

Hot Chips 16

Ultrawideband : Technology & Issues

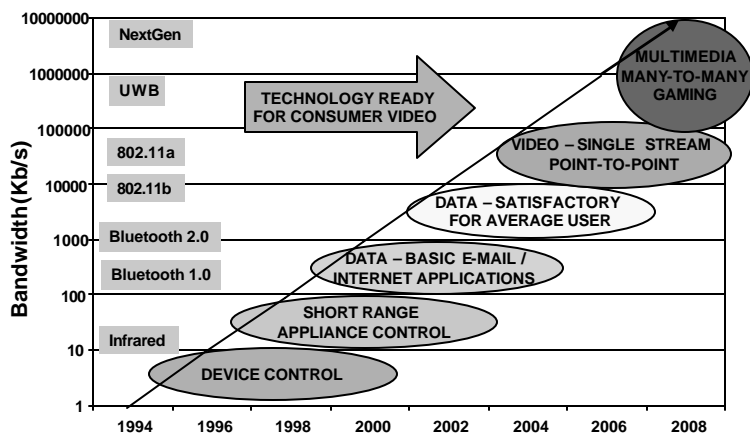
Market Perspective & Applications

Sandeep Kumar
President & CEO, Adimos Inc.

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Wireless bandwidth trend

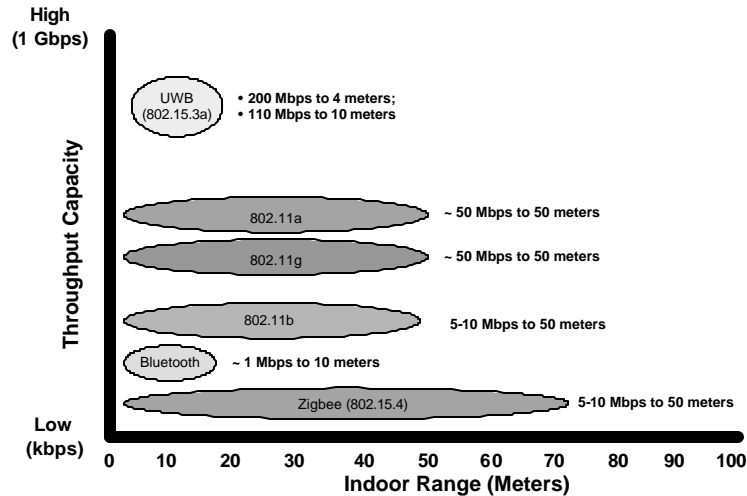


10X increase in bandwidth every 2 years.

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Indoor Wireless : Throughput & Range



From Parks Associates Presentation

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Defining UWB

Ultra-wideband (UWB) is not one technology *per se* (at least in its many pre-standard variations). According to the FCC ruling that allowed for commercial deployment of UWB applications (First Report and Order, February 14, 2002), **UWB is defined as any signal that has a fractional BW of 0.2 or occupies 500 MHz or more of the spectrum at all times.**

Characteristics of Ultra-wideband (IEEE 802.15.3a)	
Range	30 feet – 12 feet (10 meters and 4 meters)
Throughput	110 and 200 Mbps
Power Consumption	100mW and 250mW
Interference Capability	Robust to IEEE systems (i.e., Wi-Fi®)
Co-existence Capability	Reduced interference to IEEE systems

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U.S. Spectrum Allocated for Unlicensed Use

Bands	Commercial Use Authorized	Operational Frequency	Bandwidth
ISM (Industry, Scientific, Medical) at 2.4 GHz	1985; revised in 1989	2.4000-2.4835 GHz	83.5 MHz
U-NII (Unlicensed National Information Infrastructure) at 5 GHz	1997	5.15-5.35 GHz 5.425-5.725 GHz 5.75-5.85 GHz	300 MHz now; 555 MHz assuming revisions
UWB (Ultra-wideband)	2002	3.1-10.6 GHz	7.500 GHz

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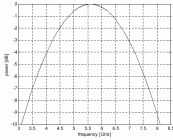
UWB: Exceptionally Low Power Requirements

Power Limitations for Unlicensed Wireless Bands			
Wireless Solution	Operational Frequency	Peak Transmit Power*	Peak Power Spectral Density (dBm/MHz)
ISM (Industry, Scientific, Medical) at 2.4 GHz	2.4000-2.4835 GHz	1W	
U-NII (Unlicensed National Information Infrastructure) at 5 GHz	5.15-5.25 GHz 5.25-5.35 GHz 5.725-5.85 GHz	50mW 250mW 1W	4 dBm/MHz 11 dBm/MHz 17 dBm/MHz
Ultra-wideband (UWB) at 3.1 GHz-10.6 GHz	3.1-10.6 GHz	.1-.2mW	41.3 dBm/MHz

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UWB: Transmission Methods Under Consideration

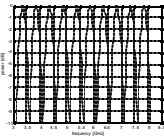


Impulse Radio (PPM) – Pulse Link, Time Domain

- Signal sent as a single pulse over a large spectrum.
- Viewed by many as “old” UWB and less “elegant” in spectrum agility and power consumption requirements.

DS-CDMA - Motorola

- Signal sent as a single pulse over a large spectrum.
- Similar in concept to Impulse Radio except designed for high bit rate applications.



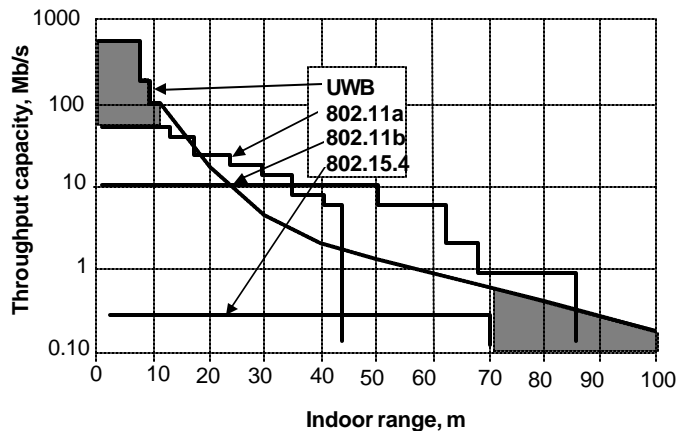
Multi-Band OFDM (FH) - MBOA

- Spectrum broken into different bands.
- Does not require constant allocation of bandwidth (power consumption).
- Flexible in detecting conflicts and turning off a band to avoid interference with such wireless technologies as 802.11a.
- Excellent results in very poor conditions. Addresses multipath interference better than other solutions.

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UWB: Main interest in two areas



From Staccato presentation by Roberto

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Competitive Technology Comparison

802.11n (normal evolution in range / BW extension of 802.11a/b/g) emerging as an alternative technology for certain applications. **UWB** is the only WPAN technology being developed that increases BW an order of magnitude. **802.11n** could delay adoption of UWB in applications that are not QoS, power or security sensitive.

Criteria	UWB	802.11n
Throughput	++	
MAC efficiency	++	
QoS	++	
Security	++	
Range		++
Power consumption	++	
Time-to-Market for standard based	UWB is currently ahead	

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The Lure and Promise of UWB

- ❑ RF energy is spread over several gigahertz.
- ❑ Broad range & low power signal appears as noise to other devices.
- ❑ Low power consumption attractive for mobile CE & PC devices.
- ❑ Order of magnitude higher BW, 500 Mbps+ data-rates are possible.
- ❑ Co-existence with Bluetooth, 802.11b, 802.11a, etc.
- ❑ Quality-of-service built into specifications.
- ❑ Flexibility in transmission techniques key to solution that meets international regulatory requirements.

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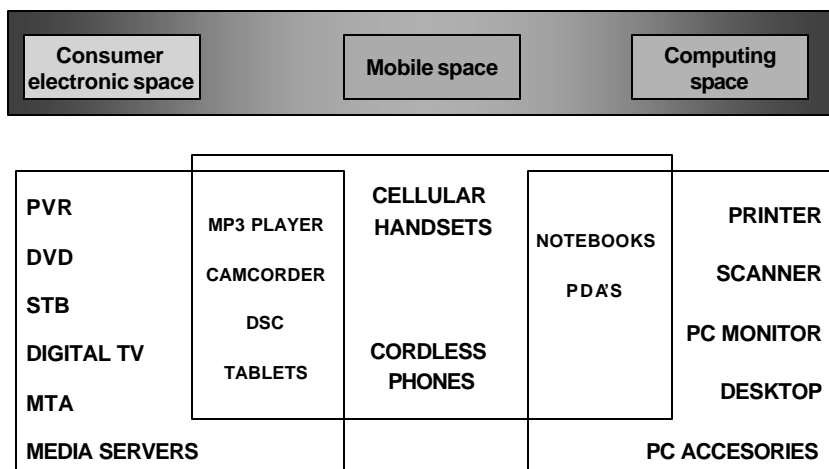
UWB: Market Segments

Application	Products	Bandwidth	Power	Multipath	Other
Consumer Electronics	Wireless TV, Portable TV, DVD, PVR..	HD: 25Mbps/ stream HDMI – 1.6Gbps	Low	Very serious	QoS, DRM
Computing	USB	480 Mbps	Very Low	Serious	Cost
Mobile consumer	Camcorder, DSC etc..	480 Mbps	Very Low	Not serious	Cost
Military	Radar, Security	Low	NA	NA	Mature
Imaging - GPR	GPR	Low	NA	NA	<960MHz; 3.1 - 10.6GHz
Imaging – Through wall	Location, movement	Low	NA	NA	<960MHz; 1.99-10.6Ghz
Surveillance	Law enforcement	Low	NA	NA	1.99-10.6GHz
Medical	Observation	Low	NA	NA	3.1 -10.6GHz
Vehicle Radar	Collision avoid, airbag, suspension	Low	NA	NA	24GHz

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UWB: Connectivity Across Platforms



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Achieving Connectivity : DLNA Approach

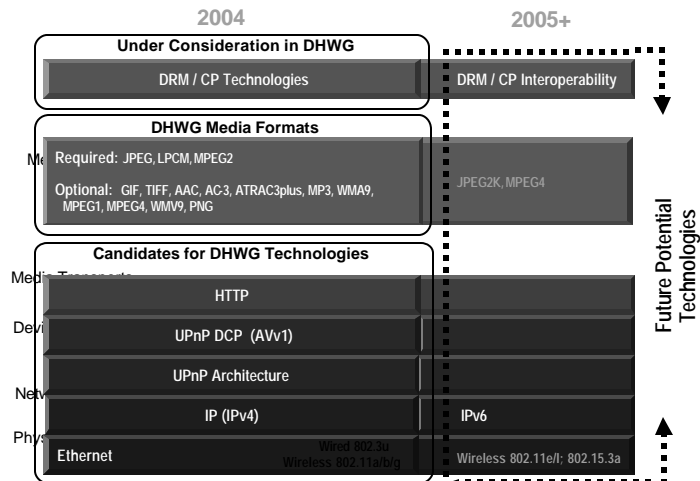
- DLNA = Digital Living Network Alliance (was DHWG).
- Deliver design guidelines based on open standards
- Provide a common baseline of media formats
- Accelerate market acceptance through compliance and verification testing



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DLNA: Framework Overview and Scope



Core DLNA Principles: Open, Fair, Interoperable

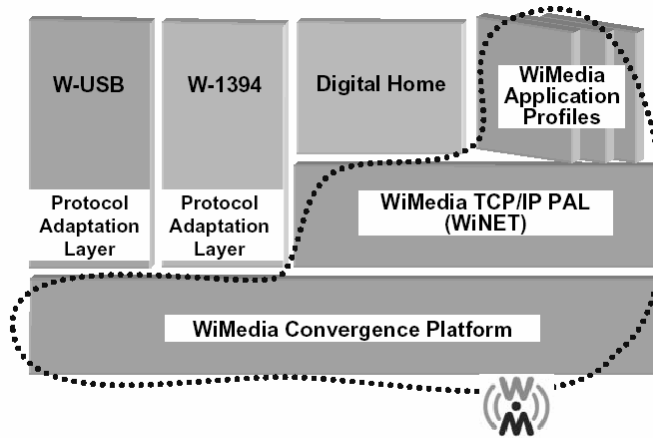
From DLNA white paper

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WiMedia & Multi-Protocol Architecture



From WiMedia

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UWB: MAC Required Properties

- Mobility
- Ad hoc network (as needed, no pre-planning)
- Peer-to-peer communication
- Fast connection time
- Dynamic membership
- QoS
- Isochronous and asynchronous data transport
- Efficient data transfer
- Power management
- Forming dependent piconets (child, neighbor)
- Security

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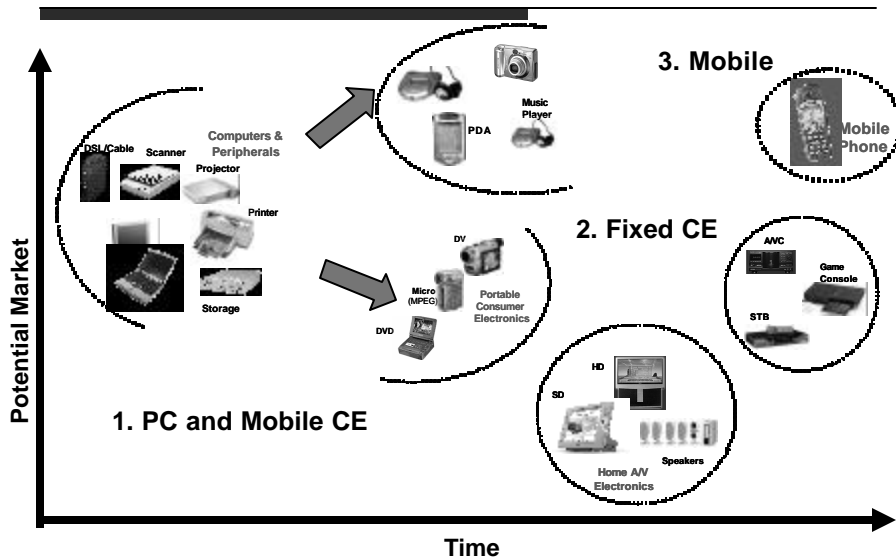
Multiple Bodies Involved

IEEE 802.15.3	Physical Layer & MAC standards
MBOA/DSSS	Physical layer proposals
WiMedia	Convergence layer & MAC impact
Wireless-USB	Application interoperability consortium
Wireless-1394	Application interoperability consortium
DLNA (DHWG)	Application interoperability consortium
Regulation bodies	Government approval bodies
FCC	US
NTIA	US
ITU	International
ETSI	Europe
MPHPT	Japan

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Anticipated Market Timing and Potential



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