UWB Radio and UWB Impulse Radar Technology

VTT Technical Research Centre of Finland Ltd
UWB Radio - High data rate wireless radio systems with Real time location support

- The technology achieves sufficient accuracy in distance measurement and in real time positioning. During the distance measurement and positioning the UWB technology provides simultaneous wireless data transmission up to 6.8 Mbit/s.
- The UWB radio technology has been applied in different applications such as short-range communication, sensor networks systems and real time location systems (RTLS).
- The UWB radio signals have an extremely wide bandwidth compared to traditional radio signals, which offers several benefits; accurate ranging, robustness to propagation fading, superior obstacle penetration, resistance to jamming, interference rejection, and fluent coexistence with traditional narrow bandwidth systems.
UWB basics

- Relatively immune to disturbances.
- Doesn’t disturb conventional radio transmitters (power level ca. 1 mW).
- Operational distance up to 300 meters in open space.
- Very broad signal bandwidth, typically > 500 MHz.

![Diagram showing frequency range with SS, NB, and UWB labels.](image-url)
UWB Worldwide Regulations

- Allowed frequency in area from 3,432 to 10,296 GHz depending on country.
- Several countries and administrations have adopted unlicensed frameworks for UWB devices such as
  - North America
  - South America
  - Europe
  - Middle East
  - Asia-Pacific countries
UWB compared to other radio technologies

UWB is wireless personal area networking (WPAN) technology for transmitting data:
- Quickly
- Cost-effectively
- With low power consumption

According to IEEE 802.15.4:
- WiMedia
- 802.11a/b/g/n Data Networking
- Bluetooth

Source: Texas Instruments
Indoor positioning  UWB TAG

UWB Loc_TAG
• UWB Radio
• BL 4.0 Radio

• Embedded software implementing positioning and data-transmission
Basics of Impulse Radar technology

- Utilises UWB bands
  - 3.1 – 10.6 GHz
- Very low energy radiation
  - -41.3 dBm/MHz
- Relatively economic solution.
- One chip only.
- No moving parts.
- Measures only flying time e.g. distance, introducing direction of measured objects need more antennas.

A transmitter antenna is emitting very short non-sinusoidal pulses.

Transmitted signals bandwidth is several gigahertzes.
UWB Impulse Radar

- Immune to interference from other radio systems, to multipath propagation, and to environmental factors like rain, fog, snow etc.
- Very broad signal bandwidth, several gigahertz
- Ability to detect through obstacles and in dense media
- Very fast pulses -> Measures the environment even more than 400 times per second with mm accuracy and maximum range of 10 - 15 meters.
- It is easy to install and move from one place to another
UWB Impulse Radar – Novelda chip

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX Pulse Generator</td>
<td>7th order Gaussian</td>
<td>NA</td>
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<tr>
<td>TX bandwidth (-10dB cutoff)</td>
<td>5.8 – 9.0</td>
<td>GHz</td>
</tr>
<tr>
<td>TX nominal output power</td>
<td>-19</td>
<td>dBm</td>
</tr>
<tr>
<td>RX sensitivity</td>
<td>-95</td>
<td>dBm</td>
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<tr>
<td>RX equivalent sampling rate</td>
<td>39</td>
<td>GS/s</td>
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<tr>
<td>Samples per frame</td>
<td>512</td>
<td>samples</td>
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<tr>
<td>RX frame offset step</td>
<td>4</td>
<td>mm</td>
</tr>
<tr>
<td>Power consumption</td>
<td>115</td>
<td>mW</td>
</tr>
</tbody>
</table>

https://www.xethru.com/x2-uwb-radar-chip.html/
Ultra-Wideband Radio

Technology benefits
- Immune to radio disturbances and signal fading
- Doesn’t disturb conventional radio transmitters (power level ca. 1 mW).
- Operational distance < 100 meters.
- Very broad signal bandwidth, typically > 500 MHz.
- Very fast pulses -> great accuracy in positioning applications.

Technology usage
- 2D and 3D real-time positioning systems (RTLS)
- Positioning of humans in factories, warehouses etc
- Distance measurements, cylinders etc.
- Fast data transmission (->6,8 Mbit/s) in harsh env.
- Combined positioning and data transmission
Ultra-Wideband Impulse Radar

Technology benefits
- Fast Impulses - > High resolution (mm)
- Independency from environmental factors (such as illumination, humidity, fog etc)
- Ability to 'see through' obstacles
- Operational distance 10-15 meters.
- Measurements even 400 times per second

Technology usage
- **Health monitoring and Rescue** - Heart and breath rate monitoring
- **Safety** – Detecting of objects (human and non-human) around a working-machine
- **Automation** - Enabling automatic, or self-automatic work process; Assisting drivers in challenging environments (dust, rain, etc.), Warnings of approaching objects, or machine approaching walls and other obstacles, High accuracy ranging

TECHNOLOGY FOR BUSINESS