The Mobile Packet Backbone Network

A compelling Multiservice IP Backbone use case

Nokia Siemens Networks

White Paper

ResIP certified

Executive summary

The mobile communications market is evolving at a furious pace. Growing competition, eroding prices, and emerging technologies are driving down mobile voice ARPU. To make up for shrinking margins, operators need to exploit new mobile technologies, develop unprecedented data services, and transport exploding traffic more cost-effectively.

This white paper discusses ways in which the CSP (communication service provider) can leverage an IP backbone and multi-service capability to cost-efficiently accommodate and capitalize on this exponential growth in bandwidth. It outlines a solution that can help operators tackle the bandwidth and traffic challenge. Called Multiservice IP Backbone, this solution is built on a platform of best-of-breed Cisco and Juniper products and delivered by a top IP solution integrator, Nokia Siemens Networks. Its architecture is mapped for multiple use cases, the most prominent of which is the Mobile Packet Backbone Network, or MPBN for short. This document explains the MPBN, and makes a case for converting TDM and packet backbones into a single efficient IP backbone.

1. Introduction

Nokia Siemens Networks expects some five billion people to be connected by 2015, with about four billion (80%) enjoying broadband access, and wireless outnumbering wireline broadband connections.

Both today's and tomorrow's technology – HSPA (High-Speed Packet Access) and LTE (Long-Term Evolution), respectively – are geared to drive traffic growth and attract even more users, for example, by cutting per-gigabyte costs and vastly improving the mobile data user experience.

Efficient new radio technologies and more and more users add up to exponential traffic growth. Projections call for as much as a 100-fold increase in the years ahead. CSPs' transport infrastructure will be hard-pressed to keep pace. Scaling legacy TDM, ATM, and Frame Relay networks up to accommodate such massive growth presents a daunting engineering challenge, and even more so when costs are factored into the equation. One technology has what it takes to create a common backbone – IP/MPLS.

Further challenges await once an IP/MPLS backbone is in place to handle all traffic: Multi-vendor, QoS, resilience and interworking capabilities will become ever more important, especially as backbone networks converge and extend out further to the access and aggregation layer in LTE, branching into other domains and encountering other vendors' equipment.

So Nokia Siemens Networks set out to ensure QoS and resilience in multi-vendor environments, helping CSPs make the transition to IP and handle business-critical traffic such as voice or signaling via IP. To this end, the company integrated best-of-breed products from Cisco and Juniper, the IP/MPLS market leaders with a huge embedded base, into its offering.

Nokia Siemens Networks, acting as a solution integrator, leverages its considerable IP and mobile skills, as well as the assets of Cisco and Juniper to deliver a remarkably affordable solution. Cost-effective and scalable, the MPBN is an IP/MPLS-based backbone that puts CSPs in the driver's seat for mobile broadband. It provides the transport power and performance capability CSPs need to satisfy skyrocketing demand for data services, grow as they go, and sustain their business for the long haul.

2. IP transport in mobile core networks

Tomorrow's mobile network technologies use native IP transport without prescribing layer-1 or layer-2 technologies. Core sites will have to support speeds of up to hundreds of gigabits per second and meet tough SLA targets to handle the predicted 100-fold increase in traffic.

IP/MPLS is flexible and open for future developments, highly scalable, and cuts the cost of deploying new services, all of which has made it the mainstream technology for fixed, mobile, and converged network cores. Some CSPs are already moving from legacy TDM, ATM, and Frame Relay networks to IP-based mobile core networks. They can continue benefiting from earlier investments by reusing network infrastructure and gradually stepping up to more scalable and economical IP packet over Sonet/SDH, Ethernet, or DWDM networks.

The MPBN drives down OPEX. It streamlines transport as well as network O&M practices by slimming down to a single technology. IP technology allows CSPs to better scale bandwidth and aggregate traffic, with fewer physical links between sites. Experience teaches that physical cable or fiber issues cause a full 80 percent of network failures. So logic dictates that better traffic aggregation translates to fewer faults.

This solution also cuts CAPEX. Products are far easier to harmonize in a single transport network. IP routers are modular, enabling CSPs to grow on the fly, adding capacity easily and cost-effectively to keep pace as demand picks up. Streamlined IP means that operating staff no longer need to deal with multiple user interfaces, disparate hardware designs, and software operating systems, all of which reduces OPEX. Also, network extensions entail far less effort and overhead.

IP/MPLS technology provides flexible, scalable transport capacity. The availability of layer-1 and layer-2 technologies in the given area is no longer a concern when leasing IP capacity. IP paired with MPLS technology enables operators to build a single multiservice network to carry voice, video, and data, whereby the mobile core is just a single application. The same network infrastructure may be used for convergence, fixed, and enterprise services.

3. Why the MPBN solution?

Voice service is moving from TDM to voice over IP; the same goes for the circuit-switched core. Mobile phone call time is up; prices are down. Commercial media gateways' capacity is steadily rising. And users expect a satisfying experience regardless of transmission technology. This places tremendous pressure on CSPs to come up with scalable, cost-efficient capacity while maintaining and improving network resilience and QoS.

Data traffic in GPRS, EDGE, WCDMA, and HSPA networks is also booming. Mobile broadband users with USB modems, dongles, and smartphones expect service commensurate with fixed DSL and cable broadband. Mobile handsets feature more pre-installed applications, more powerful processors, and larger higher-definition displays, encouraging consumers to browse, e-mail, message, stream, and use voice over IP on their mobile devices.

Given encrypted connections between handsets and enterprises, business users are taking advantage of e-mail, web-based enterprise applications, and other corporate services. And rather than reaching for a wireline phone, many are opting for mobile devices in office WLANs.

Conventional mobile networks' topology is hierarchical, with base stations connected to a controller connected to an MSC or SGSN, and the SGSN connected to a GGSN. There is no such pecking order in HSPA and LTE networks, and new 3GPP features such as Direct Tunnel and multipoint Iu/Gb allow traffic to bypass some of these network elements. One element can already communicate with various others, and in LTE traffic will be carried between base station sites. So the mobile network's topology must also evolve from a stringent hierarchy to a meshed network.

Tomorrow's network must be able to handle enormous amounts of traffic, transport VoIP and signaling in real time, reach across network borders and IP routers, and keep delay and jitter numbers low.

All this compels CSPs to find more cost-efficient, scalable ways of offering mobile voice and wireless broadband services to subscribers without settling for being a mere bit pipe supplier.

4. More about the MPBN

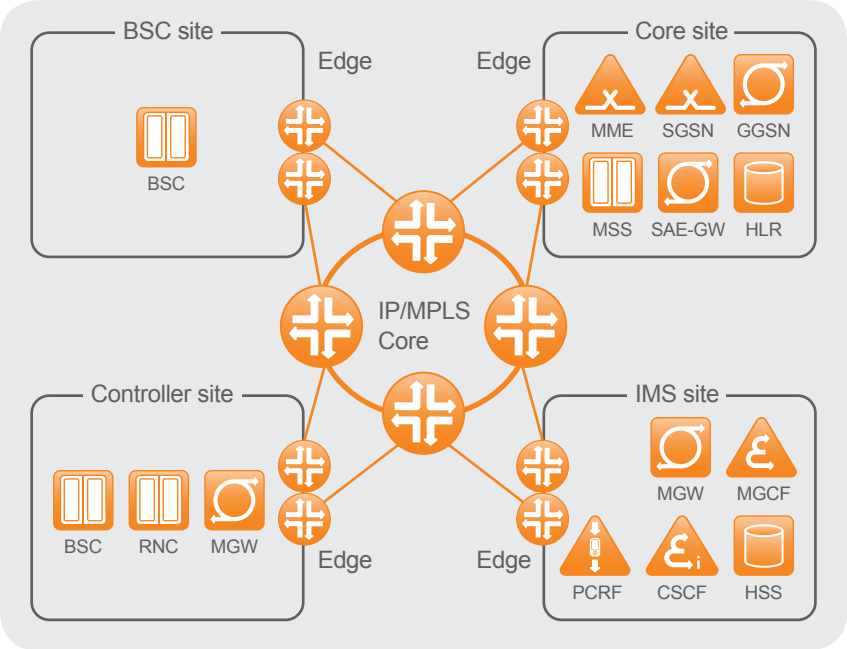

Figure 1: Mobile packet backbone network

Nokia Siemens Networks developed and verified the MPBN solution to help CSPs tackle these challenges and grow their business.

Featuring the world-leading routers of Cisco and Juniper, as well as IP/MPLS capability, it provides cost-effective, scalable transport between mobile core domains and radio network sites in both circuit-switched and packet-switched domains.

Nokia Siemens Networks has also verified and proven that the IP/MPLS network in the circuit-switched core can reliably carry Release 4 voice traffic, as countless customers will attest. Designed to meet future mobile, converged, and fixed networks' scalability requirements, world-class Cisco and Juniper routers ensure carrier-grade resilience and high availability. Providing the underpinning for a real multi-vendor multiservice IP/MPLS network, the MPBN enables CSPs to deliver content and media in ways that satisfy both enterprise and consumer demands.

The edge routers – Cisco 7609 and ASR 9000 or Juniper M and MX models – deliver MPLS layer-3 VPN services between mobile sites. The connection between the site switch and site edge router in the layered infrastructure is engineered for fast failover times. Various routing alternatives cater to individual operator's preferences, whereby traffic separation is always maintained to ensure service security and availability.

The MPBN's core has proven its merits over many years in Nokia Siemens Networks' ResIP center. The IP/MPLS core network recovers as quickly as legacy SDH networks. Availability exceeds five nines, and a stringent QoS policy and smart traffic engineering minimize latency, variance, and packet loss for time-critical traffic. A properly configured MPBN will not drop a phone call even in the event of a failure, as rigorous tests of high-availability features with Cisco and Juniper routers have confirmed.

Router features such as line rate packet filtering, unicast Reverse Forwarding Path (uRPF), flow monitoring, and IPSec VPNs, in combination with the operating system's modular design, ensure service remains available and routers accessible even during a denial of service attack.

Nokia Siemens Networks designed the MPBN to satisfy the SLA requirements of 3GPP Release 4 and subsequent releases, ensuring the network is robust enough for any mobile network application. Soon the packet-switched domain will need more capacity and its topology must be made to support meshed communications. This solution provides the means to do this, as well as the scalability to incorporate radio sites.

This solution also offers secure traffic isolation and a reliable transport network for charging, subscriber provisioning, and O&M connections. Any or all traffic in these different domains may be encrypted on demand.

The MPBN provides a launch platform for next-generation services while protecting investments in ATM, Frame Relay, and TDM networks. Routers scale from E1 interfaces to Gigabit Ethernet interfaces within the same chassis to make the most of earlier investments in hardware. And the MPBN is easily IPv6-enabled with a software license – no upgrade required.

This solution provides the underpinning for converged multiservice networks and makes mixed Cisco-and-Juniper environments work. Multi-vendor backbones benefit from Nokia Siemens Networks' design, testing, and certification efforts because the Mobile Packet Backbone ensures highest QoS and resilience across the entire IP backbone. And CSPs benefit because they can take advantage of multi-vendor backbones created in response to network mergers and pricing policies.

Nokia Siemens Networks' network management system NetAct now addresses Cisco and Juniper edge and core routers. This enables CSPs to configure the entire IP/MPLS network from end to end using the same management system as for the radio network, which simplifies network management. Fault and performance management for Cisco and Juniper components has also been integrated.

5. Summary

Nokia Siemens Networks is the market leader in next-generation mobile networks and packet core deployments. The company is well-versed in delivering mobile packet core solutions, and the IP solution integrator of choice for CSPs seeking to accommodate a 100-fold increase in traffic. Featuring routers made by the leaders in the global IP/MPLS market, Cisco and Juniper, the Multiservice IP Backbone's architecture is mapped for multiple use cases, one of which – the Mobile Packet Backbone Network – enables CSPs to transform TDM and packet backbones into a single powerful IP backbone and benefit from the exponential growth in mobile bandwidth. This MPBN solution provides resilient, scalable, and cost-effective means of implementing the mobile core network and eventually extending it to incorporate the IP RAN. It is ready for LTE deployments, and its network management capabilities cover Cisco and Juniper products.

6. Abbreviations

3GPP	Third Generation Partnership Project
ARPU	Average Revenue per User
ATM	Asynchronous Transfer Mode
BSC	Base Station Controller
CAPEX	Capital Expenditure
CSCF	Call Session Control Function
DSL	Digital Subscriber Line
DWDM	Dense Wavelength Division Multiplexing
E1	E-carrier level 1
EDGE	Enhanced Data Rates for GSM Evolution
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
HLR	Home Location Register
HSS	Home Subscriber Server
IP/MPLS	Internet Protocol/Multiprotocol Label Switching
IPSec	Internet Protocol Security
IPv6	Internet Protocol Version 6
MGCF	Media Gateway Control Function
MGW	Media Gateway
MME	Mobility Management Entity
MPBN	Mobile Packet Backbone Network
MPLS	Multiprotocol Label Switching
MSC	Mobile Switching Center
MSS	Mobile Switching Server
OPEX	Operational Expenditure
O&M	Operation and Maintenance
PCRF	Policy Charging and Rules Function
QoS	Quality of Service
RAN	Radio Access Network
ResIP	Resilient IP
RNC	Radio Network Controller
ResIP	Resilient Internet Protocol
SAE-GW	System Architecture Evolution Gateway
SDH	Synchronous Digital Hierarchy
SGSN	Serving GPRS Support Node
SLA	Service Level Agreement
SONET	Synchronous Optical Network
TDM	Time-Division Multiplexing
USB	Universal Serial Bus
VoIP	Voice over IP
VPN	Virtual Private Network
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Network

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