JUNIPER NETWORKS ADVANCED MOBILE BACKHAUL SOLUTION

Network Optimization for Mobile Transport of all Revenue-Generating Services—Both Voice and Data

Challenge

Mobile carriers seek new, high-speed data services to improve ARPU and customer retention while decreasing OpEx and CapEx. As bandwidth demand grows, providers need a scalable backhaul solution that protects their investment at the cell site while providing flexibility to add next-generation technologies quickly and cost effectively.

Solution

Juniper's solution cost-effectively supports a full range of transport types, enabling a flexible architecture for the coexistence of multi-generational networks. The solution includes products for the cell site, metro backhaul network and aggregation site, all managed by a comprehensive network management solution.

Benefits

- Flexibility to support converged networks that accommodate both IP and legacy services (leveraging proven circuit emulation techniques)
- Scalability to support emerging data-intensive technologies
- Cost-effectiveness to compensate for rising levels of backhaul traffic
- Investment protection via support of legacy and next-generation technologies at the cell site

The Challenge

Consumers are demanding more mobile services—especially bandwidth-hungry data services. Service providers are already seeing rapid growth in data services, and this trend will continue to accelerate. New value-added services such as push-to-talk, interactive gaming, multimedia messaging, mobile VPNs, and video streaming offer operators new ways to attract and hold subscribers and grow revenues. Realizing this potential requires upgrading the mobile infrastructure, especially mobile backhaul.

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 they must upgrade 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 and securing traffic, and maintaining strict service-level agreements (SLAs). Next-generation mobile backhaul solutions must address all of these concerns.

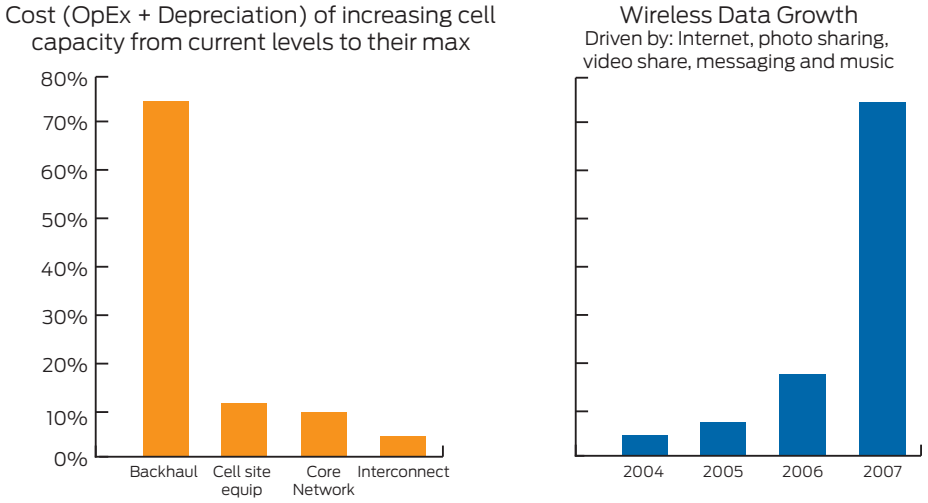

Figure 1: Backhaul dominates the cost of scaling the network

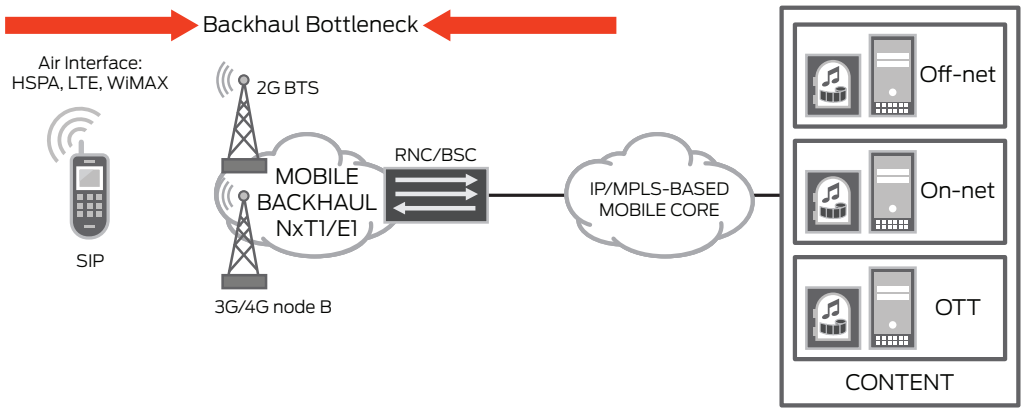

Figure 2: Solving the backhaul bottleneck requires a flexible, scalable, economic solution

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 Mbits/sec of bandwidth. New data-intensive mobile services could double this requirement—and more. 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 the 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 Advanced Mobile Backhaul Solution

IP/MPLS is the ideal next-generation mobile backhaul solution because it enables mobile operators to optimize their networks for the transport of all revenue-generating services—both voice and data. The Juniper Networks® Advanced 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 comprehensive solution is a fully integrated, high-performance architecture addressing the needs of the cell site, metro backhaul and aggregation. This solution, which also includes a comprehensive network management component to increase operational efficiency and minimize OpEx, provides mobile operators with a common mobile backhaul network that can support multiple types of transport including TDM, ATM, DSL, and Ethernet. This allows for the co-existence and leveraging of legacy, current, and future-generation mobile networks. Carriers' requirements for simplicity are met with the Juniper Networks BX7000 Multi-Access Gateway, a single platform which natively supports TDM, ATM, and Ethernet transport while offering an optional line card to support DSL interfaces or additional Ethernet port density.

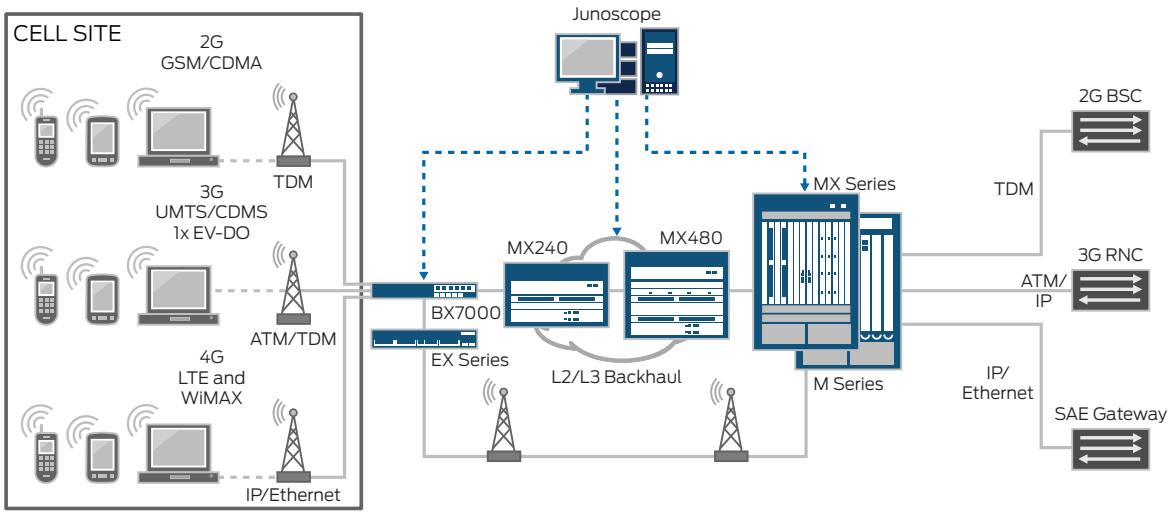

Figure 3: The Juniper Networks Advanced Mobile Backhaul Solution includes the BX 7000 Multi-Access Gateway, EX Series Ethernet Switch, M Series Aggregation Site Gateway with Circuit Emulation PICs, and the MX Series for Metro Backhaul Aggregation

Solution Features/Benefits

Streamlined Network Management

Juniper Networks Junoscope IP Service Manager network management software is an integral part of Juniper's Advanced Mobile Backhaul Solution portfolio. It consists of a comprehensive set of interconnected components such as powerful device instrumentation (NETCONF/XML, SNMP, CLI), rapid deployment support, and complete remote management that includes remote software upgrade, service provisioning, monitoring, and diagnostics tools. Junoscope's zero-touch facility allows Juniper's BX7000 Multi-Access Gateway to configure itself out-of-the-box—with no manual intervention—using the configuration available on the network, on local USB removable media, or on a combination of both.

As a result, the BX7000 can be sent directly from the warehouse to the deployment site without requiring any pre-configuration steps. In addition, because the device knows how to find its proper configuration information and make itself available on the network for remote management, no tech-savvy personnel are needed at the deployment site. This enables rapid mass deployment of a large number of these devices.

Junoscope supports transport (generic routing encapsulation, MPLS, traffic engineering) and service provisioning of pseudowires. It also offers monitoring and diagnostics of provisioned services, device configuration management, and remote software upgrade. Juniper's operations support system (OSS) alliance partners provide industry-leading solutions for fault and performance monitoring. Complete remote management, including zero-touch deployment and remote software upgrades significantly reduce administrative processes and associated operational costs.

Sophisticated Timing and Synchronization

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

In a typical TDM network, the various entities are synchronized on a common Primary Reference Source. As the industry moves to packet-based transport networks to distribute TDM services, the same level of synchronization is needed to avoid cut-outs, 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.

Juniper Networks Advanced Mobile Backhaul Solution is able to meet these requirements because it supports multiple clock domains within the same platform. Juniper's solution supports all timing synchronization options, including Synchronous Ethernet, Adaptive Clock Recovery, IEEE 1588 v2, DSL NTR, and BITS input. The system's aggregation site gateway and BX7000 Multi-Access Gateway can derive timing from multiple sources simultaneously, to ensure that each mobile operator gets timing from its own clock source and maintains accurate clock recovery.

Ultimately, Juniper's ability to accurately address timing and synchronization requirements enables carriers' backhaul networks to perform optimally and meet the expectations of a high end user experience.

Future Proof

In addition to providing mobile operators with key requirements such as the flexibility to transport multiple types of traffic across the same network, seamless network management and accurate timing and synchronization, Juniper Networks Advanced Mobile Backhaul Solution helps mobile operators protect their investments in this increasingly important piece of their networks. Operators can use the solution's capabilities for their legacy networks today and into the future to integrate other 4G radio access technologies such as WiMAX and Long-Term Evolution/service activation engine (LTE/SAE).

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 results in savings of up to 70 percent or more for each cell site. The comprehensive 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.

Improved Scalability

Juniper's IP/MPLS-based solution scales much more easily than other solutions, since operators can purchase incremental bandwidth as needed from fixed-line operators. Using packet-based backhaul avoids the problem of unused bandwidth that is common with TDM leased line backhaul. Operators can also consolidate all traffic on a single cost-efficient and high-speed Ethernet uplink as opposed to multiple groups of slow and expensive TDM circuits. In addition, because of carrier Ethernet's option of fine-grained bandwidth, mobile operators can "pay as they grow," dialing up bandwidth as subscriber traffic increases.

Investment Protection with Comprehensive Solution

The BX7000 cell site router interfaces with 2G cell sites, making it an easy addition to existing infrastructures. At the same time, the Juniper solution supports 3G and evolving 4G technology to future proof investments in cell site installations. Juniper's EX Series Ethernet switches provide a cell site solution to optimize HSPA data offload for operators in later stages of evolution towards all-packet infrastructure. Juniper's comprehensive solution allows mobile operators to use an end-to-end common IP/MPLS transport network that can support Layer 2 or Layer 3 backhaul as well as business and residential services.

Solution Components

Juniper Networks BX7000 Multi-Access Gateway

Designed for the demanding environment of the cell site, the BX7000 interfaces to common uplinks including T1 and E1, DSL, and Ethernet. It reliably transports TDM, ATM and packet traffic over IP/MPLS using pseudowire technology. The BX7000 includes a replaceable interface module that supports higher density at the cell site while minimizing equipment variety.

The BX7000 supports a range of timing synchronization options, with future-proofing provided by a slot for field-replaceable timing modules. The BX7000 supports today's technologies as well as emerging standards such as WiMAX and Third-Generation Partnership Project (3GPP) LTE.

By deploying the BX7000 Multi-Access Gateway, 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.

Features

- Provides transport of legacy T1/E1 circuits across an ATM network
- Compact form factor (9.45 inches/24 cm deep) ideal for cell site deployments
- Temperature-hardened option for uncontrolled environments
- Passive cooling design for increased reliability and reduced power consumption
- Unique expansion slots for additional advanced clocking and backhaul options
- Feature-rich software support for TDM and ATM pseudowires, ATM-IMA, MPLS, and GRE

Juniper Aggregation Site Gateway (M Series with Circuit Emulation PICs)

The Juniper Aggregation Site Gateway terminates pseudowires, sending TDM traffic to the base station controller, and ATM and IP traffic to the radio network controller. Based on Juniper Networks M Series Multiservice Edge Routers, the Juniper Aggregation Site Gateway features two new circuit emulation PICs designed specifically for mobile backhaul applications: 12-port T1/E1 circuit emulation PIC and 4-port ChOC3/STM1 circuit emulation PIC.

Features

- Provides transport of legacy T1/E1 circuits across an ATM network
- Software configurable
- Support for synchronization across packet networks
- L2 or L3 VPNs

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 backhaul transport. They offer all the benefits of IP/MPLS—fast reroute, resiliency, reliability, and operation, administration and management (OAM). The MX Series implements both Layer 2 and Layer 3 VPNs.

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 3D Universal Edge Routers, including:

- **Pseudowire-VPLS interworking:** The Juniper solution with the MX Series supports pseudowire interworking with VPLS, in which an access pseudowire from the BX7000 Multi-Access Gateway is 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.
- **Comprehensive network management:** Junoscope IP Service Manager allows network operators to manage the full end-to-end mobile backhaul network from a central location, as described below.

EX Series Ethernet Switches

Juniper Networks EX Series Ethernet Switches provide carrier-class reliability, leveraging the same field-proven Juniper technology - including high-performance ASICs, a carrier-class system architecture, and Juniper Networks Junos® operating system that powers the world's largest service provider networks.

Features

- **Security risk management** – Tightly integrates with Juniper's UAC solution, dynamically delivering network protection, guest access and identity-based QoS based on user, device, and location.
- **Performance** – Delivers wire-speed performance on all ports for any packet size.
- **Virtualization** – Virtual Chassis technology allows up to 10 switches to be interconnected and managed as a single, logical device, delivering the reliability, scalability, and manageability of traditional chassis-based systems in a cost-effective, compact platform.
- **Application control** – Supports eight QoS queues per port, ensuring proper prioritization of control plane, voice, video, and multiple levels of data traffic—with room to converge other networks, such as building automation and video security systems.
- **Lower TCO** – Enable new architectures that reduce cost and complexity.

Junoscope IP Service Manager with Extensions for Mobile Backhaul

Junoscope is a suite of comprehensive Web-based tools for operational management and administration of Juniper Networks routers, including the BX7000, M Series, and MX Series. Juniper has extended Junoscope with powerful new features designed to address the demanding requirements of mobile backhaul.

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

Summary—The Juniper Networks Advanced Mobile Backhaul Solution: Scalability, Flexibility, Performance, and Reliability

For more than a decade, Juniper Networks has been helping service providers evolve to secure, converged packet infrastructures. With its new IP/MPLS-based mobile backhaul solution, Juniper Networks 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.

Juniper Networks BX7000 Multi-Access Gateway, M Series Multiservice Edge Routers with customer edge PICs, MX Series 3D Universal Edge Routers, EX Series Ethernet switches, and Junoscope IP Service Manager, offer support for multiple transport technologies, enabling mobile operators' future growth. 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.

Next Steps

To learn more about Juniper Networks Advanced Mobile Backhaul Solution, please visit **www.juniper.net** or contact your local Juniper Networks sales representative

About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. 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
Airside Business Park
Swords, County Dublin, Ireland
Phone: 35.31.8903.600
EMEA Sales: 00800.4586.4737
Fax: 35.31.8903.601

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