WHITE PAPER KB202608

SDVoE Network Topology Guide

Designing SDVoE Networks from 2 to 1280 Endpoints

A practical topology guide for AV installers

Copper 10G | Fiber 10G | Fiber 100G | Fiber 400G | Spine-leaf | A/B redundancy

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1. Executive summary

The easiest SDVoE network is the one that uses the fewest switch layers. For small systems, use one switch. For medium systems, use spine-leaf. For very large systems, use spine-leaf-access. For mission-critical systems, use a redundant A/B network only when the SDVoE endpoints support two network paths.

> **The simple rule**
> Use a single switch when possible. Add a spine only when the number of endpoints or physical layout requires it. Add A/B redundancy only when the endpoints and controller support it.

2-24 endpoints Single switch	25-48 endpoints 48-port island	49-320 endpoints Spine-leaf	320-1280 endpoints 400G spine

2-24 endpoints: use one access switch.

25-48 endpoints: use one 48-port switch when all endpoints are close together.

49-320 endpoints: use a spine-leaf design.

320-1280 endpoints: use spine-leaf-access with a 400G spine.

2-640 redundant endpoints: use two separate fabrics, normally called Fabric A and Fabric B.

This paper gives copper and fiber options. Copper means the SDVoE endpoints connect by 10G Base-T. Fiber means the SDVoE endpoints connect by SFP+ into the 48-port fiber switch.

2. Contents

3. How to read the topologies

An SDVoE endpoint is one encoder or decoder. In this paper, one endpoint normally consumes one 10G switch port. A transmitter sends video. A receiver receives video. Both are counted as endpoints.

A topology is the physical switch design. It tells the installer how many layers the network has and where the endpoints connect.

Term	Meaning for the installer
Access switch	The switch where SDVoE encoders and decoders plug in.
Spine	The central switch that connects multiple access switches together.
Leaf	A middle layer between access switches and the high-capacity spine.
Fabric	One complete network path. In redundant designs there is Fabric A and Fabric B.
Uplink	The high-speed link from an access switch to a spine or leaf switch.
Breakout cable	A cable that turns one 400G port into four 100G links.

> Do not design by port count only
> Also check where video will actually flow. If many receivers on one switch watch sources on another switch, the uplinks between those switches become important.

4. Product roles

The same products are used repeatedly. The key is to use each switch in the correct role.

Product	Relevant ports / role	Best use in SDVoE design
N10GSM24XP	24 x 10G Base-T access switch + 2 x 100G uplinks	Main copper SDVoE building block for 2-24 and larger copper systems.
N10GSM48X2Q	48 x 10G Base-T access switch + 2 x 100G uplinks	Best for a simple 25-48 endpoint copper island.
N10GSM8QF48	48 x 10G SFP+ fiber ports + 8 x 100G uplinks	Main fiber endpoint/access switch.
N100GSM32	32 x 100G QSFP28 L3 fiber switch	100G spine for medium systems or leaf aggregation in large systems.
N400GSM32	32 x 400G QSFP112 L3 fiber switch	400G spine for very large systems and redundant large fiber systems.
NRS-D100G1	100G QSFP28 passive DAC cable	Short 100G interconnect between access and spine switches.
400G to 4 x 100G breakout	QSFP-DD 400G to four 100G lanes	Used between N400GSM32 spines and N100GSM32/fiber access designs; exact SKU/length/price to confirm.

400G breakout planning note

The 400G to 4 x 100G breakout cable is important in the large designs. It keeps the N400GSM32 practical, because one 400G port can feed four 100G links. The exact SKU, length and price must be confirmed before quotation.

5. Common SDVoE switch settings

The topology only works if the switch settings are correct. These are the common starting settings for SDVoE designs. Always check the endpoint manufacturer recommendations as well.

Setting	Recommended value	Installer note
Port speed	10G for every SDVoE endpoint port	If a port links at 1G, fix cabling or endpoint configuration.
Jumbo Frame	Enable; use 9000 bytes as safe working MTU	Do not exceed the lowest supported value in the chain.
EEE / Green Ethernet	Disable	Power-saving modes can introduce delay or instability.
IGMP Snooping	Enable on the SDVoE VLAN	Required to stop multicast video flooding everywhere.
IGMP Querier	One active querier per AV VLAN/fabric	Do not create multiple uncontrolled queriers.
Fast Leave / Immediate Leave	Enable on endpoint ports	Do not enable on ports that feed another switch with multiple receivers behind it.
QoS	Use AV profile or simple trusted priority	Do not rate-limit SDVoE video.
Storm control	Do not set low multicast limits	Low limits can break video.
VLAN	Use a dedicated SDVoE VLAN	Avoid mixing office data and SDVoE video.

Commissioning rule

First make the SDVoE system work with a clean AV VLAN. Add security rules, ACLs and advanced restrictions later, after video and control are stable.

6. Copper endpoint topologies

Use these designs when the SDVoE endpoints connect by 10G Base-T copper. The main access switch is the N10GSM24XP for scalable designs. The N10GSM48X2Q is best for one 48-endpoint island.

Endpoint range	Topology	Main switches	How it works	Recommendation
2-24	Single switch	1 x N10GSM24XP	All endpoints connect directly to one switch.	Default for small rooms.
25-48	Single switch	1 x N10GSM48X2Q	All endpoints connect directly to one 48-port switch.	Use 2 x N10GSM24XP only if rooms/racks are split.
49-320	Spine-leaf	N10GSM24XP + N100GSM32	Each access switch uplinks with 2 x 100G.	Limit to about 20 active endpoints per leaf if strict 1:1 uplink headroom is required.
320-1280	Spine-leaf-access	N10GSM24XP + N100GSM32 + N400GSM32	N100GSM32 aggregates access switches; N400GSM32 provides high-capacity spine.	Use 400G to 4 x 100G breakout for clean high-density cabling.

6.1 2-24 copper endpoints

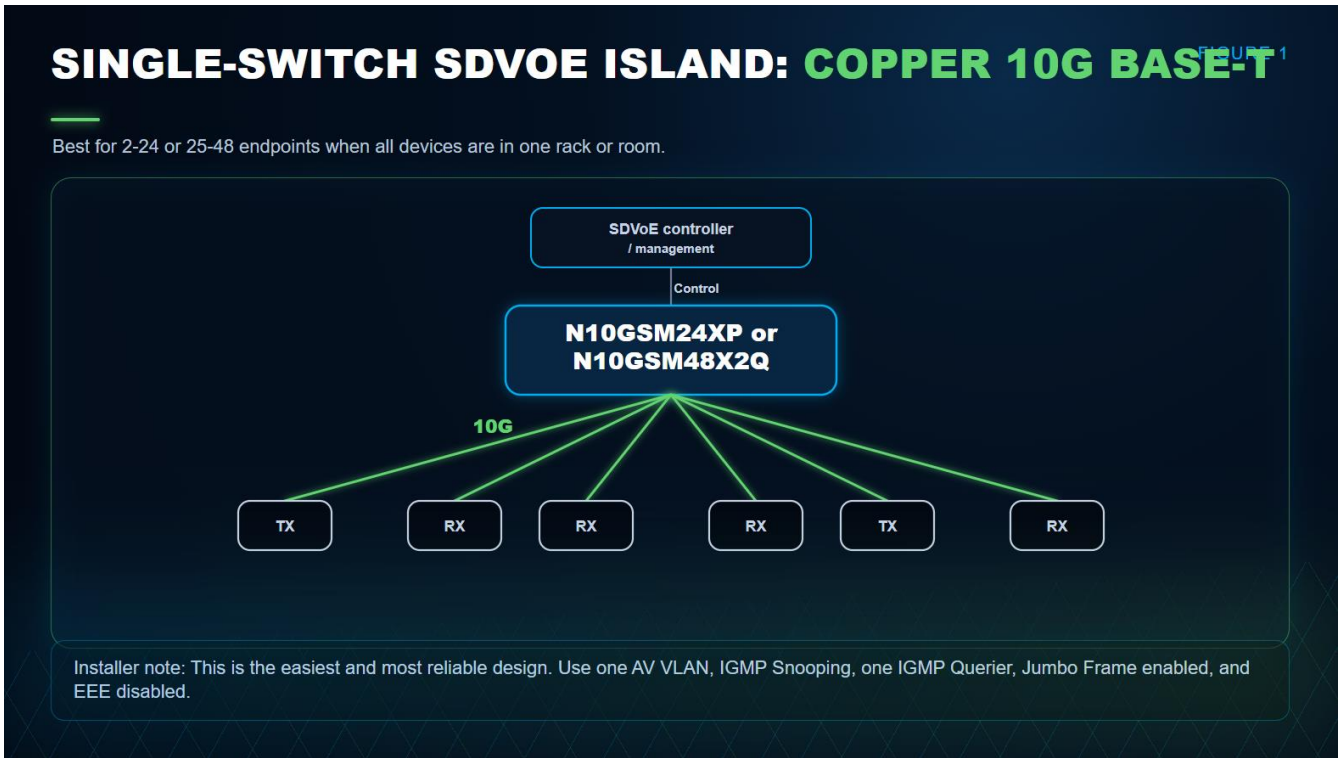

Figure 1. Single-switch SDVoE island: Copper 10G Base-T

6.2 25-48 split copper endpoints

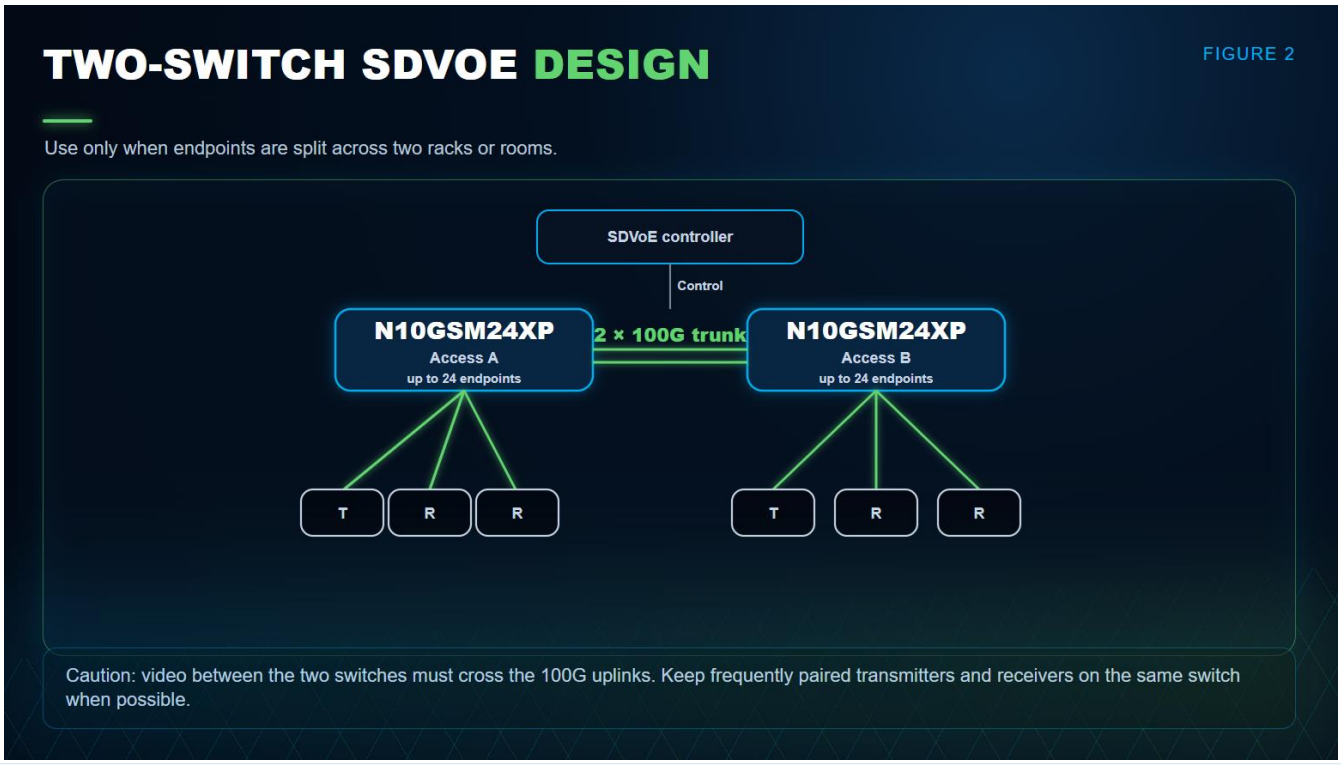

Figure 2. Two-switch SDVoE design for split racks or rooms

6.3 49-320 copper endpoints

Once the design grows beyond one or two switches, use a spine-leaf design. The N100GSM32 becomes the 100G spine. The N10GSM24XP switches become access leaves.

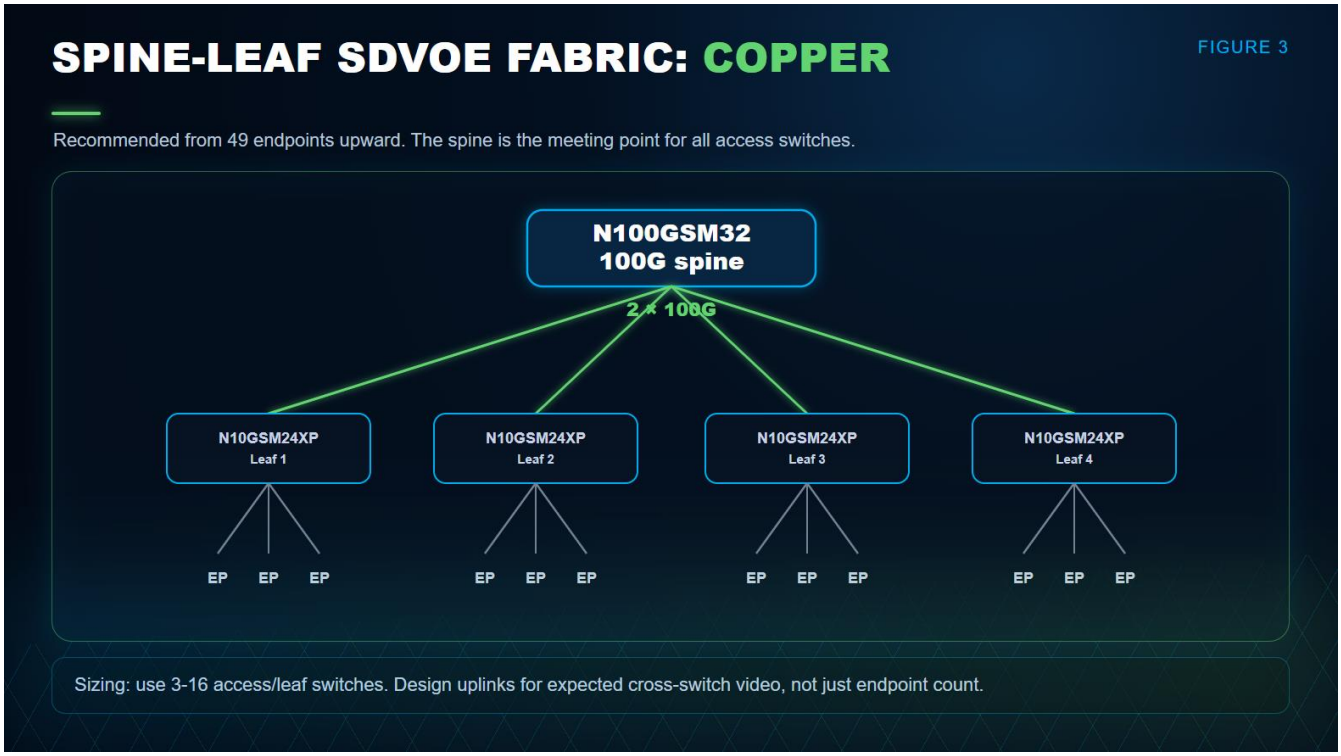

Figure 3. Spine-leaf SDVoE fabric: Copper

Copper bandwidth note

An N10GSM24XP has 24 x 10G access ports and 2 x 100G uplinks. That is 240G of endpoint ports and 200G of uplink. For strict headroom, keep about 20 active endpoints per access switch or make sure most traffic stays local.

7. Fiber endpoint topologies

Use these designs when the SDVoE endpoints connect on fiber using SFP+. The main fiber endpoint switch is the N10GSM8QF48 with 48 x 10G SFP+ ports and 8 x 100G uplinks.

Endpoint range	Topology	Main switches	How it works	Recommendation
2-24	Single switch	1 x N10GSM8QF48	Use 2-24 of the 48 SFP+ ports.	Simple but overprovisioned for very small systems.
25-48	Single switch	1 x N10GSM8QF48	All fiber endpoints connect directly.	No spine needed.
49-320	Spine-leaf	N10GSM8QF48 + N100GSM32	Use 4 x 100G uplinks per access switch as the practical design.	Use more uplinks or a larger core for strict no-oversubscription designs.
320-1280	Spine-leaf-access	N10GSM8QF48 + N100GSM32 + N400GSM32	Fiber access switches connect to N100GSM32 leaves; leaves connect to N400GSM32 spine.	Covers up to 1280 endpoints with 400G breakout.

7.1 2-48 fiber endpoints

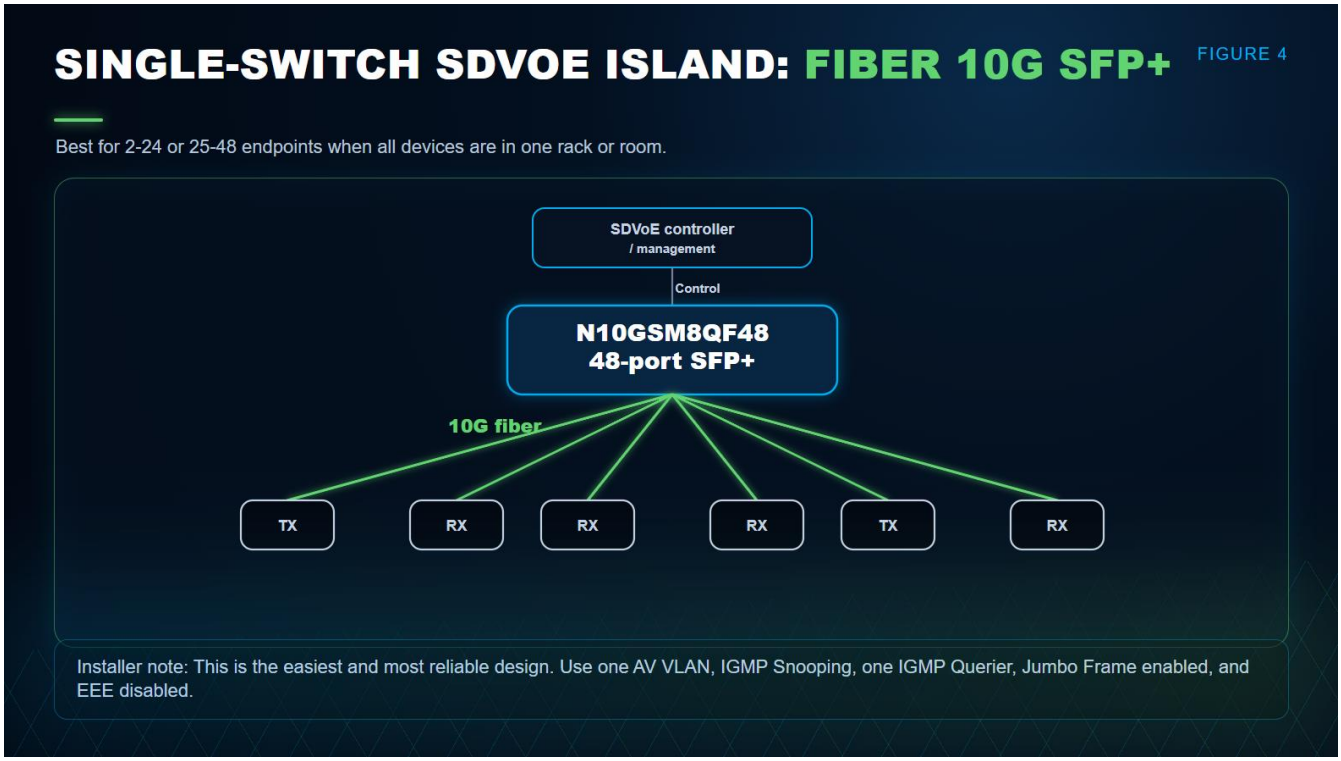

Figure 4. Single-switch SDVoE island: Fiber 10G SFP+

7.2 49-320 fiber endpoints

Multiple N10GSM8QF48 Access Switches with Dual-Spine Failover

For larger fiber-based SDVoE systems, multiple N10GSM8QF48 switches can be used as 48-port 10G SFP+ access switches. Each access switch connects SDVoE endpoints on its 10G SFP+ ports and uses its 100G uplinks toward the core.

This design should not be described as a simple “stack” unless a confirmed stacking configuration is used for the exact switch model and firmware. The preferred design is a small spine-leaf fabric, or paired MLAG design, where the 100G uplinks provide high-capacity paths toward one or two core switches.

For a resilient design, connect each N10GSM8QF48 to two spine switches:

- 4 × 100G uplinks to Spine A
- 4 × 100G uplinks to Spine B
- Up to 40 active SDVoE endpoints per access switch for fully non-blocking operation during spine failover
- Up to 48 endpoints per access switch when limited oversubscription is acceptable during a spine failure

In normal operation, the switch has 800G of uplink capacity. If one spine fails, 400G remains available. Because each SDVoE endpoint requires up to 10G, the clean non-blocking failover limit is 40 endpoints per access switch.

A practical scalable block is:

Design block	Quantity
N10GSM8QF48 access switches	8
SDVoE endpoints per access switch	40
Total non-blocking endpoints with spine failover	320
100G uplinks per access switch	8
Uplinks to Spine A	4
Uplinks to Spine B	4

This design is suitable for medium-to-large SDVoE systems where fiber endpoints are distributed across multiple racks, rooms, or technical areas, but where the project still needs simple scaling and redundant core connectivity.

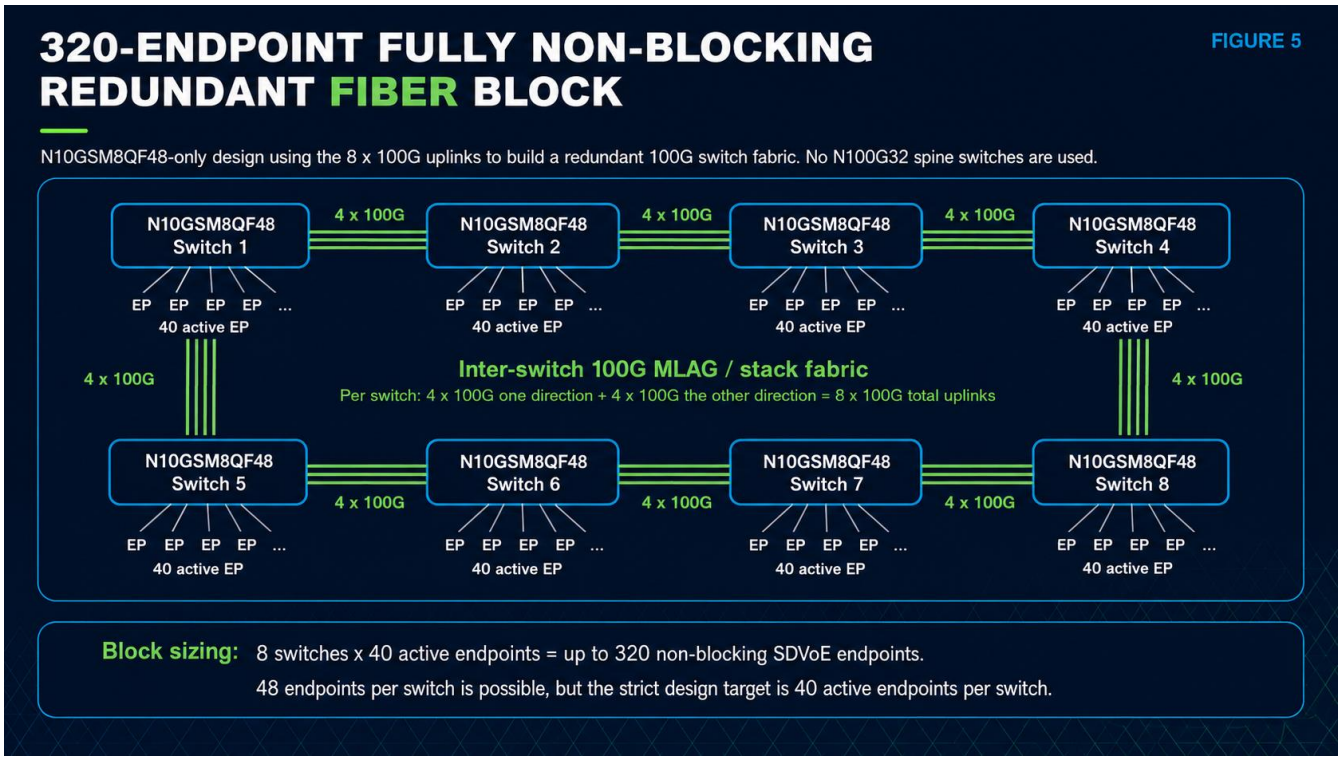

Figure 5. 320-endpoint fully non-blocking redundant fiber block

8. Large-system designs

For 320-1280 endpoints, use three layers: access, leaf and spine. Endpoints connect to the access switches. Access switches connect to N100GSM32 leaf switches. N100GSM32 leaf switches connect to the N400GSM32 spine.

8.1 Copper large-system design

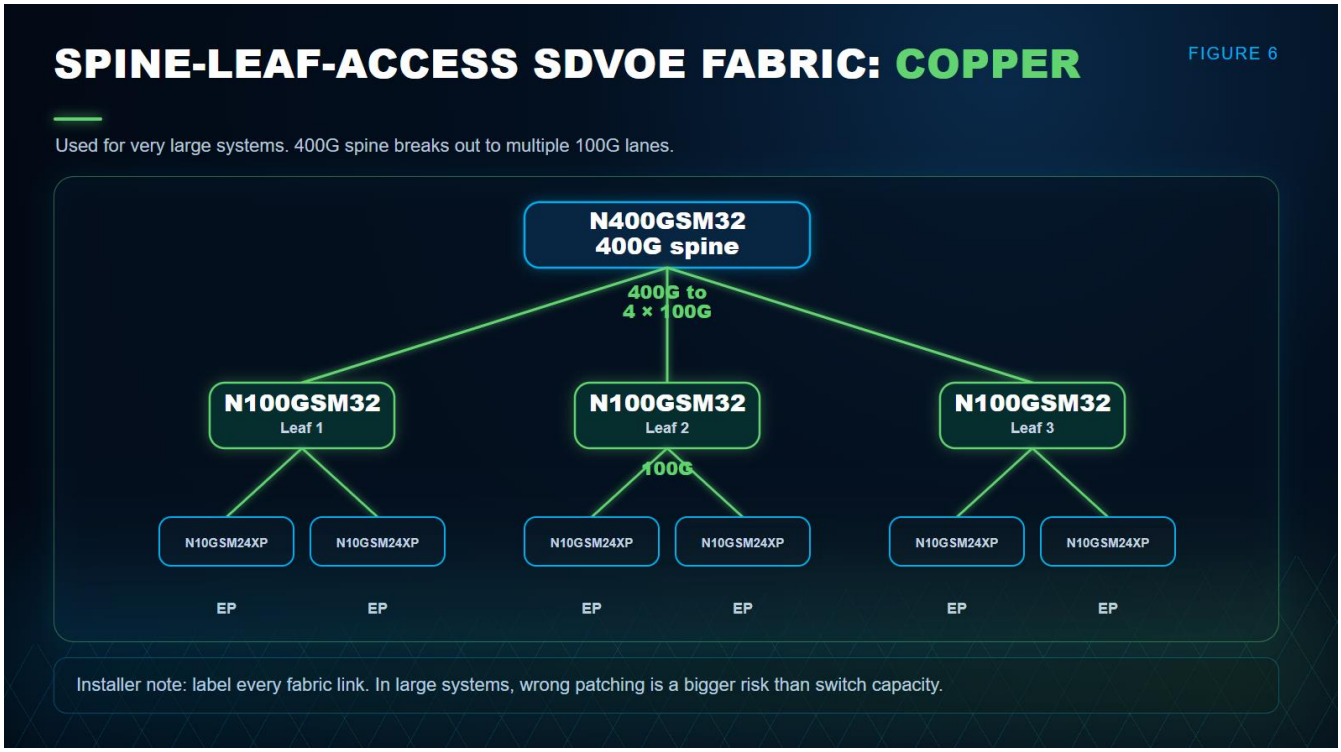

Figure 6. Spine-leaf-access SDVoE fabric: Copper

8.2 Fiber large-system design

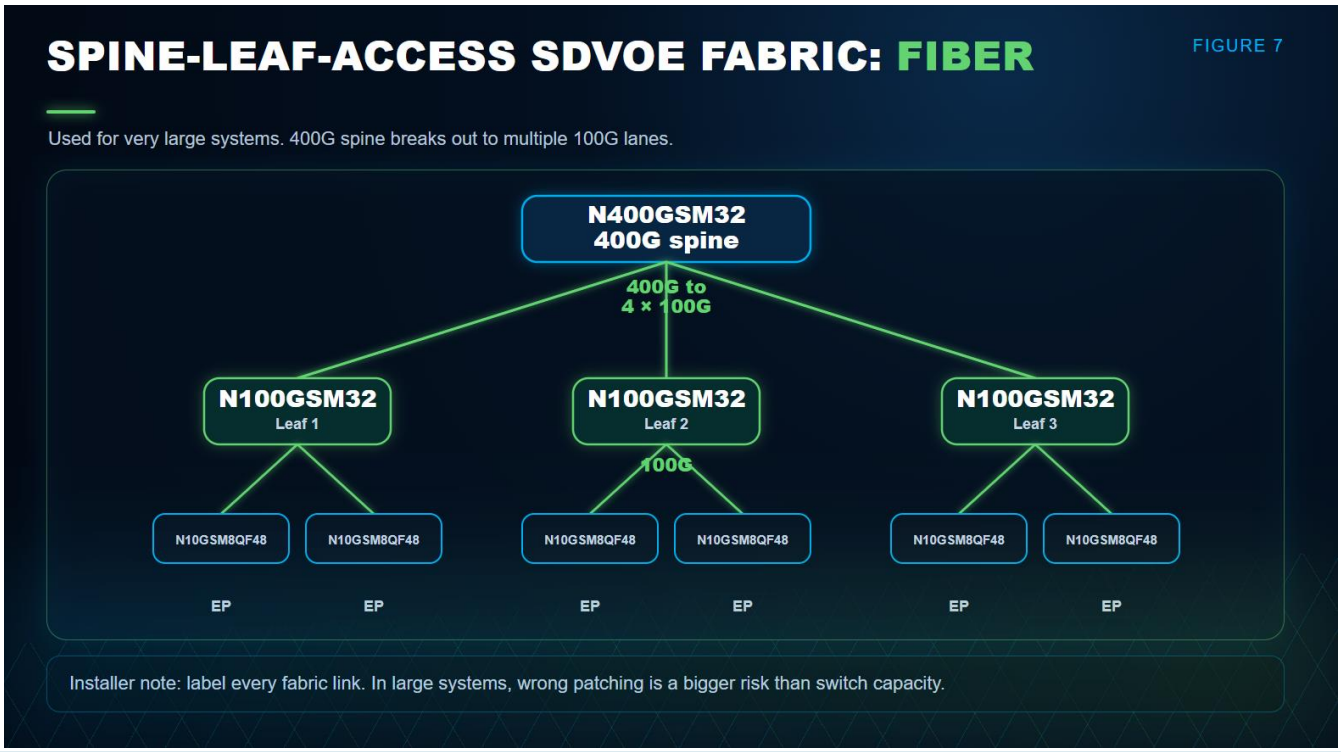

Figure 7. Spine-leaf-access SDVoE fabric: Fiber

Why 400G matters

Very large SDVoE systems need many 100G links. The 400G spine reduces cabling density because one 400G port can break out into four 100G links.

9. Redundant A/B designs and spine failover

Redundancy is not just adding extra cables. A true redundant SDVoE design has two separate network paths: Fabric A and Fabric B. The SDVoE endpoint must be able to use both paths. If the endpoint has only one network port, the network can protect the spine, but it cannot protect the endpoint connection itself.

Endpoint range	Medium	Topology	Main products	Installer warning
2-24	Copper	Dual independent access switches	2 x N10GSM24XP	Full A/B only if endpoints have two network ports.
2-24	Fiber	Dual independent fiber access switches	2 x N10GSM8QF48	Each endpoint needs a path to Fabric A and Fabric B.
25-48	Copper	Dual independent 48-port access switches	2 x N10GSM48X2Q	Use two 24-port switches per fabric if rooms are split.
25-48	Fiber	Dual independent fiber access switches	2 x N10GSM8QF48	No spine layer needed.
49-320	Copper	Dual-fabric spine-leaf with two spines per fabric	N10GSM24XP + 4 x N100GSM32 total	One 100G uplink from each access switch to each spine in the same fabric.
49-320	Fiber	Dual-fabric spine-leaf with two spines per fabric	N10GSM8QF48 + 4 x N100GSM32 total	Four 100G links to each spine per fiber leaf.
321-640	Copper	Dual-fabric spine-leaf with two spines per fabric	N10GSM24XP + 4 x N100GSM32 total	Failover works, but bandwidth is degraded after one spine fails.
321-640	Fiber	Dual-fabric using 400G spines	N10GSM8QF48 + 4 x N400GSM32 total	Uses 400G to 4 x 100G breakout; breakout SKU/price to confirm.

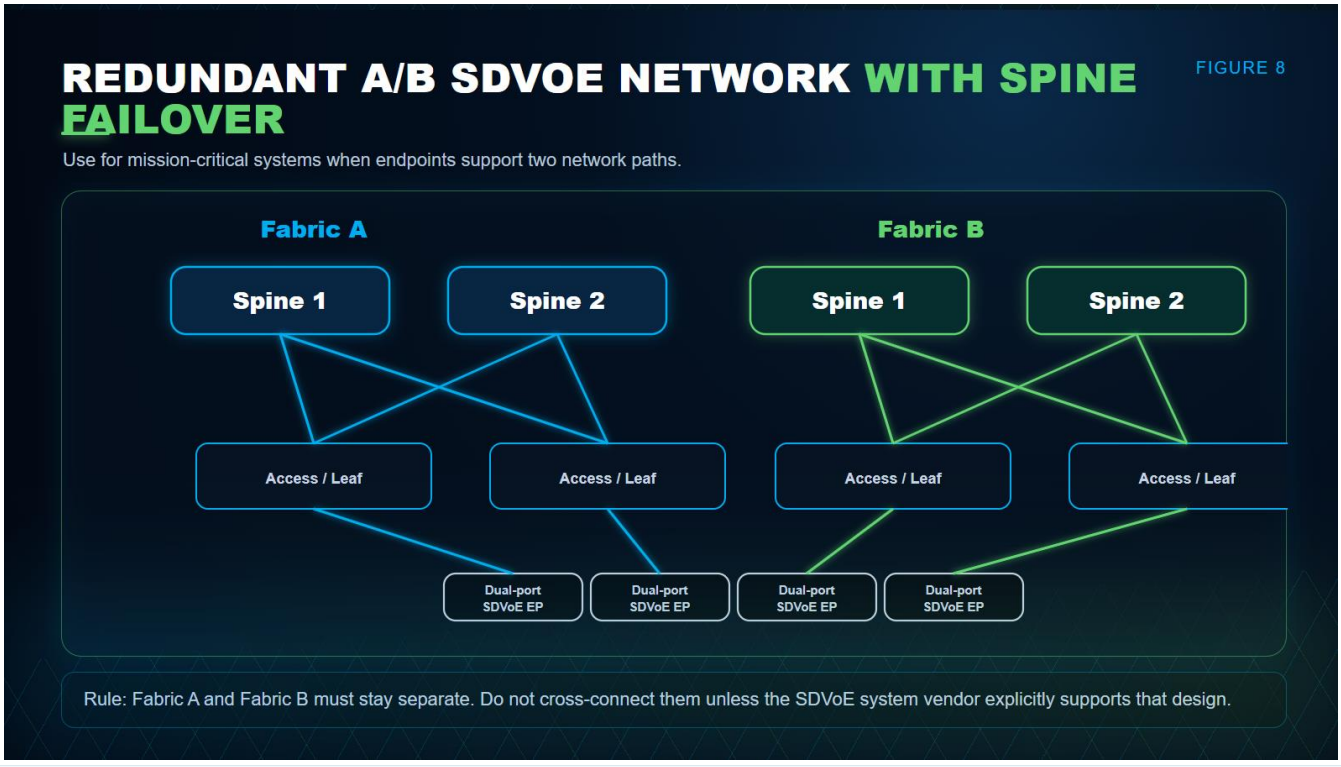

Figure 8. Redundant A/B SDVoE network with spine failover

9.1 What happens when a spine fails?

In redundant spine-leaf designs, every access switch connects to two spines in the same fabric. If one spine fails, the fabric can still pass traffic through the other spine. However, available uplink bandwidth is reduced.

Design	Normal operation	After one spine fails	What the installer must test
Copper access	Each N10GSM24XP has 2 x 100G uplinks.	Only 1 x 100G remains from that access switch.	Worst-case video switching and cross-switch viewing.
Fiber access	Each N10GSM8QF48 can use 4 x 100G to each spine.	400G remains to the surviving spine.	Full-load behavior if many sources are on another access switch.
A/B fabric	Both Fabric A and Fabric B are available.	The endpoint or controller must fail to the other fabric.	Actual endpoint failover with real SDVoE devices.

> **Important**
> Do not promise seamless failover until it has been tested with the actual SDVoE endpoints and controller. Network redundancy and application failover are not always the same thing.

10. Quick BOM guide

The tables below are simple quantity guides. They intentionally avoid distributor pricing so the white paper can be shared with installers. Use the detailed workbook for pricing and exact quote preparation.

10.1 Non-redundant copper BOM guide

Range	Products	Typical quantity at range maximum	Notes
2-24	N10GSM24XP	1	No spine required.
25-48	N10GSM48X2Q	1	Alternative: 2 x N10GSM24XP for split rooms.
49-320	N10GSM24XP + N100GSM32	Up to 16 access + 1 spine	Strict 320-endpoint design assumes 20 active endpoints per 24-port access switch.
320-1280	N10GSM24XP + N100GSM32 + N400GSM32	Up to 54 access + 7 leaves + 1 spine	Covers a 1280 endpoint target with 1296 physical endpoint capacity.

10.2 Non-redundant fiber BOM guide

Range	Products	Typical quantity at range maximum	Notes
2-24	N10GSM8QF48	1	Add SFP+ modules as required by fiber type.
25-48	N10GSM8QF48	1	All endpoints on one fiber access switch.
49-320	N10GSM8QF48	Up to 8	Uses 8 x 100G uplinks per access switch in the practical design.
320-1280	N10GSM8QF48 + N100GSM32 + N400GSM32	Up to 27 access + 7 leaves + 1 spine	Requires 400G to 4 x 100G breakout.

10.3 Redundant quantity guide

Range	Medium	Switch quantity guide	Notes
2-24	Copper	2 x N10GSM24XP	No spine.
2-24	Fiber	2 x N10GSM8QF48	No spine.
25-48	Copper	2 x N10GSM48X2Q	No spine.
25-48	Fiber	2 x N10GSM8QF48	No spine.
49-96	Copper	8 x N10GSM24XP + 4 x N100GSM32	A/B fabrics, two spines per fabric.
49-96	Fiber	4 x N10GSM8QF48 + 4 x N100GSM32	A/B fabrics, two spines per fabric.
97-192	Copper	16 x N10GSM24XP + 4 x N100GSM32	A/B fabrics, two spines per fabric.
97-192	Fiber	8 x N10GSM8QF48 + 4 x N100GSM32	A/B fabrics, two spines per fabric.

Range	Medium	Switch quantity guide	Notes
193-320	Copper	28 x N10GSM24XP + 4 x N100GSM32	A/B fabrics, two spines per fabric.
193-320	Fiber	14 x N10GSM8QF48 + 4 x N100GSM32	A/B fabrics, two spines per fabric.
321-640	Copper	54 x N10GSM24XP + 4 x N100GSM32	A/B fabrics, two spines per fabric.
321-640	Fiber	28 x N10GSM8QF48 + 4 x N400GSM32	Uses 400G breakout.

11. Installer checklist

Use this checklist before the customer sign-off. It is deliberately simple and field-oriented.

11.1 Before installation

Confirm endpoint type: copper 10G Base-T or fiber SFP+.

Confirm number of transmitters and receivers. Count both as endpoints.

Confirm whether endpoints have one network port or two network ports.

Confirm cable distance and fiber type: multimode or single-mode.

Confirm whether the system needs A/B redundancy or only normal network availability.

Confirm whether all endpoints are in one rack, multiple racks, rooms, floors, or buildings.

11.2 During configuration

Create a dedicated SDVoE VLAN.

Set SDVoE endpoint ports as access/untagged ports in the SDVoE VLAN.

Enable IGMP Snooping globally and on the SDVoE VLAN.

Enable exactly one IGMP Querier per VLAN/fabric.

Enable Jumbo Frame and keep a safe 9000-byte working MTU unless endpoint vendor specifies otherwise.

Disable EEE / Green Ethernet on all SDVoE ports.

Do not set low multicast storm-control or rate-limit values for SDVoE video.

Label access switches, spine switches, uplinks, fabrics, VLANs and patch panels.

11.3 During testing

Verify every SDVoE endpoint links at 10G.

Verify the SDVoE controller can discover and switch all endpoints.

Test multicast join and leave behavior by switching receivers between sources.

Check uplink utilization when receivers watch sources on other switches.

For redundant systems, test access link failure, spine failure and power failure.

Document final port mapping and save the switch configuration.

12. Common mistakes

Mistake	Why it matters
Using a normal office switch	SDVoE needs 10G ports, multicast control and proper AV settings.
Forgetting the IGMP Querier	IGMP Snooping needs a querier to maintain multicast group tables.
Creating too many queriers	Multiple uncontrolled queriers can create unpredictable multicast behavior.
Leaving EEE enabled	Energy-saving Ethernet can cause instability in real-time AV.
Using low storm-control limits	The switch may treat legitimate video traffic as a storm.
Overselling redundancy	A redundant switch core does not protect endpoints that have only one network port.
Undersizing uplinks	Source and receiver placement can overload uplinks even when port count looks correct.
Unlabeled A/B fabrics	A/B redundancy becomes unreliable when patching is not clearly labeled.

Practical support advice

If video behaves strangely, first check link speed, VLAN membership, IGMP Snooping, the IGMP Querier, Jumbo Frame, EEE and uplink load. Most SDVoE support cases start there.

13. Glossary

Term	Plain-English meaning
SDVoE	Software Defined Video over Ethernet. A high-performance AV-over-IP technology normally using 10G links.
Endpoint	One SDVoE encoder or decoder.
TX	Transmitter or encoder.
RX	Receiver or decoder.
IGMP Snooping	Switch function that learns which receivers want which multicast streams.
IGMP Querier	Device that asks receivers to report which multicast streams they need.
Jumbo Frame	Larger Ethernet frame size used to improve efficiency for high-throughput traffic.
Spine-leaf	Network design where access switches connect to a central high-speed spine.
A/B network	Two independent networks used for redundancy.
Breakout	Splitting one high-speed port, such as 400G, into several lower-speed links, such as 4 x 100G.

Final design rule

Use the smallest topology that fits the project, but do not undersize uplinks or redundancy. For small systems, simple is better. For large systems, a clean fabric design is better than many ad-hoc inter-switch trunks. For redundant systems, test real failover before handover.