



Advisory Report

LTE – The Market & Its Requirements

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LTE – The State of the Network

2009 saw the deployment and expansion of HSPA and EV-DO networks around the world. LTE, however, remained the most talked about wireless technology of the year. As an evolutionary upgrade to today's 3G networks, it is not difficult to understand the focus on the technology. For operators, LTE promises to drive down the costs of delivering mobile broadband services while enabling new mobile applications – all of which should extend the reach of mobile data services to new audiences. For vendors, LTE gives incumbent network suppliers a chance to leverage existing relationships into new revenue streams (i.e., network upgrades) while holding out hope for other vendors that they can use the technology shift to break into new accounts.

Yet, if 2009 was the year that discussion around LTE reached a fever-pitch, 2010 looks to be the year in which momentum truly picks up. How can we tell? The number of high-profile trials and commercial contracts already publicly announced provide one indication.

Operator	Country	Trial / Commercial	Vendor	Description
Belgacom	Belgium	Commercial	Huawei	Radio network swap including 2G, 3G and LTE plans.
China Mobile	China	Trial (pre-commercial)	Alcatel-Lucent Huawei Motorola	Pre-commercial TD-LTE launch for Shanghai 2010 World Expo.
KDDI	Japan	Commercial	Motorola	Nationwide launch in 1.5GHz and 800 MHz bands. Trials in mid-2010.
Metro PCS	U.S.	Commercial	Ericsson	Planned launch in 2010.
MTS	Uzbekistan	Commercial	Huawei	Pilot plan (2010-2012) in capital.
Net4Mobility	Sweden	Commercial	Huawei	Tele2 and Telenor JV, with plans to cover 99% of Swedish population by end of 2013.
NTT DoCoMo	Japan	Commercial	Ericsson Nokia Siemens	Base station development and core network contract for late 2010 launch.
Telenor	Denmark	Commercial	Nokia Siemens	6-year 2G/3G radio network upgrade, including LTE support.
Telenor	Norway	Commercial	Huawei	Part of complete network renewal, including installation of packet core from Starent.
Telia Sonera	Norway Sweden	Commercial	Ericsson Huawei	Commercial launch starting from Mid-December.
Zain Bahrain	Bahrain	Commercial	Nokia Siemens	Network modernization (RAN/core) including LTE/EPC upgrade.
Verizon	U.S.	Commercial	Alcatel-Lucent Ericsson Nokia Siemens Starent	Nationwide launch starting in 2010.

Another indication is simply the number of LTE engagements (i.e., lab trial, field trial and commercial) the major network vendors are claiming, whether or not they've all been announced.

- Alcatel-Lucent: 19
- Ericsson: 40
- Huawei: 42
- Motorola: 27
- Nokia Siemens: 25
- ZTE: 7

If we know, then, that 2010 will be an exciting one for LTE and we define the market as the networks, devices and launch supports needed to get LTE services up and running, several questions naturally follow. What do recent product and trial trends tell us about the technology's development? What do operators in the process of planning their LTE launches need to consider in terms of LTE solutions and vendors? How do the market's leading vendors compare at this early stage in the game?

LTE – The Current Trends

Vendor posturing aside, one need only look to the number of operator commitments to LTE in order to see its potential: per the GSA, there were 51 LTE network commitments in 24 countries as of early December 2009. To get a better view, however, into how vendors are attacking the market – where their focus lies, how they see operator requirements, how they're attempting to grow the LTE opportunity – one need only look at a sampling of the announcements coming out of key LTE vendors in the latter part of this year (since September).

Date	Title	Announcement
Dec-14	TeliaSonera: World First LTE Launch	Commercial launch of LTE services in Stockholm, Sweden and Oslo, Norway with networks powered by Ericsson and Huawei, respectively.
Dec-12	NSN: LTE Call Demonstration	Completion of a voice and SMS call leveraging NSN's Fast Track over LTE solution.
Dec-10	ZTE: TD-LTE Demonstration	Demonstration of a TD-LTE network downlink scaling to 130Mbps.
Nov-24	NSN: Interoperability Testing with LG	Completion of LTE interoperability testing (at 2100 MHz) with device support from LG. The company had announced in October plans for IOT with four device vendors.
Nov-18	NSN: TD-LTE Demonstration	TD-LTE femtocell demonstration along with the completion of a TD-LTE call at the GSMA's Mobile Asia Congress.
Nov-11	Motorola: LTE Product Launch	New LTE base station – frame-based version of its WBR 500 eNodeB.
Nov-06	ALU: LTE Demonstration	LTE connected car demonstration in New York under the auspices of the ng Connect Program.
Nov-05	Huawei: TD-LTE Testing	Completion of mandatory and optional tests for its TD-LTE infrastructure to be deployed by China Mobile for the Shanghai World Expo 2010
Nov-05	GSMA: Announces One Voice Initiative	AT&T, Orange, Telefonica, TeliaSonera, Verizon, Vodafone, Alcatel-Lucent, Ericsson, Nokia Siemens Networks, Nokia, Samsung, and Sony Ericsson defined a preferred way to ensure the smooth introduction and delivery of voice and SMS services over LTE.
Nov-05	Ericsson: Demonstrates TD-LTE Interoperability	Demonstration of interoperability between Ericsson's TD-LTE and Evolved Packet Core (EPC) and end-user equipment supplied by Aeroflex.
Oct-27	Huawei: SON Testing	Completion of LTE self organizing network (SON) testing with T-Mobile Austria.
Oct-23	Huawei: Interoperability Testing with Samsung	LTE interoperability testing with Samsung LTE devices planned for November in Europe...in the run-up to initial LTE launches.
Oct-23	Ericsson: Interoperability Testing with Samsung	LTE interoperability demonstration leveraging Samsung devices.
Oct-10	VZW: Starts LTE Fund	Verizon Wireless starts 4G Venture Forum to grow the LTE ecosystem. The forum includes vendor funding, product incubation, and market testing. Both Ericsson and Alcatel-Lucent are participating in the forum.
Oct-07	ZTE: TD-LTE Interoperability Testing	TD-LTE interoperability demonstration with Hong Kong's government research agency.
Oct-05	Motorola: TD- LTE Demonstration	Demonstration, with China Mobile, of TD-LTE, operating at 2.6 GHz.
Sep-03	Motorola: EPC Product Launch	Evolved Packet Core (EPC) solution launch – WBC 700 – leveraging Starent for P-GW and S-GW and internally developed MME.

So, What Do All of These Announcements Tell Us?

Against the backdrop of LTE appearing to be ‘the next big thing’ in wireless, infrastructure vendors are currently trying to jockey into position for success: staking their claim to the LTE credibility and taking actions to put themselves in the best position for when the market blossoms. More to the point, these announcements point to a focus on a handful of key technologies, business development and marketing efforts.

- **LTE Product Proof Points:** In the initial stage of any new network technology, it is not unusual for a vendor to demonstrate one or two pieces of – often prototype – gear. Prototypes and demonstrations touching on a few models, however, aren’t what operators need to launch commercial services. Thus, in the run-up to commercial service launches, vendors are scrambling to demonstrate an ability to roll out LTE on commercial platforms while expanding their LTE portfolios with new products or product extensions.
- **Interoperability Testing (IOT):** IOT allows a vendor to show the readiness of its solutions (hopefully commercial ones) at a level of sophistication beyond a demonstration. In particular, it argues that the vendor’s gear can meet critical performance thresholds while playing nice with other vendors. At its most fundamental level, successful IOT argues that a vendor’s solution is built to industry standards; critical for winning operator contracts since no operator wants to be locked into an end-to-end LTE solution from one vendor and no vendor can effectively deliver an end-to-end LTE solution with the network and device product diversity operators want.
- **Ecosystem:** At its core, the aim of IOT is to ensure that a broad ecosystem network and device products can develop around a technology, driven by adherence to a standard. Why? An ecosystem of diverse infrastructure products drives down costs and makes it easier to build networks. An ecosystem of devices and applications, in turn, makes the service more attractive to end-users. One of the failures of the 3G market was a general lack of compelling devices and applications when the initial networks launched. It has taken several years for a proper ecosystem to develop around 3G; stakeholders in LTE market (vendors/operators) don’t want to see a repeat of the problem.
- **Voice over LTE:** The promise of LTE is true broadband mobility teamed with network economics that can support operator profitability. Today, however, voice remains the primary revenue driver for mobile operators. It’s not surprising, then, that solutions for delivering voice over LTE (VoLTE) have been a hot topic since the start of the year. Like many emerging technologies, the market has a vision for where it wants to go with VoLTE in the long-term; a vision elaborated by the GSMA’s One Voice initiative. In the near-term, various solutions - Nokia Siemens Networks’ Fast Track voice over LTE, voice over LTE via generic access (VoLGA), and circuit switch fallback (CSFB) – are competing to be stopgap or interim measures.
- **TD-LTE:** Since UMTS was created with TDD and FDD modes, it seems only natural that LTE would follow suit. Yet, while the TDD version of UMTS seemed like a natural fit for the TDD spectrum obtained in Europe’s 3G auctions, TD-LTE is clearly being driven by a different geography: China. Realizing the limited scale of TD-SCDMA, China Mobile has been aggressively pushing vendors to ramp up their TD-LTE R&D. And, these vendors have responded: infrastructure vendors have demonstrated their products, claiming substantial LTE and even WiMAX R&D synergies; device and silicon vendors have discussed future product roadmaps that include support for both TD-LTE and LTE. Of course, it’s in the interest of both LTE vendors and China Mobile to see the technology reach beyond China in order to grow the market and market opportunity.

LTE – What the Operator Needs

Against this backdrop, it's clear that operators have been relatively successful at elaborating their LTE requirements. It's equally clear that vendors have been busily working to build solutions that meet those requirements and – both at a baseline and for evolving demands like VoLTE or TD-LTE. This begs the question of what operators actually need to launch an end-to-end LTE service.

Radio Access Network / eNodeB

- **What It Is:** The eNode B represents the “edge” of the LTE network: the LTE base station.
- **What Operators Need:** As with 3G, LTE base stations will need to support various form factors and capacities, as well as support for mixed 2G, 3G, LTE functionality. Ideally, LTE upgrades to existing 3G assets will be available – along with support for TD-LTE.

Transport and Backhaul

- **What It Is:** No different than today's mobile broadband (and narrowband) networks, LTE base stations will need to be connected into an operator's core network and other data networks. Transport products provide this connectivity.
- **What Operators Need:** As an all-IP technology promising data capabilities well in excess of 3G, LTE will require backhaul upgrades at the network edge and deeper in the core. More broadly, operators looking to converge 2G, 3G and LTE traffic on a common backhaul network will want solutions scaling to, at least, 100 Mbps per site and the flexibility to leverage multiple access technologies (copper, optical, microwave) and traffic types (circuit, packet, hybrid).

Evolved Packet Core

- **What It Is:** An evolution of today's PDSNs, GGSNs and SGSNs, the Evolved Packet Core (EPC) will link LTE users to operator data assets, external data networks, and other wireless networks – all while securing connectivity and managing handovers.
- **What Operators Need:** At a minimum, operators will need a complete EPC solution, including all of the key components: bearer-oriented SAE and Packet Data Network gateways; the signaling and handover-oriented Mobility Management Entity; QoS and charging elements (Policy and Charging Resource Function); and eHRPD gateways for supporting integration with CDMA2000 networks. To ensure these products meet their needs, operators will want to know that they can scale in terms of throughput, session activation and user load as well as advanced application support, all while keeping reliability and resiliency as a given.

Service Delivery

- **What It Is:** On their own, LTE radio access and packet core assets do little more than deliver mobile broadband access. Operators, however, will want to use these networks to deliver services such as voice, messaging, media delivery, etc. IMS and Service Delivery Platform solutions will support these demands.
- **What Operators Need:** In the long-term, IMS looks to be the preferred way to deliver voice as well as other compelling applications over an IP network like LTE. Beyond IMS, operators will need access to deep service delivery platform assets along with voice capabilities they can roll out in the near-term, whether thanks to CSFB or something that promises a smoother migration to IMS going forward.

Vendor Services

- **What It Is:** The deployment of new RAN, packet core, and backhaul assets assumes the need for professional services including installation, maintenance, training, application development, network optimization and – for aggressive operators – some level of multi-vendor network management.
- **What Operators Need:** It's not uncommon for operators to contract for service support with vendors that are not a part of their network build. That said, operators will need to be certain that their LTE vendor partners are ready to support them with a standard stable of technical services, as well as more complex professional and managed services. Just as importantly, with LTE representing a new network architecture – relying on IP more than ever before and supporting a new generation of applications – vendor support will need to be paired with solid IP and application expertise.

Devices

- **What It Is:** A gating factor on the uptake of any new wireless technology, devices will be a critical part of any LTE rollout – actually putting LTE services into the hands of users.
- **What Operators Need:** Early data-centric LTE services will be driven by PC Card, USB dongle and netbook devices with mainstream handset forms following. Ultimately, however, operator interest in using LTE to connect consumer electronics will require embedded module solutions.

LTE – Who Wins

If we return to the proposition that LTE is about providing users with evolved mobile broadband speeds and helping operators to turn a profit from those services, it seems pre-ordained that the biggest winners from LTE will be the operators and end-users. Yet, with mobile operators around the world declaring LTE to be the planned evolution of their 3G networks, LTE is obviously a huge opportunity for vendors – one that will create winners and losers on the networks front.

Who Will Those Winners and Losers be?

With only two markets in the world graced by commercial LTE services as of mid-December (Telia Sonera's launches in Stockholm and Oslo), it's clearly too early to make any iron-clad declarations. That said, one need only look back to Stockholm and Oslo to identify what should be two LTE front-runners: Huawei and Ericsson.

Putting aside the world's first commercial LTE services for a minute, consider their credentials. Ericsson has a base of 2G and 3G customers that few other vendors can match – customers primed to be LTE operators going forward. From a network standpoint, the company was one of the last to launch its next-gen multi-standard base station platform (the RBS 6000 series). It is here now, however, promising solid capacity and form factor diversity. When linked to its fixed-line assets, unparalleled professional services expertise and the (relative) financial stability necessary for on-going LTE R&D, it is not hard to see how the company pulled in marquee wins at Verizon, DoCoMo and TeliaSonera. For its part, Huawei may not claim Ericsson's base of 2G and 3G customers, or its history with professional services. It can, however, claim one of the fastest growing (and most financially successful) wireless infrastructure businesses backed by a cost-effective set of products that stretch from the mobile edge into the carrier core and what it claims is a strategic focus on ramping up its professional services capabilities. Perhaps more importantly, its multi-standard base station platform has been in the market for some time, proving out its capabilities and setting up LTE upgrade opportunities. And, where an operator wants a real end-to-end solution (or just a little help in ramping up early device supplies), Huawei is well known for supporting operators with mobile broadband devices including USB dongles and phones.

This doesn't mean that Ericsson and Huawei's LTE competitors are doomed. Where the ingredients to LTE success include proven, commercial RAN gear (ideally in multiple forms) married to transport, EPC, service delivery and device assets, there's no shortage of market contenders. For its part, Alcatel-Lucent has an impressive backhaul and services story to tell, as well as an eNodeB strategy leveraging its 2G and 3G install base. NSN beat even Huawei to the multi-standard RAN story and its Juniper JV boosts its fixed-line credibility. Motorola's WiMAX success lends it obvious TD-LTE credibility while ZTE can claim many of Huawei's strengths (costs, focus on multi-standard RAN), if not its focus on professional services.

Regardless, given the opportunity presented by LTE, it is fair to say that vendor competition will be fiercer than for any other wireless technology. Operators will benefit, but any vendor hoping for success will need to execute on all fronts.

Recommended Actions

Recommended Vendor Actions

- Huawei needs to highlight the LTE migration capabilities of its 3900 platform. To its credit, the company has plenty of customers using the solution for CDMA and WCDMA services. These customers, in turn, put it in a position to not only demonstrate its Huawei's LTE expertise, but its ability to evolve customer networks to LTE. Given their stated plans to launch LTE services, Bell and Telus in Canada stand out as good candidates.
- Ericsson needs to prove out the TD-LTE capabilities of its commercial LTE platforms. Given the importance of TD-LTE in China, there's been no shortage of TD-LTE demonstrations, including Ericsson's interoperability demonstration with Aeroflex in November. IOT demonstrations with test platforms, however, do little to signal that a vendor's go to market LTE platforms are ready to support the technology – making demonstrations (or, better yet, field trials) based on 6000 series base stations critical as competitors get ready to support China Mobile's work at the Shanghai World Expo next year.
- NSN needs to ramp up its commercial LTE momentum with new, high-profile wins. Early on, an association with DoCoMo lent the company an impressive, early-market image. Since then, competitors have stolen a march on the vendor, either thanks to bigger wins or a larger number of them. While it's obviously early in the LTE game – with many commercial opportunities left to be tapped – it may be hard to execute on those opportunities unless operators see traction that verifies NSN's LTE capabilities.
- Alcatel-Lucent needs to continue explaining – and demonstrating – the LTE migration capabilities of its 2G and 3G RAN assets. Like most major wireless infrastructure vendors, ALU promises base stations that can support 2G, 3G and LTE services. Building on its legacy RAN platform, however, this message was not always as clear or well conveyed as competitor multi-standard base station strategies. Demonstrations, then, of current customers leveraging their ALU base stations to roll out LTE trials would make the point very clearly.
- Motorola needs to land an LTE reference beyond KDDI. Beyond KDDI, the vendor's only LTE reference remains China Mobile for TD-LTE deployment at next year's Shanghai World Expo. This leaves the company with one non-commercial endorsement and one endorsement from a customer who already relies on Motorola for its 3G network. With a relatively limited 3G position, few vendors need to prove their LTE value proposition more than Motorola – something it cannot do based on pre-commercial work and existing customers.
- In order to drive its LTE business, ZTE needs improve – and better message – its professional services capabilities. In general, Chinese telecom vendors have not been well known for their ability to support complex network launches, multi-vendor network management, network optimization, etc. For its part, ZTE's Chinese compatriot, Huawei, has explained its plan to grow its services expertise while pointing to the growth of its managed services business – something ZTE will need to follow suit with if it hopes to emerge as a strong LTE player.

Recommended User Actions

- In planning their LTE network launches, operators need to closely follow their prospective vendors' financials. On the one hand, today's revenue weaknesses may not adequately

telegraph the strength of a vendor's LTE products. On the other hand, a protracted bout of losses could easily impact the vendor's stability, R&D capabilities and service support.

- Operators would be remiss in not investigating the financing support being offered by China's wireless infrastructure vendors. Short of vendor financing deals, the banking relationships established by Huawei and ZTE could help operators – established or new – get access to the capital needed to launch a robust LTE network. If nothing else, a better understanding of these options should put operators in a better position to negotiate with other vendors when making LTE plans.
- As a new radio access technology, it is understandable that the radio access network – and the eNodeB – gets a lot of attention in the LTE launch process. LTE launches, however, require more than new base stations or base station upgrades. They require EPC gear, transport network upgrades, applications which leverage the new bandwidth, etc. None of these components beyond the base station can be ignored.
- Operators should not get overly concerned with the delivery of voice over LTE, in the near-term. Most initial LTE launches will focus on data services driven by PC cards and USB dongles – not voice services. When voice services are demanded (and LTE devices are available to deliver them), the market has agreed on a strategy for delivering them: the IMS-oriented One Voice solution. Until then, CS fallback should provide an interim solution. That said, to make sure vendors are ready to actually deliver on CS fallback promises; operators need to demand demonstrations in the near-term.