Unlicensed radio spectrum:

CASE WLAN

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24.11.2004

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Introduction

- Radio spectrum licensed for nearly a century
- Kick start from the Titanic disaster in 1912
  - primitive radio terminals unable to receive the distress calls
- Public authorities responded by licensing the use of spectrum
  - only one signal in each carrier frequency
- Some unlicensed frequencies available
- Discussion about open spectrum
  - fundamentals of regulation have changed over the years
- WLAN shows the potential of unlicensed spectrum

Technology overview

- Current unlicensed bands: 900MHz, 2.4 GHz, 5 GHz
- IEEE 802.11 standard first significant wireless application
  - IEEE 802.11 for 2.4 GHz band in 1997
  - First amendment IEEE 802.11a (5 GHz) in 1999
  - Second amendment IEEE 802.11b (2.4 GHz) in 1999 (higher data rate)
- Standard enables:
  - Changes to radiated power levels
  - Changes to channel frequencies
- Original standard developed in the U.S
  - Partnership with ETSI and certain individual regulatory bodies in Europe

Regulatory status

- Regulation enables authorities to monitor and prevent interference
- Definition of International Telecommunications Union (ITU):

> *"effect of unwanted electromagnetic energy on reception of radio communications, manifested by any performance degradation, misinterpretation or loss of information that could otherwise have been extracted in the absence of the unwanted energy"*

- To be able to keep the interference in a tolerable level, national regulatory arrangements have been carried out.

Regulatory status (2)

- Regulation in EU & U.S.
  - Spectrum management by European Conference of Postal and Telecommunications (CEPT)
  - Telecommunications standard by European Telecommunication Standards Institute (ETSI)
  - In U.S. regulation by The Federal Communications Committee (FCC)
- Regulation in EU coordinated by these bodies
  - Implementation up to individual countries

Regulatory status (3)

- 2.4 GHz band
  - Specifications in ETSI standard EN 300 328 (EU)
  - FCC Rules & regulations 15.247 (U.S.)
  - Radiated power limits significantly lower than in the U.S.
  - France & Spain require reduced frequency band
- 5 GHz band
  - Preferred standard in the U.S.
  - In Europe more strictly regulated (variation between countries)
  - Harmonization between U.S. and Europe in June 2003 (FCC World Radio communications Conference)
  - Common rules for frequencies & transmit power limits

Band allocation of 5 GHz devices in EU & U.S.

Band (GHz)	Channels	Use
5.15 - 5.35	8 (36-64)	Common between Europe & the US. Used in almost every European country.
5.47 - 5.725	11 (100-140)	Expected to be available in all European countries by late 2004. Made available in the US in late 2003.
5.725 - 5.85	5 (149-165)	Available in US and China, not permitted in the E.

Open vs. licensed spectrum

- Impetus to frequency spectrum licensing from technological constraints
- Concept of spectrum created to help regulators to monitor the use of frequencies
  - Limited amount of licenses -> competition between entities
  - Several strategies for assigning the licenses among competing users
- Development of technology has changed the situation
  - Spectrum not any more a scarce physical resource
- Internet a good example of an “uncontrolled” system
  - Intelligence towards the edges
  - No need to control the communication between terminals

Case WLAN

- 2.4 & 5 GHz band designated for ISM application for many years ago
  - IEEE 802.11 first important communications technology based on those frequencies
- Variety of solutions:
  - Infrastructure networks (public, corporate, residential environments)
  - Ad hoc networks
- Public WLAN experienced enormous growth
  - Hotspots: 28.000 -> 160.000 (’03 -> ’04)
- Manufacturer business expected to grow until 2006

Conclusions

- Technological performance not the only matter behind license allocation
  - Financial standing
  - Ability to provide auxiliary activities
- WLAN vs. 3G
  - Auction costs have slowed down the 3G service releases
  - At the same time WLAN business grows fast ‘
- Frequency regulation must be rethought

THANK YOU!

Questions?