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Deep Dive: Which LPWAN Technology is Right for IoT?

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Connectivity Use Cases in IoT

Diverse use cases and solutions that encompass competing requirements:

- Bandwidth
- Latency
- Power Use (Battery)
- Remoteness
- Reliability

- Device to device
- Device to cloud
- Cloud to device

Clustered Assets

Remote Control

Remote Sensor

Personal Area Network

Mobile Devices

Ethernet WiFi

Connectivity Options for IoT

Existing Technologies

strongly address short-range and long-range, high-power cases

Business Cases

many long-range technologies are expensive and only use public networks

IoT Technologies

optimized for their task - communication aspects must be, too

Short Range High Speed

- Ethernet
- Wi-Fi

Short Range Moderate Speed

- 802.15.4
- ZigBee
- ZWave
- Bluetooth
- Thread

Long Range High Power

- Cellular
- Satellite
- Microwave

Long Range Low Power

Supplemental Selection Factors

Usage Models/Licensing

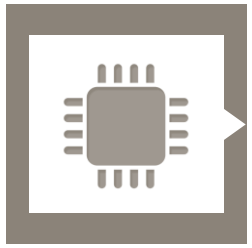
- SIGFOX – Required to utilize their public network
- LoRa – Proprietary physical layer but open MAC
- Weightless – Entirely open

Regional Regulatory Differences

- **Example:** In Europe, an 868 MHz ISM gateway cannot transmit more than 10% of the time.
- **Example:** LoRaWAN in Japan/Korea require use of the 433 MHz band with specific spacing requirements

Upstream/Downstream Biases

- Example: SIGFOX is nearly entirely upstream so use is typically limited to sensor networks
- Example: LoRaWAN has three device classes supporting different balances of upstream/downstream data



Hardware/Network Availability

Sources: SIGFOX, Lora Alliance, Weightless SIG, Link Labs

LPWAN – Pros/Cons

LoRa™

Pros	Cons
• Private and public networks • MAC & network layers are open • Good hardware availability • Flexible for broad uses • Inexpensive • Excellent battery life	• Proprietary PHY layer • Transceivers only available from Semtech • High downstream latency

SIGFOX
One network A billion dreams

Pros	Cons
• Easy/quick product development • Well capitalized and good network availability • Inexpensive	• Must use public network • Very limited data transfer • Use is limited and caters to sensor networks, status monitoring, etc.

waviot

Pros	Cons
• Public and private networks • Great use of spectrum • Good hardware availability • Excellent link budget and performance in varied environments	• High latency • Very low speed • Less flexibility than LoRa, Weightless

INGENU

Pros	Cons
• Private and public networks • Excellent bi-directional communication • Scalable base stations • Good bandwidth utilization	• Works in crowded 2.4 GHz band • Higher frequency less penetrable

LPWAN – Pros/Cons

W-N

Pros

- Very similar to SIGFOX – great for sensor networks
- Good urban range
- Open standard

Cons

- Upstream data only
- Very slow (100bps)

W-P

Pros

- Bi-directional communication
- Variable data rates offer flexibility (200bps–100kbps)
- Open standard

Cons

- Limited hardware availability
- Wider channels offer slightly less scalability than Weightless-N
- Limited communication range

W-W

Pros

- Wide channels (5MHz) leads to high data rates (10Mbps)
- Little contention for spectrum
- Great range and signal penetration
- Open standard

Cons

- Differing country-specific regulations on use of whitespace
- Slow adoption leads to lower support in the marketplace

ADAPTRUM

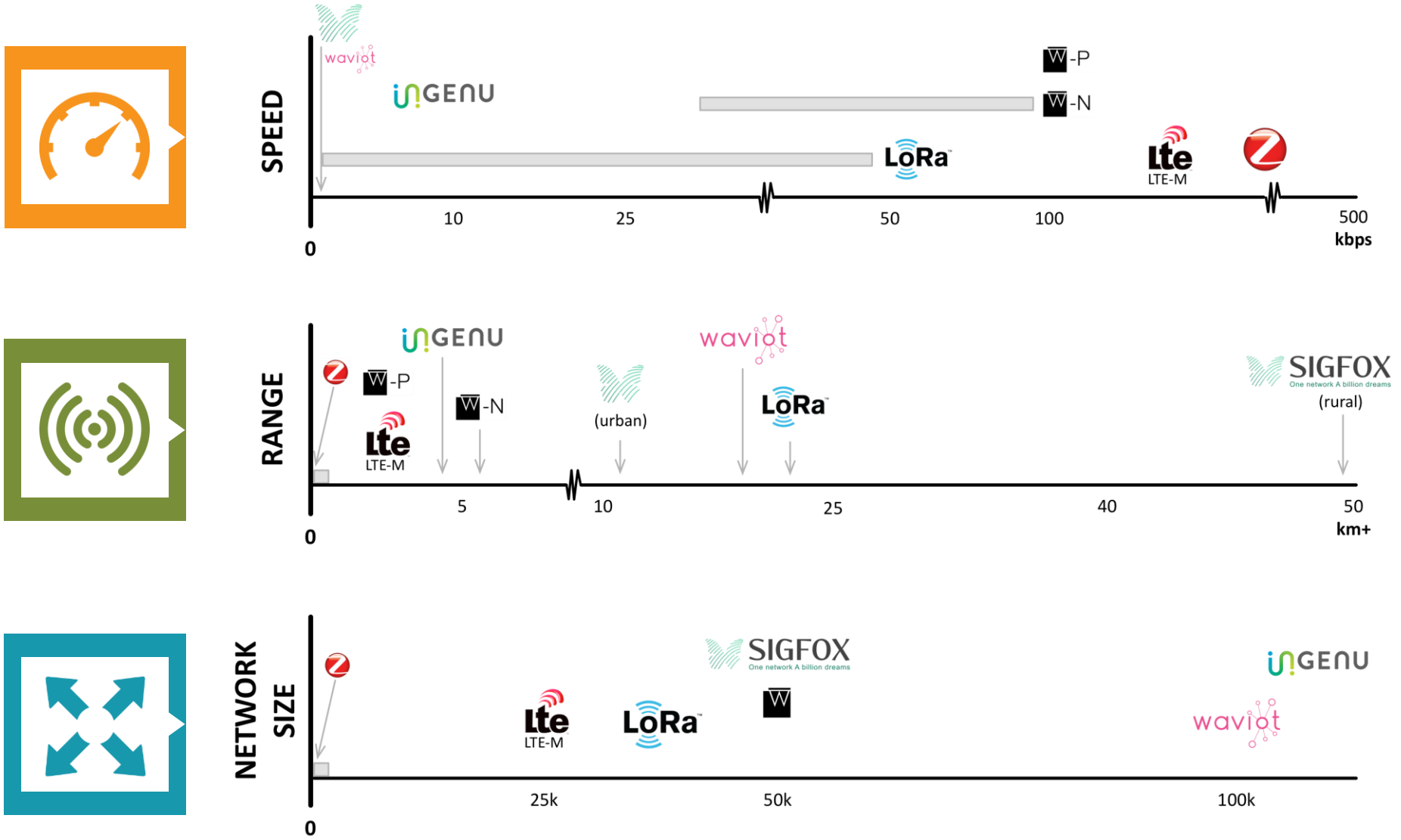
Pros

- Supported whitespace technology with good hardware availability
- Flexible to adapt data rates and communication directionality
- Mobile device support

Cons

- Differing country-specific regulations on use of whitespace

LPWAN – Comparisons



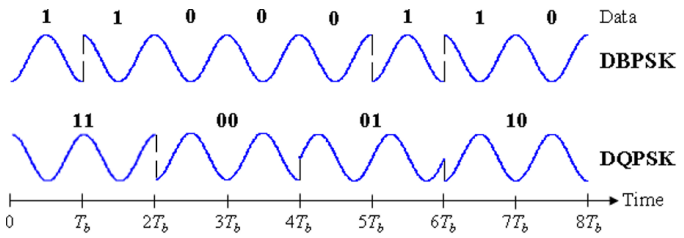
Sources: WAVIoT, NWave, Weightless SIG, and EE Journal

LPWAN – Technology Details

	UNB	UNB	NB	LoRa	NB-Fi	RPMA	OFDM
Implementation	SIGFOX	Weightless-N	Weightless-P	LoRa	WAVIoT	Ingenu	GreenWaves
Frequency Range	Sub-GHz	Sub-GHz	Sub-GHz	Sub-GHz	Sub-GHz	2.4 GHz	2.4 GHz Sub-GHz
Modulation	BPSK	DBPSK	FDMA/TDMA	CSS	DBPSK	DSSS	OFDM
Channel Width	100 Hz	200 Hz	12.5 kHz	125 kHz	100 Hz	1 MHz	-
Typical Range	10-50 km	5 km	2 km	22 km	17 km	4 km	-
Typical Data Rate	100 bps	30-100 kbps	0.2–100 kbps	0.3-50 kbps	10-100 bps	0.0-8 kbps	1 Mbps

Sources: WAVIoT, GreenWaves, Weightless SIG, LoRa Alliance, and EE Journal.

Weightless-N – DBPSK



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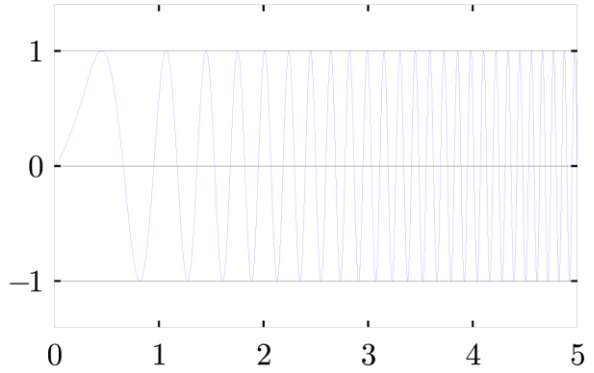
LoRa – CSS



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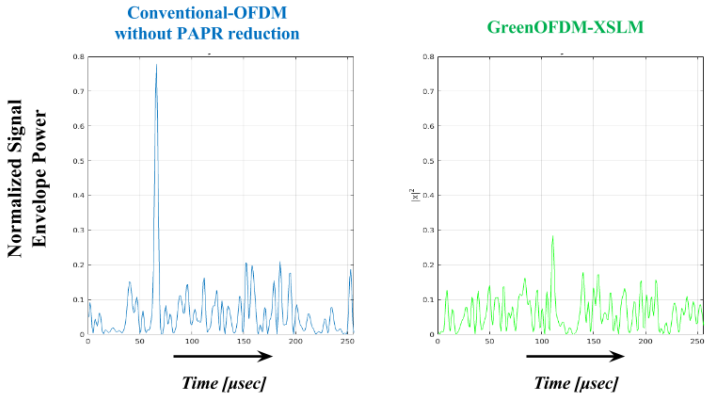
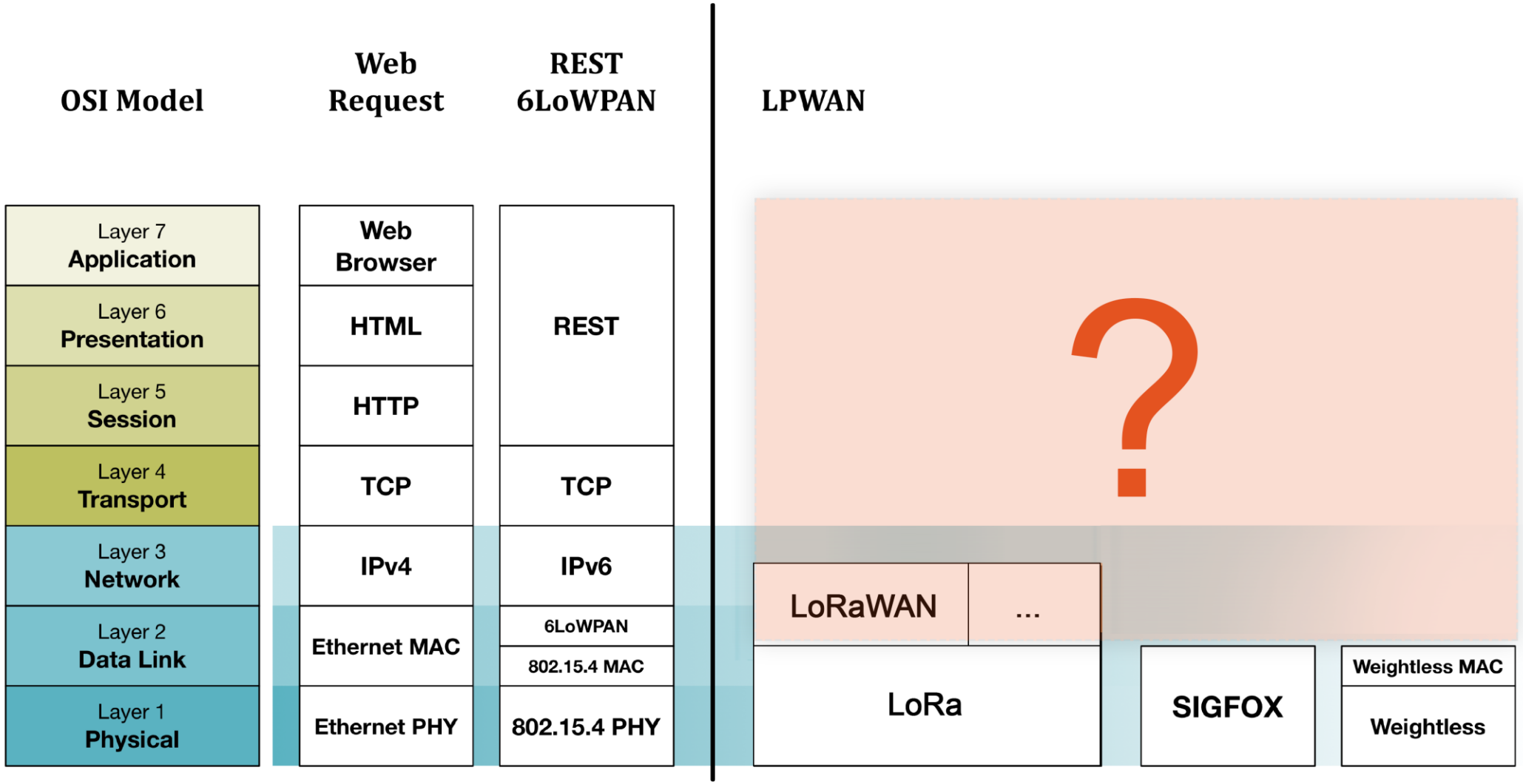
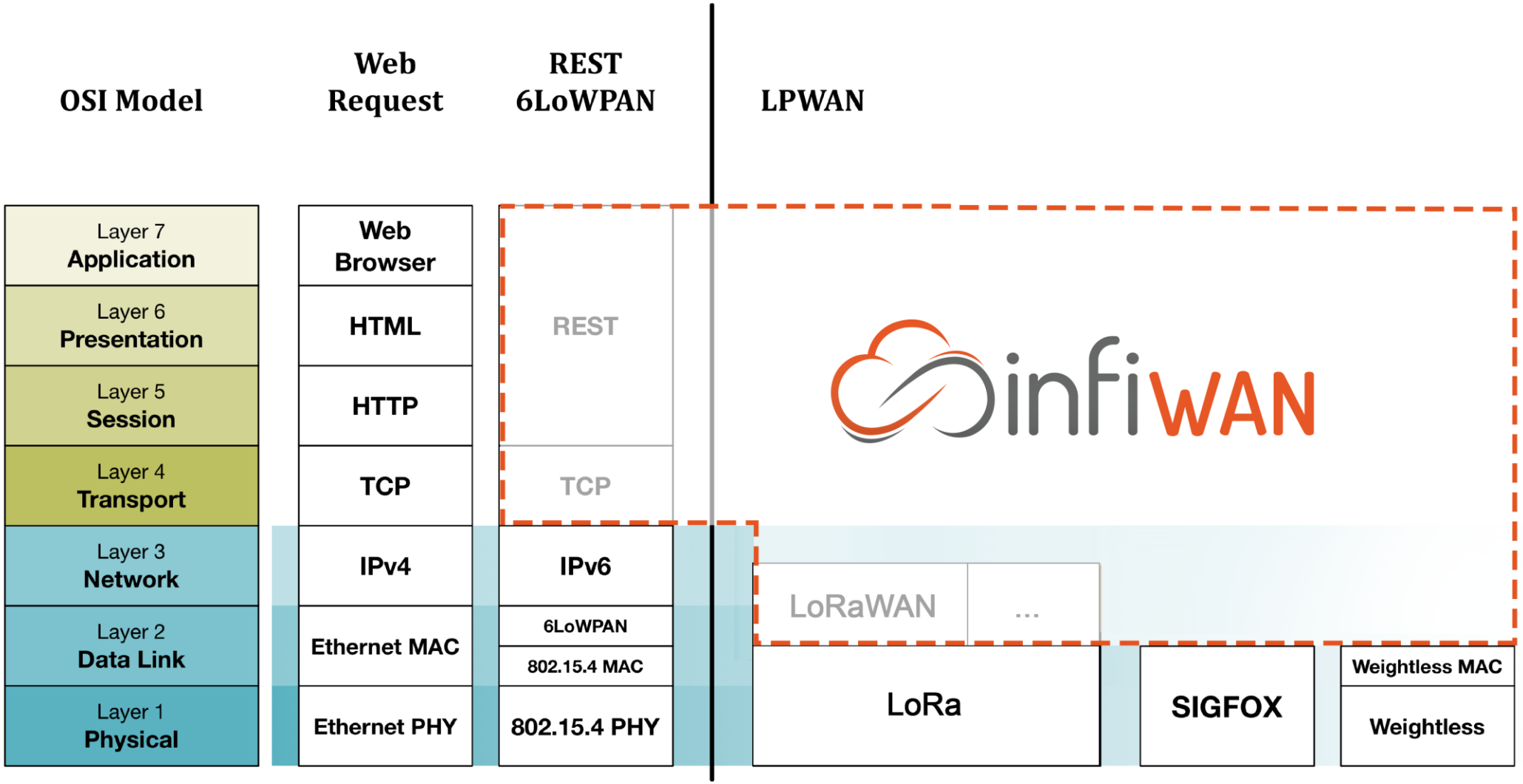
GreenWaves – OFDM



LPWAN – Looking Toward the Future



LPWAN – Looking Toward the Future



Thanks!

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