

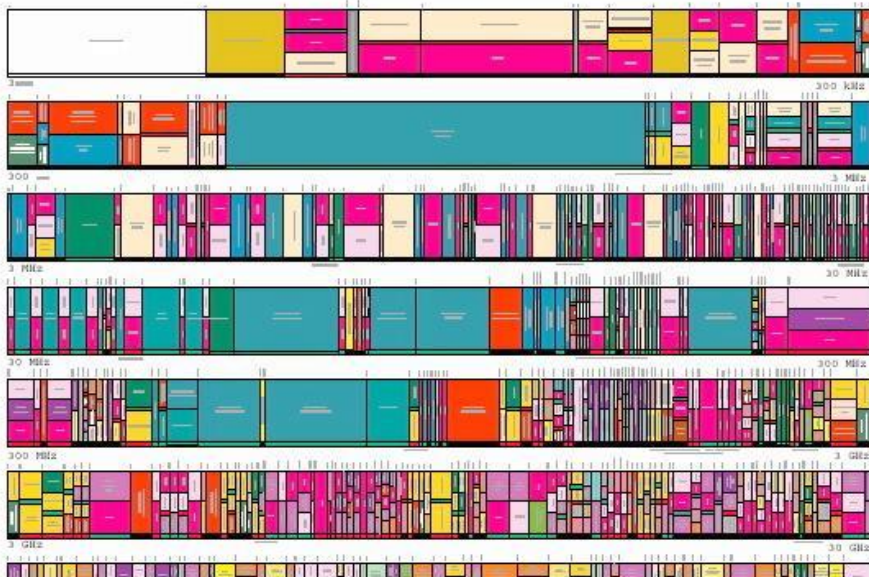
Chairman – LoRa Alliance

6Lowpan Creator

Former White House Presidential Innovation Fellow - IOT

UNITED STATES
FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM



**Choosing the
“RIGHT”
Connectivity
technology
for your IoT
Application**



$$A_{LT} = \frac{P_s \times P_k / y \times \lambda_d}{\lambda_s + y \times s + \Theta} \times$$

$$\frac{\partial L}{\partial q_i} - \frac{d}{dt} \frac{\partial L}{\partial q_i} \times$$

$$\sum_{n=1}^{10} 2n \times \pi_d \times t(n) + 42$$

SO WHAT'S THE PROBLEM

M2M World of Connected Services

The Internet of Things



IoT SDOs and alliances landscape

(after comments of marco + juergen + jochen + nigel rix, Thomas Paral + Levent)

Service & App

HYPER/CAT Advancing open standards for the information society



Open Automotive Alliance



B2C (e.g., Consumer Market)



B2B (e.g., Industrial Internet Market)



WIRELESS WORLD

RFSEARCH FORUM



Connectivity

Source: Modified from an initial contribution from Huawei

Let's talk wireless

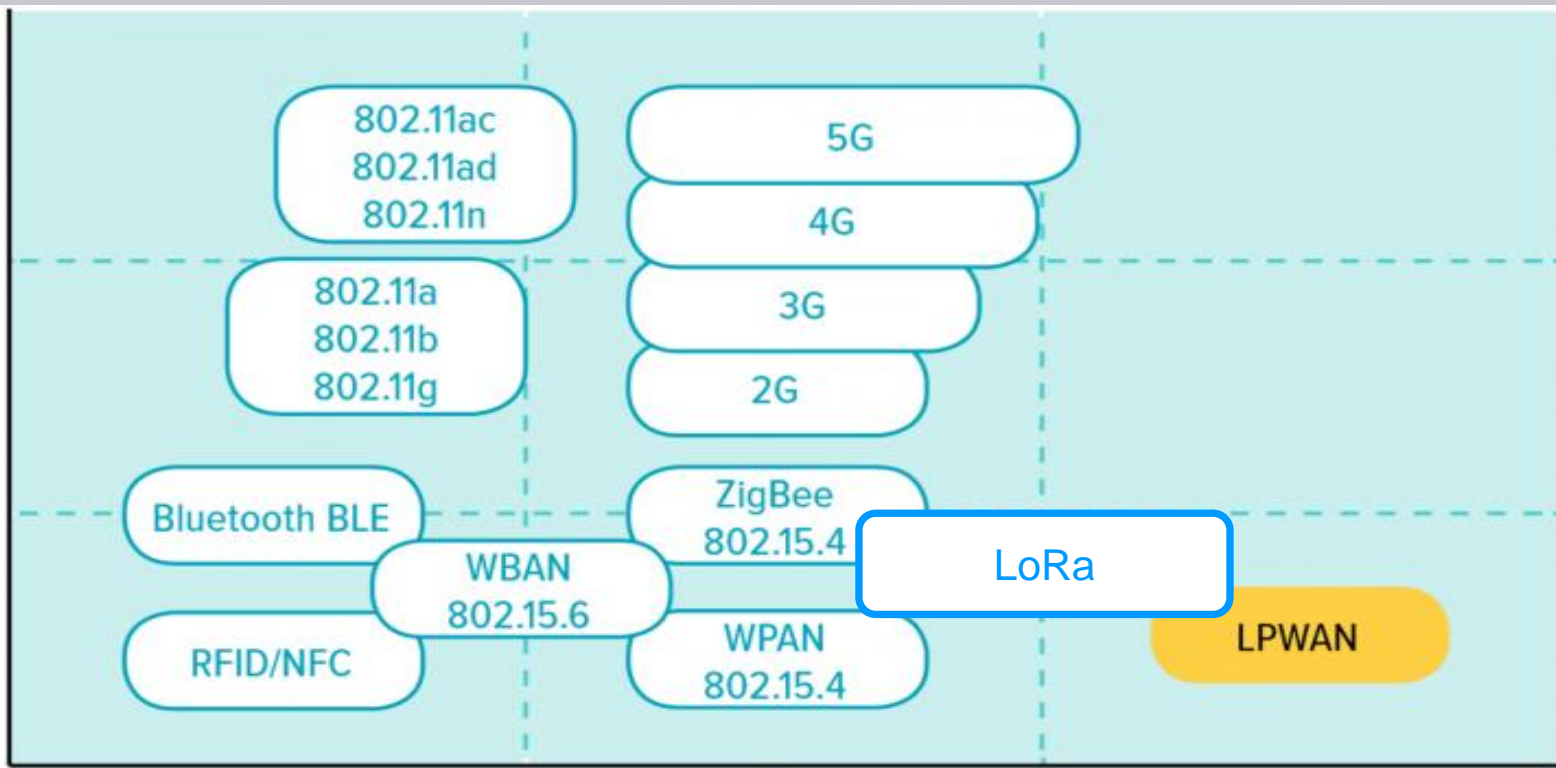
Low Power

Pick Two

Long Distance

High Speed

BANDWIDTH REQUIRED



RANGE CAPABILITY

- Ubiquitous
- High Speed - Mbps
- Medium Range – 100M
- Requires a lot of power
- Applications
 - Streaming (audio, video), hi-fidelity data

- Also ubiquitous
- High speed – Mbps
- Short ranges – 10s M
- Still relatively high power
- BTLE
 - Lower power
 - Shorter Range
- Applications
 - near high speed communications

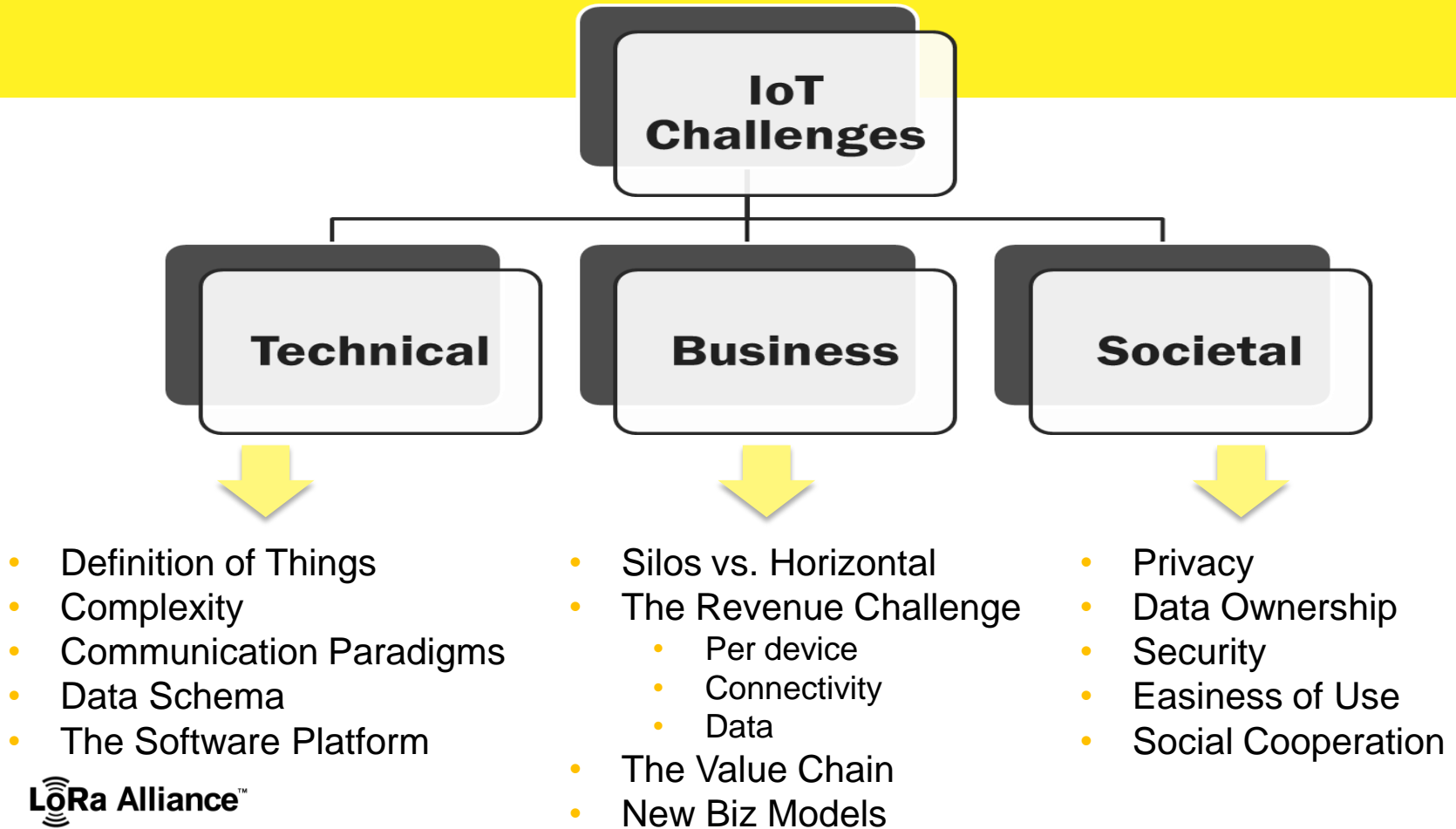
- Lots of different implementations and versions
- Medium Speed – 100s Kbps
- Medium Distance – 100 M
- Mesh Networks – Multi-hop
- Applications
 - Home control, Building Control
- 802.15.4g – WiSUN
 - Greater distance and larger packets

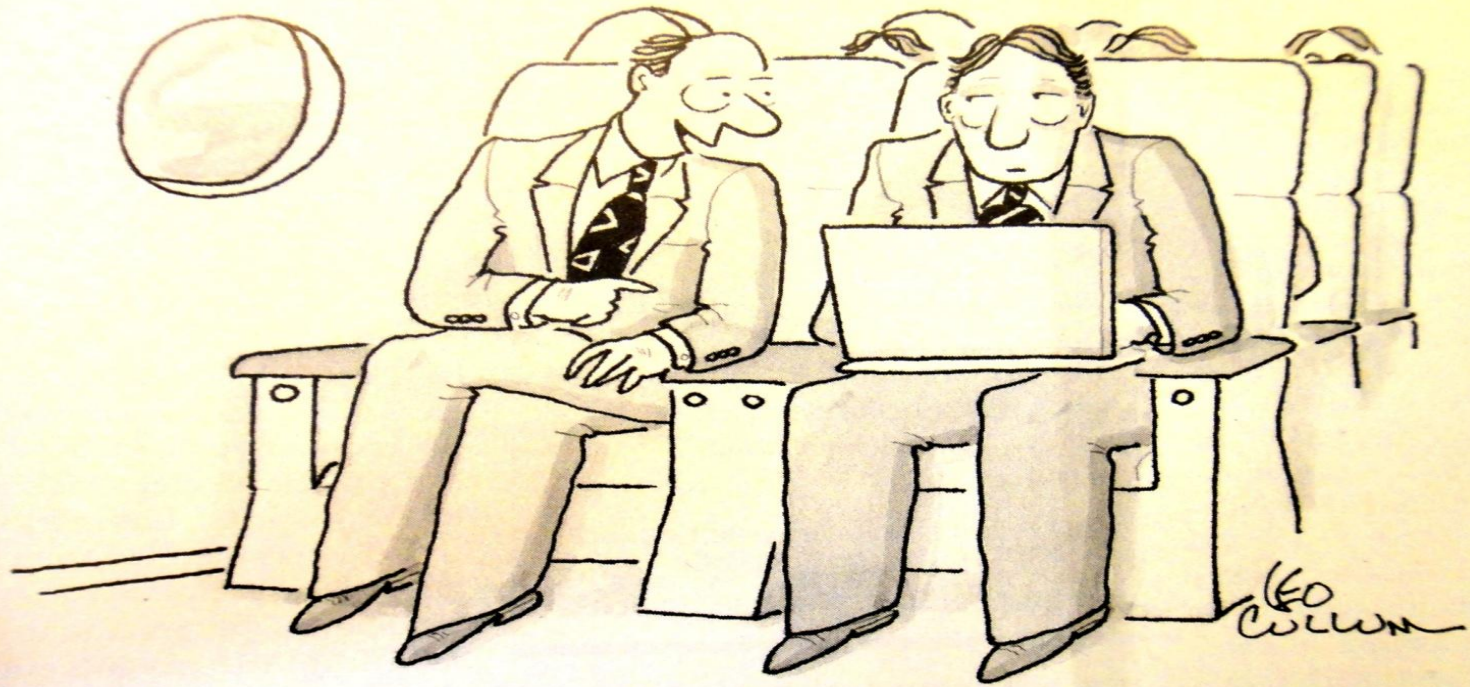
- Low Power Wide Area Networks
- Battery Operated
- Long Range
- Low Cost

- Narrow Band
 - 100 bps
 - 140 msg/day uplink ~ 4 msg/day downlink
- Generally uplink / limited downlink
- Low Power
- Multiple Chip sources
- One single operator world wide

- CAT-1
 - 1Mbps to 10Mbps
 - >\$10
- CAT-M1 (2017)
 - 100Kbps to 1Mbps
 - >\$5
- CAT-M2 (NB-IoT) (2018)
 - <100Kbps
 - <\$5

- LPWAN based on LoRa Radio
- Unlicensed band
- Open standards based (uses IP/TCP)
- Openly available specification
- Open Business model
- Low capex and opex





"You spelled 'confidential' wrong."

- Security is a technology
 - Protocols, Encryption, Passwords, Biometrics
- Privacy is a policy
 - Life of the data
 - Who owns and who can use data
- Use Security technologies to enforce Privacy Policies

Use Open Standards
IP is your friend
Walled Gardens Fail
Cloudification doesn't solve all problems
Do not ignore Privacy

Thank You

Geoff Mulligan
geoff@mulligan.com