

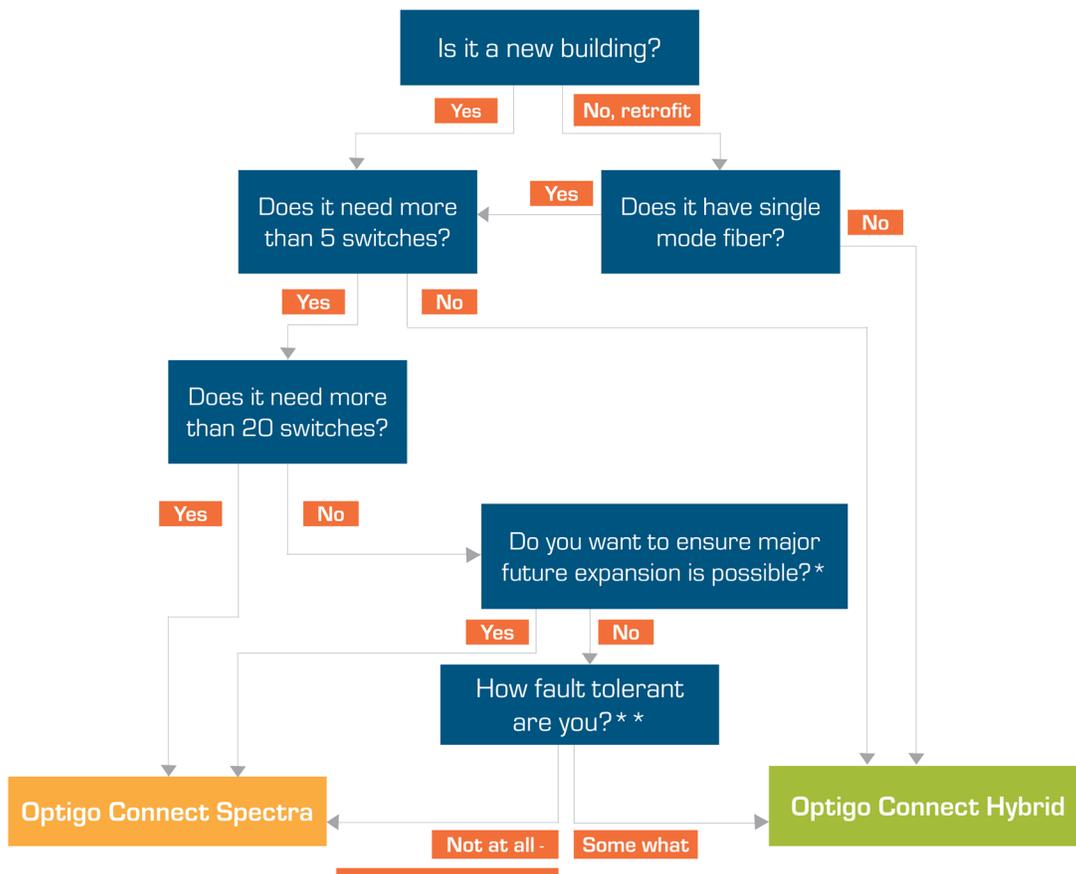
How to design Optigo Connect

In order to design an Optigo Connect project, you need to decide if you are using Connect Spectra or Connect Hybrid, then the topology, and finally the specific switches and products. This document will walk you through the steps and the decision making criteria for each one.

Optigo Connect Spectra or Hybrid?

Optigo Connect Spectra is a high-performance fiber network solution, best for new builds or large retrofits. The Optigo Connect Hybrid solution can use copper (CAT5) or fiber, and is typically for smaller or less complex networks, or retrofits.

Use the following decision chart to help decide which solution is best-suited to your project.



*Possible future expansions could include adding major services which may need more ports (e.g. access control or more IP controllers), new services that could require more bandwidth (e.g. CCTV or analytics) or increased network reach (e.g. expanding to more floors or next building).

**While uptime is important for all networks, Optigo Connect Spectra has redundancy offerings. If you are using Optigo Connect on critical infrastructure, we recommend a solution with redundancy.

You should now know if you are designing a network with Optigo Connect Spectra or Hybrid. For Hybrid, jump ahead to page 8.

SPECTRA

High Availability (Redundancy)

If you have critical infrastructure, you will want to have redundancy to reduce the impact of a failure.

Do you want redundancy? (If no, skip to section 3).

If yes, we offer 2 types of redundancy: Aggregation Switch (99.9% uptime) and Path Redundancy (99.99% uptime).



The Optigo Connect Spectra family

At a minimum, you need a redundant Aggregation Switch (ONS-S8). If an Aggregation Switch goes down, the second Aggregation Switch will take over and ensure the network functions as normal. As Optigo Connect Spectra uses Passive Optical Networking, the nature of this topology is that a single switch failure will not impact other switches. However, it does not provide protection for failure in the cabling (e.g. fiber cuts/breaks).

Do you want fault tolerance on your passive infrastructure (cabling)? If so, use Passive Rings. See the High-Rise Redundancy Shopping List document, page 3, for more details.

If you only want a redundant Aggregation Switch, use dual-input splitters. See the High-Rise Redundancy Shopping List document, page 2, for more details.

Topology

For Optigo Connect Spectra, the topology will depend on both the layout of the building and your redundancy choices.

If you want fault tolerance on your passive infrastructure (cabling), you will select Passive Ring(s). See High-Rise Redundancy Shopping List document, page 3, for more details.

If you are designing for a high-rise or a network around the perimeter of a building or campus, you will want

to select a Passive Daisy Chain(s). See High-Rise Shopping List document for more details.

For any other type of building (e.g. a low-rise, campus, shopping center, data center, wide flat areas, or factory), you will select a star topology.

Refer to the shopping lists to get an idea of the topologies, and the items that you will need.

Switch selection - Current needs

Once you have decided on the topology, you will need to figure out which switch you need in each location. Keep in mind that you can change out switches in the future to get more ports. However, it will be hard to change the mounting method (rack- vs DIN rail-mounted). Plan for this in advance.

If you think you will ever need more than 8 ports, we recommend using rack-mounted switches (ONS-C810p, ONS-C2401p, ONS-C4801p), as rack-mounted switches can have more ports. You can switch out an ONS-C810p for a ONS-C2401p in the future very easily. We do have an ONS-C1601pi if necessary to have up to 16 ports DIN rail-mounted, but this is the largest option for rack-mounted switches.



Optigo Connect Edge Switches

If you will be needing less than 4 ports in a location, use the ONS-C401i.

ONS-C401i	ONS-C801pi	ONS-C1601pi	ONS-C810p	ONS-C2401p	ONS-C4801p
4 Ethernet ports	8 Ethernet ports	16 Ethernet ports	8 Ethernet ports	24 Ethernet ports	48 Ethernet ports
DIN-rail mounted	DIN-rail mounted	DIN-rail mounted	Rack mounted	Rack mounted	Rack mounted
No PoE	PoE	PoE	PoE	PoE	PoE
Power supply sold separately (ACC-PS-24V10W)	Power supply sold separately (ACC-PS-48V300W)	Power supply sold separately (ACC-PS-48V300W)	Internal power supply	Internal power supply	Internal power supply

Network Controller

Every Optigo Connect project needs an ONS-NC600, to host Optigo OneView network management software. If you need redundancy in an Optigo Connect Spectra design, you will need 2, one for each ONS-S8.



Network Controller and Connect Spectra Aggregation Switch

Spectra Aggregation Switch

For Optigo Connect Spectra, you will use the ONS-S8 as your Spectra Aggregation Switch. If you need redundancy, you will need a second ONS-S8.

Bandwidth

In Spectra systems, every ONS-S8 has 8 passive optical fiber trunk ports, and each fiber trunk port supports 1Gbps upstream and downstream.

BAS: For BAS systems, the bandwidth required per device is typically small. However, if you expect to use any kind of analytics software, please account for its bandwidth requirement.

Cameras: How much bandwidth do you expect to need? Consider burst and continuous rates. For example, in a system with security cameras, the data rate is fairly regular and predictable. See camera bandwidth calculators provided by your camera vendor. Then, calculate the total amount of expected bandwidth and use the maximum.

Take into consideration any future expansion that could take place. Will you be adding new devices? Putting security devices or analytics on the network? If so, make sure you have some extra bandwidth, or unused optical ports.

Choosing your splitters

Splitters are passive devices that split the light going through a fiber to turn 1 fiber into 2 or more fibers. There is a maximum number of times a single fiber can be split. Refer heavily to the shopping list guides to see the splitter options and recommendation for your layout and redundancy needs.



Optigo Connect's Passive Optical Splitters

High-rise / Passive Daisy Chain Topology: You will need to use the YPS-x-Axx splitters to split the light asymmetrically. The basic template is to split off 5% of the light for the first 7 splits, then 6 splits at 10% as you go higher up the highrise. In the end the last split will be a symmetric 1:2 (50%/50%) split. This formula is good for 15 switches in a Passive Daisy Chain. Other combinations can be used. Please refer to the Optical Budget Calculator to ensure the topology fits in the optical budget.

If you have stacked comm rooms, you can use -LR splitters (Long Range splitters) to connect the splitters directly to each other. This means you won't need to run cable between floors, reducing cabling and labour costs. Any splitter-to-splitter connection will need 1 coupler.

Star Topology: If you have a star with a large number of splits (e.g. 1 to 32), you will likely want a rack-mounted splitter.

Otherwise, you will use a regular splitter. Refer to the shopping list guide.

Patch Cables: If you are connecting splitters to each other, consider adding some patch cables to your order. These are short fiber cables that can go between splitters to extend the reach of their fibers. It's always good to have a few on hand, and they can be helpful to leave a split open for future use.

Every patch cable needs 2 couplers with it (1 on each end). **Do not** attempt to save money on couplers. They are very cheap, and easily lost. Having a coupler delay a project is a very painful and easily avoidable situation.

Use the shopping list guide docs to make your designs!

SFPs

Every fiber run from the ONS-S8 will need 1 ONS-SX-SFP (connecting the ONS-S8 and the fiber network).

Every Edge Switch will need 1 ONS-CX-SFP, connecting the fiber to the Edge Switch.



ONS-SX-SFP



ONS-CX-SFP

Optical Budgeting

Once you have a design, use the Optigo Connect budget calculator to determine optical budget and if it's okay for your design. See the topology guides for rules of thumb.

Optimum light budget of 10dB minimum attenuation to 26dB max attenuation. Use the budget calculator.

Future Expansion

When designing the network, consider how easy it will be to add to the network in the future.

- If there is a possibility of adding new devices, you will need more ports. How will you do this?
- If you have unused ports, you can start by using those.
- You could trade out current switches for switches with larger port count
 - If you have an ONS-C810p you could swap it out for an ONS-C2401 with 3 times more ports
 - If you have an ONS-C401i can you can replace it with a DIN-mounted C801pi or C1601pi, but you will need to make sure you have space for the larger switches in the panel
 - If you have a C801pi, you can swap it out for a C1601pi with twice as many ports in the same size switch
- If you have a fiber run that is not at full optical and bandwidth capacity, you could split it again and add more switches.
- If you are not using all 8 fibers trunk ports on the ONS-S8, you could run a fully new fiber with new switches (consider running this additional cable now to make things much easier in the future)

If your Edge Switches have no open ports, the ONS-S8 has 8 fibers running from it, and each fiber is maxing its optical budget, future expansion will be tough. You will need to add a new ONS-S8 and ONS-NC600 if you need to add a single devices. Consider redesigning the network to leave more room for future changes.

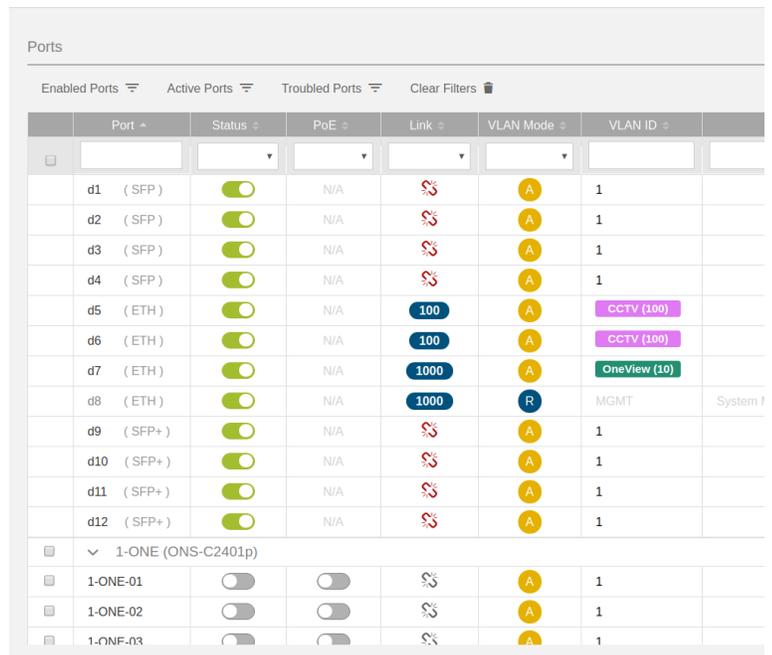
Software

Optigo OneView Software License: Every Optigo Connect project needs to have a software license for the ports. Count all of the copper (RJ-45) ports on all switches that your you are purchasing. The first 100 ports are included in the cost of the ONS-NC600. After that, each additional block of 100 ports will require a software license called ONS-SW-100p. For example, if you have 238 ports, you will need 2 units of ONS-SW-100p.

If it's easier, the calculation is as follows: (total # of ports - 100)/100 rounded up.

Redundancy Software License: Every pair of redundant fiber ports needs 1 unit of ONS-SW-RED, regardless of path or Aggregation Switch Redundancy.

 Optigo OneView - ONS-S8 (Customer Demo)



Port	Status	PoE	Link	VLAN Mode	VLAN ID
d1 (SFP)	ON	N/A	🔴	A	1
d2 (SFP)	ON	N/A	🔴	A	1
d3 (SFP)	ON	N/A	🔴	A	1
d4 (SFP)	ON	N/A	🔴	A	1
d5 (ETH)	ON	N/A	100	A	CCTV (100)
d6 (ETH)	ON	N/A	100	A	CCTV (100)
d7 (ETH)	ON	N/A	1000	A	OneView (10)
d8 (ETH)	ON	N/A	1000	R	MGMT
d9 (SFP+)	ON	N/A	🔴	A	1
d10 (SFP+)	ON	N/A	🔴	A	1
d11 (SFP+)	ON	N/A	🔴	A	1
d12 (SFP+)	ON	N/A	🔴	A	1
1-ONE (ONS-C2401p)					
1-ONE-01	OFF	OFF	🔴	A	1
1-ONE-02	OFF	OFF	🔴	A	1
1-ONE-03	OFF	OFF	🔴	A	1

Optigo Connect OneView for Spectra

Extras

You will want to consider the following items in your design and bill of materials:

- Power supplies - every industrial switch (ONS-Cxxx), requires an external power supply. Rack mounted switches do not require an external power supply. Refer to the chart above to determine the appropriate power supply.
- Couplers - you will need 1 coupler for every splitter. If you are connecting splitters to each other, or using patch cables, you will need a coupler for every connection.
- Fiber cleaner - keeping fiber clean is crucial to a successful project and installation. Every site should have one fiber cleaner. You cannot substitute with a rag or towel.
- Fiber patch cables - if you will need to connect fibers together, extend fibers to reach a splitter, or extend splitters to connect to one another, fiber patch cables come in a variety of sizes. It's always good to have a few on hand, as they are inexpensive and can minimize delays if fiber doesn't reach as planned.
- Attenuators - attenuators reduce the light signal when it is too intense (less than 14dB insertion loss). These come with the ONS-SX-SFPs. Additional ones can be purchased.

Always have extra patch cables, couplers, and SFPs. They are cheap, easy to misplace, and missing or running out of them can significantly delay an installation.

Note: ONS-SX-SFP and ONS-CX- SFPs are not interchangeable.

Budgetary (cost) trade-offs

The following are a few extra things to consider when designing an Optigo Connect Spectra network.

General

- Consider using fewer types of switches to reduce replacement and training costs. For example, instead of having 9 ONS-C810p and 1 ONS-C2401p, consider a design with 12 ONS-C810p. In this case, you may stock an additional ONS-C810p in case of failure, instead of stocking 1 ONS-C810p and 1 ONS-C2401p.
- Whenever possible, use 1 port per device and IP. This will ensure higher availability, as you won't have traffic from multiple devices running through one port. It also allows you to manage the network much more easily. For example, if you need to disable a device, you can simply disable that port remotely.
- If you must Daisy Chain BAS controllers, we recommend a maximum Ethernet Daisy Chain of 25 devices in a loop with Rapid Spanning Tree Protocol OR 50 devices in a single-ended chain.
- If you are looking to have a repeatable design with a panel shop or cabinet, use a DIN-rail mounted switch. However, note that it will be limited on future upgrades.

Budgetary

- Labour vs. equipment cost. It is tempting to reduce cost by putting fewer switches into a project. If you put a switch on every floor, the up-front hardware cost will be slightly more, as will the upfront installation cost. In an effort to reduce this cost, you could put a switch on every 3rd floor. However, keep in mind that you will incur additional costs pulling cable to the alternate floors, labeling and testing them. Then, as you are commissioning the system or troubleshooting in the future, devices will be on a different floor from the switch which will be more time consuming and costly. Few switches and less open ports also makes future expansion harder. The cost difference between the options will also depend on labour rates in your region.
- When ordering cable, consider the conduit space. If it's open air, you won't have problems. If it's using a conduit, and particularly if there is a tight conduit, you may not want to use pre-terminated fiber.
- More redundancy / higher availability means less chance of your network being interrupted, but it comes at a cost.
- Rack-mounted switches have internal power supply and are cheaper per port.

HYBRID Topology

If you are using Optigo Connect Hybrid, you will be using up to 4 active Daisy Chains of switches. The final number of Daisy Chains will depend on the layout of your building. We recommend not stacking more than 5 switches per Daisy Chain to avoid bottlenecks and low reliability.



The Optigo Connect Hybrid family

Switch selection - Current needs

Once you have decided on the topology, you will need to figure out which switch you need in each location. Keep in mind that you can change out switches in the future to get more ports. However, it will be **hard to change the mounting method** (rack vs DIN-rail mounted). Plan for this in advance.

If you think you will ever need more than 8 ports, get a rack-mounted switch (ONS-C810p, ONS-C2401p,

ONS-C4801p), as rack-mounted switches can have more ports. You can switch out an ONS-C810p for a ONS-C2401p in the future very easily. We do have an ONS-1601pi if necessary to have 9 - 16 ports DIN-rail mounted, but this is the largest option for rack-mounted switches.

If you will be needing less than 4 ports in a location, use the ONS-C401i.

ONS-C401i	ONS-C801pi	ONS-C1601pi	ONS-C810p	ONS-C2401p	ONS-C4801p
4 Ethernet ports	8 Ethernet ports	16 Ethernet ports	8 Ethernet ports	24 Ethernet ports	48 Ethernet ports
DIN-rail mounted	DIN-rail mounted	DIN-rail mounted	Rack mounted	Rack mounted	Rack mounted
No PoE	PoE	PoE	PoE	PoE	PoE
Power supply sold separately (ACC-PS-24V10W)	Power supply sold separately (ACC-PS-48V300W)	Power supply sold separately (ACC-PS-48V300W)	Internal power supply	Internal power supply	Internal power supply

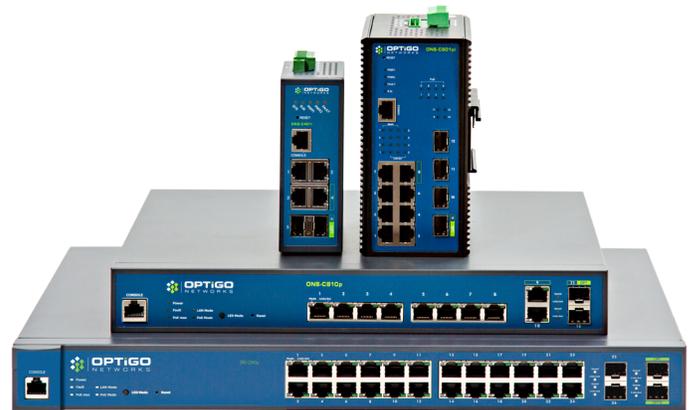
Network Controller

Every Optigo Connect project needs an ONS-NC600 to host Optigo OneView network management software.

Hybrid Aggregation Switch

The default Hybrid Aggregation Switch is the ONS-C810p.

- If you only need a couple ports and are trying to save money, you can use the ONS-C401i
- If you need more than 8 ports, the C2401p is the best option. You can consider the ONS-C1601pi, but the copper ports on this (and all of our DIN-rail mountable switches) have limited bandwidth which may cause bottlenecks.



Connect Hybrid Aggregation Switches

ONS-C401, ONS-C801, ONS-C1601 are DIN-mountable, and may be a better physical fit. Note that the copper ports on these switches have limited bandwidth (100Mbps) which may cause bottlenecks.

Bandwidth

In Hybrid systems, every connection between switches (connecting SFP ports) are bi-directional 1 Gbps (upstream & downstream).

We recommend placing all high bandwidth aggregation devices (e.g. servers) in the core or centre of the network (i.e. connected to an aggregation switch), and not at the edge.

BAS: For BAS systems, the bandwidth required per device is typically small. However, if you expect to use any kind of analytics software, please account for its bandwidth requirement.

Cameras: How much bandwidth do you expect to need? Consider burst and continuous rates. For example, in a system with security camera, the data rate is fairly regular and predictable. See camera bandwidth calculators provided by your vendor. Then, calculate the total amount of expected bandwidth and use the maximum.

Take into consideration any future expansion that could take place. Will you be adding new devices? Putting security devices or analytics on the network? If so, make sure you have some extra bandwidth, or unused optical ports.

SFPs

You will need 2 ONS-CU-SFP per edge switch (not including the switch acting as an aggregation switch). These 2 ONS-CU-SFPs will go on either end of the cable, connecting it to the aggregation switch and the edge switch, or between two edge switches in a daisy-chain.

We recommend buying a couple extra SFPs. They are cheap, easy to misplace, and you don't want them to slow down your installation.

Software

A one-time software license is required if your system has more than 100 copper (RJ-45) ports. Note that the copper ports on the Aggregation Switch are included in this count.

If you have more than 100 ports, you will need 1 unit of ONS-SW-100p for each additional 100 port license ((# of ports/100)-1, rounded up).



Transceiver plug-ins for multimode, copper, and single-mode fiber

Optigo Connect OneView for Hybrid

Extras

Power supplies - every industrial switch (ONS-Cxxxxi) requires an external power supply. Rack mounted switches do not require an external power supply. Refer to the chart above to determine the appropriate power supply.

Future Expansion

Optigo Connect Hybrid is not built to be prepared for future expansion, as there are limits to how many switches the solution supports. However, if you do need to add devices in the future, you can consider these options:

- If you have unused ports, you can start by using those.
- You could trade out current switches for switches with larger ports
- If you have ports supporting fewer than 4 switches, you could add switches to your daisy chain
- You could convert your system to an Optigo Connect Spectra network, but note that this will require single-mode fiber

Budgetary (cost) trade-offs

Hybrid is naturally the lower budget option. When choosing switches, keep in mind that rack mounted switches have an internal power supply, and are therefore cheaper per port.