Orchestrating a brighter world NEC

Solution Brief

NEXT-GENERATION MICROWAVE TRANSPORT NETWORK

NEC and Juniper Networks deliver best-of-breed microwave backhaul and fronthaul solutions for 4G and 5G

Challenge

4G and 5G mobile networks demand scalable, cost-effective, and high-capacity microwave transport solutions.

Solution

NEC and Juniper have joined forces to provide an innovative solution in microwave radio, networking, and network planning to meet these challenges. The joint solution includes the following products:

NEC:

- iPASOLINK Series Microwave and Millimeter wave radio
- UNMS/PNMSj Network Managers
- Backhaul Resource Manager (BRM)

Juniper Networks:

- ACX series Universal Access Router
- MX series 3D Universal Edge Routers
- SRX series Services Gateways and vSRX virtual firewall
- Junos Space Connectivity Services Director
- NorthStar
- Mobile Edge Computing solution

Benefits

- An integrated solution for low latency and high bandwidth
- Best-in-class timing solutions and integrated network management

JUNIPER NETWORKS

As mobile technology advances to new heights, new requirements for low latency and high capacity are emerging that will bring current network infrastructure to its knees. Juniper and NEC are working together to deliver sophisticated solutions for the construction of reliable and secure 4G and 5G mobile networks.

The Challenge

Fifth-generation (5G) technology is driving the next wave of innovation in the mobile industry. New technologies will increasingly catalyze creation of even more diverse services and applications beyond what is imaginable today. The Internet of Things (IOT) promises a rich assortment of devices that must be connected in a staggering number of ways. The entire network should be able to handle these emerging applications, services, and devices - improving and enrich people's lives.

The fundamental focus of 5G is low latency and massive connectivity and capacity. Millisecond order latency and gigabit order access in high-density areas are envisioned. New services promise to be revenue enablers for the network operator, allowing increased innovation and increased value from the mobile network. However, a coordinated effort of all devices, management systems, and support systems in the network will be needed to realize these 5G visions. Moreover, there is no "one size fits all" solution, thus solution breadth is a necessity.

The NEC and Juniper Networks Microwave Transport Solution

Convergence

Traditionally, radio access networks (RAN) require backhaul, which provided connectivity from the base station site to the mobile core network. Modern RAN network must consider fronthaul as well, which provides connectivity from the base station modem to the Remote Radio Unit (RRU). Fronthaul and backhaul together should be treated as a single integrated wireless transport network, which will reduce the complexities associated with managing and operating two separate networks. Being a single network, redundancies in microwave spectrum usage can also be reduced. Convergence of IP, optical, and microwave networks is an effective strategy for bolstering resiliency and visibility within the network, resulting in improved scalability and service provisioning. Gradual convergence in other areas, and ultimately transport and software-defined networking/network functions virtualization (SDN/NVF) convergence will unify a majority of network elements and functions, eliminating complexities and further enhancing resiliency and visibility.

From the perspective of mobile backhaul, L2 and L3 convergence is pivotal. Construction of end-to-end L3 network will realize the scalability and resiliency necessary for advanced mobile services. There will be portions of the network where the underlying L2 microwave transparently transports L3 traffic between routers (IP over Ethernet). Network engineering is also essential to the construction of optimized networks with clear migration paths. IP/MPLS is an important tool for engineering a scalable, flexible IP network that will meet current and future needs.

IP/MPLS networks, transported over microwave, provide features that allow service providers to cost effectively expand the range of services they offer. A converged transport network provides secure, flexible and scalable L2 and L3VPN services not only for mobile backhaul, but for enterprise and government customers as well.

Low Latency

The end-to-end performance requirement of 5G networks will demand a drastic change in network design that cannot be handled by existing systems. For one, the latency requirement is expected to be within 1 ms, which is an order of magnitude smaller than that of 4G networks. This is nearly impossible to achieve in a current network where most traffic traverses to the mobile core for various processing steps.

Some have suggested that distribution of certain central functions closer to the edge/access layers can realize substantial reduction in transit latency. One area that can be realized by this approach is X2 handover. With base stations that are capable of direct device-to-device communications or by constructing a local mesh network with appropriate distributed central functions, it is feasible to realize millisecond-order latency that fulfills the 5G latency requirement.

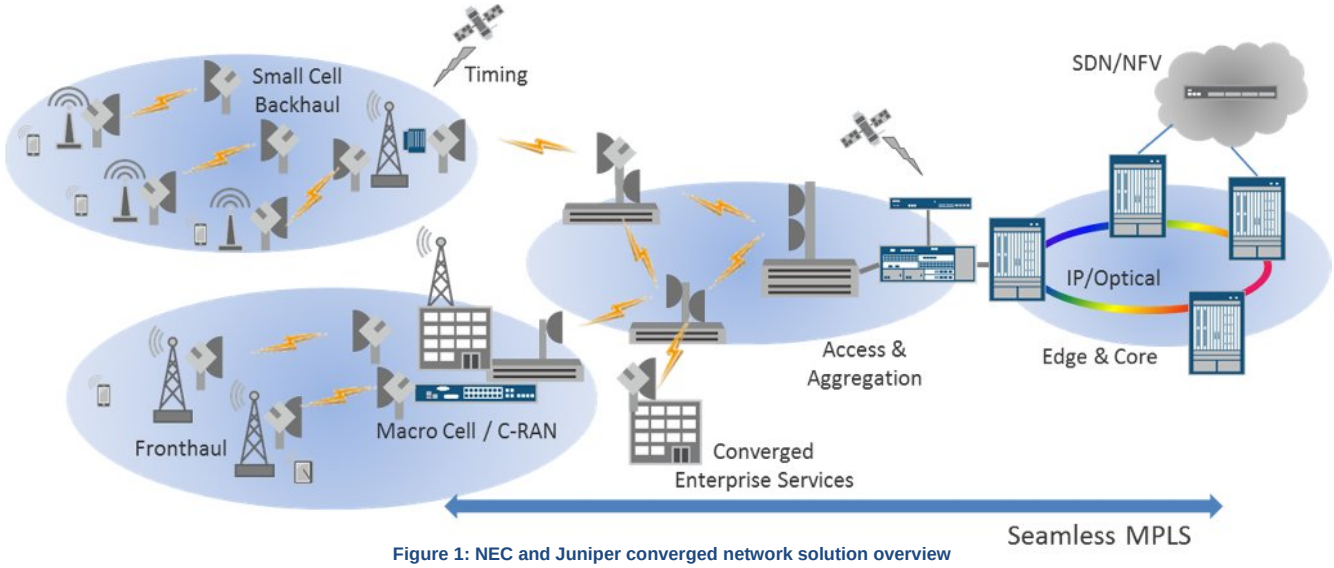

Figure 1: NEC and Juniper converged network solution overview

However, careful network engineering needs to be executed in order to deploy the right device in the right place, for cost, performance, and functional optimizations. Deployment of distributed functions will impact TCO by having to install additional hardware at key locations that maximize latency reductions.

High Capacity

To keep in line with evolving radio access technologies, the backhaul network must also evolve. An ideal network for 5G would be a high-capacity, all fiber network, but this will be extremely burdensome, in both cost and time-to-market, for operators without fiber installations. Radio has always been the choice for operators to quickly and cost effectively extend service coverage, and now with various techniques to attain high-capacity transport, it has become a viable alternative to fiber.

The NEC iPASOLINK series supports ultra-high modulation and wide channel bandwidth, compression, and radio traffic aggregation. Through multiband utilization and the combination of these techniques, iPASOLINK achieves a 10-gigabit link rate over microwave, which is comparable to fiber. It also supports 10GbE optical interfaces for connectivity to wavelength-division multiplexing (WDM) solutions. Note that NEC's E-band solution provides multi-gigabit capacity in a single RF channel.

Both microwave and millimeter wave solutions can be deployed simultaneously to enhance the link availability. For high capacity, millimeter wave radio can be established as the primary link. When the weather is not clear the link can be provided by microwave radio, which is more robust in degraded weather conditions.

Figure 2: Multiband utilization for higher channel capacity (millimeter wave and microwave)

Network Densification / Small Cell

In the 5G era, massive connectivity for devices will be the norm. Widespread adoption of handsets with high-speed wireless transmission and proliferation of connected devices such as cars and wearables will push the limits of mobile backhaul even further. Innovations in this segment must be realized in order to keep pace with growing demand for higher bandwidth.

Automatic configuration through extensive programmability would alleviate the burden of having to configure massive numbers of devices one at a time. Add intelligence to the mix, and an optimized network could be configured with minimal intervention from network administrators.

In urban centers where a high concentration of active end users exists, use of new spectrum should be considered, as insufficient spectrum bandwidth is likely to hamper capacity growth, and consequently delay adoption of 5G. A shift to terahertz range is actively being studied now, as it enables higher capacity and wider channel allocations.

Security

Security is a growing concern for both operators and end users. For privacy and confidentiality, end users are demanding that effective security measures are in place. Operators, in response to such demands and also for the integrity of the network itself, are deploying security gateways in the mobile core. However, future mobile technology such as LTE-Advanced and 5G require threat prevention and mitigation in home and roaming networks, and at application and transport strata.

In order to realize security at these levels and to meet the stringent latency requirement, the logical choice would be to decentralize the security functions at the mobile core and bring them closer to where they are needed. For example, to satisfy the latency requirement of X2 traffic in LTE-A/5G where it is mandatory, you need to apply IPsec locally. The choice of security devices varies depending on local performance levels. Juniper's security solution combines the power of Juniper Networks® ACX Series Universal Access Routers for access locations, the MX Series 3D Universal Edge Routers for distributed and core security gateway functions, and the SRX Series Services Gateways for centralized security gateway applications, with vSRX providing a virtualized solution.

Intelligence

End subscribers always want more applications that require greater capacity. New applications are developed by OTT players that gobble up huge traffic capacity, but their contribution to service provider revenue is minimal at best.

In order to maximize revenues and profits, service providers must be ingenious and creative, offering new services and technologies that end users will not be able to live without. Speed is of the essence. Usually, first to market takes it all, thus creating a climate of intense competition. Rapid service creation is enabled by ease of configuration and sophisticated management systems and orchestrators.

In this new environment, service providers must maximize their return on network investments. In the past, oversubscription of transport links was frequently used to maximize link usage, at the penalty of reduced quality of experience (QoE). It is no longer necessary or advisable to provision capacity greater than a level which will guarantee excellent QoE for the end user. Juniper Networks NorthStar Controller automatically learns multiple routes and forwards the traffic accordingly to optimize network utilization. Similarly, during night times or hours with low activity, it is possible to shut down a portion of the network for energy conservation. The same technology also enables self-healing, where network intelligence detects failures and appropriately diverts traffic around affected regions, or diagnoses suspicious nodes or links and takes proactive measures to route traffic away from them before failure.

Demand for greater service offerings is becoming increasingly diversified, and lost opportunities may arise if they are responded to one by one. SDN and virtualization solutions allow resource deployment that matches the requirements of users. Since it is dynamically performed across the entire network, quick and efficient response to traffic increases and fluctuations is delivered. NEC and Juniper offer industry-leading open SDN solutions for cloud and NFV, with proven security, availability, performance, and automation. NEC's Traffic Management Solution adds yet another value for service providers. It effectively optimizes application traffic, such as video, depending on the real-time conditions of the network, thus maximizing QoE for end users.

Timing Solution

Delivery of synchronization information across evolved networks differs drastically from 2G/3G networks. Previously, TDM circuits provided both traffic and frequency synchronization information. However, newer mobile networks are packet-based, which means that a radically different approach is required.

Synchronous Ethernet and Precision Timing Protocol (PTP/IEEE-1588v2) are enablers of time synchronization for the Ethernet-based packet technology. However, IEEE-1588v2, being packet-based, is prone to delay variations and jitters in the network. NEC's low-latency radio, coupled with the ACX Series timing-aware mobile backhaul solutions, provides high accuracy synchronization for both frequency and phase/time. In addition, the Juniper Networks ACX500 fanless mobile backhaul routers provide highly reliable phase accuracy as needed for LTE-Advanced networks, and provide timing redundancy when used as an Edge Grandmaster with standard-based Assisted Partial Timing Support (APTS) on the boundary clock.

The ACX500 Edge Grandmaster can have Global Navigation Satellite Service (GNSS) as the primary clock source and network-based PTP master as a secondary clock source (frequency backup), assuring the delivery of stable phase synchronization (long holdover periods) even when GNSS tracking is not available. With growing security threats, it is possible to attack/jam or spoof the GNSS system and this mandates a fallback mechanism using network-based synchronization (PTP). APTS allows the operator to effectively make use of existing network infrastructure to propagate timing information over a PTP-unaware network as a frequency backup to Edge Grandmasters.

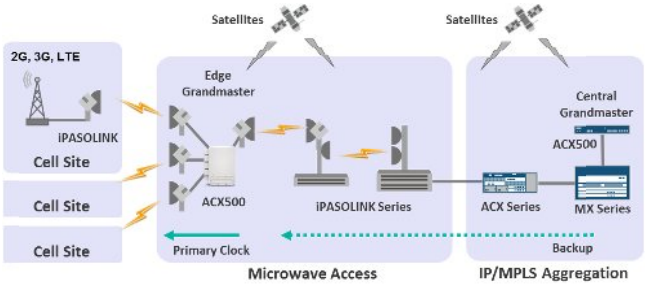

Figure 3: PTP network timing solution with APTS

Mobile Edge Computing (MEC)

5G architecture is driven by the need for low latency over a wide range of endpoint bandwidth demands. Service providers are designing their networks for low latency and high bandwidth in order to achieve the promise of LTE-Advanced. Mobile Edge Computing is an initiative by the European Telecommunications Standardization Institute (ETSI) backed by industry-leading mobile service providers. MEC provides a virtualized cloud environment near the RAN to run services and end-user applications close to mobile devices that are consuming those applications. In this way, virtualized local applications can take advantage of ultra-low latency and high bandwidth. MEC services provide information about the mobile user location and radio environment to local and remote applications, which can be used to improve network utilization, optimize content delivery, and enhance the overall user experience. For example, the Radio Network Information Service provides real-time data about RAN congestion that can be used by upstream content providers to optimize content delivery.

MEC allows service providers to create new service offerings for IoT and mobile users. The availability of computing power near the mobile device enables concentration and analytics of wireless sensor data. Local breakout can keep enterprise small cell traffic near the facility and enable value-added content delivery. Use cases where an uplink video stream is chosen from several video streams on a single evolved Node B (eNB) would be cost prohibitive in a traditional centralized model, but are feasible when the selection is done at an MEC servers.

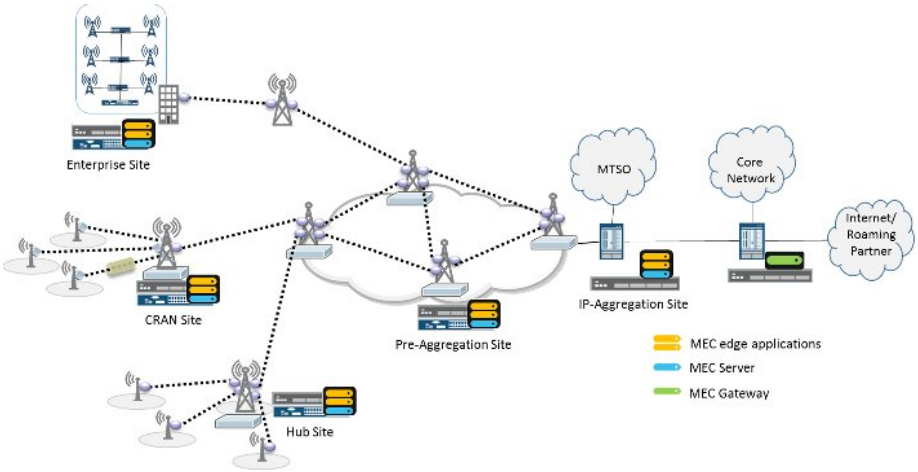

Figure 4: MEC deployment in the microwave backhaul network

Typical deployment locations of the MEC server are shown in the Figure 4. Microwave backhaul networks can take advantage of MEC by placing the MEC server at microwave hub sites. Integrated management between the microwave transport and MEC strata enables management of the complete solution at lower cost.

Features and Benefits

Feature	Benefit
Layer 2 and Layer 3 convergence	Simplified operations, multiple traffic types at highest QoE
High-capacity, low-latency microwave transport network	4G capable and 5G ready
Best-in-class network timing solution over microwave	LTE-Advanced quality timing
Automation-driven integrated network management with UNMS/PNMSi and Juniper Networks Junos® Space Connectivity Services Director	Reduced operations costs

Table 1: Features and Benefits

Summary – Best of Breed Microwave and Networking for 4G and 5G Evolution

NEC and Juniper Networks are industry technology leaders driving the development of cutting-edge microwave and networking technologies. SDN, intelligent management, and accurate timing are areas where both NEC and Juniper excel. Through a joint effort to bring networking solutions that cater to the stringent requirements of advanced mobile technologies, NEC and Juniper are working together to deliver sophisticated solutions for the construction of reliable and secure 4G and 5G mobile networks. By combining their industry-leading products and expertise, they are providing an innovative solution in microwave radio, networking, and network planning, one that responds to society's evolving needs for a communications infrastructure that can support the quality, safety, and security of today's next-generation microwave transport networks.

Next Steps

To learn more about converged microwave/MPLS solutions for mobile backhaul, and enterprise and government networks, contact your NEC or Juniper account representative.

About NEC Corporation

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 http://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.

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