# Eclipse IOT day April 3016
# LoRa Overview

brian.wyld@wyres.fr

www.wyres.eu

© Wyres SAS 2016

# Contents

- LoRa objectives
- LoRa PHY overview
- Licenses / State regulation
- LoRa MAC : LoRaWAN
- Other MAC protocols
- Technology alternatives
- Example of use

# LoRa Objectives

- Low energy usage for endpoints
- Long range / good building penetration
- Ability to run in unlicensed bands
- Allow high density of nodes

# Technology alternatives

- Zigbee
- Sigfox
- 802.15.4
- Bluetooth
- Wifi
- Wireless M-Bus
- Z-Wave
- WiMax
- 3G/4G/LTE

# LoRa PHY

- Aimed at sub-GHz unlicensed spectrum (868/915/433MHz) for world-wide operation
- Splits band into multiple channels
- Spread-spectrum encoding system:
  - allows sharing of channels with different 'spreading factors'
  - Can demodulate at 20db below noise floor
- Variety of bandwidths selectable (related to SF) 7.8kHz – 500kHz
  - Generally low throughput and small packets
- Channel access may implement Listen Before Talk to avoid clash

# LoRa PHY implementation

- One supplier only so far (Semtec)
- Single chip radio controller for endpoints (SX1272)
- PCB antennas possible
- Reference implementations available
- Separate chip for 'gateway' concentrators (simultaneous multi-channel/SF reception)

# Licensing

- Radio spectrum : ISM bands
  - 868MHz EU
  - 915MHz US
  - Various 700-900MHz bands in Asia
- Chipset is approved in each area for use in the band
- Software may be required to implement access controls eg LBT or specific TX duty cycle (typ.1%)
- License to use LoRa included in SEMTEC chip – no extra license fee
- No State license required to operate a network
  - public and private networks are possible

# LoRaWAN

- Defines network MAC layer over LoRa PHY for bi-directional scalable operation (concepts from 802.15.4)
- Star architecture : central gateway / multiple endpoints
- Gateway:
  - requires specific central gateway chip (multi-channel/SF reception)
  - Powered operation
  - Controls auth/encryption/downlink scheduling
- Endpoint :
  - Can be very low power
  - Tx and rx data
- Standardised / interoperable protocol specification (controlled by LoRa Alliance technical committee)
- Free source code LoRaWAN implementation for endpoint operation available on GitHub

# LoRaWAN design objectives

- Designed for virtualized CLOUD BASED network layer:
    - Simpler base stations, less maintenance
    - All NW antennas behave as one, no handover necessary.
- Close ALIGNMENT WITH IEEE 802.15.4 in order to preserve higher layers
    - 6LoWPAN compatibility
    - IEEE sensor address space
- MINIMAL ENERGY REQUIREMENTS: Eliminate useless overheads.
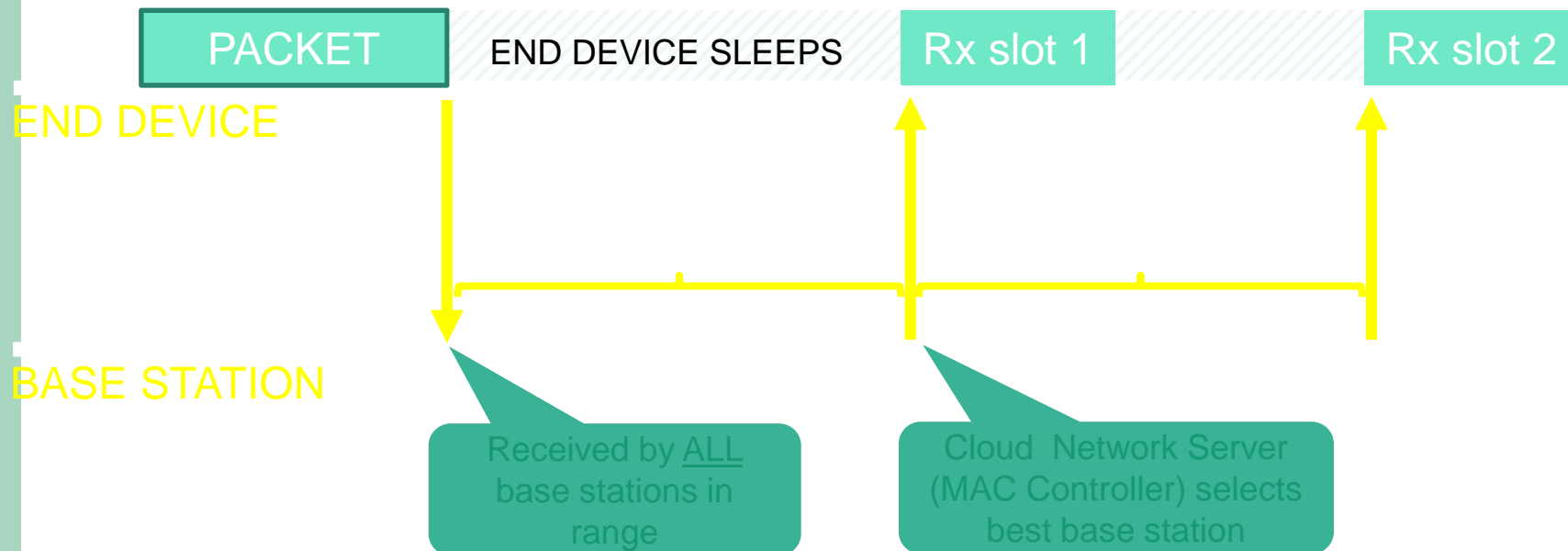- Enables SMOOTH VERSIONING

# LoRaWAN device classes

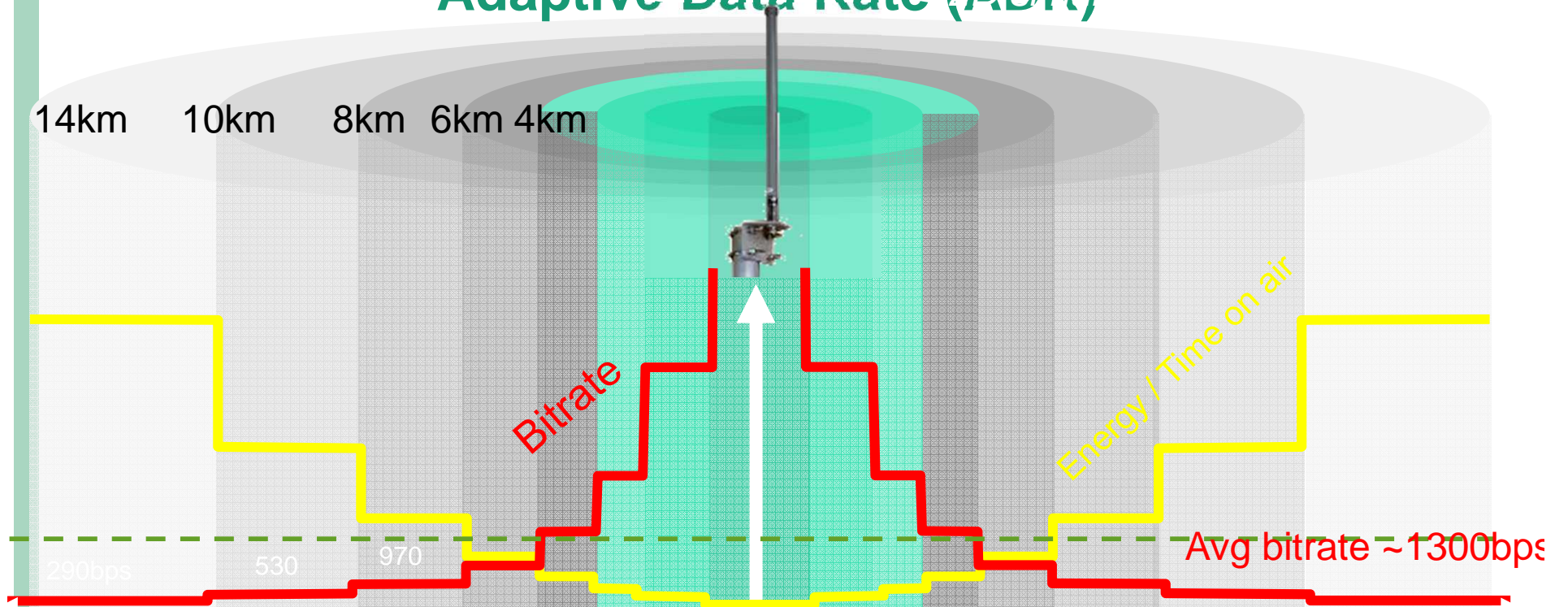| CLASS NAME | INTENDED USAGE |
|---|---|
| **A**<br>(« all ») | **Battery powered sensors**, or actuators with no latency constraint<br>Most energy efficient communication class.<br>Must be supported by all devices |
| **B**<br>(« beacon ») | **Battery powered actuators**<br>Energy efficient communication class for latency controlled downlink. Based on slotted communication synchronized with a network beacon. |
| **C**<br>(« continuous ») | **Mains powered actuators**<br>Devices which can afford to listen continuously.<br>No latency for downlink communication. |

# Bidirectional communication, class A

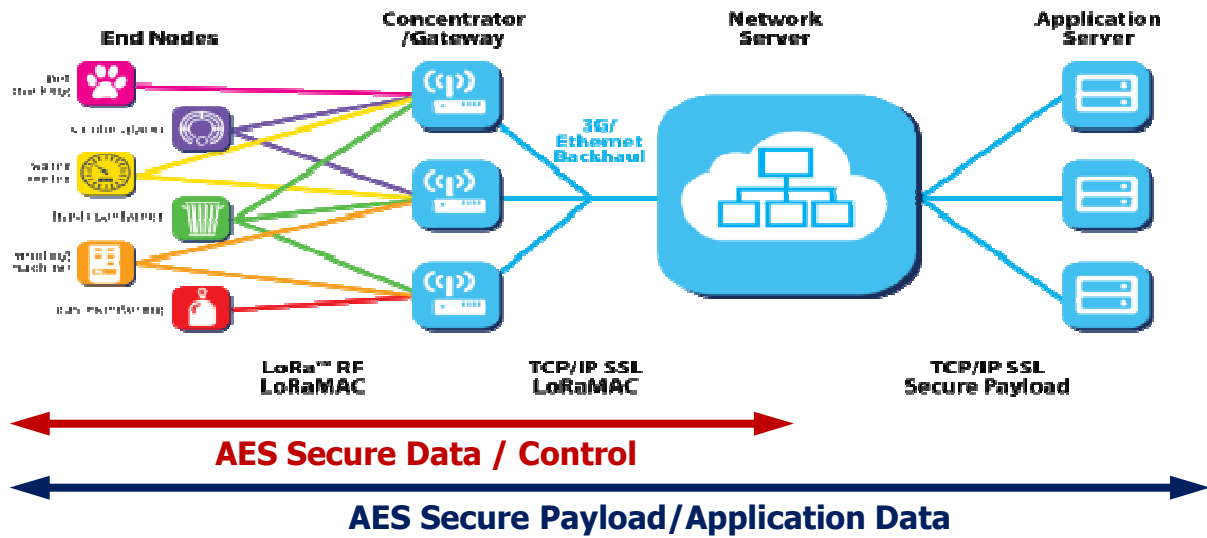## Receiver Initiated Transmission strategy (RIT)

| PACKET | END DEVICE SLEEPS | Rx slot 1 | | Rx slot 2 |

END DEVICE

BASE STATION

Received by ALL base stations in range

Cloud Network Server (MAC Controller) selects best base station

# Adaptive Data Rate (ADR)

14km   10km   8km   6km 4km

Bitrate

Energy / Time on air

290bps   530   970

Avg bitrate ~1300bps

# LoRaWAN authentication and encryption



- 
-

# Other MACs

- Currently no other standardised MAC protocols (eg mesh)
- Some board providers have defined message formats and operations
  - Eg for serial link emulation
- Lacking an interoperable endpoint-endpoint protocol…
  - New open source project opportunity!
  - LoWAPP : peer to peer group protocol

# Usage example

- Wyres : indoor geo-loc using connected objects:
  - 'beacon' fixed to walls
  - 'tag' mobile to be located
  - Card with STM32/Lora radio + MEMS captors
  - Both are battery powered
- Communication between objects using proprietry radio exchanges
- Data up/downlink to cloud : LoRaWAN to Wyres owned gateways (Multitech).
- Code development using EclipseIDE and derivations (CoIDE)
- Processing cloud with Open source components : MQTT/Paho/OpenVPN/Tomcat/MongoDB/Cassandra…