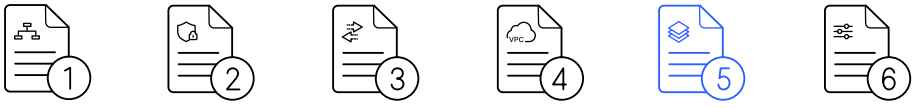
Setup Guide: Stacking with LANCOM switches

Stacking switches involves the physical and logical connection of multiple network switches so that they can behave and be managed as a single unit. Stacking combines multiple switching backplanes into a single entity, which appears as a device with just one MAC and IP address. This provides redundancy and flexibility in the network, and also allows for expansion without any configuration effort.

This Setup Guide informs you all about stacking terminology, the stacking management options available with the LANCOM switch series, and how to calculate the maximum network size.

This paper is part of the **series "switching solutions"**.
Click on the icons to find out more about the information available from LANCOM:



Basics	**Basics**	**Design guide**	**Setup guide**	**Setup guide**	**Setup guide**
Two-tier & three-tier switch architectures	Switch security with IEEE 802.1X	Redundancy concepts for switch networks	VPC configuration with LANCOM switches	Stacking with LANCOM switches	Configuration options LANCOM XS-6128QF

Stacking terminology and roles in a nutshell

→ The **management switch (also manager or master)** manages the stack and configures the stack's systemic and interface-related functions. As an example, a firmware update is installed on the management switch first, and this then performs the updates on the other switches in the stack. If the stack is expanded to include additional devices, the management switch automatically configures them by means of zero-touch provisioning. A manual mode is available as an alternative.

→ The **operational standby (also backup, management standby)** is the stack member with the highest priority after the management switch. This switch takes over the configuration and stack management if the management switch fails. To ensure that the operational standby is prepared for a failover event, the management switch continuously feeds it with status information. For example, any changes to the current configuration are automatically copied to the backup.

→ A **stack member** is a switch in the stack that does not handle management-switch or standby-manager functions.

→ **Stack unit** refers to any switch in the stack, including the management switch and the operational standby.

→ A **standalone unit** is any switch that is not part of a stack. The standalone unit can become a management switch if the stacking ports are set up accordingly and another switch is connected to it. In the same way, a management switch becomes a standalone unit if it loses all connections to the other stack members.

→ A stack operates as a ring or daisy chain. To prevent the network being torn into two separate parts if a stack member fails, it is always advisable to use the **ring topology**. This means that more than one physical connection is used between the switches via Direct Attach Cable (DAC) or optical transceiver modules (SFP modules).

General information about LANCOM stacking

A LANCOM stack can consist of up to 8 switches (stack units).

LANCOM stacking supports mixed stacks of fiber optic and copper switches. The only requirement is that all devices in the stack must have the same stacking interfaces (ports) and be equipped with an identical firmware version. This means that stacks can be formed, for example, with the following devices:

	GS-4500 series	XS-4500 series	XS-5110F	XS-5116QF	XS-6128QF	YS-7154CF
GS-4500 series	✓ per 40G QSFP+ or 10G SFP+ ports	–	✓ per 10G SFP+ ports	✓ per 40G QSFP+ ports	–	–
XS-4500 series	–	✓ via 100G QSFP28 or 25G SFP28 ports	–	–	–	–
XS-5110F	✓ per 10G SFP+ ports	–	✓ per 10G SFP+ ports	–	–	–
XS-5116QF	✓ per 40G QSFP+ ports	–	–	✓ per 40G QSFP+ ports	–	–
XS-6128QF	–	–	–	–	✓ per 50G SFP-DD FleX ports	–
YS-7154CF	–	–	–	–	–	✓ per 100G QSFP28 ports

Stack members can all be interconnected at a single location, e.g. in a shared rack with a Direct Attach Cable (DAC), or they can be decentrally distributed. If the stack is distributed across two or more sites, it still behaves as a single stack in a common location and can be configured as a unit with a single IP address. Over large distance, optical transceiver modules (SFP modules) should be used between the stack member switches.

Non-stop forwarding enables stack units to continue forwarding packets even if the control and management plane of the management switch need to be restarted as a

result of a failure of the power, hardware, or software. Data streams that enter and exit the stack via network ports on a stack unit other than the management switch are therefore continued with minimal interruption if that very management switch fails. The failover time of the control plane (max. 1 second) depends on the stack size, the complexity of the configuration, and the CPU speed.

To take full advantage of nonstop forwarding, using a LAG group ensures that layer-2 connections from network devices like access switches are shared between two or more stack units. What this means is: Access switches always need to be physically connected to two different stack units on the aggregation layer. Similarly, layer-3 routes such as ECMP routes with next hops via physical ports should also be split between two or more stack units. The hardware can then quickly move data streams from LAG members or ECMP paths on a failed unit to a stack unit that is still functioning.

Stacking options for LANCOM switches

Stacking with GS-4500 series access switches

The stackable fully managed access switches can be stacked via two of the 10G SFP+ ports as well as via the higher-performance 40G QSFP+ ports on the rear panel.

Stack structure and max. network size in small scenarios with the LANCOM XS-5110F

With the aggregation switch LANCOM XS-5110F, two of the eight 10G SFP+ ports can be used for stacking. To use the stacking function, the SFP+ ports 7 and 8 must first be configured as stacking ports via CLI or WebGUI, because the default setting for these ports is “Ethernet”.

Accordingly, six SFP+ ports are still available for further connections. Consequently, a stack featuring a maximum of eight LANCOM XS-5110F models provides up to 48 SFP+ ports. Since the access switches have redundant connections, up to **24 access switches can be used for networking further end devices**. If these 24 access switches are each equipped with 48 ports, **up to 1,152 clients** can be networked.

Calculating a redundant stack scenario based on the LANCOM XS-5110F	
n * m/2 = max. number of access switches * 48 = max. number of clients	
n	Number of aggregation switches (min. 2 – max. 8)
m	Downlink ports (max. 6)
/2	Redundant connection of one access switch to two aggregation switches
8 * 6/2 = 24 *48 = 1,152	

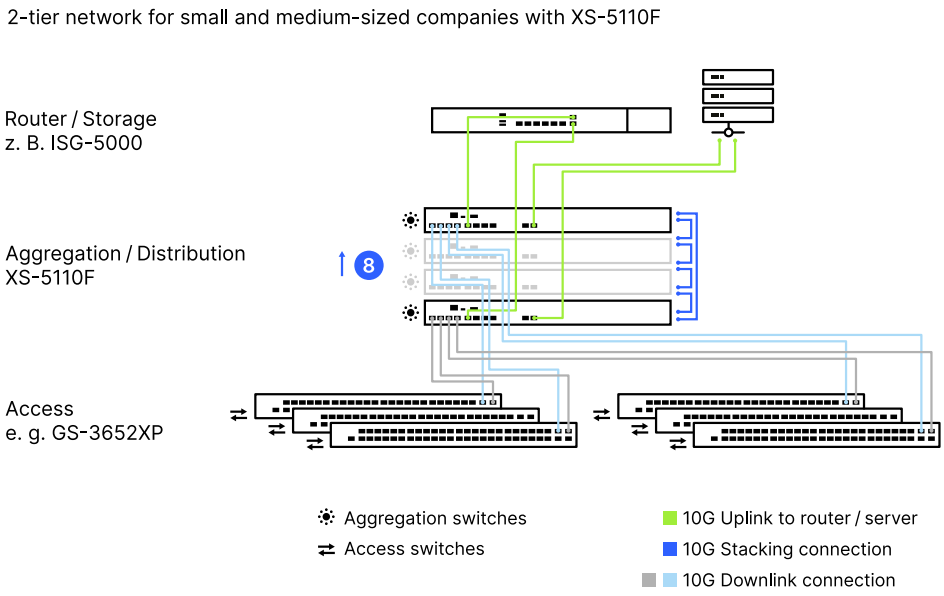


Figure 1:
Network scenario with up to eight LANCOM XS-5110F in the stack

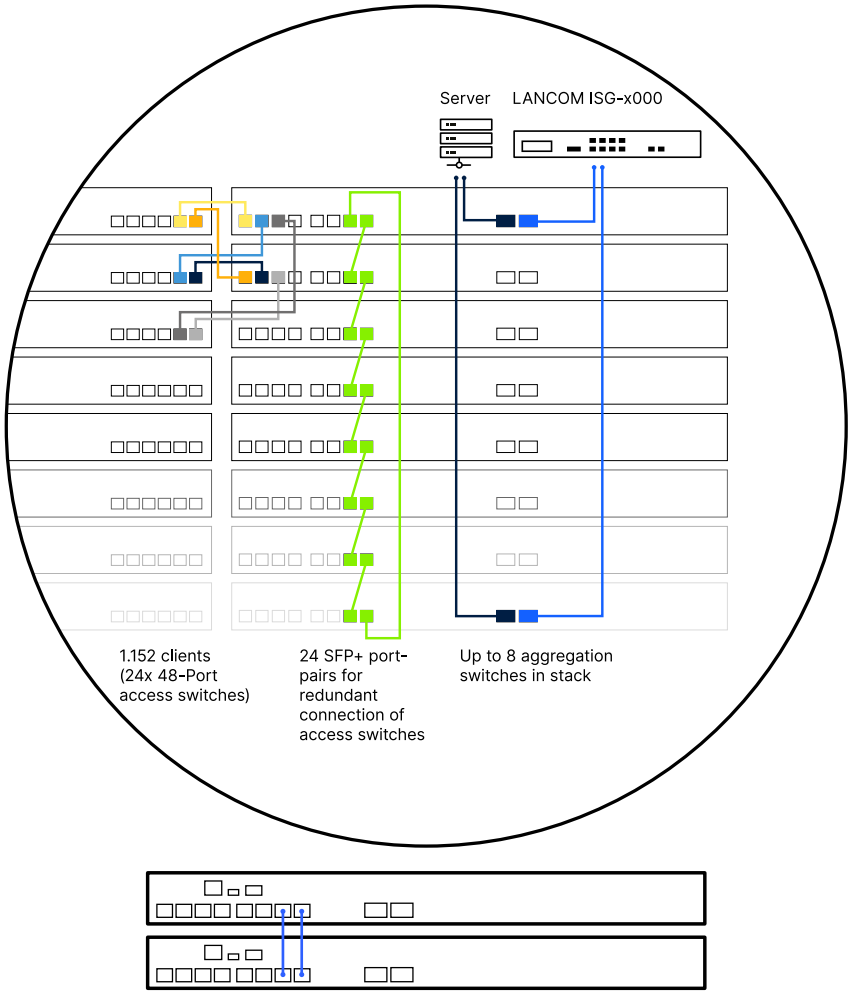


Figure 2:
Detail view with up to eight LANCOM XS-5110F in ring-topology stacking, and an illustration of the cabling of a stack of two

Stack structure and max. network size in medium scenarios with the LANCOM XS-5116QF

The LANCOM XS-5116QF has twelve 10G SFP+ ports along with two further combo ports that can either act as additional downlink ports to increase the number of aggregated access switches to up to 14, or for uplinking in the direction of the WAN or connected storage. The two additional 40G QSFP+ ports can either be used for a very broadband uplink to the core or server layer. They can also be reconfigured in software to be stacking ports. Due to the QSFP+ ports, the number of SFP+ ports classified as downlink ports remains the same even when operating the switch in a stack. If we assume that the two combo ports on two stack units have sufficient capacity for connecting to an upper-layer router, more than twice as many SFP+ ports remain for connecting access switches than the LANCOM XS-5110F. To ensure redundancy, the resulting 14 ports are again divided by two. With a maximum of eight devices in the stack, the seven potential access switches at a stack unit result in a number of **52 possible 48-port access switches or max. 2,640 clients**.

Calculating a redundant stack scenario based on the LANCOM XS-5116QF	
n * m/2 – 2 * 2 = possible number of access switches * 48 = max. number of clients	
n	Number of aggregation switches (min. 2 – max. 8)
m	Downlink ports (max. 14)
/2	Redundant connection of one access switch to two aggregation switches
2 * 2	10G ports (for connecting storage and router)
8 * 14/2 - 4 = 52 *48 = 2,640	

2-tier network for medium-sized companies with XS-5116QF

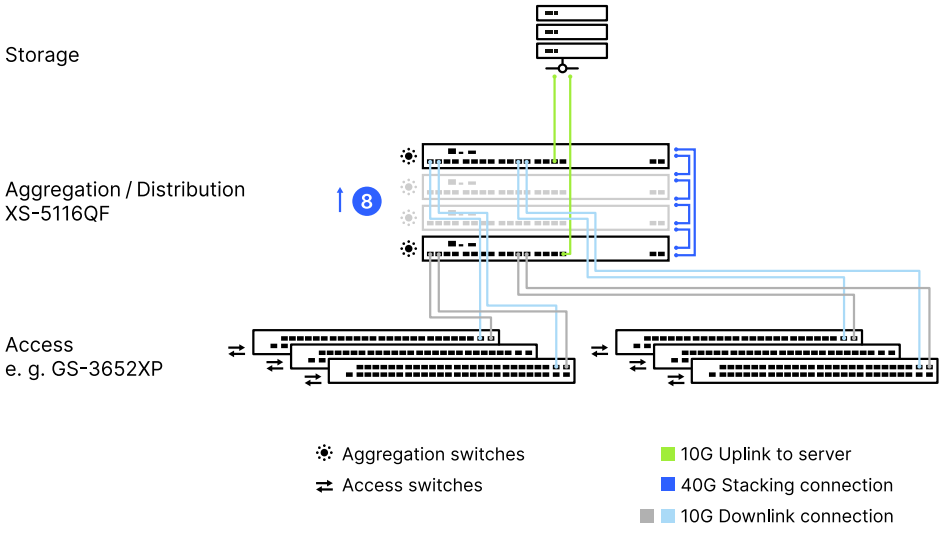


Figure 3:
Network scenario with up to eight LANCOM XS-5116QF in the stack

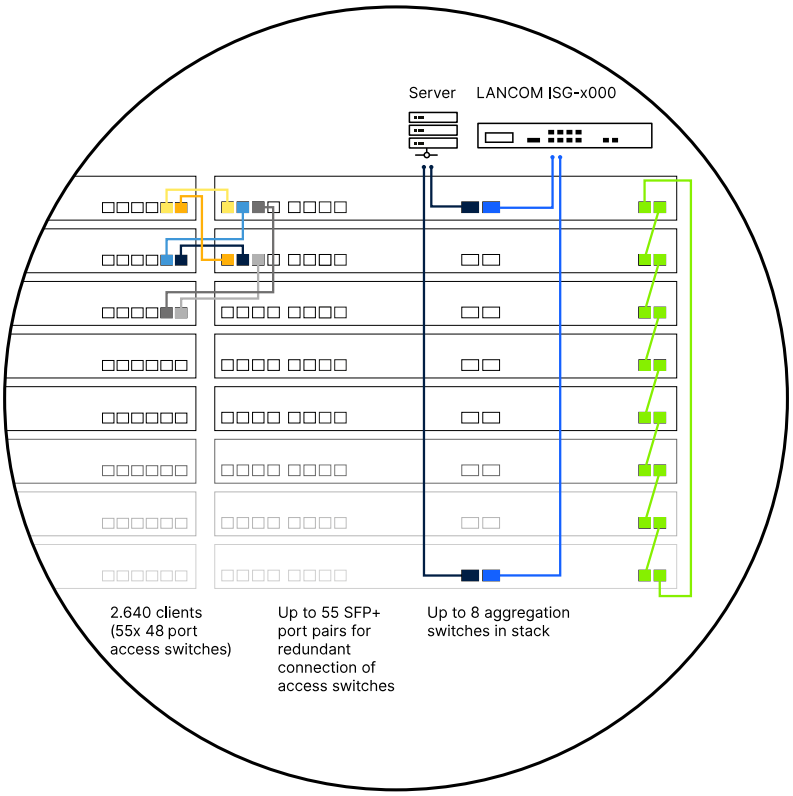


Figure 4:
Detailed view of up to eight LANCOM XS-5116QF in ring-topology stacking

With the LANCOM XS-5116QF in a stack of two, the 2× 40G QSFP+ ports provide 80G in both directions, i.e. a total of 160G data bandwidth in full-duplex operation. Consequently, a stack of three and eight results in the following connection schemes:

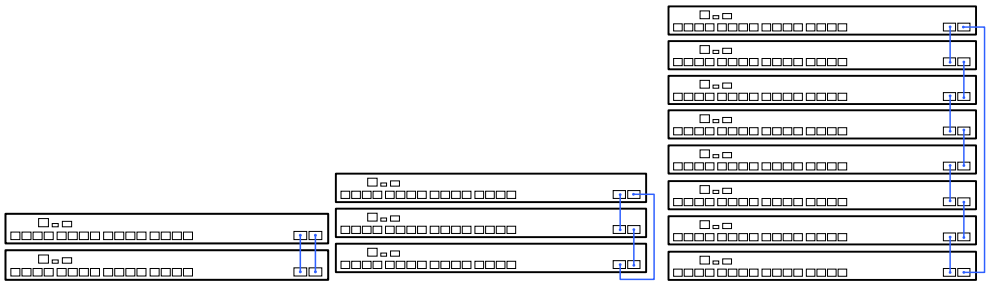


Figure 5:
Illustration of the cabling of stacks of two, three, and eight with the XS-5116QF

Stack structure and max. network size in large scenarios with the LANCOM XS-6128QF as collapsed core, or with core switch CS-8132F

The LANCOM XS-6128QF has 24 10G SFP+ ports (including four combo downlink ports), four 25G SFP28 ports, two 40G QSFP+ ports, and four dedicated 50G SFP-DD stacking ports. As with the previous switch models, the stacking FleX ports on the rear panel can be used as uplink ports as well as stacking ports. This makes it possible to

connect to a data center or storage as a collapsed core in a two-tier design (Figure 7) or to a core switch on the layer above it, such as the LANCOM CS-8132F in a three-tier design (Figure 8).

Suitable for use with the stacking ports are the direct attach cables LANCOM SFP-DD-DAC50 or SFP-DAC25 as well as the optical transceiver modules LANCOM SFP-SR-LC25 or SFP-LR-LC25. The latter enables decentralized stacking.

For example, if two 50G LANCOM SFP-DD-DAC50 are used for stacking, these two cables are operated at 50G per direction to result in an overall bandwidth of 200G between the switches (full duplex). To further increase the bandwidth, four LANCOM SFP-DD-DAC50s can be used with two stacked switches. With 4× 50G per direction, this results in an overall bandwidth of 400G (full duplex):

With a stack of three or more, the guideline for optimal cabling is as follows: To fully utilize all of the stacking ports, two LANCOM SFP-DD-DAC50s are used to connect each of the neighboring switches and, to complete the ring, two cables also directly connect the first and last switches:

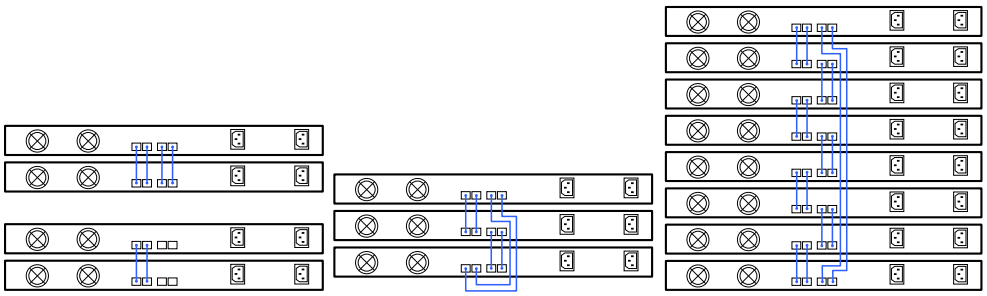


Figure 6:
Illustration of the cabling of a stack of two (two or four connections), three, and eight with the XS-6128QF

The 20 available downlink ports allow up to ten access switches to operate redundantly at each aggregation switch. Theoretically, a possible stack of eight could **connect up to 80 access switches**. With a maximum of 48 ports per access switch, **up to 3,840 clients** can be connected.

Calculating a redundant stack scenario based on the LANCOM XS-6128QF	
n * m/2 = number of possible access switches * 48 = max. number of clients	
n	Number of aggregation switches (max. 8)
m	Downlink ports (max. 20)
/2	Redundant connection of one access switch to two aggregation switches
8 * 20/2 = 80 *48 = 3,840	

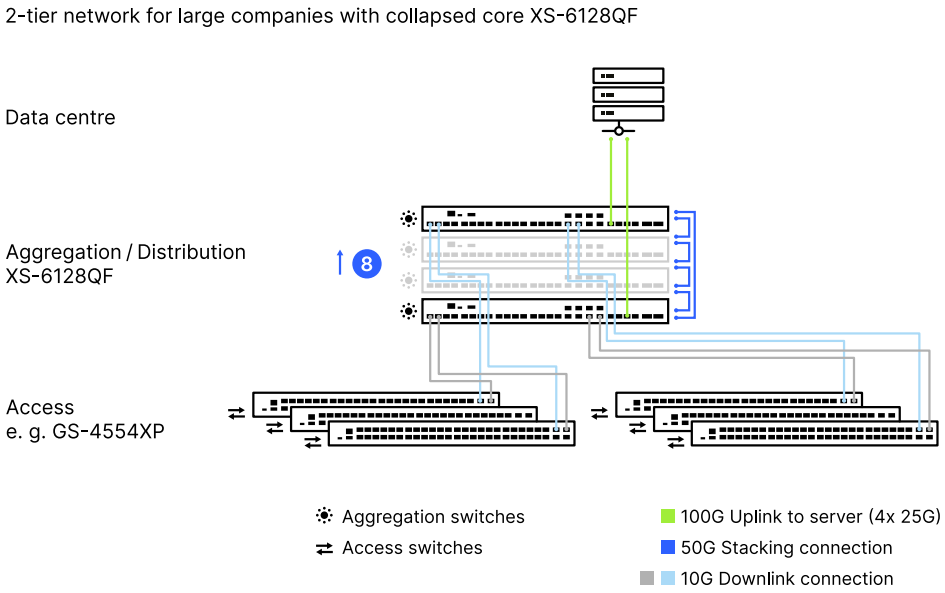


Figure 7:
Network scenario with up to eight LANCOM XS-6128-QF as collapsed core in the stack

The LANCOM CS-8132CF with 32× 100G ports offers enormous CPU performance and high-performance switching chips for up to 6.4 Tbps switch capacity.

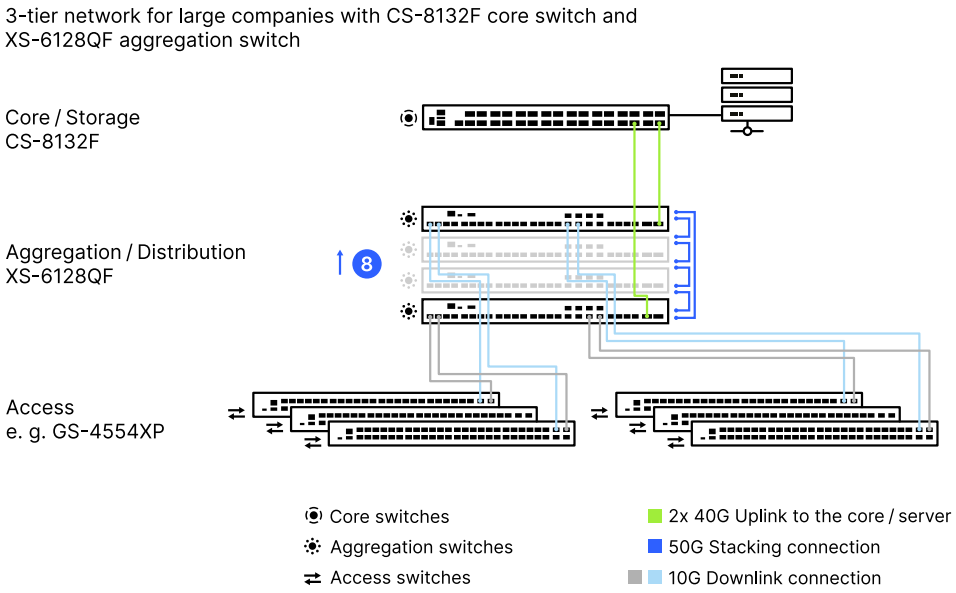


Figure 8:
Network scenario with up to eight LANCOM XS-6128QF in the stack with an upper-layer core switch

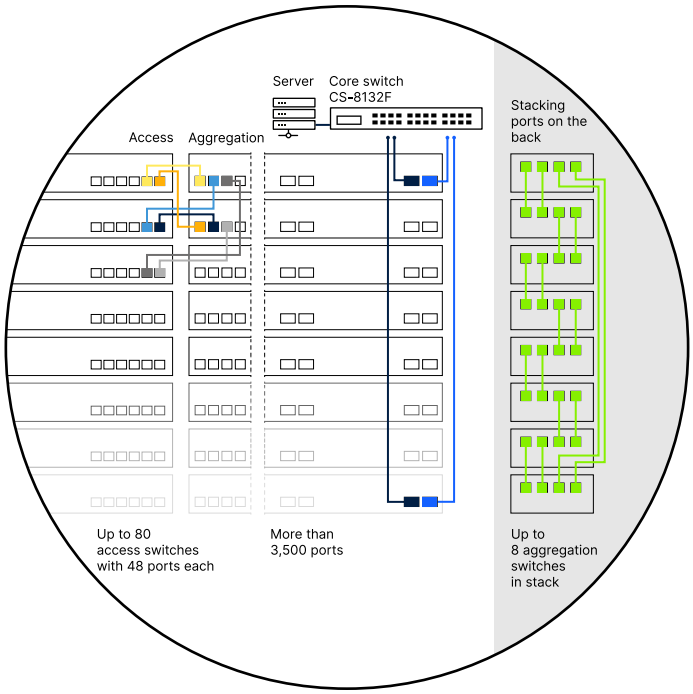


Figure 9:
Detailed view of up to eight LANCOM XS-6128QF in ring-topology stacking

In redundancy scenarios where each access switch is connected to the aggregation layer by two 10G ports, using the 25G ports that are not used for the uplink in the stack makes it possible to operate a network with 184×48/2, i.e. **4,416 ports**. To achieve the latter, each of the free 25G SPF28 ports is equipped with a 10G SFP+ transceiver. This is possible because the SFP28 optics standard is also backwards compatible with 10G.

Stack structure and max. network size in distributed enterprise and campus scenarios with the LANCOM YS-7154CF and CS-8132F

The 25G stackable fiber aggregation switch LANCOM YS-7154CF offers up to 3.6 Tbps switch capacity with 48× 25G SFP28 and 6× 100G QSFP28 ports. Four of the six QSFP28 ports can be used for stacking. A possible stack of eight could therefore connect up to **192 access switches**. With a maximum of 48 ports per access switch, **up to 9,216 clients** can be connected.

Calculating a redundant stack scenario based on the LANCOM YS-7154CF and CS-8132F	
n * m/2 = number of possible access switches * 48 = max. number of clients	
n	Number of aggregation switches (min. 2 – max. 8)
m	Downlink ports (max. 48)
/2	Redundant connection of one access switch to two aggregation switches
8 * 48/2 = 192 *48 = 9,216	

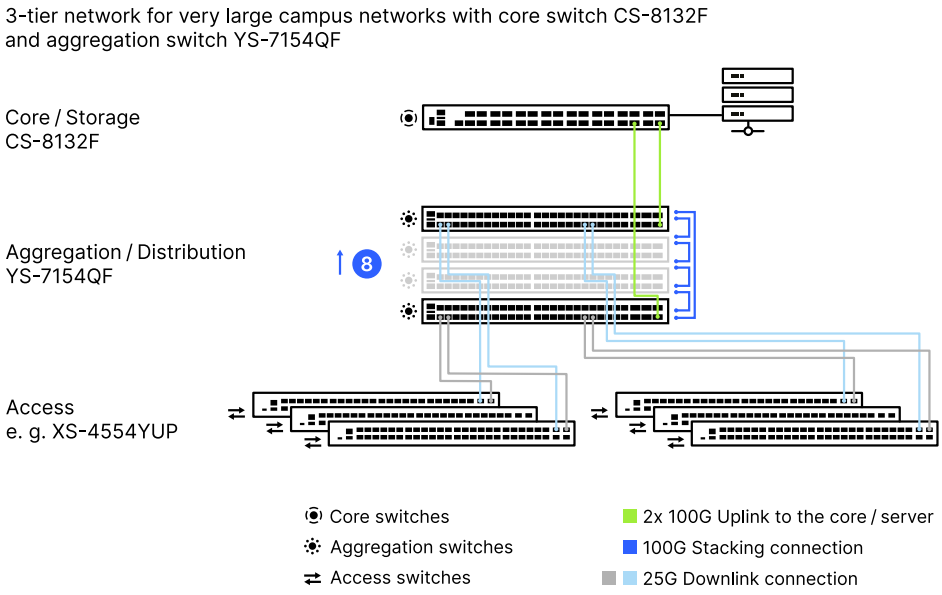


Figure 10:
Network scenario with up to eight LANCOM YS-5116QF in the stack with an upper-layer core switch

Stack management by WebGUI

If all of the switches for stacking were to be connected to one another, the stacking configurations for a LANCOM XS-6128QF, for example, are listed under "**Stacking**“ (1). Note that, with a stack in place, clicking on (2) displays the front and rear views of the selected stack unit. Without a stack configured, you will only ever see (1) displayed, since there are no other devices to view.

Click the Stacking tab and follow the two submenus “NSF” and “Base”.

The "**NSF**” menu, i.e. non-stop forwarding, controls what happens if the management switch should fail. We recommend that you leave this function switched on and configure an operational backup accordingly.

After clicking “Base”, all stack units and relevant stack configurations are displayed on the dashboard “**Stacking summary register**”. In this case it is a single, standalone switch and thus a potential management switch. Additional information on the stack status is also displayed, such as the firmware versions of the members.

Figure 11:
GUI view of the Stack Summary tab of the XS-6128QF

Under **Unit configuration** you see details such as serial number, status, etc. for all of the switches selected on this page. The item “Admin Management Preference” can be used to specify the role of this switch in a subsequent stack. The switch with the highest value becomes the manager when the stack is formed.

Using **“Firmware update”**, the network administrator can manually control any firmware updates and specify which is the next switch for the manager to provision with firmware. The status depends on the firmware version on the manager device.

“Firmware synchronization” controls whether or not the management switch manages and initiates automatic firmware updates. Also, SNMP traps can be output during the update process, and a setting determines whether a newly added switch with a potentially higher firmware version can be reset to an earlier version by the manager.

The **“Port configuration”** tab can be used to determine whether the rear ports are used for stacking or whether they should instead act as normal Ethernet ports.

The **“Statistics”** and **“Diagnostics”** tabs display the current status of the stack and the data throughput.

Port nomenclature: Once a stack has been configured and successfully booted, the next step is to configure the ports. For the sake of simplicity, only the VLAN configuration page is shown here, which is found under **Switching > VLAN > Port configuration**. It is immediately apparent that the interface names consist of three digits:

1. The **first** digit indicates the **unit number** of the stacked switch. Strictly speaking this depends on the “Admin Management Preference” setting, but for this example we assume that “1” is assigned to the management switch. The first digit “2” indicates the operational backup.
2. The **second** digit indicates the blade or chassis slot and, in the case of the LANCOM XS-6128QF, this is always “0” because it does not have a modular structure.
3. The **third** digit indicates the **port number** of the selected stack unit.

Note that there are also interfaces that begin with a “0” and a subsequent “3”. These are reserved LAG groups.

Figure 12:
Port Configuration tab

Stack management by CLI

For the CLI commands of the stacking function, please refer to Chapter 2 of the highly detailed CLI manual for the XS switch series, which you can find for the corresponding switches on the LANCOM product website under “Downloads & Links” or in the LANCOM Publications section.

Pairing a switch stack with the LMC

For a central **network management and stack configuration** we recommend that you use the central management interface LANCOM Management Cloud (LMC) – even before the switches are physically connected. This allows a network administrator to set up the switches remotely and in advance.

After the switch has been successfully created, it can be paired with the LANCOM Management Cloud via the management switch using a device license. The cloud then automatically detects how many devices are in the stack, and the LMC device list displays a stack symbol along with the manager’s switch type. Clicking the stack name shows the usual device detail view, with the difference that a stack can contain up to eight switches.

In addition to the device information, details about the status of the stack are displayed via the green check mark symbol for each stack unit, the uptime, and other information such as the CPU load. Configurations such as the assignment of individual VLANs or a LAG group can also be carried out directly on this page by clicking on a port on the stylized front panel of the switch.

Figure 13:
LMC – A stack in the device list

With central, cross-network and individually adjustable port-template groups, port configurations can be easily reused for new stacks at different sites. Port template groups can only be assigned by explicitly selecting the stack in the device overview, and they require the port mode “Unit network default”. Alternatively, configuration can still be carried out locally via CLI or WebGUI.

Figure 14:
LMC – Stack details view

Anomaly detection can also be activated for all stackable switches via a toggle switch in the Project specifications menu. The monitoring system monitors power supply, fan, temperature, and stack errors for all active stack units or individual devices of the LANCOM XS and GS-4000 series.

Figure 15:
LMC – Configuration of warnings in the project specifications

Summary

The stackable LANCOM switch portfolio offers models that are suited for any switch architecture and size of company: For three-tier, distributed enterprise and campus scenarios, the combination of the core switch LANCOM CS-8132F with the aggregation switch YS-7154CF ensures powerful 100G performance. Whether you require stacking at a single site or decentralized stacking over two or more locations, the LANCOM XS-6128QF is an ideal basis for a cost-efficient solution. The intelligent combination with the high-performance LANCOM access switches means that there are almost no limits to the potential applications—especially for medium-sized companies. If the requirements of the network are less complex and the stacking performance of the two smaller switches LANCOM XS-5110F and LANCOM XS-5116QF is sufficient, these aggregation switches when combined with access switches of the GS-4000 series and the potential for mixed stacks form an excellent basis for small and medium-sized companies.

Are you planning to set up or expand your network with LANCOM switches?

Experienced LANCOM technicians and the specialists from our system partners will help you with the planning, installation and operation of a needs-based, high-performance and future-proof LANCOM network designs.

Do you have any questions about our switches, or are you looking for a LANCOM sales partner?

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