Tecnologie wireless per la città e per l'ambiente cittadino

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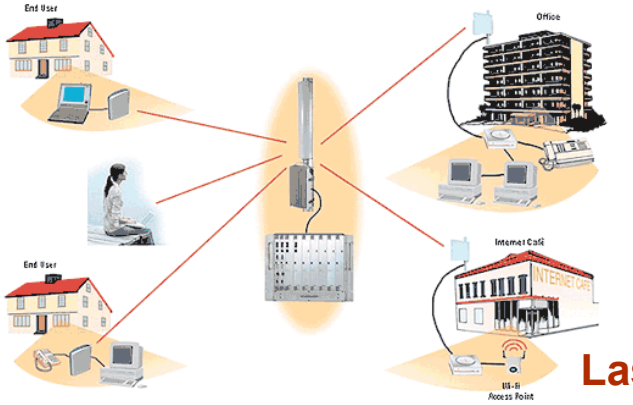
Outline

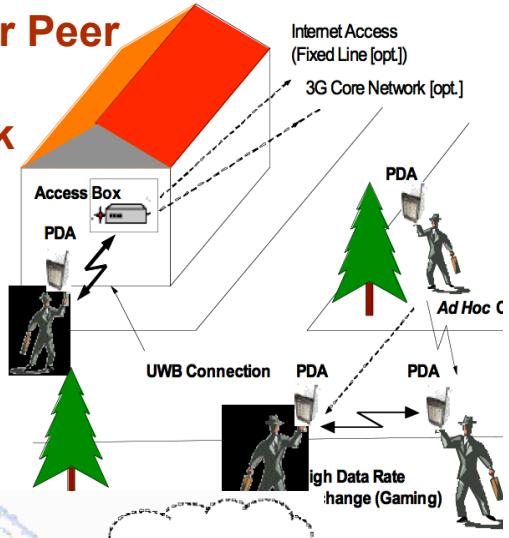
- Application scenarios in urban environment
- Technologies
  - WiFi
  - WiMax
  - Bluetooth
  - Future technologies (UWB)

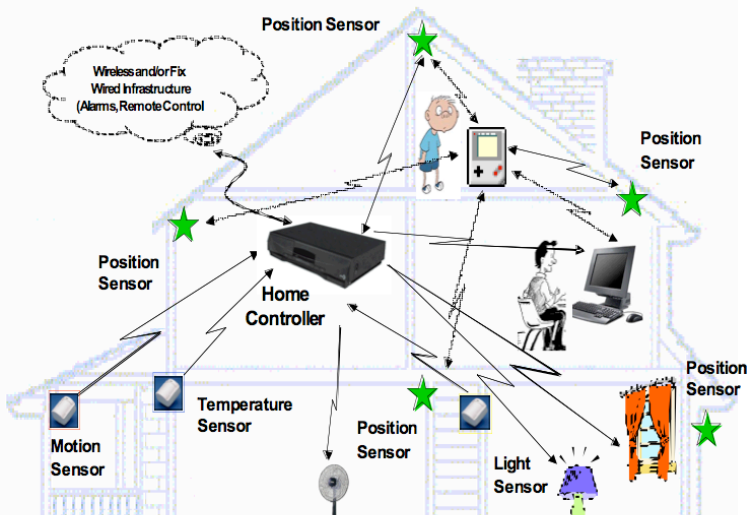
Application scenarios

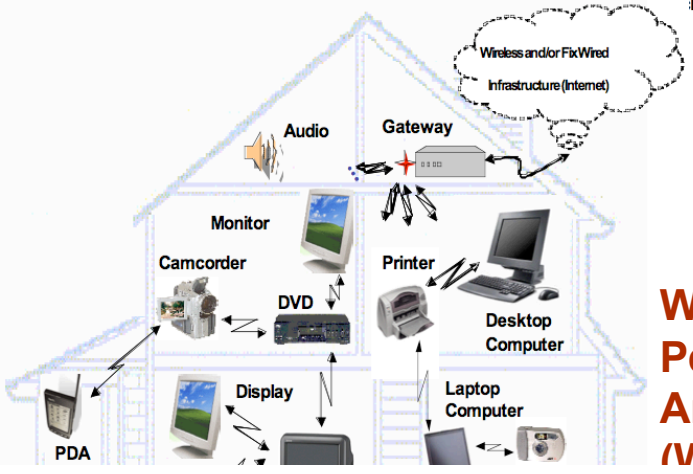


Last mile wireless coverage

Outdoor Peer to Peer Network

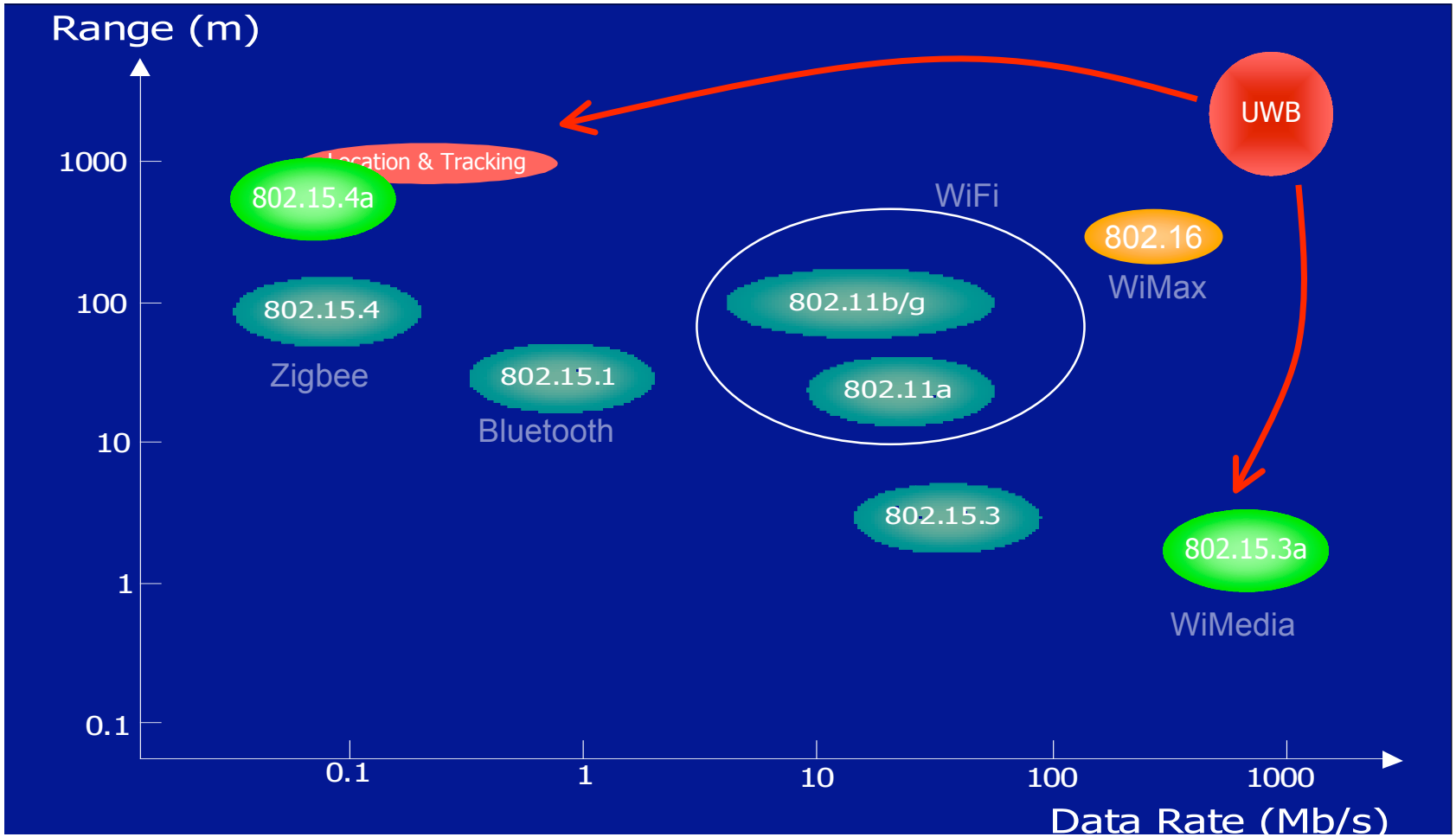




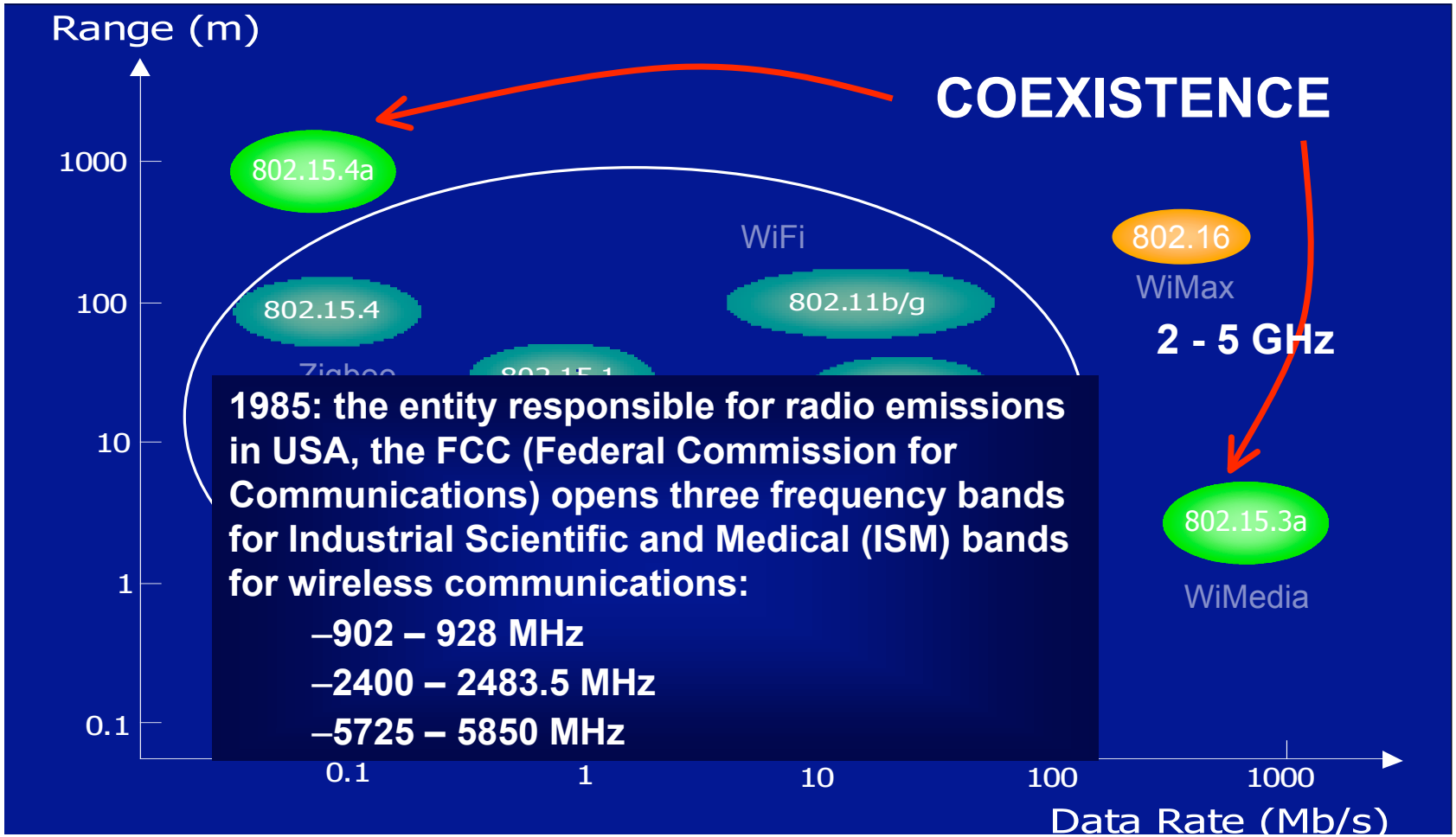


Wireless Personal Area Netw (WPAN)

The technologies



Frequency bands



The IEEE 802.11 standard: Wi-I

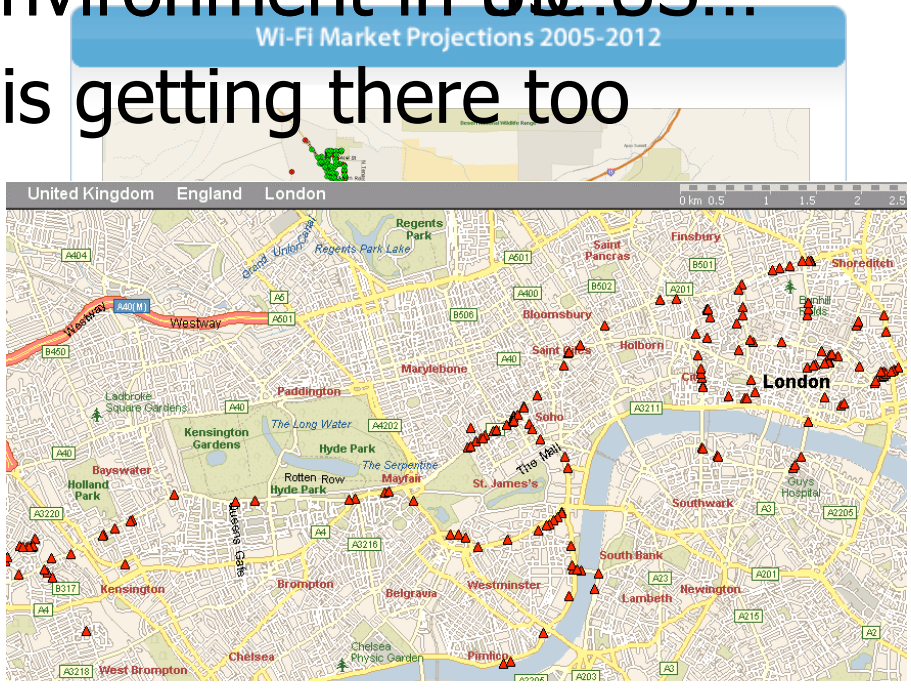
- 802.11b:
  - Born in 1999 and called Wi-Fi:
    - RF in 2.4 GHz ISM band
    - 5.5 – 11 Mb/s (now up to 22 Mb/s)
    - DS-Spread Spectrum, Complementary Code Keying Modulation
- 802.11a:
  - Shortly after 802.11b:
    - Higher bit rate : from 6 up to 54 Mb/s
    - RF in 5 GHz ISM band
    - *OFDM* (*Orthogonal Frequency Division Modulation*)

The IEEE 802.11 standard: Wi

- 802.11g:
  - Released in 2003
  - *OFDM* (*Orthogonal Frequency Division Modulation*)
  - Same bit rate as 802.11a (54 Mb/s)
  - Same ISM band as 802.11b
- 802.11n:
  - Draft finalized
  - Bit rate up to 248 Mb/s
  - 40 MHz bandwidth occupation
  - OFDM + MIMO (Multiple Input Multiple Output) up to 4x4

Wi-Fi market penetration

- Wi-Fi market is growing faster and faster
- Wi-Fi provides almost seamless coverage in urban environment in the US...
- Europe is getting there too



Wi-Fi in Italy

- WiFi penetration and coverage is increasing
- E.g.: Rome
  - Free hot spots by municipality
  - Hundreds of private/commercial access points

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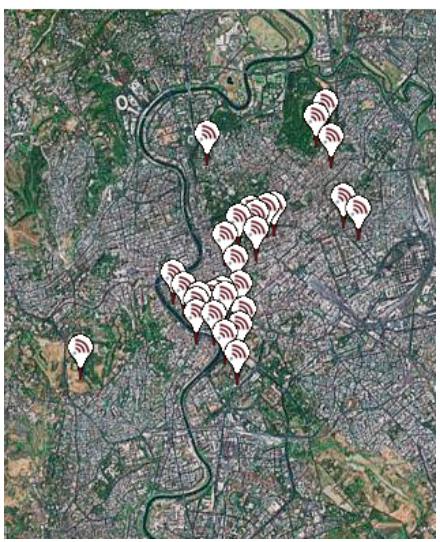
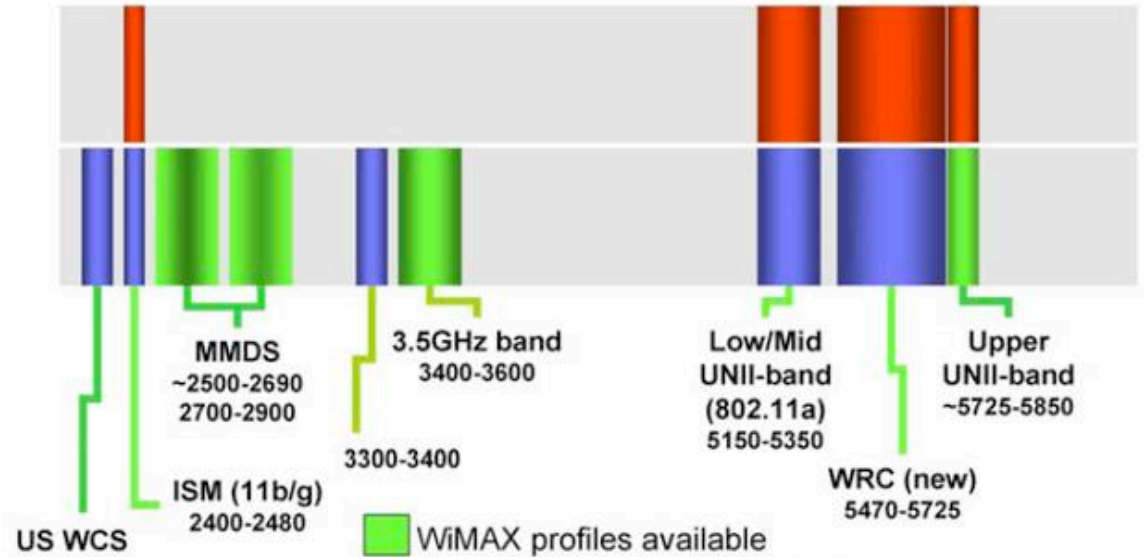


The 802.16 standard: WiMax

- WiMax is a Broadband Wireless Access (BWA) System
- Last update in 2005 to allow for mobile users (802.16e)
- Orthogonal Frequency-Division Multiplexing (OFDM) is used at the Physical Layer (256 subcarriers)
- Channel bandwidth between 2 and 10 MHz
- Bands reserved or available for WiMax are in the 2.3 - 5.8 GHz range:



Bluetooth (IEEE 802.15.1)

- Based on Frequency Hopping
- Works in the ISM 2.4 GHz band, as 802.11b/g
- Compared to 802.11:
  - Lower bit rate (1 Mb/s)
  - Lower range:
    - 100 m for Class 1 devices (P_{out} = 20 dBm)
    - 10 m for Class 2 devices (P_{out} = 4 dBm)
    - 10 cm for Class 3 devices (P_{out} = 0 dBm)
  - Limited scalability (a *piconet* has up to 8 active devices)
  - Typically designed for ad-hoc topologies
  - Lower flexibility

Bluetooth is not a competitor for 802.11, rather

Advanced technologies: UWB

IEEE 802.15.3a
very high data rate data (VHDR) transfers

- *VHDR example: A Mercedes-Benz R500 with the capability of streaming high-definition video live from a consumer electronic device to a rear seat entertainment system thanks to a UWB link using WiMedia technology. (presented at CES 2007 in Las Vegas)*

Advanced technologies: UWB

IEEE 802.15.4a
low data rate data transfers with POSITIONING

- *Emergency services*
- *Search and rescue*
- *Firefighters*