

PUBLIC-INTEREST FINDING FOR PROPRIETARY-MATERIAL USE

ROUTE: VAR DES NO: VAR

PROJECT NO: VAR COUNTY: VAR

PROJECT DESCRIPTION: Programmatic approval.

FHWA OVERSIGHT: YES NO

PROPRIETARY MATERIAL:

Routers (SR), Ethernet Routing Switches (ERS), and Ethernet Switching Virtual Services Platform (VSP):

ERS 4800, ERS 3500, VSP 4000, VSP 7000, VSP 8000, and VSP 9000.

Manufactured by AVAYA.

1. Description of Need:

The ITS Technology Deployment Division of the Indiana Department of Transportation is seeking approval for the equipment essential to the creation and maintenance of the INDOT ITS network.

Routers and routing switches are designed to join multiple area networks. On the INDOT network they serve as in intermediate destinations for network traffic: receive TCP/IP packets, look inside each packet to identify the source and target IP address, and direct packets accordingly. Multitude of configurations allows designer select model/configuration guarantying various functionalities.

Required functionalities include:

- Provide unique addressing in the network using Internet Protocol address.
- Provide protection from unwanted intrusions of unauthorized users (firewall)
- Provide separation of multiple networks in one physical location.
- Provide creation of required back-bone multi-layer redundancy with minimal hardware.
- Provide ability to use for communication wireless or fiber optic devices.
- Provide wide range of the bandwidth.

2. Product History: These devices have been chosen at the inception of the system approximately 15 years ago and since are the main part of each core (back-bone and TMC), field core (relay sites), and remote component. Over 700 of ERS and routers combined are currently being used in Indiana. They demonstrate very high reliability (over 96% uptime) and maintainability. Desired product is currently listed on INDOT Approved Materials List for Traffic Signal and ITS Control Equipment under ITS Networking Equipment. Testing was conducted according the ITM No. 950-10P

3. Product Availability: ERS/SR, manufactured by Nortel/Avaya, is only product on the market, meeting all requirements. Although there are routing switches and routers on the market providing unique IP addressing, firewall protection, and separation of multiple networks, none of them is capable of interfacing with existing network. There were no attempts by the manufacturers to present their

products to be tested to ITM No. 950-10P. Google search for Ethernet Router Switch or Router returns multiple devices, meeting some of the requirements, but not all.

4. Product Cost: There is no equipment on the market to make cost comparison. The next closest product is the SSA-G1018-0652 suite priced at \$15,298.99. However, this product will not communicate with the existing field and core hardware.

5. Project Compatibility: Desired product is the only product on the market that is compatible with existing ITS hardware. Application matrix below describes which model can be used for which application. The lowest cost ERS model is being selected for any particular project based on the technology needs.

Model \ Function	VSP 4000	VSP 7000	VSP 8000	VSP 9000	ERS 4000	ERS 3500
Ethernet Routing Switch					X	X
Ethernet Switching Virtual Services Platform	X	X	X	X		
Unique IP addressing	X	X	X	X	X	X
Fire Wall Protection	X	X	X	X	X	X
Modular	X	X	X	X		
Stackable					X	
Managing of large networks, high capacity, high complexity.	X	X	X	X		
Managing of sub-midsize networks					X	
Managing Wide Area Networks (WAN)	X	X	X	X	X	
IP Telephony						
Cost (Dependent on configuration)	\$4,000 to \$5,000	\$8,000 to \$10,000	\$20,000 to \$50,000	\$20,000 to \$150,000	\$3,000 to \$5,000	<\$1,000
Application	Mid Rack Switch	Rack data Center Solution	MDF/IDF Core switching/routing	MDF Core Routing/ Switching	Relay Sites	Remote Sites

6. Maintenance: Desired equipment is designed such a way, that most of maintenance functions: monitoring up/down time, restoring functionality, updating/upgrading – can be done remotely, which drives down maintenance cost. Training is available on line in Wiki Notes, accessible for tech personnel from any location in Indiana. Low failure rate (less then 3% including “acts of God”) and short order turn around time results in the minimal storage requirement.

7. Engineering Analysis: This application is programmatic by nature and unique not to a specific ITS project, but to the ITS architecture that is already in place. ERS and SR are essential components that allow communication between TMC and core and field hardware. The specifications are needed for synchronization with existing system and not unique to the specific project.

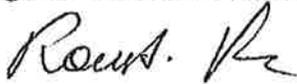
8. Expanded Economic Analysis: Due to the fact, that there is no equipment on the market to do comparison life cycle analysis, it may be stated that actual yearly maintenance cost is low. The average life cycle of the ERS is evaluated as 10 years. There are units currently in service installed in 2005. Annual replacement rate, including damage done by lightning, is negligible. Replacement of ERS and SR is predominantly driven by technology progress, rather than wear.

9. Contractual or Performance Implications: Use of desired items does not impose any restrictions on the use of other items on the contracts.

10. Attach Supplemental Documentation: Attached are:

- a) INDOT ITS Architecture;
- b) ITM # 950-10P ITS Ethernet Switches.

11. Length of Time that Approval is Effective: 01/2016 until 01/2019



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Field Engineer

INDOT-ITS Technology Deployment Division

Date: 01/25/2016

Based upon the above finding, the use of the proprietary material listed is in the public interest and is hereby approved.

APPROVED: Jim M. Poth Date: 1/27/16
INDOT Deputy Commissioner
Engineering Services and Design Support

APPROVED: Thomas L. Dunca Date: 2/04/16
Federal Highway Administration





Engage The Power of We™

Avaya Virtual Services Platform 8000 Series

Compact Form-Factor Ethernet Switches designed to deliver sophisticated yet simplified functionality for deployments by businesses striving for greater efficiency.

Avaya heralds the introduction of a new concept in networking, the 'Compact Form-Factor' Ethernet Switch, a design that seeks to address the needs of 'middle business', but is able to address a range of deployment scenarios from mid-market through to larger Enterprises.

The Compact Form-Factor

The Avaya Virtual Services Platform 8000 Series is the first incarnation of a new concept in data networking, the compact form-factor (CFF) Ethernet Switch. The CFF concept seeks to address the needs of businesses that range from the mid-market all the way up to mid-to-large Enterprises, with highly flexible deployment capabilities. These businesses are increasingly dependent upon IT, and access to business applications - much like their larger cousins - but they do not have the same IT resources or funding available to build-out and maintain feature-rich networks using conventional techniques and products. They need sophisticated capabilities, but delivered in a streamlined, simplified, and cost-effective package.

It is this challenge that has driven the development of the CFF concept and the creation of the Avaya Virtual Services Platform 8000 Series (VSP 8000). By delivering a package that combines simplicity, agility, efficiency, and versatility, Avaya has created a compelling solution for businesses that have fewer resources but want to do more.

The VSP 8000 Series features tight integration between the Industry's leading hardware and Avaya's proven VSP Operating System (VOSS), delivering enhanced levels of functionality and robustness. Leveraging Avaya's unique virtualization technologies - Switch Cluster and Fabric Connect - businesses can benefit from real-time service agility, avoiding the delays associated with conventional designs, and the outages introduced trying to maintain them. The CFF concept revolutionizes the cost/benefit proposition for the mid-market/mid-sized Core Switch role; delivering - when compared to a conventional Chassis - higher port density, better price/port, a lower entry price point, better power efficiency, it features reduced maintenance, a smaller physical footprint, and it scales seamlessly.

Essentially, the CFF gives businesses everything that they need, and enables them to avoid the 'Chassis Tax'; the costs and burden traditionally associated with conventional Chassis-based designs shoe-horned into smaller deployment scenarios. Leveraging next-generation hardware and software technologies help this platform support

VSP Operating System Software 5.0 delivers the following major enhancements:

- Avaya Fabric Connect enhancements, including Fabric Attach Server, Fabric Extend, & Switched UNI
- IPv6 enhancements, including BGP+, OSPFv3, OSPF Graceful Restart, RIPng, & First-Hop Security
- Introduces additional VSP 8400 Ethernet Switch Module options

today's connectivity-centric requirements and be primed for tomorrow's software-defined future.

Game-changing capabilities

The Core of the network has traditionally been the place where the Chassis-based Ethernet Switch came into its own; the virtues of port density, reliability, scalability, and performance mandated something more than simply a variation of the products deployed into the Wiring Closets themselves. There's been a resistance to using 'Stackables'; even those featuring Avaya's clearly superior Stackable Chassis technology - with all of its positive attributes - have not always been universally embraced in this particular role for smaller deployments.

But time moves on, and technology advances. Avaya is now able to debut the Compact Form Factor concept. With CFF products, we are able to change the game, delivering higher port density - especially for high-capacity 10/40 Gigabit connections - offering better price per port (relatively to a Chassis), a much lower entry price point (without the overhead of Chassis, Control Processor and Switch Fabric modules, etc.), combined with numerous efficiencies in the areas of operational simplicity and reduced operational costs. Key enabling technologies from the Avaya Networking toolkit - Switch Cluster and Fabric Connect - deliver solutions that promote flexibility and scalability.

In short, the CFF delivers the benefits typically associated with Chassis-based solutions, but without the penalties that are usually encountered, both in terms of capital costs and operational burden.

Confluence of Advancements

It's a confluence of technology advancements that make the delivery of the CFF concept possible.

The first is something called 'die shrink', a term that refers to the scaling of semiconductor devices, essentially the mass of transistors that form a chipset. Shrinking a semiconductor die, creating superior circuit density, is made possible by using a more advanced fabrication process. This reduces overall costs of the chipset, delivering more from less. That's a roundabout way of saying that you can get more capacity and capability by leveraging the most advanced chipsets, and additionally reducing costs and being more power efficient.

This has, of course, been occurring in PC and Server markets for years - we commonly refer to the phenomenon as 'Moore's Law' - and now it has finally made its way to Networking. What this specifically delivers is the ability to drive many more high-capacity connections using a more intense chipset. These developments have reached the point where it's the physical requirement of the interfaces that determine now how small the box can be made, rather than size being driven by a mass of circuitry behind the front panel. So, to begin with, we've got these incredibly sophisticated and intense chipsets to build upon.

In parallel, we've seen a tremendous advancement in the functionality of network virtualization, led of course by the Avaya Fabric Connect technology, an extended implementation of the Shortest Path Bridging standard. Fabric Connect offers the ability to create a simplified network that can dynamically

virtualize elements, empowering efficient provisioning and utilization of resources, thereby reducing the strain on the network and IT personnel. Fabric Connect offers a robust and resilient alternative to conventional offerings and it delivers innovative services and solutions while maintaining Ethernet's key value propositions of simplicity and cost-effectiveness. Fabric Connect delivers new capabilities in the crucial areas of simplicity, scalability, performance, reliability, and service orchestration and abstraction.

Finally, there a subtle but important transition in how the various physical connectivity requirements - the actual interfaces - are delivered. A traditional Chassis-based solution requires multiple interface module types in order to cover a broad range of physical media types and interface speeds; from copper to various forms of fiber, and from 10/100Mbps, through to 10Gbps and now beyond. However, the commoditization of Pluggable Transceiver technology is making that traditional approach largely redundant, thereby highlighting its inherent inefficiency. We now recognize that a better way to deliver versatility of interface is to leverage the wide array of available Transceivers. This change means that a networking device can support multiple interface requirements by leveraging low-cost Transceivers.

These three trends converge to produce a tipping point; together they create the potential for change. The rationale for proceeding with change, as opposed to change merely for the sake of change, is to enable an evolution away from old-world, conventional, and inflexible networking.

Avaya Switch Cluster: Improving Resiliency, Enhancing Availability

Avaya pioneered, more than a decade ago, the concept of the high-availability network with development of the Switch Cluster technology. Creating a single, unified, logical Core from two physically independent Switches - clustering them - ensures that no one single point-of-failure can disrupt dual/multi-homed connectivity. This is the very essence of end-to-end always-on availability. Deploying Switch Cluster technology in the Core delivers high-availability for the Edge of the network, supporting the Campus Wiring Closet, Servers, Routers, or other networking devices in the Core/Data Center.

The Switch Cluster technology is built using the Split Multi-Link Trunking protocol that is unique to our products, yet is fully interoperable with third party Switches, Servers, Appliances, and Routers. This delivers a series of benefits that provide real value; while it may be possible to simulate certain individual elements, no competitive offering can rival the combined capabilities, particularly in terms of simplicity and efficiency.

Switch Cluster delivers an interoperable solution that extends beyond simply Switches. This means that high-availability is not limited to only the switching network (the Switches themselves and their direct links), but to the total network; importantly also extended to attached Servers, Appliances, and WAN Routers, etc. Competing offers are based on interactions purely within the Switch domain, and crucially do not extend to the application hosts themselves. Most rival offerings are based on variations of the Spanning Tree Protocol (STP);

however, support for this is limited to Switches alone and is not commonly supported by other devices. By excluding Servers from the active resiliency technology, these solutions cannot extend high-availability to the applications. The Switch Cluster technology is independent of STP and extends to support any device that utilizes Link Aggregation, a technology that is both basic and ubiquitous. Devices that attach to the Switch Cluster create a virtual connection using multiple physical links, this provides resiliency together with additional capacity.

Delivering availability and facilitating in-service maintenance and optimized performance are well-known features of Switch Cluster technology. Enabling sub-second failover and recovery remains extremely important, perhaps never more important, however it is not necessarily a feature that remains unique. Enhancements to STP - namely rapid reconfiguration - can be aggressively configured to deliver similar levels of failover performance. However, all flavors of STP remain tied to the concept of detecting and acting upon changes to the network topology. This makes a network extremely sensitive to the reliability and availability of particular devices (Root Bridges, etc.). Avaya's Switch Cluster technology is built around the concept of mirrored devices and virtualized capabilities. Switch Cluster technology is so effective that the loss of an entire Switch - for planned maintenance or through failure - can be accommodated without any loss of overall application availability.

One of the typical rationales for a Chassis-base Core is that a big, complex, and expensive device is the only really dependable option. However, always-on availability is not merely a function of hardware, but

more correctly a product of the 'solution'. The Avaya Switch Cluster technology delivers this, and when executed on a CFF platform, it provides a compelling offering for the mid-market and smaller Core deployments within the Enterprise. In short, rather than over-investing in a 'highly resilient' Chassis, with redundant hardware, but vulnerable control plane and based on obsolete networking techniques, the Switch Cluster technology enhances network survivability through physical separation of the switching hardware.

Therefore, building a Core using a cluster of cost-effective VSP 8000 Series CFF Ethernet Switches enhances a business' resiliency posture. In addition to the various high-availability factors offered by conventional Chassis-based products (i.e. CPU, switching fabric, power, cooling, and of course, link), the combination of Switch Cluster and distributed hardware delivers total physical independence, and includes the ability to have the 'virtual' Core split and deployed across different

End-to-End

Adding Fabric Attach and Fabric Extend to Avaya Fabric Connect delivers a genuine end-to-end service delivery network. Virtualization and automation are abstracted from transport, enabling service agility and business efficiency.

physical locations, independent and isolated control planes (delivering genuine process separation, isolation, and greater protection), and enabling in-service software upgrades. Big business, operating at larger scale, has for years benefitted from being able to deploying Switch Cluster technology with Avaya's high-end products; the VSP 8000 Series now brings this advantage to mid-sized businesses. The primary difference is that this capability is now available at a vastly different price point, tailored for mid-sized businesses operating more modest IT delivery models.

Another of the historical justifications for a conventional Chassis-base Core is that it delivers flexibility of hardware and therefore ensures scalability. This is largely true; however, it comes at a cost, in terms of up-front capital investment, operational burden, and even in terms of future expansion. Every component has a premium attached as a function of embedding this flexibility. Additionally, there are often life cycle considerations that mean the flexibility that businesses assumed would be worth the extra cost does not actually materialize when they ultimately go to exercise it.

Switch Cluster technology can be implemented in the classic - physically connected - manner, but in an evolution of the technology, also with a 'Virtual IST'. This is an enhancement of the Inter-Switch Trunk functionality; it leverages a virtualized connection between the Cluster members, rather than via the traditional physical link. This delivers greater flexibility, optimizes utilization of high-value backbone connections, and forms the basis of further developments that will include scalability of a Cluster beyond two

members, and the ability to mix-and-match device types within a Cluster.

Virtual IST (VIST) delivers a dependable scalability capability and de-risks purchasing decisions; the Core can provide both always-on high-availability and flexible pay-as-you-grow efficiencies.

Avaya's Switch Cluster technology delivers a level of network resiliency that also facilitates in-service maintenance. The deterministic nature of Switch Cluster empowers network operators to compartmentalize the network, making essential services even more resilient, and allowing for individual failures to be repaired in real-time, without service restoration work impacting on collateral components or applications.

Avaya Fabric Connect: Replacing Complexity with Capability

Traditionally, to provision new services or to change existing ones, engineers are required to touch every device in the service path, configuring every device to enable both the active and redundant links. The bigger the network the more complex and risky this becomes.

The Avaya Fabric Connect technology is based on an extended implementation of the Shortest Path Bridging (SPB) standards of IEEE 802.1aq and IETF RFC 6329, augmented with Avaya enhancements that deliver Enterprise-specific optimization. It offers the ability to create a simplified network that can dynamically virtualize elements to empower efficient provisioning and utilization of resources. This can reduce the strain on the network and IT personnel.

Leveraging Fabric Connect technology to virtualize the network enables a profound change. Rather than the network appearing as a mass of individual devices, it becomes an opaque cloud, so that engineers only need to touch the single unique device that is providing service directly to the end-point. Fabric Connect technology automatically and instantly propagates all service attributes to every other node within the cloud, delivering end-to-end connectivity.

Creating a fault-tolerant, powerful, and self-aware end-to-end Fabric, this technology creates a solution where service provisioning occurs only at the perimeter. The advantage is immediate and pronounced; administrative effort is reduced, errors can be avoided, and time-to-service is vastly enhanced. The beauty of the underlying technology is that it masks devices, links, and protocols and delivers what is logically an extended Ethernet LAN that provides connectivity for multiple end-points. That's the simple concept, and it is achieved in an interesting and quite unique way. Fabric Connect leverages a dynamic link-state routing protocol called Intermediate System-to-Intermediate System (IS-IS) and uses standardized extensions to share topology, reachability, and device information between every node in the domain. With nodes holding their own self-determined view of the network, including the optimal path to any destination, a fully distributed and dynamically maintained solution is created.

Fabric Connect technology has the added advantage of separating and segmenting traffic to unique service constructs. This delivers 'stealth networking' solutions that help with compliance for business processes such as those that require special handling for credit card payments (PCI) or the protection of healthcare data (HIPAA).

Network segmentation means that each service is uniquely encapsulated and carried independently of every other service. Leveraging a single unified protocol, with integrated IP Routing and IP Multicast capabilities, enables Fabric Connect to deliver the Industry's premier solution for simplified, scalable, and resilient IP Multicast-based applications. The Edge-only provisioning model also delivers significant advances in how the network interacts with virtual machine mobility. Layer 2 VLANs can be easily and seamlessly extended throughout the Core or Data Center whether that is a single site or multi-site. Traffic flows are automatically load-balanced and more protected across all available links.

In the Data Center context, Fabric Connect combines with both Avaya and third party orchestration solutions to fully synchronize the provisioning of the networking requirements of workload mobility within and between locations. Dynamically moving or extending virtualized computing resources, without adding complexity, is a key value point of Fabric Connect. Fabric Connect offers a robust and resilient alternative to today's existing offerings. It delivers innovative services and solutions while maintaining Ethernet's key value propositions of simplicity and cost-effectiveness. Fabric Connect delivers new capabilities in the crucial areas of

simplicity, scalability, performance, reliability, and service orchestration and abstraction.

Fabric Connect devices support a number of different User-Network-Interface (UNI) types to provide agile deployment capabilities:

- VLAN UNI (C-VLAN) - a node-specific VLAN ID maps to a L2 Virtual Service Network (VSN). All physical ports on that node associated with this VLAN are therefore associated with the service.
- Flex UNI has the following sub-types:
 - Switched UNI - a combination of VLAN ID and a Port maps to a L2 VSN. With this UNI type, VLAN IDs can be re-used on other ports and therefore mapped to different VSNs.
 - Transparent Port UNI - a physical port maps to a L2 VSN. All traffic through that port, 802.1Q tagged or untagged, ingress and egress is mapped to the VSN.
- E-Tree UNI - Private VLANs extend beyond one node to form a network-wide E-Tree service infrastructure. An E-Tree UNI is a L2 VSN where broadcast traffic flows from Hub sites to Spokes sites, from Spokes to Hubs, but not between Spoke sites. E-Tree Hubs can be formed with any VLAN UNI, while E-Tree Spokes must be configured as Private VLAN UNIs.
- L3 VSN UNI - a node-specific VRF maps to an L3 VSN, and the control plane exchanges the L3 routes with all nodes belonging to the same VSN. All VRFs in a network sharing the same L3 VSN, effectively forming an L3 VPN. L3 VSNs can be configured to simultaneously support both IP Unicast and IP Multicast.

Transitioning to an autonomic virtualized network delivers crucial advantages. It means that businesses no longer need to configure the Core of the network for every service change; service is only configured at the Edge of the network. This has dramatic impacts for the entire change paradigm.

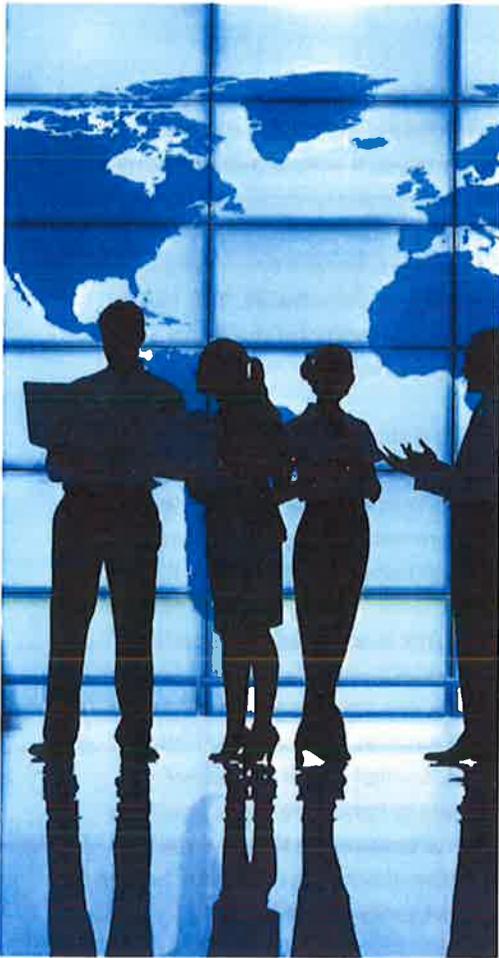
Fabric Connect has garnered a well-earned reputation for simplifying how networks are built and improving how they are run. Independent research commissioned by Avaya¹ reports that Fabric Connect deployments feature up to 91% less implementation time, up to 66% change less wait time, and an 85% reduction in both configuration and troubleshooting times. Similarly, Fabric Connect delivers enhanced resiliency, with failover times more than 2,500x better, and outages caused by human error virtually eliminated.

Avaya Fabric Attach: The Missing Link for Service Automation

Service automation is the Holy Grail for IT. Creating solutions that enable business systems and processes to spin-up, move, or be decommissioned in real-time transitions IT from roadblock to facilitator. Avaya has developed technology to address automation of the critical "last yard", where end-point devices meet the virtualized network.

The Avaya Fabric Connect technology delivers a number of key networking benefits. The independent Fabric Connect Customer Experience Research that Avaya commissioned demonstrates dramatic improvements in areas: implementation, configuration, and troubleshooting times, recovery, and error-induced outages are all

¹ Dr. Cherry Taylor, Fabric Connect Customer Experience Research Report, Dynamic Markets, 2015. This report was commissioned by Avaya and details quantitative and qualitative research with IT professionals in companies that have implemented Avaya this technology.



Avaya is bringing game-changing innovation to networking, packaging and tightly integrating the latest technology advances with proven capabilities to deliver businesses a compelling new offering.

improved. Fabric Connect is able to deliver these benefits by leveraging the power on the underlying Shortest Path Bridging protocol. This, amongst other characteristics, enables services to be defined only at the network edge, mitigating the traditional requirement for link-by-link, device-by-device configuration change. It is this legacy requirement that typically slows service deployment and introduces undesirable risk.

However, a challenge remains. That of delivering an automated attachment capability to an increasing large and diverse base of users and end-point devices, in what is a highly virtualized networking scenario. Any solution must be flexible, open, and complement the desire - in some cases, the mandatory requirement - to maximize the isolation of different traffic flows and minimize the unnecessary exposure of sensitive or mission-critical networks.

It is important, at this point, to be more specific about the challenge. The concept of implementing at least some level of automated attachment is not new. Vendors have independently developed MAC- and RADIUS-based solutions, and the industry has collaborated on open solutions such as the 802.1X Extensible Authentication Protocol. More recently, the 802.1AB Link Layer Discovery Protocol with media extensions assists with the deployment of VoIP/unified communication applications.

However, those approaches rely on the increasingly flawed assumption that the network edge has already been provisioned with access to all network segments (typically implemented as virtual LANs). This may have made perfect sense when the network was essentially just a single "data" network, and when a single "voice" network was later added.

In response to this challenge, Avaya has developed Fabric Attach, a standards-based capability that facilitates the automatic attachment ("Auto-Attach" in standards verbiage) of end-point devices. Businesses can leverage Fabric Attach to dynamically deploy end-points, temporarily extending unique networking services to the edge as required. Auto-attached end-point devices connect to the appropriate network resources: this would typically be a Fabric Connect Virtual Service Network (VSN), or it could be a conventional VLAN. The Fabric Attach capability delivers the "Enabled Edge", a foundational tenet of the Avaya SDN Fx architecture.

Fabric Attach is designed to streamline the deployment of generic IT end-point devices, networking devices, compute resources, and business-centric Internet of Things (IoT) end-point devices. In its simplest form, Fabric Attach facilitates the assignment of these devices to the correct network segment, where necessary extending segment presence to the edge node only for the duration of active, valid sessions. Fabric Attach can also deliver enhanced service differentiation through the implementation of granular business-driven policy.

Fabric Attach works by creating a "gateway" automation function between conventional end-point devices and the network. Typically, the network will be a Fabric Connect private cloud, although the standardized nature of Fabric Attach means that it is equally relevant to conventional 802.1Q VLAN-based networks. The 802.1AB Link Layer Discovery Protocol is utilized to pass signalling between Fabric Attach components, meaning that it is highly flexible, extensible, and portable.

Fabric Attach has been submitted to the IETF for consideration as a standard², and in collaboration with Wind River, Avaya has contributed Fabric Attach to the Open vSwitch open source development project³.

The focus for facilitating auto-attach is at the network edge, where end-point devices first connect and are most visible. This where a Fabric Attach Client (FA Client) agent would reside, being software code that can be implemented in a number of flexible ways. The FA Client could take the following forms:

- In an Avaya Ethernet Access Switch, detecting conventional end-points devices – generic PCs, IP Phones, Printers, IP Cameras, etc – and extending customized network service connectivity and attributes
- In an Avaya Wireless LAN Access Point, facilitating simplified hands-free deployment, service delivery, and device connectivity
- In an Avaya IP Phone, automating service turn-up and portability
- Leveraging the Avaya-Wind River collaboration: any Open vSwitch-based device system, including Xen, KVM, and VirtualBox Hypervisors, and the new Avaya Open Networking Adapter product line
- Leveraging the IETF submission: any end-point or networking device operating a compliant implementation; this could include third party Switches or any Ethernet-enabled networking device

Individual FA Clients may require specific networking services – particular VSN IDs, VLAN IDs, etc – or they can simply make a generic request, and rely upon centralized policy for assignment. For example, IP Phones will be assigned to the default

“Voice VLAN”, whereas IP Cameras – recognized by virtue of their hardware addressing – would be assigned to the “Video Security VLAN”. Further, a Virtual Machine could request application-specific network assignment during the spin-up process. Fabric Attach compliments the existing techniques for device recognition, authorization, and authentication – i.e. MAC- and/or RADIUS-based, 802.1X, and 802.1AB – and leverages these to integrate with network provisioning and policy enforcement.

The FA Client communicates, using LLDP extensions, with a Fabric Attach Server (FA Server), either directly or via a Fabric Attach Proxy (FA Proxy). The FA Proxies are conventional Networking Switches, deployed as and when the topology requires, that pass auto-attach requests from FA Clients through to the FA Server. It is also feasible that a Switch acting as an FA Proxy will simultaneously be acting as an FA Client. This would be the case when the Switch is providing FA Client functionality for directly attached end-point devices (e.g. PCs and IP Phones), and also acting as a proxy for an attached FA Client (e.g. an Avaya Wireless LAN AP). The FA Proxy and FA Client agent functionalities easily coexist to provide for maximum deployment flexibility.

The FA Server is a Networking Switch, but is distinguished from the FA Proxy insofar as it is the boundary between the Fabric Connect private cloud and the conventional Ethernet Access network. The FA Server, being a Fabric Connect node, has full network and service awareness and can dynamically extend networking services – again, via the FA Proxy

when dictated by topology – to the FA Client and any attached end-point devices. Putting it another way, end-point devices are connected to the broader network by the FA Client obtaining service extensions from the FA Server; providing the mapping of conventional VLANs to Fabric Connect VSNs. VOSS 5.0 Introduces the FA Server capability to the VSP 8000 Series product line; additionally, it is also now supported on the VSP 7200 Series and VSP 4000 Series products.

The Fabric Attach process dynamically and automatically extends networking services from the FA Server to both FA Clients and end-points devices hosted by FA Clients. It gives an “elastic” nature to the network, stretching services to the edge only as required and only for the required duration. As and when end-point devices closedown or disconnect, redundant networking services retract from the edge; this has the added benefit of reducing exposure and the attack profile.

And important value-added element to this solution is the Avaya Identity Engines policy server. Fabric Attach can deliver basic connectivity automation without Identity Engines, however the solution is significantly enhanced by Identity Engines delivering advanced authentication services for users and end-devices. Identity Engines enables more granular control of networking services, over-and-above VSN/VLAN assignment. Leveraging per-user and/or per-device authentication enables custom networking services to be dynamically created and applied on-demand.

² Paul Unbehagen, et al, Auto-Attach using LLDP with IEEE 802.1aq SPBM Networks (IETF, July 2014).

³ Avaya Goes “Hands-Free” for vSwitch Network Services Configuration with Wind River (Avaya, September 2014)

There is also a variation on the typical deployment: here Fabric Attach is used in a purely conventional VLAN-based network, and no FA Server (i.e. Fabric Connect node/network) exists. In this scenario, the FA Proxy Switch operates in "standalone" mode, and addresses FA Client requests for VLAN IDs. Identity Engines can also be applied to this model, providing enhanced user and/or device authentication and policy control. This variant of Fabric Attach delivers an auto-attach capability even to those businesses that are yet to implement Fabric Connect.

Fabric Attach delivers substantial operational benefits. End-point devices can be deployed in real-time, without the need for IT intervention and manual configuration, with a centralized policy engine defining and policing device auto-attach in compliance with business policy. Replacing static network device configuration with dynamic programming reduces overall complexity in the network and has a corresponding benefit in reducing the risk of outage.

Avaya Fabric Extend: Taking Benefits to a Broader Audience

For many adopters, Fabric Connect has delivered an almost ideal networking solution. Ideal that is, except perhaps for the fact that Shortest Path Bridging, the standard upon which Fabric Connect has been developed, is designed around the concept of physical Ethernet. Being limited to Ethernet-based networking topologies means, for example, that businesses have been unable to extend services-based connectivity end-to-end, across their wide-area networks. Technically, this limitation is due to a dependence for the

"establishment" of NNI links - network-to-network interface links - over which IS-IS adjacencies are formed and services defined and delivered. This means that the extent of Ethernet availability has defined an arbitrary boundary for the Fabric Connect network virtualization cloud.

This situation has represented something of a constraint for those businesses that want to fully integrate remote sites into their private cloud. There could be driven by a need to distribute support for IP Multicast-based applications throughout the entire company, or quickly roll-out IPv6 but the infrastructure is not fully ready. There are times when there's a requirement to offer an extended multi-tenant/segmentation capability, or perhaps the issue is as simple as wanting to surgically deploy Fabric Connect in a mixed-vendor environment. Whatever the specific requirement, there's lots of reason why Routed IP connectivity alone isn't a complete-enough solution and why businesses would benefit from being able to extend their Fabric Connect cloud.

Now, with Avaya's development of its Fabric Extend technology, businesses can fully integrate remote locations with the Fabric Connect cloud. Fabric Extend enables configure NNI interfaces to be logically defined, and through VXLAN encapsulation, seamlessly tunnel Shortest Path Bridging connectivity across IP-based topologies such as MPLS and Optical Ethernet. Fabric Extend is a versatile technology that can deliver VLAN and VRF extension, Layer 2 and Layer 3 Hub-and-Spoke networking, and site interconnect for dispersed Campus and Data Center locations.

Fabric Extend perpetuates Fabric Connect's well-earned reputation for simplifying the network. Continuing

this theme, the Avaya Fabric Orchestrator management platform incorporates a new Tunnel Manager utility that automatically configures the bi-directional tunnels required to integrate new nodes into Fabric Extend domains. Tunnel Manager delivers an intuitive, graphical capability to deploy both any-to-any and hub-and-spoke configurations; additionally, a command-line option remains if manual setup is preferred.

In terms of product support, VOSS 5.0 introduces Fabric Extend on three Ethernet Switch platforms: natively on the VSP 8000 Series and VSP 7200 Series products, and also the VSP 4000 Series when deployed in combination with the Avaya Open Networking Adaptor.

Avaya's new Fabric Extend technology provides a flexible and scalable solution to enable network-wide extension over private and provider IP infrastructures for the very significant benefits that Fabric Connect is delivering businesses today.

Management

The Avaya VSP 8000 Series can be managed in a variety of ways. Simple on-box management functions are delivered by a web-based GUI called Enterprise Device Manager (EDM), and a generic CLI is also available for manual configuration. For centralized management of multiple devices, the Fabric Orchestrator software platform delivers a comprehensive unified management capability. Additionally, Fabric Orchestrator provides the platform upon which emerging SDN capabilities will be progressively delivered.

This powerful appliance-based solution offers the following functionality:

- Single Pane-of-Glass – a fully integrated suite of tools working together to provide a comprehensive, unified view of the network, streamlining workflows and reducing operational costs
- Discovery and Visualization – providing rich network and device discovery and visualization capabilities. Includes the ability to discover network-attached devices, including servers, storage servers, switches, routers, phones, virtual machines and their hosts, plus Avaya Aura applications.
- Fault and Diagnostics – leverages information collected from the network to determine the most likely cause of network outages, and correlates events to determine affected devices and services.
- Configuration and Orchestration – facilitates even the most complex of network configurations through simplified, intuitive wizards and easy-to-use templates. Configuration templates are created once, stored, and then conveniently applied in order to accelerate time-to-service and reduce the risk of human error.
- Virtualization Management – provides insight into the complete lifecycle of virtual machines – activation, migration, and retirement – including the automatic provisioning of those companion networking services needed to parallel VM migrations.
- Performance Management – delivers tools to monitor, analyze and report application behaviors and their bandwidth utilization trends. Collected data gives valuable insight into traffic patterns, application behaviors, and top talkers. Performance management tools enable capacity planning and change monitoring.

- Integrated SDN capabilities – Crucially, Fabric Orchestrator is built with a clear eye towards the future. The platform provides an integration point for Open Daylight-based SDN Controller plugins, third party tools and controllers accessible through north-bound REST interfaces, and OpenStack ML2 drivers that enable network orchestration in conjunction with storage and compute resources.

SDN that redefines Networking

Software-Defined Networking is certainly topical; however, much of the discussion remains centered on finding real-world business justification for what is essentially a technology side step. Avaya takes a pragmatic view and delivers solutions aimed fairly and squarely at simplifying and automating tasks that are currently complex and manual; Avaya is more concerned about what the technology delivers and less about what it is labeled.

A case in point is the new Avaya Fabric Attach technology. An adjunct to Avaya Fabric Connect, this innovation allows businesses to extend network virtualization directly into the conventional Wiring Closet, deployed on existing, non-Fabric products, and fully automate the provisioning of devices to the appropriate virtual network. This is particularly relevant for the mass of unattended network end-points that are permeating businesses, such as IP Phones, Wireless Access Points, and IP Cameras.

This is a perfect example of how networking is being redefined through the seamless integration of a pervasive services-orientated network virtualization technology with intelligent and open policy-based access management

techniques. The VSP 8000 Series is designed to deliver the Fabric Attach Server Switch functionality in the model, interfacing conventional Switches with the Fabric Connect cloud.

Summary

Personal Computers have been with us for decades, and Laptops and portable computing for a decade or more; however, these devices were never universally integrated into people's everyday lifestyle in the way that Tablets now are.

This new class of product, the Tablet, was created by the relatively simple act of packaging a number of technology advancement into a new compelling offering. However, until it actually happened, until one manufacturer had the vision to change, it wasn't something that people actually knew they wanted. Crucial to the success of a new product category is unification of the right emerging technologies, and faultless execution is absolutely vital.

Avaya is bringing this same attitude for game-changing innovation to networking. We have packaged and tightly integrated the latest technology advances with proven capabilities to deliver a compelling new offering, one that businesses may not necessarily have envisioned until Avaya demonstrated the vision and leadership necessary to pioneer change.



VSP 8284XSQ 84-port Switch



VSP 8284XSQ Highlights

- 80 ports of 10 Gigabit Ethernet and 4 ports of 40 Gigabit Ethernet
- AC or DC high-availability power
- Non-blocking, wire-speed switching architecture
- Integrated design that is optimized for low latency
- Flexible L2/L3 address table entry architecture delivers MAC, ARP, and IP Routing scalability
- Feature-rich support for Standards-based VLAN, MLT, STP, and SPB technologies
- Advanced IPv4 & IPv6 Routing
- IPv6-optimized Hardware
- Integrated Layer 2, Layer 3, IP Routing, & IP Multicast network virtualization
- MACsec and Enhanced Security Mode options

VSP 8284XSQ Ethernet Switch

The Virtual Services Platform 8284XSQ is the fixed model in the VSP 8000 Series range of CFF Ethernet Switch products. With it, businesses can easily transition their network from the inefficiencies of legacy technologies, migrating to a genuine next-generation solution that dramatically reduces the operational burden and helps businesses realize revolutionary benefits in service agility.

Every IT department is seeking solutions that enable them to spend less of their time maintaining basic operations. Research indicates that 80-85% of IT effort is currently focused on satisfying the day-to-day operational burden⁴. The VSP 8284XSQ is just such a solution to that time-consuming activity. The platform can deploy and operationalize quickly, minimize ongoing operational burden, and enable real-time, in-service change and maintenance. The VSP 8284XSQ enables businesses to put their finite IT resources to work on important value-adding projects. Additional benefits include lifetime warranty, reduced maintenance costs, and all-inclusive software licensing combine to deliver a package with a dramatically enhanced total cost of ownership.

Leveraging both next-generation hardware and software technology delivers a solution that is ready to support both today's requirements and tomorrow's emerging needs. The VSP 8284XSQ also provides business with a future-ready solution that is based on the Industry's most software-definable network virtualization technology.

Product Overview

The VSP 8284XSQ Ethernet Switch provides a total of 84 fixed ports, configured as 80 ports of 10 Gigabit Ethernet with SFP+ sockets, and 4 ports of 40 Gigabit Ethernet with QSFP+ sockets.

The innovative design leverages the most advanced chipset from the Industry's leading supplier, featuring 2.56Tbps of switching and 1,428Mpps of frame forwarding performance. The selected chipset is designed to deliver Terabit-scale, wire-speed capabilities, with a fully integrated 10/40/100 Gigabit ASIC architecture that facilitates multiple design opportunities. Latency has been optimized, with a 40% advance over current best examples. Five-fold efficiency gains, relative to existing static designs, are delivered by intelligent buffer technology that self-tunes thresholds to improve burst absorption. A flexible, Unified Forwarding Table allows for future in-field optimization, with up to four mission profiles supported. This chipset has the ability to also be developed to provide embedded support for a range of advanced technologies such as DCB, SPB, VXLAN, PIM, FCoE, and NAT/PAT.

Benefits

The VSP 8284XSQ delivers significant flexibility, and is compatible with, and complementary to, existing products and technologies from the Avaya Networking portfolio. A new product, introducing the Compact Form-Factor concept, the VSP 8284XSQ, provides the very high-capacity, high-performance connectivity solution for mid-sized Campus networks.

Building genuine high-availability enhances a network's resiliency posture. In addition to the various HA factors offered by premium Chassis-based products, Switch Cluster technology delivers physical independence; isolated control planes (delivering process separation, isolation, and greater protection), and allows for in-service software upgrades. The VSP 8284XSQ brings the advantages of deploying Switch Cluster technology to mid-sized businesses.

The VSP 8284XSQ also natively supports the Avaya Fabric Connect network virtualization technology. Some of the key advantages that Fabric Connect delivers include:

- Making the need to configure network-wide VLANs obsolete
- Replacing multiple sequential legacy protocols with this one single unified technology
- Removing the risk of network loops
- Delivering the Edge-only provisioning model which seamlessly integrates with orchestration and automation
- Fully optimizing all links and all devices, enabling businesses to get the most out of infrastructure investments

Features & Capabilities

- Non-blocking, wire-speed switching architecture
- Integrated design that is optimized for low latency
- Flexible table architecture delivers MAC, ARP, and IP Routing scalability

- Feature-rich support for Standards-based VLAN, Multi-Link Trunking, Spanning Tree Protocol, and Shortest Path Bridging technologies
- IPv4 & IPv6 Routing includes support for Static, RIP/RIPng, OSPF/OSPF+, eBGP, BGP+, ECMP, VRRP, PIM-SM, and VRF
- IPv6-optimized Hardware
- Avaya Switch Cluster technology supports Triangle & Square configurations, with both Layer 2 Split Multi-Link (SMLT) and Layer 3 Routed Split Multi-Link Trunking (RSMLT) functionality, and Virtual IST
- Avaya Fabric Connect technology supports L2 Virtual Service Networks (VSNs), Layer 3 Virtual Service Networks, Inter-VSN Routing, IP Shortcut Routing, IP Multicast-over-Fabric Connect, Fabric Attached Server, Fabric Extend, and Switched UNI

High Availability Power & Cooling

- Up to 2 field-replaceable, hot-swappable internal AC Power Supplies
- 4 field-replaceable Fan Modules

Warranty

- Lifetime Next Business Day shipment of replacement hardware
- Lifetime Basic Technical Support
- 90-Day Advanced Technical Support
- A complete range of support options are also available, either directly from Avaya or indirectly from our Authorized Business Partner network

Software Licensing

- Base Software License, included with hardware purchase, enables most features with the exception of those specifically noted as enabled by the Premier Software License.
- Premier Software License, an optional accessory, enables the following features: Layer 3 Virtual Service Networks and - where local regulations permit - MACsec.

Country of Origin

- China (PRC)

VSP 8404 Ethernet Switch

The Virtual Services Platform 8404 is the flexible model in the VSP 8000 Series range of CFF Ethernet Switch products. It complements the existing VSP 8284XSQ, adding a high degree of interface flexibility and diversity to the value proposition common to all VSP 8000 Series products. The VSP 8404 enables businesses to satisfy many typical deployments scenarios with a consistent hardware platform, and one that leverages the unified VSP Operating System Software (VOSS) code base to deliver feature parity across a range of products.

Transitioning the network from the inefficiencies of legacy technologies, and migrating to a next-generation solution, positions businesses to reduce their operational burden. This networking philosophy can also help businesses to realize revolutionary time-to-service enhancements.

The VSP 8000 Series debuted the Compact Form-Factor design concept, ushering in a unique approach to product and solution design. The original VSP 8284XSQ has come to define simplification, and the new VSP 8404 now adds flexibility to the equation. Leveraging the ability to support a diverse mix of Ethernet interfaces – from 100Mbps to 40Gbps, Copper- and Fiber-based – businesses can use the VSP 8404 to address a range of networking applications. The VSP 8404 is equally at home in the Core of a mid-sized network, or as the Spine Switch in a Data Center Spine/Leaf Top-of-Rack deployment. The VSP 8404 can also be deployed as a Campus Distribution Switch, providing and aggregation point between the Core and Access

tiers. Supporting Avaya's innovative Fabric Connect and Switch Cluster technologies, in addition to conventional Routed IPv4 and IPv6, the VSP 8404 is an agile and versatile player in a number of distinct scenarios.

The VSP 8404 deploys and operationalizes quickly, minimizes ongoing operational burden, and Avaya's unique network virtualization technologies enable real-time service deployment. As a product line, the VSP 800 Series enables businesses to redirect their finite IT resources to important value-adding projects.

The VSP 8404 shares the same next-generation hardware and software technology basis as the VSP 8284XSQ. This positions the product line to support both today's requirements and tomorrow's emerging needs. The VSP 8000 Series provides business with a future-ready solution that leverages the Industry's most software-definable network virtualization technology.

Product Overview

The VSP 8404 Ethernet Switch provides four front-panel slots that support the flexible deployment of high-density VSP 8400 Series Ethernet Switch Modules. By default, the VSP 8404 is a "zero port" system, with a Chassis that pre-integrates the switching fabric, CPU, and all associated control and management electronics.

Ethernet interfaces are delivered by the addition of one or more field-swappable Ethernet Switch Modules (ESMs).



VSP 8404 4-Slot Ethernet Switch



8408QQ Ethernet Switch Module



8418XSQ Ethernet Switch Module



8418XTQ Ethernet Switch Module



8424XS Ethernet Switch Module



8424XT Ethernet Switch Module



8424GS Ethernet Switch Module



8424GT Ethernet Switch Module

In this manner, the VSP 8404 provides a low-cost, pay-as-you-grow solution for mid-sized businesses that wish to retain a high degree of flexibility as they develop solutions for their networking requirements.

Ethernet Switch Modules

The VSP 8400 Series Ethernet Switch Modules are as follows:

- 8408QQ 8-port 40 Gigabit Ethernet QSFP+ ESM
- 8418XSQ 16-port 10 Gigabit Ethernet SFP+ and 2-port 40 Gigabit Ethernet QSFP+ Combo ESM
- 8418XTQ 16-port 10 Gigabit Ethernet RJ45 and 2-port 40 Gigabit Ethernet QSFP+ Combo ESM
- 8424XS 24-port 10 Gigabit Ethernet SFP+ ESM
- 8424XT 24-port 10 Gigabit Ethernet RJ45 ESM
- 8424GS 24-port Gigabit Ethernet SFP ESM
- 8424GT 24-port Gigabit Ethernet RJ45 ESM

It should also be noted:

- The VSP 8404 currently enables 6 of the 8 ports physically supported by each 8408QQ ESM
- 40 Gigabit Ethernet QSFP+ ports support Channelization and can therefore be individual sub-divided into four 10 Gigabit Ethernet channels.
- 10 Gigabit Ethernet SFP+ ports also support a wide range of 1 Gigabit Ethernet SFP Transceivers.
- 10 Gigabit Ethernet RJ45 ports also support 100/1000Mbps connectivity.

- Gigabit Ethernet SFP ports support a wide range of 1 Gigabit Ethernet SFP Transceivers.
- Gigabit Ethernet RJ45 ports support 10/100/1000Mbps connectivity.

Please refer to the product technical documentation for further details.

As with the VSP 8284XSQ, the VSP 8404 leverages the most advanced chipset from the industry's leading supplier, featuring 2.56Tbps of switching and 1,428Mpps of frame forwarding performance. This delivers Terabit-scale, wire-speed capabilities, with a fully integrated 10/40/100 Gigabit ASIC architecture that facilitates multiple design opportunities.

Benefits

The VSP 8404 delivers enhanced flexibility, and is compatible with, and complementary to, existing products and technologies from the Avaya Networking portfolio. Extending the Compact Form-Factor concept, the VSP 8404 provides the very high-capacity, high-performance, and flexible connectivity solution for mid-sized Campus and Data Center networks.

Building genuine high-availability enhances a network's resiliency posture. In addition to the various HA factors offered by premium Chassis-based products, Switch Cluster technology delivers physical independence; isolated control planes (delivering process separation, isolation, and protection), and allows for in-service software upgrades. The VSP 8000 Series brings the advantages of deploying Switch Cluster technology to mid-sized businesses.

VSP 8404 Highlights:

- Flexible support for up to 96 ports of 1/10 Gigabit Ethernet or 24 ports of 40 Gigabit Ethernet
- Supports AC or DC high-availability power
- Non-blocking, wire-speed switching architecture
- Integrated design that is optimized for low latency
- Flexible L2/L3 address table entry architecture delivers MAC, ARP, and IP Routing scalability
- Feature-rich support for Standards-based VLAN, MLT, STP, and SPB technologies
- Advanced IPv4 & IPv6 Routing
- Integrated Layer 2, Layer 3, IP Routing, & IP Multicast network virtualization
- IPv6-optimized Hardware
- MACsec, and Enhanced Security Mode options



The VSP 8404 also natively supports the Avaya Fabric Connect network virtualization technology. Some of the key advantages that Fabric Connect delivers include:

- Making the need to configure network-wide VLANs obsolete
- Replacing multiple sequential legacy protocols with this one single unified technology
- Removing the risk of network loops
- Delivering the Edge-only provisioning model which seamlessly integrates with orchestration and automation
- Fully optimizing all links and all devices, enabling businesses to get the most out of infrastructure investments

Features & Capabilities

- Non-blocking, wire-speed switching architecture
- Integrated design that is optimized for low latency

- Flexible address table architecture delivers MAC, ARP, and IP Routing scalability
- Feature-rich support for Standards-based VLAN, Multi-Link Trunking, Spanning Tree Protocol, and Shortest Path Bridging technologies
- Routed IPv4 & IPv6 includes support for Static, RIP/RIPng, OSPF/OSPFv3, eBGP, BGP+, ECMP, VRRP, PIM-SM, and VRF
- IPv6-optimized Hardware
- Avaya Switch Cluster technology supports Triangle & Square configurations, with both Layer 2 Split Multi-Link Trunking (SMLT) and Layer 3 Routed Split Multi-Link Trunking (RSMLT) functionality, and Virtual IST
- Avaya Fabric Connect technology supports Layer 2 Virtual Service Networks (VSNs), Layer 3 Virtual Service Networks, Inter-VSN Routing, IP Shortcut Routing, IP Multicast-over-Fabric Connect, Fabric Attach Server, Fabric Extend, and Switched UNI.

High Availability Power & Cooling

- Up to 2 field-replaceable, hot-swappable internal AC or DC Power Supplies
- 4 field-replaceable Fan Modules

Warranty

- 12-month Hardware Warranty
- A complete range of support options are also available, either directly from Avaya or indirectly from our Authorized Business Partner network

Software Licensing

- Base Software License, included with hardware purchase, enables most features with the exception of those specifically noted as enabled by the Premier Software License.
- Premier Software License, an optional accessory, enables the following features: Layer 3 Virtual Service Networks and - where local regulations permit - MACsec.

Country of Origin

- China (PRC)

VSP 8000 Series Standards Compliance

The VSP 5.0 Software release provides compliance with the following IEEE and IETF standards:

IEEE

802.1 Bridging (Networking) and Network Management

- 802.1D MAC Bridges (a.k.a. Spanning Tree Protocol)
- 802.1p Traffic Class Expediting and Dynamic Multicast Filtering
- 802.1t 802.1D Maintenance
- 802.1w Rapid Reconfiguration of Spanning Tree (RSTP)

- 802.1Q Virtual Local Area Networking (VLAN)
- 802.1s Multiple Spanning Trees (MSTP)
- 802.1v VLAN Classification by Protocol and Port
- 802.1ag Connectivity Fault Management
- 802.1ah Provider Backbone Bridges
- 802.1aq Shortest Path Bridging (SPB) MAC-in-MAC

- 802.1Qbp Equal-Cost Multi-Path (Shortest Path Bridging)
- 802.1X Port-Based Network Access Control
- 802.1AE Media Access Control Security
- 802.1AX Link Aggregation

802.3 Ethernet

- 802.3-1983 CSMA/CD Ethernet (ISO/IEC 8802-3)
- 802.3i-1990 10Mb/s Operation, 10BASE-T Copper
- 802.3u-1995 100Mb/s Operation, 100BASE-T Copper, with Auto-Negotiation

- 802.3x-1997 Full Duplex Operation
- 802.3z-1998 1000Mb/s Operation, Implemented as 1000BASE-X
- 802.3ab-1999 1000Mb/s Operation, 1000BASE-T Copper

- 802.3ae-2002 10Gb/s Operation, Implemented as 10GBASE-SFP+
- 802.3an-2006 10Gb/s Operation, 10GBASE-T Copper
- 802.3ba-2010 40Gb/s and 100Gb/s Operation, Implemented as 40GBASE-QSFP+

IETF

- 768 UDP
- 783 TFTP
- 791 IP
- 792 ICMP
- 793 TCP
- 826 ARP
- 854 Telnet
- 894 Transmission of IP Datagrams over Ethernet Networks
- 896 Congestion Control in IP/TCP Internetworks
- 906 Bootstrap Loading using TFTP
- 950 Internet Standard Subnetting Procedure
- 951 BOOTP: Relay Agent-only
- 959 FTP
- 1027 Using ARP to Implement Transparent Subnet Gateways
- 1058 RIP
- 1112 Host Extensions for IP Multicasting
- 1122 Requirements for Internet Hosts - Communication Layers
- 1155 Structure and Identification of Management Information for TCP/IP-based Internets
- 1156 MIB for Network Management of TCP/IP
- 1157 SNMP
- 1212 Concise MIB Definitions
- 1213 MIB for Network Management of TCP/IP-based Internets: MIB-II
- 1215 Convention for Defining Traps for use with the SNMP
- 1256 ICMP Router Discovery
- 1258 BSD Rlogin
- 1271 Remote Network Monitoring MIB
- 1305 NTPv3
- 1321 MD5 Message-Digest Algorithm
- 1340 Assigned Numbers
- 1350 TFTPv2
- 1398 Ethernet MIB
- 1442 SMIPv2 of SNMPv2
- 1450 SNMPv2 MIB
- 1519 CIDR
- 1541 DHCP
- 1542 Clarifications & Extensions for BOOTP
- 1573 Evolution of the Interfaces Group of MIB-II
- 1587 OSPF NSSA Option
- 1591 DNS Client
- 1650 Definitions of Managed Objects for the Ethernet-like Interface Types
- 1657 Definitions of Managed Objects for BGP-4 using SMIPv2
- 1723 RIPv2 Carrying Additional Information
- 1812 Router Requirements
- 1850 OSPFv2 MIB
- 1866 HTMLv2
- 1907 SNMPv2 MIB
- 1930 Guidelines for creation, selection, and registration of an AS
- 1981 Path MTU Discovery for IPv6
- 2021 Remote Network Monitoring MIBv2 using SMIPv2
- 2068 HTTP
- 2080 RIPng for IPv6

- 2131 DHCP
- 2138 RADIUS Authentication
- 2139 RADIUS Accounting
- 2236 IGMPv2 Snooping
- 2284 PPP Extensible Authentication Protocol
- 2328 OSPFv2
- 2362 PIM-SM
- 2404 HMAC-SHA-1-96 within ESP and AH¹
- 2407 Internet IP Security Domain of Interpretation for ISAKMP¹
- 2408 Internet Security Association and Key Management Protocol¹
- 2428 FTP Extensions for IPv6 and NAT
- 2452 TCP IPv6 MIB
- 2453 RIPv2
- 2454 UDP IPv6 MIB
- 2460 IPv6 Basic Specification
- 2463 ICMPv6
- 2464 Transmission of IPv6 Packets over Ethernet Networks
- 2466 MIB for IPv6: ICMPv6 Group
- 2474 Differentiated Services Field Definitions in IPv4 & IPv6 Headers
- 2475 Architecture for Differentiated Service
- 2541 DNS Security Operational Considerations
- 2545 BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing
- 2548 Microsoft Vendor-specific RADIUS Attributes
- 2572 Message Processing and Dispatching for SNMP
- 2573 SNMP Applications
- 2574 User-based Security Model for SNMPv3
- 2575 View-based Access Control Model for SNMP
- 2576 Coexistence between v1/v2/v3 of the Internet-standard Network Management Framework
- 2578 SMIPv2
- 2579 Textual Conventions for SMIPv2
- 2580 Conformance Statements for SMIPv2
- 2597 Assured Forwarding PHB Group
- 2598 Expedited Forwarding PHB OA&M RFCs
- 2616 HTTPv1.1
- 2716 PPP EAP TLS Authentication Protocol
- 2787 Definitions of Managed Objects for VRRP
- 2818 HTTP over TLS
- 2819 Remote Network Monitoring MIB
- 2863 Interfaces Group MIB
- 2865 RADIUS
- 2874 DNS Extensions for IPv6
- 2925 Definitions of Managed Objects for Remote Ping, Traceroute, & Lookup Operations
- 2933 GMP MIB
- 2934 PIM MIB for IPv4
- 2992 ECMP Algorithm
- 3046 DHCP Relay Agent Information Option 82
- 3162 RADIUS and IPv6
- 3246 Expedited Forwarding PHB
- 3315 DHCPv6
- 3376 IGMPv3

- 3411 Architecture for Describing SNMP Management Frameworks
- 3412 Message Processing and Dispatching for SNMP
- 3413 SNMP Applications
- 3414 USM for SNMPv3
- 3415 VACM for SNMP
- 3416 Protocol Operations v2 for SNMP
- 3417 Transport Mappings for SNMP
- 3418 MIB for SNMP
- 3484 Default Address Selection for IPv6
- 3513 IPv6 Addressing Architecture
- 3569 Overview of SSM
- 3579 RADIUS Support for EAP
- 3587 IPv6 Global Unicast Address Format
- 3596 DNS Extensions to support IPv6
- 3748 Extensible Authentication Protocol
- 3768 VRRP; plus draft-ietf-vrrp-ipv6-spec-08
- 3810 MLDv2 for IPv6: Host Mode-only
- 4007 IPv6 Scoped Address Architecture
- 4022 TCP MIB
- 4087 IP Tunnel MIB
- 4113 UDP MIB
- 4213 Basic Transition Mechanisms for IPv6 Hosts and Routers
- 4250 SSH Assigned Numbers
- 4251 SSH Protocol Architecture
- 4252 SSH Authentication Protocol
- 4253 SSH Transport Layer Protocol
- 4254 SSH Connection Protocol
- 4255 DNS to Securely Publish SSH Key Fingerprints
- 4256 Generic Message Exchange Authentication for SSH
- 4291 IPv6 Addressing Architecture
- 4292 IP Forwarding Table MIB
- 4293 IP MIB
- 4301 Security Architecture for IP¹
- 4302 IP Authentication Header¹
- 4303 IP Encapsulating Security Payload¹
- 4308 Cryptographic Suites for IPsec
- 4363 Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering and Virtual LAN Extensions
- 4443 ICMP for IPv6
- 4552 Authentication/Confidentiality for OSPFv3
- 4835 Cryptographic Algorithm Implementation Requirements for ESP & AH¹
- 4861 Neighbor Discovery for IPv6
- 4862 IPv6 Stateless Address Auto-Configuration
- 5095 Deprecation of Type 0 Routing Headers in IPv6
- 5187 OSPFv3 Graceful Restart (Helper-mode)
- 5308 Routing IPv6 with IS-IS
- 5340 OSPF for IPv6
- 5798 VRRPv3 for IPv4 & IPv6²
- 6105 IPv6 Router Advertisement Guard
- 6329 IS-IS Extensions supporting Shortest Path Bridging QoS RFCs
- 7610 DHCPv6 Shield: Protecting against Rogue DHCPv6 Servers

Additional Information

For further information about the Avaya Virtual Services Platform 8000 Series please visit www.avaya.com/products, and for the complete Avaya Networking portfolio, www.avaya.com/networking.

About Avaya

Avaya is a leading, global provider of customer and team engagement solutions and services available in a variety of flexible on-premise and cloud deployment options. Avaya's fabric-based networking solutions help simplify and accelerate the deployment of business critical applications and services. For more information, please visit www.avaya.com.

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