

Overview

A flurry of companies including large and small, well established and start-ups have entered the Internet of Things (IoT) race to market. These companies include stalwarts of the wireless infrastructure industry such as Ericsson, Huawei, and Nokia as well as established silicon companies such as Intel and Qualcomm. There is a growing number of companies who are actively working on IoT use cases in vertical markets from Education to Agriculture, from Automotive to Robotics, to name just a few of the opportunity areas being addressed. The market is anticipated to grow rapidly over the next 5 years based on 3GPP technologies such as enhancements for Machine Type Communications (eMTC), Narrow Band IoT (NB-IoT) and EC-GSM-IoT, which in combination with Power Saving Mode (PSM) and Extended Discontinuous Reception (e-DRX), makes GSM/EDGE markets prepared for IoT.

In an interesting industry development in March 2016, the Ministry of Science, ICT and Future Planning (MSIP) of South Korea announced it would adjust the output power in the unlicensed 900 MHz band from the current 10mW to 200mW as an effort to stimulate the emerging IoT-related industry.

This is just one example of how IoT is impacting the mobile industry and GSA will follow, record and publish the progress that IoT and in particular NB-IoT technology will have on the wireless industry and new vertical markets.

NB-IoT Forum

The foundations for the GSMA NB-IoT Forum were laid down in a preparatory meeting, chaired by Vodafone, in November 2015. The forum was created to promote NB-IoT technology and to facilitate industry trials and pilots. The GSMA NB-IoT Forum has been formally adopted by the GSMA and is now part of the Connected

24 Operators are committed to deploying NB-IoT

7 Commercial and 3 trial Cat-1 Networks have been announced by Operators

2 Cat-M1 Networks are being trialled with one planned

9 Operators are trialling pre Cat-NB1 standard networks

20 Commercial NB-IoT Networks are forecast by end of 2017 - GSA

NB-IoT Technology Status

Living programme's Mobile IoT industry initiative. Current members include ARM, Bell Mobility, China Mobile, China Telecom, China Unicom, Deutsche Telekom, Etisalat, Ericsson, Huawei, Intel Corporation, KDDI Corporation, KT Corporation, LG Electronics, MediaTek Inc., Mobileum, Nokia, NOS, NTT DOCOMO, Oberthur Technologies, Qualcomm, Sequans Communications, Safaricom, Sierra Wireless, SK Telecom, TDC A/S, Telecom Italia, Telefónica, Telit, Telstra, Turk Telekom, Two Degrees Mobile, u-blox, Verizon Wireless, Vodafone and ZTE Corporation. Vodafone's R&D director Luke Ibbetson is chair of the GSMA NB-IoT Forum.

The GSMA NB-IoT Forum aims to:

- Facilitate demonstrations and proof of concept trials which strengthen the NB-IoT solution to meet LPWA (Low Power Wide Area) requirements;
- Lead partners to build a strong end-to-end industry chain for NB-IoT future growth and development;
- Drive and proliferate NB-IoT applications in vertical markets for new business opportunities;
- Promote collaboration between all NB-IoT industry partners to ensure interoperability of solutions.

The creation of five NB-IoT labs to focus on new NB-IoT service innovation, interoperability testing and product compliance and certification have also been announced by China Mobile, Etisalat, LG Uplus, Shanghai Unicom, Telecom Italia and Vodafone. Vodafone and Huawei opened the first NB-IoT Open Lab at Vodafone's headquarters in February 2016.

For more information about the Mobile IoT and the GSMA NB-IoT Forum please visit www.gsma.com/connectedliving

NB-IoT is part of 3GPP Release-13. The Release was frozen in March 2016 although the finalization of NB-IoT has been extended due to the workload. The NB-IoT standard part of Release-13 should be completed by June 2016, following the plenary meeting during the week of 13th June. This report will be updated following the output of that plenary meeting as needed.

Two new UE Categories have been defined in Release-13, Cat-M1 and Cat-NB1 (Previously referred to as Cat-M2). Cat-1 already exists from Release-8 and Cat-0 was introduced in Release-12. Operators are mainly focusing on Cat-1 for Machine-to-Machine (M2M) use cases for the moment, especially the ones requiring higher data rates, QoS or voice. There currently appears to be limited industry appetite for Cat-0.

There are on going discussions in relation to radio technologies to meet the very low power consumption requirement for NB-IoT, and M2M communications as well as ways to reduce the burden on the network from the anticipated huge number of IoT endpoints expected over the next 10-15 years. These potential enhancements are expected to be part of the input to Release-14 but have yet to be decided on or defined.

The ultimate objective of the NB-IoT work is to deliver a specification that enables less complex User Equipment (UE) with reduced bandwidth, reduced transmit power, reduced support for downlink transmission modes, ultra-long battery life via power consumption reduction techniques and extended coverage operation to support low coverage use cases such as meters or sensors in buildings, basements or in remote locations.

Customer pilots using pre-NB-IoT technology are already underway – see Operator Trials section. Pre-commercial deployment based on the 3GPP Rel-13 standard is expected during the second

half of 2016, with first commercial roll-out from early to mid 2017.

Spectrum

Indoor penetration and rural coverage are key factors for NB-IoT applications and although the NB-IoT specification should provide an additional 20 dB of coverage, initial feedback from the industry is that the devices supporting spectrum in the sub 1 GHz band is the initial priority.

The Ericsson EC-GSM-IoT trial with Orange in France in Paris (Nov-15 to Feb-16) used the operator's 900 MHz spectrum.

KT have launched a Cat-1 network at 1800 MHz. It remains to be seen what band the operator will use for NB-IoT.

First NB-IoT products and trials are initially expected to use the 900 MHz and 800 MHz bands and in some cases 1800 MHz. GSA will be actively following the debate on NB-IoT spectrum usage.

Operator Trials

GSA believes that most of the Tier 1 operators have Cat-1 capable networks although all may not yet be promoting Cat-1 or M2M services.

AT&T:

Ericsson is working with AT&A to roll out a new NB-IoT software solution (Network Software-17A) that runs over existing LTE networks and introduces power-saving functionality for NB-IoT and LTE-Machine type communication (LTE-Cat-M1) offering more than 10 years of device battery life.

The proof of concept demo and field trial for NB-IoT and Cat-M1 is planned for 2Q2016.

Network Software-17A, which is slated for commercial availability in the fourth quarter of 2016, should extend coverage for NB-IoT in order to hit remote and deep indoor areas by adding up to 20 dB coverage improvement.

China Mobile: CMCC

In December 2015 China Mobile and Ericsson signed an MoU covering an extensive range of 5G research and development cooperation including NB-IoT. As part of this agreement, Ericsson jointly demonstrated connected sheep/livestock tracking utilizing pre-NB-IoT technology at China Mobile's booth during MWC 2016.

At the China Mobile Global 5G event on 31st May, 2016, ZTE demonstrated an early iteration of NB-IoT in the CMCC Shenzhen 5G innovations lab. CMCC demonstrated a virtualization (NFV)-based virtual core network.

China Mobile has been following the 3GPP NB-IoT standardization process and a large-scale trial is planned for the 4Q 2016 with commercial service expected from early 2017.

China Unicom:

In May 2016 Ericsson announced it had signed a Memorandum of Understanding (MoU) with China Unicom to collaborate on network architecture including Internet of Things (IoT) around Mobile cellular IoT network end-to-end solutions and services.

At the National IoT Technology and Application Conference held at the end of May 2016, Tian Wenke, general manager of customer department of China Unicom, said they will conduct large-scale NB-IoT networking field trials and business demonstration based on 900 MHz and 1800 MHz this year.

China Unicom has been trialling pre-NB-IoT in Disneyland Shanghai and has announced it is planning large-scale NB-IoT field trials in more than five cities with the objective to start commercial service by the end of 2016. The company is aiming for full nationwide NB-IoT coverage by 2018. Trials will start in the 900 MHz and 1800 MHz bands.

Deutsche Telekom:

Deutsche Telekom (DT) and Huawei were the first to announce a field trial of pre-NB-IoT in October 2015. The field trial took place in Bonn, Germany, and DT and Huawei were able to evaluate the capabilities of this early version of NB-IoT and test the usability for an application to provide smart parking. The field trial focused on verifying the performance of the technology in a variety of challenging, actual deployment scenarios.

Huawei provided the equipment and software upgrade to the Radio Access Network (RAN) and the trial was run over licensed spectrum where the network communicated with sensors. The field trial focused on verifying the performance of the technology in a variety of challenging, actual deployment scenarios.

EE:

In September 2015 EE launched its Connect Platform to offer dedicated services for large-scale M2M and IoT installations.

Etisalat:

In April 2016, the United Arab Emirates operator Etisalat and Huawei announced a successful trial of pre-NB-IoT smart parking in a live network in both Abu Dhabi and Dubai.

Korea Telecom - KT:

KT has launched a commercialized nationwide LTE network that offers IoT/IoST (Internet of Small Things) services, to leverage its legacy LTE network. The Cat-1 network launch followed lab testing in October 2015 and a Cat-1 demonstration in commercial network in Daejeon in November. The nationwide LTE Cat-1 network is deployed at 1.8 GHz across over 110,000 base stations nationwide.

KT said it will supply 100,000 Cat-1 LTE-M modules, developed in cooperation with Telit, TechPLEX and AM Telecom, to service providers

for free and without any service charges until the end of 2016.

KT will also work to commercialize NB-IoT during 2017 since it is more specifically designed for IoT, anticipating there will be 4 million IoT connections by the end of 2018. The company said it would invest KRW 150 billion (USD\$ 131 million) in NB-IoT-focused network, device and ecosystem development by the end of 2018.

LG Uplus:

In March 2016, LG Uplus (formally known as LG Telecom) also made public that it is releasing an IoT-specific LTE module co-developed with LG Innotek, and will be rolling out an IoT solution featuring their module by the end of the first half of 2016.

Orange:

In November 2015, Ericsson announced it was trialling a pre-standard NB-IoT network as well as Extended Coverage GSM (EC-GSM) with Orange in the operator's 900 MHz frequency band.

The three main areas of exploration were to examine how to improve indoor coverage, cut the cost of IoT devices and extend battery life.

Orange has been deploying LoRa, a proprietary Low Power Wireless Access (LPWA) technology. It is however widely expected that Orange will eventually adopt NB-IoT as its preferred LPWA solution.

SK Telecom:

SKT, Sony Mobile and Ericsson conducted lab testing of key functionality of LTE Cat-1 and Cat-M1 in the Ericsson radio labs in Kista, Sweden in September 2015. The tests evaluated the reduced complexity and potential impact on cost reduction of devices and battery life.

In March 2016, SK Telecom revealed a plan to

build what it refers to as the Internet of Small Things (IoST). The initial IoST network will be based on an independent LoRa LPWA network and linked to the current LTE as its mobile backhaul.

Telefónica:

Telefónica has been building its partnerships for NB-IoT with companies like Accenture, Qualcomm, Geotab, Cisco, Telit, Ericsson, Nokia, Huawei, Intel and Amdocs and claims over 700 companies are part of its IoT Partner Program (IPP).

In the Mexico city of Guadalajara, Telefónica has provided a Smart City platform linked to a waste management service operator with 600 sensors in waste containers.

There is also an IoT R&D centre in Chile described as a “living experience” to field test IoT technologies.

The strategy is to offer the best connectivity for each IoT need, sector and application and Telefónica have deployed a Sigfox pilot network in Peru and Chile while also testing NB-IoT. There are commercial pilots with customers around livestock, agriculture, smart metering in urban areas and urban furniture (street lights for example).

Telecom Italia Mobile -TIM:

At MWC 2016, Huawei and TIM signed a Memorandum of Understanding (MoU) for the development of IoT solutions on NB-IoT technology. This followed on from initial collaboration in 2015 on the Huawei pre-standard NB-IoT technology.

TIM will also construct a NB – IoT Open Lab in Turin dedicated to research and innovation. The lab will represent an open platform for companies and developers to support and accelerate the growth of Internet of Things

services and the progress of industrial applications.

TIM and Huawei will carry out field trials on NB-IoT solutions together with partners from vertical industries, to promote the rapid improvement and deployment of NB-IoT technology into the market.

Telstra:

At MWC 2016, Ericsson announced a proof of concept demo and field trials of NB-IoT and Cat-M1 starting in Q2 2016 that would include Telstra.

Telstra have been running information sessions with some of its enterprise and government customers on Cat-M1 and NB-IoT using the demo set up that Ericsson used at Mobile World Congress earlier in 2016.

In February 2016 Telstra announced the launch of its Cat-1 network and this will be closely followed by the introduction of both Cat-M1 which will increase coverage and reduce device cost, and ultimately NB-IoT.

T-Mobile:

T-Mobile promotes its CAT-1 capable IoT network, in particular supporting GSM customers. T-Mobile US has a relationship with Wylless extending back to 2006 that has led to the creation of Porthos, an industry IoT management platform. Porthos hosts the connections of over 1,700,000 T-Mobile SIM cards utilizing 2G, 3G, and 4G wireless bands.

Türk Telekom

Türk Telekom signed an MoU on 5G with Nokia in April 2016 to also accelerate the development of 5G radio access network technology and the applications that will drive the Internet of Things.

The companies will work together on testing Internet of Things technologies for tracking, metering, smart cities, smart-home and latency-sensitive applications.

Verizon:

In October 2015 Verizon said it had 15 million-machine type consumer and business connections, which had generated over \$500m in revenue so far that year.

Verizon also said it would be launching a new IoT core in early 2016 that meets new IoT profiles at a much lower cost.

The recently announced Verizon ThingSpace easy web based platform for developers should make easy on-ramp of IoT applications for developers.

Vodafone:

Vodafone has been a strong supporter of Cellular IoT – now renamed Narrow Band IoT – and has been keen to ensure the reuse of existing RAN and transmission while using a separate dedicated and optimised core network with virtual network technology.

Vodafone already has a global M2M network and this will connect with the Vodafone NB-IoT access layer.

In December 2015, Vodafone Group, Huawei and u-blox announced the completion of a successful trial of pre-standard NB-IoT in Spain, sending an NB-IoT message to a u-blox module in a water meter. The improved penetration using NB-IoT made it possible to connect devices simply and efficiently using an established mobile network.

The pre-NB IoT trial used the u-blox SARA module and software and successfully implemented narrowband communications in the 900 MHz band.

In May 2016, Vodafone Australia revealed it had successfully carried out a pre-standard NB-IoT trial with Huawei at multiple sites in Melbourne's central business district and suburbs. The trial demonstrated significantly greater coverage in terms of distance and depth compared to those offered by existing 2G, 3G and 4G technologies.

NB-IoT would be able to penetrate two to three double brick walls enabling connectivity to be achieved with objects in places such as underground car parks and basements, something that is critical to many IoT use cases.

Vodafone Australia also reported they had achieved extended coverage during tests in suburban Melbourne of distances up to 30 kilometres.

During its Q1 group financial results presentation, Vodafone's CTO Johan Wibergh said the company aims to deploy NB-IoT at all of the company's 4G-LTE base stations by 2020.

Zain Saudi Arabia (Zain KSA):

Zain KSA signed a Memorandum of Understanding with Nokia to collaborate on a two year smart city initiative in Jeddah to include advanced networking technologies for the Internet of Things (IoT) expanding the utilization of small cells and Wi-Fi to ensure continuous connectivity throughout the city.

To ensure privacy and fulfil public safety requirements, the companies will place a strong focus on the reliability and security of the network.

Operator Cat-1 Network Deployments

Region	Operator	Status
US	AT&T	Commercial
US	Verizon	Commercial
US	T-Mobile	Commercial
APAC	Telstra	Commercial
APAC	KT	Commercial
Europe	EE	Commercial
MEA	Etisalat	Commercial
LATAM	Telefónica Mexico	Trial
MEA	Türk Telecom	Trial
APAC	LG Uplus	Trial 3-4Q 2016

Altair Semiconductor:

The Altair FourGee-1160 CAT-1 chipset has completed AT&T's ADAPT validation process and has been certified for deployment on Japan's KDDI network. The FourGee-1160 is designed specifically for IoT and M2M applications, such as wearables, vehicle telematics, smart meters and security applications.

Altair has also confirmed its IoT cellular roadmap includes CAT-1, CAT-M1 and Cat NB1 products.

In January 2016 Sony Corporation announced that it has reached an agreement with Altair Semiconductor and its major shareholders to acquire the company for US\$212 million.

AM Telecom:

AM Telecom in Korea make LTE modules, routers and modems based on their own chips. In 2014 they announced the AME5220 LTE IoT module that would be supplied to Softbank in Japan.

Encore Networks:

The Encore Networks EN-1000TM Cat-1 router is available to connect to the Verizon network in the US and is designed for Kiosks, retail point of sale, security panels and business continuity back-up services.

Gemalto:

At MWC in February 2016, Gemalto unveiled its Cinterion® M2M Cat-1 LTE wireless module with the ability to fall-back to 2G in Europe, Middle East Africa and to 3G in North America for areas where LTE connectivity is not yet fully available.

The Cinterion® Cat-1 LTE M2M module had been certified to connect to the Verizon network in the U.S.

Intel:

The Intel XMM 7115 modem will sample to customers in the second half of 2016 and is designed for integration with sensors, smart meters and other low power endpoints supporting peak data rates below 200 kbps and devices requiring extended battery life. Vertical markets that are applicable to the XMM 7115 are expected to be energy, agriculture and transportation.

The Intel XMM 7315 will support both the LTE Cat-M1 and NB-IoT standards and combines an LTE modem and IA application processor on a single chip. The XMM 7513 is ideal for low power and low cost endpoints that require wide-scale coverage supporting speeds up to 1Mbps (Cat-M1) and below 200 kbps (Cat-NB1). The XMM 7315 is planned for commercial delivery in 2017.

For applications and endpoints that are required in 2016, the Intel XMM 7120M supports Cat-1 M2M applications for low and high-speed connectivity as well as those applications that require voice. Optimized for size the XMM 7120M modem offers Cat-1 speeds up to 10 Mbps in the downlink and 5 Mbps in the uplink with optional fall back to 3G or 2G and assisted GPS. The modem will sample in Q1 2016.

MediaTek:

The MediaTek MT7687, MT7697 and MT7697D chip-sets are all based on an ARM Cortex M4F and are targeted at the Smart Home.

MT7687 - a low power, Wi-Fi System-on-Chip (SoC) launched in 2015 - allows home appliances and smart devices to connect to and be controlled through a home network. The MT7697 provides both Wi-Fi and Bluetooth connections for smart gadgets and wearables. The MT7697D offers dual band 2.4 GHz and 5 GHz support. The MediaTek MT7697 will be available in the first half of 2016.

At MWC MediaTek announced Orange would participate in their IoT Booster Program with the aim to market a family of MediaTek chip-sets with an Orange SIM Card or integrated with the Orange SIM Card in partner's modules.

The offering will include the price of connectivity structured for IoT needs. The ready-to-use IoT offer will allow professional developers to accelerate deployment of their connected objects onto the cellular network by removing the need to seek out complex arrangements for chipset and connectivity separately.

MediaTek has been following the 3GPP NB-IoT standardization process and will deliver solutions for low power and low cost devices that require wide area application supporting speeds below 200kbps (NB-IOT) in 2017.

NimbeLink:

NimbeLink is expanding its Skywire family of cellular modems with the addition of a 4G LTE Cat-1 embedded modem. This new product is specifically designed to bring 4G LTE capabilities to the Internet of Things (IoT) and machine-to-machine (M2M) applications.

Based on the Gemalto Cat-1 LTE chipset, the Skywire 4G LTE Cat-1 embedded modem has FCC and carrier-required end-device-certification.

Bands supported are band 4 (1700 MHz) and band 13 (750 MHz).

Oviphone:

Oviphone are a Shanghai based smart device manufacture of smart watches, smart health and smart location products. Oviphone have carried out field trials of a Narrow Band IoT smart watch using the u-blox SARA chipset platform. The first fully standards compliant NB-IoT smart watch is planned to be available at the end of 2016 with additional existing products that are GSM based, kids smart watch: pet tracker, which will be made

NB-IoT compliant during 2017.

Qualcomm:

In October 2015 Qualcomm announced its new range of modem solutions – MDM9207-1 for Cat-1 LTE connectivity and the MDM9206, which is suitable for LTE Cat-M (eMTC) and NB-IoT. The MDM9207-1 has been purpose-built for IoT applications like smart metering, industrial automation, security, asset tracking, wearables, and point-of-sale- applications that usually require high reliability and power efficiency.

The MDM9206 is engineered to support low cost-optimized solutions for low data rate IoT applications and with its low power profile will support the long term IoT goal of 10+ years battery life – depending on the application power budget.

The MDM9207-1 is anticipated to be available in the first half of 2016 while the MDM9206 will be available in line with the development of the ongoing NB-IoT work in 3GPP Release-13.

Quectel:

Quectel Wireless Solutions, a supplier of GSM/GPRS, UMTS/HSPA/LTE and GNSS modules, solutions and services, will launch its LTE Cat-1 module optimized specially for M2M and IoT applications in Q2, 2016. Samples of this module are available now.

Sequans:

Sequans is collaborating with Verizon on CAT-1 LTE technology. The company has provided its Calliope CAT-1 chipset platform for testing on Verizon's network for current M2M applications. The partnership has also been extended to support the Monarch Cat-M1 capable chipset platform that is in development and will initially address newer IoT applications, including wearables, asset trackers, smart meters, smart cities and industrial sensors.

In March 2016, Sequans announced the successful completion of interoperability testing of the Calliope Cat-1 LTE chipset with NTT DOCOMO.

Sierra Wireless:

At Mobile World Congress 2016, Sierra Wireless demonstrated their prototype Cat-M1 (eMTC) module with an Altair chip working via an Ericsson base station. Module size was 15 mm x 18 mm x 2.5mm. Sierra Wireless is committed to both Cat-M1 and NB-IoT but is focusing on Cat-M1 in the short term while waiting for the NB-IoT specification to be completed.

Sierra Wireless say operator interest in Cat-M1 is very strong in the US, in particular from AT&T and Verizon which looks like an early market.

Sierra Wireless say they are trialling Cat-M1 but have so far not made any announcements, although they are cooperating with smart meter vendors including Itron and SageCom.

Sierra Wireless have used Mediatek, Qualcomm and Intel chip-sets in previous products but are also investigating other silicon vendors for their LPWA modems.

The first Cat-M1 module will be commercially available in Q1 2017 while the first NB-IoT module will be available around 6-9 months after the standard is finalised.

Telit:

Telit will expand its family of xE910 and xE866 modules to include Cat-M1 and Cat-NB1. US operators are interested in Cat-M1 with Cat-NB1 likely to follow later in 2017. Interest in NB-IoT is coming mainly from operators outside of the US.

Altair provides the Cat-1 chip for the xE866 module, while the xE910 flagship module chip suppliers are Intel and Qualcomm; a decision on supplier for the LPWA versions of these modules

will be made during 2Q/3Q 2016.

In April 2016 Telit announce it had acquired several module product lines and IP related assets from Novatel Wireless Inc., including a product line based on Sequans LTE Cat 1 chipset.

The path from the current family of xE910 and xE866 will be extended to Cat-M1 and Cat-NB1. Cost optimisation is a product roadmap focus with customers looking for single digit \$ module pricing in 2017.

The LE866-SV1, LE910-SV1, LE910-NA1 modules have been developed for use with North American wireless network carriers, while the LE910-EU1 is for Europe, all leverage existing LTE technology aligned with carriers' plans to support the CAT-1 standard in their respective markets.

Telit is working with both Verizon and AT&T who are focusing initially on Cat-M1. Deployment with Verizon at Band 4 (1700 MHz) and band 13 (700 MHz) and with AT&T at bands 2 (1900 MHz), Band 4 (1700 MHz) and band 12 (700 MHz).

In Europe and Asia Telit expect Band 20 (800 MHz), Band 8 (900 MHz) and Band 28 (700 MHz) to be the main requirements.

Trials of Cat-M1 are expected Q3/Q4 of 2016 in the US with Verizon and Q1 2017 for AT&T. Commercial Cat-M1 service is planned for Q2 2017.

Support for European operators with Cat-NB1 will happen in Q2-Q3 2017 and a little later for Asia. Cat-M1 will follow after this.

The Telit LE866-SV1, an LTE Cat-1 module has been certified on Verizon's 4G LTE network. Its compact 15 x 25 mm footprint is targeted at wearable trackers, health monitoring devices and smart watches.

In May 2016, Telit received certification from AT&T for the LE910-NA1 dual-mode LTE CAT-1 IoT

module, with fall-back to 3G supporting bands 2, 4, 5, 12 and 13 as well as 3G bands 2 and 5.

Also in May, Telit announced its collaboration with M2M Engineering, a provider of communication solutions to the utility industry, with the goal to embed intelligence within individual remote meters, elevating them to real-time sensor nodes within the Smart Grid.

TechPLEX:

TechPLEX is a Korean chip manufacturer who are bringing to market, in 2016, a Cat-1 chipset. The TLC1250KT will support Band 3 (1800 MHz) and Band 8 (900 MHz) and be software upgradable from Release-10 to release 12 and 13.

u-blox:

The u-blox NB-IoT SARA-N range is a pre-standard Release-13 NB-IoT module that has been used for operator trials, including Vodafone in Spain and is the first of a series of NB-IoT modules u-blox will bring to market. Announced trials have mainly focused on smart metering solutions. The SARA-N series module form factor is 26 mm x 16 mm and 2.4 mm deep and is currently working in the 900 MHz band with the focus on testing out initial NB-IoT capabilities.

u-blox are using a chip from Hisilicon in the SARA-N module although the longer term objective would be to use an internally designed chip.

The next version of the SARA-N module with a software update should be available in Q3 2016. Engineering samples for customers should be available from Q4 2016 with commercial production from Q1 2017 – all dependent on the completion on the 3GPP Release-13 standard.

A world version of the SARA-N module should become available in 2017 covering the sub 1 GHz bands (900-850-800 MHz)– depending on operator demand.

The IoT ecosystem has multiple companies offering IoT platforms, usually as a service. In addition, many IoT start-up companies have developed their own platform and have sought to offer this to other IoT device manufacturers. The result is a very fragmented IoT platform ecosystem. The following is only a subset of platform companies offering their services to the IoT industry and will be amended continually in future when updates of this report are published.

Ericsson:

Since September 2015, Ericsson has announced a suite of new software products to accelerate the uptake of IoT, intended to remove roadblocks to mass-market IoT adoption by improving battery life, extending coverage and enabling low cost devices. Networks Software-17A supports millions of NB-IoT device connections per cell site. The new software products to existing network infrastructure will support fast roll-out of reliable, secure mobile connectivity.

In April 2016 Ericsson announced its IoT Accelerator, available as a service initially focused on public safety, utilities, transport and smart city applications. Ericsson regional business labs will support IoT ecosystem cooperation to develop solutions for rapid market delivery.

The Ericsson IoT platform includes data management, billing, device management, connectivity services and analytics. Planned expansion modules include a self-service portal, developer environment and software development kit. IoT Accelerator will leverage the Ericsson Cloud System to support hybrid cloud deployments and meet data sovereignty and security requirements. All main connectivity standards are supported and the Accelerator will leverage Ericsson's Cellular for Massive IoT software solutions, including support for NB-IoT,

LTE Cat-M1 and EC-GSM-IoT technologies for low power wide area applications.

Ericsson opened a Networked Society Lab in cooperation with the Brazilian Government in April 2016. The intent is to test new technologies and measure the positive impact of Internet of Things (IoT) projects including smart water, agriculture, rainforest protection, disaster prevention and monitoring applications.

Nokia:

Nokia demonstrated its NB-IoT technology at Mobile World Congress in collaboration with Intel and Vodafone Group. The demo showcased the network coverage enhancements and benefits of future NB-IoT services in both rural and urban scenarios, supported by NB-IoT enabled network equipment from Nokia and client device technology from Intel.

Tero Kola, head of Portfolio Management, Radio Networks at Nokia suggested that by 2020 there could be as many as 6.8 trillion daily connection requests from IoT end devices beyond simple metering applications.

Nokia combines radio and core networks, including Mobile Edge Computing, with Connectivity Management, Device Management and Application Enablement components, and includes end-to-end security. The company is also building a complete ecosystem and collaboration community around IoT.

The Nokia IoT portfolio includes radio for IoT, optimizes LTE and TD-LTE cell capacity and smartphone user experience. The Nokia network core for IoT is designed to drive down total cost of ownership for IoT solutions and allows for a business mix of high ARPC (Average Revenue Per Connection) and low ARPC IoT traffic. Connectivity Management helps operators manage the high numbers of connections from sensors and devices, especially when they use

SIM connections, and offers flexible deployment and selectable modules like billing, mediation and CRM. Application Enablement helps operators create customized IoT applications and services quickly and cost-effectively. The platform makes it easier to handle the complexity of these applications including managing devices, networks and systems.

In May 2016, Nokia and the Russian MTS Group signed a 5G collaboration agreement that included implementation of LTE-Advanced Pro features such as enhanced carrier aggregation and LTE-broadcast, coverage and capacity improvements using LTE-Unlicensed (LTE-U) and Licensed Assisted Access (LAA) and innovative IoT projects using Narrow Band Internet of Things (NB-IoT), LTE-Machine (LTE-M) and Extended Coverage GSM technologies.

Nokia are also promoting its mmWave small cells that can be deployed anywhere and deliver the low latency and flexibility critical to NB-IoT.

Kii:

Japanese Internet of Things (IoT) cloud platform provider has formed a strategic collaboration with KDDI of Japan for the Kii Cloud Platform Service (KCPS). The KCPS is a mobile app and IoT platform designed for enterprises to drive the next steps in IoT development and increase focus on the cloud in building the back-end support of these apps in Japan.

Initial Use Cases for NB-IoT

IoT and NB-IoT use cases are gaining momentum. The examples that follow are just a selection of some of the use cases that are being tested, trialled or commercialised.

Smart Agriculture/Connected Vineyard:

Ericsson, Intel and Orange have showcased how EC-EGPRS will address the challenge of extending coverage to difficult-to-reach indoor locations

such as basements as well as remote rural locations, such as vineyards and farms to extend the reach of NB-IoT technology.

Connected eBike:

Ericsson, Intel and Nokia have demonstrated an innovative bike tracking solution that utilises pre-NB-IoT technology to track the real-time location and status of eBikes through urban underground or even rural environments with lower signal levels.

Fleet tracking and Smart Grid monitoring:

Ericsson and Intel have demonstrated how Cat-M1 technology supports extended coverage in underground or rural areas for IoT applications such as fleet management and smart grid management.

Mobile IoT Water Meter:

Huawei, Neul, Vodafone and u-blox have demonstrated how pre-NB-IoT technology helps to provide real time usage information and fault management using live results relayed from Vodafone's Proof of Concept trial in Valencia, Spain.

Connected Consumer and Industrial Devices:

Sierra Wireless have a Cat-M1 solution for a variety of consumer devices, such as connected shoes, wearables and healthcare devices, as well as industrial devices, such as smart meters.

Pet Tracking:

Huawei and Vodafone have been working on using NB-IoT technology and location aware applications to make sure pets are kept safe and sound.

Soil Monitoring:

In Galicia, Spain, sensors are being used to monitor vineyard soil conditions to provide early

warning of disease and enable traceability from grape to bottle.

Goods labelling:

Retailers are linking smarter goods labelling with consumer behaviours and in-store displays, to measure footfall and deliver prompts about special offers.

Fault Monitoring:

Manufacturers are using increasingly sensitive connected monitors to enable more predictive fault monitoring, maintenance and planning of spares.

Asset Tracking:

Construction firms are using location sensors to track equipment usage, support planning and guard against theft.

Connected Cows:

Dutch start-up Sparked has fitted cows with wireless sensors that send a message to the farmer when an animal is sick or pregnant.

Telematics:

The UK vehicle breakdown company, RAC has installed M2M SIMs in its fleet of 1,700 recovery vehicles so it can understand its drivers' behaviour and cut fuel costs.

The SIM is contained inside a black box plugged into the vehicles' diagnostic port and sends data back to the company's offices for monitoring. The RAC has cut its annual fuel costs by 17 per cent – £500,000 – using M2M telematics in its recovery vehicles to encourage more fuel efficient driving behaviour.

Connected Sewers:

In Australia, Optus and Vodafone are trialling pre-NB-IoT technology in city sewers. The two operators and Huawei are partnering with South East Water for the trial in urban areas that include

Melbourne. The trial will see NB-IoT sensors placed on sewer manhole covers to inform city workers of unauthorized access, to reduce the risk of injury and damage to water assets. NB-IoT technology will also be fitted to rainwater tank management systems to monitor storage levels amid efforts to optimize storm water runoff and rainwater harvesting.

Information for producing this report is obtained from network operators, suppliers, company statements, press releases and briefings in order to confirm facts to ensure the accuracy of the report findings.

GSA strives at all times to ensure that the information provided is representative of the current industry status. The information is provided to GSA in good faith but cannot always be fully guaranteed. Therefore such content is provided without warranty in currentness, completeness or correctness.

Errors and Omissions Excepted.

Your comments about this report and updates are welcome by email please to info@gsacom.com

Further Information

For further information and to join the NB-IoT and broader IoT discussion join the GSA LinkedIn group at:

<http://www.linkedin.com/groups?gid=8358660>

Other GSA LinkedIn Groups

LinkedIn discussion groups managed by GSA

Global mobile Suppliers Association (GSA)

<http://www.linkedin.com/groups?gid=2313721>

APT700 band

<http://www.linkedin.com/groups?gid=4759091>

HD Voice (W-AMR)

<http://www.linkedin.com/groups?=&gid=3032759>

LTE1800

<http://www.linkedin.com/groups?=&gid=3129390>

LTE-Broadcast

<http://www.linkedin.com/groups?gid=7435919>

LTE Public Safety and Critical Communications

<http://www.linkedin.com>

LTE TDD

<http://www.linkedin.com/groups?gid=3978061>

LTE User Devices

<http://www.linkedin.com/groups?gid=4146472>

UMTS900

<http://www.linkedin.com/groups?gid=3031942>

Spectrum

<http://www.linkedin.com/groups?gid=8362083>

IoT and M2M (NB-IoT)

<http://www.linkedin.com/groups?gid=8358660>

LTE-U

<http://www.linkedin.com/groups?gid=8307556>

5G

<http://www.linkedin.com/groups?gid=5089259>

About GSA

GSA (the Global mobile Suppliers Association) is a not-for-profit industry organisation representing companies across the worldwide mobile ecosystem engaged in the supply of infrastructure, semiconductors, test equipment, devices, applications and mobile support services.

GSA actively promotes the 3GPP technology road-map – 3G; 4G; 5G – and is a single source of information resource for industry reports and market intelligence. GSA Members drive the GSA agenda and define the communications and development strategy for the Association.

Contact

Contact: GSA Secretariat



Email: info@gsacom.com

Tel: +44 1279 439 667



Fax: +44 1279 435 443

GSA website: www.gsacom.com

