HOW TO READY YOUR MOBILE BACKHAUL NETWORK FOR LTE

LTE has outperformed service provider expectations, driven by end-user demand. That’s a huge opportunity for operators—if they commit to re-architecting the backhaul network.

Introduction

LTE is exceeding the expectations of end users and operators—unlike 2G and 3G services, which were characterized by long delays and slow adoption. The growing momentum behind LTE creates revenue and cost saving opportunities for operators, particularly with fixed-mobile convergence (FMC) services that can’t be driven by 3G alone. But realizing this promise requires a backhaul network that can keep pace with the huge traffic volumes created by LTE.

It’s time to rethink the way network capacity, performance, and flexibility are architected and provisioned. It’s time to make the move not just to LTE, but to a backhaul network that can truly deliver on all of the opportunities for monetization and cost cutting that LTE opens up. This article examines the rapid adoption of LTE, the market opportunities for operators, and the requirements of next-generation backhaul network architectures.

LTE Momentum: Greater Than Expected

The vast majority of telecommunications industry pundits expected the transition from 3G to 4G LTE to mark the end of the “voice” era and the advent of the “data” era. Few experts, however, predicted the magnitude and the speed with which end users have embraced LTE.

There are already 198.1 million LTE subscribers worldwide, up a remarkable 115 percent from 92.3 million last year, according to an IHS iSuppli Wireless Communications Special Report. The subscriber base is now expected to reach 1 billion as early as 2016, according to the IHS study.

And there were already 560 LTE-enabled consumer devices available in November 2012, three times as many as a year earlier, according to a white paper recently published by Heavy Reading. In all, more than 100 mobile operators worldwide have already successfully launched LTE services in more than 50 countries, and the full-scale ramp-up of new services is just beginning. Clearly, LTE is exceeding the expectations of operators and end users alike.

LTE Revenue Opportunities: Largely Untapped

For operators, the best news about the LTE market is that much of the revenue potential has yet to be exploited. Opportunities for creating or expanding services remain available on multiple fronts:

- LTE subscribers consume far more data than 3G subscribers, creating opportunities for operators who can find innovative ways to monetize and deliver data-intensive services efficiently. For example, while only 10 percent of Verizon Wireless subscribers have LTE devices, this 10 percent accounts for around a third of Verizon Wireless’ total traffic. In addition, many LTE operators now report that as much as two-thirds of their traffic is now video, underscoring both the growth and the revenue potential of new rich media applications.

- LTE also creates new revenue and cost saving opportunities with FMC that weren’t driven by 3G alone. For example, Verizon Wireless launched its HomeFusion home broadband service via LTE in 2012. Leveraging an antenna deployed at the customer premises, the DSL substitution service offers downlink speeds of 5-12 Mbps and uplink speeds of 2-5 Mbps, the same speeds that Verizon Wireless commits to LTE customers in the mobility environment.

- The traffic volumes generated by LTE are leading operators to build out transport networks and edge routing networks that are shared for both mobile backhaul and enterprise networks, leading to potential cost efficiencies. Telecom Italia, for example, has adopted this FMC strategy on the network side, while in the U.S., many alternative access vendors (AAVs) that have built out backhaul networks are now adding enterprise customers to these networks.

The Challenge: Keeping Up with Network and Backhaul Requirements

To capitalize on the opportunities presented by LTE, operators will need to fully understand and respond to the new requirements imposed by LTE on the network architecture and particularly the backhaul network.

As depicted in the diagram below, the network architecture changes fundamentally in the transition from 3G to LTE.

Figure 1: Evolution from 3G to LTE network makes IP backhaul mandatory rather than optional.
To summarize the differences, in the LTE architecture:

1. The radio network controller (RNC) is pushed out to the core and eNodeB, respectively, eliminating 3G’s RNC node.

2. There is a single IP-based mobile network core for voice and data (the Evolved Packet Core or EVC)—not separate voice and data networks as with 3G. This reduces both cost and latency and enables voice over LTE (VoLTE), as well as a host of real-time multimedia services such as rich communication services (RCS).

3. Evolved Packet Core (EPC) can be deployed anywhere, not just close to the Node B as in 3G networks. This includes pool mode (via the S1-Flex feature) or in a virtualized configuration in the cloud.

4. IP backhaul is mandatory rather than optional.

5. There is a new X2 interface between base stations that provides a direct transport path between eNodeBs to enforce good performance at the cell edge.

The architectural changes required in LTE networks also change the requirements for the backhaul network. Specifically, the backhaul network must now:

- Evolve from static point-to-point SDH, or an Ethernet network supporting a slow changing network of macro cells, to a much more flexible, content rich, voice, video, and multimedia distribution network

- Support a heterogeneous network of macro cells and small cells that are evolving rapidly and dynamically

- Allow EPC and service delivery platform (SDP) elements to be deployed much more flexibly throughout the network and according to a variety of new leading-edge networking models to reduce capital expenditures (CapEx) and operational expenditures (OpEx).

How to Build Capacity into the Backhaul Network

Today’s backhaul networks are predominantly fixed, point-to-point architectures. To deliver the capacity and performance required by LTE applications and business models, they will clearly need to evolve.

For operators, the first step should be to consider how to transition to a more future-proof network topology—an environment that supports greater physical path diversity such as via ring or partial mesh architectures.

And this new architecture will need to perform well irrespective of which protocols operators have deployed or plan to support across the backhaul, because a networking constraint imposed by a network topology is a constraint no matter which protocol runs over the network.

In terms of current protocol trends, Heavy Reading estimates that packet-based backhaul has been rolled out in live commercial service to about 40 percent of the world’s cell sites, and will reach 85 percent of those sites by the end of 2015. That still leaves 60 percent of the world’s cell sites with only time-division multiplexing (TDM) today—and TDM is slowly being pushed out of the network altogether.

From the core side, IP/MPLS has made inroads into the aggregation domain and will probably be the most widely deployed protocol in the aggregation domain of mobile networks by the end of 2015. L2 carrier Ethernet has already started losing ground to IP/MPLS in the aggregation layer, and several major operators that have launched LTE are also considering IP/MPLS for deployment further out in the access domain.
Moreover, given the Third-Generation Partnership Project (3GPP) roadmap for Self-Organizing Networks (SON), operators need to increase the flexibility and automation capabilities of the backhaul network, and MPLS is the optimal protocol to support that advancement. Some operators are now following a path to so-called seamless MPLS, which promises a fully automated single-label switched path from the access layer to the core.

Security Considerations in the Evolved Backhaul Network

Of course, improvements to the capacity and agility of the backhaul network alone will not be sufficient to support the surge of LTE subscribers. The evolution from 3G to LTE also creates new security threats and vulnerabilities which need to be addressed. For example:

- **IP backhaul**, which is inherently vulnerable to hacker attacks, is mandatory rather than optional as an alternative or complement to TDM backhaul.

- **Distribution of the radio resource control to eNodeB and EPC** means that in LTE, the 3GPP encryption terminates in the eNodeB at the edge of the network rather than deeper in the network in the RNC.

- **The elimination of the RNC node** means that an attacker who is able to access a cell site can potentially gain direct access to the mobile operator’s core.

These and other exposures must be closed in order to protect the operator’s subscriber base. As recommended by 3GPP, one of the key solutions for mitigating these new risks is the use of IPsec for both authentication of eNodeBs and encryption of traffic across the S1 and X2 interfaces. Operators such as T-Mobile in Germany, Everything Everywhere in the U.K., and Telecom Italia are leading the way with a policy of implementing IPsec at their LTE cell sites.

Some network planners still tend to view IPsec with an element of trepidation since it is new to the backhaul network. However, implementing IPsec across the S1 and X2 in a manner that supports the operator’s network latency target for LTE is extremely important. Consistent with that, the implementation also needs to support the low packet delay variation requirements of synchronization standards like IEEE 1588v2, for example, by enabling synchronization packets to be excluded from the IPsec tunnel and transmitted along an express path, marked up with the highest prioritization so that they bypass standard queuing mechanisms.

In addition to encryption, IPsec in the LTE backhaul also leverages Internet Key Exchange v2 (IKEv2) and a Public Key Infrastructure (PKI) for authentication of eNodeBs to protect against base station spoofing or man-in-the-middle attacks.

In the years ahead, eNodeB authentication based on IKEv2 can expect to see greater adoption. Leading UMTS Terrestrial Radio Access Network (UTRAN) vendors have also put significant development resources into automated certificate enrollment and certificate management through the use of Certificate Management Protocol (CMP) as recommended in the 3GPP specifications. These enable eNodeBs to be securely auto-configured and have their certificate managed over their lifetime.
Summary

The upward spiral in LTE adoption is a mixed blessing for operators. The success of LTE creates huge market opportunities over the long haul, but it also creates the need to improve the capacity, performance, and flexibility of the backhaul network right away. And that means additional complexity and expense in the short term.

The most forward-looking operators are already making the move and transforming their backhaul networks for LTE, but there is still plenty of opportunity left for operators to carve out their slice of the burgeoning market for LTE services.

The key is to start by creating a roadmap for incorporating the cost saving and revenue-generating potential of software-defined networking (SDN) into the backhaul network, and to recognize the value of MPLS as an increasingly important protocol for enabling this transformation across the core and backhaul domains.

Learn More

For additional information about LTE as the catalyst for rethinking the backhaul network, read the white paper entitled “LTE: The Trigger for Next-Gen Backhaul,” from Heavy Reading.

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