Capgemini engineering

# CAPGEMINI ENGINEERING NARROWBAND IOT SOLUTION

As the number of devices that make up the Internet of Things (IoT) continues to grow exponentially, customers are looking for new network solutions that are highly scalable

## What is Narrowband IoT?

With the number of cellular devices reaching the billions globally, the Third Generation Partnership Project (3GPP) has been working to create standards for cellular networks that will allow service providers to keep up with today's connectivity demands. **Narrowband IoT (NB-IoT)** is a Low Power Wide Area Network (LPWAN) radio technology that supports the use of low-cost devices. It offers long battery life and the provision of excellent coverage, whilst supporting a massive number of devices in a cell – all rolled out as software on top of existing LTE infrastructure.

### Key Features of NB-IoT:

- Operable within 200kHz bandwidth in Standalone mode, In-band and Guard band (See Fig. 1)
- Like LTE, NB-IoT uses OFDMA in the downlink and SC-FDMA in the uplink
- The design of NB-IoT has fully adopted LTE numerology, using 15kHz subcarriers in the uplink and downlink, with an additional option for 3.75kHz subcarriers in the uplink to provide capacity in signal-strength-limited scenarios

### Applications for NB-IoT:

- Smart metering (electricity, gas and water)
- Facility management services
- Intruder and fire alarms for homes and commercial properties
- Wearables to monitor health parameters
- Tracking of persons, animals or objects
- Smart city infrastructure, such as streetlamps or dustbins
- Connected industrial appliances, like welding machines or air compressors

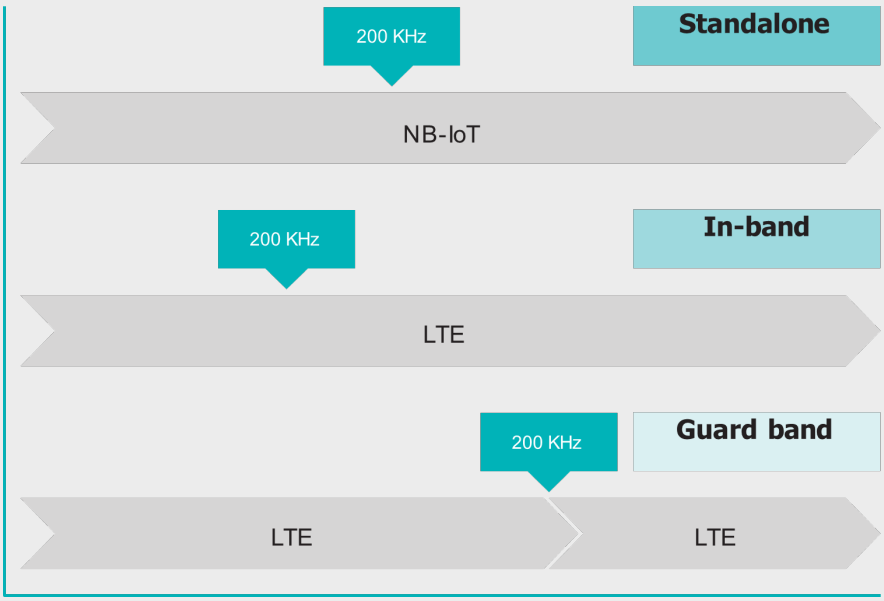


Figure 1: NB-IoT Channel allocation

## Capgemini Engineering eNB NB-IoT Offering

Capgemini Engineering's Narrowband IoT (NB IoT) solution enables and optimizes IoT devices for today's fastest long-range LTE networks. Our solution complies with all industry standards set by the 3GPP, making it easily interoperable with other vendor solutions, while adding value to our OEM and CSP clients by accelerating time to market.

Our IoT core solutions are virtualized, allowing customers to deploy in a standalone system as well as in cloud-based scalable solution. In addition to being highly scalable, these solutions are also adaptable across different categories of IoT devices, including the NB-IoT deployments common for APAC regions, and CAT-M1 devices in the US. This is especially beneficial to our global customers, who need solutions adaptable for all regions.

Capgemini Engineering has leveraged the existing LTE Base release to implement the eNB feature in a phase-wise manner on a x86 based host release and integrated as well with intel Transcede L1 on T3K Soc. This feature is also integrated on x86 based L1 partner, with supported contents, as shown in Figure 2.

| | | |
|---|---|---|
| **Mode of Operation** | *FDD mode, Standalone mode, In-Band & Guard Band, along with LTE cells* | |
| **Features** | • Single cell support in Standalone mode<br>• Up to 3 cells are supported in C-RAN for in-band and guard band<br>• Standalone Mode of Operation (200KHz bandwidth)<br>• Support for 128 Connected/Active UEs<br>• Single and Multi-Tone UL transmission<br>• 15 KHz sub-carrier spacing in DL<br>• 3.75 KHz and 15 KHz sub-carrier spacing in UL<br>• Half Duplex-FDD (Type B)<br>• New Physical Channels support in UL and DL<br>• NPDCCH (DCI-N0 and N1)<br>• FAPI L1-L2 interface Compliance<br>• Support for transmission only (i.e. no retransmission support) | RLC AM mode with Status reporting enabled<br>NPRACH format 1 supported<br>UE Specific Search Space with aggregation level 1 and 2 supported<br>Control Plane CIoT EPS optimization (PDN type IP only)<br>SIB3-NB, SIB4-NB, SIB5-ND<br>Connected mode DRX<br>BLER-based DL Link adaptation<br>DL Code-rate validation<br>KPI statistics<br>Cell Re-configuration<br>Paging<br>Support for CE Level 0<br>Repetition number in Control and Data |
| **Integrity & Ciphering** | AS Integrity & Ciphering is not applicable for CP-CIoT EPS optimization | |
| **3GPP Release** | Release 14 | |

Figure 2: Capgemini Engineering eNB Key Features

## Capgemini Engineering C-SGN Offering for Core

The Capgemini Engineering C-SGN (CIoT Serving Gateway Node) provides an optimized solution for cellular IoT, wide-area coverage, long battery life, low-cost devices, low deployment costs and support for massive IoT connections. C-SGN combines the MME, P-GW and S-GW functions to provide a highly optimized CIoT solution.

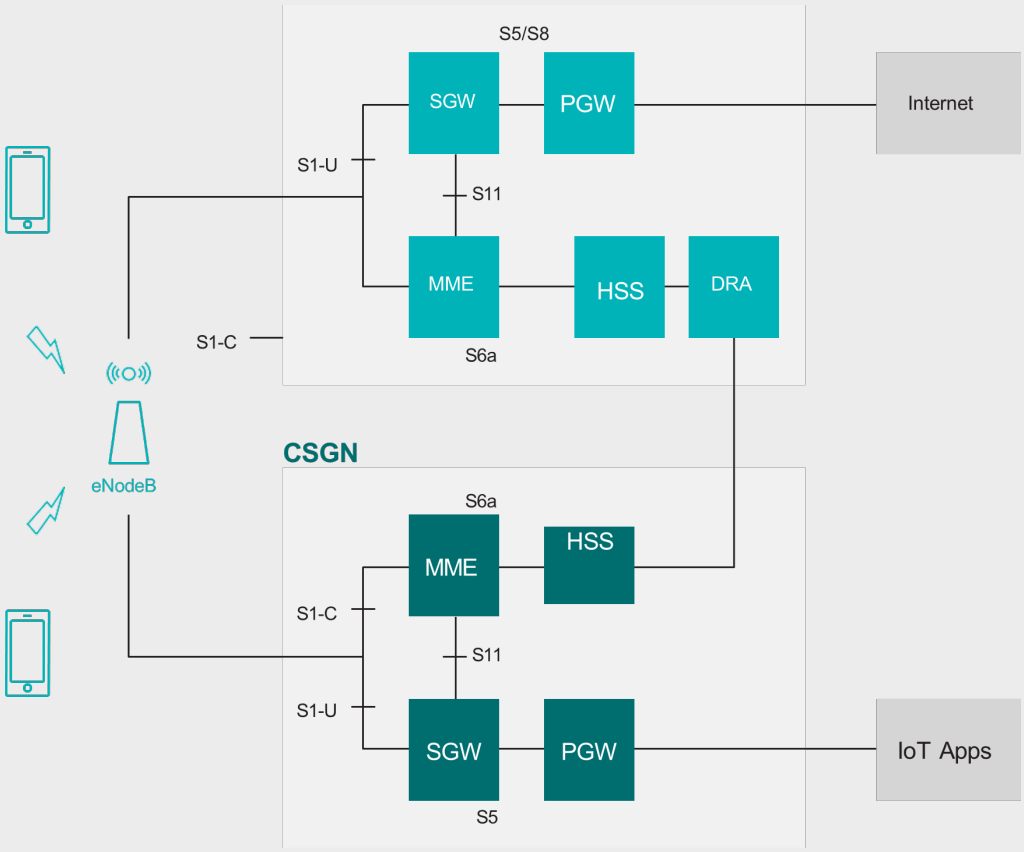


Figure 3: Capgemini Engineering IoT Core

| | |
|---|---|
| **Features** | • Capacity: 1M attached UEs<br>• UE Support: CAT-M, CAT-M1, Cat NB1<br>• High availability (1:1 Hot redundancy)<br>• FCAPS through Web-based Element Management System and SNMP<br>• Support for IPv4 and IPv6<br>• Protocol Features<br>  • Control Plane Optimization - Data delivered to/from MME in NAS PDUs<br>  • Data delivery over SGi interface to application server, or from MME to Service capability server (SCEF)<br>  • PSM and e-DRX support<br>  • Data buffering for UEs that do not wake up<br>  • IP data support, without IP header compression<br>  • Non-IP data Support<br>  • Packet set to defined destination (configured per APN) |
| **3GPP Release** | Release 13 |
| **Platform** | Any COTS server with RHEL/Centos OS |

Figure 4: Supported NB-IoT feature list in core

## Why Capgemini Engineering?

Capgemini Engineering works with original equipment manufacturers (OEMs) to develop and customize their LTE core for IoT. By customizing the core to meet their specific needs, Capgemini Engineering can deliver significant business value, including:

### Accelerating time-to-market

- Capgemini Engineering's ready-to-use, high-value, pre-integrated software stacks and frameworks reduce the OEM's R&D investment
- Leveraging our team of experienced LTE consultants and engineers in the development of an end-to-end solution, from design to product rollout, streamlining the development process and reducing development time

### Availability on generic platforms

- Capgemini Engineering's core solution can run on any commercial off-the-shelf (COTS) hardware - single/multi-core or single/multi-blade system on a server or ATCA/ATCA chassis - or any proprietary hardware running on Linux
- We ensure the customer incurs zero or minimal hardware integration expense

### Reducing risk through feature-rich and carrier-grade offerings

- Capgemini Engineering provides a strong feature set that includes most commercial-grade features available in the product roadmap
- Ensure compliance to the latest 3GPP R10 (June '11) specifications, with backward compatibility
- Offload offerings (HeNB Gateway in Femto and ePDG/SaMOG in Wi-Fi deployments)
- Interoperability credentials with top Tier-1 OEM eUTRAN and EPC nodes

### Built-in flexibility for faster market response

- Capgemini Engineering delivers highly customizable solutions to ensure customers meet their business objectives
- We participate in demonstrations and trials with OEM clients around the world which helps to provide the pre-integrated solutions to the OEMs for their end customers.
- Our flexible engagement models reduce investment risk and maintain the technology supremacy needed to gain (and hold) market share.
- Deep expertise and experience with over 70 LTE clients inform Capgemini Engineering's LTE offerings and professional services

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## About Capgemini Engineering

World leader in engineering and R&D services, Capgemini Engineering combines its broad industry knowledge and cutting-edge technologies in digital and software to support the convergence of the physical and digital worlds. Coupled with the capabilities of the rest of the Group, it helps clients to accelerate their journey towards Intelligent Industry. Capgemini Engineering has more than 55,000 engineer and scientist team members in over 30 countries across sectors including Aeronautics, Space, Defense, Naval, Automotive, Rail, Infrastructure & Transportation, Energy, Utilities & Chemicals, Life Sciences, Communications, Semiconductor & Electronics, Industrial & Consumer, Software & Internet.

Capgemini Engineering is an integral part of the Capgemini Group, a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided every day by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of over 340,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2021 global revenues of €18 billion.

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