

# Optimizing global mobility through seamless coexistence and evolution of GSM, WCDMA and LTE

The impressive uptake of mobile broadband services based on High Speed Packet Access (HSPA) is founded on excellent performance, low cost and seamless fall-back to GPRS/EDGE, which results in great coverage from day one. New technologies are being developed to further improve the coexistence of GSM and WCDMA and pave the way for the introduction of LTE.

# Market overview

In today's competitive and dynamic market, operators need to continually adapt their business to win and retain subscribers and increase revenue. Innovation, however, is not simply a matter of introducing new technology or adding new services. When it comes to making long-term network infrastructure investment decisions, technology is just one factor.

The key business challenge for all mobile operators is generating the maximum return on their technology investment over the longest period of time. Operators need to continue to reduce the production cost of traffic and get more capacity from existing investments, through innovative solutions that reduce total cost of ownership while avoiding any barriers to future business development and growth. Operators that have established a market-leading position for voice and SMS services will want to maintain or improve this position in the emerging mobile data market.

The 3rd Generation Partnership Project (3GPP) family of standards – GSM, EDGE, WCDMA, HSPA and LTE – is proof that standardized, evolutionary solutions can meet this challenge over several decades. Experience shows that operators can build and maintain a profitable business that encompasses everything from basic voice telephony and text messaging to advanced

multimedia services over mobile broadband based on global standards.

The 3GPP family ensures interoperability, roaming, backward compatibility and economies of scale – as evident from GSM voice services. Driven by the 3GPP's standardization work, full-coverage mobile broadband services can be rolled out at an incremental capital cost of less than EUR 3 per subscriber per month.

Such cost efficiency is part of the reason that the 3GPP technology track is now the preferred option for most operators around the world. About 200 operators have already commercially deployed HSPA and many of the world's largest 3GPP and 3GPP2-aligned operators have chosen LTE as their next-generation mobile broadband technology. More than 1.5 billion people already have access to HSPA-enabled networks.

Among mobile operators in mature markets, mobile data is overtaking messaging as a revenue source – and growing by 50 percent per year – making it the biggest success since voice.

The introduction of LTE emphasizes the need for efficient solutions to simplify the combined operation of all three generations of radio technology, as well as the need for cost-efficient RAN transport solutions.

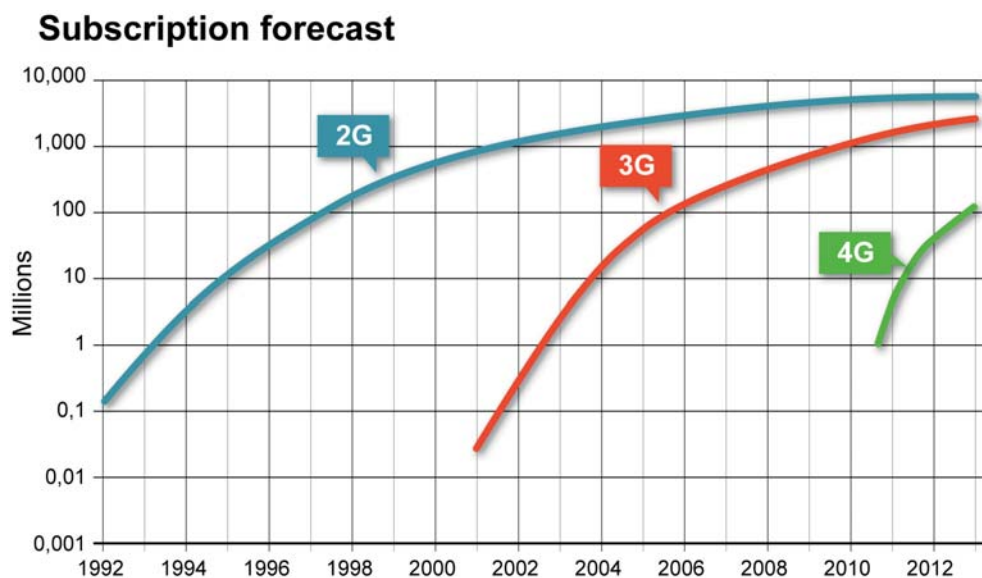


Figure 1: The 3GPP family of standards, GSM, WCDMA and LTE, will continue to coexist into the foreseeable future.

# More efficient voice, higher-speed data

Today, the 3GPP family of standards serves 88 percent of the global market for mobile voice and data services. As 3GPP2-aligned operators have chosen LTE for high-speed data the continued success of 3GPP technologies is now driven by the powerful market forces of economies of scale and widely available development and operational expertise.

The 3GPP family of standards enables operators to meet demand for high-speed mobile broadband services using WCDMA/HSPA and later LTE and TD-SCDMA. At the same time, it enables operators to satisfy continuing growth in demand for mobile voice and data services through ever-more efficient GSM technology, especially in emerging markets.

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## A thriving device ecosystem

A key aspect of delivering popular, affordable mobile communications services is the availability of a wide variety of attractive and affordable devices. The 3GPP has provided the basis of the world's most successful and vibrant device ecosystem by ensuring the fundamentals are in place in the form of specifications that both infrastructure and device vendors comply to and implement.

In December 2008, there were 3.5 billion subscribers to services based on 3GPP standards, according to the GSM Suppliers'

Association, encouraging a highly competitive market and a vast variety of designs. The availability of more than 1000 different HSPA devices and over 2000 device models with EDGE support is proof of this.

The low-cost and attractive design of 3GPP-standards-capable handsets, and the continued strength of GSM/EDGE services, means GSM/EDGE will continue to be built into WCDMA/HSPA handsets for many years to come.

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## GSM will live on – and mobilize the next 3 billion subscribers

As well as being the world's most popular mobile technology – and still adding around 50 million subscribers each month – GSM is also the undisputed choice for addressing the next 3 billion mobile subscribers. Device cost and network efficiency are just two factors ensuring that GSM will live on for another decade, and beyond.

One reason for GSM's popularity is its continued technological enhancement: GSM is still developing, with new technologies such as Wideband AMR for high-quality voice and EDGE Evolution for high-speed data.

A key driver of GSM growth is the much lower cost per terminal it offers – a factor which is set to stay the same for the

foreseeable future. For example, Ericsson has calculated that the UK telecoms industry alone has saved EUR 3.2 million a year by continuing with GSM-only handsets.

In new coverage areas, GSM technology offers the enormous advantage of being able to deliver affordable broadband internet access in a way that can evolve to match the region's population and level of infrastructure development.

In December 2008, there were more than 410 EDGE networks delivering commercial services – an increase of 30 percent on the previous year. Of the 3GPP-standard-compliant handsets to be delivered between 2008 and 2010, about three-quarters will

support EDGE, according to a June 2008 forecast from Strategy Analytics.

EDGE Evolution, which initially offers downlink speeds of up to 1Mbps, is being commercially rolled out in 2009 – ensuring that mobile broadband services will be

available almost everywhere.

EDGE and EDGE Evolution are an important complement to WCDMA/HSPA and LTE, as they lay the groundwork for higher-speed data services and increase trust in the mobile broadband service.

## Mobile broadband has passed the tipping point

WCDMA/HSPA-enabled mobile broadband is becoming a mass-market success, spurred on by attractive flat-fee pricing, ease of use, affordable USB modems and, more recently, built-in modems. According to Informa Telecoms & Media there are more than 262 million WCDMA subscribers, including 70 million HSPA subscribers, worldwide. More than 92 percent of commercial WCDMA networks have launched HSPA, and there are now more than 1000 HSPA devices on the market – impressive figures for a service that was only launched in 2006.

By 2013, it is likely that there will be about 3 billion broadband subscriptions, and more

than two-thirds of these (2.2 billion) are likely to be mobile, according to Ericsson estimates.

HSPA offers ever-improving performance: today, commercially-proven transmission bit rates of up to 21Mbps are in operation using 64 QAM modulation; in 2009 commercial networks will deliver 42Mbps in the downlink; and next year 84Mbps in the downlink will be available.

3GPP and merged 3GPP2 technologies will continue to evolve and enhance their capabilities – with a clear roadmap for reaching at least 150Mbps and even higher speeds with LTE, moving on to a target of 1Gbps.

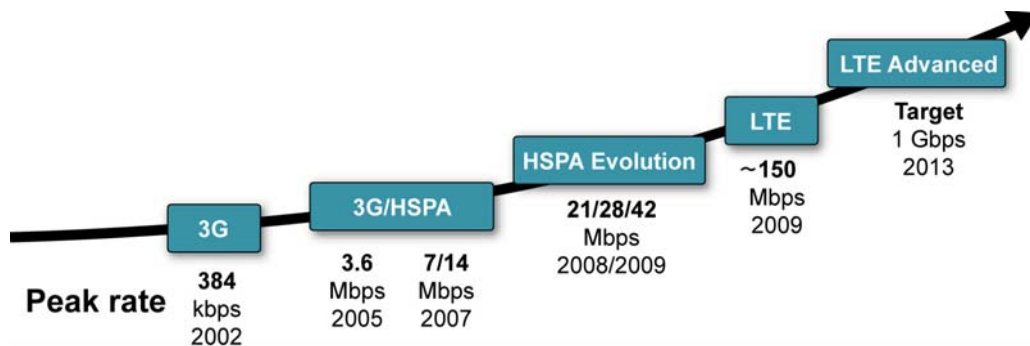


Figure 2: Continuous evolution of 3GPP capabilities

## Mobile broadband delivers 40 percent margin

The WCDMA/HSPA price-to-performance ratio has now reached a level that encourages a mass-market for mobile broadband.

As part of the 3GPP family of standards currently serving more than 3 billion subscribers, HSPA offers unmatched economies of scale that benefit all players in the ecosystem. It is an ecosystem that

provides unrivalled breadth and depth, covering both traditional mobile terminals and personal consumer devices such as laptops, ultra mobile PCs, cameras, portable game consoles and music players.

Several consulting companies has carried out business case analyses with operators, looking at the delivery of PC-based mobile

broadband services over HSPA. At an average revenue of EUR 15 per subscriber per month – a level that many subscribers around the world are prepared to pay (see Figure 3) – these studies have found that earnings before interest, depreciation, taxation and amortization (EBIDTA) are typically more than 50 percent and earnings before interest and taxation (EBIT) are more than 40 percent. For these figures we refer to PRTM management consultants. Rollout costs for WCDMA/HSPA have typically been split between mobile broadband and terminal

voice and data traffic, putting mobile broadband profitability on a par with that from voice.

When taking into account that the incremental cost of delivering mobile broadband per subscriber is less than EUR 3 per month for 3GB of data, the business case is clear. This explains the current shift in focus from the corporate market to the mass market for mobile broadband services, repeating the pattern seen with mobile voice services in the early 1990s.

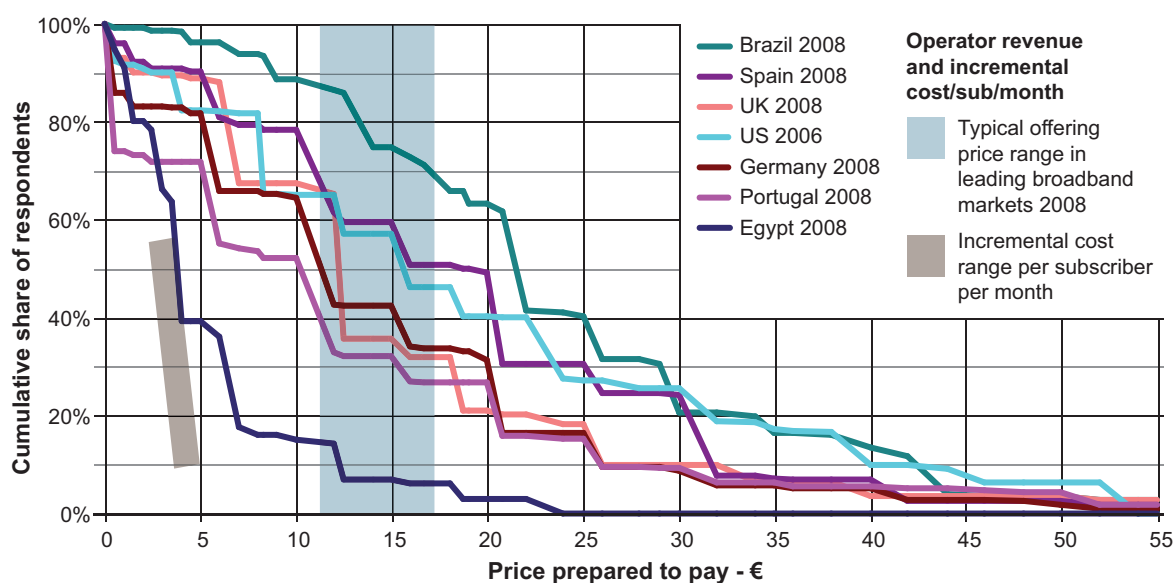


Figure 3: Consumers' willingness to spend on mobile broadband across seven markets. The coexistence of GSM, WCDMA and HSPA makes mobile broadband affordable for everyone.

## LTE – the first true global standard

LTE has been designed for smooth introduction into existing networks, continued low total cost of ownership and long-term investment protection. WCDMA operators are likely to introduce LTE in high-capacity areas from the end of 2009. 3GPP2-aligned

operators with CDMA2000/EVDO networks are likely to introduce LTE sooner, as these technologies will not offer the same speeds as WCDMA/HSPA (see Figure 4). Sweden, the US and Japan are among the first adopters of LTE.

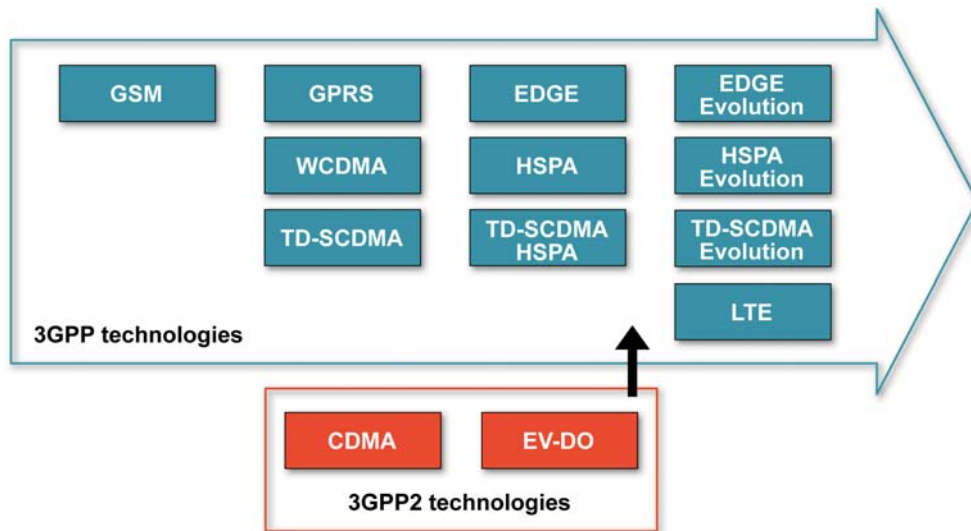


Figure 4: 3GPP and 3GPP2-aligned operators can evolve to LTE

LTE is an excellent complement to WCDMA/HSPA networks: the WCDMA/HSPA network provides wide-area coverage for mobile broadband and LTE technology can be used to enhance data performance in selected parts of the network. The HSPA network can be evolved over time through the addition of new software features that deliver higher bit rates and lower cost per Gigabyte and month.

As HSPA and LTE data traffic performance is comparable initially, operators are free to

take factors other than technology into consideration when planning their rollout.

These include long-term total cost of ownership, investment protection, revenue-generation potential, availability of competitive devices, flexibility, simplicity of operation and compatibility with other technologies. Ericsson provides services that support operators to evolve their networks in the most cost-efficient way and fulfill strategic and business targets.

## Managing interworking across systems for service continuity

Operators need solutions that help them manage traffic across all three networks to: maintain service continuity by reducing dropped calls; avoid congestion; position emergency calls; and focus investments where they will provide the best return.

The comprehensive toolbox of tried and tested hand-over mechanisms used to manage traffic between GSM and WCDMA networks will continue to be applied. This includes mechanisms such as idle-mode camping to distribute users to the WCDMA or GSM network they are most likely to be served by, and hand-over between WCDMA and GSM when coverage is being lost or there is a lack of capacity. Many operators push voice traffic to the GSM domain to, for example, extend handset battery life.

The WCDMA experience highlights the

importance of enabling interoperability with wide-area coverage networks to ensure fall-back when evolving to the next technology. Further, the uptake of mobile broadband, primarily driven by HSPA capability, increases data traffic in GSM/EDGE networks. In this way, EDGE/WCDMA/HSPA will provide the wide-area coverage fall-back needed to ensure LTE can establish a foothold. At the same time, data traffic in EDGE/WCDMA/HSPA cells is expected to increase, stimulated by improved data performance from both LTE and HSPA Evolution. Mobility between LTE and CDMA has been incorporated in the 3GPP2 standard ensuring operators with CDMA2000/EVDO can also evolve to LTE and that there will be handsets to support the development.

## The importance of standards in device interoperability

Device interoperability is a prerequisite to creating a mass market, and is therefore key to success of the service. This requires a thorough standard that covers all aspects of device interfaces. The 3GPP family of standards provides a reliable design base and access to the worldwide market ensuring an abundance of terminals. Today there are more than 1000 HSPA devices available from at least 130 vendors.

Manufacturers of 3GPP-standards-compatible devices actively pursue interoperability testing and multivendor terminal verification, with a focus on verification of the generic interworking between the terminal and the network as they evolve.

## GSM, WCDMA and LTE: global coexistence for optimal voice and data

Once handset technology matured, coexistence of GSM and WCDMA technologies ensured mobile broadband became affordable and attractive. As the success of HSPA is now secured, the continuation follows by widening (through LTE and Edge Evolution) and deepening (higher bitrates on HS) the scope of coexistence.

Coverage and service quality are improved with EDGE Evolution, which provides data speeds up to 1Mbps in GSM networks. This contributes to a significantly improved internet user experience, in particular in areas where capacity has previously been lacking, such as deep indoors and in rural areas. What is more, corporate users will be prepared to pay a premium for a more reliable service.

LTE and LTE Evolution will initially offer data

speeds of 150Mbps and evolve to 1Gbps just four years from now. Existing mobile broadband networks based on WCDMA can already deliver 21Mbps. Network speeds will increase drastically as shown in Figure 5.

Depending on the operator's business strategy and existing infrastructure, a competitive data service can be rolled out incrementally while maintaining a high-quality voice service.

Ensuring optimal rollout and operation of seamless services across multiple generations of 3GPP radio networks is made possible through well-established interworking mechanisms, evolved radio networks, a common core network, innovative management solutions, efficient transport networks and multi-technology devices.

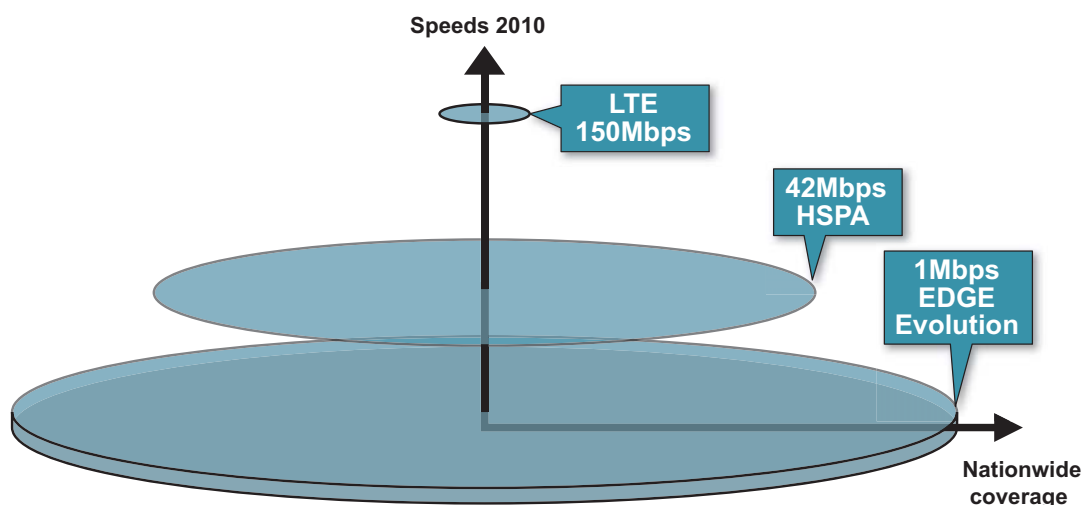


Figure 5: The benefits of coexistence in terms of coverage and data speed. Other benefits include handset price, availability and battery life.

## Common core network keeps it all together

The 3GPP-standardized common core network is designed for efficient deployment of both voice and data services over one or several radio access technologies.

Key features of the 3GPP common core network include support for voice, messaging and data services as well as mobility and security functions, as shown in Figure 6. The roaming capabilities supported in the core network have been fundamental to global uptake of 3GPP technologies, enabling any user to access services in virtually any country.

A common core network for all access technologies allows efficient sharing of network resources, increased operational

efficiency, and a smooth and financially sound migration path for mobile operators. It also simplifies deployment by enabling existing network equipment to be reused when new access technologies are introduced.

A common core network helps maintain a quality user experience, for both packet data and voice services, as users move between access technologies. Mobility use cases for packet data services include LTE core network support for interworking with CDMA access technologies. This enables 3GPP2-aligned operators to migrate to 3GPP network technology with the inherent benefits of economies scale and global roaming.

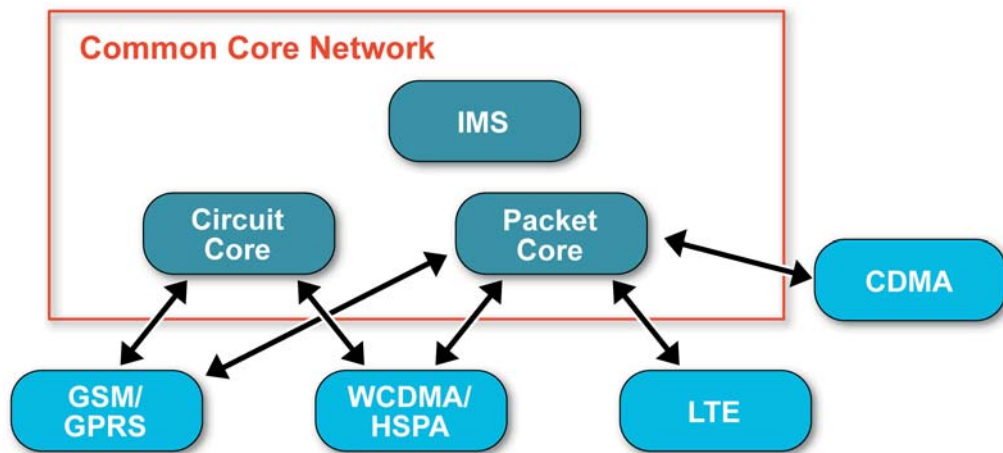


Figure 6: The common core network will enable roaming between GSM/EDGE, WCDMA/HSPA, LTE and CDMA.

## Shared transport: moving to an all-IP environment

While it might be possible to squeeze enough backhaul capacity from existing resources to deliver 3.6Mbps and possibly 7.2Mbps WCDMA/HSPA services, the next wave of 21Mbps WCDMA/HSPA will require a capacity upgrade.

Connecting IP base stations over Gigabit Ethernet backhaul is a very cost-efficient and future-proof way of delivering higher bandwidths. All-IP RAN over Ethernet solutions help operators achieve lower total

cost of ownership through greater flexibility and efficient aggregation, whether over optical, copper or microwave connections.

These solutions should enable mobile operators to absorb the traffic increase without increasing net backhaul costs. Typically, in a mobile broadband context, all-IP RAN over Ethernet solutions provide 20-30 percent lower total cost of ownership compared with TDM, especially as bandwidth demand grows.

## Evolved Radio Access Network

Innovation in 3GPP radio access network (RAN) technology solutions has brought about dramatic reductions in the capital and operating costs of rolling out, operating and evolving RANs through greater capacity and coverage, and more efficient use of energy and transmission resources.

Improvements in integrated circuit design and miniaturization over the past decade mean many times more subscribers can be served per cubic meter of equipment than with previous technology generations, enabling highly efficient GSM/WCDMA site sharing solutions.

This is highly significant when considering that site costs account for 75 percent of the capital expenditure associated with rolling out networks. In Western Europe, for example, there has been little need to create new sites when rolling out WCDMA networks, as sites for GSM already exist. What is more, bandwidth at these sites can be improved through a simple software upgrade to enable HSPA and HSPA Evolution. “Evolved RAN” solutions take this idea one step further. They include multi-standard, energy-efficient (GSM/WCDMA/LTE) radio base stations that can be dynamically reconfigured to provide GSM/EDGE, WCDMA/HSPA and LTE coverage, and new nodes that combine the functions of GSM base station controllers (BSC) and UMTS radio network controllers (RNC) in a common network controller.

Many operators are expressing a strong interest in multi-technology, multi-band radio networks of the kind enabled by Evolved

RANs. The key reason for this is flexibility: operators can keep their options open, whatever direction the market takes, without over investing in any individual technology.

By maximizing infrastructure reuse across multiple radio standards, an Evolved RAN protects operator investments for the long term. As many GSM operators will need to invest in new hardware in the coming years anyway, it makes sense for them to invest in common solutions.

Evolved RAN solutions will enable operators to continue to serve GSM customers efficiently while they build up their WCDMA/HSPA, and ultimately LTE, coverage and capacity without the need to make accurate predictions regarding the balance of future GSM and WCDMA/HSPA traffic in their networks.

Evolved RAN solutions help to reduce complexity as common, multi-technology equipment is much easier to integrate into overall network coverage plans. Spectrum efficiency is improved and, ultimately, having a common radio resource management solution will provide much simpler, more efficient control.

There are also significant potential cost savings in having “site in a box” solutions that offer much higher capacity per square meter – reducing site footprint, O&M, and transmission and power needs. In the longer term, Evolved RAN solutions reduce the number of platforms the operator needs to support and enables better utilization of skilled personnel.

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## Efficient management through automation, visibility and skills reuse

As operators manage multiple generations of radio technologies they will benefit from solutions that enable them to evolve their networks smoothly and effectively.

Properly implemented Operation Support Systems (OSS) enable operators to shift their focus from simply keeping the network running to putting more energy into seeing that it works well. They can increase the

productivity of operations staff by automating routine activities and increase return on investment by assuring the delivery of revenue-generating services and ensuring that assets are fully utilized.

With each successive step forward in mobile technology there has been a significant increase in the complexity of the systems to be managed – an issue the

industry is tackling by incorporating an intelligent-network approach in LTE standardization. This includes the integration of auto-provisioning and network optimization tools into domain management as they grow in importance in daily network operations.

But it is not just about new technology; effective network management needs a full network approach. The goal is not just to manage independent systems but also to manage the interactions between systems – whether in configuration, monitoring performance or fault handling. Increasingly this means managing both the network and service environments and having the ability to correlate service and delivery domains irrespective of the underlying technology.

In the multi-technology environment – and with an eye on fixed-mobile convergence – there is an increased focus on end-to-end visibility of network operations. This means having both the “helicopter view” and the

ability to drill down for detailed analysis.

Systems integration in a well-standardized environment can provide much of this cross-system interoperability, but there are clear advantages to a unified OSS approach with a common environment handling all three 3GPP technology generations.

There are generic advantages in having a simpler IT environment, reusing existing competence and increasing the network scope within the Network Management System domain. System-specific characteristics are handled near to the equipment, while information management, of all kinds, can be seamlessly consolidated across the entire network. Whether it is monitoring services, rolling out new capacity or tracking network loading, operators can gain a clearer view of what is happening. Better informed means better managed – which is good for both operators and customers alike.

# GSM, WCDMA and LTE will continue to coexist for many years to come

There are four key reasons the 3GPP family of standards will continue to be the dominant standards in mobile communications:

- They are strict standards that are supported by the majority of operators and vendors, so there is an abundance of terminals on the market (more than 1000 different HSPA devices from 130 suppliers, and more than 2000 device models with EDGE, as of December 2008).
- The evolutionary approach to introducing each new technology generation means that the latest standard offers full backward compatibility and fall-back coverage from day one.
- They cover the whole range of service development – from basic voice and SMS, through GPRS and EDGE data services, to mobile broadband with HSPA and LTE. What is more, GSM is still developing with new

services such as Wideband AMR for high-quality voice and EDGE Evolution for high-speed data.

- Successful CDMA operators are now joining the LTE track.

It is clear that the three generations of 3GPP radio technologies will continue to coexist for many years to come, and operators will need to manage these generations in parallel. Features such as multi-standard radio and increased integration of O&M systems support this requirement by, for example, enabling dynamic traffic load sharing across the different radio networks.

The strong business case for HSPA is simply another proof point in the continuing success of 3GPP standards, and prepares the way for exciting new possibilities for LTE.

# Glossary

<b>3GPP</b>	3 <sup>rd</sup> Generation Partnership Project
<b>AMR</b>	Adaptive Multi-Rate is a patented audio data compression scheme optimized for speech coding.
<b>BSC</b>	base station controller
<b>EBIDTA</b>	earnings before interest, taxes, depreciation and amortization
<b>EBIT</b>	earnings before interest and taxation
<b>EDGE</b>	Enhanced Data Rates for Global Evolution
<b>EUR</b>	euro
<b>EV-DO</b>	“evolution, data only” or “evolution, data optimized” or officially known as CDMA2000, High Rate Packet Data Air Interface. EV-DO is a standard for high speed wireless broadband.
<b>GPRS</b>	General Packet Radio Service
<b>GSM</b>	Global System for Mobile communications
<b>HSPA</b>	High-Speed Packet Access
<b>IP</b>	Internet Protocol
<b>LTE/SAE</b>	Long-Term Evolution/System Architecture Evolution
<b>NMS</b>	Network Management System
<b>O&amp;M</b>	operation and maintenance
<b>OSS</b>	Operation Support Systems
<b>RAN</b>	radio access network
<b>RNC</b>	radio network controller
<b>SMS</b>	Short Message Service
<b>TDM</b>	time division multiplex
<b>TD-SCDMA</b>	Time Division-Synchronous Code Division Multiple Access
<b>UMTS</b>	Universal Mobile Telecommunications System
<b>USB</b>	Universal Serial Bus
<b>WCDMA</b>	Wideband Code Division Multiple Access

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