Cisco 6400 Carrier-Class Broadband Aggregator

THE CISCO 6400 CARRIER-CLASS BROADBAND AGGREGATOR IS A HIGH-PERFORMANCE, SCALABLE SERVICE GATEWAY THAT ENABLES THE SELECTION AND DELIVERY OF BROADBAND NETWORK SERVICES, VIRTUAL PRIVATE NETWORKS (VPNS), AND VOICE- AND ENTERTAINMENT-DRIVEN TRAFFIC OVER THE FULL SUITE OF ACCESS MEDIA. THE CISCO 6400 COMBINES THE RICHNESS OF CISCO IOS® SOFTWARE, ASYNCHRONOUS TRANSFER MODE (ATM) SWITCHING AND ROUTING CAPABILITIES, AND VALUE-ADDED SERVICE SELECTION IN A MODULAR, SCALABLE, REDUNDANT, NETWORK EQUIPMENT BUILDING STANDARD (NEBS) CERTIFIED AND ETSI FORM FACTOR.

Applications

The digital subscriber line (DSL) market is quickly maturing from a technology and pilot service phase to large-scale deployments. As part of this evolution, service providers need to offer scalable services to both business and residential customers, supporting security, service selection, quality of service (QoS), and virtual private networks (VPNs). Cisco Systems is the first to acknowledge the complexity in meeting this need and offers the first end-to-end service-oriented DSL architecture from the customer premises equipment (CPE) to core ATM switching. The Cisco 6400 is an integral component of this architecture, enabling service providers to make the most of their DSL and dial service offerings.

Figure 1   Cisco 6400

The Cisco 6400 may reside within the operating company's infrastructure (directly or via co-location) to aggregate access media (DSL, cable, wireless, and dial), serving as the intelligent equal access point that allows a multitude of operating companies and service providers access to the end users. In addition, the Cisco 6400 may reside at the network edge between the operating companies and ISP or corporation, providing the aggregation of sessions and tunnels as well as service and network selection capabilities required in the delivery of advanced broadband services.

When deployed by a wholesale service provider, the Cisco 6400 allows users to dynamically select on-demand services. It then switches user traffic to the selected services, applying full-edge routing and QoS policies. As a full-IP and ATM edge device, it forwards the traffic simultaneously to multiple IP domains, after preparing it for delivery to core networks, such as those powered by the Cisco 12000 Gigabit Switch Router (GSR) and Cisco BPX® 8600 product families.

When deployed by an ISP, the Cisco 6400 applies familiar dial-aggregation services to subscriber connections. It terminates and aggregates numerous end-user sessions and delivers the traffic to the ISP's backbone and host value-added services, such as e-mail, Web hosting, Web caching, Internet gaming, multipoint videoconferencing, streaming video and entertainment-driven traffic.

The Cisco 6400 may also be deployed by enterprises offering employees fast, reliable, authenticated access for telecommuting to both corporate networks and the Internet via secure VPNs.

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In order to meet the demands of these diverse roles, the Cisco 6400 uses its fully-featured Layer 2 and Layer 3 Cisco IOS base. The Cisco 6400 can operate as a pure ATM switch, forwarding cells transparently or terminating local ATM virtual circuits, as a pure router, performing IP services or Point-to-Point Protocol (PPP) termination/PPP tunneling via Layer 2 Tunneling Protocol (L2TP), or a combination of both.

Product Overview

The Cisco 6400 consists of a fault-tolerant ATM switching core and multiple fault tolerant routing engines. The ATM switch, based on Catalyst$^®$ 8500 + Per-Flow Queuing (PFQ) technology, provides the necessary ATM switching and traffic management capabilities, while the router modules enable the service provider to offer scalable Layer 3 services, described below. ATM interfaces connect the Cisco 6400 to dial access servers, DSLAMs, and Cisco IP DSL Switches, and ATM and packet interfaces connect to the network core. The Cisco 6400 is designed for use in high-availability environments such as operating companies' central offices (directly or via co-location), ISP offices, and corporate premises. As such, it includes switch, router, and line card redundancy, as well as 12-inch packaging (key for central office deployment).

The Cisco 6400 provides the following benefits:

- *Session scalability*—The Cisco 6400 represents a quantum leap in session scalability, capable of supporting up to 96,000 subscriber sessions through one fully configured system. This scalable and flexible approach enables service providers to deliver secure PPP-based services to a much broader customer base by leveraging any end user's hardware and system configuration.
- *Modular design*—The Cisco 6400 is a modular platform, with capacity starting at 2000 subscribers in its entry level configuration. The Cisco 6400 is capable of expanding to 96,000 subscribers quickly and cost-effectively as business grows, all the while delivering industry leading performance with the lowest cost per subscriber session in the industry.
- *Routing and VPN scalability*—Using the Cisco 6400, service providers can simultaneously route end-user traffic over secure, independent pathways exceeding 1000 different domains or end destinations, with an aggregate throughput of over 2.4 gigabit per second forwarding capacity for handling even the most bandwidth-intensive broadband traffic. Each domain represents a VPN that may be assigned its own secure private path and own

QoS level, enabling service providers to generate revenue by assigning QoS levels for each domain connection or service and charging fees accordingly.
- *Flexible service architecture*—The Cisco 6400 forms the basis of a foundation architecture which supports the widest variety of services in the industry. The Cisco 6400 supports a variety of client architectures, including bridging, routing, PPP over ATM (PPPoA), PPP over Ethernet (PPPoE), and L2TP. Supported network architectures include IP, IP over ATM, Multi-protocol label switching (MPLS) VPNs and IPSec. All of these services are supported by the full suite of Cisco IOS routing protocols.
- *Reduction of provisioning costs*—By terminating PPP sessions and mapping them to as many as 1000 routing domains without concern for overlapping private IP address spaces, the Cisco 6400 does away with the high provisioning costs and complexities of a point-to-point network architecture.
- *Dynamic service selection*—The Service Selection Gateway (SSG) allows subscribers to dynamically select on-demand services. As the gateway to New World services, the SSG enables services such as videoconferencing, streaming video, personalized Internet, business-grade Internet, shopping, and gaming to create new revenue streams and help attract and retain subscribers. The SSG allows each family member to access multiple services simultaneously for the ultimate in service utility, flexibility, and advertisement.
- *Captive Web-based service selection portals*—The Service Selection Dashboard (SSD) software works in conjunction with SSG, allowing service providers to create customized network portals for individual subscribers. Because the software is Web-based, end users need no additional software other than their own Web browser, and service providers incur no costs for software royalties or support. Through the Web-based portals, users can access their own personalized profile, on any computer and operating system, and select any number of simultaneous services by simply pointing and clicking. Access to different networks, such as the Internet, corporate intranets, gaming or other entertainment-based services is provided via an authenticated log-on that is available to all users connected from homes or small business LANs.
- *Flexible accounting*—The SSG lets service providers track and bill individual user session on a per-service basis, or even on a per-service, per- family-member basis, further enabling the

deployment of on-demand services. Each individual family member may have a different set of privileges and be billed accordingly.

- *Full Cisco IOS*

Cisco 6400 Components

- *Chassis*—Network Equipment Building System, Level 3 (NEBS3) certified and ETSI compliant packaging; full redundancy; DC power; external AC power (internal/external)
- *Dual fault tolerant Node Switch Processor (NSP)*—5-Gbps switching matrix with PFQ
- *Node Route Processor (NRP2)—next generation Node Route Processor*—Cisco IOS software routing engine with 622-Mbps throughput-up to six NRP2s per chassis (up to eight when using only Gigabit Ethernet interfaces)
- *Node Route Processor (NRP)—the first Node Route Processor*—Cisco IOS software routing engine with 155-Mbps throughput-up to seven NRPs per chassis (up to eight when using only Fast Ethernet interfaces)
- *Multiple fault tolerant node line card (NLC)*—Two-port OC-3/STM-1 ATM interface; two-port DS3 ATM interface; one-port OC-12 ATM interface; all interfaces provide automatic protection switching (APS) in redundant configuration. Maximum configuration supports up to 32 DS3 or OC-3/STM-1 ATM interfaces, or up to eight OC-12 ATM interfaces per chassis
- *Cisco IOS software*—For the NSP, NRP2, and NRP. The NRP2 and NRP also support multi-domain PPP Termination Aggregation (PTA) as well as WebSelection. Cisco IOS software provides a scalable and comprehensive set of networking features such as its cohesive inter-network operating system, security protocols and network management.
- *Service Connection Manager (SCM)*—A powerful management tool with fully featured graphical user interface (GUI) based provisioning and monitoring management system.

Node Switch Processor

- 5-Gbps nonblocking shared-memory switch supporting 32K permanent virtual circuits/switched virtual circuits (PVCs/SVCs) (including soft virtual channel connections [VCCs] and virtual path connections [VPCs]) based on the successful Catalyst 8500
- Optional redundant NSP for low-delay fail-over
- Online insertion and removal (OIR) for standby NSP
- ATM QoS (constant bit rate [CBR], variable bit rate [VBR], unspecified bit rate [UBR], UBR+) - per PVC traffic shaping

- Per-Flow Queuing for advanced traffic management, virtual circuit (VC) merge, and VC/virtual path (VP) shaping
- PVCs, SVC, Integrated Local Management Interface 4.0 (ILMI), TM 4.0, Private Network-Network Interface 1.0 (PNNI), User Network Interface 3.0/3.1/4.0 (UNI)

Next-Generation Node Route Processor

- 622-Mbps forwarding capacity derived from Cisco 7200 technology (NPE 300)
- Pairs of NRP2s support fault tolerant enhanced high system availability (EHSA) architecture
- Up to six NRP2s in a single Cisco 6400 for scalability, reserving two slots for NLCs (up to eight when using only Gigabit Ethernet interfaces)
- OIR
- 16,000 RFC1483 Ethernet bridged, 16,000 PPP over ATM (PPPoA), or PPP over Ethernet (PPPoE) per NRP2 or 96,000 PPP sessions per chassis (6 x NRP2)
- Virtual routers or multidomain PPP termination aggregation (PTA) to provide connectivity to up 500 simultaneous domains
- Full multi-protocol label switching (MPLS) support
- Integrated Gigabit Ethernet interface for access to local content, servers, and packet cores
- Integrated Layer 3 service selection with Web-based dashboard
- Multi-domain user-provisioned access to multiple services with support for overlapping IP address space

Node Route Processor

- 155-Mbps throughput routing engine derived from Cisco 7200 technology (NPE 200)
- Pairs of NRPs support fault tolerant enhanced high system availability (EHSA) architecture
- Up to seven NRPs in a single Cisco 6400 for scalability; seven NRPs with one slot reserved for NLC (up to eight when using only Fast Ethernet interfaces)
- OIR
- 2000 RFC1483 Ethernet bridged, 2000 PPP over ATM (PPPoA), or PPP over Ethernet (PPPoE) per NPR or 14,000 PPP sessions per chassis (7 x NRP)
- Virtual routers or multidomain PPP termination aggregation (PTA) to provide connectivity to up 500 simultaneous domains
- Full multi-protocol label switching (MPLS) support
- Integrated Fast Ethernet interface for access to local content, servers, management, and packet cores
- Integrated Layer 3 service selection with Web-based dashboard
- Multi-domain user-provisioned access to multiple services with support for overlapping IP address space

Node Line Card

- Two-port single-mode (SM) OC-3/STM-1 ATM interface; two-port DS3 ATM interface; single-port single mode OC-12/STM-4 interface
- Pairs of NLCs support APS over Synchronous Optical Network (SONET)/Synchronous Digital Hierarchy (SDH)
- OIR
- Other interfaces available via equipment bundles

Service Models

- Full ATM switching via NSP
- RFC 1483 Routing and/or Routing with Bridge Encapsulation
- RFC 1483 Routing into MPLS VPN
- PPP aggregation into L2TP tunnels via NRP for Internet wholesaling and secure telecommuting
- PPP termination into routing for local ISP and content (Cisco Cache Engine, IP/TV® system) access
- Multi-domain PTA support with PPP termination and IP forwarding into multiple domains with or without private IP address spaces
- Service selection with Web-based dashboard for user-provisioned access to multiple destinations (multi-platform support)

Network Management

- Port RX and TX LEDs, switch and common equipment status LEDs

- One Ethernet and dual EIA/TIA-232 serial ports for optional out-of-band management on ATM Switch Processor

Chassis Specifications	
Dimensions (H x W x D)	21.85 x 17.5 x 12 in. (55.5 x 30.48 x 44.45 cm); standard 19-inch rack mount 13.75 in. (34.9 cm) with optional cable cover
Weight	Empty: 80 lb (37 kg) Fully Loaded: Depends upon loading; approximately 130 lb (59kg)
Maximum Power Budget	20 A @ -48 VDC, optional AC power available DC -48 VDL nominal 40 VDC minimum 72 VDC maximum AC 200-240 VAC 1200 watts maximum radiated heat
Mean Time between Failure	1.5 x 105 hours (17 years) MTBF per RIN
Safety Certifications	UL 1950 EN 60950 CSA-C22.2 No. 950-93
Electromagnetic Emissions Certifications	FCC Class A (Part 15) EN 55022 Class B CE Mark VCCI Class II NEBS Level 3 and ETSI
Operating Requirements	Altitude: -200 to 10,000 ft (-61 to 3048 m) Temperature: 25 to 104 F (-5 to 40 C) (131 F/55 C for 16 hours) Relative humidity: 5 to 95% noncondensing

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