Low-Power Wide-Area Networks

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Low-Power Wide-Area Networks
25 mW transmission power

Low-Power Wide-Area Networks

20 years on simple battery
Low-Power Wide-Area Networks

15-50 km rural outdoor

2-3 km urban indoor
Low-Power Wide-Area Networks

- No scheduling
- No routing
- Device-initiated com
- Huge densities
- Low throughput
250 kHz or less

Narrow-band

Low-Power Wide-Area Networks
Narrow-band
Low-Power Wide-Area Networks

License free
250 kHz or less

Collisions
Duty cycling
Acknowledgements

Data-over-NAS
Guard-bands
In-band

In licensed spectrum
Low-Power Wide-Area Networks (LP-WAN) are designed for low-power consumption, wide-area coverage, and long battery life. They operate in license-free bands or in licensed spectrum, using narrow-bandwidth channels with limited bandwidth:

- **250 kHz or less** transmission bandwidth
- **25 mW transmission power**
- **20 years on simple battery**
- **15-50 km rural outdoor** range
- **2-3 km urban indoor** range

**Key Features:**
- **License free**
- **In-band**
- **Guard-bands**
- **No scheduling**
- **No routing**

**Protocols:**
- **ALOHA**
- **Device-initiated comm**
- **Huge densities**
- **Low throughput**

**Communications:**
- **100 bps (50 kbps max)**
- **12 byte payload (50 byte payload)**
- **140 messages uplink**
- **4 messages downlink**

**Acknowledgements:**
- **Collisions**
- **Data-over-NAS**
- **Duty cycling**
- **In-licensed spectrum**
- **In-band**
- **License free**
- **Guard-bands**

**Applications:**
- **Long-term monitoring**
- **Low data rate applications**
- **Energy-efficient devices**

**Examples:**
- **LP-WAN - RIOT Summit 2016**
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Compression
Management

![Diagram showing energy consumption in LP-WAN.
At 869.4, there is a significant peak at 500mW, followed by smaller peaks at 868.0 and 865.6 at 25mW and 25mW respectively.]

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Building the next 10 bln devices

• Device software stack
  – Drivers (available for Contiki)
  – MAC (e.g. LoRaMAC – open C implementation)
  – IP/UDP/CoAP with SCHC IP compression
  – CoOL/CoMI for network and app management
  – RESTful APIs
  – Certificates, COSE, secure element, code verification
    • Design for disposable devices + devices that will be there for 10+ years

• Development tools!
  – Independent of LPWAN technology

• But wait, there is more…
  – 6TiSCH
Thank you! Questions?

IETF LPWAN BoF on Monday
- Join the lp-wan mailing list
- Technical session on Sunday
- Key documents:
  - draft-toutain-6lpwa-ipv6-static-context-hc
  - draft-gomez-lpwan-fragmentation-header

CoOL/CoMI on CoRE:
- draft-ietf-core-yang-cbor
- draft-veillette-core-cool
- draft-somaraju-core-sid