LoRa™ Alliance

Wide Area Networks for IoT

Brief LoRa Introduction

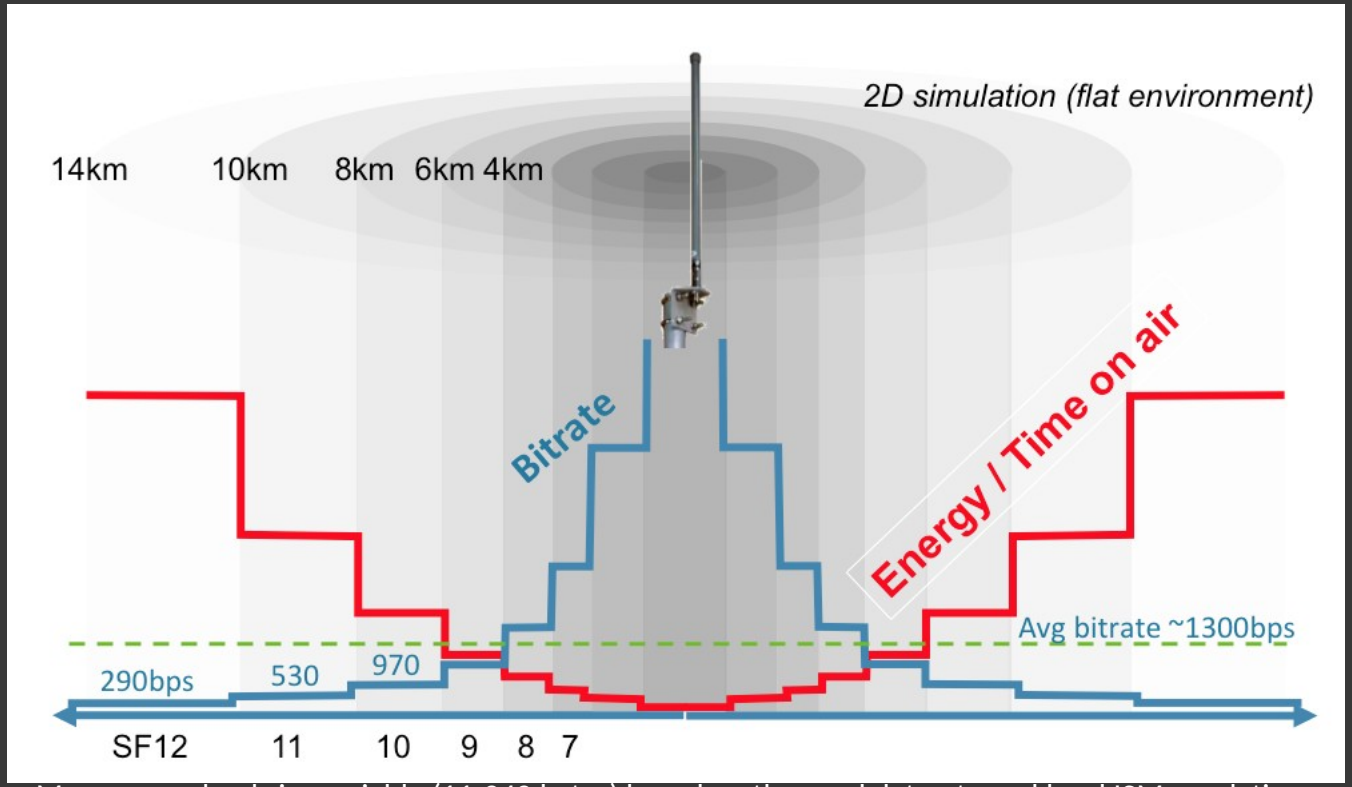
Alper Yegin, LoRa Alliance Strategy Committee Vice-chair / Actility

IETF 96

LoRa 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

Adaptive Data Rate (ADR)

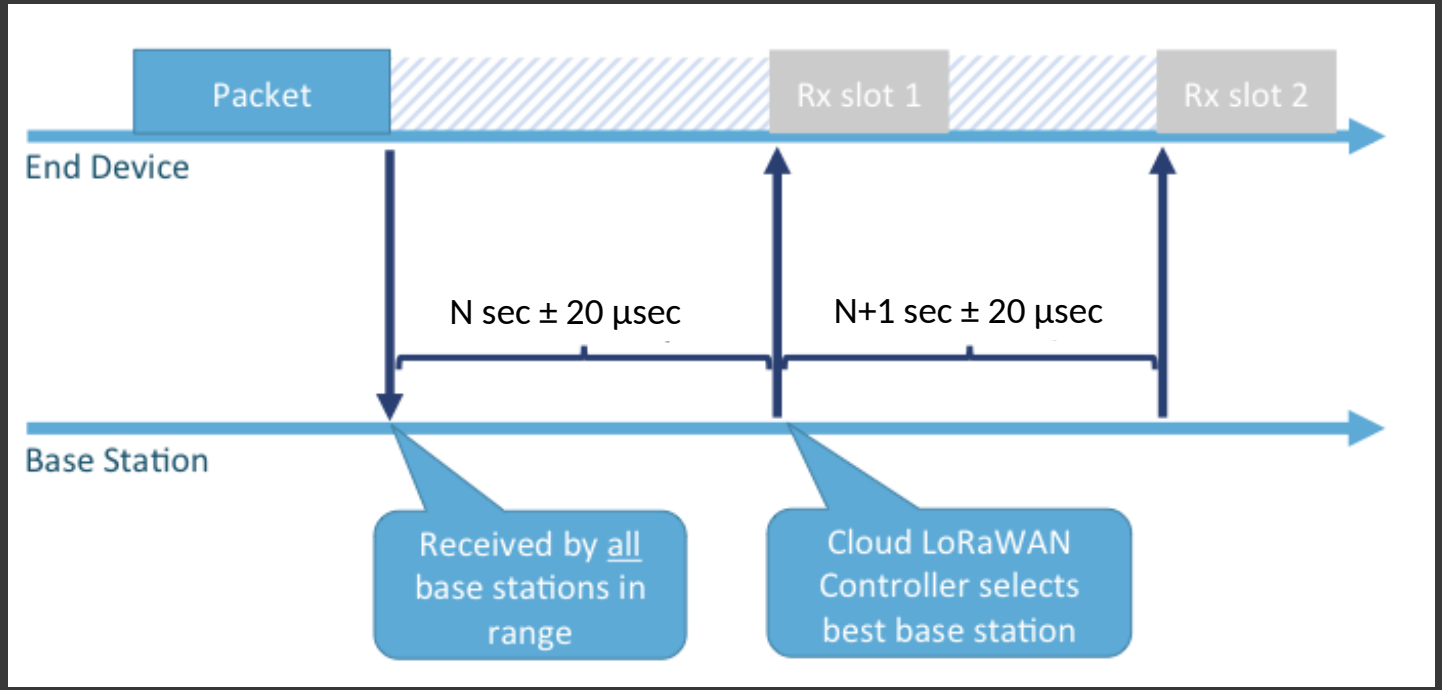


Max app payload size variable (11-242 bytes) based on the used datarate and local ISM regulation

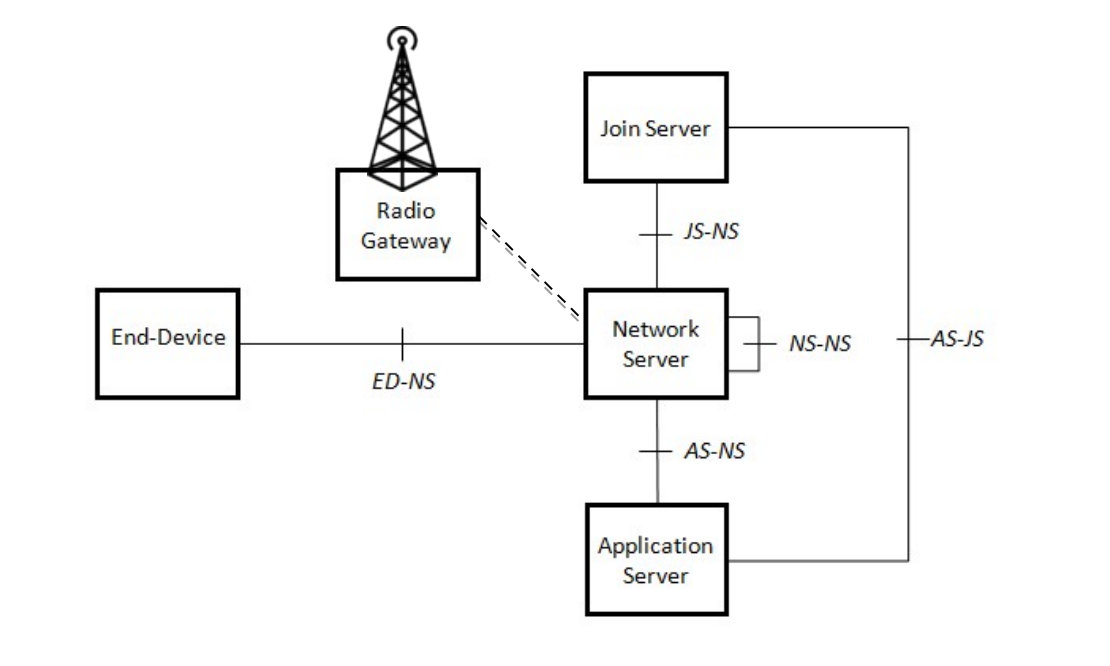
Device Classes

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

Class A TX/RX

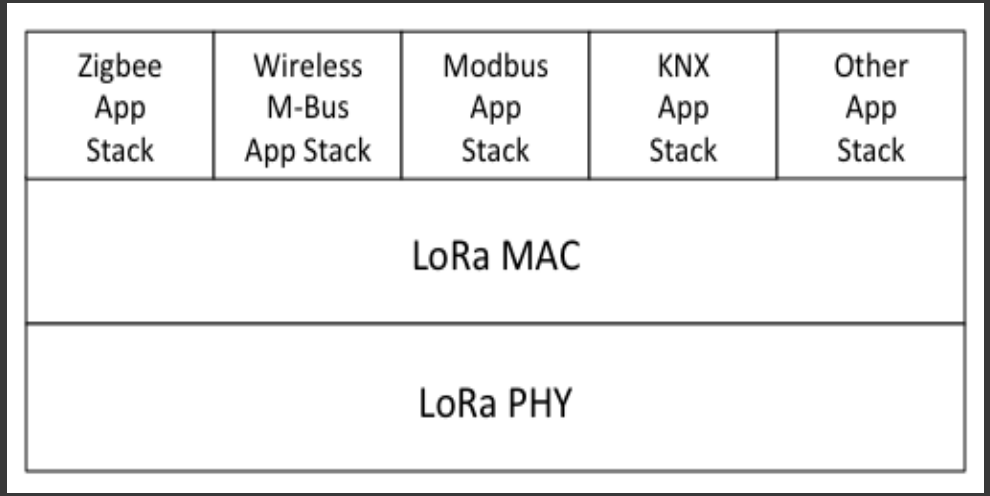

Packet
Rx slot 1
Rx slot 2
End Device
N sec ± 20 µsec
N+1 sec ± 20 µsec
Base Station
Received by all base stations in range
Cloud LoRaWAN Controller selects best base station

Architecture



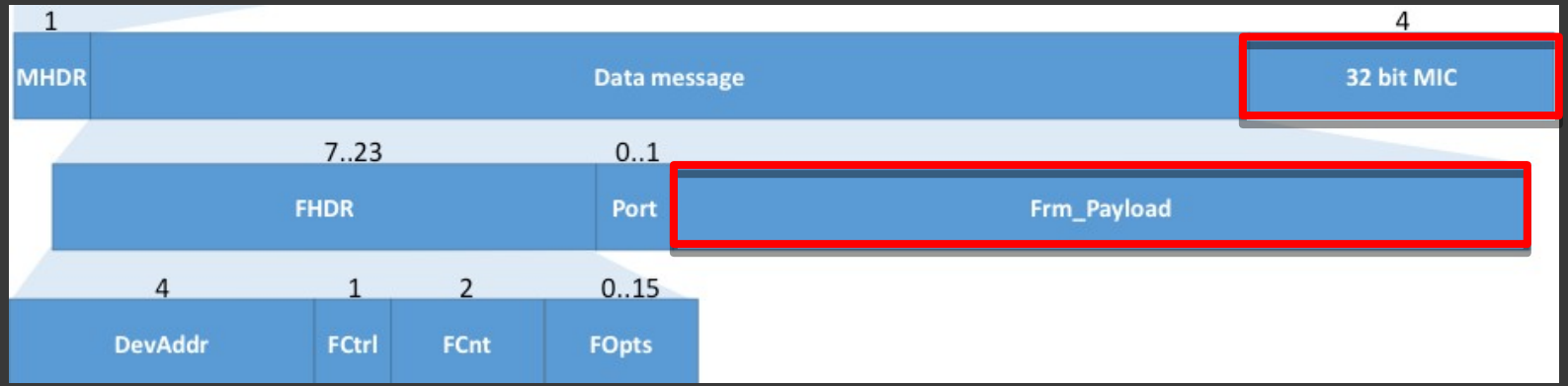
- Star topology, P2P links
- MAC layer (LoRaWAN) between the Device and NS
  - Compressed 802.15.4
  - Release 1.0 -- https://www.lora-alliance.org/portals/0/specs/LoRaWAN%20Specification%201R0.pdf
- 64bit device identifier (DevEUI)
- 32bit device address (DevAddr)
- Public and private deployments
- Release 1.1 (Q4 2016):
  - Backend Interfaces
  - Roaming
  - App & Nwk key separation

App Stacks


Zigbee App Stack
Wireless M-Bus App Stack
Modbus App Stack
KNX App Stack
Other App Stack
LoRa MAC
LoRa PHY

Security

- Per-device AppKey, NwkKey (AES128)
- Mutual end-point authentication via Join Procedure [AES-CMAC, RFC 4493]
- Data origin authentication, integrity protection, replay protection
- Encryption of MAC commands (over-the-air), app payloads (end-to-end) [IEEE 802.15.4/2006 Annex B (CCM*)]
- Key hierarchy with root and session keys, session rekeying



LoRa Alliance

- An open, non-profit association to develop standard specifications and ecosystem for LoRa-based secure, interoperable, and carrier-grade IoT network technology
- Founded in March 2015
- 359 members: chipset/module/device/infra vendors, operators
- 16 announced nationwide/operator deployments, 56 on-going trials
- Committees: Strategy, Technical, Certification, Marketing

LoRa™ Alliance

Wide Area Networks for IoT

Thank you

The LoRa™ Alliance

"ENABLING THINGS TO HAVE A GLOBAL VOICE"

LoRa™ Alliance

Wide Area Networks for IoT

LoRa-Alliance.org