

# thingenix

IoT networks made easy

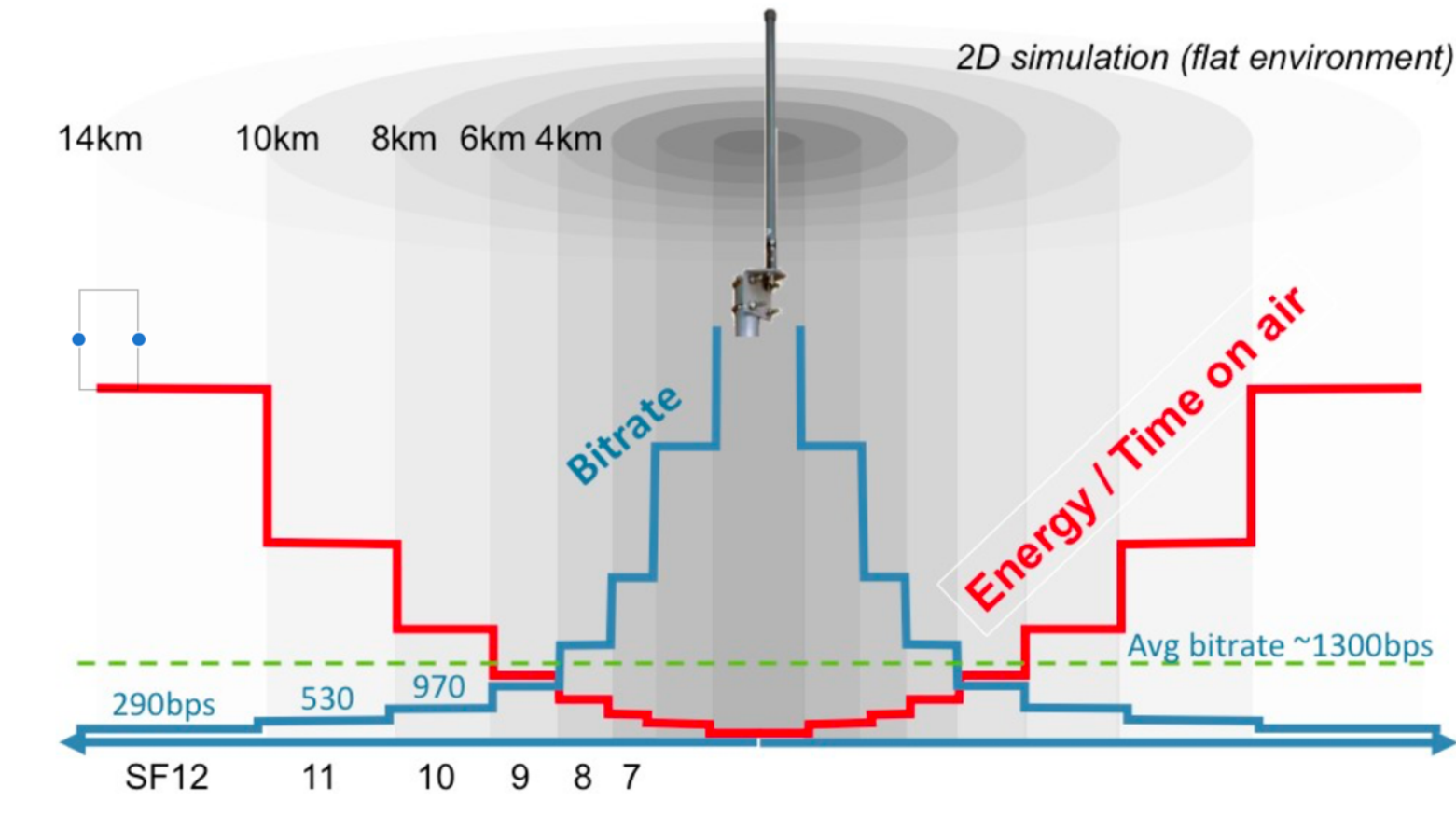
# A wonderful world around us



# Lora fundamentals - RF

Characteristics	LoRa RF
Modulation	LoRa (spread spectrum)
Frequency	Sub-GHz ISM
Channel bandwidth	125-500 KHz
Data rate	300 bps – 50 kbps
Gateway sensitivity	-142 dBm/300bps
Range	10+ km, deep indoor coverage
Payload size	11 – 242 bytes (variable)
Battery consumption	10mA RX / 32mA (14dBm) TX -- 10+ year
Communication type	Bidirectional unicast, network multicast
Interference immunity	Spread-spectrum w/ FEC
Scalability	Self scaling network capability through Adaptive Data Rate
Mobility	Handover support, geo-location

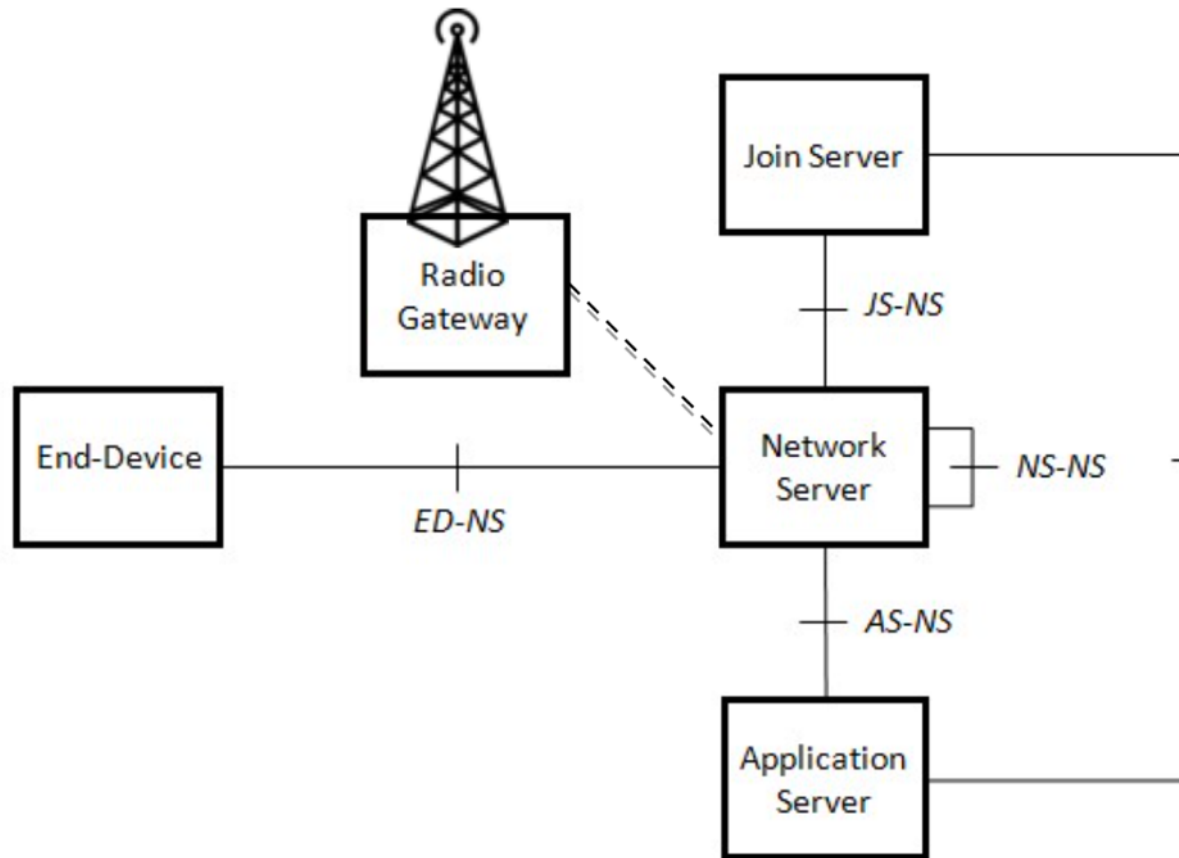
# Lora fundamentals - ADR



# Lora fundamentals - device classes

Class name	Intended usage
<b>A</b> (« all »)	<b>Battery powered sensors</b> , or actuators with no latency constraint. Most energy efficient communication class. Downlink TX can only happen after uplink.
<b>B</b> (« beacon »)	<b>Battery powered actuators</b> Device opens receive window at scheduled slots.
<b>C</b> (« continuous »)	<b>Mains powered actuators</b> Devices which can afford to listen continuously. No latency for downlink communication.

# Lora fundamentals - network structure

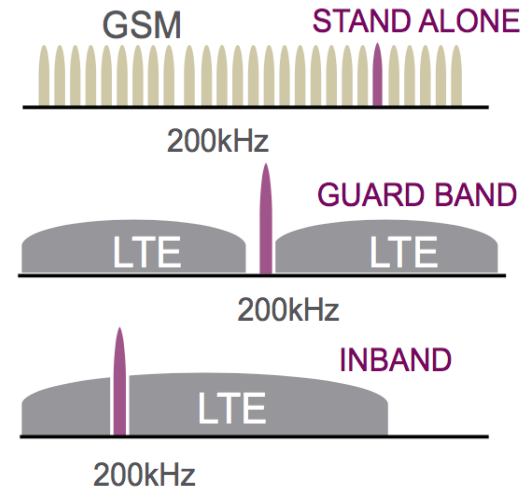


- Star topology, P2P links
- MAC layer (LoRaWAN) between endpoint and NS
  - compressed 802.15.4
- 64-bit device identifier (DevEUI)
- 32-bit device address (DevAddr)
- Public and private deployments
- Release 1.1 (Q4 2016):
  - backend interfaces
  - roaming
  - app and Nwk keys separation



# NB-IoT fundamentals - RF

- Targeting implementation in an existing 3GPP network
- Applicable in any 3GPP defined (licensed) frequency band – standardization in release 13
- Three deployment modes
- Processing along with wideband LTE carriers implying OFDM secured orthogonality and common resource utilization
- Maximum user rates 30/60 (DL/UL) kbps



The capacity of NB-IoT carrier is shared by all devices  
Capacity is scalable by adding additional NB-IoT carriers

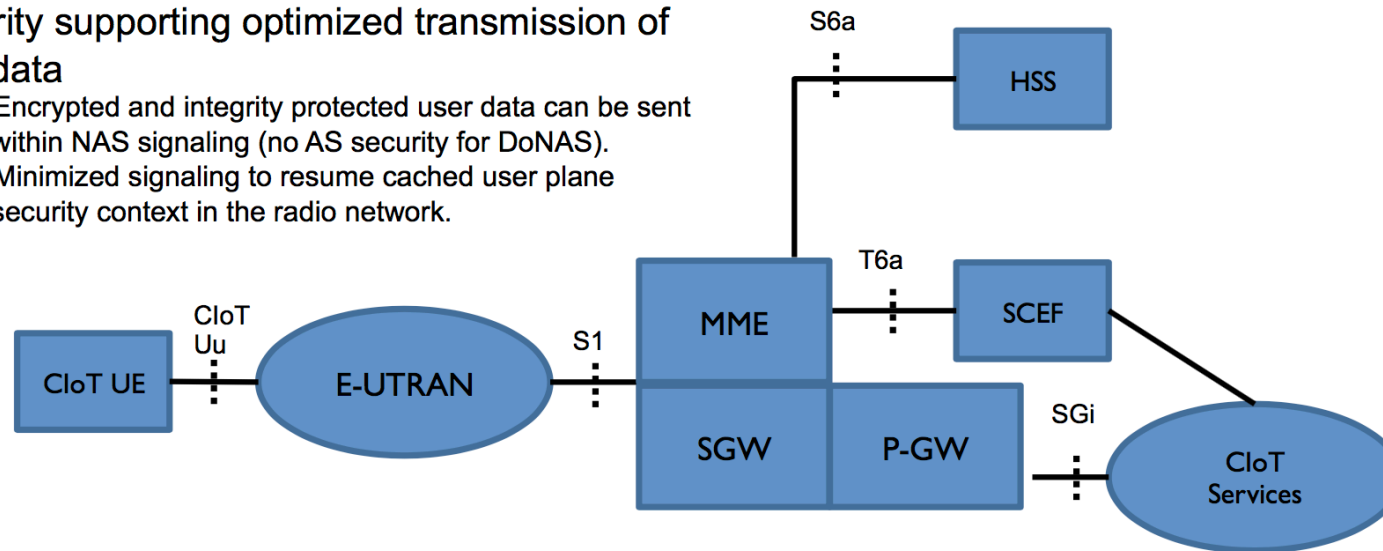
# NB-IoT fundamentals

- Highest modulation scheme **QPSK**
- ISM bands vs licensed bands
  - NB-IoT currently specified on licensed bands only
  - Narrowband operation (180 kHz bandwidth)
    - in-band (LTE), guard band (LTE) or standalone operation mode (e.g. refarm the GSM carrier at 850/900 MHz)
  - Half Duplex FDD operation mode with 60 kbps peak rate in uplink and 30 kbps peak rate in downlink
- Maximum transmission block size 680 bits in DL, 1000 bits in UL (In Rel-13)
- Use repetitions for coverage enhancements, up to 2048 reps in DL, 128 reps in UL data channels
- > 10 year battery life time

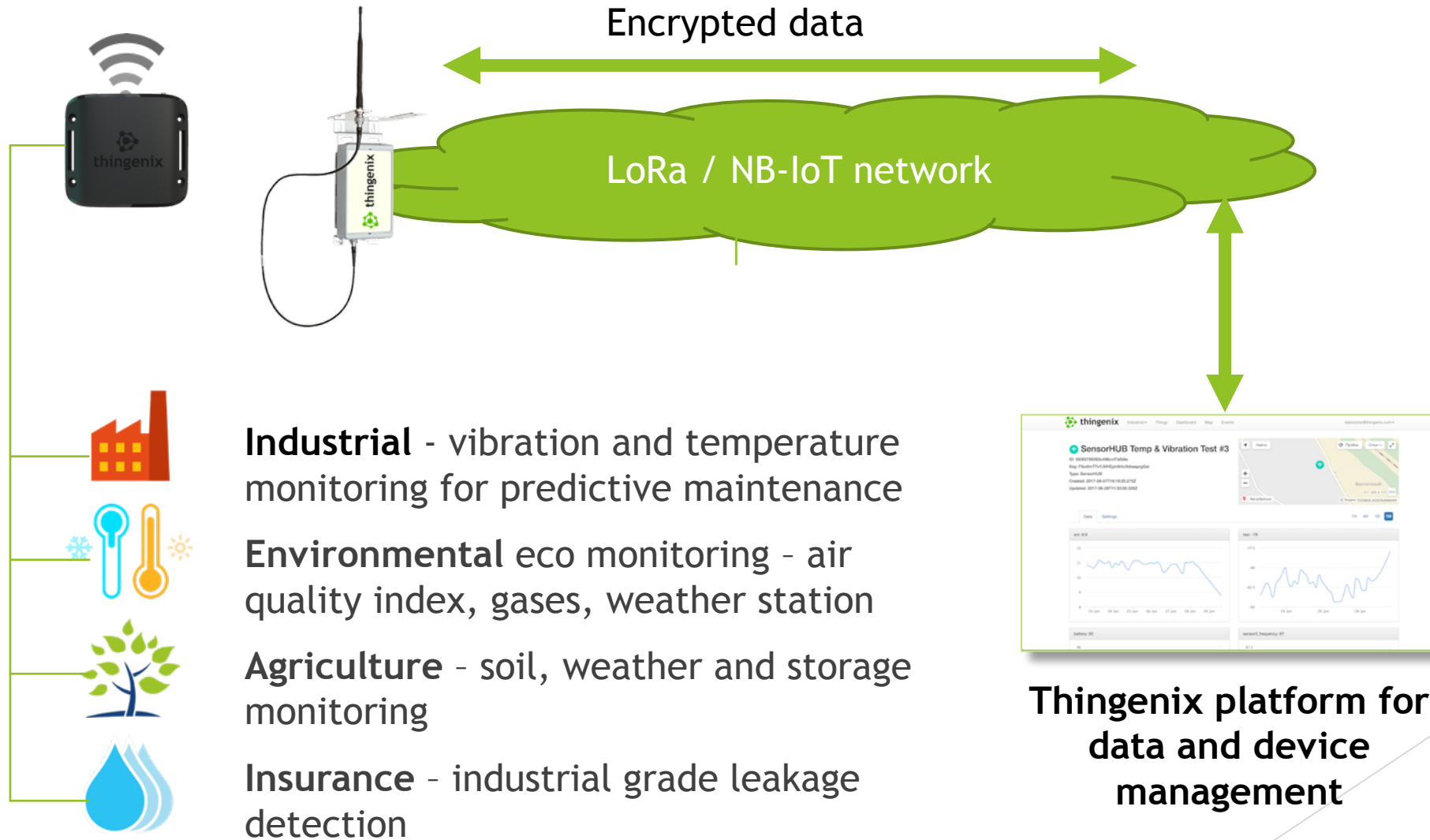


# NB-IoT fundamentals - architecture

- Architecture is based on evolved Packet Core (EPC) used by LTE
- Cellular IoT User Equipment (CIoT UE) is the mobile terminal
- evolved UMTS Terrestrial Radio Access Network (E-UTRAN) handles the radio communications between the UE and the EPC, and consists of the evolved base stations called eNodeB or eNB
- NB-IoT security properties
  - Authentication and core network signaling security as in normal LTE
  - Security supporting optimized transmission of user data
    - Encrypted and integrity protected user data can be sent within NAS signaling (no AS security for DoNAS).
    - Minimized signaling to resume cached user plane security context in the radio network.



# Vertical IoT solutions



....without headache!

# SensorHUB: data collection made easy

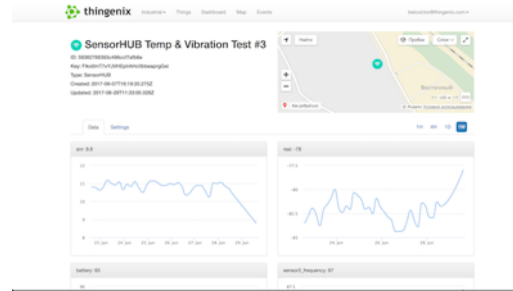
- ▶ Autonomous or external power options, including solar, with long battery life
- ▶ Variety of sensors and applications
- ▶ LoRa or NB-IoT connectivity
- ▶ Powerful Cortex-M4 MCU for local data processing (fog computing)
- ▶ 4 plug and play sensors in any combination
- ▶ Easy installation, no special training required
- ▶ Industrial grade enclosure with IP65 protection



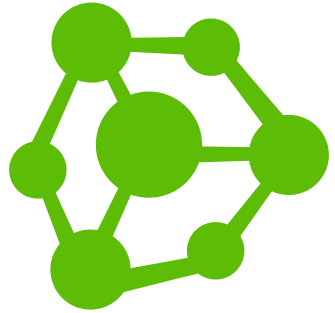
**Robust and modular device - variety of applications!**

# Data and device management platform

- ▶ **Compatible** with Actility, LORIoT, TTN, Thingenix, IP/3GPP or can work on top of an existing IoT platform
- ▶ **Flexible device configuration and management** designed for LPWAN
- ▶ Supports any 3<sup>rd</sup> party devices
- ▶ **Mobile apps** in 3Q17
- ▶ **Firmware over the air** for LPWANs in 4Q17



**Ultimate device management designed for LPWAN!**



# thingenix

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