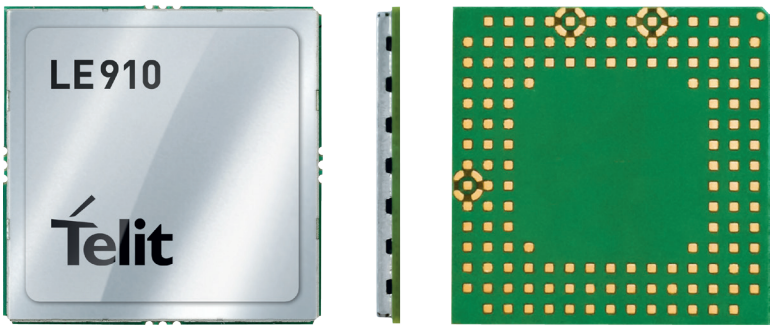
LTE & The IoT-M2M Environment

A white paper that examines the impact of 4G communications on the performance and functionality of an industry that is experiencing exceptional growth.



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ONE STOP. ONE SHOP.

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Summary

In this paper we consider the Internet of Things (IoT) to be a concept that is based on Machine-to-Machine (M2M) technology. A "thing" is any smart device that can acquire data and transmit it to a facility that processes it into actionable, real-time information. In some cases the device might pre-process the data. The resulting concept will be an environment having unprecedented functionality and a plethora of business opportunities. It will be populated with billions of devices that can communicate with each other in numerous ways, many of which cannot be foreseen right now. Tomorrow's world will be connected and in many if not most cases the functionality it provides will become an invisible part of our everyday experience. However, we will also see a dramatic change in our lives and the way we conduct business.

Rationale

The rationale for creating this paper is the fact that the importance of LTE (Long Term Evolution) is not widely understood and this is particularly true for M2M communications. For example, LTE (aka 4G) has been marketed by mobile network operators (MNOs) as a high-speed / low-latency service, which it is, but the network has far more bandwidth than most M2M applications need. However, these new networks employ OFDM (orthogonal frequency-division multiplexing), a method of digital modulation in which a signal is split into several narrow band channels having different frequencies. This allows bandwidth to be assigned in a very flexible way and in turn that will allow operators to offer cost-effective, low-bit rate services for use in M2M solutions.

In addition, LTE networks are significantly more efficient than those of earlier generations. They are based on a simplified, flat, all-IP architecture having open interfaces and an evolved packet core. This will result in a global infrastructure that can accommodate up to 10 times more traffic and that will facilitate the deployment of tens of billions of smart devices that are predicted for the Connected World.

In a nutshell, LTE is distinguished from earlier networks by a groundbreaking combination of efficiency and flexibility. This paper will examine the ground that is being broken and the benefits that result, but first we need to define the network terminology.

LTE is marketed as 4G: marketed that way because technically it's 3.9G. LTE-Advanced (LTE-A) is the real 4G because it meets the ITU's requirements for fourth-generation wireless systems. These requirements are known as IMT-Advanced and the performance targets they set include a peak download traffic data rate of 1 Gbps and an uplink rate of 500 Mbps. LTE Release 8 already supports rates of up to 300 Mbps in the downlink and 75 Mbps in the uplink.

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Overview

Cellular networks have transitioned from circuit-switched 2G through to packet-switched 3G, 3.5G (HSPDA) and 3.75 G (HSPDA +), but 4G represents a quantum-sized step involving larger bandwidths and next generation technology like OFDM. Larger bandwidths enable LTE's high-speed performance, which has been optimized in order to deliver low-latency traffic. That combination was the design objective and that is the way operators have been marketing LTE / 4G services, the target audience being consumers who want to download video to their smartphones and tablets. To date, M2M usage has focussed on high bandwidth applications such as emergency response, security video and automobile entertainment.

Machina Research indicates that over 99% of the wireless M2M connections in 2013 employed 2G and 3G networks, the split was 60% / 40% but this figure is set to change dramatically. By 2018 2G will fall to 20%, 3G to 50% and 4G comes in at 30%. By 2022 it will rise to almost 70%, the majority of the traffic coming from cost-effective low-bit rate services that will serve the Connected World. Factors that will drive this transition include:

- Decommissioning inefficient 2G networks and refarming the spectrum,
- Rapidly expanding 4G network coverage,
- The order of magnitude increase in traffic capacity,
- New LTE-based modules having an improved design and lower prices.

In addition, a key feature of LTE technology is the efficient use of spectrum, a precious commodity, and in time this will translate into lower operating costs for MNOs. That will result in lower tariffs for users because:

- Operators will need to monetize their investment,
- Traffic levels will soar as we enter the IoT era.

Market perceptions

When market pull coincides with technology push the result is an inflection point — a turning point in the economy after which significant changes take place. Andy Grove, Intel's co-founder, described a strategic inflection point as „an event that changes the way we think and act."

LTE's inflection point can be attributed to the faster than expected rollout of networks around the world. At the time of writing, Q2 2014, 263 networks were in commercial operation in 97 countries and 154 manufacturers have announced more than1.500 LTE-enabled user devices. In 2013 742 new devices were introduced: this represents a 90% annual growth.

This will change the perception that 4G is just another advance in wireless data rates. LTE is much more than a high-speed network: the data rates on HSPDA+ networks are more than adequate for most M2M applications. Nor will coverage be limited to urban areas, another early perception. Instead LTE is set to become a common technology standard that will enable economies of scale and provide global roaming. It will have a significant impact on our personal and business lives: on the way we think and act.

Market drivers

LTE is the first network technology that can comfortably accommodate demanding applications like real-time video surveillance and at the same time provide cost-effective connectivity for low-speed applications. Therefore although these apps have widely different performance requirements, the market will be able to build a wide-ranging ecosystem on a single, wide area communication technology. Moreover, LTE has or will have everything

going for it: superior performance; ubiquitous connectivity; scalability (enabled by support for IPv6); low cost per bit, delivery of whatever QoS customers require, and longevity (MNOs are or will be retiring older network types). The only significant issue is the operating band, which varies from country to country. However, 1800 MHz is the best-supported frequency, with more terminals able to operate in this band than in any other.

Build a much better network and the market will beat a path to its door.

An overlooked feature is the fact that LTE networks will fallback to an earlier generation network if the attached device cannot detect a 4G signal. This will ensure that the automotive on-board platforms that deliver a simultaneous array of entertainment, traffic, navigation, maintenance and safety features will continue to provide services when there is no LTE coverage.

Market enablers

Multi network type support is provided on the company's LE910 and LE920 series. The former, which currently has initial variants for North America and Europe, comprises 3GPP Release 9 compliant modules designed to expedite migration to 4G for existing designs, including those already based on 2G or 3G members of the xE910 family.

The LE920 Series also combines two high-speed cellular modes: LTE delivering 100Mbps downlink and 50Mbps uplink data rates and full fallback compatibility with HSPA+. With 2.5G quad-band support, LE920 modules are also fully backward compatible with existing GSM/GPRS networks, which enables connectivity in remote areas where there is no 3G coverage. The series comprises band-combination variants designed for the market requirements in North America and Europe. Solutions for Australia, Korea and Japan will follow.

Future-proof solutions

The fallback feature is important since it allows companies to future-proof their solutions. Companies that recognize that LTE technology will be the global standard and who are marketing solutions that will stay in place for many years cannot rely on the longevity of earlier networks. We know that 2G is being decommissioned in the U.S. and other countries will follow. Moreover companies whose solutions have long life times, ten years or more in key segments like automotive, cannot rely on 3G since it too might reach decommissioning status within this timeframe. Therefore employing a combination of LTE and HSPDA+ is a sound business decision, one that looks forward to the network technology roadmap.

The LE920 goes further by providing backward-compatibility with existing EDGE and GSM/GPRS networks to ensure that connectivity will be maintained even in remote areas where there is no 3G coverage and GSM/GPRS/EDGE is available.

Total cost of ownership

Mitigating the risk of betting on an established cellular technology makes sense, but LTE modules cost more than 2G and 3G modules. That's inevitable. LTE is a relatively new development and the technology is more complex, e.g. support is needed for the different channel bandwidths. In addition, manufacturing volumes are low at this early stage. Costs will go down in future, that's a given, and we have every reason to expect that LTE's low data rate services will be competitive, but the timeline is not clear.

Companies will therefore need to balance an initial higher bill of materials cost against potentially lower operating costs and also factor in the lifetime of the solution in order to determine the total cost of ownership (TCO).

When decisions are made based solely on purchase price, then there may be a need to reinvest in application development and support services in order to upgrade devices in order to match sales growth. In a TCO evaluation the ability to ramp and scale easily with no additional investments has an enormous net present value impact, one that offsets disadvantages in purchase price of the module. However, studies by the GSMA indicate that the cost of hardware is only around 15% of the average TCO.

Telit and other leading module vendors are developing less expensive ways of deploying and managing M2M apps in order to reduce the TCO. That was a short take on a mission-critical issue. It is covered in detail on the **Telit Web site.**

The U.S. market

There is a logical transition from 2G GSM networks, but in the U.S. an alternative cellular technology, CDMA, was introduced. Sprint, Verizon and U.S. Cellular adopted CDMA. AT&T and T-Mobile used GSM. CDMA had superior data rates for some time, but GSM became a global standard and the network equipment providers stopped developing technology. Therefore in order to stay competitive the CDMA operators had to make a forklift upgrade and Verizon Wireless, for example, now provides LTE coverage in over 97% of the USA.

3GPP Release 10

Although marketed as a 4G wireless service, LTE (as specified in 3GPP Release 8 and 9) did not meet the ITU-Advanced specification. A more accurate, but somewhat clumsy term is 3.9 G. LTE-Advanced is the version of LTE that addresses IMT-Advanced requirements, as specified in Release 10. LTE-Advanced is both backwards- and forwards-compatible with LTE.

Release 10 allows the radio interface to be configured with up to eight carriers, of any bandwidth, including different bandwidths in any frequency band. This is the way that bandwidth can be assigned in a very flexible way and it is the cornerstone technology that will allow operators to offer cost-effective, low-bit rate services for use in M2M solutions.

Fine tuning low-speed performance

As indicated earlier, LTE employs large bandwidths in order to deliver high-speed, low-latency traffic. That was the primary objective and at the design stage the network equipment providers would not have foreseen the potential of relatively low speed M2M communications on an LTE network. This means that high-speed performance was optimized; low speed was not. There are no intrinsic issues; OFDM has the requisite functionality. The air interface can be split into several narrow band channels having different frequencies. Release 8 permits channel bandwidths of 1.4, 3, 5, 10, 15, and 20 MHz with no fundamental change on the radio architecture. Allowing bandwidth to be assigned in a very flexible way makes it ideal for M2M and IoT applications.

However, while the process works, performance is not optimized. Various standards bodies are working on improving the LTE protocol as well as providing support for next-generation low-cost devices that are less complex. Congestion at cell sites is another issue that standards bodies are addressing as well as mobility management functions like longer sleep cycles.

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Conclusions

LTE did take a long time to evolve, which is not surprising given the high performance and functionality bar that was set by 3GPP, but network deployments are proceeding at a much faster rate than originally predicted, as is the availability of LTE-compliant devices.

LTE is distinguished from earlier networks by a groundbreaking combination of **efficiency** and **flexibility.** The efficient use of spectrum will lead to lower costs and the ability to combine high-speed, low-latency transmission with a range of cost-effective low bit rate services.

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For a quicker and more rewarding integration experience join the Telit Technical Forum. There you can browse the first open forum covering all m2m topics, get direct support by region (EMEA, North America, Latin America, APAC), take part in this quickly growing m2m community and exchange experiences.

Telit Communications S.p.A.
Via Stazione di Prosecco, 5/B
I-34010 Sgonico (Trieste), Italy
Phone +39 040 4192 200
Fax +39 040 4192 383
E-Mail EMEA@telit.com

Telit Wireless Solutions Inc.
3131 RDU Center Drive, Suite 135
Morrisville, NC 27560, USA
Phone +1 888 846 9773 or +1 919 439 7977
Fax +1 888 846 9774 or +1 919 840 0337
E-Mail NORTHAMERICA@telit.com

Telit Wireless Solutions Inc.
Rua Paes Leme, 524, Conj, 126
05424-101, Pinheiros
São Paulo-SP-Brazil
Phone +55 11 3031 5051
Fax +55 11 3031 5051
E-Mail LATINAMERICA@telit.com

Telit Wireless Solutions Co., Ltd.
8th Fl., Shinyoung Securities Bld.
6, Gukjegeumyung-ro8-gil, Yeongdeungpo-gu
Seoul, 150-884, Korea
Phone +82 2 368 4600
Fax +82 2 368 4606
E-Mail APAC@telit.com

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