



International Committee on
Global Navigation Satellite Systems

Case Studies: Ultra Wide Band and Ligado

Disclaimer

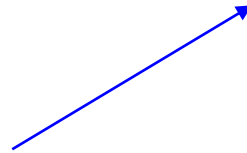
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What's Ultra WideBand (UWB)

Very narrow time
domain pulses



Create a very wide
frequency spectrum



Sub-nanoseconds in time \Rightarrow GigaHertz
in frequency spectrum

UWB vs GPS – Conflict in Priorities

- The FCC and companies like Intel, Microsoft, and Sony saw UWB as an important step forward
 - Wideband, multipath-free communications
 - “Free” spectrum
 - UWB energy is lightly sprinkled across many frequency bands
 - With such low spectral power density, who could care?
- Omnidirectional users of satellite signals care
 - Because satellite signals are extremely weak



Part 15 of FCC Rules

MODEL FKB4700 SERIES

FCC ID: C9S4D5KB4700

FUJITSU LIMITED

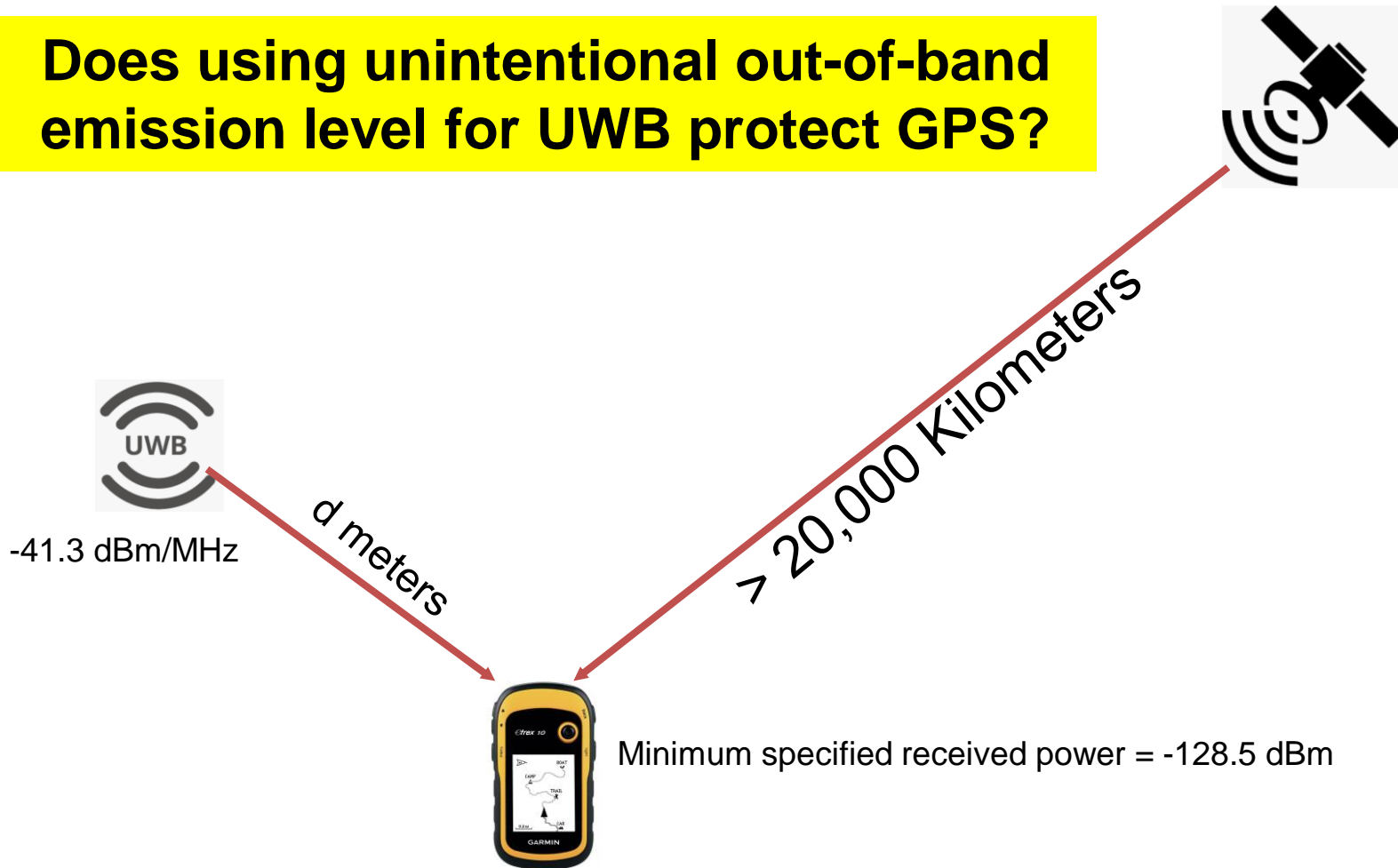
MADE IN MALAYSIA

"Certified to comply with the limits for a Class B computing device pursuant to Subpart J of Part 15 of FCC Rules. See instructions if interference to radio reception is suspected."

Unintentional radiation is limited by FCC Part 15 rules to -41.3 dBm/MHz EIRP

Received GPS Signal is Very Weak

Does using unintentional out-of-band emission level for UWB protect GPS?



UWB Criteria Selected for GPS Protection

- It is **not** possible to regulate the user density of Unlicensed, Uncontrolled, Ubiquitous UWB emitters
 - One prediction: “1,000’s in homes, 1,000,000’s in an industry”
- It is only possible to regulate the emissions from **each** individual device
 - Backed by a vigorous testing and product recall program
- Therefore, in the GPS bands the UWB criteria is:
 - Allow each UWB emitter to raise the GPS noise floor
 - By 26% (1 dB) at a distance of 6 feet (1.83 m)
 - Which requires an EIRP at or below -75.3 dBm/MHz
- In comparison, the cost and the time required to raise the power of all 28-31 GPS satellites by 26% would be Billions of dollars and at least 15 years



Cover of December 2001 FCC Presentation

Walk DON'T Run - The First Step in Authorizing Ultra-Wideband Technology



Ron Chase

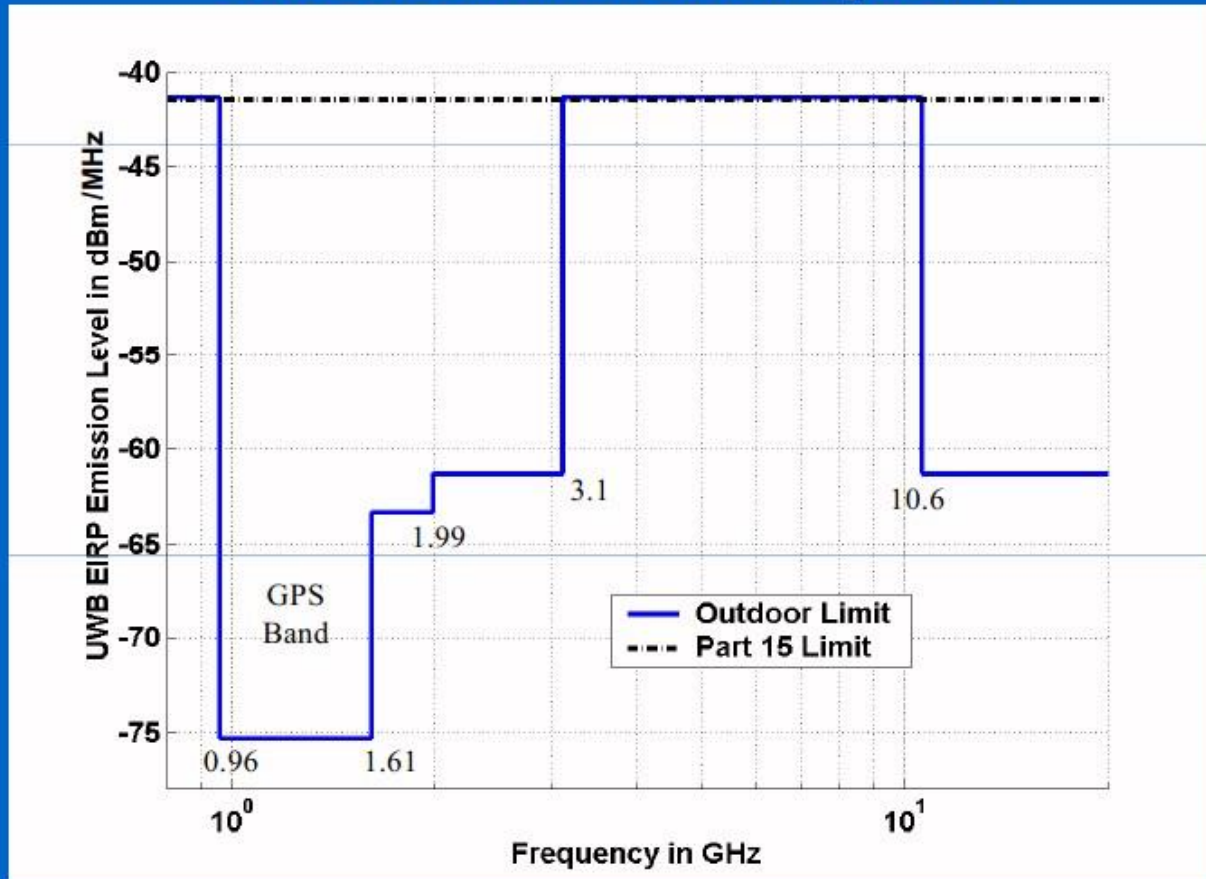
ITU-R Chair U.S Task Group 1/8 on UWB

Federal Communications Commission

-75.3 dBm/MHz, 34 dB Below Part 15 Limit

UWB Emission Limits

Outdoor Communication Systems



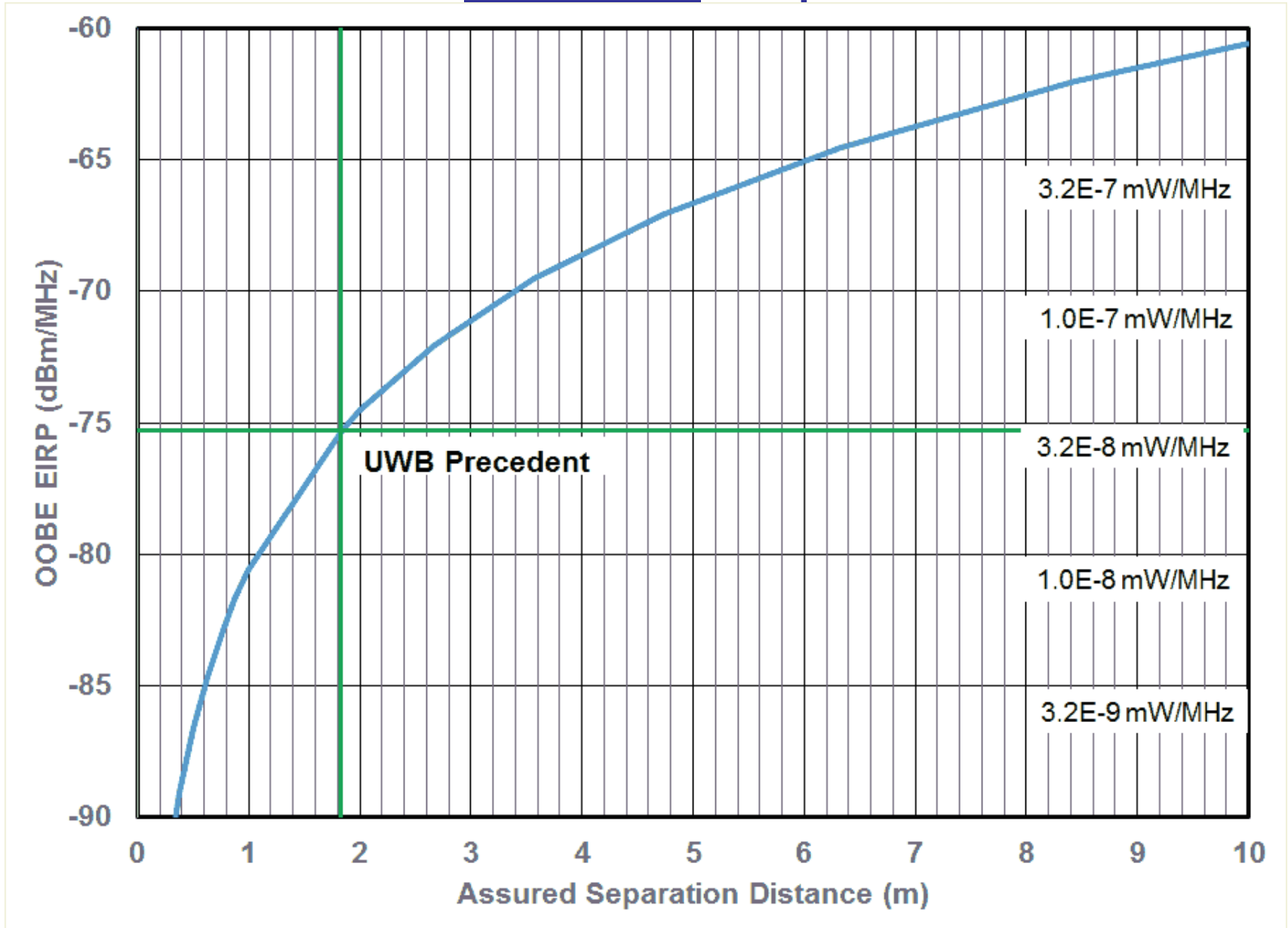
Equipment must be hand-held.

Using the UWB Agreement as a Model

- Based on the UWB Agreement, the following chart shows:
 - The Equivalent Isotropic Radiated Power (EIRP)
 - Of Out-Of-Band-Emissions (OOBE)
 - Received within the GPS L1 band
 - From a transmitter at an assured minimum distance from any GPS receiver
- This must be achieved by
 - Filtering at the transmitter
 - Transmitter power control if needed
- Assured distance means the GPS receiver and the transmitter must never be that close



OOBE EIRP vs. Assured Separation Distance



Unintentional Radiation Limit

- The FCC regulates unintentional radiation with Part 15 rules, requiring EIRP to be less than -41.3 dBm/MHz
- The UWB industry asked the FCC for permission to intentionally transmit that level of noise-like signal, including within the GPS spectrum
- Ultimately, the FCC UWB Report & Order (R&O) limited most UWB emissions to -75.3 dBm/MHz EIRP, 34 dB less than Part 15 power in GPS bands
- *What standard does your country use?*



Adjacent Band Concern Example: Ligado

What is an adjacent band?

- Two frequency bands next to each other are called "**adjacent bands**"
- Radio Regulation services allocated in adjacent bands have characteristics that allow them to be **compatible**
- Compatible adjacent band services are typically similar, e.g. ground to Earth satellite emissions
- Services that are incompatible and therefore not suitable to be in adjacent bands are typically very different in nature
 - eg TV (very high power) and mobile phone (high power) networks



Being a 'good neighbour'

- Adjacent band compatibility means that the emissions of radio services in adjacent bands do not cause unacceptable interference to each other – they are good neighbours
- How do you know different services will be good neighbours?
- Ask the ITU!
- ITU Member State experts (working within ITU **Working Parties**) consider in detail how two different services would work as neighbours



Adjacent band compatibility studies

- ANY proposal to change the Radio Regulations to make a new allocation for a radio service is always studied carefully to assess the impacts on existing services
- The studies consider the parameters for each service as well as how they are used, or would be used
 - eg, power levels, antenna types/direction, receiver sensitivity, frequency characteristics, indoor/outdoor, fixed position or mobile
 - these are built into a model to determine the degree to which the two services interfere with each other
 - depending on results, the proposed allocation may or may not be compatible with the existing service



When it can go wrong

- If new allocations/services are introduced:
 - without compatibility studies being carried out
 - or if incorrect parameters are used
 - or assumptions about existing usage are incorrect⇒ then **interference is a real risk!**
- this could happen if a country decides to introduce new services without proper studies
- this is especially risky for GNSS, with such low level signals:
 - spectrum occupancy measurements are unlikely to show the presence of GNSS signals
 - if other radio services then use nearby frequencies⇒ **interference to GNSS is a real risk!**

