

NB-IoT Communication Technologies & Solutions

Lecture 3

IoT Security

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Foreword

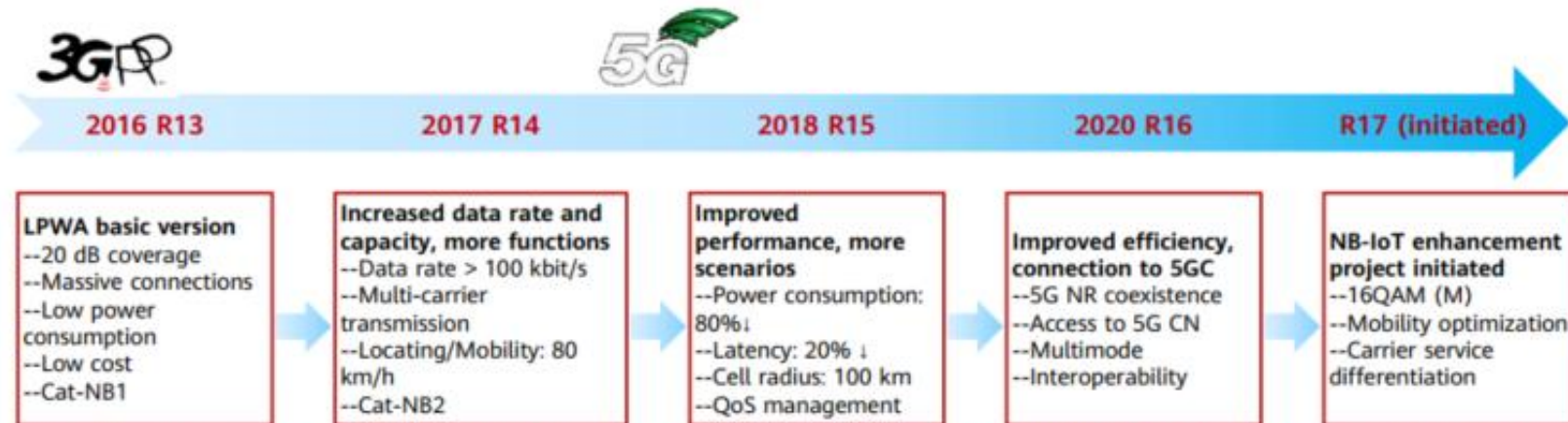
- Unlike the traditional Internet, the Internet of Things (IoT) works in diverse and complex communications scenarios. Different wireless communications scenarios vary in their requirements. We summarize the communications scenarios in which small packets are occasionally transmitted through passive devices as low-power wide-area (LPWA) scenarios.
- In LPWA scenarios, NB-IoT is one of the most widely used technologies. This technology complies with the 3GPP specifications, deployed on authorized frequency bands of operators, and provides a public network for IoT devices, encouraging the development of IoT public utilities.

Objectives

At the end of this course, you will have knowledge of:

- The evolution of the NB-IoT standards and the development of the NB-IoT industry
- Key technologies of NB-IoT
- NB-IoT application scenarios and solutions

Evolution of NB-IoT Standards



Technologies Defined by 3GPP Will Evolve to 5G

- On July 7, 2019, 3GPP and the 5G Promotion Group of MIIT put forward the NR and NB-IoT proposals to the ITU.
- 3GPP Release 15: **NB-IoT and NR can coexist**. Existing UEs are not affected.
- 3GPP Release 16: Technical standards meeting 5G requirements are officially accepted as a 5G technical standards.

The industry recognizes NB-IoT evolution and agrees to incorporate NB-IoT into the overall 5G plan.

Company	Proposal
China Mobile	✓ Jointly promote NB-IoT access to 5G devices and the core network based on R16.
DT	✓ No requirement on developing NR-based LPWA solutions. NB-IoT can meet IMT-2020 requirements.
E	✓ In the 5G era, continue using NB-IoT and LTE-M to meet LPWA service requirements.
Q	✓ NB-IoT/eMTC is 5G mMTC.

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LPWA Technologies Adopted by Global Operators

NB-IoT first + eMTC	       
	       
	    
eMTC first + NB-IoT	  
LoRA first + eMTC	  

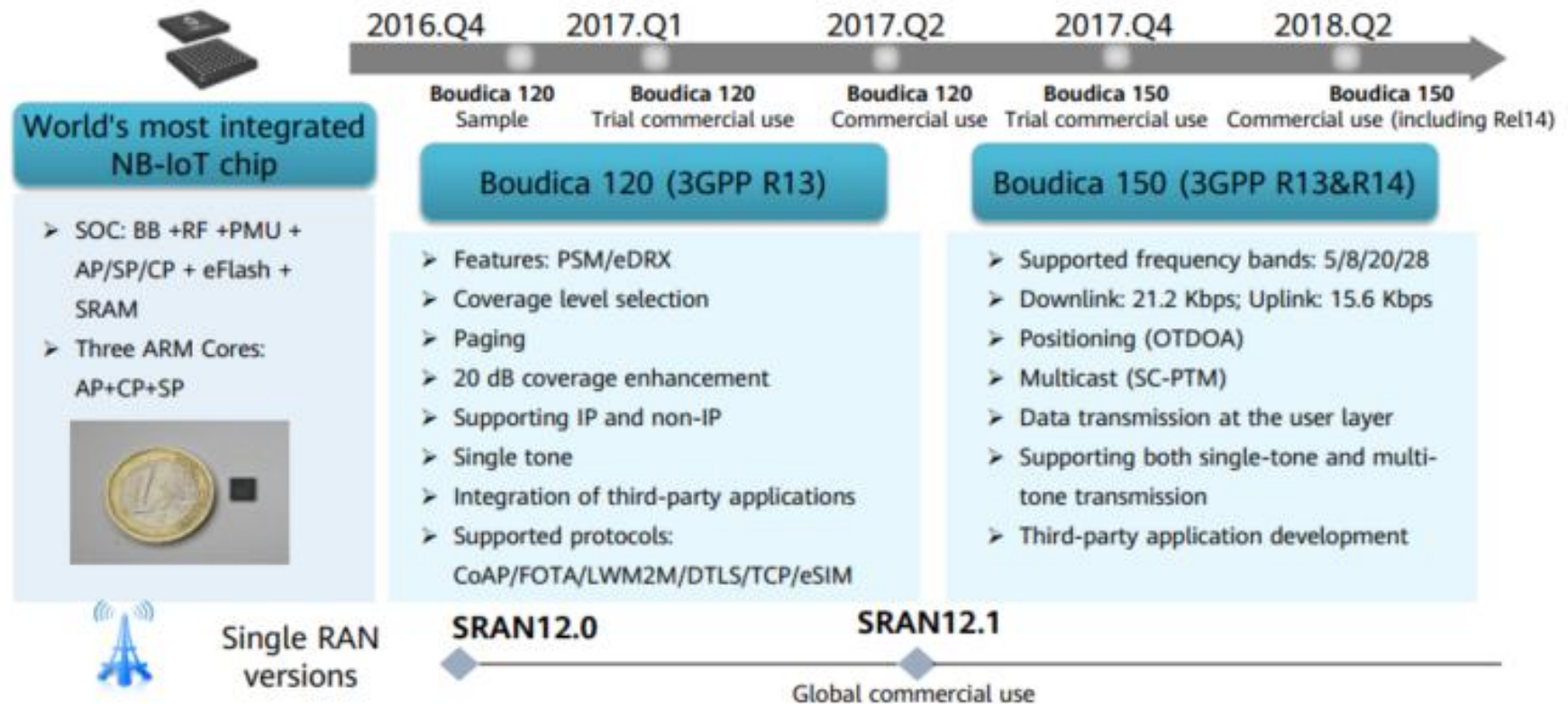
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NB-IoT Spectrum Selections of Global Operators

APT 700 MHz	  Latin America
800 MHz	   Germany Hungary
850 MHz	    
900 MHz	       Germany, Holland, Poland, Austria Germany
1800 MHz	   

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Huawei Releases World's First Commercial-Use NB-IoT Chip and Network Version



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NB-IoT Physical Layer

Physical layer design

- System bandwidth: 180 kHz
- Downlink technology: OFDMA; SCS 15 kHz; 12 subcarriers
- Uplink technology: SC-FDMA

Physical channels and physical signals

- To simplify implementation, NB-IoT removes unnecessary physical channels, leaving only three types of physical channels and two types of reference signals in the downlink and two types of physical channels and one type of reference signal in the uplink.

- Two types of uplink physical channels:
 - NPUSCH
 - NPRACH
- One type of uplink physical signal:
 - NDMRS



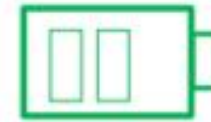
- Three types of downlink physical channels:
 - NPBCH
 - NPDCCH
 - NPDSCH
- Two types of downlink physical signals:
 - NRS
 - NSS

- Through a smaller target rate, repeated transmission, and lower-order modulation, **NB-IoT** physical channels achieve **wider coverage, lower costs, and lower power consumption**.

Key NB-IoT Features



Ultra-low cost



Ultra-low power
consumption



Ultra-wide
coverage

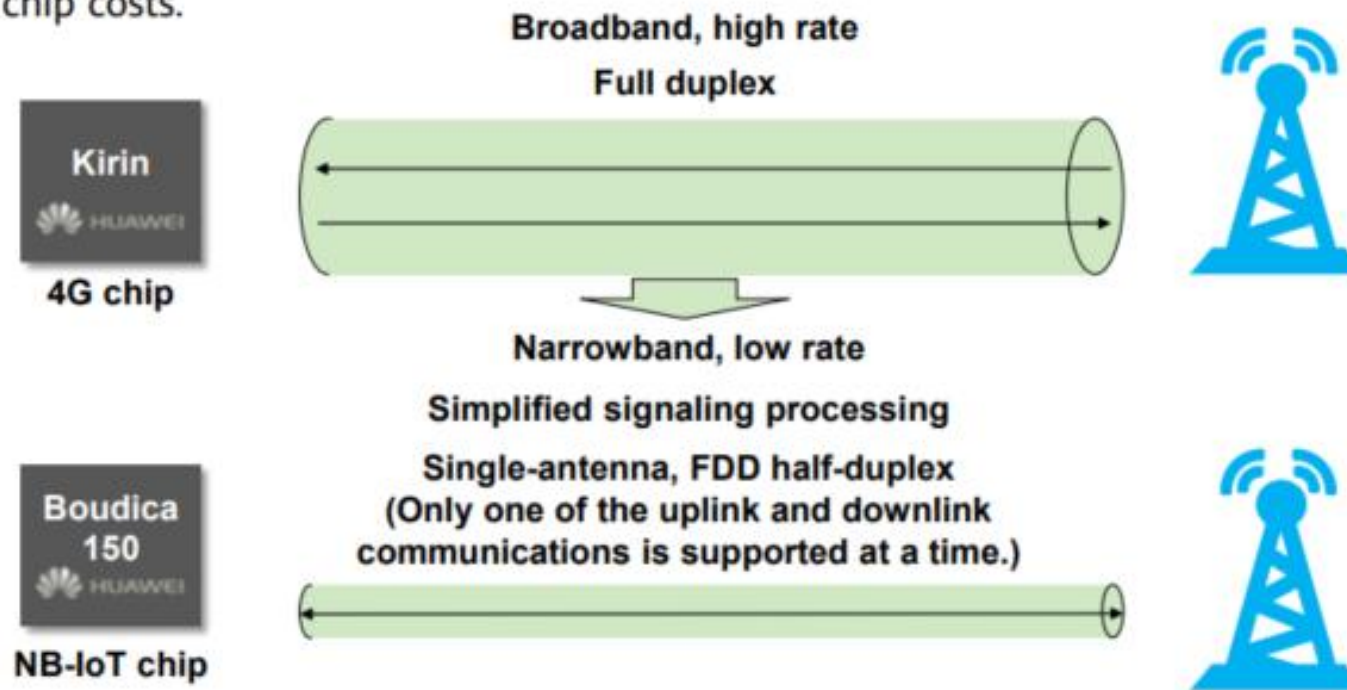


Massive connections

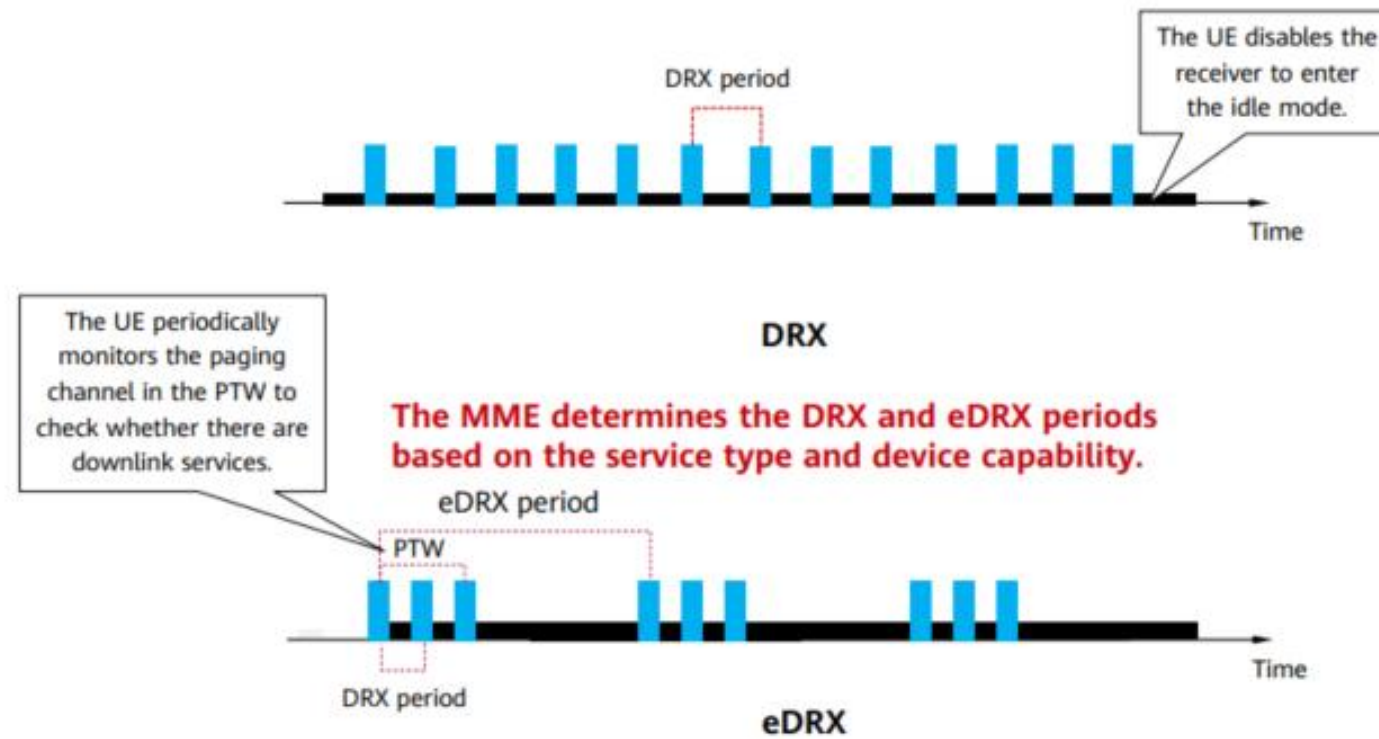
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Ultra-Low Cost: Communication Chips Especially Designed for IoT

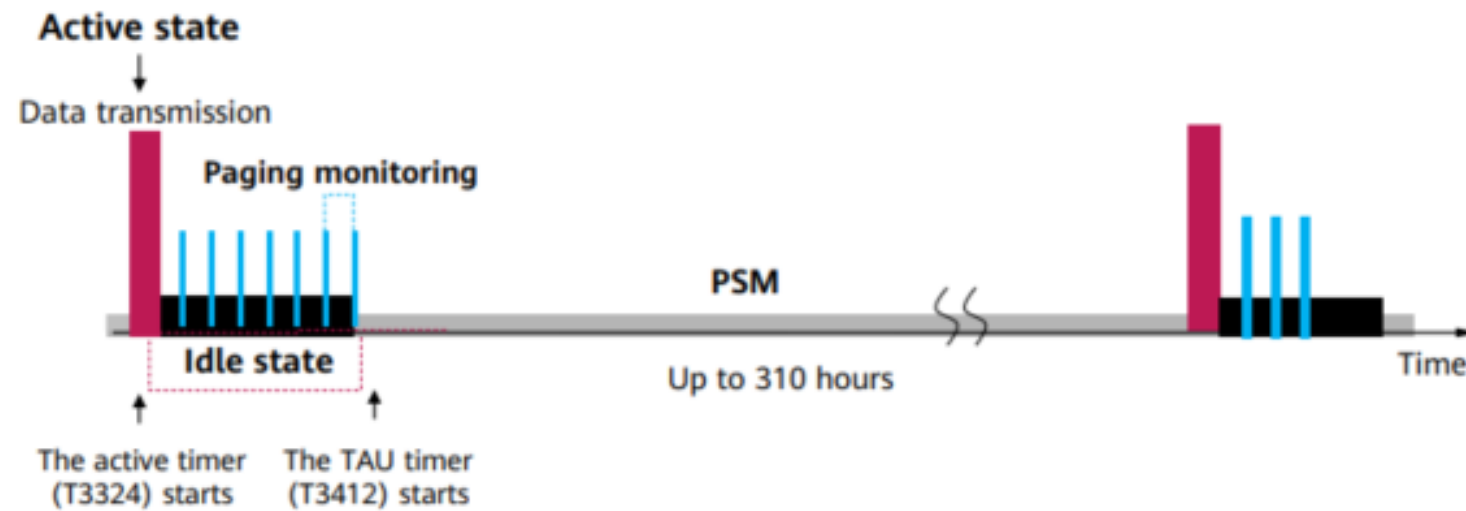
- Non-essential physical hardware modules are tailored using simplified functions and algorithms, reducing chip costs.



Ultra-Low Power Consumption: DRX & eDRX



Ultra-Low Power Consumption: PSM



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Ultra-Wide Coverage: Increased Power Spectral Density, Time-Domain Retransmission

Deep coverage solution

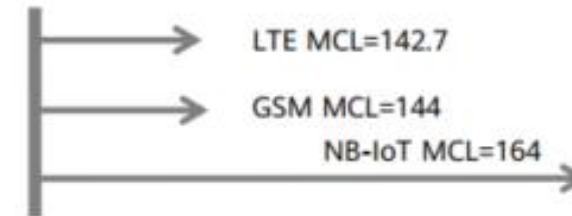


Downlink gain increased by 9 dB
Uplink gain increased by 12 dB

Repeated transmission

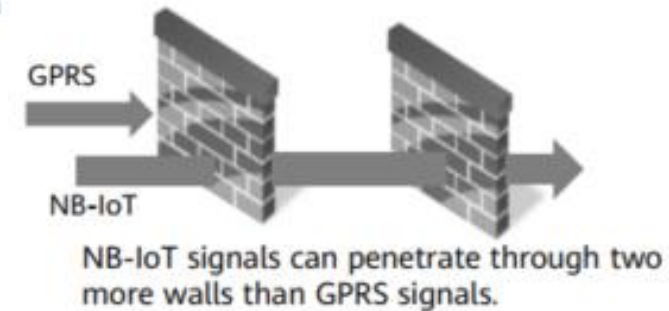


20 dB more maximum coupling loss (MCL) than GPRS



The coverage distance of NB-IoT is three times that of GPRS.

Coverage comparison



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Summary of Key NB-IoT Features



Low Cost

\$5 module cost

- Simplified RF hardware
- Simplified protocols to reduce costs
- Reduced baseband complexity

Low Power Consumption

10-year battery life

- Simplified protocols and lower chip power consumption
- High PA efficiency
- Short TX/RX duration

Wide Coverage

20 dB gain

- Increased narrowband PSD
- Retransmission times: 16
- Coding gains

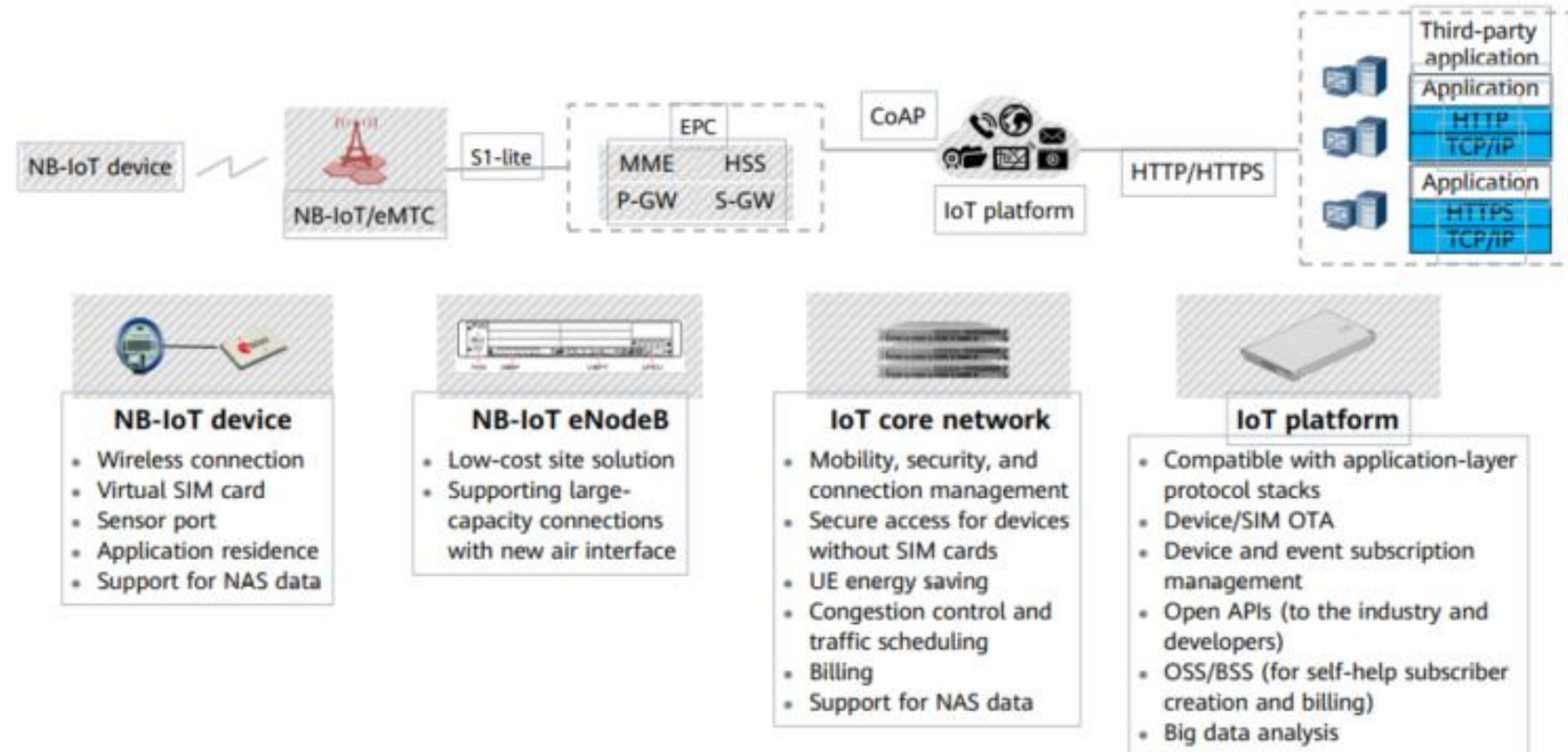
Massive Connections

50,000 connections per cell

- High spectral efficiency
- Small-packet data transmission
- Low device activation ratio

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NB-IoT Solution Architecture



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NB-IoT Application Cases





Thank You