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Narrow Band Internet of Things (NBIoT) a Game Changer for Cellular Industry

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ABSTRACT: In this paper NBIOT - A Game Changer for Cellular Industry examined the trends in the market for NB-IoT applications and discusses technology options that operators can select from in order to enter this new business Studies are conducted on the background, for IOT applications for narrow-band Internet of Things (NB-IoT). This Paper Primarily present NB-IoT general background, development history, and standardization. Then, presented the NB-IoT features through the review of current national and international studies on NB-IoT technology, where the focus on basic theories and key technologies, i.e., Connection count analysis theory. Delay analysis theory, Coverage enhancement mechanism, Ultra-low power consumption technology and coupling relationship between signaling and data. Future opportunity for India on the road to 5G Subsequently, compare several performances of NB-IoT and other wireless and mobile communication technologies in aspects of latency, security, availability, data transmission rate, energy consumption, spectral efficiency, and coverage area. Moreover, the paper investigates five intelligent applications of NB-IoT, including Smart cities, Smart buildings, Intelligent environment monitoring, Intelligent user services, and Smart metering. Finally, summarize security requirements of NB-IoT, which need to be solved urgently. The discussions aim to provide a comprehensive overview of NB-IoT, which can help to clearly understand the scientific problems and future research directions of NB-IoT and upcoming opportunity for India on the road to 5G. Keywords: Energy, distributed generation, management, grid, network, renewable.

Keywords: Internet of Things; NBIoT, 6LoWPAN, LPWAN, Sigfox, LoRa and cellular short-range communications such as ZigBee, Advanced Encryption Standard (AES), Application Programming Interface (API), Bluetooth Low Energy (BLE), General Packet Radio Service (GPRS), Industrial, Scientific, and Medical (ISM) Band.LTE, machine-type communication networks ,machine-type data traffic volume, home appliances, wearable devices, 5G networks, LTE-M, 3GPP, LTE-V2X.

I. INTRODUCTION

For about 10 years, the LPWA market has existed; it is not a new phenomenon. There are decentralized and non-Standardized current technologies (solutions) driving this sector, so there are shortcomings such as poor reliability, poor safety, high operating and maintenance costs. In addition, the latest overlay network implementation is complex. NB-IOT [1] overcomes the above-mentioned drawbacks with all benefits such as wide area uniform coverage, rapid enhancement of existing network, low power consumption guaranteeing 10 years of battery life, high coupling, low cost gateway, plug and play, high latency and high carrier-class network security, single enterprise platform management. Investment in the network can be significant and is very low. Initial investment in the network can be very substantial and there are very few additional costs. NB-IOT suits the specifications of the LPWA [2] market exactly, allowing operators to join this new sector. NB-IOT helps providers to operate traditional businesses such as Smart Metering, Surveillance, and also opens up new market possibilities, such as Smart City, eHealth, with ultra-low-cost ($ 5) modules and super networking (50K / Cell).

NB-IOT makes it possible for more items to be connected, but it is also a major challenge to handle the economic value of the resulting Big Data, operators can collaborate with related industries, they can also sell data in addition to selling connections. The world has never seen such a thing, and not even science fiction movies have predicted exactly that. We saw a drop in the ocean of what was going to happen, reaching us at the speed of lightning. As the revolutionary market is expected to be $19 trillion, and the Internet of Things (IoT) is coming, by 2020 50 billion computers will be connected to the internet, and by 2025 the Internet of Things (IoT) will be in full swing, however, this idea started from nothing.

Evolution from M2M TO IOT

IoT (Internet of Things) is the interconnection of Machine-to-Machine (M2M) technologies that facilitate the establishment of the "smart world" round us. Our world is becoming a hyper-automated society, from health monitoring to intelligent utility metres and self-driving aircraft to sophisticated logistics.

The transformation from M2M to IoT was an aggregating step, led by the change from a device-centric approach to a process-focused approach, as shown in Fig.1.

	Stage	Description	Comments
Device centric M2M	1	Reactive information	• Devices can be polled for information, or provide information according to a set timetable
	2	Proactive information	• Devices communicate information as necessary
	3	Remotely controllable	• Devices can respond to instructions received from remote systems
	4	Remotely serviceable	• Software upgrades and patches can be remotely applied
Process centric M2M	5	Intelligent processes	• Devices built into intelligent processes
	6	Optimised propositions	• Use of information to design new products
	7	New business models	• New revenue streams and changed concept of 'ownership'
	8	The Internet of Things	• Publishing information for third parties to incorporate in applications, control commands from diverse sources

Fig. 1. Hierarchy of evolution from M2M to IoT.

II. IOT MARKET SIZING AND FORECAST

IoT communications are oriented towards violent growth, as stated in the introduction of this essay. As an efficient IoT communication tool with increased mobile broadband reach, cellular networking is getting even more useful. While a large proportion of IoT communications would be fixed and short-range, cellular infrastructure is still projected to evolve as the IoT device technology of choice. Figure 2 displays Machina Research's anticipated overview of different wireless technology for IoT usage during the next decade, with a total of approximately 30 billion IoT connections.

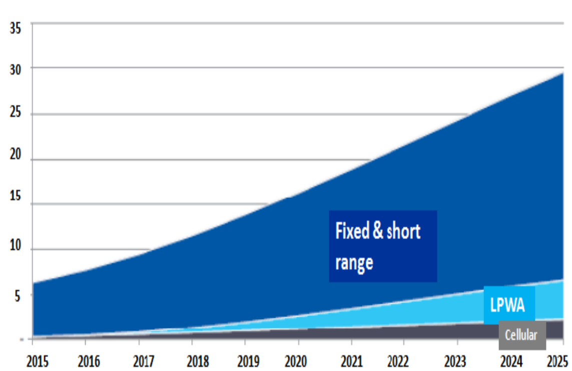

Fig. 2. Billion global connections, 2015-2025.

The GSMA forecasts that the overall number of wireless Internet connections in 2020 will hit close to 1 billion, of which 10 percent will be cellular IoT connections (Fig. 3).

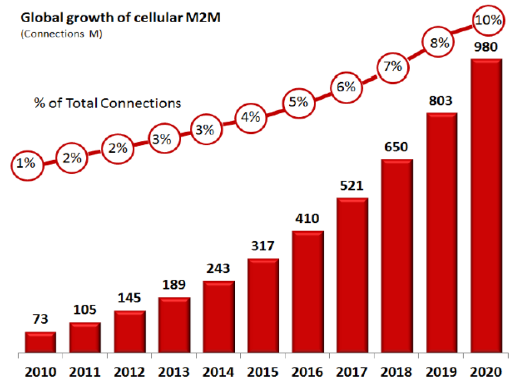

Fig. 3. Conservatively projected growth on cellular (3GPP and 3GPP2 based) IoT connections untill 2020. Billion Global Connections, Machina Research, May 2015."“12 Global Mobile Economy Report, GSMA, 2015”.

III. ARCHITECTURE OF IOT

Functional architecture of IOT is shown below in fig. 4.

Device/Gateway

A device like a laundry machine and a car has been incorporated into a network infrastructure which connected to a network via an IoT solution, allowing the machine to connect to a cloud services (the other 'IoT machine'), apps on other computers such as smartphones and tablets and other separate devices. The connectivity interface, like a network machine, may be linked with a short-range network, like WiFi, Zigbee and Bluetooth, to a local gateway, or it can be directly connected with a broad network, like a cell network. In comparison to the "Minority Report" or "Iron Man" form of interactivity, instead of wireless, the gateway device would be linked to the home by cables. All our machines must link locally to get linked in a local network and then it is connected to the wide-area network to get connected.

Access Network

The wide area connectivity network in IoT is often wireless, also in wired networks. The range of networks varies depending on the application requirements—whether mobility is necessary (e.g., will the mobile device operate without a wireless connection?) or whether private networks are required (e.g., a company can require that all of its devices have their own private IP address). As mobile wireless networks link users, more and more devices are coming to be linked to mobile cellular network. This helps these devices to become autonomous and to take on new rolesThe portable radio access network (RAN) is interchanged inside the mobile network between customer and IoT traffic. Historically (in the past), cell networks have been built with low latency, heavy consumer traffic and IoT optimisation not taken into account. Smart phones have faced significant connectivity problems, but in 2011 they began developing fast, broadband-capable technological solutions. Dev ices deployed deep inside buildings, such as in subways, basements or subway stops, that later decreases the cost of signalling traffic and devices, especially reduce the cost of batteries. Simultaneously, broad-based, IoT-optimized wireless networks are created.

Mobile Core Network

In the 3GPP specification on the IoT framework, the mobile core network support functions are not specified. There are two main forces at stake, one being the newest mobile telecommunication standards (3GPP) and the other being the implementation in the mobile core network of software-defined networking(SDN) and network function virtualization(NFV) technology that will provide new features that will be more readily available to a multitude of uses cases, such as IoT. The 3GPP MTC offers applications for IoT for both the cellular and the non-cellular world. The cellular fits in the short code environment, and the non-cellular environment is ideally suited for low complexity and low power use. It is also suited for small data transfer [5].

SDN and NFV technologies enable a modular and software-driven core network design in which the core network can be slid and scale dynamically, according to the event, types of devices and other parameters. NFV and SDN technologies enable a modular and software-driven core network design in which the core network can be slid and scale dynamically, according to the event, types of devices and other parameters. This network operator feels it is likely that a network that is able to build mobile core instances for certain use cases rather than one network that has been designed to match all existing scenarios. I assume that wireless convergence and the coexistence of physical network characteristics with cloud computing will lead to the advances of the next generation of telecommunications, which will be mobile, agnostic and software-based, providing access to nearly every data and/or service.

Connectivity Platform

A low IoT (ARPU) average and a variety of core needs, including the need of bulk provision, have allowed telecommunications operators to reduce running costs by creating a network for the resolution, activation, deactivation and connectivity issue of SIM provision. There was a tremendous degree of consistency in the rating criterion for IoT dependent on the terms and conditions of the deal and the use of the nice. Typically, the networking device can have rating system unique for the operators charging system. The collaboration system most frequently includes a middleman who creates and manages data-exchange between users and applications. The data communication server may be used as part of the application platform.

Firmware patches, configuration and diagnostics, and device life cycle support are included in the management platform.

Application Platform

In IoT solutions, an Application Development and Execution Platform (ADEP) is used to create and execute the application. The IOT applications will be built and operated via the application framework. It contains the essential core functions that every programme would have: gathering, storing and transmission of data and introduction of valuable knowledge to the users of the application. As part of the platform, the messaging server, rule engine and database is part of it. Asset maintenance including property management and decommissioning are assured through network infrastructure or a SIM. the essential requirements of every programme is to obtain, preserve and process data and present the valuable knowledge to consumers. The framework comprises a messaging server, rule engine and data storage. The administration of Resource management including the boarding and decommissioning of properties is performed and communicated through cell phones. This would be one of the creation layers of the IoT. Application Program Interfaces (APIs) are provided to render the platform services more user-friendly. Most of the accounting and finance systems such as ERP are integrating cloud or on-demand services.

IV. CHALLENGES

The way the Future views data security and safety can very much alter the Internet of Things (IoT). There are possible dangers that you might face if you have used a computer. They involve any piece of equipment that captures, manages, holds, or transmits any useful data. The study showed that seventy percent of the most popular and most utilised internet of things devices have access vulnerabilities in protection. Here are the specifics on HP's results on the top ten protection threats that they identified in IoT devices.

- Quickly render vulnerable network services.
- The lack of travel encryption.
- Privacy problems surrounding unstable web interfaces.
- An invalid account or password was given.
- Device initialization and activation is really challenging.
- Is unreliable tech.
- The hospitals lack sufficient protection.
- A insecure cloud link
- An unreliable smartphone interactivity.
- “28 HP Study Reveals 70 Percent of Internet of Things Devices Vulnerable to Attack, HP, 29 July 2014”.
- “29 Verizon State of the Market the Internet of Things, 2015”.

- The diversity of IoT tools makes it difficult to achieve successful governance and cyber protection.

V. APPLICATION OF LTE AND NB-IOT

Various services such as networking and business mobility are utilised in the deployment of MTC systems. The LTE-based MTC and NB-IoT networks provide a substantially extended set of opportunities for the IoT owing to its omnipresence, decreased resource usage, and broader support of a number of peak data speeds. Any explanations for main usage cases for applying "cellular IoT solutions and their requirements are shown in Table1."

Table 1: Traditional vs Smart-micro grid.

Application	Data rate	Mobility	Latency tolerance	Duty cycle	Range	Battery-life
Fleet Management & Logistics: *Real-time and accurate information across supply chin*	Up to 100s of Kbps UL	High speed: 10-150km/h	Low (seconds)	1 report/hour ~ 1 report/day	Few km	Smartphone-like (car power distribution) 3 months (tracking ship containers)
Automotive Telematics: *Post crash systems, emergency support calls and remote diagnostics*	Up to 10s of Mbps UL	Pedestrian: <5km/h	Low (seconds)	Ad-hoc emergency communicatio n	Few km	Smartphone-like (car power distribution)
Automation & Monitoring: *Asset management, Remote monitoring of utility-based equipment for gas/water metering applications*	50-500 of Kbps UL	No: Fixed position	High (hours)	1 report/hour ~ 1 report/day	Few km	10 years
Security & Surveillance: *Real-time monitoring and control, e.g. video surveillance*	0.5-8 of Mbps UL	No: Fixed position	Zero (millisec.)	Real-time UL stream	Few km	Smartphone-like (connected to electrical grid)
Health Monitoring *Health care delivery and monitoring*	50-500kbps UL	Pedestrian: <5km/h	Low (seconds)	1 report/hour ~ 1 report/day + ad-hoc emergency	Less than 10s of meters	2 years
Wearables:*Personal Proximity Network: D2D discovery and synchronization for data exchange, e.g. sports app data sharing*	Up to 10s of Mbps	Pedestrian: <5km/h	Low (seconds)	Ad-hoc data exchange and signalling	Less than 10s of meters	1 week (intelligent wrist-band, smart watch, smart glasses)
Wearables: *Proximity Social Services: D2D communication, e.g. video streaming, file sharing, gaming*	20 Mbps and above	Pedestrian: <5km/h	Low (seconds)	Ad-hoc data exchange and signalling	<100s of meters	Smartphone-like

VII. WORKING MODE OF NB-IOT

The NB-IoT standard only allows 180 kHz bandwidth FDD transmission and 2 different deployment forms of the modes are shown in Fig. 4. [6,7]. When operating in Stand-alone mode, the device utilises a frequency band that does not overlap with the frequency band of LTE, which means the device can be used in every situation and at all times without any interference from other nearby electronic devices. This design utilises a guard band on LTE frequencies to keep interference away from the modified LTE protocol. In their effort to deploy LTE, carriers have deployed LTE technology through the PRB (Packet Relay Beacon) of an LTE frequency band, which requires only one resource assignment for this technology[3,4].

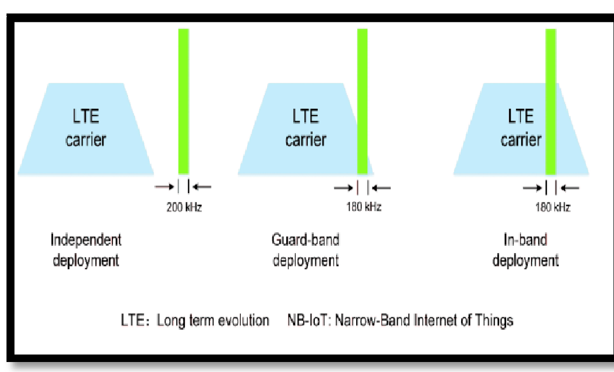

Fig. 4. Types of deployment scenes.

X. APPLICATION OF NB-IOT

NB-IOT USE CASES & MARKET POTENTIAL

Several analyst firms have been motivated by the solid development of NB-IoT to forecast the amount of interactions and revenue realised by the market. By 2020, the global Internet of Things industry is forecasted to hit a trillion dollars. A subset of NB-IoT is the growing IoT market, and operators must realise where they stand in terms of the total market potential. We can, first, look at the sectors and verticals where NB-IoT can bring valuebefore contemplating the countries here it will be implemented. Nine sectors in which NB-IoT facilities provide massive market prospects are included [8,9] in Fig. 5.

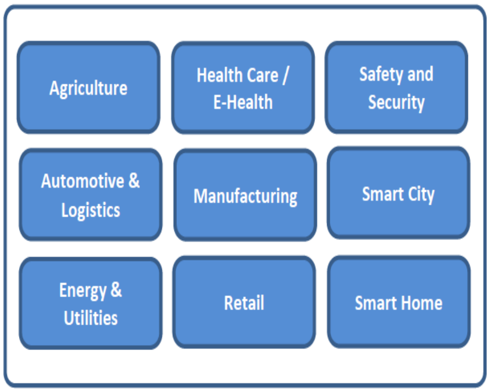

Fig. 5. Target Industries for NB-IoT Services.

The future business value of NB-IoT in terms of USD 1.67 billion over five years would equate USD 334 million annually. Thanks to the launch of NB-IoT networks, the German wireless market would see an approximately 2.2% growth boost. This summarises the positive points and the promise of NB-IoT, with cautious assumptions, which operators can invest in now if they do not want other players to win this lucrative sector.

XI. CONCLUSION

In this paper the background and status of NB-IoT and IoT [10,11] have been given. For the first part of the speech, the general NB-IoT context was presented, and for the remainder of the speech, a quick summary of the background and standardisation of NB-IoT growth over the last years was provided. The entire technical features, basic theory, and main NB-IoT technical mechanisms were then put in place, such as connection analysis, latency analysis, mechanism for facilitating coverage, etc.

Next, the paper looked at the variations between NB-IoT and a number of different communication technologies, including Enhanced Messaging Technologies (eMTCs), Bluetooth, and Wi-Fi. Describe the simple scene which can be realised by the NB-IoT application and include the corresponding illustration to enforce the intelligent application of NB-IoT There were three levels involved: first, the data scene was evaluated; second, the hardware was tested and then initially the algorithm and code was checked afterwards. While the goal of this paper is to provide you with a "detailed" description and "overview" of NB-IoT.

REFERENCES

[1]. 3GPP. (2016). Standardization of NB-IoT completed. Accessed October 18, 2017, from http://www.3gpp.org/news-events/3gpp-news/1785-nb_iot_complete

[2]. Analysys Mason. (2016). LPWA networks for IoT: Worldwide trends and forecasts, 2015–2025. Analysys Mason.

[3]. Deutsche Telekom. Accessed October 06, 2017, from https://warpaccelerator.com/nb-iot/

[4]. Deutsche Telekom. (2017a). Deutsche Telekom rolls out Narrow Band-IoT Network across Europe, Press Release Deutsche Telekom AG 23.2.2017.

[5]. ITU. (2012). ITU Recommendation ITU-T Y.2060 2012.

[6]. "Cellular Networks for Massive IoT", Ericsson White Paper, [online] Available: https://www.ericsson.com/res/docs/whitepapers/wp_iot.pdf.

[7]. "Cellular System Support for Ultra Low Complexity and Low Throughput Internet of Things", 3GPP TR 45.820.

[8]. "Further LTE Physical Layer Enhancements for MTC", 3GPP TSG RAN Meeting #65.

[9]. "Narrowband IoT (NB-IoT)", 3GPP TSG RAN Meeting #69.

[10]. Bagga, T., Sodhi, J., Shukla, B., Qazi, M. (2017). Smartphone Security Behaviour of the Indian Smartphone User, Man In India. **97**(24), pp. 333-344.

[11]. Addanki, A., Pandey, V., Sodhi, J. Bagga, T., (2017).Next Generation Indian Campuses going SMART. *International Journal of Applied Business and Economic Research*, **15**(21), pp. 385-398.