting 2400W of load dissipates heat equivalent to 24 people. This additional heat generated needs to be considered in terms of the rooms ability to absorb and disperse the heat, all be that through natural dispersion or with the aid of comfort cooling. If the room is unable to affectively absorb and disperse the heat the room temperature and consequently the equipment temperature in the rack will rise proportionately. Furthermore consideration also needs to be given to the actual people in the room and the effect of any potential rise in ambient temperature that may result from the additional heat if not effectively absorbed and dissipated.

As well as considering the effects on temperature, both in the office and the NetShelter CX itself during normal office hour's consideration should also be given to the temperature changes at night and at weekends if the office is not used or the temperature is not controlled in anyway.

The positioning of a cabinet within an office can also influence the power level that can be managed within the cabinet, so a few simple things should be taken into consideration when positioning the cabinet, as listed below.

1. Ensure the cabinet is not positioned near a heat source.
2. Ensure the cabinet is not positioned next to a window in direct sunlight.
3. Ensure the cabinet is not in a confined area that will restrict the air intake and or exhaust, with a minimum of 200mm (8") gap to the sides.
4. If practical consideration can also be given to exhausting the heated air from the cabinet out of the main room using appropriate ducting. Positioning the cabinet in such a way to allow this.
5. Ensure there is a gap between NetShelter CX cabinets if more than one is being used.
6. Where multiple NetShelter CX cabinets are being used ensure the load is split proportionately.

In addition, spreading the network and or server equipment within the cabinet also helps, such that equipment which is heat generating is not next to similar equipment, but interspersed by non-heat generating equipment such as patch panels or blanking panels. The blanking panels also prevent recirculation of warm air so should always be used to minimize any large gaps between equipment.

Electrical power considerations

The actual power drawn by the equipment in the cabinet, in many cases, will be directly converted into heat developed by the installed equipment, which has to be removed from the cabinet. The key exception to this, as previously mentioned, is network equipment that is providing Power over Ethernet (PoE), as much of that power can be dissipated, as heat, outside of the cabinet at the Powered Device (PD). Examples of a PD are Voice over Internet Protocol (VoIP) phones, security cameras or wireless access points. Where PoE is being used the actual electrical power going into the cabinet will be greater than the associated thermal loading in the cabinet, but that which is dissipated as heat in the cabinet must not exceed the limits shown in Table 2.

Table 4 gives an estimation of the maximum admissible PoE power at Power Devices (100% Gigabit Ethernet) considering thermal loading capacity for non-critical loads shown in table 2.

Table 4

Estimated maximum cumulated PoE power at PDs

NetShelter CX	Estimated max PoE power at Power Devices
AR4038A & AR4038IA	~7200 W
AR2024A & AR4024IA	~4800 W
AR4018A & AR4018IA	~2400 W
AR4000MV	~1600 W

Note:
Such estimation could vary depending on the building temperature, the power supply efficiency, the cabling performance, the network speed…
Other possible limitations, such as the maximum admissible equipment weight, the NetShelter capacity (number of Us), the power supply capacity of the access switches, etc., shall also be taken into account.

Related resource
White Paper 88

Power and Cooling Considerations for Power-over-Ethernet (PoE)

Further details and discussion on powering and cooling when deploying PoE equipment can be found in Schneider Electric White Paper #88 “Power and Cooling Considerations for Power-over-Ethernet (PoE)”.

With the flexibility and transportability of the NetShelter CX cabinets consideration has to be given to how the power into the cabinet is to be connected and that the appropriate power outlet is available adjacent to the cabinet. In many countries the maximum UPS size that can be supported from a standard wall outlet is 3kVA, typically units above this size need to be hardwired and installed by a qualified electrical engineer. In all cases local and international wiring codes must be observed when installing a NetShelter CX cabinet.

UPS selection

Given the thermal loading limits of the NetShelter CX cabinets and taking into account potential PoE installations the largest UPS that will likely be required in a NetShelter CX cabinet installation is 5kVA. Whilst there are various UPS topologies the most common types used to support network and server equipment are Line Interactive or Double Conversion On-Line.

The UPS should be sized to support the total power draw from the installed equipment, this should be the actual power draw rather than the rating label of the

equipment which will typically be much higher. As a guide the total normal loading on the UPS should not exceed 80% of its nominal capacity.

In addition to the power rating of the UPS the runtime, battery backup, required in the event of a line failure needs to be considered. The runtime included needs to be long enough to allow an orderly shutdown of the supported equipment, via the UPS PowerChute software, or to allow for a transition to an alternative line supply, typically a diesel generator.

Whilst the fans in the NetShelter CX cabinets consume relatively little power they do need to be included within the overall power requirements to ensure they continue to run in the event of a line failure. The power consumption by the fans in each cabinet is given in Table 1.

System power connections

The NetShelter CX cabinets are each supplied with a “Basic Rack” Power Distribution Unit (PDU), an AP9567 providing 14 NEMA outlets and the AP9568 providing 15 IEC 320 outlets (except for AR4000MV), the number of outlets available to the user, in each system, are as detailed below in Table 5. Although the supplied PDU, in each case, has a greater number of outlets some are used to connect the NetShelter CX fan modules or tray, this is reflected in Table 5.

Table 5

NetShelter CX user power outlets

NetShelter CX	(Qty) NEMA outlets	(Qty) IEC 320 outlets
AR4038A	(11) 5-15R	None
AR4038IA	None	(12) C13
AR2024A	(12) 5-15R	None
AR4024IA	None	(13) C13
AR4018A	(13) 5-15R	None
AR4018IA	None	(14) C13
AR4000MV	(3) 5-15R	(3) C13

Cooling considerations

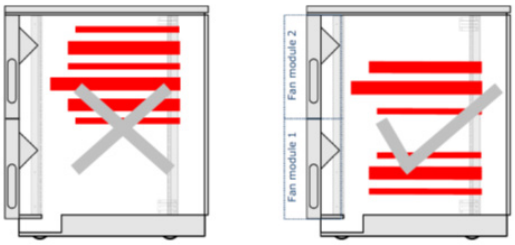
As the NetShelter CX cabinet draws air in from the environment in which it sits, and has no means of reducing the temperature, the average air temperature within the cabinet will always be equal to or more likely slightly greater than the incoming air temperature. The flow of air through the NetShelter CX cabinet is optimized to ensure the heat, generated by the installed equipment, is removed as effectively as possible. However, how the equipment is installed in the cabinet and the total thermal loading by the equipment within the cabinet are two key factors in determining the temperature rise that will be seen within the cabinet and ultimately by the IT equipment itself.

The importance of minimizing the temperature rise within the cabinet is that, as with all electronic equipment, the life expectancy of equipment reduces with increasing operating temperature above a nominal +20°C to +25°C.

Positioning of installed equipment

Figure 3

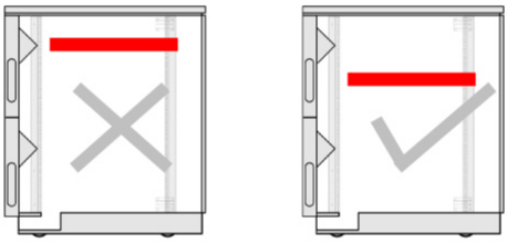
Highlights how equipment should be positioned in a NetShelter CX cabinet



Avoid clustering hot-running equipment such as servers, dense Redundant Arrays of Independent Disks (RAID), and large Voice-over-Internet-Protocol (VoIP) switches in one part of the enclosure. Distribute the thermal load evenly up and down the enclosure such that each fan module supports an equal amount of the thermal load.

Figure 4

Highlights how equipment should be positioned around the fan modules in a NetShelter CX cabinet



Each fan module has a triangular metal section protruding slightly into the enclosure. This does not create an issue for installation of most equipment, but to allow for ample cabling space to the rear of the enclosure, deep servers should be installed in the enclosure space above and below these triangular metal protrusions.

Thermal loading of equipment

The type and quantity of equipment installed in the NetShelter CX cabinet will determine the actual thermal loading, so it is important to note the limits, as shown in Table 2 earlier in this document. In addition, as previously mentioned, if a network device is installed that provides Power over Ethernet (PoE) the actual electrical power being drawn will likely be higher than the power dissipated in the cabinet, in the form of heat, as some of the power is fed through the cabinet to PoE Power Devices outside the cabinet, where the power is dissipated.
Like the air intake to the cabinet, which comes from the environment in which it sits, the exhausted air is also returned into that environment, at a slightly higher temperature, unless ducted away. When the air is exhausted back into the local environment the heat in that area increases, which unless dissipated naturally or removed via a heat removal system will increase the temperature of the associated room and the equipment in the cabinet.

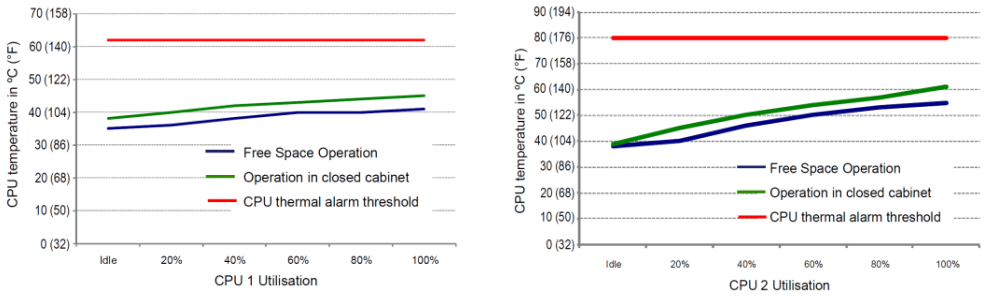
Temperature rise on installed IT equipment

Although the NetShelter CX is very effective at removing heat from the cabinet, there will typically still be a level of temperature rise within the installed equipment.

Testing has shown that for a typical system with three industrial standard rack servers and three network switches, supported by a 3kVA UPS, the average temperature rise in the server CPU's was 3.2°C compared with the same equipment operating in an open rack.

Figure 5

Shows an example of the CPU temperature measurements taken during testing



The test conditions were as follows.

Room ambient	24°C / 75°F (+/-0.5°C).
Server utilization	Idle, 20%, 40%, 60%, 80% and 100%.
Temperature measurements	System was allowed to stabilize for 1 hour at each CPU utilization level before temperature readings were taken. The CPU temperatures were taken from the server manufacturer's management software.
Reference system	The open rack used as a test reference was the NetShelter CX cabinet without any side panels, fan modules or front and rear doors.
UPS loading	The UPS was loaded to 1076W when all the CPU's were at 100% utilization.

Noise considerations

Whilst just installing IT equipment in an open rack within a room may be beneficial from a heat removal perspective it would in general be unacceptable from a noise perspective if in an office environment. For this reason, the NetShelter CX is designed to minimize the noise and maximize the heat removal from any installed IT equipment to make it suitable for installation in an office environment.

In order to appreciate the level of noise reduction provided by the NetShelter CX it is important to put the sound levels into perspective against common references, such as those listed below:

- 50 dBA background noise in an average office, without speech
- 55 dBA background noise in a busy office, without speech
- 60 dBA normal conversational speech
- 45 to 50 dBA typical noise from fully integrated or cassette-type building air conditioning
- 55 dBA + typical noise from portable air conditioners

In figure 6 below it shows the respective sound levels of four and eight servers in an open frame rack compared to the same servers installed in a NetShelter CX cabinet. The sound levels were measured at a distance of 1m (39in) and are referenced against the common noise levels. These results show an 18.5 dBA reduction in broadband noise level from the servers when installed in the NetShelter CX cabinet compare to operating under the same condition in an open rack. This is the equivalent to a 98.5% reduction in server noise.

Figure 6

Comparative noise levels of identical IT systems operated in an open rack or in a NetShelter CX cabinet

Cabling architecture, addressable users and equipments

Thanks to its flexibility, when deployed in Office Building, NetShelter CX can be directly installed in open spaces, saving costly m² and drastically cutting cable use.
As shown in table 6, depending on its size, the NetShelter CX can indeed save up to 2/3 of the area used by traditional Floor Distribution rooms and 2/3 of the copper cable thanks to proximity of the end-users.
This can reduce significantly the CAPEX of an office building, remaining on standardized network architecture.

Schneider Electric recommends using smaller NetShelters because it will lead to shorter cables. As power is inexorably increasing in LAN cables, shorter cables will result in less power waste, and less heat.

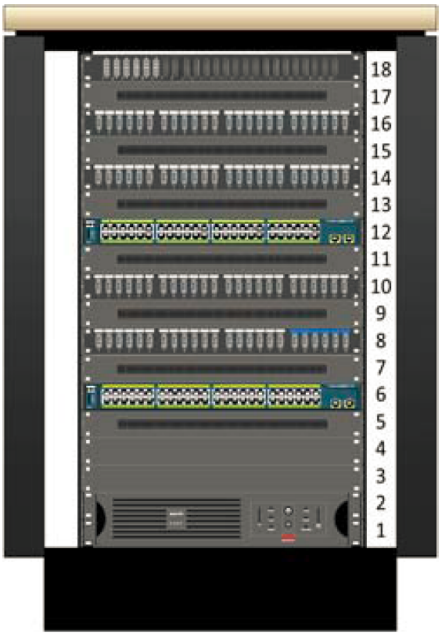
Table 6

NetShelter CX benefits, ground occupancy and cable average length

NetShelter CX	#U	m² used	RJ45 ports	Users[1] (80%)	Scenario for 1000 users		Avg horizontal cable length	
Technical room (typical value)		8.0 m²		174	46.0 m²	Ref.	37.6 m	Ref.
AR4000MV	12	1.2 m²	48	19[2]	65.4 m²	+42%	13.0 m	-65%
AR4018(I)A	18	1.5 m²	96	38	40.6 m²	-12%	15.6 m	-58%
AR4024(I)A	24	1.5 m²	144	57	27.0 m²	-41%	18.1 m	-51%
AR4038(I)A	38	1.5 m²	240	96	16.1 m²	-65%	23.4 m	-37%

Figure 7

Example of configuration in NetShelter CX 18U AR4018(I)A



1 x FO panel ref. VDIG150991 V2
and related accessories
➔ RU #18

6 x brush panels ref. VDIG188201
➔ RU #5, 7, 9, 11, 13, 15 and 17

4 x 24-ports RJ45 panels ref. VDIG11y241F
➔ RU #8, 10, 14 and 16

96 x S-One Cat.6A ref. VDIB177yXB12
96 x 1-meter Cat.6A S/FTP patch cords
ref. VDIP185X46010

2 x Cisco – Catalyst 3850 Series Switch
ref. WS-C3850-48P
➔ RU #6 and 12

2 x blank panels ref. VDIG188021
➔ RU #3 and 4

1 x APC – SMART UPS 2200VA (2U)
ref. SMT2200RMI2U
➔ RU #1-2

[1] 2 outlets per user

[2] AR4000MV cable capacity is limited to 30 cables and therefore AWG26 cable shall be used here to reach the maximum user count

Conclusion

The Netshelter is an **« all in one » enclosure** to be installed **in ambient space** in Office Buildings, being a concentration point and integrating active switches, UPS, batteries and pure cabling products.

This is made possible thanks to the integration of **cooling system** and a **noise reduction** design.

Thus, The NetShelter CX is providing a unique, cost effective, and flexible solution for deploying IT equipment quickly and efficiently in an office or similar environment.

It also saves much space. Indeed, the space of the former technical rooms is given back to the user (more seats, more meeting rooms etc.), leading to an **improved m²/people ratio** in the building.

In term of network architecture, the Netshelter allows a great flexibility. The incoming links can be in copper, but also in fiber, directly from the basement technical room, so that space is also saved in the basement room. The outgoing links towards the use, the WAP,cameras etc. are in copper. They are much shorter than in a traditional configuration with technical rooms. In the following example in appendix, it is demonstrated that in the **length of copper cables could be decreased by 50%.** As a consequence, **the deployment costs are as much reduced.**

The Netshelter is a standard solution that can be **“standardized”** in any building, **simplifying how is organized space** when designing the workplace,
also **simplifying downstream maintenance procedures.**

Such solutions can also be part of a disaster **recovery plan** allowing rapid deployment of configured systems to the required location or locations

About the author

François Durand is a Project Application Engineer with Schneider Electric based in Paris suburb, France. He has worked in Structured Cabling industry for over 20 years, and 15 years in R&D department successively working for Nexans Cable, Schneider Electric.
François is a graduate of Ecole Centrale de Lyon engineering school. He was awarded Schneider Electric’s certification as an Edison Expert in 2010.

Resources

NetShelter CX deployment in an SMB or Branch Office Environment
Application Note 173

Power and Cooling Considerations for Power-over-Ethernet (PoE)
White Paper 88

Calculating Power for Cisco StackPower and the Cisco Catalyst 3750-X Series Switches
Cisco White Paper

802.11ac wave 2 and the Cisco Catalyst 3750-X Series Switches
Cisco FAQ

Download Center
http://www.schneider-electric.com/en/download/

Appendix A: Case study

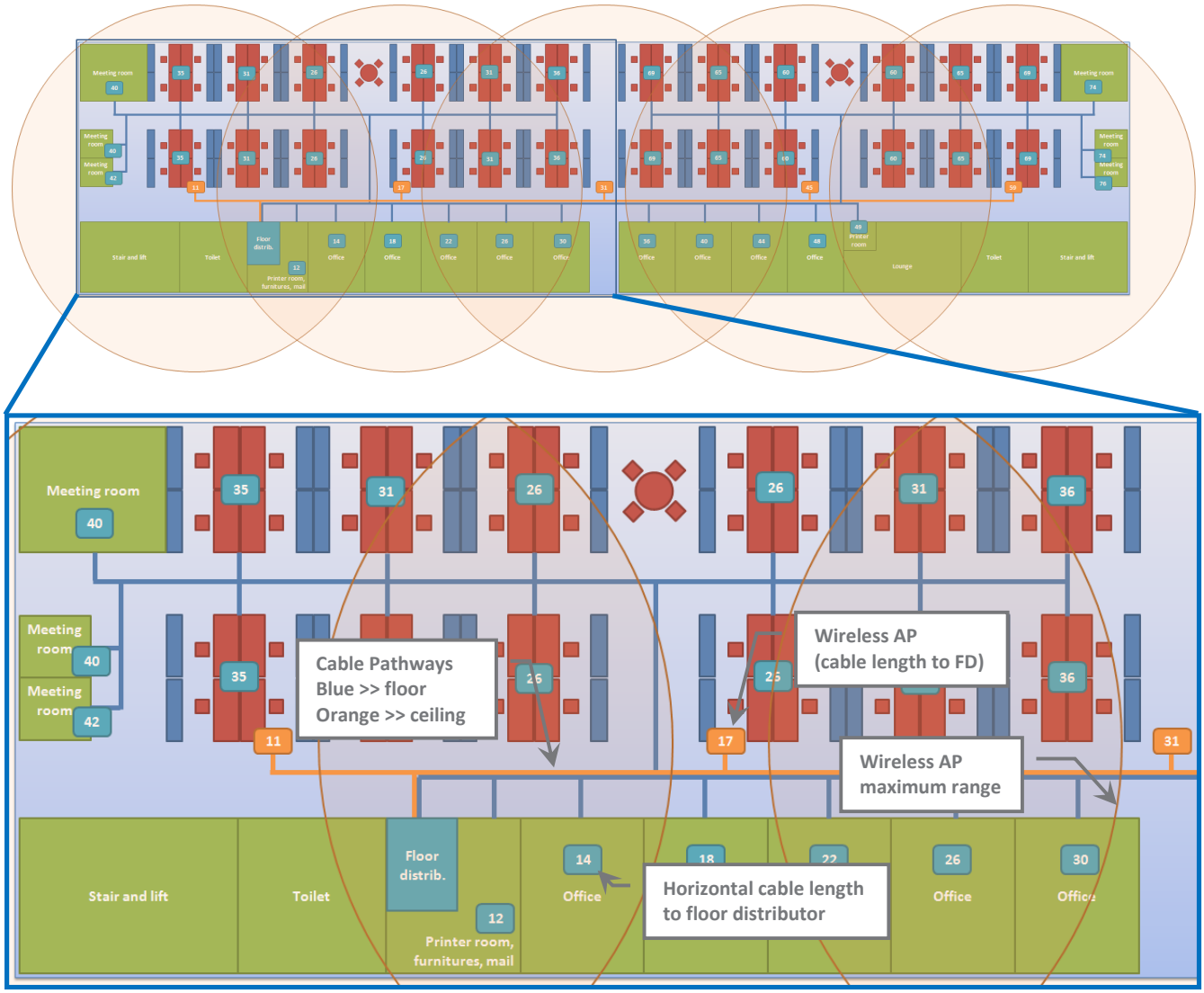
That case study aims at evaluating of the benefits NetShelter CX could provide to the customer compared to a standard network building architecture with dedicated floor distributors.

The following example only takes into account one part of a typical office building floor.

1st case: standard architecture

Figure 8

Drawing of one part of a traditional office buiding



As per Fig.8, the part of the building used for this study is made of:

- 2 open spaces of 48 offices each
- Individual offices
- Meeting rooms
- Other rooms: floor distributor room, printer room, toilet, lounge, stair and lift

Detail of the links:

- 96 offices in open space:
  96 IP phones
  96 additional outlets

- 9 individual offices:
  9 Video IP phones
  27 additional outlets

- 6 meeting rooms:
  4 IP phones
  2 Video IP phones
  6 additional outlets

- 5 Wi-Fi Access Points:
  High-speed IEEE 802.11ac wave2 Wi-Fi Access Points (e.g. Cisco Aironet 3800)
  10 links

- 2 printer rooms
  4 outlets

Number of links: 254
Total length: 11400m
Average length: 44.9m

Switches:

- 4 x 48-Port PoE (or better) Gigabit Ethernet switches, e.g. Cisco WS-C3850-48P
- 1 x 24-Port PoE (or better) Gigabit Ethernet switches, e.g. Cisco WS-C3850-24P
- 1 x 48-Port 4p-PoE 10GBASE-T switch for IEEE 802.11ac wave2 Wi-Fi Access Points, e.g. Cisco WS-C3850-12X48U

Note: possible alternative option

- 5 x 48-Port PoE (or better) Gigabit Ethernet switches, e.g. Cisco WS-C3850-48P
- 1 x 24-Port 4p-PoE 10GBASE-T switch, e.g. Cisco WS-C3850-24XU

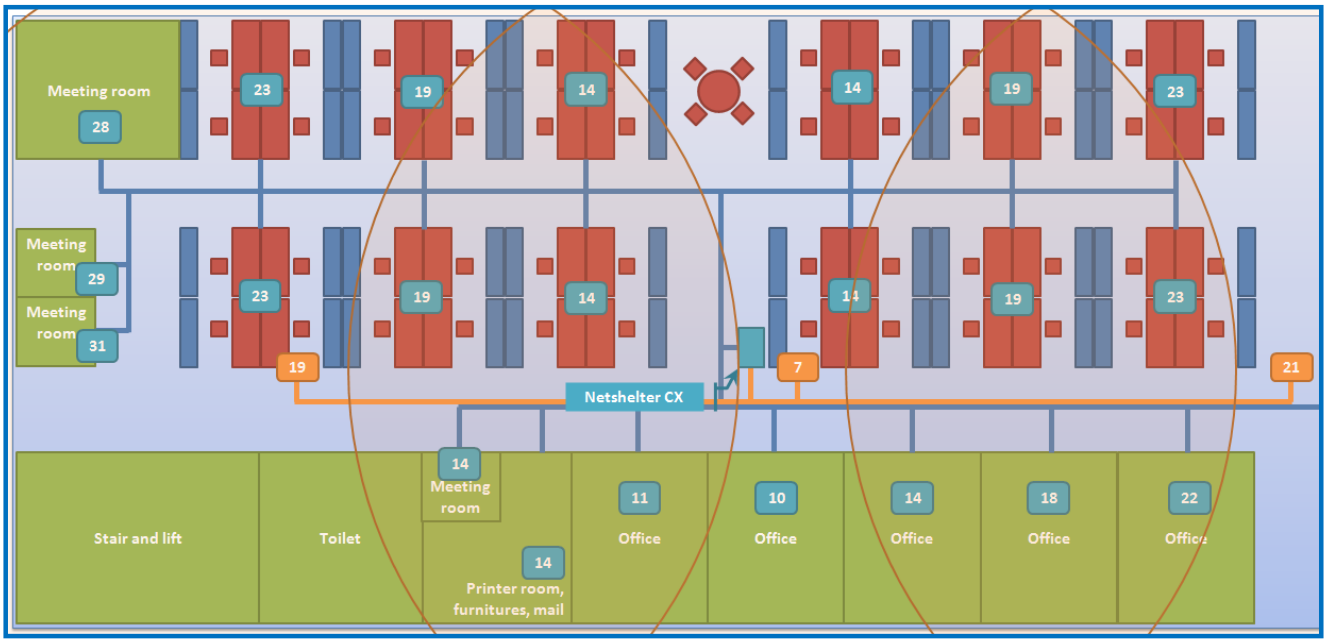
That option has not been chosen as it looks more expensive considering Cisco references.

2nd case: NetShelter CX architecture

2 NetShelters are placed in the open space areas to distribute all the links

Figure 9

Drawing of one part of an office buiding with NetShelter CX in openspace



Detail of the links:

- 96 offices in open space:
  96 IP phones, 48 in NetShelter CX #1and 48 in NetShelter CX #2
  96 additional outlets, 48 in NetShelter CX #1and 48 in NetShelter CX #2

- 9 individual offices:
  9 Video IP phones, 5 in NetShelter CX #1 and 4 in NetShelter CX #2
  27 additional outlets, 15 in NetShelter CX #1 and 12 in NetShelter CX #2

- **7 meeting rooms** (instead of 6)
  5 IP phones, 3 in NetShelter CX #1 and 2 in NetShelter CX #2
  2 Video IP phones, 1 in NetShelter CX #1 and 1 in NetShelter CX #2
  7 additional outlets, 4 in NetShelter CX #1 and 3 in NetShelter CX #2

- 5 Wi-Fi Access Points:
  High-speed IEEE 802.11ac wave2 Wi-Fi Access Points (e.g. Cisco Aironet 3800)
  10 links, all in NetShelter CX #1 (to not duplicate specific switches)

- 2 printer rooms:
  4 outlets, 2 in NetShelter CX #1 and 2 in NetShelter CX #2

Number of links: 256
Total length: 4800m
Average length: 18.8m

Switches: no change vs. 1st case – standard architecture

- 4 x 48-Port PoE (or better) Gigabit Ethernet switches, e.g. Cisco WS-C3850-48P
  2 in NetShelter #1 and 2 in NetShelter #2
- 1 x 24-Port PoE (or better) Gigabit Ethernet switches, e.g. Cisco WS-C3850-24P
  In NetShelter #2
- 1 x 48-Port 4p-PoE 10GBASE-T switch for IEEE 802.11ac wave2 Wi-Fi Access Points, e.g. Cisco WS-C3850-12X48U
  In NetShelter #1

Details of NetShelter CX #1 configuration:

- 61 IP phones and 61 additional outlets
- 1 video IP phones and 1 additional outlet
- 5 IEEE 802.11ac wave 2 WAPs / 10 links
- 2 links for printers

TOTAL: 136 links

Bill of materials:

- 1 x Fibre Optic patch panel, ref. VDIG150991001
- 3 x 48-port switches: 2 with PoE (IEEE 802.3xx) and 1 with UPoE or 4-pair PoE (IEEE 802.3xx)
- 6 x 24-port RJ45 panels, ref. VDIG112241F
- 10 x brush panels
- UPS
- Battery

Assumptions for that case study:
Cabling type: Cat.6A shielded
Temperature of the building: 24°C

WAP: Cisco Aironet 3800
Access switches:

- 1 x Cisco 3850-12X48U
- 2 x Cisco 3850-48P

Σ PoE @ PSE = 484 W (it includes the power dissipated by the cables and in the Powered Devices)
Total switch power consumption: 1086 W

The selected UPS solution anticipates an increase of 20% of the power demand because of future expansion.
That solution is made of:

- 1 x UPS unit, ref. SMX2200HV
- 1 x battery, ref. SMX120BP

28U are needed for this configuration, hence, NetShelter AR4038(I)A is chosen.
The total power dissipated in the NetShelter CX equals 765 W which is far below the 38U-NetShelter CX cooling capacity (3600 W).
Total weight in the NetShelter reaches 180 kg, below the 250 kg limit.

Conclusion for this case study

Thanks to the NetShelter CX, copper cable consumption dropped by 59% and 1 meeting room could be added (6 m² saved).
There was no impact on access switch list.

Note in the example, if in the 1st case, the position of the floor distributor was optimised, the copper cable need would still be 50% less with NetShelter CX solution (18.8m vs 37.6m).