
UltraWideBand - UWB

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UltraWideBand - UWB

- **UltraWideband is . . .**
- **Low power short range data links potentially over all of 3.1-10.6GHz**
- **Essentially UWB = Wireless USB or Firewire**
- **UWB allows a high data rate to be achieved with relatively simple equipment but results in transmissions spread across large parts of the spectrum used by others.**
- **UWB might be used to deliver wireless connections between DVD players, displays and speakers, for example, simplifying installation and removing the need for unsightly wires. It might provide a wireless high data rate link between digital cameras and computers or link computers, PDAs and other computing devices in a local area.**
- **Intel expects UWB to be integrated into PC Motherboards in 2006**
- **Likely to be popular for high speed Video streaming etc**

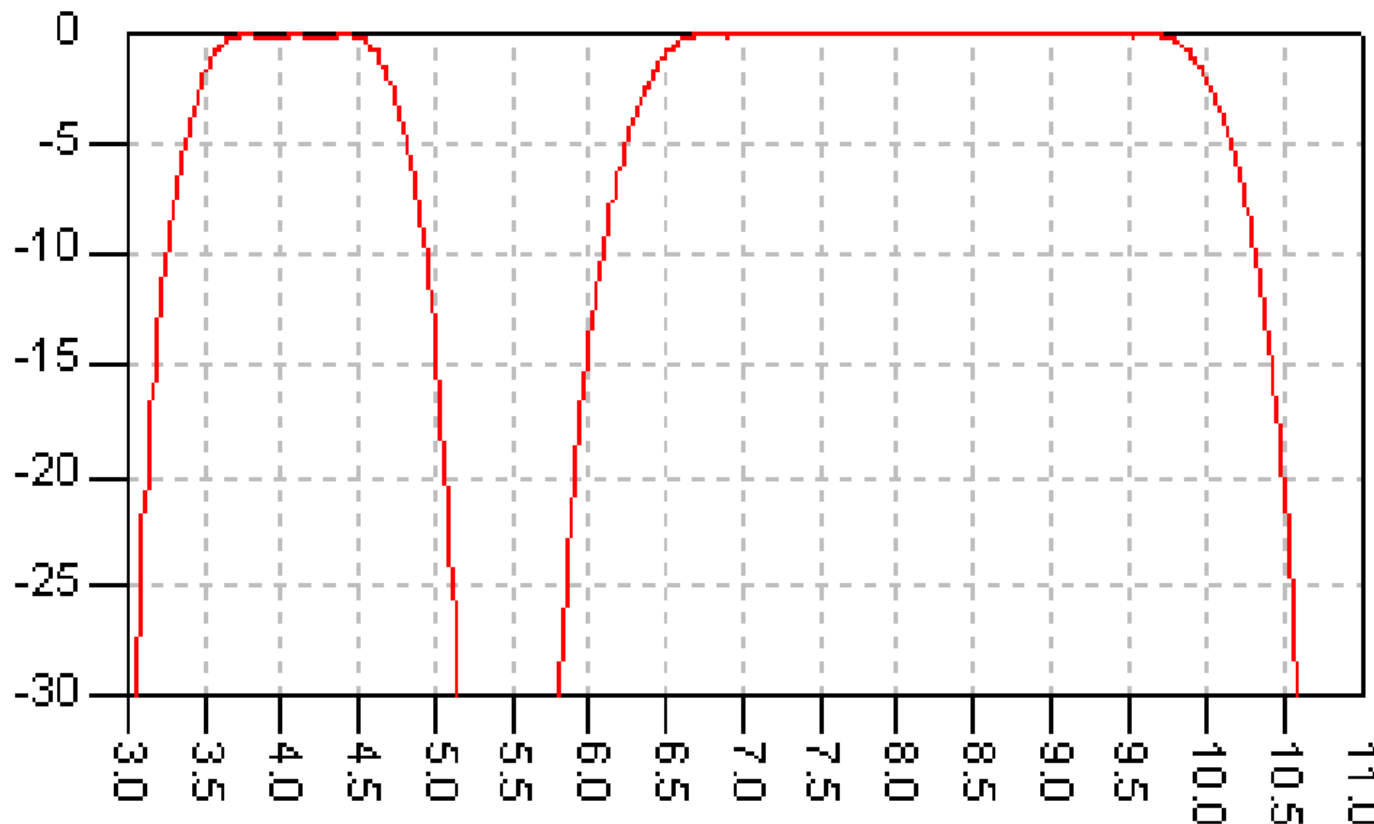
UltraWideBand - UWB Standards

- **Brief Intro to Ultrawideband Spectrum follows, but this is dependent of which standard is used**
- **Two Camps with incompatible standards**
 - Freescale (Motorola) Direct Sequencing
 - Intel OFDM Alliance
- **IEEE 802.15 trying to resolve battle**
 - <http://www.ieee802.org/15/>
 - NB Fierce debate in latest minutes at <http://grouper.ieee.org/groups/802/15/pub/Minutes.html>
- **Both camps will only use lower bands for now due to chipset availability and costs**

Direct-Sequence UWB

<http://www.uwbforum.org/>

- **DS UWB - Two bands only**
- **Largely a Motorola (Freescale) Initiative**
- Lower band occupies 3.1 GHz to 4.85 GHz and the
- Upper band occupies 6.2 GHz to 9.7 GHz.
- NB - The upper end seems to be rather higher than 9.7 and hit 10GHz+



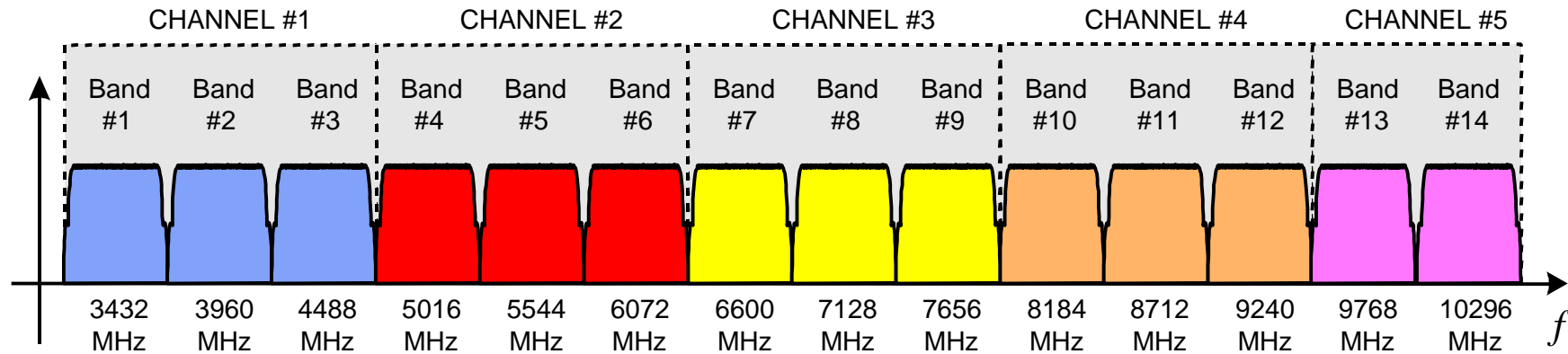
DS UWB Channels

| Piconet Channel | Centre Frequency |
|----------------------------|-----------------------------|
| • 1 | 3939 MHz |
| • 2 | 3978 MHz |
| • 3 | 4017 MHz |
| • 4 | 4056 MHz |
| • 5 | 3900 MHz |
| • 6 | 4094 MHz |
| • 7 | 7878 MHz |
| • 8 | 7956 MHz |
| • 9 | 8034 MHz |
| • 10 | 8112 MHz |
| • 11 | 7800 MHz |
| • 12 | 8190 MHz |

NB No Scope within a spectral band for selective channel notching

OFDM UWB

<http://www.multibandofdm.org/>



- **OFDM uses sub-bands with more scope for notches/spectral sculpting**
- **Mode-1 uses Group-1 only**
- **Broad Industry Alliance led by Intel and PC Companies**

| Band Group | BAND_ID | Lower frequency | Center frequency | Upper frequency |
|------------|---------|-----------------|------------------|-----------------|
| 1 | 1 | 3168 MHz | 3432 MHz | 3696 MHz |
| | 2 | 3696 MHz | 3960 MHz | 4224 MHz |
| | 3 | 4224 MHz | 4488 MHz | 4752 MHz |
| 2 | 4 | 4752 MHz | 5016 MHz | 5280 MHz |
| | 5 | 5280 MHz | 5544 MHz | 5808 MHz |
| | 6 | 5808 MHz | 6072 MHz | 6336 MHz |
| 3 | 7 | 6336 MHz | 6600 MHz | 6864 MHz |
| | 8 | 6864 MHz | 7128 MHz | 7392 MHz |
| | 9 | 7392 MHz | 7656 MHz | 7920 MHz |
| 4 | 10 | 7920 MHz | 8184 MHz | 8448 MHz |
| | 11 | 8448 MHz | 8712 MHz | 8976 MHz |
| | 12 | 8976 MHz | 9240 MHz | 9504 MHz |
| 5 | 13 | 9504 MHz | 9768 MHz | 10032 MHz |
| | 14 | 10032 MHz | 10296 MHz | 10560 MHz |

OFDM continued...

- **The relationship between centre frequency and band number is given by the following equation:**
 - Band centre frequency = $2904 + 528 \times n_b$ MHz, where $n_b = 1 \dots 14$
- **This definition provides a unique numbering system for all channels that have a spacing of 528 MHz and lie within the band 3.1–10.6GHz.**
- **Based on this, five band groups are defined, consisting of four groups of three bands each and one group of two bands.**
- **Band group 1 is used for Mode 1 devices (mandatory mode).**

- **122 Subcarriers are used out of 128 (100 data, 12 pilots, 10 guard)**
- **Subcarriers at 4.125MHz spacing (128x4.125=528MHz multiplex)**

- **Default Spectral shaping is to drop Ch-2 or Band-5 to protect 5.7GHz LANs, but smarter notching theoretically possible at subcarrier level by software only - a great attraction**
- See http://www.multibandofdm.org/papers/Spectral_Sculpting_and_Future_Ready_UWB_Sept_04.ppt

OFDM Modes

- Initial Chipsets will use Mode-1 only
- Mode-2 likely to be next with other channels reserved for future expansion
- Other than the 3.4GHz band - looks very Amateur friendly

