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WHERE'S THE MASS-MARKET DEMAND?



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Executive summary

While the global hype around long-term evolution (LTE) continues unabated, the market remains driven by service provider competition rather than mass market demand. Commercial LTE deployments are characterized by operators seeking to exploit a perceived first-to-market advantage, along with competitors mobilizing to keep pace with market leaders. Multiple service providers have deployed LTE networks in 10 of the 20 nations where services are available. Of note, there is scant data available on the actual uptake of LTE services, which is a telling reminder of a very nascent end-user market and unproven '4G' packaging and marketing plans.

In response to the exponential and unrelenting growth of high bandwidth demanding mobile data traffic, LTE is emerging as the technology of choice for Tier 1, often pan-regional, operators in major markets around the world. With numerous trial activities, a raft of pre-commercial LTE networks recently announced, and open and pending new spectrum auctions, we look set to see LTE deployments more than doubling by the end of 2011, up from the 18 launches recorded at the end of 2010, and 35 launches as of September 2011.

The LTE market environment is diverse in terms of differing operator technology roadmaps, use of spectrum resources and the range of business models. LTE currently has the potential for deployment across 10 spectrum bands in a single band deployment

approach or with combined band usage.

Satellite spectrum is also in the equation, with wholesale operators including LightSquared in the U.S. and NBNCo in Australia proposing to use satellite frequencies in provisioning their LTE services. Regional variations are also notable, dictated by factors including technologies already deployed, levels of competition and market structures within individual nations, end-user market maturity and preferences, and regulatory conditions – not least how they apply to the availability of spectrum and its allocation.

This report examines the global status of LTE at the end of September 2011. Section 1 provides background on the commercial, technical and radio frequency developments shaping LTE's growth, while providing a synopsis of regional LTE nuances.

Section 2 examines the status of commercial LTE deployments in detail. It highlights differences in operator business models, with a focus on the emerging trends with LTE infrastructure and technology. It also highlights network and spectrum sharing models which are expected to increase as LTE takes hold and more spectrum resources are released for mobile broadband.

Section 3 concludes the report with a discussion of key issues that are both fostering and hindering LTE's progress. Namely, spectrum availability, challenges for the emerging LTE device ecosystem and LTE end-user service packaging and pricing strategies.

"LTE is emerging as the technology of choice for Tier 1, often pan-regional, operators in major markets around the world."

Section 1

LTE market background

The global long-term evolution (LTE) landscape is shaping in response to the spiraling demand for mobile broadband services and the exponential growth of mobile video and web traffic, along with rapid growth in smartphone penetration. Competition between service providers and the progressive release of suitable spectrum are continuing to drive commercial LTE deployments and planned LTE migrations.

At the end of September 2011, 35 commercial LTE networks had been launched in 20 nations. These launches were spread across the use of spectrum in nine different frequency bands. Whether in single use or multi-band strategies, 2,600 MHz is in use in 20 of the 35 deployments on record, while 10 networks rely to some degree on the use of re-farmed 1,800 MHz spectrum.

Growing momentum

In addition to the growing number of commercial LTE networks, numerous operators around the world continue to launch LTE trials. Many operators also continue to announce network upgrades, notably to HSPA+. The award of network upgrade contracts to bring operators to a position of 'LTE readiness' has seen remarkable growth, with such contracts now numbering in the hundreds around the world.

The growing momentum behind both HSPA+ and LTE deployments, along with LTE choices made by many Tier 1 operators – many of which are in large markets, including China, India, the U.S. and Europe – show LTE emerging as the dominant 4G technology. However, despite WiMAX losing its first mover advantage, it will remain a niche technology in the mobile marketplace, coexisting with LTE, along with legacy 2G and 3G network technologies.

While frequency division duplex (FDD) remains the LTE flavor of the day, the momentum behind time division duplex (TDD)-LTE has escalated in 2011, with commercial launches witnessed in Poland and Saudi Arabia. China and India remain the bastions of TDD-LTE focused developments. China Mobile's efforts have had a huge impact on the global preference for TDD-LTE, which we expect will be commercialized with dual mode FDD/TDD-LTE devices in 2012. India's Reliance/Infotel may beat its Chinese peers if it launches in Q4 2011, as company releases have suggested.

Similarly, Softbank in Japan is deploying a 2,300 MHz TDD-LTE network with Huawei, and is targeting a Q4 2011 commercial launch. Other examples include Australia's VividWireless working with Huawei on the launch of 2,300 MHz TDD-LTE and Germany's E-Plus. The KPN subsidiary is exploring a converged FDD/TDD-LTE network at 2,600 MHz, which may also extend to the use of spectrum at 1,800 and 2,100 MHz for LTE, in collaboration with ZTE and China Mobile.

An overlay of TDD-LTE is also emerging as a preference for established WiMAX players, including P1 in Malaysia, which is planning a dual mode WiMAX/LTE deployment using spectrum in the 2,300 MHz range. Saudi Arabia's Mobily has made the switch from WiMAX to LTE, as has Yota in Russia.

Other operators, including Hi3G Access in Sweden and Denmark and Aero2 in Poland, are planning dual mode FDD/TDD deployments. We expect that the dual mode model will be supported by the device ecosystem and chip set suppliers, but in the short to medium term, will lack the scale of conventional FDD configurations.

"At the end of September 2011, 35 commercial LTE networks had been launched in 20 nations. These launches were spread across the use of spectrum in nine different frequency bands."

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LTE's regional differences

There are significant variances in the way that regional LTE markets are shaping up. These differences are primarily influenced by existing technology deployments, the level and nature of market competition in individual nations, market maturity and the allocation and availability of sufficient and suitable spectrum for LTE provisioning.

In Western Europe, LTE deployment activity centers on the use of the 2,600 MHz band, spurred by auctions of this spectrum across a growing number of nations, most recently in Spain, France and Italy. Momentum is also building around LTE at 800 MHz using spectrum freed up via the transition from analog to digital broadcasting, although such activity awaits the allocation of 800 MHz for mobile broadband. This is pending in the majority of nations in the region. Partnerships focused on shared infrastructure and spectrum are also taking hold in Europe, as discussed in the next section of this report.

In Eastern Europe, the LTE landscape is dominated by launches from TeliaSonera and MTS, and trials and planned deployments from Orange, Telenor, Tele2 and Telefónica. Telefónica is also spearheading LTE activity in Latin America along with Claro, although the focus in the region remains on network upgrades, and scale in LTE deployments is not anticipated before the 2013 to 2014 timeframe.

The situation in Latin America is influenced by a lack of available spectrum being awarded for LTE, which is also an issue in many nations in the Middle East and North Africa region. In the Middle East, Saudi Arabia's three operators and the UAE's Etisalat were all scheduled to launch commercial LTE services in September 2011.

LTE is on the radar in Asia Pacific, with commercial networks launched in Singapore, South Korea and Australia in 2011, complementing those launched in 2010 in Japan and Hong Kong. With China and India poised to launch TDD-LTE and FDD/TDD dual networks in 2012, along with a number of WiMAX operators transitioning to LTE, the region is poised as a hub of LTE activity in 2012.

As in Europe, a number of operators in Asia are taking advantage of 2G and 3G frequency re-farming and the use of multiple spectrum bands for LTE, in part to deal with spectrum constraints.

The North American LTE landscape has been energized in 2011 with commercial services by AT&T in the U.S. and Rogers Communications and Bell Mobility in Canada. These launches follow the 2010 LTE debuts of MetroPCS and Verizon Wireless in the U.S.

While numerous second tier operators have conducted LTE trials, smaller rural operators are showing a preference to align with partnership models focused on wholesale and roaming agreements – notably with LightSquared and under Verizon's rural partner scheme. The viability and advantages of these partnership models remain to be tested, and uncertainties surrounding LightSquared's LTE network deployment must be resolved before we can assess the market outcomes of the agreements in place.

"LTE is on the radar in Asia Pacific, with commercial networks launched in Singapore, South Korea and Australia in 2011."

Section 2

Global LTE deployments and business models

As September 2011 closed, competition and the progressive release of suitable spectrum are continuing to drive commercial LTE deployments. Figure 2-1 identifies LTE launches on a regional basis, with 12 commercial networks in six Western European nations representing the largest share of deployments. In 10 of 20 nations where LTE is live, there have been deployments by more than one competing operator.

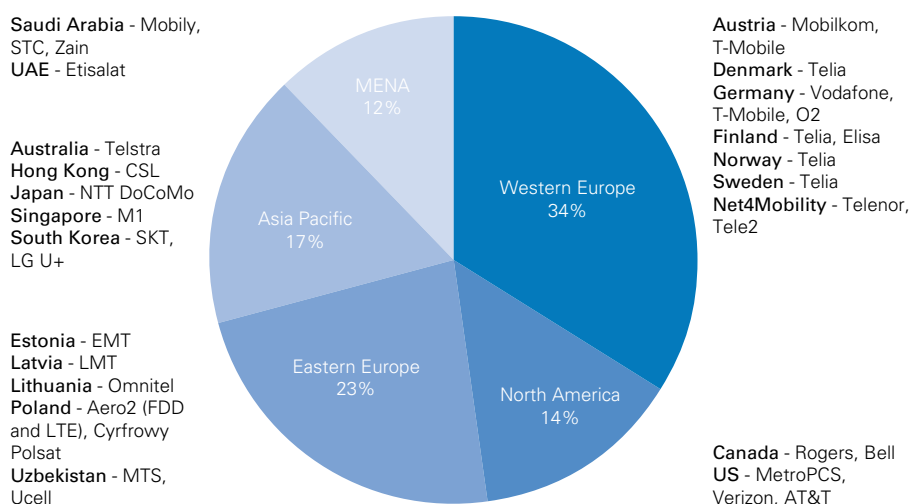
Although Net4Mobility, the joint venture between Telenor and Tele2 in Sweden, bid collectively for LTE spectrum, the two operators are providing distinct commercial services and their deployments are therefore counted as separate events.

Poland's Aero2 is also counted with two launches, one using 1,800 MHz FDD spectrum, while the second employs TDD-LTE spectrum in the 2,600 MHz band. Networks based on a wholesale business model are included in our LTE count, as are those that are initially limited to providing commercial services to enterprise customers.

These 35 commercial launches are spread across the use of spectrum in nine different frequency bands. Key characteristics of the use of spectrum for the provision of LTE services to date are:

- 28 or 80 percent of launched networks are using spectrum in a single band;
- Seven LTE deployments are leveraging spectrum in multiple bands, all are combining the use of spectrum at 2,600 MHz with spectrum in a single or multiple lower spectrum bands;
- Whether in single use or multi-band strategies, 2,600 MHz is in use in 20 of the 35 deployments on record;

Figure 2-1: Commercial LTE deployments as at September 2011



Source: Operator, Vendor and Regulator Releases, Tolaga Research 2011

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- Of single band deployments, 46 percent are using 2.6 GHz spectrum and of these, 23 percent are TDD-LTE based deployments;
- six live deployments using a single band model using 1,800 MHz spectrum, and an additional four multi-band deployments that include the use of 1,800 MHz;
- 12 launches using spectrum in a single band are based on the deployment of LTE in legacy 2G and 3G bands; and
- Of the seven multi-band deployments, five are also using re-farmed spectrum to a degree.

The variety of spectrum bands used for LTE creates challenges for device and infrastructure vendors whose technology must have sufficient scale to meet market demands.

With a raft of pre-commercial LTE networks recently announced, along with open and pending new spectrum auctions, we expect to see LTE deployments doubling by the end of 2011, up from the 18 launches recorded at the end of 2010.

The following section provides a summary of the commercial LTE networks that have been launched as at September 30, 2011. This unrelenting wave of launches encompasses a wide variety of operator business models spanning parameters including:

- network migration strategies and technology roadmaps;
- LTE network coverage and coverage plans;
- spectrum band usage, including multi-band strategies;
- partnership models;
- different customers targeted— consumers, enterprises and wholesale;
- device profiles and prices, and planned device offerings;
- data service plans and pricing, with dramatic differences in terms of monthly data allowances or caps, overage charges,

advertised and theoretical service speeds and contract periods.

A brief deployment history of LTE

In December 2009, TeliaSonera launched the world's first LTE commercial networks in Stockholm, Sweden and Oslo, Norway. Across its operations in Europe, TeliaSonera is primarily sourcing LTE network equipment from Ericsson, NSN and Huawei. Uzbekistan's MTS claimed the world's third LTE commercial launch in July 2010. TeliaSonera's subsidiary UCell (Uzbekistan) followed suit in August 2010, launching its LTE service in partnership with ZTE. Following close behind, in September 2010, Poland's Mobyland and CenterNet (Aero 2), partnering with Huawei, launched commercial LTE wholesale services using spectrum in the 1,800 MHz band.

September 2010 also saw the launch of North America's first commercial LTE service coming from MetroPCS using 700 MHz spectrum. In Europe, Telekom Austria and T-Mobile launched LTE services in Vienna and Innsbruck respectively, using newly acquired 2.5 GHz FDD spectrum.

November 2010 witnessed a spate of further deployments led by Telia2 and Telenor partnering under the banner of Net4Mobility to launch LTE in Sweden. The operators are using shared 900 MHz and FDD 2,500 MHz spectrum holdings. While the operators are sharing both infrastructure and spectrum, their commercial LTE services are separate offerings. Meanwhile, TeliaSonera continued its LTE push with the launch of services in Finland.

Asia Pacific's first LTE commercialization came from CSL in Hong Kong, launching its 1,800 MHz network in November 2011.

In December 2010, Vodafone continued the cause, launching LTE services in Germany following a pre-launch in October 2010. Vodafone is using newly acquired spectrum in the 800 MHz band. In the U.S., Verizon rolled

After a slow start, LTE launch momentum has picked up

out LTE services on December 5, 2010, using 700 MHz spectrum.

Also in December, TeliaSonera launched LTE services in Denmark and Estonia, while Elisa joined TeliaSonera launching Finland's second LTE network using NSN gear. Finally, on December 24, 2010, Japan's NTT DoCoMo launched its LTE offering.

The LTE launch momentum has continued unabated in 2011, albeit after a slow start. In April 2011, T-Mobile launched services in Germany using a combination of 800/1,800/2,600 MHz spectrum. TeliaSonera's Lithuanian arm, Omnitel, also turned on its LTE network using spectrum in the 1,800 MHz band.

In May, Poland's Aero2 launched its 2.6 GHz TDD network in association with Huawei. Aero2 also recently partnered with Huawei with plans to launch a combined TDD/FDD-LTE network. Latvia's LMT, again a TeliaSonera subsidiary, followed in June 2011, launching its 1,800 MHz based commercial network.

June 2011 saw the focus of launch activity turning back to Asia where Singapore's M1 led the way with an 1,800/2,600 MHz deployment. SKT stole the lead in South Korea, launching its services on July 1, 2011 using spectrum in the 850 MHz band.

LG U+ followed at the end of July, launching its network with equipment supplied by Samsung, Ericsson and NSN. July 2011 also saw LTE launched by O2 in Germany and by Rogers Communications in Canada, representing the North American nation's first commercial LTE offering using Advanced Wireless Services spectrum. In Europe, In August 2011, Poland's Cyfrowy Polsat launched its services based on the use of wholesale spectrum on Aero2's 1,800 MHz LTE network.

Mobily's TDD-LTE variant is using spectrum at 2.6 GHz owned by its subsidiary Bayanat Al-Oula. The TDD-LTE service is initially

available in six cities, with 88 percent population coverage planned by year-end. The service is offered with a wireless broadband router. Having partnered with NSN, the leading mobile operator STC followed suit just a day later to launch the Kingdom's second TDD-LTE network in the nation's western region. STC has also contracted with Huawei in its LTE deployment. STC launched its offering along with a USB modem. Zain Saudi Arabia followed close behind, launching LTE services in three cities, also using spectrum in the 2.6 GHz range.

In September 2011, Canada saw the launch of its second commercial LTE service provided by Bell Mobility, initially in five cities. Bell's deployment has been supported by vendors including NSN and Huawei and the operator is launching with a laptop modem provided by Sierra Wireless.

Bell is primarily focusing on urban deployment, with rural expansion tied to acquiring spectrum in the pending 700 MHz auction in Canada slated for next year.

Next in line is AT&T, which switched on its LTE network in five cities on September 18. The operator is targeting coverage of 70 million people (15 cities) by the end of 2011. The carrier is initially offering USB (two devices) and mobile hotspot access, along with a data tablet.

The UAE's Etisalat launched its commercial 2,600 MHz FDD LTE network in September 2011, prior to the launch of end-user devices in October. The operator has adopted a multi-vendor strategy, with Alcatel-Lucent, Ericsson and Huawei contracted to deploy its networks

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in different regions of the UAE. Rounding out the commercial LTE launch list is Telstra, which turned on its LTE network in Australia at the end of September 2011 using spectrum at 1,800 MHz.

LTE models based on resource sharing

LTE is influencing a growing trend of operational models based on various forms of shared assets of individual operators – with both infrastructure and spectrum. Within this sharing realm, two distinct trends are emerging:

- Attempts to build a single, open access national infrastructure for LTE. However, open access models are facing significant challenges, not least of which are arising from incumbent operators' resistance and a high degree of political wrangling. This is the case in Russia, the U.S. and Kenya, as discussed below.
- Joint ventures, infrastructure and spectrum sharing agreements between operators. Such partnerships are gaining far greater traction and we anticipate that sharing models will increasingly characterize LTE market developments. Through such agreements, operators are seeking to maximize network and spectrum efficiencies, while bringing live LTE networks to the market more quickly and at less cost.

Wholesale open access models face challenges

In March 2011, Yota (Scartel) was tasked with building Russia's LTE access network and backhaul infrastructure. The operator was previously permitted to use WiMAX designated spectrum for LTE deployment. Yota holds both TDD and FDD spectrum in the 2,500MHz band. It has been following a dual mode (WiMAX/FDD-LTE) development path with its vendors.

The original plan was for this single LTE network to be accessed by Russia's four large

operators – Megafon, MTS, Vimpelcom (Beeline) and Rostelecom – on a wholesale basis.

While this solution was originally agreed between Russia's major operators, and sanctioned by the government, the model is now under a cloud. In September 2011, MTN and Vimpelcom announced plans for joint LTE network deployment, indicating they no longer wished to provide LTE access through Yota.

Historically, Russia's spectrum and regulatory environment has been complicated by bureaucratic conflicts, spectrum incumbency issues and complex regional licensing arrangements. Russia's path to LTE has been marred by delays in spectrum allocation and trial license permits and a lack of clarity in the technology restrictions associated with specific licenses.

With the fate of Yota's plans to deploy LTE across 180 cities covering a population of 70 million between 2011 to 2014 now in question, so too is Russia's position as a leading LTE market.

Kenya's government is pursuing a proposal to contract the building of a national LTE network, under a public/private partnership model. The network operator would adopt a model of wholesaling access to the network to multiple operators. Kenya's incumbent operators have instead pushed for individual 4G licensing, along with the release of associated spectrum.

Safaricom provides 3G services and has undertaken LTE trials using its spectrum holdings at 900 MHz, while Telkom Kenya/Orange launched 3G services in August 2011. The government appears steadfast in its approach while also insisting that the operator contracted to deploy the LTE network must be 20 percent Kenyan-owned. Such provision would work in the favor of Safaricom, while working to the disadvantage of Essar Telecom Kenya and Airtel Kenya.

A key issue to be overcome is release of

Operator business models are based on sharing network and spectrum assets

2,600 MHz spectrum held by the military in Kenya and not due for release until 2015.

Backed by the hedge fund Harbinger Capital Partners, LightSquared is positioning to deploy a wholesale-only, open access 4G wireless broadband network across the U.S. It will primarily use spectrum in the 1.5/1.6 GHz and 2GHz bands. Launch of the data network is scheduled for Q3 2011, with near nationwide coverage (92 percent) anticipated in 2015 through LightSquared's terrestrial network and 100 percent coverage through its two satellites. LightSquared has announced plans to offer terrestrial only, satellite only and a combination of both terrestrial and satellite services.

Notwithstanding the fact that LightSquared has announced a rolling list of wholesale and roaming partners, the Harbinger acquisition of Skyterra carries regulatory obligations including the deployment of two next-generation satellites.

LightSquared is required to build a terrestrial network with coverage milestones applied to reach a level of 260 million points of presence (POPs) by the end of 2015. The operator must also maintain nationwide satellite network coverage. There is also a stipulation to offer dual mode devices that will support both terrestrial and satellite services. The phased coverage milestones identified by LightSquared for its terrestrial network are:

- December 2011 – 9 million POPs
- December 2012 – 100 million people
- December 2013 – 145 million people.

These targets are formidable and the issue of whether LightSquared can secure adequate and sustainable project financing remains. On top of the many questions surrounding the viability of the LightSquared business model, the operator is stuck until it can resolve issues around interference with GPS services.

Operator partnerships show better prospects

LTE commercialization developments in Europe are notable in terms of operator business models based on the sharing of both network and spectrum assets. A key example of this activity is seen in Poland where Aero2 and CenterNet have launched a joint LTE network utilizing FDD spectrum in the 1,800 MHz band.

The operators have bypassed 3G, moving directly to an LTE wholesale network model

In August 2011, Cyfrowy Polsat launched its commercial LTE service under the PolsatNet brand, using Aero2's wholesale network. Meanwhile, in May 2011, Aero2 launched TDD-LTE using spectrum in the 2.5 GHz range with support from Huawei, and in September 2011, the operator announced a new contract with the same vendor to launch a combined TDD/FDD LTE network.

On the ownership side, in May 2010, Aero2 acquired a non-controlling stake in CenterNet and in September 2011, CenterNet's parent, NFI Holdings, announced plans to buy Aero2. NFI Holdings has also recently announced plans to acquire Polkomtel, after divesting interests held in Cyfrowy Polsat.

Also, in September 2010, P4 and Orange received regulatory permission to form a joint venture with a focus on wholesale LTE deployment. This follows another network-sharing agreement between T-Mobile and Orange to be managed by the joint venture NetWorkS! created by the two companies. In September 2011, Polkomtel and P4 also announced plans for network sharing.

While Aero2 is leading the LTE march in Poland, the other mobile operators are all looking to establish themselves in the nation's 4G market. The recently announced network sharing agreements seek to reduce costs and enhance efficiencies in the shared use of physical resources, including base stations.

They are also oriented towards aggregating spectrum holdings, as in the case of Aero2

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and Polkomtel. They would hold a combined 161.4 MHz of spectrum, including 55 MHz of TDD spectrum, if Polkomtel's acquisition is approved by the regulator. The other operators are also planning to bid jointly for new LTE spectrum with the auction of 2.5 GHz FDD and 800 MHz spectrum pending in Poland.

Examples of previous adoptions of this joint bidding model include Telenor and Tele2 in Sweden, which bid for 800 MHz LTE spectrum under the Net4Mobility joint venture. The same approach was adopted in Hong Kong where PCCW and Hutchison secured 30 MHz of 2600 MHz FDD spectrum under the Genius Brand joint venture.

As in Sweden, the Hong Kong operators will provide separate commercial 4G services. Genius Brand has since awarded a network upgrade contract to Huawei and plans to launch its LTE services in Q1 2012.

Denmark's TeliaSonera and Telenor announced a joint radio access network sharing agreement in June 2011. Telenor is pioneering this latest round of network sharing agreements.

Malaysia's Celcom Axiata and Digi (part owned by Telenor) announced an LTE network

sharing agreement in January 2011, modeled on a similar deal between the operators in Bangladesh. The operators plan to launch LTE using spectrum in the 2,600 MHz band where their combined provisional holdings amount to 40 MHz FDD. However, the spectrum will not be available for use until 2013. In meantime, both Celcom and Digi awarded network upgrade contracts in 2011. With the lack of availability of 2,600 MHz spectrum, Malaysia's Maxis is also eyeing a sharing agreement with Asiaspace whereby Maxis would launch LTE using 2,300 MHz spectrum licensed to Asiaspace.

Emerging business models oriented around joint ventures and sharing of network and spectrum assets bear close monitoring as operators seek to maximize spectral efficiencies and improve overall economics in the mobile industry. This is particularly the case in saturated markets where mobile penetration is high, and where smaller players are disadvantaged in terms of spectrum holdings. Partnering will also be driven by spectrum packaging dictated by regulators, which provide for only a limited number of operators to secure blocks of scarce spectrum.

"Emerging business models oriented around joint ventures and sharing of network and spectrum assets bear close monitoring as operators seek to maximize spectral efficiencies and improve overall economics in the mobile industry."

Section 3

The prospects for LTE in 2012

With 35 commercial LTE networks in service by October 2011 and scores of launches slated for 2012, LTE is on a clear path towards becoming a mainstream technology. However, three key issues that continue to influence LTE deployments and service uptake are:

- the availability of spectrum suited to LTE,
- the availability of devices, and
- end-user LTE service offerings and pricing.

Spectrum availability and standards

While there is movement on these issues – with an array of regulators moving on the spectrum allocation front, spectrum re-farming taking hold among operators, and an ever growing pool of data-enabled devices – critical issues remain around timing. Moreover, a lack of innovation in LTE service pricing and packaging when coupled with the confusion around '4G' marketing are muting the short-term demand drivers for LTE to migrate to a mass market position.

Despite moves to auction spectrum in the key 800 and 2,600 MHz bands, legacy incumbency issues mean that this spectrum will not be available for use in a number of countries in the short term. To this point, many regulators are seeking to expedite allocations, taking heed of developments in Europe where operators have been quick to obtain new spectrum resources for commercial launches.

Most recently, both Telefónica and Vodafone have launched pre-commercial LTE services in Spain. Both operators are initially offering services to corporate customers using spectrum acquired in Spain's August 2011 auction of 800 MHz and 2.6 GHz spectrum. Across these bands, Telefónica secured 60 MHz of paired spectrum while Vodafone picked up 50 MHz.

Operators are also responding to the issue of spectrum constraints. On the one hand we are seeing many LTE launch and trial activities that are utilizing spectrum combinations across multiple bands. In other cases we are seeing a focus on urban deployments, with operators holding back plans for rural coverage until spectrum around 700 and 800 MHz can be secured. For example, this is the strategy adopted by Bell Mobility in Canada in the absence of the licensing of 700 MHz spectrum.

There is also growing interest in using re-farmed spectrum in the 1,800 MHz band to fulfill both coverage and capacity requirements. Although the propagation features of the higher 1,800 MHz band are inferior to those at 900 MHz, the band offers a larger pool of 75 MHz of paired spectrum.

In many cases the 1,800 MHz systems are collocated and used in conjunction with 900 MHz systems, with the aim of simultaneously addressing coverage and capacity. Moreover, spectrum at 1,800 MHz is a prime candidate for dual use with newly allocated or pending release of spectrum in the lower 800 MHz digital dividend range and the higher 2,500 MHz band.

While there has been less activity using 900 and 2,100 MHz for the same purposes, we expect that such activity will be spurred based on experience gleaned from the use of 2,100 MHz for LTE in nations including Japan and South Korea. Sweden's Tele2 and Telenor are also using 900 MHz along with 2,600 MHz spectrum as part of their joint LTE network undertaking.

The development of the LTE device ecosystem faces serious challenges, which derive from the highly heterogeneous nature of the LTE market. The LTE spectrum scene is as diverse as the operational roadmaps for

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migration to LTE and this lack of harmonization demands solutions from vendors that span multiple spectrum bands, and band combinations, that also differ regionally.

Spectrum fragmentation is a big issue with some 10 spectrum bands in play in support of both FDD and TDD LTE and continued use of legacy 2G and 3G networks for voice services, data offload for low bandwidth services, and in areas of a country where LTE coverage is limited.

Issues surrounding roaming capabilities and interference, both within countries and across regions, must also be addressed where operators are deploying LTE in different spectrum bands that are not necessarily supported by existing devices.

Technology vendors are responding to the diverse demands from service providers with flexible architectures that anticipate evolving requirements as the LTE market defines itself. Commercial LTE services were originally data-focused and provided primarily through routers, USB modems and laptops. More recently tablets and mobile hotspots, vendors and chipset makers are looking to multi-technology, multi-band and multi-mode device developments that are critical to the medium- to long-term mass market success of LTE.

On a more positive note, in addition to ongoing global standards developments, global collaborations around LTE are taking hold that are aimed at advancing standards, technology and technology migration roadmaps and spurring the emerging LTE device ecosystem, while at the same time seeking to address major issues presented by spectrum fragmentation.

For example, the Global TD-LTE Initiative was founded in February 2011 by Aero2, Bharti Airtel, China Mobile, Clearwire, E-Plus, Softbank and Vodafone, and the collaborative boasted 31 members in September 2011. In

addition, China Mobile, Verizon Wireless and Vodafone have collaborated on ongoing TDD and FDD technology trials, along with vendors.

Pricing, packaging and devices

Another potential inhibitor to LTE uptake relates to service packaging and pricing plans which, to date, are lacking in innovation and targeted marketing. So far service providers are adopting conservative approaches to LTE service packaging and pricing. The lack of innovation in pricing plans is indicative of the unwillingness of operators to adopt aggressive strategies in light of the nascent LTE service and device markets.

While there are exceptions, the lack of unlimited, flat rate and contract-free LTE plans indicates service providers are adopting a wait-and-see approach, rather than focusing on service differentiation to drive uptake. The usual pricing and packaging strategies remain the norm for LTE service offers.

Encouragingly, a number of operators are offering free devices associated with an LTE service contract, following a trend that we have seen with 'free' smartphone offerings in some postpaid markets. However, we believe increased service innovation is necessary for the full benefits of LTE to be realized in the marketplace.

In addition to the many contingencies and uncertainties surrounding LTE, including the need for multi-band devices and chipsets and the timing of the availability of multi-mode devices, service providers' pricing strategies are creating a lackluster end-user market dynamic for LTE.

Service differentiation and messaging around a new and unique user experience is dampened due to pricing models based on measured usage data services, fair use policies and relatively long contract periods.

An increasing number of LTE resource sharing agreements are expected in 2012

While there is more evidence of innovative pricing and packaging on the LTE devices side, the market remains largely limited to USB modem offerings. In many cases, actual (versus advertised and theoretical) LTE service speeds also lack differentiation relative to existing 3G services and associated bandwidth caps.

2012: A big year for LTE?

In addition to tracking and analyzing the progress of LTE in the 20 markets that have launched commercial services, key markets to watch in 2012 include: China, India, Spain, the

Philippines, Croatia, Mexico, Colombia, Taiwan, France, Romania, Moldova, Switzerland and Uruguay.

In each of them, there are firm operator commitments to launch LTE in 2012, with planned deployments spanning an array of technology and spectrum usage scenarios.

Next year is also expected to see an escalating number of LTE resource-sharing agreements and partnerships between operators. Driven by efforts to reduce costs, optimize shared infrastructure use and scarce spectrum resources. These emerging, joint LTE business models will bear close monitoring.

How TM Forum's Framework can help monetize LTE

TM Forum's Framework suite of standards provide the blueprint for effective business operations, enabling you to assess and improve performance by using a proven, service-oriented approach to operations and integration which allows you to focus on growing your business.

Developed in TM Forum's unique Collaboration Community, Framework is the result of on-going, cross-industry development by TM Forum's member companies from all over the globe. Framework is driven by service providers' requirements, and is constantly evolving in line with market needs. It is only available to TM Forum members, who collectively serve more than 90 percent of the world's communications subscribers.

In the context of LTE deployment, business models and monetization, Framework can help you:

- Reduce operating costs continually to improve margins in a world of commoditized data services.
- Give service providers the flexibility to deliver innovative new services efficiently and economically, that exploit the potential of high speed mobile broadband.
- Improve revenue assurance and tackle charging and billing issues associated with high-volume and partner-based business models.
- Enable and manage partner-based services, including over the top services.

For more information, please go to <http://www.tmforum.org/TMForumFramework/1911/Home.html>

You can read how Framework has helped operators round the world to launch new services successfully in the 2011 and 2012 editions of *TM Forum Case Study Handbook* [here](#)



tmforum ENABLING INNOVATION

The game is changing for communications service providers. Cutting costs is merely a ticket to play, not to grow. The key to growth lies with innovation – underpinned by business agility, smart partnerships and inspired creativity.

As the global industry association focused on simplifying the complexity of running a service provider's business, TM Forum brings together a

community of more than 50,000 professionals on the cutting edge of innovation. As a unifying force for the industry, it's time for you to join more than 750 companies across 195 countries collaborating to simplify service innovation.

Visit www.tmforum.org to learn more about TM Forum membership and how we help you enable innovation.

Have you seen our other recent TM Forum publications?

Free to TM Forum members and now available for non-members to purchase online

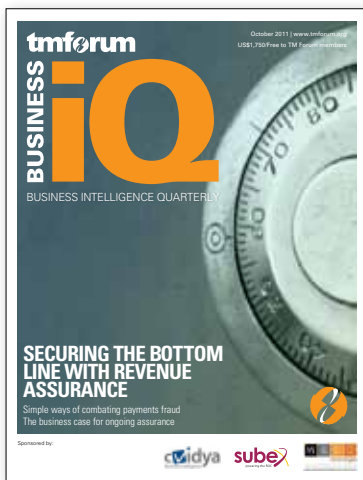


TM Forum Case Study Handbook 2012

The TM Forum *Case Study Handbook 2012* is packed with up-to-date success stories from service providers around the globe. All have used the Forum's Framework suite of standards, best practices, training, Business Benchmarking and Catalyst Programs to evolve their businesses and gain big advantages in our highly competitive world.

TM Forum surveyed 86 of the world's top 100 service providers about their use and projected use of Framework and 83 percent of respondents said they are already using our standards. Now readers can learn for themselves as the service providers share details of their success.

The *Case Study Handbook 2012* sums up everything the Forum stands for – enabling shared expertise, knowledge, investment and effort to benefit service providers of all kinds and sizes, from anywhere on the globe.

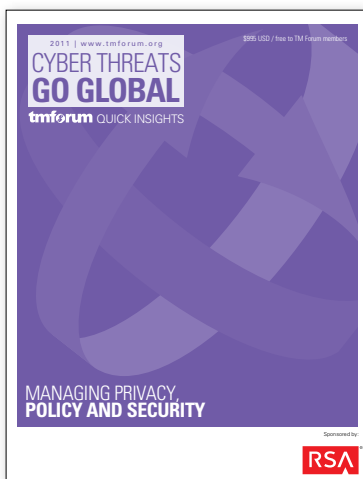


Business Intelligence Quarterly: Securing the bottom line with revenue assurance

Whether you operate in a mature market such as North America or an emerging market like India, revenue assurance becomes a critical issue for every service provider. Fighting fraud and managing risk are high on the executive agenda.

This issue of the *Business Intelligence Quarterly* arms you with all the information you need to understand how crucial the many aspects of revenue assurance are. We share details from one of the Forum's Catalyst projects 'Measuring the impact of revenue assurance' with input from service providers across the globe, including BT, China Unicom, China Telecom, Swisscom and O2.

As well as a panel discussion with leading industry executives, the report also contains new, real-life insight from TM Forum's benchmarking performance-based studies and case scenarios from its Revenue Assurance Maturity Model.



Cyber threats go global: Managing privacy, policy and security

Breaches in security and privacy can damage countries, companies and individuals. How to keep networks secure and data private is an issue galloping up the corporate agenda. Many would argue progress isn't fast enough, is late in the day and that things look set to get worse. Strong leadership and clear strategy are vital.

In this report, we explore the simple measures that can be taken to improve matters quickly, including those specific to OSS. We look at how policy-based management is used now and how it could evolve as the means to cope with security and privacy in the face of ever-increasing data.

Addressing security and privacy requires collaboration among service providers. Take inspiration from the Forum's award-winning collaboration work with the defense industry and find out how your organization can get involved.

Visit www.tmforum.org/researchandpublications to find out more

