

Product Assessment: **Cisco - Catalyst 6500**  
 Report Date: December 06, 2011  
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 Service: Hot Topics , Business Technology and Software  
 Market: Data Center , Enterprise Networking  
 Class: Enterprise High Capacity Switch Routers  
 Current Perspective: ★★★★★☆

## Summary

### Buying Criteria



### Current Perspective



The Cisco Catalyst 6500-E remains threatening to the competition, because as Cisco's primary switching platform for enterprise backbones and Gigabit Ethernet data center applications, this platform has received a great deal of Cisco's product development attention and continues to see considerable development. The E-Series chassis improves backplane capability to 80G per slot, providing customers with performance capabilities for another generation of line cards – which when coupled with the new Supervisor 2T and accompanying line-cards extends the useful life of the 6500 family once again. The Catalyst 6500-E is available in three-, four- six-, nine- and 13-slot models, with differing backplane configurations that affect the amount of bandwidth available per slot. Specifically, the newer Catalyst 6513-E chassis is capable of doing 80G per slot on all 13 slots and provides a total 2 Terabit system scalability. The 6500 is a feature/functionality leader, offering a broad set of MPLS, virtualization, security and QoS features as well as wireless controller module and enterprise WAN and IP services line cards including firewall, VPN, Layer 4-7 switching, SSL acceleration, IDS and network analysis, making the 6500 a true convergence platform.

Cisco's strategy in selling the Catalyst 6500-E is to get customers in at least at the base level, with a 32 Gbps offering suitable for small- to medium-sized networks, though certainly Cisco begins the sales and solution discussion with a higher performance solution. Cisco offers tiered performance: Supervisor Engine 32 (S32) for user access and WAN support for rich features and limited bandwidth requirements, while the new Supervisor Engine 2T provides the highest end performance and scale and is positioned for backbone and server access where feature richness and/or higher bandwidth are required. Many of Cisco's high-performance interface cards offer a distributed forwarding card (DFC) upgrade option, which effectively adds local switching, Netflow capacity and forwarding engine capabilities to the line card module, removing the module's dependency on the supervisor module for switching horsepower. All of the configuration options, line cards and daughter cards can make the Catalyst 6500-E a difficult platform to compete against, but also a difficult platform for customers to cope with from a cost, configuration and logistics standpoint.

The Catalyst 6500-E is the target of many competitive attack campaigns because it is the most prolific LAN chassis in the world. Though even with the new 2T release, it does not quite match some of the new competing products coming to market with greater performance and higher density. This includes Cisco's own Nexus family, which is Cisco's premier data center switch platform. Those customers who embrace the Nexus in the data center though can find value in redeploying the 6500 as a services node with the complement of modules available. However, in the LAN campus, the 6500-E still reigns king today, though it is facing increasing competitive intensity from competitors with high-density products.

## Strengths and Weaknesses

### Strengths

- The Catalyst 6500-E can scale from 32 Gbps in an entry-level configuration, up to 4 Tbps and more than 1440 million packets per second in a fully distributed, VSS-based configuration (2 chassis).

### Weaknesses

- Configuring and deploying the Catalyst 6500-E for high-performance backbones can be complex since there are four generations of line cards available. Most customers will order either S32+61xx line cards or S2T + 69xx line

- The Catalyst 6500-E is the industry's only enterprise backbone services switch offering traditional Layer 2-4 connectivity as well as a full array of service modules including firewall, VPN (IPSec and SSL), IDS, SSL acceleration, WLAN switching, content switching, application acceleration and network analysis monitoring (NAM).
- The Catalyst 6500-E offers rich feature set that include Virtual Switching System (VSS), network virtualization (MPLS/VRF-Lite), high availability, security and QoS features to satisfy an enterprises switching needs no matter the scale or application demands.
- Customers can scale performance through the use of modular distributed forwarding cards, which allow the customer to upgrade performance of individual fabric-capable line cards if they so desire. Cisco also has a robust range of power supplies for the Catalyst 6500-E, giving it full power redundancy up to and including 420 ports at Class 3 15.4 Watts.
- The Catalyst 6500-E can also be used as a WAN router with appropriate line card modules, and supports Cisco 7xxx series port adapters. Catalyst 6500-E supports enterprise WAN, Internet access and data center interconnect (DCI) features such as Ethernet over MPLS, VPLS, generic routing encapsulation (GRE), virtualization with Layer 2 and 3 MPLS VPN.

cards, slightly reducing complexity.

- As the 6500 was designed with such a rich feature set, upgrading the operating system (IOS) can be a taxing activity as there may be special versions for each application module in addition to the basic switching features in deployments where the 6500 is used as a services platform as well as a switch.
- The Catalyst 6500-E architecture requires a supervisor (with integrated uplink ports and switch fabric), plus a selection of bus- or fabric-enabled line cards. The selection of DFCs for performance optimization is optional for the GbE fabric cards whereas eight- and 16-port 10G cards come with DFC by default.
- Cisco has provided good investment protection and transition paths for the chassis, but even that has occasionally required a forklift upgrade to accommodate changes in cooling architecture over the years as the technology has evolved.
- Cisco charges some of the highest prices in the industry, particularly when configured for wire speed performance beyond 32 Gbps. The fabric-based architecture of the Catalyst 6500-E drives up the overall cost of the solution and obscures the cost of the product when compared to many competitors' solutions.
- While the primary use case for the 6500 is as a core switching platform and aggregation device in the data center, it is used in some wiring closet use cases. The only caveat is that compared to stackable solutions, including Cisco's own 3750 the economics may not be favorable unless using the 6500 in a redeployment as the CapEX and OpEX are quite high relative to the 3750 offering.

## Point and Counterpoint

### Point

- The Cisco Catalyst 6500-E chassis promises the user nearly unlimited functionality and expandability, but most customers never realize the performance of the system, instead opting for an entry-level configuration for economic reasons.

### Point

- Cisco continues to charge a premium for a product that, in an entry-level configuration, is typically outclassed by competing products both from a performance and price perspective.

### Point

- Cisco's management applications for the Catalyst 6500-E are scattered across multiple tools, although partially addressed in the Prime for Enterprise platform.

### Point

- Cisco's 10 Gigabit solution is blocking in most configurations, and often does not deliver the wire-speed deterministic performance that competing architectures built for high-density 10 Gig can offer.

### Counterpoint

- Cisco gives customers the flexibility to deploy only what they need today, with the ability to expand the Catalyst 6500-E chassis to multiple higher performance levels in the future. Unlike many competing solutions, the Cisco Catalyst 6500-E can be upgraded in place without having to forklift upgrade the entire chassis.

### Counterpoint

- Cisco's Catalyst 6500-E is the one of the only chassis in the industry that has proven to scale beyond its first-generation design without sacrificing performance or introducing significant performance bottlenecks in the switch architecture. While other vendors may offer more performance today, some of the current generation products will require a hardware roll or replacement to accommodate emerging features and technology currently in standards development without replacing the entire switch.

### Counterpoint

- Cisco offers a rich set of MIBs and numerous management tools tailored to meet the varying needs of different sized enterprises and their respective set of management solutions. In addition to policy and QoS management through AutoQoS, SmartPorts and Cisco QoS Policy Manager, Cisco firewall service manager (FWSM) can be managed through the Content Switching Module (CSM); Cisco's Application Control Engine (ACE) can be managed through the Application Network Manager (ANM).

### Counterpoint

- The Catalyst 6500-E can be configured for both blocking and non-blocking 10 Gigabit performance. Cisco offers four-, eight- and 16-port 10G line cards to address the various aggregation and interconnect needs in an enterprise backbone. In many instances, a blocking 10G port still

simplifies deployment over multiple GbE links. In addition, rarely does a customer truly need wirespeed performance on multiple ports on the same linecard simultaneously, and therefore customers can deploy a less expensive and more dense solution.

#### Point

- Cisco's own Nexus family is marketed as the data center backbone switch with the Catalyst 6500 relegated to a supporting role. Purchasing a Catalyst 6500-E is an investment in old technology that even Cisco admits is no longer industry-leading technology for the data center.

#### Counterpoint

- The Nexus family is, in fact, Cisco's newest high performance platform. However, Catalyst 6500-E and Nexus are complementary platforms. Enterprises that need the highest non-blocking performance can use the Nexus as the core with Catalyst 6500-E providing significant on-going benefits with its diversity of service modules and Data Center Interconnect features. Also, the newer Catalyst 6513-E chassis provides 2-Terabit scalability. Enterprises that don't require the very highest performance can continue to invest in and utilize the Catalyst 6500-E for years to come. Purchasing a Catalyst 6500-E is an investment that will take customers from 10/100Mb to 40Gb interfaces whereas the Nexus 7000 will take customers from 1G to 100G interfaces while also offering unified fabric benefits.

## Buying/Selecting Criteria

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### Management/Ease of Use



- The Catalyst 6500-E offers multiple levels of integrated services features, including the well-known IP services modules (firewall, IDS, VPN etc.) These modules strongly contribute to the Catalyst 6500-E's overall ease of use, ease of deployment and TCO.
- The Catalyst 6500-E supports non-stop code upgrades, which provide high availability networking, even during maintenance periods. With this feature, the switch software can be upgraded, new modules can be installed, and system memory can be upgraded without a switch reboot. Cisco claims millisecond failover times in the event of a network or equipment failure in the Catalyst 6500-E.
- The Catalyst 6500 Series offers Operational Manageability tools to help customers easily monitor and manage network. Operational Manageability tools include: Cisco Smartports, Cisco AutoQoS, Cisco AutoSecure, Embedded Event Manager (EEM), Generic Online Diagnostics (GOLD) and Smart Call Home.
- Cisco's IOS interface is the industry standard for switch and router management. The Cisco CLI is the best known and most taught interface, and also the most copied.

### Performance



- The Catalyst 6500-E is scalable from 15 million packets per second to over 800 million packets per second, with backplane speeds varying from 32 Gbps to 2.08 Tbps. The Catalyst 6500-E has two backplanes: a shared bus that operates at 80 Gbps, and a crossbar switch that delivers 2,080 Tbps in a VSS system.
- The Supervisor 2T integrates switch management, fabric and uplinks into a single module, providing up to 720 Mpps performance and 1040 Gbps of switching bandwidth, but this performance can only be realized when DFC-enabled line cards are deployed in the chassis.
- With the Supervisor 2T installed, the performance is scaled to 80 Gbps (full duplex) per slot, or 1.04 Tbps per system. Leveraging Cisco's VSS solution with Supervisor 2T, a system can scale to 2.08 Tbps and 1440 Mpps.
- New products from Cisco, Juniper and Brocade all provide higher performance and greater numbers of full line rate ports than the Catalyst 6500 family. While still more than adequate for the majority of enterprise installations, the Catalyst 6500 is no longer the top performing core platform available.

### Port Diversity



- The Cisco Catalyst 6500-E series is hands down one of the most port diverse products available on the market today. Nearly any interface available can be installed in the Catalyst 6500-E, allowing it to serve customers with almost any port needed.
- Cisco's inclusion of so many ports is a boon, but the myriad configuration options make it difficult to understand what ports are non-blocking, which are wire speed, and in what configuration.
- Cisco offers many additional interfaces, including a routing module that can take any standard Cisco port adapter interface (Packet over SONET, ATM OC-3, DS-1s, DS-3s and HSSI).
- Cisco offers PoE and POE+ options for some Catalyst 6500 line cards, which extend the functionality of the switch to supporting more enterprise environments. Cisco is one of only a few vendors that offer this PoE/POE+ functionality on a high capacity switch router.

## Scalability



- The Catalyst 6500-E is available in three-, four-, six-, nine-, and 13-slot chassis to address a wide variety of enterprise size and capacity requirements. The 13-slot E-chassis is the largest chassis that supports full fabric bandwidth on every slot. There is also the Cisco Catalyst 6509-V-E vertical chassis for environments that require front-to-back airflow.
- The Catalyst 6500-E supports up to 577 Gigabit over copper 10/100/1000 connections, up to 385 fiber Gigabit connections and up to 130 10 Gigabit ports (260 in a 2 Chassis VSS configuration).
- Integrated IP services modules including wireless, firewall, VPN, SSL acceleration, content switching, IDS and network analysis allow for unique enterprise backbone and data center functionality including enhanced enterprise security and forensic analysis between departments, locations and customers.
- Cisco's distributed forwarding architecture enables customers to achieve wire-speed non-blocking performance in most configurations. Cisco's distributed forwarding architecture essentially puts a local forwarding engine on each line card, which in turn relieves the Supervisor of the responsibility of processing packets for that line card. While highly scalable, configuring the Catalyst 6500-E chassis for very high-performance networking in environments with small packet sizes requires DFC enabled line cards.
- The Catalyst 6500-E provides for native IPv6 hardware forwarding and MPLS functionality on the Supervisor 720, Supervisor 32 and on any DFC-enabled fabric card that connects to the Supervisor 720.

## Total Cost Of Ownership



- Initial costs for the Catalyst 6500-E may appear low, but these costs reflect only the base configuration capable of switching at 32 Gbps and 15 million packets per second. Configurations comparable to competing switches significantly raise the initial entry costs, because a Supervisor 720 or 2T must be purchased in addition to the chassis, power supply and system software.
- Ultimately, the Cisco 6500 series chassis is an expensive solution to buy incrementally. While initial purchasing costs are on par with competitors, each additional module adds cost in the form of the module and the necessary DFC processor that enables the platform to perform at a level equal to competitors' native switching performance. Additionally, as current generation platforms' performance and density increases, the 6500's economics become less compelling for new deployments.
- Nine- and 13-slot chassis provide plenty of room for new media and service modules that Cisco is delivering for the Catalyst 6500-E platform, providing value over and above that of an ordinary switching platform.
- Cisco has demonstrated twice in the life of the 6500 that it can and will deliver significant performance upgrades that extend the life of the Catalyst 6500-E beyond the five- to seven-year expected lifespan of most competing products. Cisco has publicly stated that customers can and should expect a ten- to 15-year lifespan for each of its chassis' generations.
- When positioned as a wiring closet device, customers pay a premium across the board for switching. The 8:1 oversubscribed 10/100/1000 modules for the Catalyst 6500-E are approximately 50% more expensive than the equivalent 4500-E series modules but perform local on-module switching, unlike the 4500-E modules.

## Metrics

### Physical Characteristics

<b>Device Class</b>	Layer-3
<b>Primary Target Market</b>	Enterprise Backbone and Datacenter GbE Access

### Qos Features

<b>Total # of Transmit Queues per Port</b>	Module dependent
<b>Total # of Receive Queues per Port</b>	Module dependent
<b>Rate Limiting Granularity</b>	32 kbps to 8 Gbps in 32 kbps increments

### Protocol Support

<b>802.3ad Trunking</b>	Yes
<b>IP Routing</b>	Yes
<b>IP Routing Protocols</b>	RIP v1/v2, (E)IGRP, OSPFv2, BGP, IS-IS, PIM (Sparse, Dense), BiDir PIM, IPv6, OSPFv3, MBGP, IS-ISv6, MPLS, EoMPLS, VPLS

### Interface Support

<b>10/100/1000Base48-port T</b>	
<b>10/100/1000Base48-port PoE (802.3af)</b>	

**T with PoE  
(802.3af/802.3at)**

<b>1000Base-X (GBIC or SFP)</b>	16-port, 24-port, 48-port
<b>10G - fixed optics</b>	None
<b>10G Modular Optics</b>	4-port, 8-port, 16-port
<b>10G-Copper</b>	16-port
<b>Other (specify type and port count)</b>	10BaseFL, DS3 ATM, Oc3 ATM, Oc12 ATM, Oc192, T1, E1, DS3, Oc3 POS, Oc12 POS, Oc48 POS, FXS
<b>Special Modules (non-line-cards)</b>	Firewall, Intrusion Detection, IPSec, Network Analysis, Content Switching, Content Services Gateway, Wireless Access, Communications Media Module, Anomaly Detection/Guard, MWAM, PSD, Application Control Engine (SSL< Balancing,>

**Chassis: Specific Characteristics**

<b>Total # of Slots in Chassis</b>	3, 4, 6, 9, 9 vertical, 13
<b>Reserved Slots</b>	1 or 2 (if redundant)

**Chassis: Fabric Module**

<b>Fabric Type</b>	Standard: shared memory bus; fabric: crossbar switch fabric
<b>Fabric Location</b>	Located on supervisor module in all modern configurations; older fabric-enabled units used separate fabric module(s)
<b>Fabric Redundancy</b>	Optional, supported in all models

**Chassis: High Availability**

<b>Hot-Swap Fan Trays</b>	Yes
<b>Hot-Swap Line Cards</b>	Yes
<b>Hot-Swap Management Module</b>	Yes
<b>Hot-Swap Fabric Module</b>	Yes
<b>Hot-Swap Power Supplies</b>	Yes
<b>Hot-Swap Other</b>	Not applicable
<b>Minimum # of Power Supplies</b>	1
<b>Maximum # of Power Supplies</b>	2
<b>Power Supply Load Distribution</b>	1+1
<b>Non-Stop Code Upgrade</b>	Yes, and modular subsystem upgrades on some versions of IOS

**Chassis: Performance**

<b>Backplane Size</b>	Standard: 32 Gbps, 256 Gbps & 720 Gbps fabrics available; 1.44Tbps in VSS1440 system
<b>Forwarding Rate</b>	15 Mpps standard, up to 400 Mpps with distributed forwarding engines; upto 800Mpps in a VSS1440 system
<b>Switch Forwarding Latency</b>	10.9 usec (10/100), 9.4usec (gigabit), 7usec (10 Gigabit)

**Chassis: Pricing**

<b>Bare Chassis Configuration</b>	6503-E: Enhanced 3 Slot Chassis = \$2,500.00 ; 6504-E: Enhanced 4 Slot Chassis = \$3,000.00 ; 6506-E: Enhanced 6 Slot Chassis = \$5,500.00 ; 6509-E: Enhanced 9 Slot Chassis = \$9,500.00; C6509-V-E: Enhanced 9 Slot Vertical Chassis = \$9,995; 6513: Chassis = \$15,250.00
<b>10/100/1000Base-T Line Card Price</b>	48-port 10/100/1000 Base-T (WS-X6148A-GE-TX) = \$7,000.00 ; 48-port 10/100/1000 Base-T, PoE, (WS-X6148A-GE-45AF) = \$9,000.00; 48-port 10/100/1000 Base-T, PoE+, (WS-X6148E-GE-45AF) = \$9,000.00; 48-port 10/100/1000 Base-T, 8 Gbps fabric connect (WS-X6548-GE-TX) = \$12,000.00 ; 48-port 10/100/1000 Base-T, 8 Gbps fabric connect, PoE (WS-X6548-GE-45AF) = \$14,000.00 ; 48-port 10/100/1000 Base-T, 40

	Gbps fabric connect (WS-X6748-GE-TX) = \$15,000.00
<b>1000Base-X GBIC/SFP Line Card Price</b>	16 port GE, fabric enabled (WS-X6516A-GBIC) = \$15,000.00; 24 port GE, 20 Gbps fabric connect (WS-X6724-SFP) = \$15,000.00 ; 48 port GE, 40 Gbps fabric connect (WS-X6748-SFP) = \$25,000.00
<b>10 Gig Line Card Price</b>	XENPAC - 4p 10G (WS-X6704-10GE) = \$20,000; 8p 10G (WS-X6708-10G-3C) = \$37,500; 16p 10G (WS-X6716-10G-3C) = \$40,000   10G XFP - N/A   10G-Copper - 16 port 10GbE 10GBASE-T (WS-X6716-10T-3C ) = \$22,500 N/A

## Support

<b>Standard Warranty</b>	90 days
<b>Enterprise Maintenance Contract</b>	Smartnet which ranges from 3% of the suggested list price up and provides for a range of options starting with software only and go up to 7x24x365 2 hr onsite.

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