

MOBILE BACKHAUL SOLUTION WITH ACX SERIES UNIVERSAL ACCESS ROUTERS

Multi-Generation Adaptive Services Architecture with Flexible End-to-End Seamless Service Delivery

Challenge

Mobile carriers seek to deliver new, high-speed services to improve ARPU and customer retention while decreasing OpEx and CapEx. A scalable backhaul solution that protects their investment at the cell site, while providing flexibility to add next-generation technologies quickly and cost-effectively is desired.

Solution

Juniper's solution supports a full range of transport types, enabling a cost-effective and adaptive services architecture for multi-generation networks. The solution includes products for the cell site, metro backhaul and aggregation network, with a unified network management solution.

Benefits

- Converged networks for IP/MPLS and legacy systems
- Unmatched performance to support emerging data-intensive services
- Operational intelligence and traffic engineering capabilities
- Proven and deployed timing technology for highest Quality of Experience (QoE)

Mobile Service Providers continue to be challenged to deliver bandwidth intensive services over legacy infrastructure. They are increasingly challenged to cost-optimize and streamline their infrastructure investments in mobile backhaul, aggregation network and packet core and in-line with the evolution needs of the mobile network to 3G/4G and LTE. While many networks have seen benefits from convergence in the core and on the edge, a similar transformation is clearly required in the access network. Juniper Networks® ACX Series Universal Access Routers are built to support an adaptive services architecture, enabling rapid deployment of access services, and transforming the network to create a seamless end-to-end service delivery platform.

The Challenge

Consumers are demanding more mobile services—especially bandwidth-hungry data services. Service providers continue to see rapid growth in data services, and all indications are that this trend will continue to accelerate. Increased demand for value-added services such as mobile-to-mobile and mobile-to-machine applications offer operators new ways to attract and hold subscribers and grow revenues. Realizing this potential, however, requires upgrading the mobile infrastructure, especially mobile backhaul. The mobile network architectural evolution to 3G/4G/LTE also brings about radical connectivity challenges in the control plane. A flattened full mesh, all IP based control plane and user plane service needs have to be met by the underlying transport infrastructure. Figure 1 shows the overlay control plane and user plane services on top of transport and the added services provided by over the top content providers. Any infrastructure investments in the mobile backhaul should address the user and control plane needs. Disparate and legacy upgrade of mobile backhaul with Layer 2 Ethernet packet switching only makes the managed service provider (MSP) network rigid¹, and it won't deliver the benefits of the evolution.

At the same time, carriers are looking for ways to reduce operating expense (OpEx) and capital expense (CapEx) in order to compensate for declining average revenue per user (ARPU), increasing competition, and new technologies. And, while they need to roll out new IP-based services in order to survive and thrive, carriers still must provide and protect legacy non-IP-based services, since these services will continue to produce a significant share of their revenue for many years to come.

To achieve their goals, mobile operators realize that they must evolve legacy backhaul networks that do not provide the flexibility or scalability to cost-effectively support multiple services on the same network. Ease of provisioning, planning, and network management is also vital to reducing OpEx and ensuring rapid new service creation and delivery. Additionally, evolving business models in the overall telecom industry are driving operators to closely integrate their networks with content and application providers in order to generate new revenue streams and differentiate from competitors. To do this, operators require a means of separating, securing, and steering traffic, and maintaining strict service-level agreements (SLAs). Next-generation mobile backhaul solutions must address all of these challenges.

¹ See Pietro Belotti, *Comparison of MPLS and Ethernet Networks at the Access-Aggregation Level* (<http://myweb.clemson.edu/~pbelott/papers/comparison-eth-mpls.pdf>).

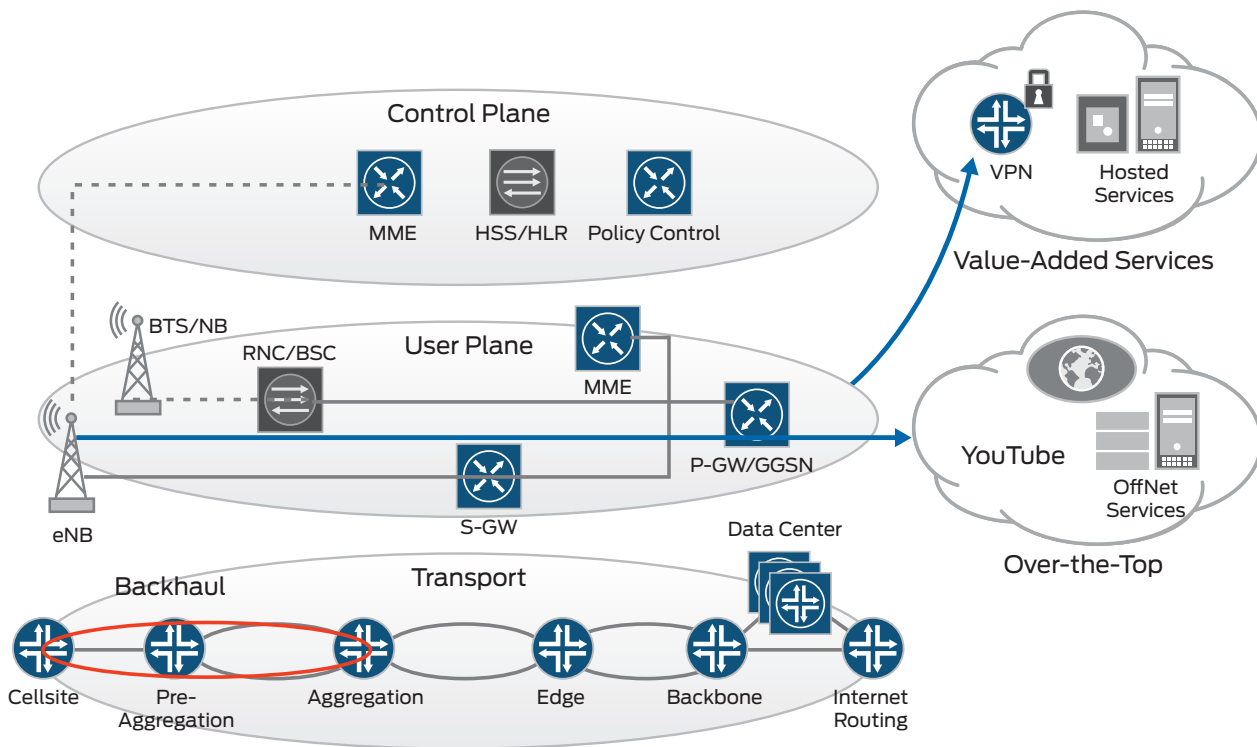


Figure 1: Control and User plane services overlay on top of legacy transport layer.

Limitations of the existing mobile backhaul solutions include:

- **Cost:** For mobile backhaul today, operators typically use copper or microwave time-division multiplexing (TDM) links, often leased from other service providers. Unlike infrastructure costs, leased line expenses are ongoing, draining profits and impacting competitiveness. Any cost savings realized in backhaul go straight to the bottom line.
- **Scalability:** A typical cell site requires two or three leased T1/E1 lines, representing 4 to 6 Mbps of bandwidth. New data intensive mobile services could more than double this requirement. Adding this much capacity via TDM lines is time-consuming and economically prohibitive. Carriers need the ability to add capacity on demand to respond to changing customer needs.
- **Flexibility:** As mobile networks evolve from 2G to 3G and beyond, cell sites must support multiple transport technologies such as TDM, Asynchronous Transfer Mode (ATM), and IP/Ethernet. Carriers have substantial investments in 2G technology, so a rip-and-replace strategy is not feasible. The next generation of backhaul components must support multiple coexistent technologies at the cell site.
- **Efficiency:** Because each T1/E1 line is dedicated, excess capacity cannot easily be shared. The current method of providing backhaul capacity invariably involves a substantial amount of unused—and expensive—bandwidth in the mobile backhaul.

The Juniper Networks Mobile Backhaul Solution with ACX Series Universal Access Routers

IP/MPLS is the ideal next-generation mobile backhaul solution because it enables MSPs to optimize their networks for the transport of all revenue generating services—both voice and data. MPLS is widely deployed in the core and even in some aggregation networks, and it is now making inroads to the access with seamless MPLS end-to-end service delivery². The Juniper Networks mobile backhaul solution leverages IP/MPLS technology already in use in many mobile packet cores across the entire mobile infrastructure.

Unlike piecemeal approaches that mix and match components, Juniper's solution is a fully integrated, high-performance architecture addressing the needs of the cell site, metro backhaul, and aggregation. This solution is built on an adaptive services architecture and extends the necessary operational intelligence to the access to deliver seamless end-to-end services. The solution includes a comprehensive network management component to increase operational efficiency and minimize OpEx. It provides mobile operators with a converged mobile backhaul network that can support multiple types of transport, including TDM, and Ethernet. This allows for the co-existence and leveraging of legacy, current, and future generation mobile networks.

Carriers' requirements for simplicity and increased operational intelligence are met with the Juniper Networks ACX Series Universal Access Routers. This portfolio includes temperature hardened fixed models and a modular platform with support for TDM, as well as Ethernet GbE and 10GbE interfaces. With throughput of up to 60 Gbps in all models, the ACX Series delivers unmatched performance for an access router.

² Refer to "Building Multi-Generation Scalable Networks with End-to-End MPLS" (www.juniper.net/us/en/local/pdf/whitepapers/2000452-en.pdf)

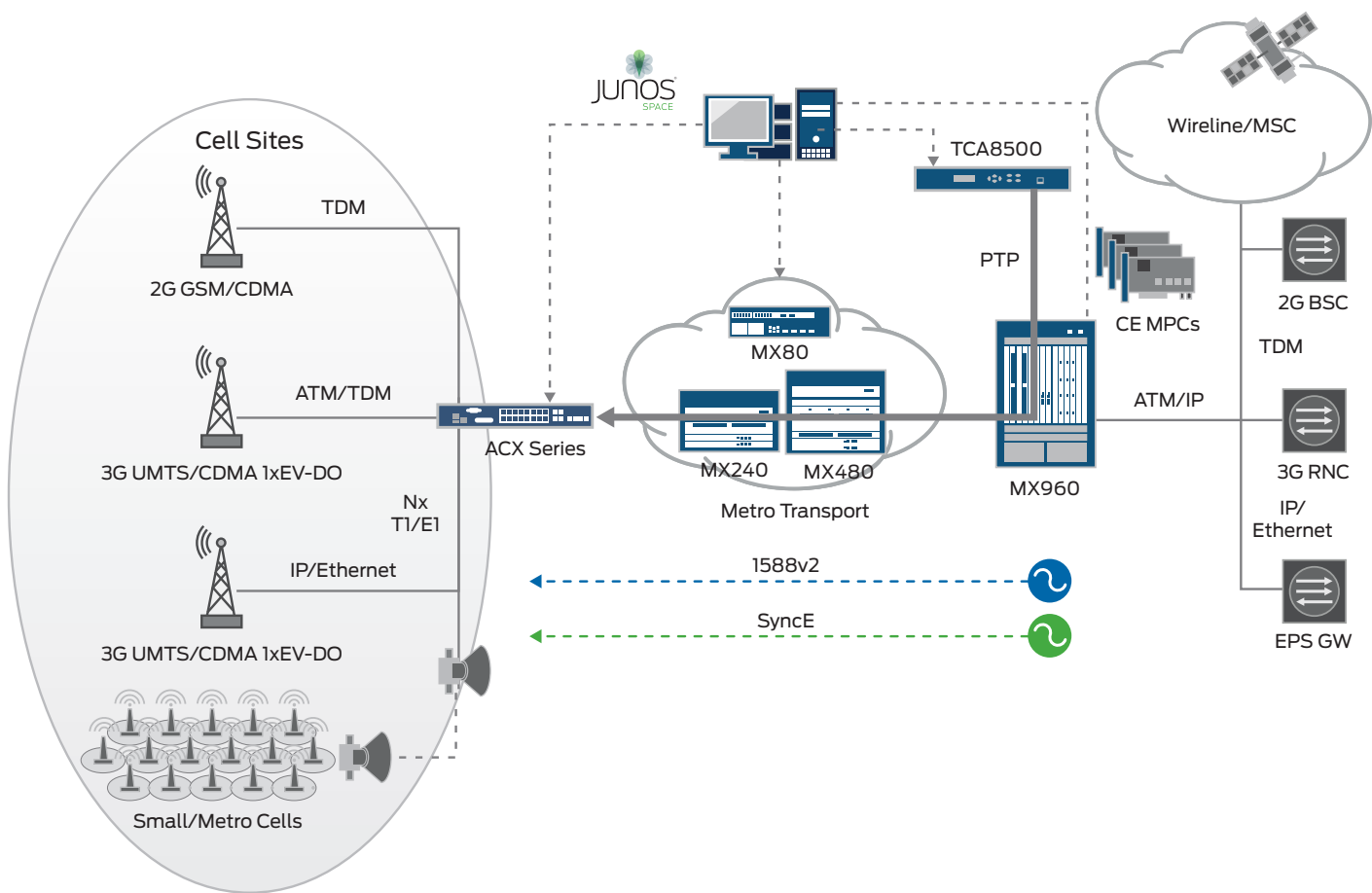


Figure 2: Juniper Mobile Backhaul Solution with ACX series cell site router, MX 3D Series Aggregation routers and Junos Space network management platform.

Features and Benefits

Juniper Networks ACX Series Universal Access Routers are next-generation access routers that address the new network imperatives with up to three times the total throughput of competitive solutions. This product family enables a seamless end-to-end service delivery platform that can grow and adapt to changing subscriber expectations and traffic demands. The Universal Access solution redefines the service provider access network with support for seamless MPLS, comprehensive network management, proven and deployed precise timing and synchronization, and an open access software development kit (SDK)-enabled programmability for easy integration with third-party services and tools.

Flexible Services with Adaptive Service Architecture

The ACX Series Universal Access Routers are powered by Juniper Networks Junos[®] operating system. Junos OS powers a comprehensive feature set with support for carrier Ethernet services, Layer 2, Layer 3, MPLS, traffic engineering, and call admission control (CAC). With simplified service provisioning and operations, the ACX Series includes the functionality needed to deploy MPLS in the access and deliver flexible services rapidly. The ACX Series platform supports a wide interface range that includes T1/E1, GbE, 10GbE, and Power over Ethernet (PoE+). With PoE+ capability, there is no electrical cabling required for microwave/WiFi access and/or surveillance cameras.

Unified Network Management for Rapid Provisioning and Intelligent Operations

Juniper Networks Junos Space network management platform with Network Activate software is an integral part of Juniper's Mobile Backhaul Solution portfolio. The Junos Space platform provides powerful device instrumentation (NETCONF/XML, SNMP, command-line interface), rapid deployment support, and complete remote management that includes remote software upgrade, service provisioning, monitoring, and diagnostics tools.

Complete remote management and remote software upgrades significantly reduce administrative overhead and associated operational costs.

Scale and Performance for Multi-Generation Networks

The ACX Series platform meets the needs of multi-generation networks by delivering an industry leading performance that is over 3x the closest competitor. With high-density GbE and 10GbE support along with TDM interfaces, the ACX Series is built to support migration to 3G/4G and Long Term Evolution (LTE). MSPs can use the solution's capabilities for their legacy networks today and into the future to integrate other 4G radio access technologies such as Worldwide Interoperability for Microwave Access (WiMAX) and Long Term Evolution/service activation engine (LTE/SAE).

Sophisticated Timing and Synchronization

In mobile access networks, including those with 2G and 3G base stations, there are stringent timing requirements for handover as mobile stations move from one cell to another. Timing and synchronization are critical elements to maintain good voice quality, reduce interference, and manage call handovers.

In a typical TDM network, the various entities are synchronized on a common Primary Reference Source (PRS). As the industry moves to packet-based transport networks to distribute TDM services, the same level of synchronization is needed to avoid cutouts, lost handovers, and blocked or failed call setup.

Some systems require not only frequency synchronization, as in TDM networks, but also phase/time synchronization. International Telecommunications Union (ITU) synchronization standards define specifications in packet networks, including the maximum network limits of jitter and wander that should not be exceeded. They also define the minimum equipment tolerance to jitter and wander that should be provided at the boundary of packet networks at TDM and synchronization interfaces.

ACX Series Universal Access Routers are able to meet these requirements and support timing synchronization options such as Synchronous Ethernet and IEEE 1588-2008. Ultimately, Juniper's ability to accurately address timing and synchronization requirements enables carrier backhaul networks to perform optimally and meet the expectations of a high quality end user experience.

Reduced OpEx

Extending IP/MPLS (a proven and familiar technology for most mobile operators) into backhaul can offer substantial reductions in cost-per-bit for backhaul transport. For example, replacing three T1 lines with carrier Ethernet can result in savings of up to 70 percent or more for each cell site. The network management features of the Juniper solution greatly reduce ongoing operational expenses and increase operational efficiency. The Juniper solution virtually eliminates site visits except for hardware upgrades.

Solution Components

Juniper Networks ACX Series Universal Access Routers

Designed for the demanding environment of the cell site, the temperature hardened ACX Series includes four fixed models: the ACX1000, ACX1100, ACX2000, and ACX2100 and a modular ACX4000 router³. With industry best scale and performance, the ACX Series can deliver up to 60 Gbps throughput and support 10GbE uplinks.

By deploying the ACX Series, mobile operators can retain their existing investment in 2G and 3G cell sites while reaping the benefits of IP/MPLS-based transport. Services can be migrated gradually, for example, by offloading the high growth data transport as a first step.

ACX Series features include:

- Provides transport of legacy T1/E1 circuits across a IP/MPLS packet network
- Compact form factor (9.4 inches/24 cm deep ETSI 300 compliant), which is ideal for cell site deployments
- Temperature hardened with passive cooling design for increased reliability and reduced power consumption

- Highest Quality of Experience (QoE) with multiple synchronization options to support evolution needs of the MSP network
- Feature-rich software support for TDM/ATM transport and Ethernet pseudowires; L3VPNs, comprehensive OAM and fault management features, extensive IP/MPLS features for building large-scale seamless MPLS networks

MX Series 3D Universal Edge Routers for Metro Backhaul Transport

Juniper Networks MX Series 3D Universal Edge Routers are ideal for IP/MPLS-based metro, aggregation, and packet gateways for an MSP network. They offer all of the benefits of IP/MPLS—fast reroute, resiliency, reliability, and OAM. The MX Series implements a rich feature set for both Layer 2 and Layer 3 VPNs, and extensive traffic engineering and OAM capabilities at large scale.

While the Juniper solution is fully interoperable with a wide range of metro aggregation architectures and components, there are a number of advantages to using MX Series routers, including:

- **Pseudowire-VPLS interworking:** The Juniper solution with the MX Series supports pseudowire interworking with virtual private LAN service (VPLS), in which an access pseudowire from the ACX Series cell site router can be cross-connected with a point-to-point VPLS instance in the metro backhaul network. This feature allows mobile operators to address a number of technical requirements, including multihoming, control plane scaling, and multicasting, as well as segmentation issues that can arise when backhaul components reside in different administrative domains.
- **Pseudowires to L3VPN mapping with pseudowire headend termination:** This capability supports flexible end-to-end seamless MPLS L3 services from the cell site to the mobile network with simplified provisioning.
- **Comprehensive network management:** Junos Space with Network Activate allows network operators to manage the full end-to-end mobile backhaul network from a central location, as described below.

Junos Space with Network Activate for Mobile Backhaul

Junos Space is a suite of comprehensive web-based tools for operational management and administration of Juniper Networks routers, including the ACX Series and MX Series platforms. Juniper has extended Junos Space with powerful new features designed to address the demanding requirements of mobile backhaul.

The Junos Space platform provides powerful device instrumentation (NETCONF/XML, SNMP, command-line interface), rapid deployment support, and complete remote management that includes remote software upgrade, service provisioning, monitoring, and diagnostics tools. Network Activate consists of a comprehensive set of interconnected components for service provisioning, path configuration, synchronization management, quality of service (QoS) configuration, and Operation, Administration, and Management (OAM).

Junos Space Network Activate supports transport (generic routing encapsulation, MPLS, traffic engineering) and service provisioning of pseudowires. Network Activate with its built in autodiscovery (AD), resource management capabilities, and service design, allows service providers to quickly start offering carrier Ethernet services in a very cost-effective manner.

³ For ACX series product details please to ACXSeries Universal Access Routers Datasheet (<http://www.juniper.net/us/en/products-services/routing/acx-series/#datasheets>)

Comprehensive fault-management, configuration, accounting, performance, and security (FCAPS) management support with Junos Space includes:

- Device-level configuration, software upgrade, alarms, script management
- End-to-end provisioning of Ethernet Line Services (ELINE), Ethernet LAN Services (ELAN), L3VPN, SyncE, IEEE1588-2008 (PTP), OAM, class of service (CoS)
- Device-level and service-level fault management
- Device-level and service-level performance management

Complete remote management and remote software upgrades significantly reduce administrative overhead and associated operational costs.

Other key components of Junos Space are the Transport Activate, Sync Manager, Qos Designer and OAM Toolkit.

Transport Activate that allows designing, provisioning, and activation of RSVP-signaled LSPs, and static LSPs that run from a specific ingress router to a specific egress router. LSPs can be configured as end-to-end, point-to-point, or point-to-multiple-point LSPs.

The Sync Manager supports configuration and provisioning of synchronization interfaces such as IEEE1588-2008 (PTP) and SyncE. Furthermore, this application also allows creation and management of timing domains that comprise PTP grandmasters and slaves.

The QoS Designer allows configuration of Quality of Service (QoS) features to provide improved service to certain network traffic types on Ethernet services. Enabling QoS on an Ethernet service can improve network service by providing dedicated bandwidth, setting traffic priorities across the network, improving loss characteristics, shaping network traffic, and managing network congestion. The QoS Designer provides the mechanism to create QoS profiles and associate them to specific Ethernet services.

The OAM Toolkit supports OAM management functions such as Ethernet Connectivity Fault Management (CFM), Ethernet Link-level fault detection and management, and Bidirectional Forwarding Detection (BFD) and exposes these functions to the other applications that require these functions.

Using the Junos Space platform, network managers can provision services, manage device configurations, track inventory, diagnose faults, and monitor the backhaul infrastructure from a central location. Junos Space can push software upgrades to all components in the Juniper mobile backhaul solution, minimizing the need for costly site visits. As a result, Junos Space reduces operating costs and improves operational efficiency.

Summary—Juniper’s Mobile Backhaul Solution with ACX Universal Access Routers Offers Industry-Leading Scalability, Flexibility, Performance, and Reliability

For more than a decade, Juniper Networks has been helping service providers evolve to secure, converged packet infrastructures cost-effectively. With its new IP/MPLS-based mobile backhaul solution, Juniper is extending its advanced mobile solution portfolio. Juniper’s industry-leading IP/MPLS expertise offers the technology best suited for mobile backhaul, providing the most scalable, flexible, reliable, and highest performing solution in the industry.

Juniper Networks ACX Series Universal Access Routers and MX Series 3D Universal Edge Routers, working in concert with Junos Space Network Activate, can meet the service provider’s need to build multi-generation networks for end-to-end flexible service delivery. With these comprehensive management tools and multiple clock synchronization options, mobile operators can deploy the most complete, high quality, end-to-end mobile backhaul solution available today.

Next Steps

To learn more about Juniper Networks Mobile Backhaul Solution and the ACX Series Universal Access Routers, please visit www.juniper.net or contact your local Juniper Networks sales representative.

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.

Corporate and Sales Headquarters

Juniper Networks, Inc.
1194 North Mathilda Avenue
Sunnyvale, CA 94089 USA
Phone: 888.JUNIPER (888.586.4737)
or 408.745.2000
Fax: 408.745.2100
www.juniper.net

APAC Headquarters

Juniper Networks (Hong Kong)
26/F, Cityplaza One
1111 King’s Road
Taikoo Shing, Hong Kong
Phone: 852.2332.3636
Fax: 852.2574.7803

EMEA Headquarters

Juniper Networks Ireland
Airsides Business Park
Swords, County Dublin, Ireland
Phone: 35.31.8903.600
EMEA Sales: 00800.4586.4737
Fax: 35.31.8903.601

To purchase Juniper Networks solutions, please contact your Juniper Networks representative at 1-866-298-6428 or authorized reseller.

Copyright 2012 Juniper Networks, Inc. All rights reserved. Juniper Networks, the Juniper Networks logo, Junos, NetScreen, and ScreenOS are registered trademarks of Juniper Networks, Inc. in the United States and other countries. All other trademarks, service marks, registered marks, or registered service marks are the property of their respective owners. Juniper Networks assumes no responsibility for any inaccuracies in this document. Juniper Networks reserves the right to change, modify, transfer, or otherwise revise this publication without notice.