

## LTE Ready Backhaul

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Long Term Evolution (LTE), the new standard for air interface for wireless handhelds, is the current “buzz” in mobile corridors, and as its name suggests, it will most likely continue to attract interest for a long time to come.

While many industry professionals tend to focus on LTE Access networks – and more specifically on spectrum allocation for new LTE services – it is also important to look at the evolution of the mobile backhaul network; the very network that will eventually carry the increasing broadband traffic.

Of the three main transport technologies in the backhaul arena - fiber, copper and wireless point-to-point microwave - the latter is perhaps the most important to look at. Used in over 50% of all mobile backhaul deployments worldwide (and nearly 70% outside the U.S.A.), point-to-point microwave systems offer simple and cost efficient backhauling for voice and high-speed data services. That's because point-to-point microwave supports higher data rates than copper T1/E1 lines, and easily overcomes the high cost and limited availability associated with fiber.

### What Does LTE Mean for Backhaul?

As far as most mobile users are concerned, LTE is unlikely to have much impact any time soon. This is mainly because LTE, like 3G, is focused on technology rather than on applications. Over the next few years “user experience” will still continue to rely on 3G (and in some regions on 2G) technology. The direction of the market however is clear. As consumers get more and more used to new services and applications, driving their “bandwidth appetite” upwards, even today's most advanced 3G networks will eventually become obsolete.

But for the mobile operator, LTE is already part of the game plan. Operators have to learn the technology and its impact on their networks, applications and service offering. In the following paragraphs, we will concentrate on the benefits LTE brings to operators. In particular, we'll see how operators can prepare their backhaul networks for LTE launches planned to commence from 2010 and onwards.

### LTE defined

Third Generation Partnership Project Long Term Evolution (3GPP LTE) is the name given to a project within the 3GPP to improve the UMTS mobile phone

standard. The promise of LTE is to provide an evolution path for mobile technology and the delivery of faster data speeds and new services. LTE will utilize a new radio access technology that is optimized for IP-based traffic and offers operators a simple upgrade path from 3G networks.

### Broadband Mobile Network Evolution

In short, backhaul systems designed to serve LTE deployments should address three basic requirements:

1. **Higher capacities:** Backhaul to a single tail site should be able scale to 100Mbps and even beyond
2. **Lower Latencies:** The requirement for 10 millisecond end-to-end leads to select a solution that supports extremely low latency
3. **All IP:** Support IP traffic from the get-go

Figure 1 below describes the capacity evolution of mobile access networks leading up to LTE. Next generation wireless backhaul solutions will achieve these systems.

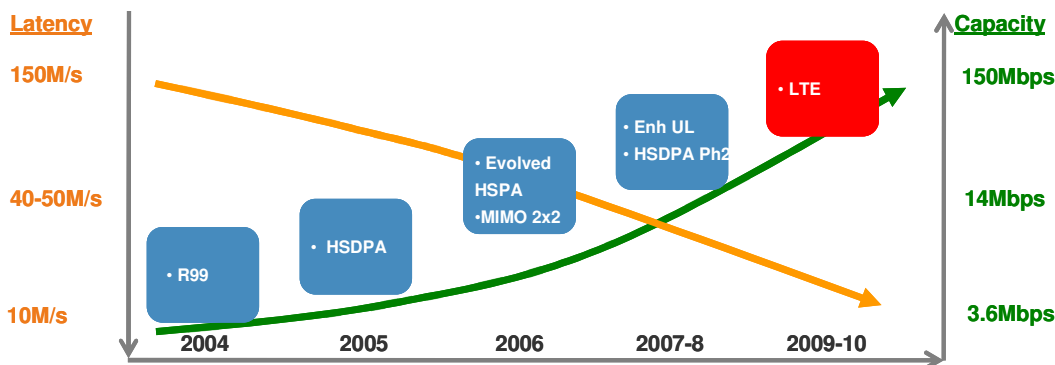


Figure 1: 3G and LTE Capacity & Latency Requirements

### Answering the backhaul challenge

Higher capacities and lower latencies are a must for LTE backhaul. So is the ability to support IP traffic and all-IP architectures, since LTE networks will be used mostly to deliver data rather than voice. And since today's backhaul networks are still dominated by TDM - be it T1/E1 lines or high-capacity SDH/SONET - one main consideration operators are faced with today is how to migrate their networks to IP.

**Migrate to IP While Leveraging Existing Legacy Equipment**

In order to make the migration process as painless as possible, backhaul networks should, in the foreseeable future, continue to support legacy services. The migration to IP does not necessarily mean that current investments in transport equipment become sunk cost. On the contrary, a good migration strategy is all about capping new investments in legacy-only equipment, and delivering new services over new high capacity, IP-enabled equipment. A good migration strategy also maintains critical services over trusted legacy technology, gradually shifting revenue generating services to the new packet network.

During the migration process, delivering Ethernet over existing TDM networks in NG-SDH/SONET or Ethernet over PDH can also be considered as an interim solution. In the long run however, these systems will encounter scaling issues, not to mention the fact that encapsulating Ethernet over TDM would only add latency instead of decreasing it.

The solution can be found in flexible backhaul systems that allow the operator to use either legacy or Ethernet – or both – in accordance with its specific needs. These “hybrid” solutions depicted in figure 2 below, support native TDM and native Ethernet simultaneously (Native<sup>2</sup>). Thus, operators can connect the TDM ports today, and gradually shift traffic to the Ethernet ports in the future. This shift can be done from remote, so no additional CAPEX or OPEX are needed.

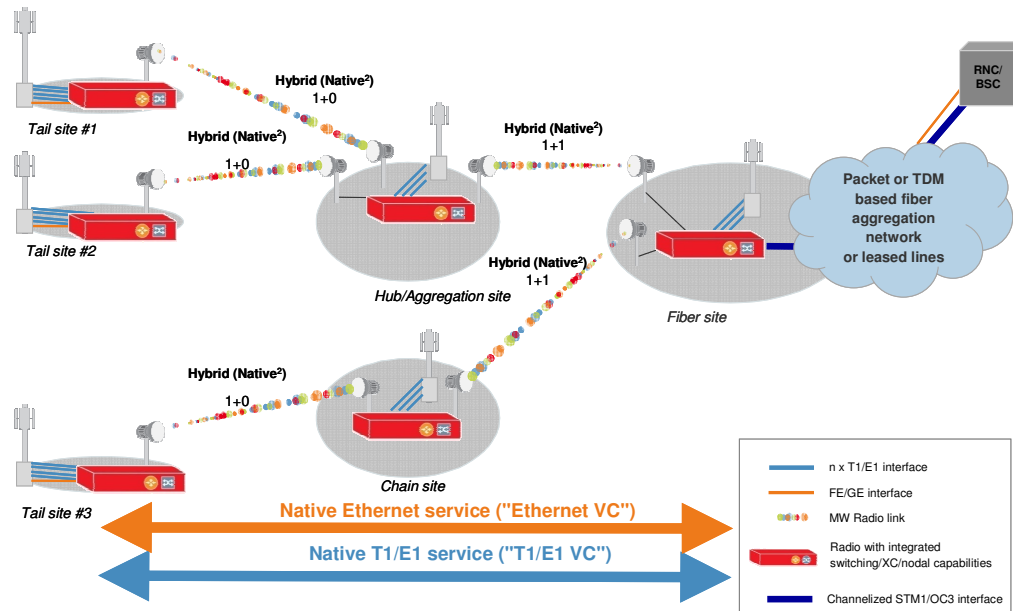


Figure 2: Native<sup>2</sup> / Hybrid Approach to support both Legacy and Ethernet over a single radio

The industry has already established that the end game of next generation mobile backhaul networks is all-IP/Ethernet. Ethernet is not only more scalable, it also offers huge cost savings across the entire network value chain. For example, using the same spectrum, antenna size and peripheral equipment used to backhaul native Ethernet packets over point-to-point Microwave delivers between 25% and 60% more bits compared with similar TDM based systems.

### LTE Ready Backhaul

LTE traffic will be dominated by data applications ranging from non-real time services such as email exchange, web browsing, peer-to-peer and file sharing – to real-time and delay sensitive services such as video and voice. We have already concluded that LTE-ready wireless backhaul systems must deliver high capacity and low latency over an IP network. Here are a few more important features these systems need to support:

- **QoS aware ACM (Adaptive Coding and Modulation):** As a great deal of the LTE traffic will be data it will use up much of the network resources, but contribution to revenue will not be proportionate to data usage. Cost-per-bit must therefore be optimized allowing more bits per Hz at any given spectrum, antenna size and transmitter power. Broadband backhaul strategies can be applied to carry extensive data traffic, assigning different availability classes to different types of service over a single radio link. This will allow more efficient planning of link capacity for the best case scenario – rather than for the worst case scenario – as it is done today. Voice and real-time video applications will continue to enjoy “five nines” availability, while non-real-time data packets can settle for four or even three nines, with little or no affect to user experience. By using ACM with prioritized data to ensure the constant flow of high priority bits at all times and to allow additional capacity most of the time, the overall radio capacity can be maximized at no extra cost. The table below shows how ACM can even be used to reduce costs by using smaller antennas to deliver equivalent prioritized capacity.

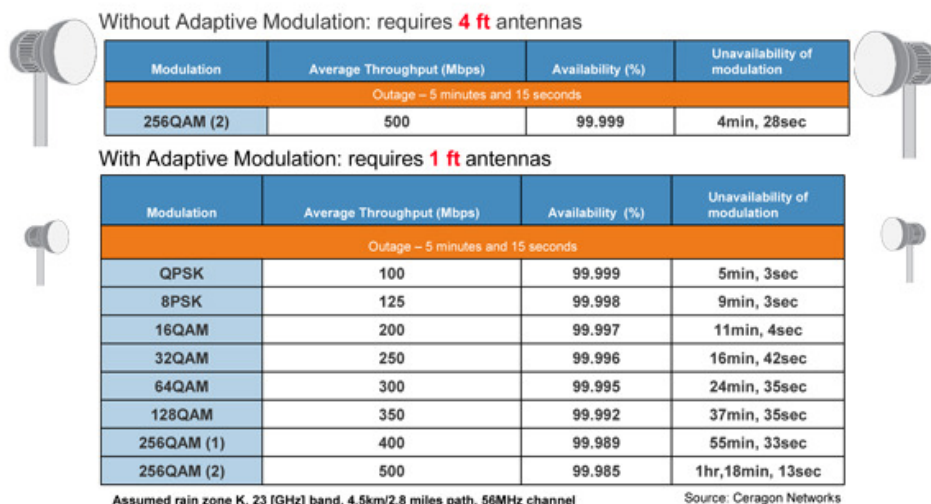


Figure 3: Point-to-Point Microwave Systems, with and without ACM

- **Statistical Multiplexing:** Unlike TDM based transport technologies, moving to Ethernet gives operators the benefit of using statistical multiplexing. This feature is especially important in Aggregation backhaul applications and will help to further optimize traffic management over the network, reduce congestion and help operators get more out of their networking investment.
- **Ethernet rings using IP/MPLS, PBT or Carrier Ethernet:** The shift to packet-based networks makes it easier to improve availability and increase capacity by making use of Ethernet Rings. Whether it is IP/MPLS<sup>1</sup>, PBT<sup>2</sup>, ITU G.8031/2<sup>3</sup> path protection or just an enhancement of xSTP. Depending on the overall network strategy, operators can consider the complexity and cost, and apply the right method for each network segment.
- **An integrated Carrier Grade Ethernet switch as part of the Radio link:** An additional switch at the site may come in handy to increase port count, for demarcation purposes, up sell additional services and for traffic management. An integrated switch will also serve cell sites with limited real estate, eliminating the need for an additional external device.

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Commercial LTE deployments are planned to begin sometime in 2010. This means that LTE is virtually just around the corner. As LTE is being deployed in the access domain, it is also important to prepare the backhaul networks that will

<sup>1</sup> MPLS – Multi Protocol Label Switching

<sup>2</sup> PBT – Provider Backbone Transport, IEEE 802.1 networking technology adding determinism to Ethernet

<sup>3</sup> ITU G.8031/2 – ITU-T Study Group 15 standard for Ethernet Linear Protection Switching

support high-speed/high bandwidth transmission between cell sites and the operator's core.

LTE-ready backhaul means: high capacity, low latency and support for all-IP architecture. Of the three backhaul technology options operators can choose from, wireless point-to-point microwave can deliver the best cost-performance features, bringing faster ROI and driving forward the proliferation of advanced mobile services in the LTE era.