Generic regulation for Ultra-Wideband (UWB) applications in Europe

2nd Congress of Portuguese Committee of URSI "Electromagnetic Compatibility and New Radiocommunications Services"

Thursday, 20 November 2008

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Plan

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- Spectrum management and UWB: general issues
- Generic UWB regulation
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  - UWB coexistence scenarios
  - Main elements
  - Decisions ECC/DEC/(06)04 and ECC/DEC/(06)12
  - Mitigation techniques
  - Additional regulatory provisions
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- Perspectives

International regulatory framework

- Administrations manages the radio spectrum resource
  - Quality to existing applications
  - Possibility to introduce new ones
- Radio Regulations (RR)
  - Rights and obligations for an individual state towards other states with respect to the use of the radio spectrum and orbital resources
  - International treaty
  - Periodically revised by World Radiocommunication Conferences (WRCs)
  - The RR allocates in the first place frequency bands to Radiocommunication Services

RR Article 5: frequency allocation table

Allocation to services		
Region 1	**Region 2**	**Region 3**
2 700-2 900	AERONAUTICAL RADIONAVIGATION 5.337 Radiolocation 5.423 5.424	
2 900-3 100	RADIOLOCATION 5.424A RADIONAVIGATION 5.426 5.425 5.427	
3 100-3 300	RADIOLOCATION Earth exploration-satellite (active) Space research (active) 5.149 5.428	
3 300-3 400 RADIOLOCATION 5.149 5.429 5.430	**3 300-3 400** RADIOLOCATION Amateur Fixed Mobile 5.149 5.430	**3 300-3 400** RADIOLOCATION Amateur 5.149 5.429
3 400-3 600 FIXED FIXED-SATELLITE (space-to-Earth) Mobile Radiolocation 5.431	**3 400-3 500** FIXED FIXED-SATELLITE (space-to-Earth) Amateur Mobile Radiolocation 5.433 5.282 5.432	
3 600-4 200 FIXED FIXED-SATELLITE (space-to-Earth) Mobile	**3 500-3 700** FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 5.433 5.435	

European regulatory framework (1)

- CEPT (*Conférence Européenne des Postes et Télécommunications*)
  - 48 administration members
  - Electronic Communications Committee (ECC)
  - Harmonisation of the use of radio frequencies in Europe
  - Implementation of Decisions and Recommendations on a voluntary basis

- European Commission (EC)
  - Decision n° 676/2002/EC of the European Parliament and of the Council of 7 March 2002 (the “Radio Spectrum Decision”)
  - EC mandates to CEPT
  - “Technical implementing measures” mandatory for EU Member States

European regulatory framework (2)

- R&TTE Directive (1999/5/CE)
  - Conditions for the placing on the market of radio equipment
  - Replaces various national type approval regimes by a harmonised ex-post control regime
  - Article 3.2
    - *"Radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communication and orbital resources so as to avoid harmful interference"*
  - Harmonised standards
    - Give presumption of conformity to the essential requirements referred to in Article 3 of the R&TTE Directive
- European Telecommunications Standards Institute (ETSI)

Spectrum management and UWB: general issues (1)

- UWB devices
  - Radio device, subject to national regulation
  - Emissions cannot be assimilated to radio noise or unwanted emissions from a regulatory perspective
  - Intended emissions not limited to the boundaries of a specific frequency band
  - UWB emissions may overlap several frequency bands allocated to Radiocommunication Services
  - Spectrum UWB regulation primarily aims to define maximum mean e.i.r.p. spectral density across relative wide frequency ranges
- Compatibility studies
  - Assess potential impact on several radio systems with very different technical and operational characteristics
  - Shall ensure the necessary protection of Radiocommunication Services

Spectrum management and UWB: general issues (2)

- The issue of spectrum management for UWB may differ pending the type of equipment that is considered:
  - equipment for a mass market
  - equipment for specific professional usage with or without the requirement for an individual license
  - equipment which use is restricted to government bodies

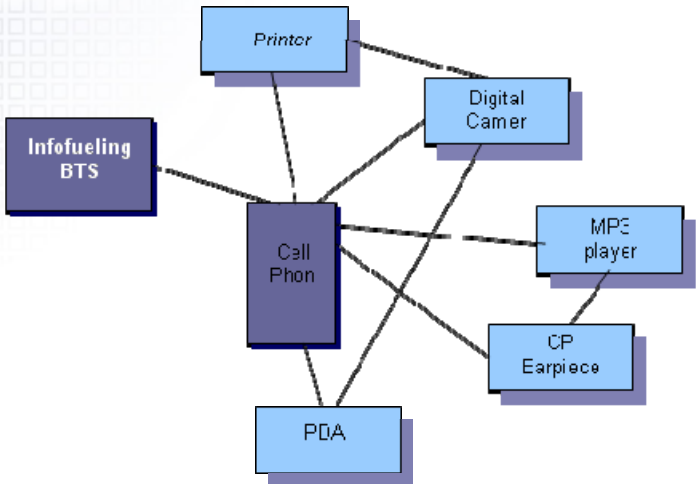
Generic UWB regulation : applications (1)

- Primarily intended to respond to the market demand for UWB indoor and handheld devices providing communication applications
  - Low cost cable replacement technology
- FCC regulations adopted February 2002
  - 500 MHz minimum bandwidth
  - UWB emissions in the frequency band 3.1 – 10.6 GHz allowed with a maximum mean e.i.r.p. spectral density of -41.3 dBm/MHz
- High data rate communication applications
- Low data rate communication applications, localisation and various sensors UWB applications

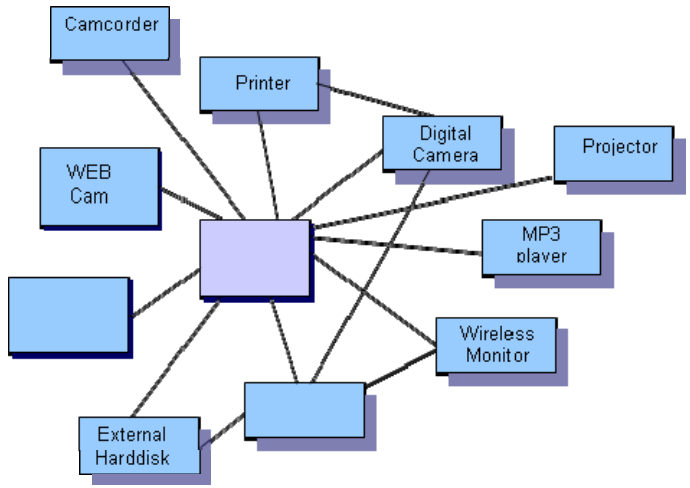
Generic UWB regulation : applications (2)

- High data rate applications
  - Wireless USB, wireless 1394 (FireWire®)
  - Target performance: 110 Mbit/s at 10 m / 480 Mbit/s at 2 m
  - Supported by the convergence of personal computer (PC), consumer electronics (CE) and mobile handset market segments

- *Typical Infofueling scenario for mobile handsets*



- *Typical PC centric scenario*



UWB coexistence scenarios (1)

- **Characterization of typical UWB coexistence scenarios**

- **« Indoor » victim receiver:**
  - Mobile terminals (GSM, IMT-2000…), RLANs, BWA, T-DAB/DVB-T…
  - Potential interference mainly due to UWB devices deployed indoor
  - Coexistence scenarios:
    - Low separation distances (e.g. 36 cm for IMT-2000 at 2 GHz and BWA at 3,5 GHz)
    - Generic emission limits based on single interference scenarios
    - Limits may be relaxed subject to the implementation of adequate mitigation techniques (DAA, LDC…)

UWB coexistence scenarios (2)

- **« Outdoor » victim receiver:**
  - Coexistence generally based on aggregate interference scenarios:
    - FS, FSS, EESS, Radio Astronomy…
    - Relevance of UWB generic emission limits directly linked to assumptions in UWB deployment scenarios (density, activity factor, split *indoor* / *outdoor*)
  - Specific case of radiolocation service
    - Coexistence primarily driven by single interference scenarios;
  - Specific case of Fixed service
    - Interference from a single fixed outdoor UWB installation to a FS Point-to-Point link

Generic regulation for UWB applications in Europe
Main elements (1)

- Regulation developed within the frame of EC mandates
  - 1st EC mandate on UWB and creation of CEPT/ECC TG3 march 2004
- Frequency band 6 – 8.5 GHz
  - Maximum mean e.i.r.p. spectral density of -41.3 dBm/MHz without the requirement for additional mitigation;
  - Identified as « long-term » regulatory solution for UWB in Europe;
    - Extended to frequency band 8.5 – 9 GHz subject to the implementation of DAA mitigation technique
- Frequency band 3.1 – 4.8 GHz
  - Maximum mean e.i.r.p. spectral density can be increased to -41.3 dBm/MHz subject to the implementation of efficient mitigation techniques (DAA, LDC);
  - Phased approach in the band 4.2 – 4.8 GHz
    - UWB devices placed on the market before 31st December 2010 are permitted to operate in the frequency band 4.2 - 4.8 GHz with a maximum mean e.i.r.p. spectral density of –41.3 dBm/MHz without the requirement for additional mitigation

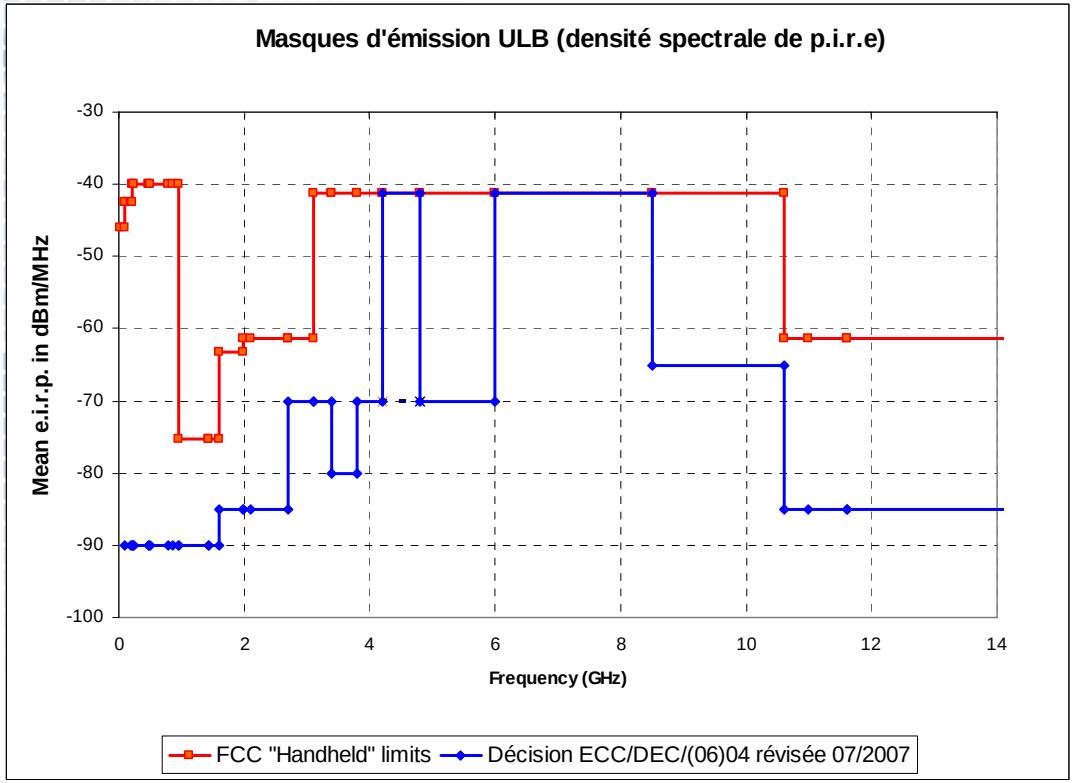
Generic regulation for UWB applications in Europe
Main elements (2)

- « *Underlay* » regulatory approach
  - Intentional emissions not limited to the boundaries of specific frequency bands
  - Applications permitted to operate within the limits of a spectrum mask and other requirements
- No restrictive regulatory definition for UWB
- Regulatory provisions aiming to minimise UWB outdoor activity
- National administrations encouraged to monitor UWB market development and potential impact on Radiocommunication Services

Decision ECC/DEC/(06)04

- Decision ECC/DEC/(06)04
  - First adoption march 2006
  - Amended July 2007
  - Defines primarily generic spectrum mask for UWB applications
- Regulatory work
  - Initial technical studies: ECC Report 64 adopted February 2005
  - Complementary technical studies 2005 / 2006
    - Review of UWB deployment scenarios, impact on outdoor FS/FSS stations…
  - Initial adoption of Decision ECC/DEC/(06)04 march 2006 subject to further work
    - Phased approach in the band 4,2 – 4,8 GHz
    - Power levels in the bands 2,7 – 3,8 GHz (amended) and 8,5 – 9 GHz (no change)
    - Installations in vehicles

Decision ECC/DEC/(06)04
Generic spectrum mask for UWB applications



Frequency band	Power spectral density (e.i.r.p.)
< 1.6 GHz	–90 dBm/MHz
1.6 - 2.7 GHz	-85 dBm/MHz
2.7 - 3.4 GHz	-70 dBm/MHz
3.4 - 3.8 GHz	-80 dBm/MHz
3.8 - 4.2 GHz	–70 dBm/MHz
4.2 - 4.8 GHz	*–70 dBm/MHz* *(–41.3 dBm/MHz)*
4.8 - 6 GHz	–70 dBm/MHz
6 - 8.5 GHz	–41,3 dBm/MHz
8.5 - 10.6 GHz	–65 dBm/MHz
> 10.6 GHz	–85 dBm/MHz

Decision ECC/DEC/(06)12

- Decision ECC/DEC/(06)12
  - Initial adoption December 2006
    - Specifies technical requirements for Low Duty Cycle (LDC) mitigation technique enabling operation at -41.3 dBm/MHz e.i.r.p. within the band 3.4 – 4.8 GHz
  - Technical studies 2007/2008
    - LDC mitigation technique in the band 3.1 – 3.4 GHz
    - Detect And Avoid (DAA) mitigation technique in the bands 3.1 – 4.8 GHz and 8.5 – 9 GHz
  - Amended by ECC October 2008

Mitigation techniques

- Low Duty Cycle (LDC) mitigation technique
  - Regulatory solution for low data rate, localisation and various sensors UWB applications
  - ECC Report 94 adopted December 2006
    - Technical Requirements for UWB LDC Devices to ensure the protection of FWA systems
  - Measurement campaign on the impact UWB LDC devices on military S-band radar performed February 2008
    - Probability of a single device to radiate into the main beam of the radar generally considered as negligible
- Detect And Avoid (DAA) mitigation technique
  - Regulatory solution for high data rate UWB applications;
  - ECC Report 120 adopted by ECC June 2008
    - Technical requirements for UWB DAA (Detect And Avoid) devices to ensure the protection of Radiolocation in the bands 3.1 – 3.4 GHz and 8.5 – 9 GHz and BWA terminals in the band 3.4 – 4.2 GHz
  - Close cooperation between CEPT and ETSI on DAA mitigation technique
    - DAA technical parameters alone do not ensure the protection of radio services by themselves. This has to be supplemented by adequate DAA measurement procedures in the related ETSI standard

Additional regulatory provisions

- Installations in road and rail vehicles
  - Operation at -41.3 dBm/MHz e.i.r.p. subject to the implementation of Transmit Power Control (TPC) with a range of 12 dB (max -53.3 dBm/MHz e.i.r.p. otherwise)
    - Specific restriction meant to reduce potential aggregate interference on outdoor stations from radio services (typically FS/FSS)
  - No additional requirement in case of LDC UWB devices
- Fixed outdoor installations
  - Fixed outdoor UWB installations operating at -41.3 dBm/MHz e.i.r.p. not compatible with outdoor stations from the Fixed Service
    - Cf. single interference analysis in ECC Report 64
  - Prohibition on fixed outdoor installations maintained in recent amendments of the generic UWB regulation
    - would also limit the operation of mobile outdoor devices
- Installations in flying models, aircraft and other aviation
  - Not covered by UWB regulation

Harmonised Standard

- ETSI harmonised standard on UWB communication applications developed within ETSI ERM TG31A
- ETSI EN 302 065 V1.1.1 published February 2008
  - Essential requirements consistent with regulatory provisions developed by ECC:
    - ECC/DEC/(06)04 amended July 2007
    - ECC/DEC/(06)12
    - contains also provisions for installations in road and rail vehicles
  - Additional technical requirements:
    - Minimum operational bandwidth 50 MHz
    - PRF (*Pulse Repetition Frequency*) > 1 MHz
    - *Transmitter timeout*
- Amendment planned in 2009

EC Decision on generic UWB

- EC Decision of 21 February 2007 (2007/131/EC)
  - Consistent with the initial versions of Decisions ECC/DEC/(06)04 and ECC/DEC/(06)12
- Amendment planned in 2009

Perspectives

- Regulatory solution aiming to balance between the protection to existing services whilst facilitating spectrum access for new innovative radio applications
- Possible basis for global harmonization?
- How to keep the evolution of DAA specifications on UWB devices in pace with the evolution of the characteristics of the victim services?
- Need to minimise UWB being used outdoor

Annex: Wimedia band plan