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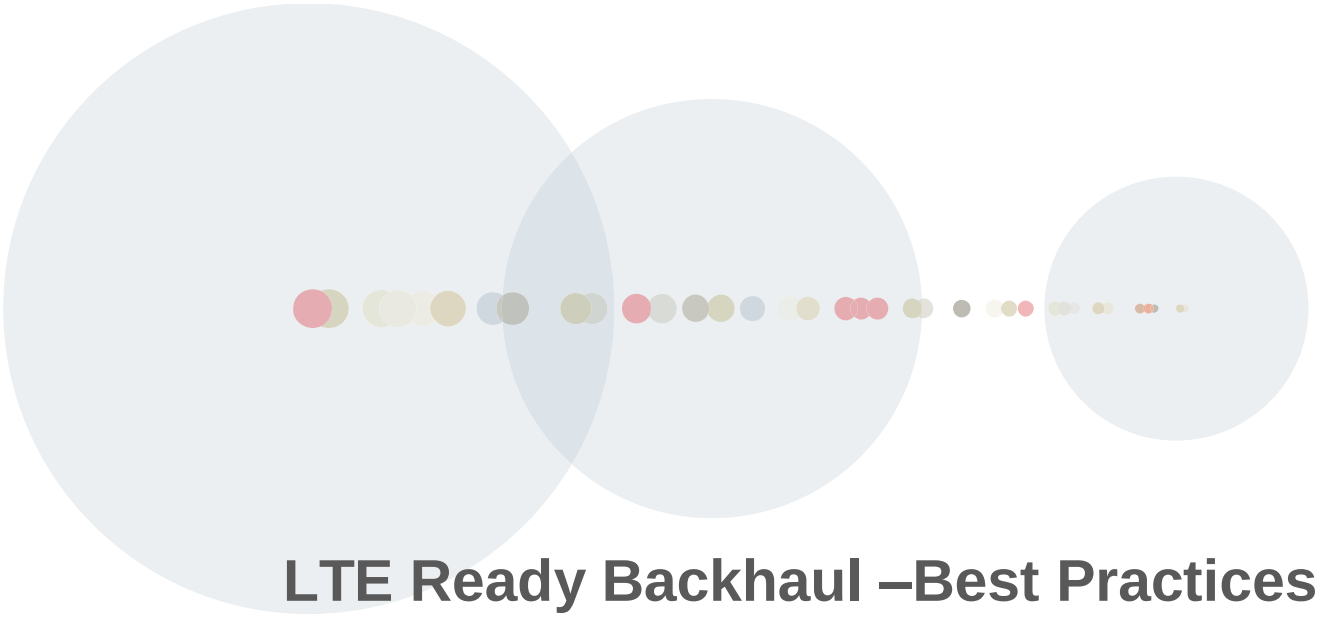

LTE Ready Backhaul –Best Practices and Dilemmas

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This paper provides guidelines for mobile operators who wish to plan a backhaul network based on Microwave to deliver the high capacities required for LTE. The paper further presents how this can be achieved without significant upfront investments while continuing to serve current 2G and 3G networks and requirements.

In this paper we show how Native^2 topologies (also referred to as Hybrid networks) help to manage the cost of the entire network life cycle. Additionally we will present a case study for building cost effective mobile backhaul at the access domain by taking advantage of Ethernet features and microwave capabilities.

Introduction

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

While the media likes to focus on LTE Access networks – and more specifically on spectrum allocation for the 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.

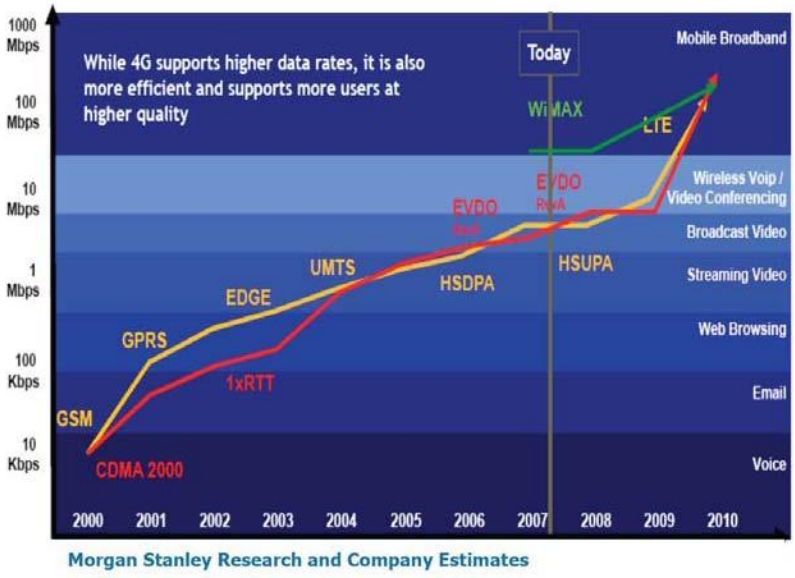

Figure 1: Mobile technology Evolution (Source: Morgan Stanly)

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.

LTE Requirements from New Backhaul Solutions

Broadband Mobile Network Evolution

The 3GPP Group is evolving in two dimensions, Access evolution and Network evolution:

1. Access evolution: Access is evolving both in terms of higher capacities as well as in achieving lower latencies to enhance user experience and service requirements.

   In this domain, mobile operators are faced with the challenge of deciding which end-to-end network solution can best fulfill the user experience promise.

2. Network Evolution: The focus is on flat, all IP architectures where base stations are self contained. Another evolution worth mentioning. In the early 90s, most mobile operators designed and built their networks as an independent silo. With 3G introduction, some mobile operators changed their perspective and moved to a more horizontal structure to be able to share resources between mobile and fixed residential and business networks. As LTE progresses, service take up will help networks to converge better. Converged operations, services and networks would in most likelihood be a major worldwide trend.

   In this domain the challenge facing mobile operators is to manage the network migration life-cycle all the way to an all IP structure.

In terms of the evolution process, the 3GPP has defined the following releases:

- R99 – The first UMTS release. Based on ATM
- R4 – Still ATM based with modification of the circuit core
- R5 – Introduction of all IP along with HSDPA
- R6 – HSUPA (E-DCH[1])
- R7 – Evolved HSPA 2x2 MIMO and flat architecture
- R8 – LTE

[1] Enhanced Dedicated Channel (E-DCH)

Figure 2 below describes the capacity evolution of mobile access networks leading up to LTE. The data in Table 1 details of how latency is expected to drop while spectral efficiency is expected to increase in order to suffice capacity requirements and overall user experience.

This leads us to the third challenge mobile operators are faced with: defining a backhaul strategy that lasts through the entire evolution process.

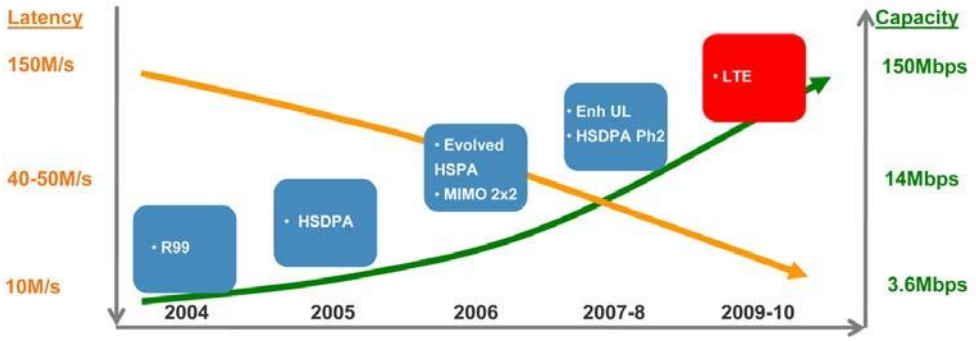

Figure 2: 3GPP Capacity and Latency Evolution

	R99	HSDPA	HSUPA	Evolved HSPA	LTE (2X2)	LTE (4X4
Latency (ms)	150	100	75	30-50	10	10
Peak DL (Mbps)	0.384	14	14	28	150	300
Peak UL (Mbps)	0.064	0.384	5.76	11.5	50	100
Channel (MHz)	5	5	5	5	20	20
Spectral Efficiency (bit/s/Hz)	0.1-0.2	0.3-0.6	0.3-0.6	1.0-1.2	1.2-1.7	1.2-1.7

Table 1: 3GPP Capacity and Latency Evolution

Though most of the discussion is around 3GPP evolution, we should mention the CDMA2000 migration as well. More than 300 operators in more than 109 countries/territories have deployed or are planning to deploy CDMA2000 with 465 million CDMA Subscribers (source - www.cdg.org). CDMA2000 offers a long-term evolutionary path forward since it will be complemented with OFDMA-based solutions (LTE) to provide additional broadband capacity.

The difference between migration of 3GPP and 3GPP2 are mainly around the core migration and how likely the operator to have already an Ethernet ready base station deployed. These

differences are out of the scope of this document. We will consider the migration to LTE as if it has the same flow for both technologies where the backhaul network will be the enabler of the network evolution toward LTE by allowing operators to face migration challenges.

Mobile Backhaul Network Evolution Requirements

Up to this point we have covered the various aspects and implications LTE will have on mobile operators' networks. Now that we understand the technology requirements, we can look at how the ongoing developments of mobile technologies affect backhaul networks.

We can sum up and say that backhaul systems designed to serve LTE deployments should address several basic requirements:

1. **Higher capacities:** Backhaul to a single tail site should easily scale to 100Mbps and even beyond. Statistical multiplexing and QoS should be largely used to prevent the linear increase of capacity of the backhaul.

2. **Lower Latencies:** The requirement for 10milisecond end-to-end leads to select solutions that support extremely low latency.

3. **Enhanced services:** The backhaul must allow point to point connection (S1 interfaces) as well as multipoint connections (X2) efficiently.

4. **Synchronization** – Synchronous Ethernet and ITU 1588v2 awareness.

5. **Legacy support** – Support services and equipment installed base

In the backhaul domain, the challenge operators are facing is maintaining these requirements under a variety of technologies and topology alternatives. We will show how this can be achieved using Native² microwave backhaul solutions in the following chapter.

Answering the backhaul challenge

What are the network planners' goals?

When planning a mobile backhaul network, network planners first analyze the current salutation, in terms of network concept, equipment installed based, upgrade options etc. Then they need to take into consideration the end game – which, as already described above, would be a high-capacity, low latency and (flat) IP based network architecture. Last, they would need to draw the line of evolution between current and future. This line takes mobile operators from the all TDM world to an all Packet one; from Low capacity to high capacity; and from link by link planning, to a much broader network concept.

Let us now dive deeper into the considerations of next generation backhaul network planners.

From this point onwards we would concentrate on Wireless point-to-point (PtP) microwave solutions. Wireless PtP solutions support higher data rates than copper T1/E1 lines, and

easily overcome the high cost and limited availability associated with fiber. Used in over 50% of all mobile backhaul deployments worldwide (and nearly 70% outside the U.S.A.), wireless PtP systems offer a simple and cost efficient solution for backhauling voice and high-speed data services.

Today's backhaul networks are still dominated by TDM - be it T1/E1 microwave or high-capacity SDH/SONET. To ease the migration process to IP, next generation mobile backhaul networks need to deliver the following:

1. **Seamless support of legacy services**: Any migration process includes a large number of elements and holds many associated uncertainties. In this environment it is important to maintain support for existing (and proven) transport networks while gradually transitioning the bulk of communication to the next generation of networks.

2. **Service Scalability**: As mobile networks evolve, both in terms of services as well as in capacities, predicting the right utilization of every wireless link well into the future becomes more complex. Using a single piece of equipment to support 16T1/E1 ports and TDM cross connect functions as well as up to 400-500Mbps (with several granularity steps in between) complete with Carrier Ethernet features, can significantly reduce migration uncertainties.

3. **Low cost per bit**: Voice and Data do not have the same ROI model. Lower revenue per bit in the data world implies that mobile operators should seek cheaper capacity over the air. Native Ethernet microwave solutions that support Ethernet ring topologies, enhanced QoS and advanced Adaptive Coding & Modulation (ACM) techniques provides exactly this. On top of the above, such solutions offer anywhere between 25% to 60% more capacity over any given bandwidth channel.

Now that we have set the ground rules, let us look at the various migration options operators can choose from.

Migration to IP - What are the options?

We can assume that during the migration period a majority of cell sites will support both Ethernet and TDM ports (to serve legacy GSM and UMTS). This will be done either by using a single box containing multiple port types or by using some type of multi-box solution.

Generally speaking, there are three major common migration strategies:

1. Carry both Ethernet and T1/E1 traffic over NG-SDH/ SONET (No major change)

2. Carry both Ethernet and T1/E1 traffic over Packet Switched Networks (The ultimate change)

3. Carry native Ethernet and native T1/E1 traffic simultaneously over the same network without using any type of encapsulation (Gradual change). This approach is also referred to as "hybrid" or Native^{2}™.

The migration to packet based backhaul networks 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 service over new high capacity, IP-enabled equipment. A good migration strategy also maintains critical services over the trusted legacy technology, gradually shifting revenue generating services to the new packet network.

Here are a few examples of how legacy equipment can be utilized during the migration period:

- Leverage install base of NG-SDH/SONET to deliver high capacity Ethernet over existing STM-1/OC-3 radios.
- Use ATM switches where applicable at the remote hubs to reduce data capacity and delay the need to upgrade to high capacity Ethernet radios.
- Apply similar statistics in the Ethernet aggregation also for HSPA traffic.
- Reuse SDH/SONET and ATM equipment that is retired due to the introduction of more Ethernet Base stations, both WiMAX and UMTS.

Opting for the NG-SDH/SONET or Ethernet over PDH can also be a good interim solution. However, over time NG-SDH/SONET will not be able to cost effectively scale as traffic becomes all-packet due to the rigid structure of the TDM based systems. EoS and EoPDH are also not cost efficient for data services and will not be able to deliver LTE's high capacity and ultra-low latency requirements.

Pseudowire (PW) implementations are also a viable interim option. But PW has its limitations too. While the main reservation about mapping Ethernet over TDM is encapsulation tax and overall spectrum utilization, when moving to PW based all packet solutions, operators need to consider - in addition to the PW "tax" - the additional impact of latency and jitter on synchronization requirements.

From the above it is clear to see 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.

A good recommendation would be to deploy flexible radio units that allow the operator to use either legacy or Ethernet in accordance with its specific needs. So, even if at this stage an all TDM approach is preferred, an operator can shift from a pure TDM to a Native^2 or even Native Ethernet architecture as required by using software license keys rather than by physically replacing entire hardware components. This technological concept is described in more detail in the following paragraphs.

The favorable base model for Ethernet microwave deployment in the backhaul is Native^2. Also referred to as the "hybrid" model, Native^2 transports both TDM and Ethernet natively (i.e. no encapsulation of one over another). Using this concept during the migration phase, each cell site is provided with an option to carry E1s/T1s (8-32 per-site and up to 75xE1/83xT1 over the air) as well as Ethernet (50-400Mbps, depending on the channel bandwidth available.

Synchronization can be handled either over T1/E1s or by using Synchronous Ethernet and ITU 1588v2 awareness.

Native²

Native² Technology enables mobile operators to install today an Ethernet Microwave system that supports the highest possible capacities per radio carrier. In addition, the same radio and indoor unit can optionally support existing legacy services.

With Native², mobile operators are assured that current services do not fail, while the highest capacities are guaranteed when required. Utilizing management functions, mobile operators would be able to firstly add more E1/T1 lines to address the growing capacity needs for UMTS, as well as Ethernet for HSPA and future LTE. When deploying Ethernet-enabled UMTS base stations, operators may choose to start off with E1/T1s, connecting the Ethernet port but not using it for real traffic. As the need arises, the system can be accessed from remote to shift some or all of the traffic to Ethernet. As confidence in the Ethernet system grows, additional traffic can be shifted, eventually retiring the E1/T1 service altogether. All of this can be achieved with Ethernet end-to-end service management and using trail management to handle E1/T1.

Migration Options: The bottom line

In a survey conducted during a Light Reading webinar[2], only a fifth of the 180 responders, voted for mapping Ethernet over SONET/SDH. 40% of the responders favored the Native² "hybrid" model, while the rest claimed to go "packet all the way" and use Pseudowire (PW) where applicable. Ceragon's experience shows that all 3 strategies are applied in the field. Most common is the Native² that provides a risk free migration path without sacrificing revenue generating services, future capacity and overall cost.

In terms of the underlying technology, it is clear that fewer operators rely on new fiber deployments in the near future due to time and cost issues. Taking into account the limitations of copper in terms of capacity and distance, Native² Microwave emerges in the early market as almost the only viable solution for off-net sites deployment.

Ceragon strongly believes that Native² is the best approach for driving the migration to packet networks when it comes to backhaul. On one hand, Native² delivers diversity at the both the cell and RNC sites. On the other hand, it helps to meet the scalability and capacity requirements for current UMTS and future LTE applications.

[2] *Ethernet Microwave Applications: From Backhaul to Enterprise Access Webinar, October 4th, 2007*

Guidelines for risk free migration

Course of action

The following presents a 7-step road map that mobile operators can adopt in order to achieve a smooth and pain-free migration process:

1. Add to or replace the existing legacy TDM Microwave in tail/chain/hub sites with a MEF certified Ethernet Microwave with advanced TDM capabilities to backhaul both types of traffic natively (Native^2).

2. Create a Microwave cloud with built-in network functions by using migration-ready microwave equipment with self contained TDM cross connect and Ethernet switching.

3. Make sure that legacy services are operating on the TDM network before shifting services to Ethernet. During the early phase of migration it is more likely to add capacity and services using a few more E1/T1s than over Ethernet.

4. Plan services in a way that maximizes the utilization of the radio, i.e., multiple services with different availability and priority profiles.

5. Introduce more capacity and network functions as the network evolves by using license-based upgrades.

6. While synchronization in pure 3GPP networks is still an issue, during the migration phase it can be overcome with native E1/T1 support. Towards LTE, radio should also offer Synchronous Ethernet and very low jitter to support IEEE1588V2 for complete migration.

7. Gradually shift traffic to the Ethernet segment and reallocate capacity over the air to serve packet transport. Retire E1/T1s completely when voice and data services are stable over the end to end packet network.

At the end of the day, deep into the next decade, the entire mobile network will be based on IP. By that time, microwave radios should provide high Ethernet capacities, capabilities and functionalities. Along the way, some revenue generating traffic would most likely continue to be transferred over legacy equipment – at least until Ethernet's full quality and cost position potential is realized.

Additional considerations

1. **Maintain sufficient T1/E1 capacity**: Using Native^2, allow concurrent backhaul of Ethernet and TDM from each cell site. Maintain sufficient T1/E1 capacity - at least 2-6 T1/E1s for voice, additional 2-10 T1/E1s for data. In addition, allocate enough Ethernet capacity to sustain current and future growth at the site. Once the migration process is completed all cell sites' traffic will run on IP/Ethernet.

2. **QoS aware ACM (Adaptive Coding and Modulation)**: As a great deal of the new capacity is data, cost-per-bit must be optimized. Microwave links should allow more bits per Hz for any give 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 best case scenario rather than for worst case 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 be reduced to four or even 3 nines with little or no sacrifice to user experience. By using ACM to drop some of the data under fading conditions and allow the constant flow of high priority bits at all time, the radio capacity can be maximized at no extra cost.

3. **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.

4. **Ethernet rings using Native Ethernet, IP/MPLS or PBT[3]**: The shift to packet-based networks makes it easier to improve availability and increase capacity by making use of Ethernet Rings. Whether it is an enhancement of the xSTP, or IP/MPLS, PBT or ITU G.8031/23 path protection. Depending on the overall network strategy, operators can consider the complexity and cost, and apply the right method for each network segment.

5. **Hierarchy– PB at the access and IP/MPLS or PBT at the aggregation**: "Switch when you can, route when you must" is still viable also when moving to Ethernet enabled NodeBs and later on to eNodeB with LTE. While some Layer 3 awareness is required for traffic management purposes, generally speaking Operators should find the solutions within the Layer 2 domain. When it comes to transport to/from multiple cell sites locations on a national coverage, operations would find it complex to monitor a packet network without the familiar tools of circuits. Moving to a Layer 3 domain means thorough training and complex management. The solution would be to adopt a hierarchy using PB (Provider Bridge – QinQ) at the 1st level of aggregation and then moving to IP/MPLS for the transport towards the core. This is will be done in a similar way to how residential broadband and business networks are planned

6. **Native Ethernet mode**: Only relevant when using a native Ethernet radio - true high capacity can be achieved by alleviating the need to map traffic with its associated overheads and delays.

[3] *MPLS – Multi Protocol Label Switching*
PBT – Provider Backbone Transport, IEEE 802.1 networking technology adding determinism to Ethernet
ITU G.8031/2 – ITU-T Study Group 15 standard for Ethernet Linear Protection Switching

7. **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 sale additional services and for traffic management.

8. **OAM** – OAM mechanisms like 802.1ag and Y.1731 should be part of the solution in order to make the Ethernet carrier class.

Multi-layer solution approach

Building a mobile backhaul network requires using multiple functions and layers:

1. Transmission: A strong radio offering with the highest possible capacities using a Native^2 radio engine.

2. Network: Functions such as TDM Trails and EVCs using integrated cross connect and Ethernet switching.

3. Service: Ethernet and E1/T1 Demarcation functions such as Ethernet Service management and OA&M.

The following figures lay out a migration strategy for mobile operators which are applicable for main stream migration scenario:

R99/R4

Appropriate solution	Requirements
Apply Native^2 Microwave starting with all E1/T1 from Tail to Aggregation/Fiber site for voice and data.	• Cross connect, nodal function • T1/E1 trail management • Apply 4-8T1s/E1s on a single channel • Clock over T1/E1

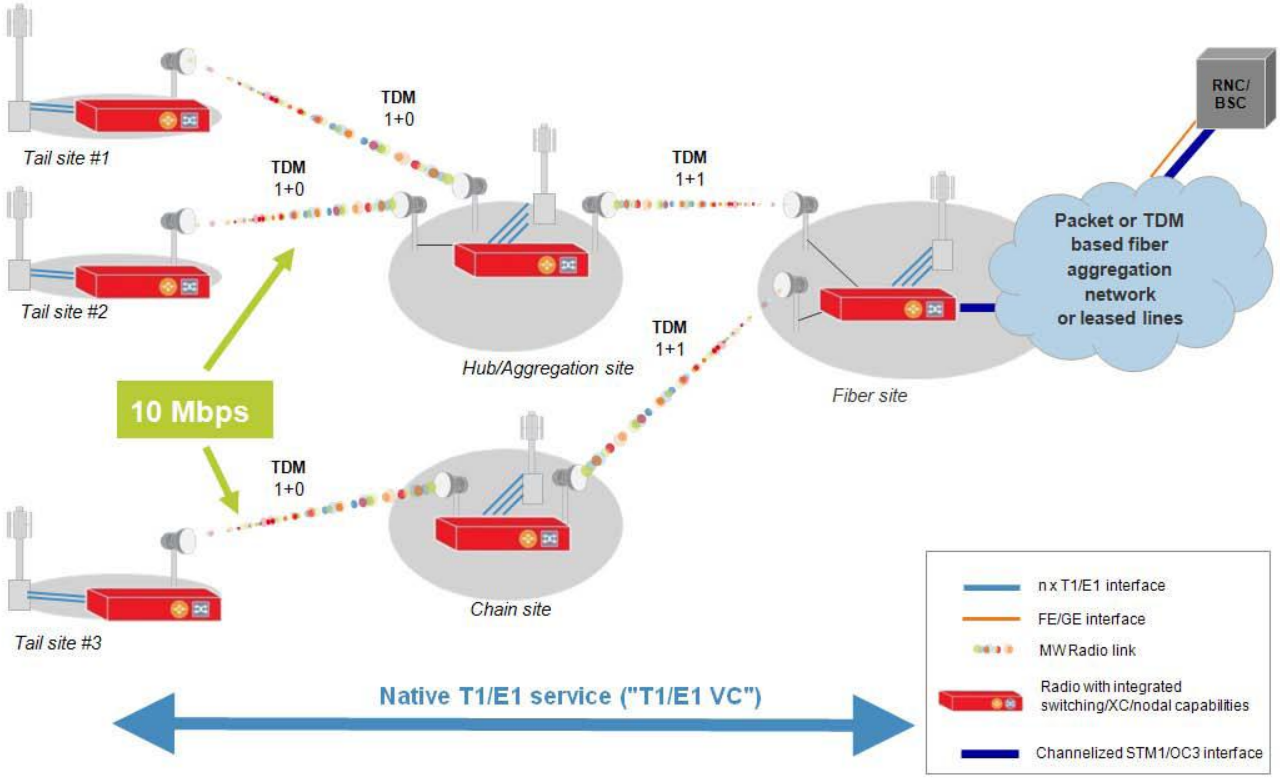

Figure 4: 2G/R99/R4 – TDM and ATM only

HSPA

Appropriate solution	Requirements
Increase number of connected T1s/E1s to the microwave. Apply ACM. Connect also non active Ethernet ports	• Remotely enhance license • Up to 16 T1s/E1s on the same channel • Up to 7 Ethernet ports (MEF Certified)

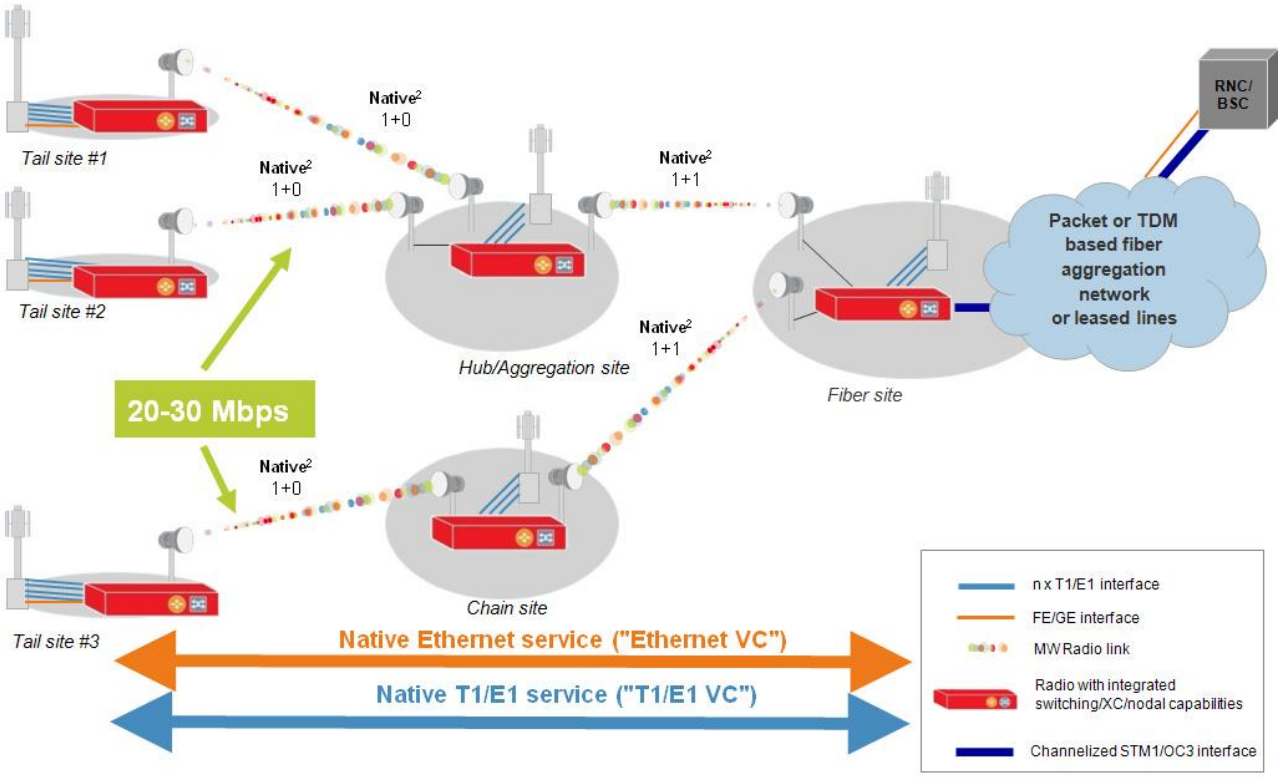

Figure 5: HSPA –TDM, ATM and Ethernet are supported

Evolved HSPA

Appropriate solution	Requirements
Shift traffic to Ethernet as ports on the NodeB are activated	• Up to 50Mbps on a channel • Activate Ethernet switch and ports • Remotely phase out T1s/E1s

LTE

Appropriate solution	Requirements
Continue shift from TDM to Ethernet. As eNodeB are all packet, only legacy BTS are still carried over E1/T1 till retirement	• Disconnect the last E1/T1 – when all are sure all is fine • Synchronization over Ethernet

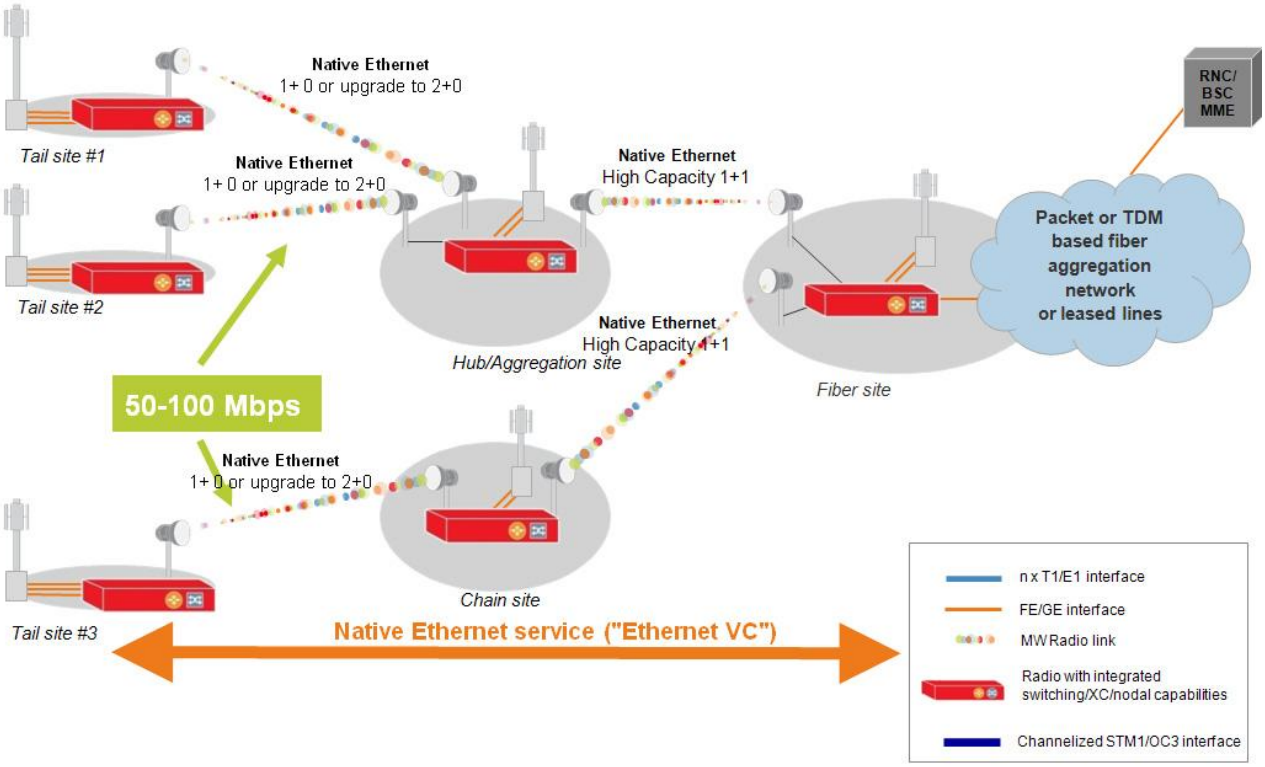

Figure 6: LTE – an All Packet network

Conclusion

The proliferation of T1/E1 lines in mobile operators' access and backhaul networks is becoming an important issue as 3G applications and services begin to drive the demand for more backhaul capacity. This will become an even bigger problem as carriers begin shifting to LTE.

The current expansion of mobile backhaul networks calls for a more flexible and cost-effective solution for handling legacy voice and new bandwidth intensive data services. While the migration is only in its initial phases, forward thinking equipment vendors are already offering a range of solutions to help operators achieve smooth and pain free transformation of their networks to Ethernet.

In Short, to be an LTE backhaul ready, a Point to Point microwave system needs to support high capacity, low latency and legacy solutions. On top of this the system must support network evolution to IP/Ethernet and deliver clock synchronization both for legacy and future services. Last, and most important, LTE-ready systems must deliver far lower cost-per-bit than current backhaul solutions based on TDM.

Appendix A: About Ceragon LTE Ready mobile backhaul offering

Ceragon has developed its FibeAir® solutions to address the requirements of mobile operators. The proposed deployment strategy offered by Ceragon is based on the capabilities of the FibeAir® IP-10 solutions family.

The versatile FibeAir IP-10 family offers a wide capacity range of 10Mbps to 500Mbps over one radio carrier, using a single RF unit, across the entire licensed frequency spectrum – from 6GHz to 38GHz. The solution easily serves the capacity requirements of a single base-station as well as those of traffic-intensive hub sites and leaves ample headroom for future capacity enhancements. The industry's most advanced Adaptive Coding & Modulation (ACM) helps to maximize spectrum utilization and capacity over any given bandwidth - and under changing environmental conditions.

Featuring enhanced Ethernet networking capabilities to simplify network design and maintenance, the FibeAir IP-10 family helps to reduce CAPEX and OPEX and improve over-all network availability and reliability in order to support advanced services with stringent SLA (Service Level Agreement). FibeAir IP-10 incorporates Ceragon's proven Native^2 concept to support native TDM and native Ethernet hybrid architecture - as well as all-IP and pseudowire architectures - requiring little or no external devices and allowing it to integrate smoothly with any network.

To adhere to the evolution requirements towards LTE, Ceragon supports an integrated XC and carrier switch together with OAM mechanism (for both Ethernet and TDM). To resolve future clock requirements, Ceragon offers SynhE support and ITU 1588v2 awareness. Where applicable to use Microwave Radio Solutions, Ceragon perfectly covers a range of different migration scenarios for mobile backhaul networks in three dimensions:

1. Deployment flexibility: From tail to nodal to hub configurations

2. Future proof: Addresses requirements of the migration phase and beyond, in an all packet architecture

3. Overall spectrum utilization: Spectral efficiency combined with compression and networking functions deliver reliably more bits per spectrum used

For more information about wireless Ethernet solutions and to learn more about Ceragon and its broad portfolio of Ethernet and TDM high-capacity backhaul product lines, please visit our website at: www.ceragon.com

Appendix B: Dilemmas and Actions

The following table describers the possible dilemmas that network planners face and propose an action plan to follow. Need to note that there are almost no two identical networks out there. Different vendors with different products and revisions, from the access to the core, not to mention the different regions, regulation and service plans

Migration dilemma	Proposed Actions
Higher Capacities serving Data Applications	Shift from non blocking backhaul architectures to aggressive statistical multiplexing. By using QoS and buffers in Ethernet Microwave, backhaul segment can absorb the differences between peak and average rates in the air interface for low priority services ,
X2 interface for Handover	The backhaul must allow point to point connections (S1 interfaces) as well as multipoint connections (X2) efficiently. Physical Mesh is not necessarily required to connect between cell sites. Enhanced services such as MEF E-LAN support enables Ethernet microwave to optimize traffic patterns between neighboring sites
Enhanced services	Service Provisioning should suffice most requirements While control plane allows flexibility but adds complexity. MEF recommendations covers the requirements in the access backhaul
Deployment Paradigms	Three main trends: 1. All TDM - Ethernet mapped over TDM for new services 2. All packet - Pseudo wires to sustain legacy 3. Native2 - Carry each traffic type natively Native2 is the path that better optimizes spectrum and doesn't add risks to current and future services:
Synchronization	Today GSM networks rely on native TDM links. In the future the Same equipment installed today should support also Synchronous Ethernet and ITU 1588v2 awareness. This also implies an Ethernet microwave with very low jitter
Use the same backhaul infrastructure to carry all services	Focus on long term ready backhaul investments and avoid additional expenses on legacy solutions as opposed to "tactical" solutions waiting further network disruptions
Lower Latencies	The requirement for 10milisecond end-to-end leads to select solutions that support extremely low latency and specific features to differentiate between delay sensitive and regular traffic

Table 2: 3G Network Evolution impact on Backhaul and planning considerations

Appendix C: Standardization

Next Generation Mobile Networks Alliance (NGMN)

Apart from the standardization bodies that deal with the technical specifications, there is an additional forum with a goal to provide the Operator community with projected requirements in the evolution of mobile networks. This body is called the Next Generation Mobile Networks Alliance, or NGMN.

According to the NGMN vision statement, the "target architecture defined by these recommendations will be an optimized Packet Switched (PS) network architecture, which will provide a smooth migration of existing 2G and 3G networks towards an IP network with improved cost competitiveness and broadband performance[4]. Though, not explicitly noted in the vision statement, the focus is definitely around LTE and its impact on networks and services. The NGMN also leads a set of recommendations that are specific for the backhaul segment.

Metro Ethernet Forum (MEF) Mobile Backhaul (MBH) Implementation Agreement (IA)

Though not directly dealing with LTE, the Metro Ethernet Forum (MEF), is also involved in shaping LTE-ready networks. MEF, a global industry alliance comprising more than 155 operators, system vendors test labs and more, examines Ethernet implication on mobile networks. The organization took upon itself to define a set of guidelines for mobile operators and service providers who plan to migrate to an all packet backhaul network. MEF's MBH IA, named as MEF 22, touches upon main pain points of service providers who consider moving from all TDM to all packet architecture (issues such as OAM, protection, QoS etc…).

MEF 22 tackles the perception limitation of Ethernet and applies MEF's well established Ethernet services specification to the special case of Mobile backhaul. This move alleviates the concern mobile operators might have when considering the migration from the old and trusted TDM to the new and promising IP technology. The agreement takes a holistic approach to mobile networks' evolution regardless of the mobile technology, be it CDMA, GSM, LTE or even WiMAX.

[4] *Source: www.ngmn.org*

ABOUT CERAGON

Ceragon Networks Ltd. (NASDAQ: CRNT) is the premier wireless backhaul specialist.

Ceragon's high capacity wireless backhaul solutions enable cellular operators and other wireless service providers to deliver 2G/3G and LTE/4G voice and data services that enable smart-phone applications such as Internet browsing, music and video.

With unmatched technology and cost innovation, Ceragon's advanced point-to-point microwave systems allow wireless service providers to evolve their networks from circuit-switched and hybrid concepts to all IP networks.

Ceragon solutions are designed to support all wireless access technologies, delivering more capacity over longer distances under any given deployment scenario.

Ceragon's solutions are deployed by more than 230 service providers of all sizes, and hundreds of private networks in more than 130 countries.

Visit Ceragon at www.ceragon.com