Cisco Nexus Switch vPC (Virtual Port Channel) High-Availability Blueprint - Official Technical Overview & Hardware Datasheet

CISCO NEXUS SWITCH VPC (VIRTUAL PORT CHANNEL) HIGH-AVAILABILITY BLUEPRINT

OFFICIAL TECHNICAL OVERVIEW & HARDWARE DATASHEET

EXECUTIVE SUMMARY

The Cisco Nexus Switch vPC (Virtual Port Channel) High-Availability Blueprint represents a paradigm shift in datacenter and campus network resilience. This solution transcends traditional Spanning Tree Protocol (STP) limitations by enabling active-active link aggregation across two separate Nexus switches, presenting them as a single logical device to the connected endpoint or upstream router. This architecture effectively doubles available bandwidth, eliminates blocked ports, and provides sub-second stateful failover without traffic disruption. Designed for mission-critical environments, this blueprint leverages the advanced forwarding engines of the Cisco Nexus portfolio to deliver carrier-grade availability, simplified operational management, and a future-proof foundation for virtualized and cloud-native infrastructures. This document serves as the definitive technical reference for the hardware and system-level capabilities underpinning this robust high-availability solution.



HARDWARE ARCHITECTURE & SILICON

The Cisco Nexus vPC solution is anchored in a purpose-built hardware architecture that seamlessly integrates high-performance application-specific integrated circuits (ASICs) with a resilient control plane. The core of the platform is built around the industry-leading Cloud Scale or Uniform Access ASIC technology, depending on the specific Nexus chassis model (e.g., Nexus 9000 or 7000 series). These ASICs are engineered to deliver wire-rate, non-blocking Layer 2 and Layer 3 forwarding with deterministic ultra-low latency. The architecture is meticulously partitioned to separate the data plane, control plane, and management plane, ensuring that control-plane protocols like Cisco Fabric Services (CFS) and the vPC peer-link protocol operate without impacting forwarding performance. The system employs a fully distributed forwarding table architecture, allowing each line card to maintain its own copy

of the forwarding information base (FIB) and adjacency tables, which is critical for maintaining line-rate performance across all active interfaces. For models supporting the NX-OS operating system, the architecture includes a robust hardware-based mechanism for handling the vPC consistency checks, role election, and state synchronization, all of which occur in hardware for maximum efficiency and speed.

KEY FEATURES & ROUTING LOGIC

- Active-Active Load Balancing: Utilizes a sophisticated hashing algorithm to distribute traffic across all member links of the vPC, providing full utilization of the aggregated bandwidth. The system supports configurable load-balancing policies based on Layer 2, Layer 3, and Layer 4 headers to optimize traffic distribution across diverse workloads.

- Stateful Failover & NS/SSO: The vPC domain implements Non-Stop Forwarding (NSF) and Stateful Switchover (SSO) for the control plane. In the event of a peer switch failure, the surviving switch seamlessly assumes all forwarding duties without any disruption to the data plane, leveraging the synchronized operational state and forwarding tables.

- Dual-Active Detection & Recovery: The system employs a robust dual-active detection mechanism using both the peer-link and a dedicated keepalive link (management or data). Upon detecting a split-brain scenario, the system initiates a recovery process, placing one switch into a recovery mode to prevent

forwarding loops and ensure network stability.

- vPC Peer-Link & Consistency Checks: The peer-link (typically a PortChannel) is the backbone of the vPC domain, carrying control plane traffic and synchronizing state information. The system performs rigorous consistency checks for VLANs, STP parameters, and other critical configurations to ensure that both peers present a unified forwarding behavior to the network.

- Hardware-Based MAC Address Synchronization: Instead of relying solely on software, the platform leverages hardware to efficiently synchronize MAC address tables across the vPC peers via the peer-link, reducing convergence time and CPU overhead. This ensures that MAC address movement is learned and propagated to both switches in near real-time.

- Support for Advanced Routing Protocols: The vPC domain fully supports a wide array of routing protocols (OSPF, EIGRP, BGP, IS-IS) and multicast protocols (PIM, IGMP). This allows for the creation of highly resilient, active-active Layer 3 gateway configurations (e.g., vPC+ with HSRP/VRRP) for a truly redundant first-hop routing solution.

COMPLIANCE & STANDARDS

The Cisco Nexus vPC platform is rigorously tested and compliant with a comprehensive set of industry standards and regulatory requirements, ensuring seamless integration into diverse networking environments. It adheres to IEEE

802.1D (STP), 802.1w (RSTP), 802.1s (MST), and 802.3ad (Link Aggregation) standards. The hardware and software are certified for IPv6 Ready Phase-2, ensuring full support for the next-generation Internet Protocol. The platform maintains compliance with MEF 9 and MEF 14 for Carrier Ethernet services. For stringent security requirements, the system supports 802.1AE (MACsec) for link-layer encryption and is validated against Common Criteria (CC) and FIPS 140-2 standards. Additionally, all hardware components meet or exceed GR-1089-CORE and GR-63-CORE requirements for electromagnetic compatibility (EMC) and environmental safety, and are fully RoHS-6 compliant for environmental responsibility.

TECHNICAL SPECIFICATIONS

The technical specifications detailed below represent a baseline for a typical modular Cisco Nexus chassis used in a vPC domain, such as the Nexus 9500 or 7000 series. Actual values are dependent on the specific hardware model and configuration chosen.

- Form Factor: Modular chassis (4RU to 13RU) or fixed-form factor (1RU/2RU) options available.
- Switching Capacity: Up to 172.8 Tbps per chassis (non-blocking).
- Forwarding Rate: Up to 9.6 Bpps (billion packets per second).
- CPU: Dual-core/Quad-core x86 processor with dedicated control plane.

- System Memory: 16 GB to 64 GB DDR4 ECC memory.

- Buffering: Configurable packet buffers up to 32 MB per ASIC.

- 40GE/100GE QSFP28 Ports: Up to 36 per line card.

- 10GE SFP+ Ports: Up to 48 per line card.

- 1GE RJ45 Ports: Available on select line cards for management or legacy connectivity.

- Management Ports: 1 x 10/100/1000Base-T Ethernet, 1 x Console (RJ45), 1 x USB (Type-A for file transfers).

- Power Supply: N+1 or N+N redundant, hot-swappable AC/DC power supplies (up to 3000W per unit).

- Cooling: Front-to-back or back-to-front airflow, hot-swappable fan trays with variable speed fans for optimized thermal management.

- Mean Time Between Failures (MTBF): >500,000 hours, calculated per Telcordia SR-332, Issue 3.

Parameter	**Specification**
Form Factor	Modular Chassis (4RU to 13RU) or Fixed 1RU/2RU
Switching Capacity	Up to 172.8 Tbps per chassis (non-blocking)
Power Supply	Dual Hot-Swappable Redundant AC/DC (up to 3000W each)

Forwarding Rate	Up to 9.6 Bpps (billion packets per second)
System Memory	16 GB to 64 GB DDR4 ECC
Supported Port Speeds	1GE, 10GE, 25GE, 40GE, 100GE (depending on line card)

ORDERING SKU INFORMATION

The following is a representative list of SKUs and product codes for building a Cisco Nexus vPC high-availability solution. Please consult your Cisco sales representative or partner for complete and current ordering information.

- Nexus Chassis: N9K-C9508 (8-slot), N9K-C9516 (16-slot), N7K-C7010 (10-slot).
- Supervisor Module: N9K-SUP-A+, N9K-SUP-B+, or N7K-SUP2E.
- Fabric Module: N9K-C9508-FM-E, N7K-F248XP-25E (Fabric-2).
- 40/100GE Line Card: N9K-X9736C-FX, N9K-X9636C-RX, or N7K-M324FQ-25L.
- 10GE Line Card: N9K-X9432C-S, N9K-X9536PQ, or N7K-M206FQ-25L.
- 1GE Line Card: N9K-X9564PX (PoE+ capable), or N7K-M148GT-11L.
- Power Supply: N9K-PUV-3000W-B, N9K-PAC-3000W-B, or N7K-AC-3KW-B.
- Fan Tray: N9K-C9508-FAN2, or N7K-FAN-1RU/2RU.
- Transceivers: SFP-10G-SR, SFP-10G-LR, QSFP-40G-SR4, QSFP-100G-SR4, QSFP-100G-LR4.

- vPC Peer-Link Cables: appropriate QSFP/QSFP-DD, SFP+ direct-attach copper (DAC) cables or optical cables.

