Ultra Wideband

An introduction to Use-cases, Players,
Market & Technology

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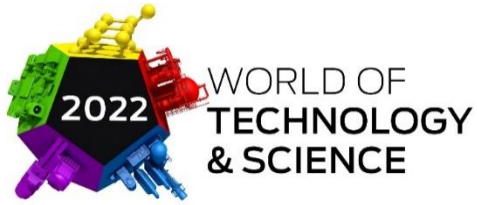
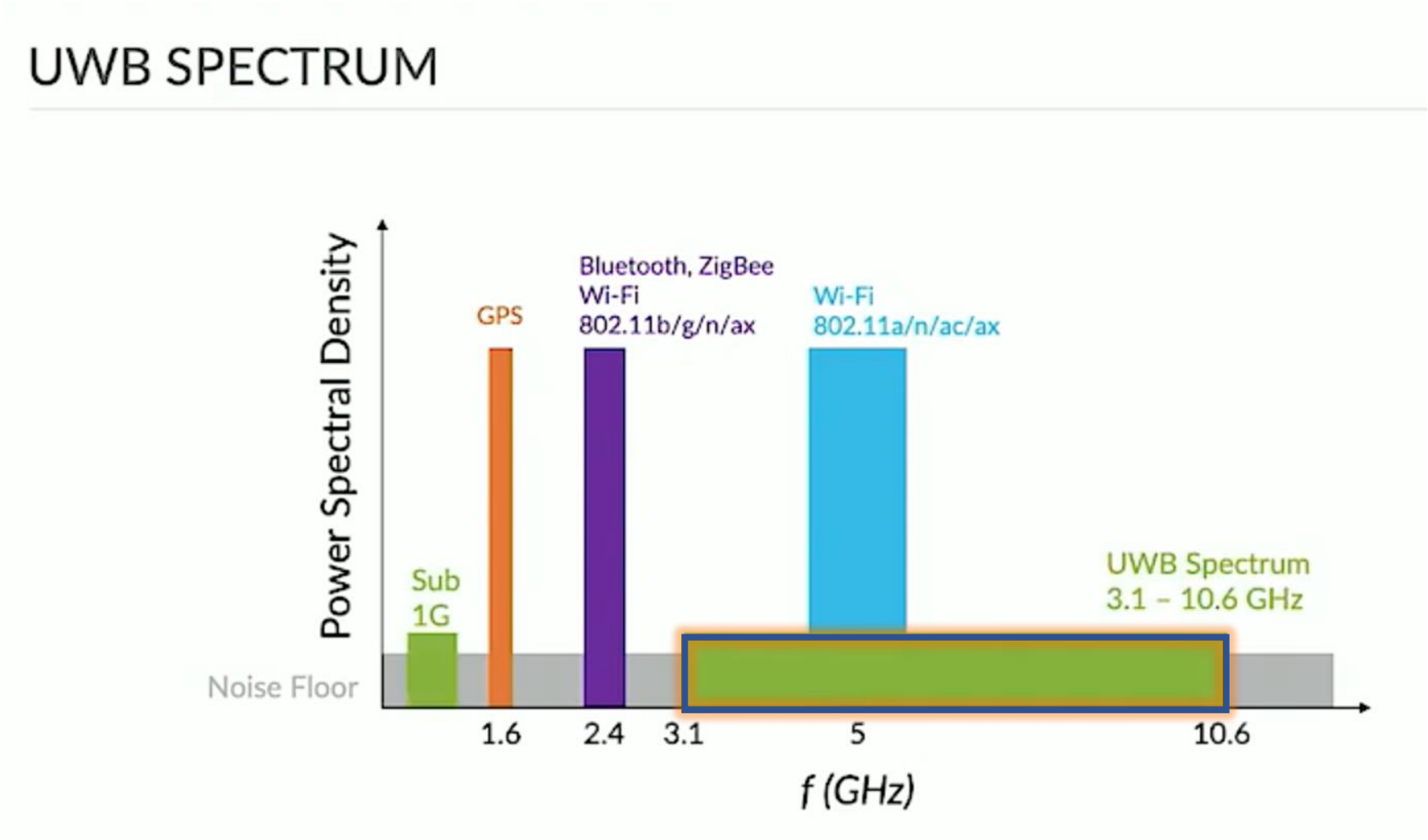


Agenda - Market

- Introduction
- UWB Market & Use-Cases
- Key Players
- Consortiums/Alliances
- Technology at a brief

Bandwidth Comparison to other Technologies



Source: https://bleesk.com/uwb.html

Ultra Wideband History

UWB Technology is not New…

1901: Marconi transmits Morse code across the Atlantic with UWB

1960: UWB used in military RADAR

2002: FCC approves UWB for commercial applications

Federal Communications Commission

1900 — 1950 — 2000

Low-Speed Data Transmission

Detecting Distance & Direction

IEEE 802.15.3 → 802.15.4 WiMedia

High-Speed Data Transmission

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This Time it is about Accurate Ranging and Positioning

UWB ALLIANCE

CARCONNECTIVITY consortium®

FiRa CERTIFIED

PHY + MAC

Digital Key – The Future of Vehicle Access

PHY + MAC

2000 | 2007 | 2016 | 2018 | 2Q19 | 3Q19 | 4Q19 | 1Q20 | 2Q20 | ..... | 2Q21

IEEE 802.15.4A

FiRa The Power to Be Precise

IEEE 802.15.4z

Accurate Relative Position Tracking → SECURE Accurate Relative Position Tracking

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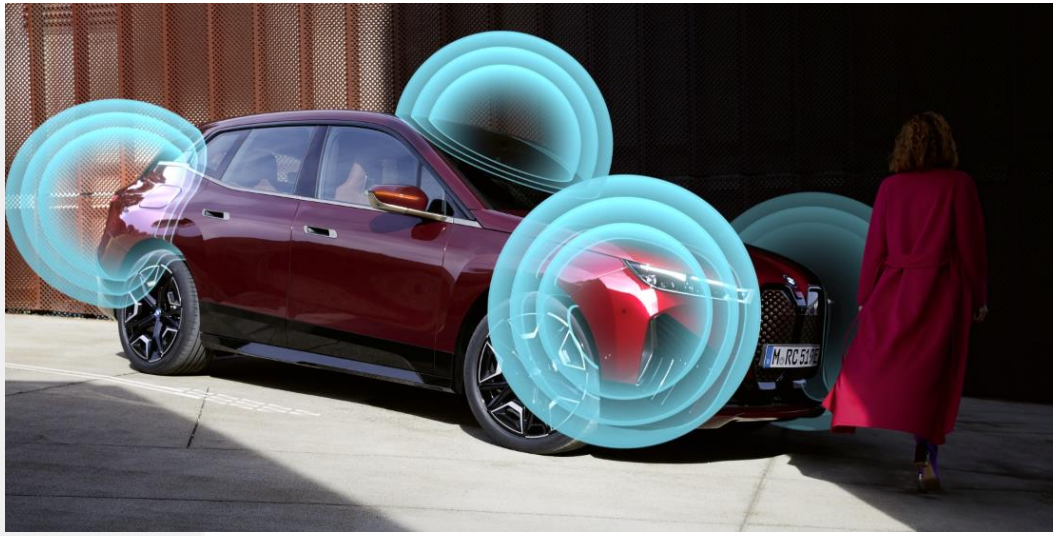
UWB-Enabled Products in 2022



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UWB market & Use-cases

Likely UWB applications are in three main use categories across a variety of verticals

HANDS-FREE ACCESS CONTROL

Simply approach the door and it opens, leave the door on the unsecure (outside) and it locks

Automatic-Access

LOCATION-BASED SERVICES

Bring positioning functionality with a high degree of accuracy to indoor environments

Navigation/Tracking

DEVICE-TO-DEVICE SERVICES

Let two UWB devices share relative ranging and positioning data to localize each other

Point-and-Trigger

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Source: FiRa Consortium

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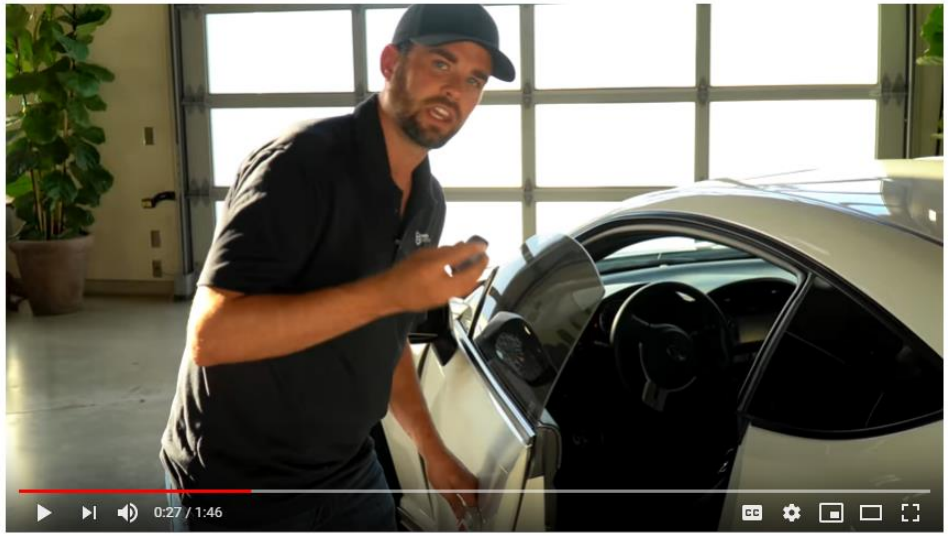
UWB Applications: Access Control

WIRED

ANDY GREENBERG SECURITY 03.21.16 10:33 AM

Radio Attack Lets Hackers Steal 24 Different Car Models



Key Fob Relay Hacking?! What it is and how a Faraday Bag can help

- Verify Identify ***and*** Verify Location
- Key fob or UWB enabled smart phone

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Source: Wired

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UWB Applications: Location Based Services

UWB technology brings GPS-style positioning functionality to indoor environments.

UWB offers **highly precise** positioning (<10 cm)

UWB operates even in crowded, multipath signal environments, and can pass through walls, machinery, and other obstacles.

UWB makes it easier to navigate large spaces, such as airports and shopping malls.

Likely UWB applications are in three main use cases across a variety of verticals

	Smart Home and Enterprises	Smart Cities and Mobility	Smart Transportation	Consumer	Smart Retail	Industry 4.0 and Healthcare
Hands-Free Access Control	• Residential access control • Restricted enterprise access	• Parking garage • Vehicle digital key (standardized by CCC)	• Rider identification (private transport services)	• Logical access control	• Unmanned store access	• Barrier-free and restricted access control
Location-Based Services	• Employee mustering in emergencies	• Bike sharing	• Ride sharing • Reserved seat validation	• AR gaming	• Indoor navigation • Foot traffic and shopping behavior analytics	• Asset tracking • Patient tracking
Device-to-Device (Peer-to-Peer) Applications	• Conference systems	• Drone-controlled delivery • V2X*, autonomous driving	• Ticket validation (public transport services)	• VR gaming and group play • Find someone nearby	• Targeted marketing • Tap-free remote payment	• Proximity-based patient data sharing • Find equipment

Source: FiRa Consortium

Use Cases

- **Smart Car Access** - unlock a car with a smartphone as soon as you approach it for keyless entry and remote start.
- **Secure Wireless Payments** - it’s more secure than NFC and you can leave your smartphone in a pocket.
- **Secure Building Access** - Automatically open doors to a secure area within a building once you approach them.
- **Smart Retail** - provide useful information about a product you just picked up or special offer for buying one.
- **Asset Tracking** - Boeing uses UWB tags to track more than 10,000 tools, carts and other items on its vast factory floors.
- **Sports & Fitness Tracking** - NFL is already tracking players on a field for instant replay animations with UWB transmitters in each shoulder pad. A football's location is updated 2,000 times per second.

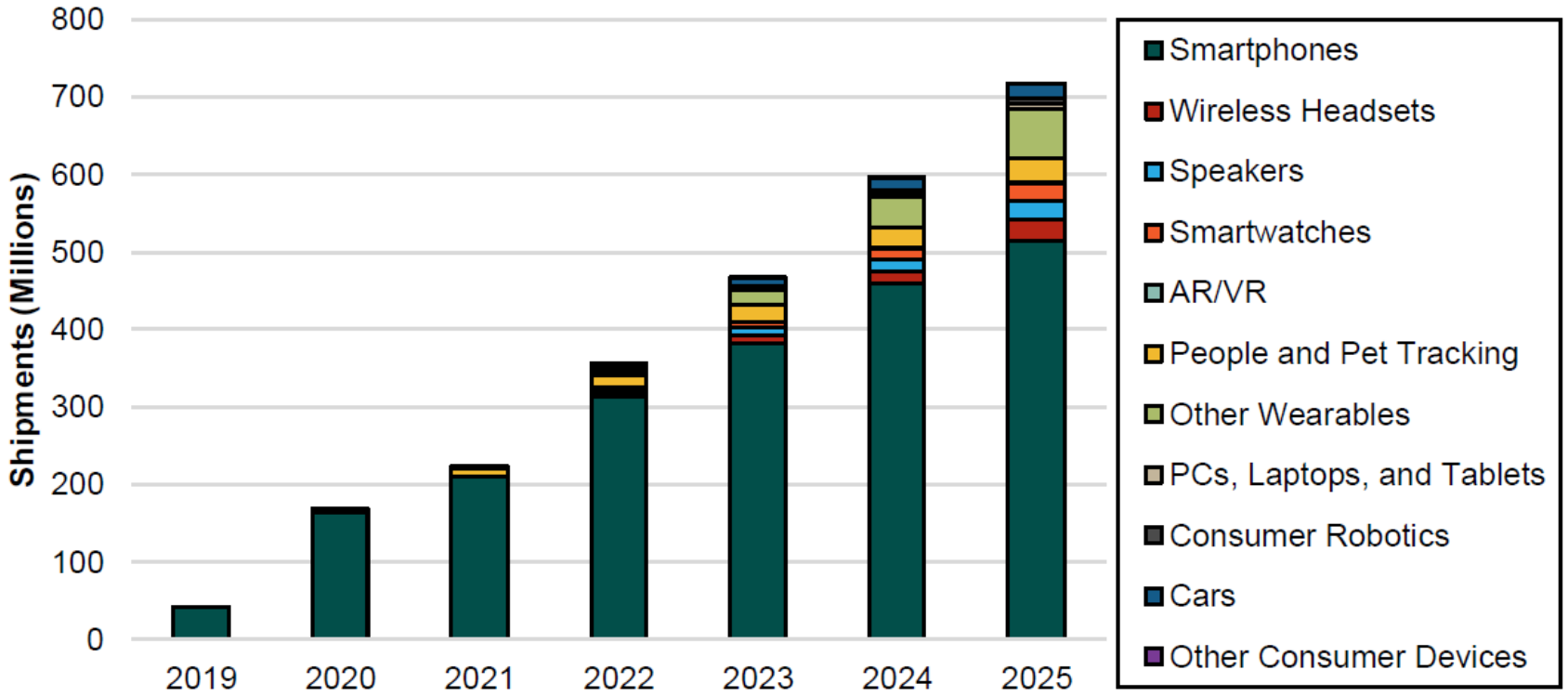
Use Cases

- **Wearable Health Sensors** - Biometric UWB bracelet that monitors body temperature, oxygen saturation levels, body movement, heart-rate 24 hours a day.
- **Indoor Navigation** - Get precise navigation indoor to your gate in the airport or a product on a shelf.
- **Smart Home** - Lights, audio speakers, and any other connected device with UWB sensing capability will be able to follow users from one room to another, for example adjust the volume of a speaker based on where you’re standing or switch Netflix profile to yours.
- **Warehouse Positioning** - Actively track people, machines and equipment indoors, accurate positioning in emergency situations - finding unconscious person.

UWB Technology Adoption is Accelerating

UWB Unit Shipments to Grow at 35% CAGR through 2025

- Primary Applications:
  - Mobile
  - Automotive
  - Smart Home
  - Wearables / Tags



Source: ABI Research

Key Players

Key Players - Semiconductor

Decawave Is Now qorvo

BeSpoon omlox | life.augmented

NXP

MICROCHIP

Consortiums & Alliances

UWB Ecosystem

STANDARD

IEEE

IEEE 802.15.4z-2020

CONSORTIUMS

UWB ALLIANCE

fira

omlox

CARCONNECTIVITY consortium®

SCOPE

- Regulatory Focus
- Consumer Focus
- Industrial Focus
- Automotive Focus

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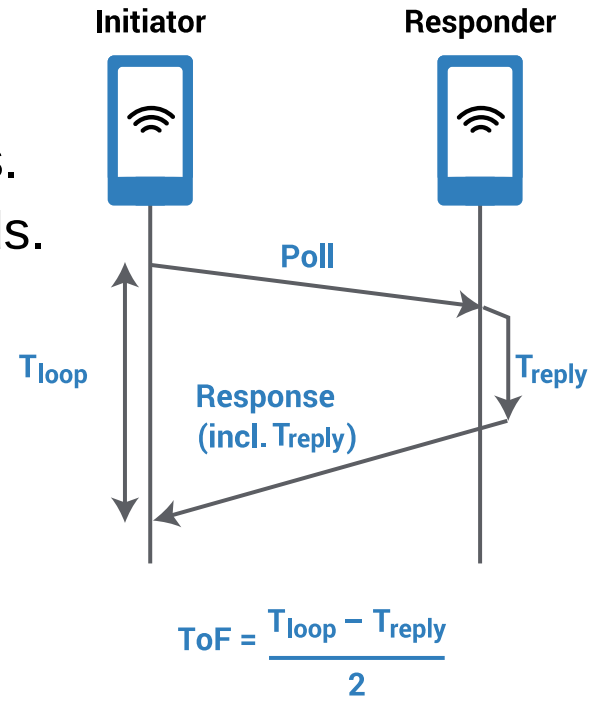
Ultra wideband – At a Brief

How does the distance-measurement work?

- By measuring the time it takes to send a packet and receive a response packet, the distance between two devices can be calculated.
- It has to be really accurate:
  - RF signals travel at approximately 300.000km/s or 300.000.000m/s.
  - A distance of 30m is a fraction of a second, at only 100nanoseconds.

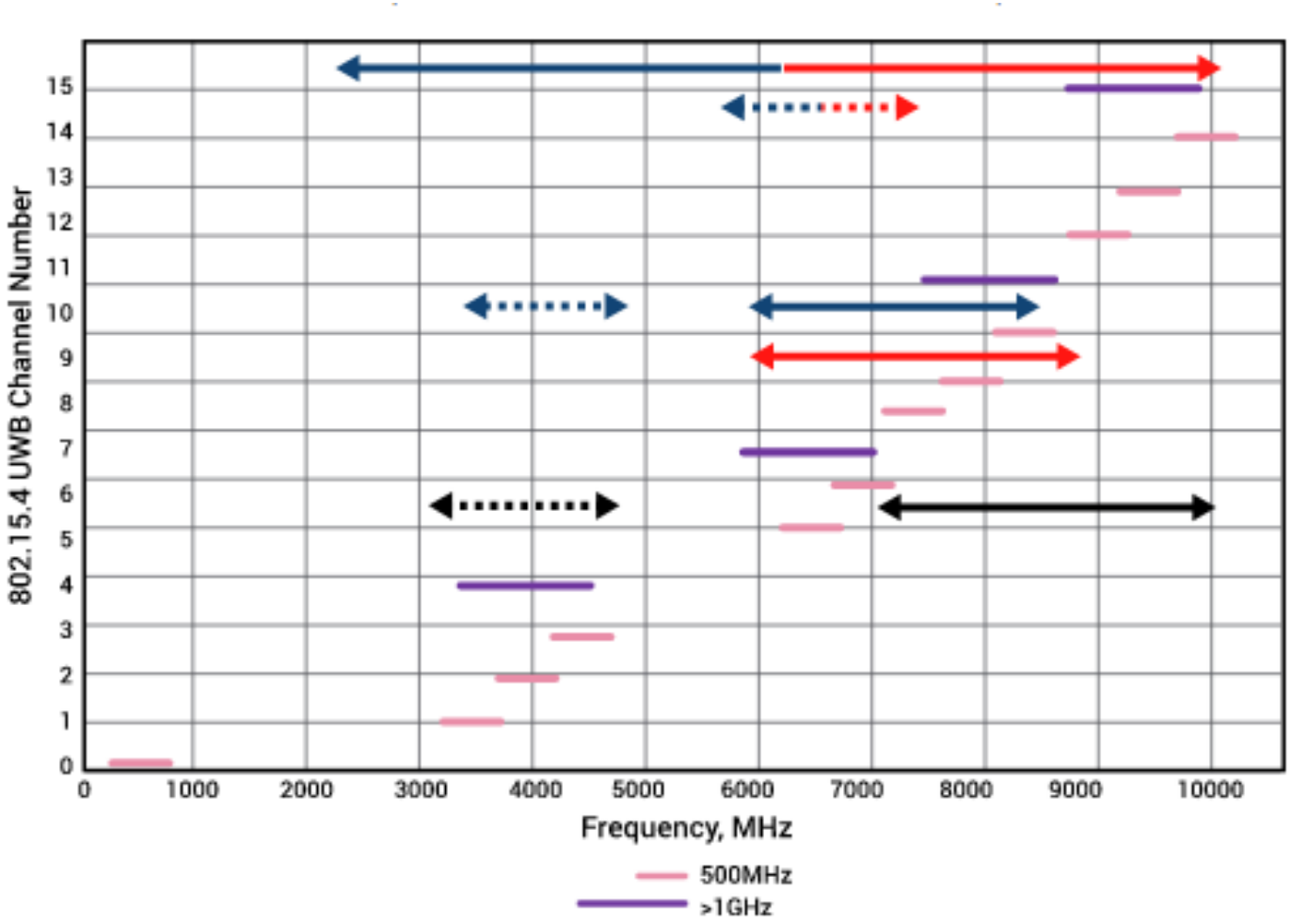


UWB: The Standard - IEEE

- UWB is based on the IEEE802.15.4A and the follow-up 802.15.4Z amendment.

- New work is already in progress by the 802.15.4AB workgroup.
  - Draft 0 expected by September 2022.

Regulatory Landscape



China

Korea & Japan

Korea with LDC or DAA

US indoors & handheld

US indoors & mobile out

Europe & others*

Europe with LDC or DAA

*e.g. Australia, New Zealand, Singapore & India (since 18 Oct 2018)

LDC = Low Duty Cycle
On for <50ms in any second (5%)
and <18s in any hour (0.5%)

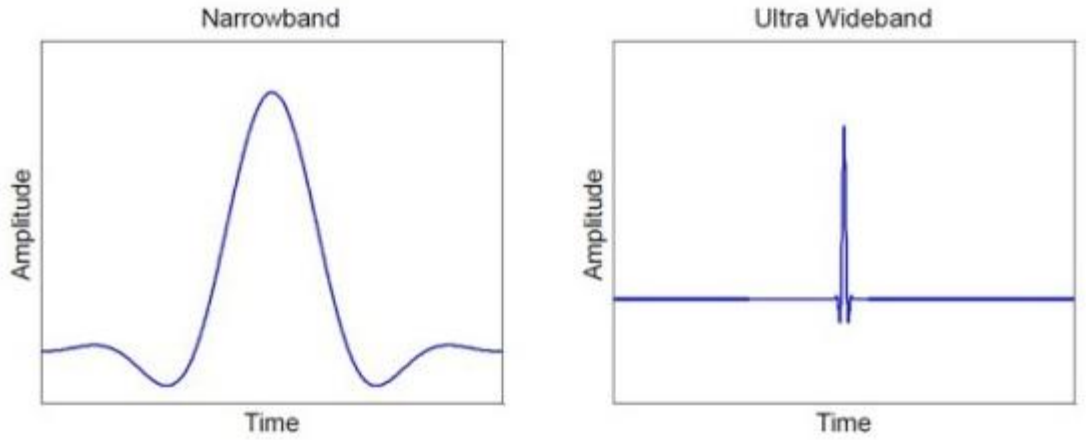
Pink and purple lines show the IEEE standard defined channels and bandwidths.

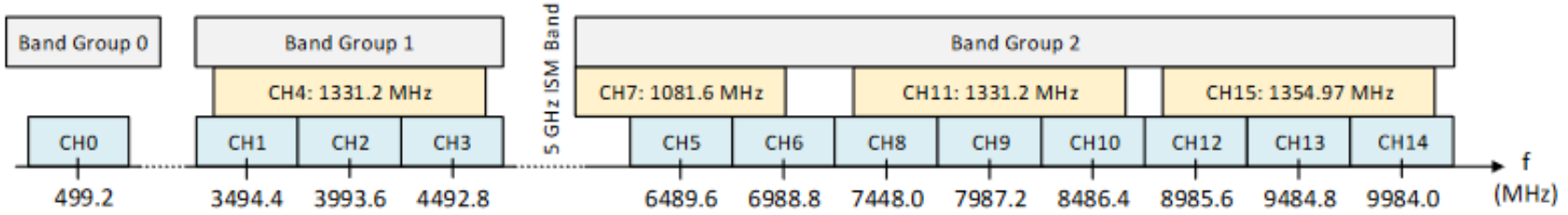
Double-ended arrows show allowed UWB frequency bands in various regions.

Source: FiRa Consortium

High Level UWB Specs (802.15.4z)

Parameter	Value
Center Frequency Range (HRP- High Band)	6489.6 – 9984.0 MHz
Channel Bandwidth	500 MHz (typical) up to >1 GHz
Transmit Output Power	< -41.3 dBm / MHz
Data Rates	110 kpbs, 425 kbps, 850 kbps, 1.7 Mbps, 6.81 Mbps, 27.24 Mbps
Ranging Support	Yes
Range	10 m – 100 m
Positional Accuracy	<10 cm





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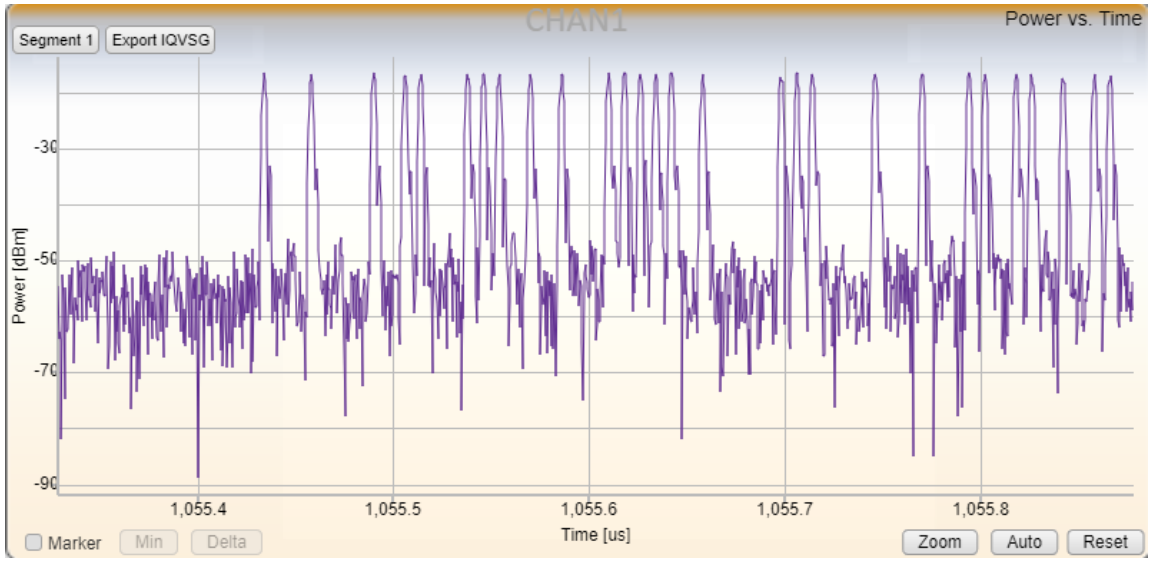
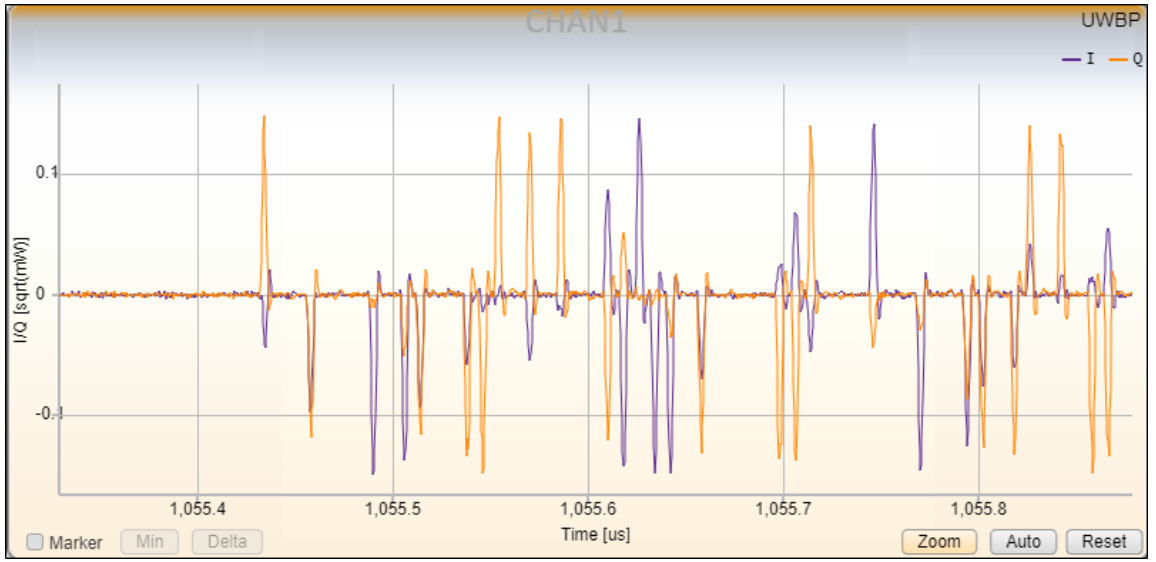
What is transmitted? – Initial part

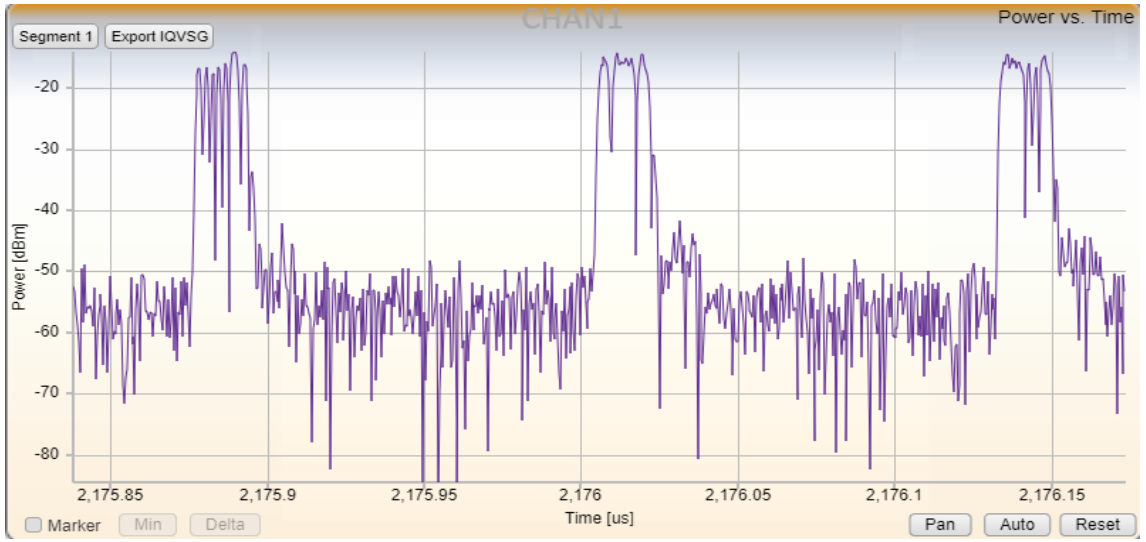
- For initial part of Frame, a train of pulses:
  - Positive
  - Negative
  - No-pulse

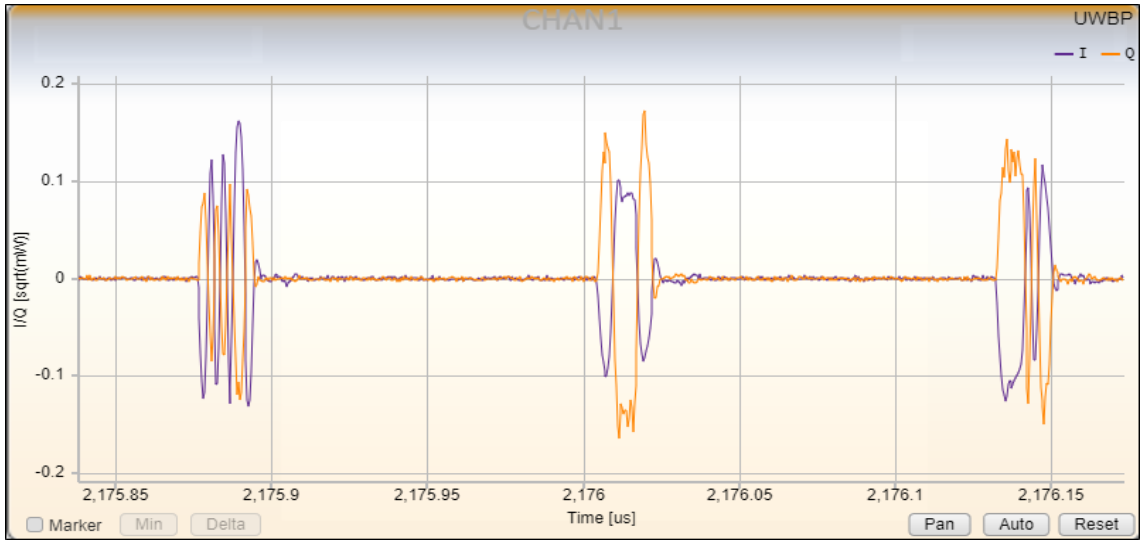




What is transmitted? - Data

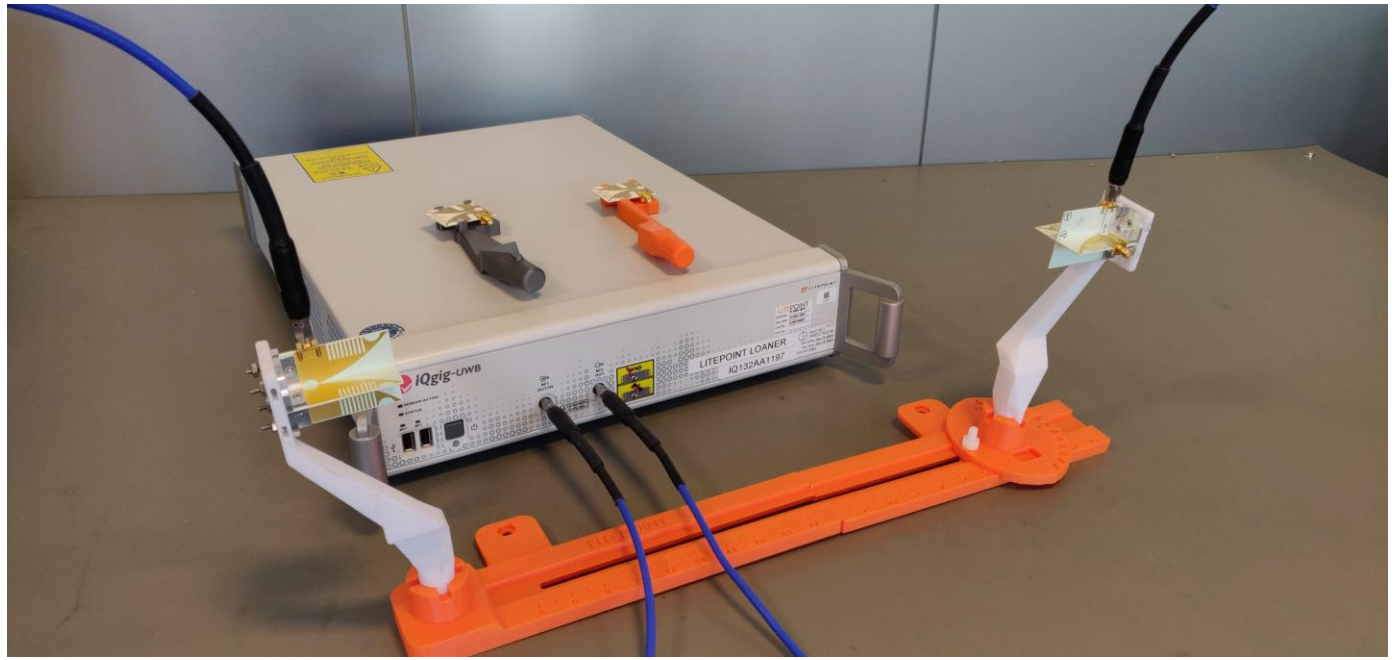
- For Data part of Frame, bursts of pulses:
  - 4/8/16 pulses depending on data-rate.





Test Coverage	Regulatory	Standards and Interoperability	Performance / User Experience
Crystal Trim Calibration		X	X
Antenna Delay Calibration			X
TX Power Calibration	X		X
Data / Preamble peak and avg power	X		
Data /Preamble peak power	X		
Spectrum Mask Margins	X		
Carrier Frequency Offset		X	X
Chip Clock and Frequency Error		X	X
Pulse Main Lobe Width, Side Lobe Power		X	X
Symbol Modulation Accuracy		X	X
Pulse NMSE		X	X
RX Sensitivity Verification		X	X
ToF Verification			X
AoA Verification			X

Come visit us at Booth 9B008



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