Delivering Scalable and Cost-Effective HetNet Backhaul

Juniper Networks and NEC Help Mobile Operators and Wholesale Providers Deliver Next-Generation Macro and Small Cell Packet Backhaul Solutions

Challenge

As communication service providers (CSP) expand their mobile backhaul (MBH) networks to support emerging small cell locations, they look for a scalable backhaul solution that protects their investment at the small cell site, while providing flexibility to add next-generation technologies quickly and cost-effectively.

Solution

ACX Series Universal Access Routers, TCA Series Timing Appliances, Junos Space and Service Activation Director; with the NEC iPASOLINK series compact and low cost micro and millimeter wave product, deliver a best-in-class, end-to-end cost effective and scalable MBH solution.

Benefits

- Superior scale and performance with reduced CapEx and OpEx employing All Out Door Radio and a simpler access, aggregation, and edge network
- Unmatched quality of experience with proven end-to-end high precision timing, synchronization, and traffic engineering
- Unified management, provisioning, and monitoring for faster service rollout
- Foundation for new revenue-generating services content and models

NEC Empowered by Innovation

Mobile operators and the industry have been referring to the bandwidth bottleneck for quite some time. As new technologies like 4G LTE and LTE-Advanced are being rolled out and gaining traction, increasing bandwidth-intensive mobile data traffic will continue to apply pressure on networks' existing capacity. This challenge, coupled with subscriber density, especially in dense urban environments, leaves providers facing an exponential growth capacity problem while revenues follow a much more moderate increase. As such, there is a need to reduce the cost of the network investment and operation expenses to keep profit margins on a positive glide path.

To address these issues, the backhaul industry has entered a period of transition through innovation in architecture and technologies. Some of these efforts lead to the introduction of the small cell as a key essential concept within the heterogeneous network (HetNet) framework. Others are leading to a shift from legacy time-division multiplexing (TDM) transport network infrastructure towards metro Ethernet and seamless IP/MPLS, as well as SDH microwave to faster packet-based millimeter wave wireless links. The use of micro and millimeter waves combined with carrier Ethernet is a necessity, and brings the advantages of capacity, scalability, and flexibility to deliver cost-effective, optimized backhaul networks.

The ability to provide an integrated network management system (NMS) for microwave links and routers, as well as the ability to deliver a highly precise end-to-end timing and synchronization over packet network, is critical for 4G user quality of experience and the efficiency of network management.

Juniper Networks and NEC jointly provide the right solution toolkit for 3G, LTE, and LTE Advanced services.

The Challenge

The small cell plane in the context of HetNet and transition to packet-based microwave are essential to fulfill the promise of 4G and beyond. However, delivering a cost-effective small cell backhaul solution is a key challenge to overcome. Planning the optimal solution requires the following considerations:

- Products and solutions that build a scalable infrastructure, meet growing bandwidth-intensive applications, and provide decoupled services from the network transport
- Flexible design to accommodate architectural evolutions, 4G and LTE topologies, smooth transition to packet microwave, and hybrid scenarios
- Highly precise timing and synchronization (SyncE/IEEE 1588v2 is a must)
- Integrated NMS of packet transport with micro and millimeter wave links
- Spectrum flexibility to address different scenarios
- Optimized hardened product in performance, physical footprint, power, and cost for different use cases (from dense urban to rural areas)
- Simpler, easier, and faster deployment

The Juniper Networks and NEC Microwave and Millimeter Wave (V and E bands) Backhaul Solution

Juniper Networks and NEC deliver an integrated backhaul solution that provides the end-to-end network optimization, provisioning, management, and packet synchronization that are essential for 4G and LTE Advanced deployment (Figure 1). The Juniper Networks® ACX Series Universal Access Routers are built to support diverse service architectures and hardened for reliable outdoor operations. This enables rapid deployment of access services, and it allows for a seamless end-to-end service delivery architecture that is decoupled from the underlying network, addressing a multitude of applications and customer types.

The operational intelligence of IP/MPLS in Juniper Networks Junos® operating system permits traffic steering and makes efficient use of existing bandwidth. Flexible services can be applied at the access layer and optimized per customer. The ACX Series provides deployment flexibility and superior quality of experience (QoE) while introducing optimization throughout the network to enable lower capital and operating expenses. The cost-effectiveness of Ethernet/MPLS technologies, optimal system characteristics of the platforms, and streamlined operations result in OpEx reduction, while the service awareness of the backhaul network enables further monetization.

Seamless MPLS enables further benefits in resiliency, convergence, and scale, which combine with the reliability of Juniper's hardware and software to maximize service availability. Extensive quality of service (QoS) and traffic engineering capabilities deliver premium quality of experience.

The ACX Series router also incorporates the Juniper Networks TCA Series Timing Appliances technology to deliver a comprehensive, high precision, carrier-class timing with synchronization that enables graceful migration to LTE-Advanced.

In addition, hauling (backhaul and fronthaul) requires different techniques and technologies. This leads to a toolkit approach that provides flexibility of choice and best leverages the constraints and advantages of the environment. Microwave has been the main medium for macro-cell backhaul and offers advantages of volume and cost. As part of the heterogeneous network, the industry is adopting millimeter wave (60 GHz and 70/80 GHz frequencies) as well, to meet the backhauling demand of small cell.

Millimeter waves allow for more densely packed wireless links resulting in very efficient spectrum utilization. The 60 Ghz high frequency spectrum combines the advantages of unlicensed or lightly licensed spectrum cost and high capacity. This particular band characteristic to oxygen absorption provides increased security through better interference immunity and is well suited for high frequency reuse and short range links in the order of 1 Km. The higher 70/80 Ghz spectrum offers a higher data capacity and usually a higher point-to-point range capability.

NEC is a recognized top-rated microwave industry market leader supporting carrier-grade Ethernet wireless links. NEC provides the All Outdoor Radio (AOR) product line—iPASOLINK— covering various use case scenarios for fast and cost-effective small cell deployments. NEC demonstrates leadership in the industry with its adoption and addition of millimeter wave technologies in its wireless link products portfolio with the ability to deliver Juniper's industry-leading timing solution.

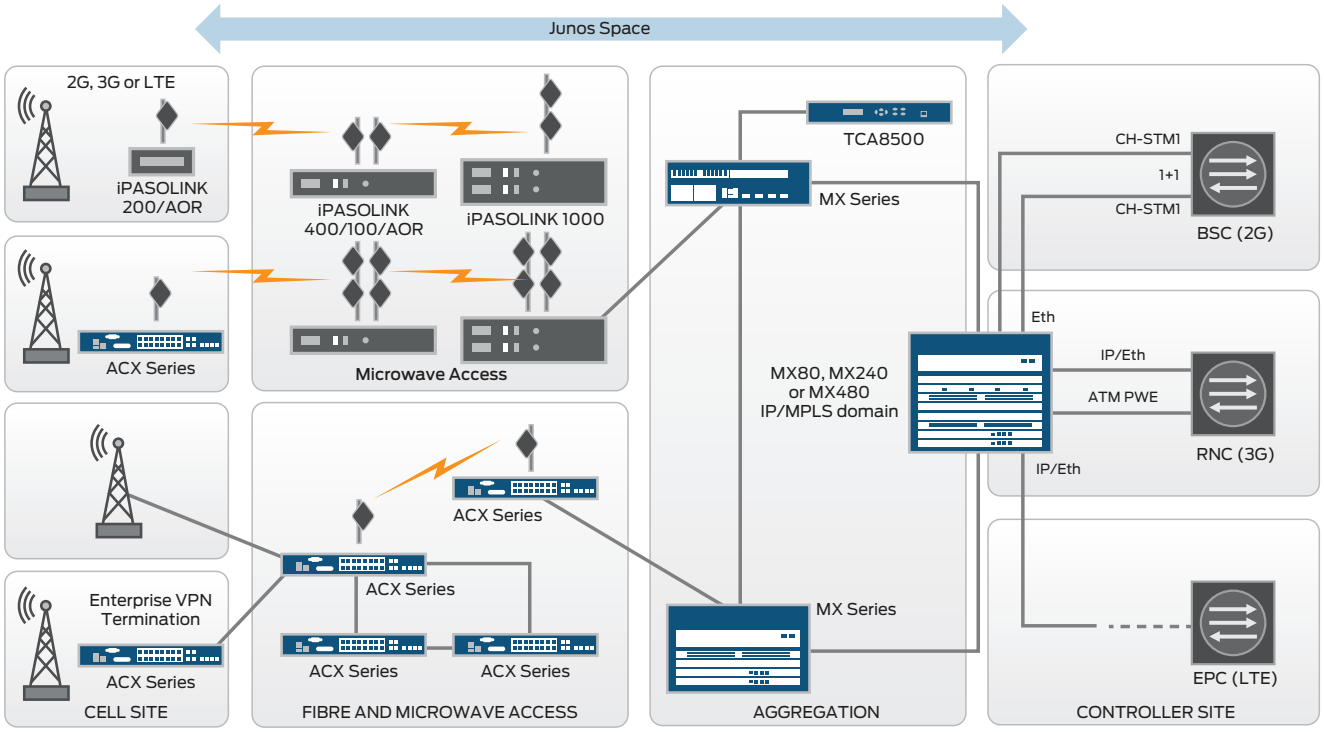

Figure 1: Expanded Juniper Networks and NEC macro and small cell universal backhaul

NEC's iPASOLINK toolkit provides all of these key technologies for best deployment scenarios and QoE. The iPASOLINK6-42 GHz AOR and iPASOLINK split-mount series provides remote small cell connectivity and urban aggregation.

The iPASOLINK60 Ghz V-band unlicensed AOR is a very compact all outdoor radio with a small antenna designed for urban street level connectivity. This makes migrating to a cutting-edge, high-densityIP transport network possible with efficient frequency planning, shorter time to market, and cost-effective network deployment.

The iPASOLINK E-band AOR spectrum covering 70-80 Ghz frequencies for urban small cell traffic aggregation, distributed radio access network (RAN) fronthaul, and last mile broadband access, is capable of delivering capacities in excess of 10 Gbps. The iPASOLINK E-band AOR exemplifies NEC's unique expertise in high modulation, spatial aggregation, and low latency radio transmission, and it utilizes new cutting-edge components to deliver value based on future-proof performance and market-leading low cost of ownership.

The iPASOLINK series is a compact, lightweight, low power consumption, and exceptionally reliable radio unit. These attributes have become increasingly important in the operation of packet radio transmission networks, as small size and low weight significantly simplify and ease installation procedures, while high reliability eliminates the costs of field replacements and repair.

The combination of ACX Series Universal Access Routers with TCA Series technology and iPASOLINK series superior network performance delivers the most flexible, integrated, end-to-end high precision timing and synchronization solution. It supports Precision Time Protocol (PTP) across microwave links, and a hybrid mode of operation combined with SyncE for enhanced performance.

Finally, a single, integrated, end-to-end management solution is possible through Juniper Networks Junos Space and Services Activation Director that couple hardware-based management, including wireless links and provisioning traffic engineering capabilities. This solution delivers a premium QoE and eases operation with a consolidated fault, configuration, accounting, performance, and security (FCAPS) management view. It includes use cases configuration templates for services enablement and timing scenarios, as well as an open standardized API to facilitate integration with operations and business support systems (OSS/BSS).

Features and Benefits

Table 1: Joint Juniper Networks NEC Solution Features and Benefits

Feature	Description	Benefits
Micro and millimeter wave toolkit	Offers an unmatched portfolio toolkit from NEC, a top ranked market leader with proven deployment history for traditional microwave radio, bringing this expertise to new emerging millimeter wave links for LTE-Advanced and small cell deployment	· Easy, simple, flexible, and cost-effective deployment for packet radio · 6-42 Ghz split mount series for remote small cell connectivity and urban aggregation · 60 Ghz V-band unlicensed for urban street level connectivity · 70-80 Ghz E-band for urban small cell traffic aggregation, distributed RAN fronthaul, and last mile broadband
High precision timing and synchronization	Provides end-to-end, best-in-class, scalable, reliable, and proven high precision timing and synchronization technologies	· Hardware-based time-stamping and superior algorithms for clock extraction · Hybrid-mode operation combining PTP and SyncE for enhanced performance · Support for boundary and transparent clocks to minimize jitter and increase timing accuracy · Future-proof hardware to ensure conformance to current and emerging standards
Seamless MPLS	Enables end-to-end flexible and scalable service architecture through IP/MPLS	· Higher scale at lower cost due to customer and service transparency in access, aggregation · Enables services decoupling from network architecture providing the foundation for a robust converged network
Fully integrated end-to-end NMS, provisioning, and monitoring	Provides end-to-end view, provisioning, and monitoring of backhaul network, including wireless links and an open API towards OSS/BSS	· Lower cost through simplified operations · Faster rollout of services and timing requirement through use case templates · Easy and facilitated integration through standardized open API

The NEC and Juniper Networks joint HetNet backhaul solution supports flexible Layer 2 and Layer 3 network topology operations in the access and aggregation domains to ease the transition towards 4G LTE and LTE Advanced, delivers an unmatched end-to-end precision timing to the base station, and an integrated orchestration and management layer with NMS to provide effective network provisioning and optimization that includes the wireless links.

Juniper Networks and NEC provide the most advanced and comprehensive backhaul toolkit available in the market to uniquely enhance network performance and drive down the cost of ownership. It is designed for easy integration into a complete universal access solution. Leveraging the mobile backhaul as a catalyst, providers with additional service models such as residential broadband, business access, and wholesaling can migrate to a single access architecture where their entire service offering footprint can be provided through the Juniper's universal access technology.

Solution Components

The joint solution consists of Juniper Networks ACX Series Universal Access Routers for the cell site router, access, and pre-aggregation; Juniper Networks MX Series 3D Universal Edge Routers for metro aggregation; TCA Series for timing and synchronization services. Junos Space and Services Activation Director for provisioning, NMS and OSS/BSS integration; and NEC iPASOLINK series for micro and millimeter wave. The functionality and benefits provided by each are summarized in the table below.

Table 2: Solution Components

Feature	Description	Benefits
iPASOLINK[1] series	• Industry-leading, high capacity microwave radio link supporting carrier-grade Ethernet • All Out Door Radio (AOR) product line • Top rated and ranked microwave vendor	• Flexible micro and millimeter wave toolkit operating in license and license light spectrum and providing up to full true gigabit rate • Offers full range of frequencies from 6-42 GHz, V-band 60 Ghz, and E-band (70-80 GHz) • Provides low cost, ultra compact lightweight unit with simplified and quick installation • Delivers end-to-end leading timing, low jitter and latency for LTE-Advanced and small cell deployments
ACX Series[2]	• Industry best-in-class cell site router for access, pre-aggregation (Carrier Ethernet AWARDS EMEA 2012) • 60 Gbps platform, hardened fanless design with 65 W power over Ethernet (PoE+) • Integrated precision timing (IEEE1588,SyncE), seamless MPLS, OAM, wide range of interfaces	• Provides most flexible and scalable decoupled services framework from network architecture through seamless MPLS • Allows for highest quality of experience (QoE) with proven integrated and deployed leading precision timing • Ensures reliable outdoor operation with environmental hardened fanless and enhanced power efficiency • Facilitates operation with Ethernet and MPLS OAM (802.1ag, Y.1731, 802.3ah) support
TCA Series[3]	• Provides carrier-grade leading packet timing server and client functionality • Supports slave and boundary PTP, and SyncE • PTP grandmaster stratum 1-3 • BITS, PPS, and frequency • Can operate with DC/AC power supplies • Sync sources(GPS, T1/E1), TOD output • Uses OCXO and Rubidium reference oscillators	• Offers a rich set of world-class timing options for better QoE • Provides deployment flexibility by allowing customers to pick the technology best suited for different segments (access, aggregation, edge) of the network • Provides investment protection in existing technologies • Supports a hybrid mode of operation, line and tree topologies • Delivers nanosecond time-stamp accuracy, exceptional holdover characteristics, and reduces or eliminates reliance on cesium
Junos Space[4]	• Uses a Web 2.0 GUI for NMS • Supports a Device Management Interface (DMI), XML, and RESTful API • Offers hot-pluggable/multitenant applications	• Provides a fully integrated NMS Web GUI for the joint Juniper-NEC solution • Supports end-to-end Sync and timing view and provisioning as well as time probe for delay and jitter measurement • Ensures error-free service provisioning and monitoring of metro Ethernet and MPLS with SAD • Includes auto-discovery of network elements, full FCAPS • Facilitates integration of third-party and existing OSS/BSS applications

[1] iPASOLINK series
[2] ACX Series
[3] TCA Series
[4] Junos Space

Summary

Industry market leaders Juniper Networks and NEC combine to offer a best-in-class, end-to-end turnkey mobile backhaul solution. With this solution, operators can immediately reduce their cost of ownership with reduced CapEx through simpler access, aggregation, and edge transport across their backhaul networks, as well as lower OpEx with easier E2E operation. In addition, the solution delivers better QoE for subscribers. This joint solution can be the foundation for many new revenue-generating services, as separation of service plane from transport plane with seamless MPLS allows for insertion of local content and services or renewed possibilities for wholesale backhaul services. The backhaul market segment is experiencing a transition driven by advancements in technologies like LTE-A, MIMO, multicarrier, and new concepts such as HetNet, fronthaul, small cell, SDN, and virtualization.

A key advantage when adopting new technologies and new network architectures is to jointly bring to market optimized backhaul solutions that allow operators to maximize their revenue. Juniper Networks and NEC are driven by a common vision of technological innovation, industry-best quality, and operational excellence.

Next Steps

Customers interested in learning more about this solution are encouraged to contact their local Juniper Networks sales representative. For additional information, please visit: www.juniper.net/us/en/solutions/service-provider/universal-access/#literature to learn more about Juniper Network's universal access for backhaul.

About NEC

NEC Corporation is a leader in the integration of IT and network technologies that benefit businesses and people around the world. By providing a combination of products and solutions that cross utilize the company's experience and global resources, NEC's advanced technologies meet the complex and ever-changing needs of its customers. NEC brings more than 100 years of expertise in technological innovation to empower people, businesses and society. For more information, visit NEC at www.nec.com.

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.
1133 Innovation Way
Sunnyvale, CA 94089 USA
Phone: 888.JUNIPER (888.586.4737)
or +1.408.745.2000
Fax: +1.408.745.2100
www.juniper.net

APAC and EMEA Headquarters
Juniper Networks International B.V.
Boeing Avenue 240
1119 PZ Schiphol-Rijk
Amsterdam, The Netherlands
Phone: +31.0.207.125.700
Fax: +31.0.207.125.701

3510499-001-EN July 2015