WHAT IS BACKHAUL? HOW WILL BACKHAUL EVOLVE?

In a telecommunications network the backhaul portion of the network comprises the links between the core network and access nodes – the “edges” of the network. The rapidly growing desire for mobile-broadband capacity and coverage is being driven by the rising popularity of connected devices – smartphones, tablets and laptops – as well as by mobile apps and cloud computing. Backhaul plays a critical role in this, and has corresponding demands placed on it both from mobile broadband and the introduction of heterogeneous networks.

CURRENT MARKET FOCUS
Overall network performance puts backhaul high on the agenda of mobile operators:

- Increased mobile data usage also affects backhaul capacity needs.
- Packet technology choices and migration strategies remains a focus area for operators, with MPLS as a technology path to a single backhaul network.
- The need for a more advanced and flexible synchronization solution is in sharper focus. Standardization work for time/phase synchronization - where Ericsson is one of the main contributors - is not yet finalized.
- Performance monitoring and management is a key area to assure the end-user experience, and in addition to help optimize network performance.
- Increased interest regarding the combination of macro and small cells into what Ericsson refers to as heterogeneous networks. Backhaul is an important component in the end-user experience, one such aspect being the ability to support new sites in more public areas with a cost-efficient roll-out. As network density increases with higher capacities, the spectrum efficiency in the backhaul becomes more critical.
- Network convergence is having an increasing impact on the backhaul requirements – some requirements coming from the mobile side, other requirements from the fixed side - as operators converge their networks for both performance and cost reasons.

CAPACITIES
The required backhaul capacities will continue to grow over the coming years. Network wide deployment of LTE and access to the spectrum in the <1 GHz band will enable cost efficient coverage build out in the rural areas and coverage sites (80% of sites). In 2015 backhaul site capacities of 1 Gbps can be expected in the network with technologies such as LTE Advanced and additional RAN spectrum, but to a limited number of sites mainly situated in dense urban areas. The major transmission media candidates available to meet these capacity requirements are microwave and optical fiber. Microwave is the dominating transmission technology for mobile backhaul
worldwide; it enables cost efficient and fast rollout of Mobile Broadband. Today microwave connects 60% of all base stations, and the high share of microwave is expected to continue.

In recent years microwave technology has taken several steps to increase capacities and add new spectrum (with more to come). Now Gigabit capacities can be available everywhere, and thanks to continuous technology innovation microwave will remain the transmission media of choice for mobile systems. This enables support for a global mobile broadband network expansion, with both 3G and LTE mobile systems.

Microwave products have during the past years pushed the capacity limits using multiple technologies – modulation, wider channels, cross-polar operation and radio link bonding to name a few. They have also evolved to work more efficiently using built-in packet aggregation and adaptive modulation to minimize costs for initial rollout or network upgrade. To meet the increased demand for bandwidth new frequency bands have been introduced, for example 42 GHz and 70/80 GHz.

PACKET EVOLUTION

Technologies

Changes in the LTE architecture open a discussion about corresponding changes needed in the mobile backhaul architecture - and the transport technologies to be used. The discussion about transport technologies is based on whether a Layer 2 (L2) or a Layer 3 (L3) based transport technology is most suitable for the mobile backhaul - which can be in turn be divided into a Low RAN (LRAN) and an High RAN (HRAN). The technologies to be used in each segment may be different - and often it is the HRAN part that becomes the subject of discussion.

The following technologies can be deployed for mobile backhaul:

› L2 services based on:
  - MPLS-TP or IP/MPLS
  - Native Ethernet
› L3 services based on:
  - IP/MPLS
  - IP (overlay)
  - IP (fully routed)

The primary requirements on the backhaul are to build a scalable solution with low complexity, and to be resilient to failures with fast re-convergence times. Cost effectiveness is another key factor that must be considered, especially in the lower parts of the networks where the number of sites can scale up to several thousands. When selecting technology it is important to consider both the capital expenditure as well as the operational cost arising after the deployment, i.e. the Total Cost of Ownership (TCO).
All technologies have their advantages and drawbacks. An L2 VPN solution based on MPLS-TP provides a transport-centric scalable service which is easy to provision and deploy given the right support from an NMS system. An L2 Native Ethernet solution offers limited complexity and scalability to a certain point – and scalability can be improved by using Provider Bridging (PB). An L3 VPN solution comes with more complexity in order to achieve fast convergence times - more complex nodes are required. A fully routed IP end-to-end requires solutions for traffic separation.

The choice between L2 to L3 is flexible, and depends on scalability and capacity issues - not on the specific radio technologies being used. Ethernet based L2 networks are preferred closer to the cell site, due to their ease of deployment and cost efficiency. MPLS based L2 and L3 networks are used in the parts closer to the core of the network, since they offer better scalability and resilience. The choice of technology will depend on the operator service mix, capacity and scalability needs.

Ericsson supports all technologies and has verified key backhaul features end-to-end, improving quality and minimizing risks.

**Synchronization**

In traditional mobile networks (TDM-based GSM and ATM-based WCDMA), frequency synchronization was obtained through a PDH signal from the transport network on a physical link (E1 or T1) connected to the base station. During the transition phases to an IP-based network the backhaul may now need to support multiple synchronization services to manage both the legacy as well as new services. The vast majority of the Ericsson RAN IP deployments are using in-built NTP, where there is no requirement for specific node support in the backhaul network to support frequency synchronization.

To meet current and future synchronization needs there are further options available depending on network requirements, and often a combination of these methods will be used:

› Global Navigation Satellite System (GNSS) - supports frequency and time/phase synchronization
› Synchronous Ethernet - supports frequency synchronization
› Precision Time Protocol (PTP), also known as IEEE 1588v2 – supports frequency and time/phase synchronization

For time/phase synchronization it is currently assumed that to support the required levels of accuracy all nodes in the backhaul will need to support time/phase synchronization. Ericsson is well prepared as one of the leaders in the standardization work to support all synchronization needs in the future.

**PERFORMANCE MANAGEMENT**

Modern networks provide a wealth of information that can be used to keep a network running at its very best, and in addition to ensure that customers are getting the service they deserve. With end-to-end performance monitoring including correlation between RAN and backhaul key performance indicators, operators can secure optimal network performance and user experience by continuously tuning their backhaul to ensure sufficient capacity and coverage to meet user needs.
HETEROGENOUS NETWORKS
The introduction of small cells in the radio access network as a complement to the macro cell layer will introduce many new sites and backhaul challenges. Typical outdoor small cell sites are 3-6 meters above street level on street furniture or building facades, with 50-300 meters inter site distance. Due to these large numbers, small cells will require more cost effective, scalable and easy to install backhaul solutions that support a uniform user experience across the entire radio access network.

Traditional backhaul technologies such as line-of-sight (LOS) microwave, fiber and copper are being adapted to meet this emerging need. However due to the positioning beneath roof height, there will be a substantial number of small cells without access to either a wired backhaul or without a clear LOS to an existing macro cell or a remote fiber backhaul point-of-presence. (more in separate backgrounder)

MULTISERVICE CAPABILITIES
We see similar market requirements and characteristics in mobile backhaul and in fixed (for instance Multicast and IPv6), but with some different flavors:
- IP-MPLS with L2/L3 services dominates in fixed networks, MPLS-TP has traction in mobile backhaul
- Router scalability and capacity requirements are typically lower in mobile backhaul

ERICSSON PORTFOLIO
Ericsson’s leadership in LTE and Mobile Broadband provides the ability to develop backhaul solutions optimized for today which will also scale to future needs.

Ericsson Mobile Backhaul solution
Ensuring end-to-end Mobile Backhaul service with Scale, Simplicity, Smartness and Superior Performance. Future proof packet deployments, increased capacities and good network performance in focus.

Microwave solutions:
- MINI-LINK PT — next generation zero footprint packet microwave solution
- MINI-LINK TN — nodal microwave solution with advanced packet functionality and integrated traffic handling
- MINI-LINK CN — compact end-node developed for cost efficient microwave hop solutions
- MINI-LINK LH — packet long-haul microwave solution providing high capacities

Aggregation Routers & Switches
- MINI-LINK SP — cell site and aggregation switch/routers for fiber and microwave solutions, supporting both MPLS-TP (L2VPN) and IP-MPLS (L2VPN, L3VPN).
- SSR 8000 family — aggregation and edge router for the modernization of networks that require massive scaling for fixed and mobile network infrastructures, supported with IP-MPLS (L2VPN, L3VPN)
Optical transport
- SPO family — Packet Optical Transport Platform (POTP) from the Metro Access to the Metro Regional network to support popular Ethernet (packet), TDM and wavelength services on a single platform.

Management system
- IPT-NMS — Single management system for all backhaul products.

Professional Services
Technical expertise in design, roll-out, upgrades, integration, network surveillance and support.
NOTES TO EDITORS

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Our offering comprises services, software and infrastructure within Information and Communications Technology for telecom operators and other industries. Today 40 percent of the world’s mobile traffic goes through Ericsson networks and we support customers’ networks servicing more than 2.5 billion subscribers.

We are more than 110,000 people working with customers in more than 180 countries. Founded in 1876, Ericsson is headquartered in Stockholm, Sweden. In 2013 the company’s net sales were SEK 227.4 billion (USD 34.9 billion). Ericsson is listed on NASDAQ OMX, Stockholm and NASDAQ, New York stock exchanges.

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