USE OF COGNITIVE RADIO TO IMPROVE SPECTRUM USAGE EFFICIENCY AND DATA CAPACITY

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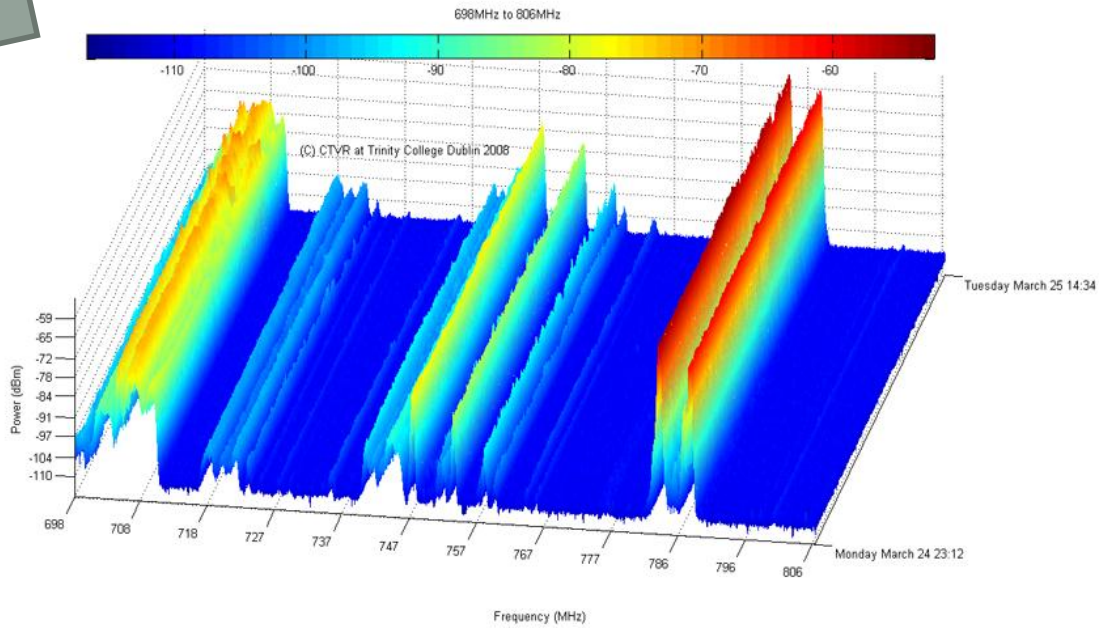
Overview

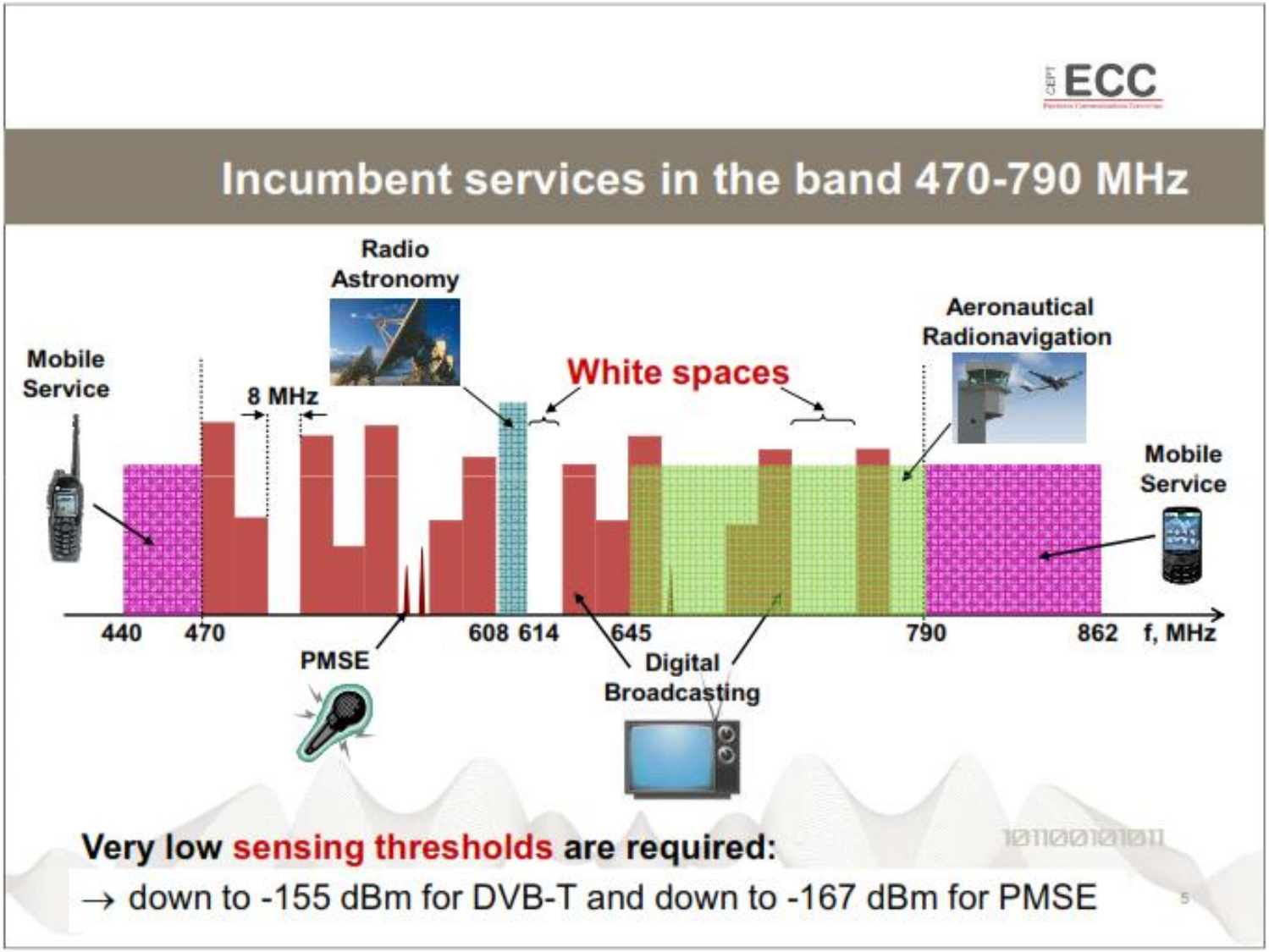
CR & Dynamic Spectrum Access



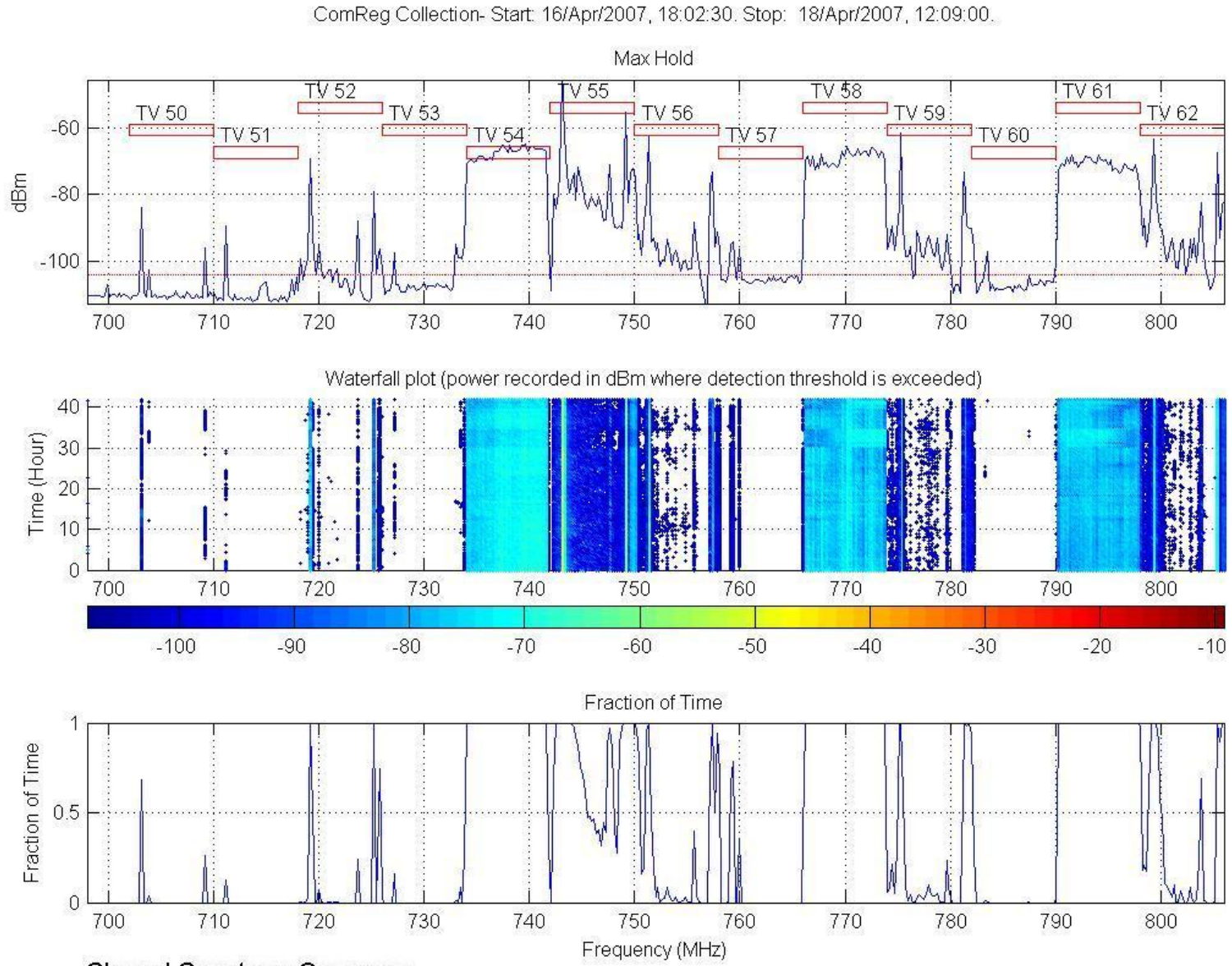
Target Frequency Range

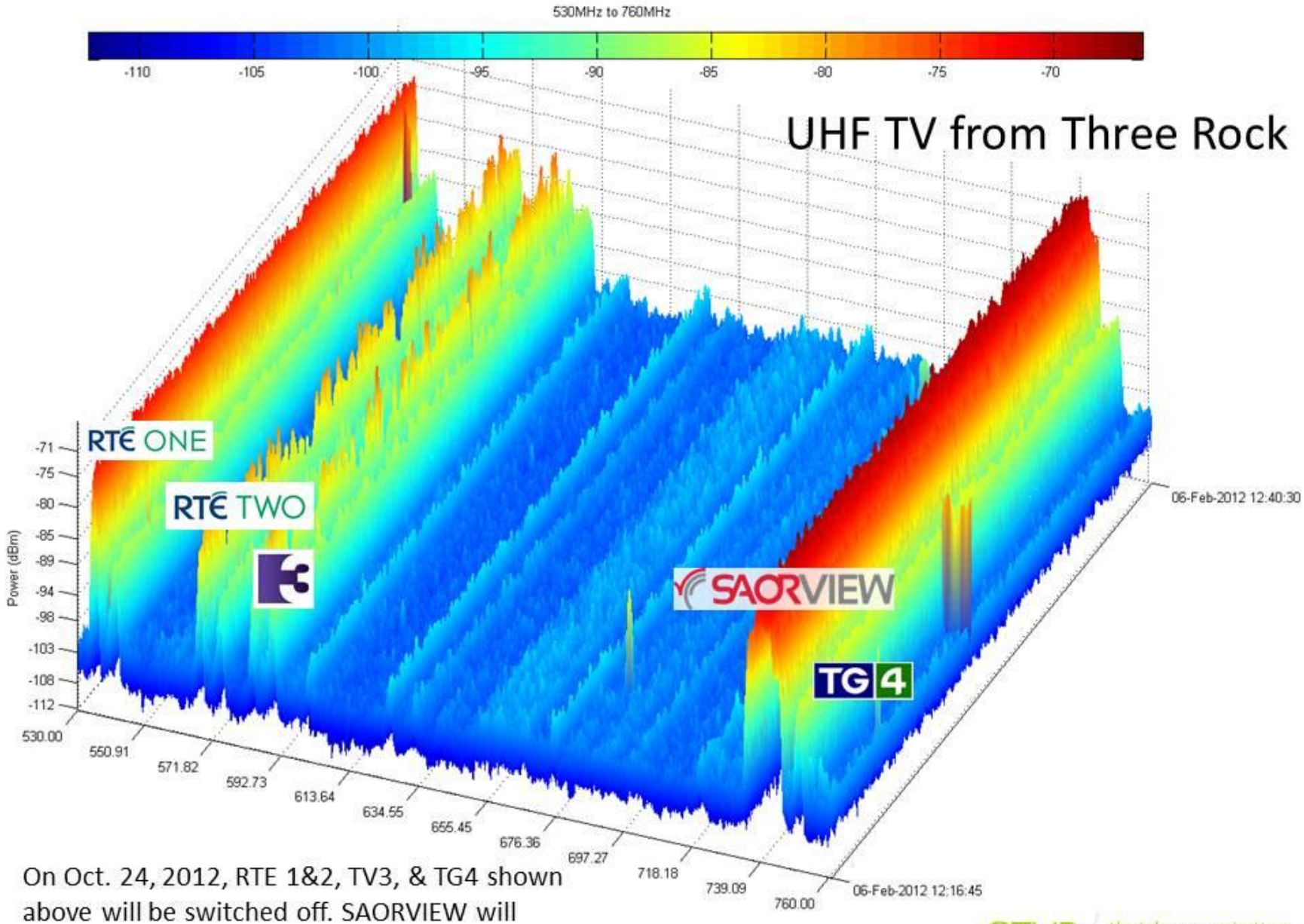
- Sub-1GHz (e.g. 700MHz, 800MHz bands)
  - Attractive due to favourable propagation characteristics
  - Sweet spot : bandwidth & coverage
  - Can provide wide coverage relatively quickly
  - Analogue switch-off increases the amount of spectrum available for new uses

Spectrum



Source: Dr. Alexandre Kholod, Chairman ECC/SE43 - Federal Office of Communications, Switzerland


ComReg Collection- Start: 16/Apr/2007, 18:02:30. Stop: 18/Apr/2007, 12:09:00.
Max Hold
dBm
-60
-80
-100
TV 50
TV 51
TV 52
TV 53
TV 54
TV 55
TV 56
TV 57
TV 58
TV 59
TV 60
TV 61
TV 62
700
710
720
730
740
750
760
770
780
790
800
Waterfall plot (power recorded in dBm where detection threshold is exceeded)
Time (Hour)
40
30
20
10
0
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
Fraction of Time
Fraction of Time
1
0.5
0
Frequency (MHz)
Shared Spectrum Company
http://www.sharedspectrum.com



On Oct. 24, 2012, RTE 1&2, TV3, & TG4 shown above will be switched off. SAORVIEW will replace them all using one TV channel

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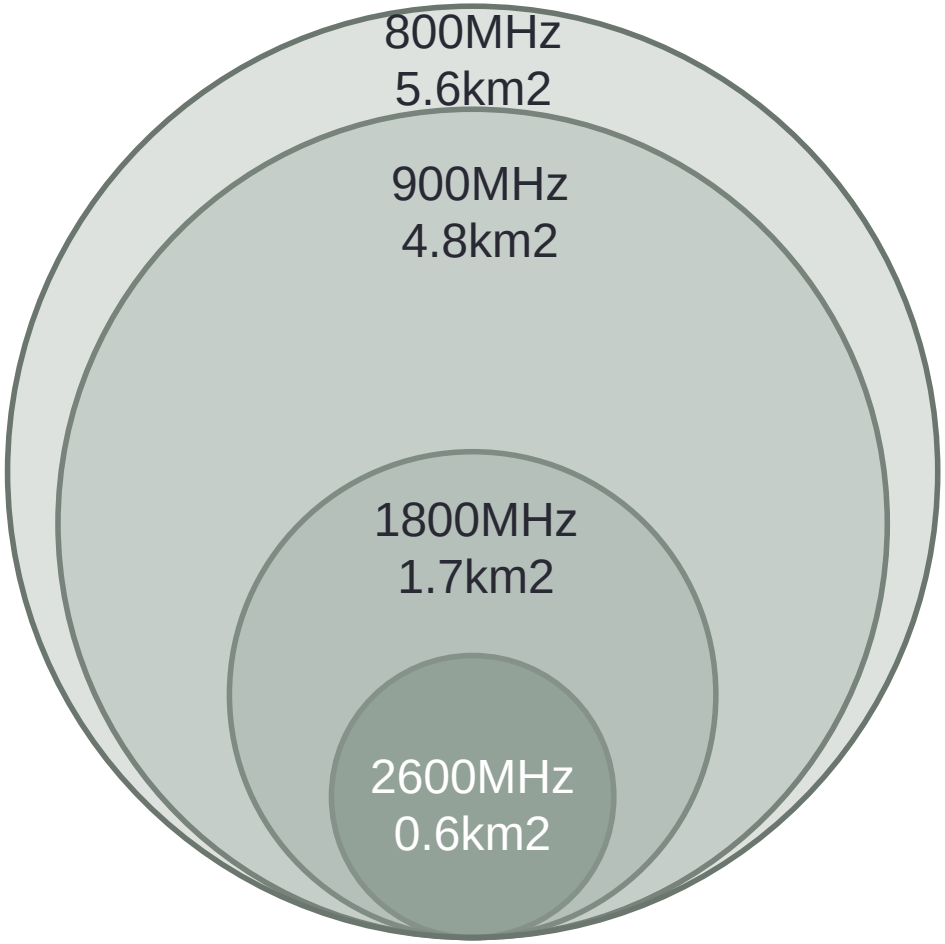
Coverage



Source: Analysys Mason 2012

Regulatory

World Radio Conference 2012

- WRC-12 recognized that no changes were needed to the Radio Regulation to support Software Defined Radio (SDR) or Cognitive Radio Systems (CRS)
  - *CR/SDR is a technology and the regulators are favouring technology neutrality*

Challenges

- Harmonisation across ITU regions
- Revenue driven – auction revenues in the order of 100s of millions to $billions
- Available spectrum not always suitable for intended applications
- Exploitation = onerous technical requirements
- Regulatory evolution much slower than market evolution

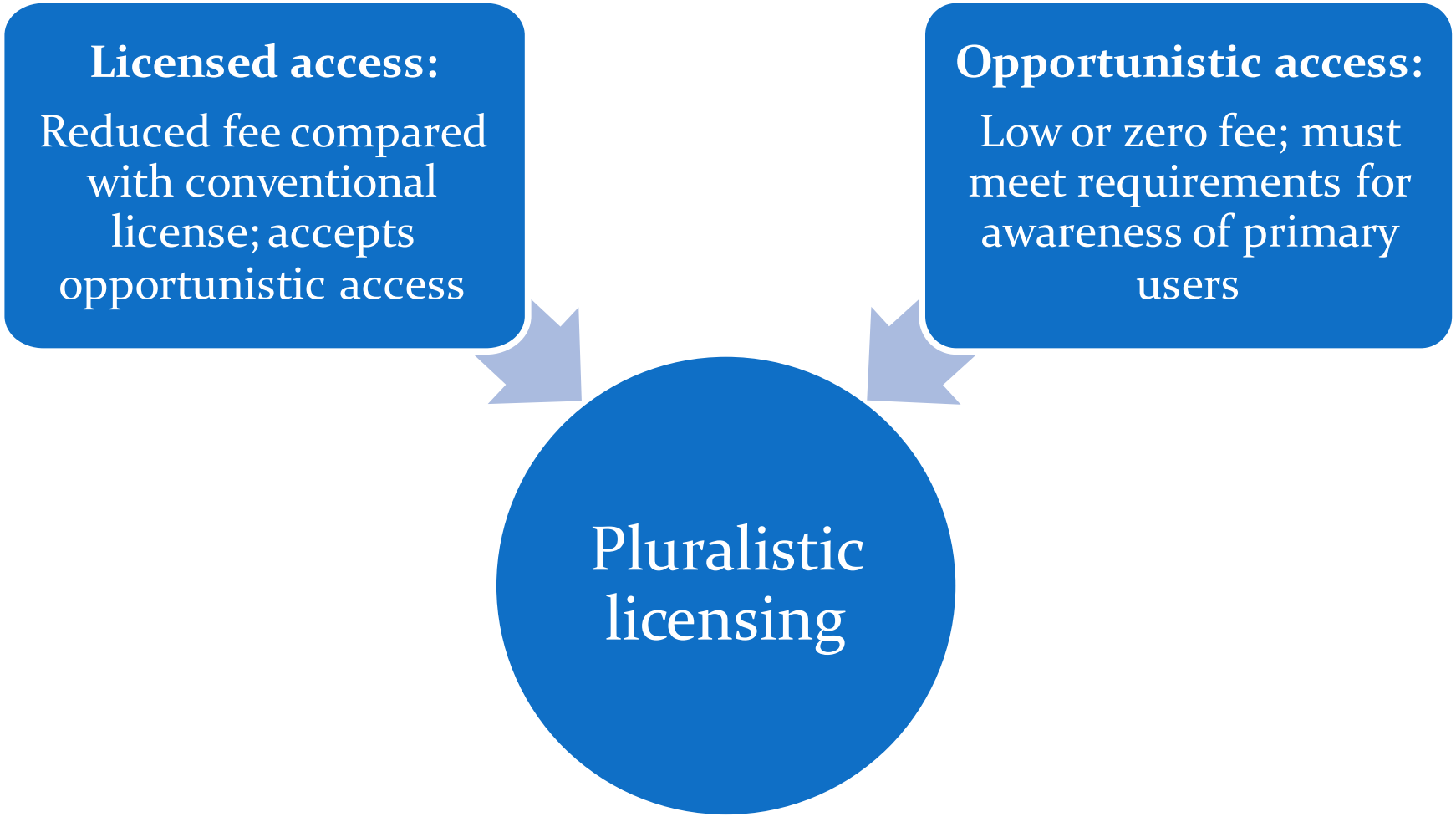
Auctions

Ireland (late 2012)

- 800 MHz, 900 MHz and 1800 MHz for the period 2013 to 2030
- 280 MHz of sub-2 GHz spectrum
- Minimum price of €20M /5 MHz lot of paired sub-1 GHz spectrum, and €10M / 5 MHz lot of paired 1800 MHz spectrum for a 15 year licence

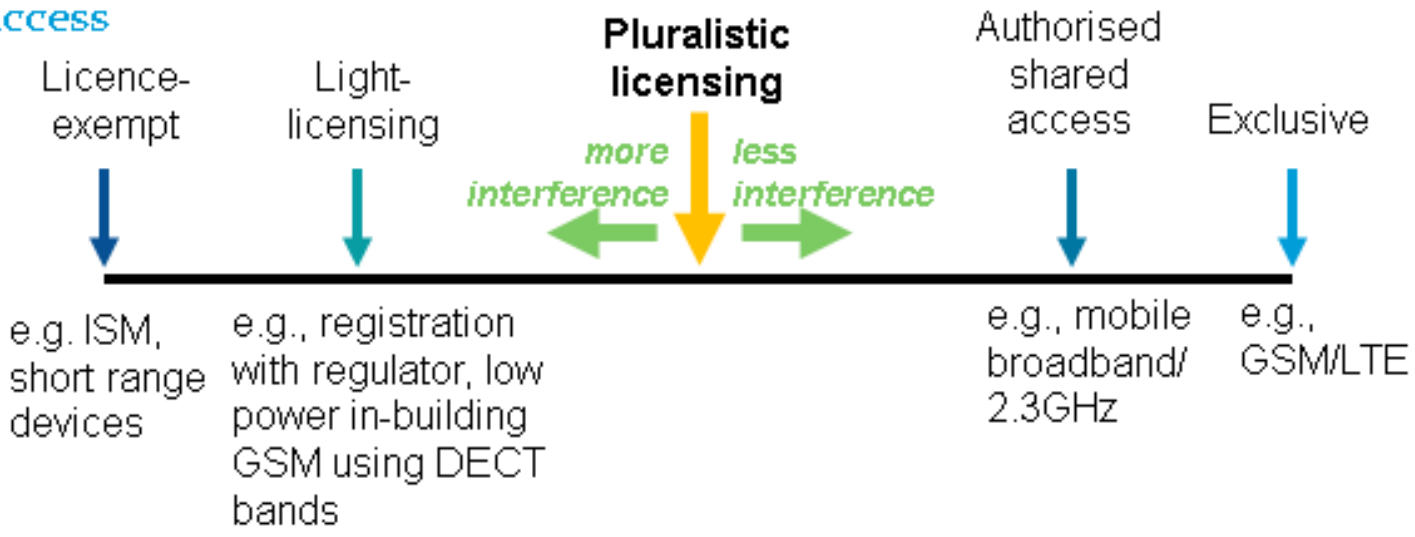
- UK (early 2013)
  - Combined reserve price: £1.4 bn

From COST-TERRA: Pluralistic Licensing

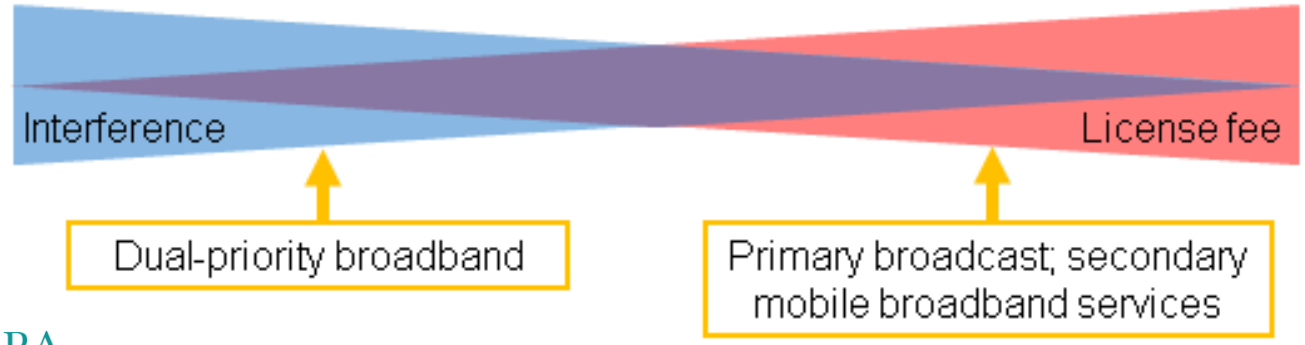


Balancing accessibility & utility

- A good, adaptable balance between exclusive use and license-exempt access



- Primary interference and license fee based on primary/secondary services



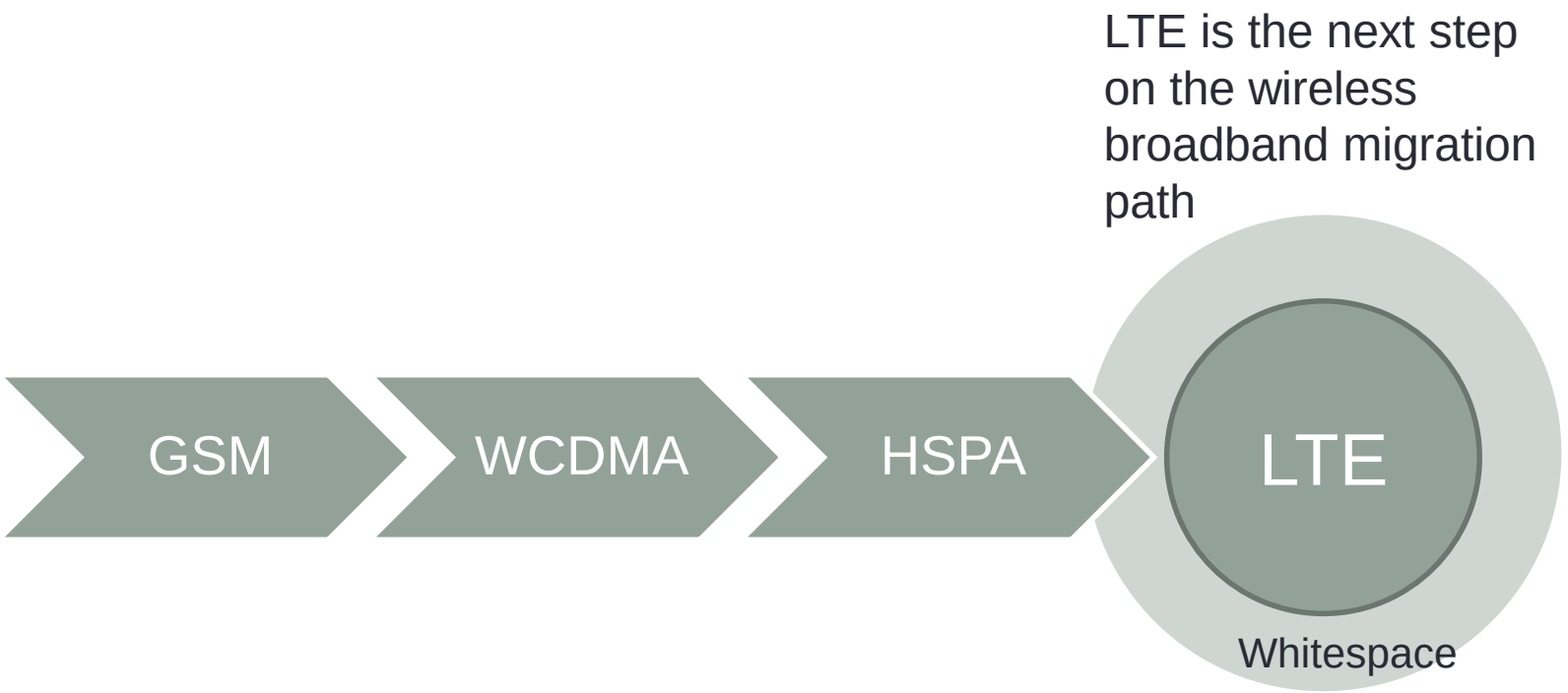
Applications

Five areas to watch…

Potential CR Application Area 1

- WiFi and data-offload
  - WiFi dominates the metropolitan area wireless network sector. It has become an important part of a mobile operators' strategy also through the use of data offloading
  - WiFi saturation is leading towards a new approach
    - Offload from WiFi to whitespace
  - Requires a geolocation database approach

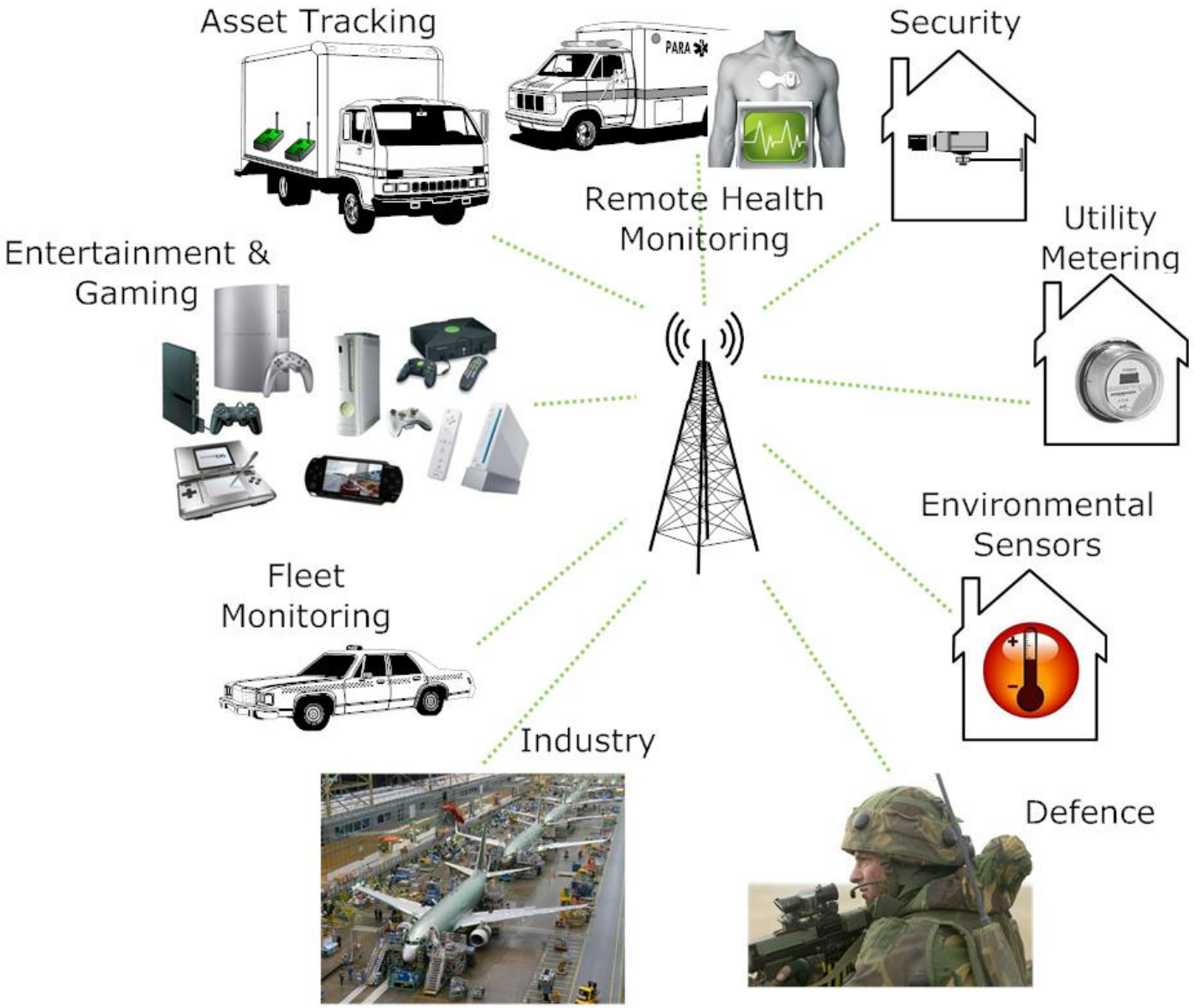
Cellular Roadmap



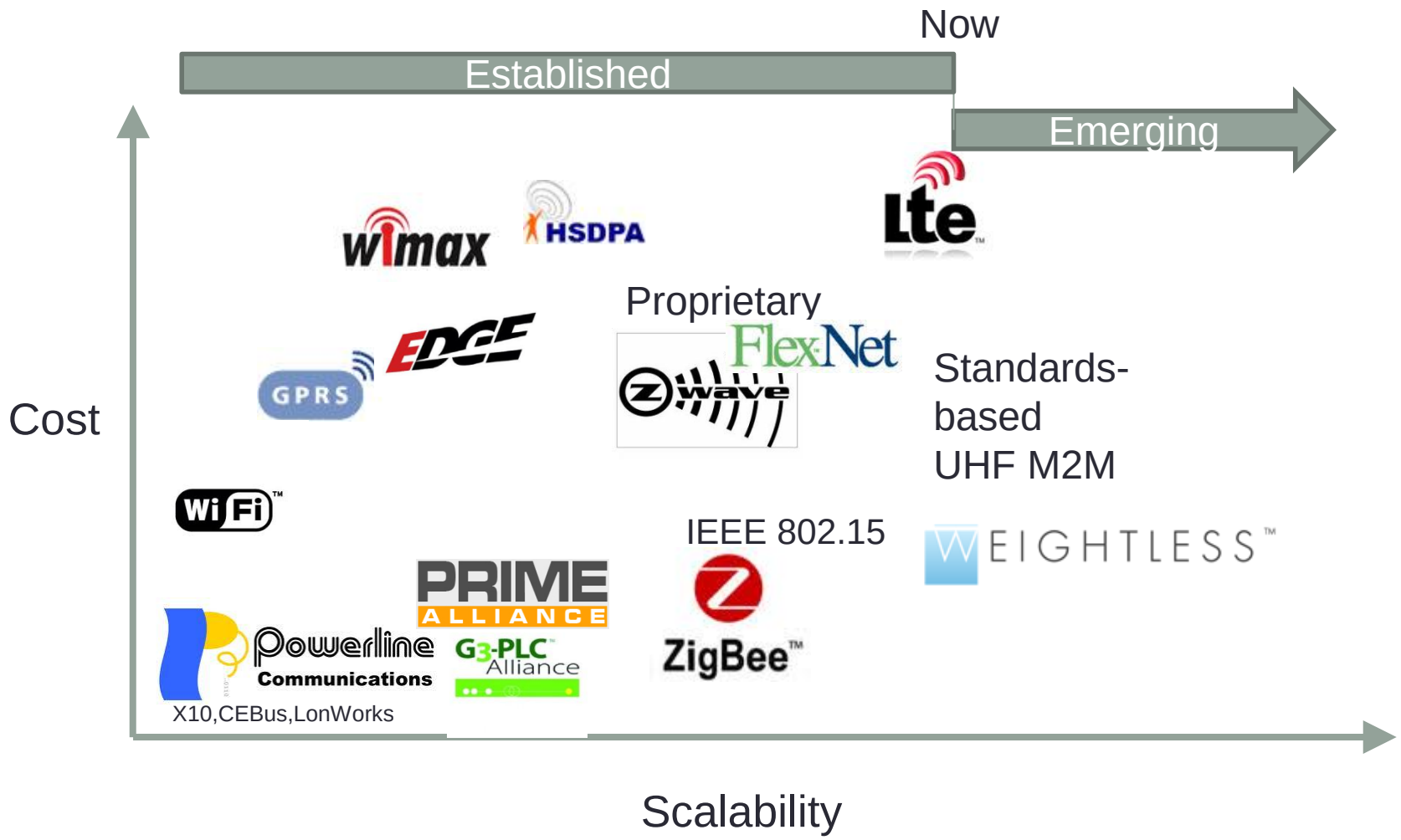
- LTE roadmap stretches beyond 2035
- Potential for whitespace for coverage, in-fill, and offloading

Potential CR Application Area 2

- Machine to Machine
  - device communications
    - used for smart meter infrastructure, telematics, health monitoring, security, environmental sensor monitoring, and a wide variety of networks that operate independently of direct human interaction
  - Support billions and trillions of devices
  - Reality: extremely low power usage requirements, <$1 comms costs, 10 year battery life
  - CR techniques more suitable to the basestation/aggregation point


Asset Tracking
PARA
Security
Remote Health Monitoring
Utility Metering
Entertainment & Gaming
Environmental Sensors
Fleet Monitoring
Industry
Defence

M2M: Potential Comms Technologies Comparison



Potential CR Application Area 3

- Rural broadband
  - Wireless internet coverage to low density rural areas
  - Original target for TV whitespace usage
  - Limited deployment in the U.S.
  - Not an entirely attractive business case
    - Low density, high cost sensitivity, onerous technical/regulatory requirements

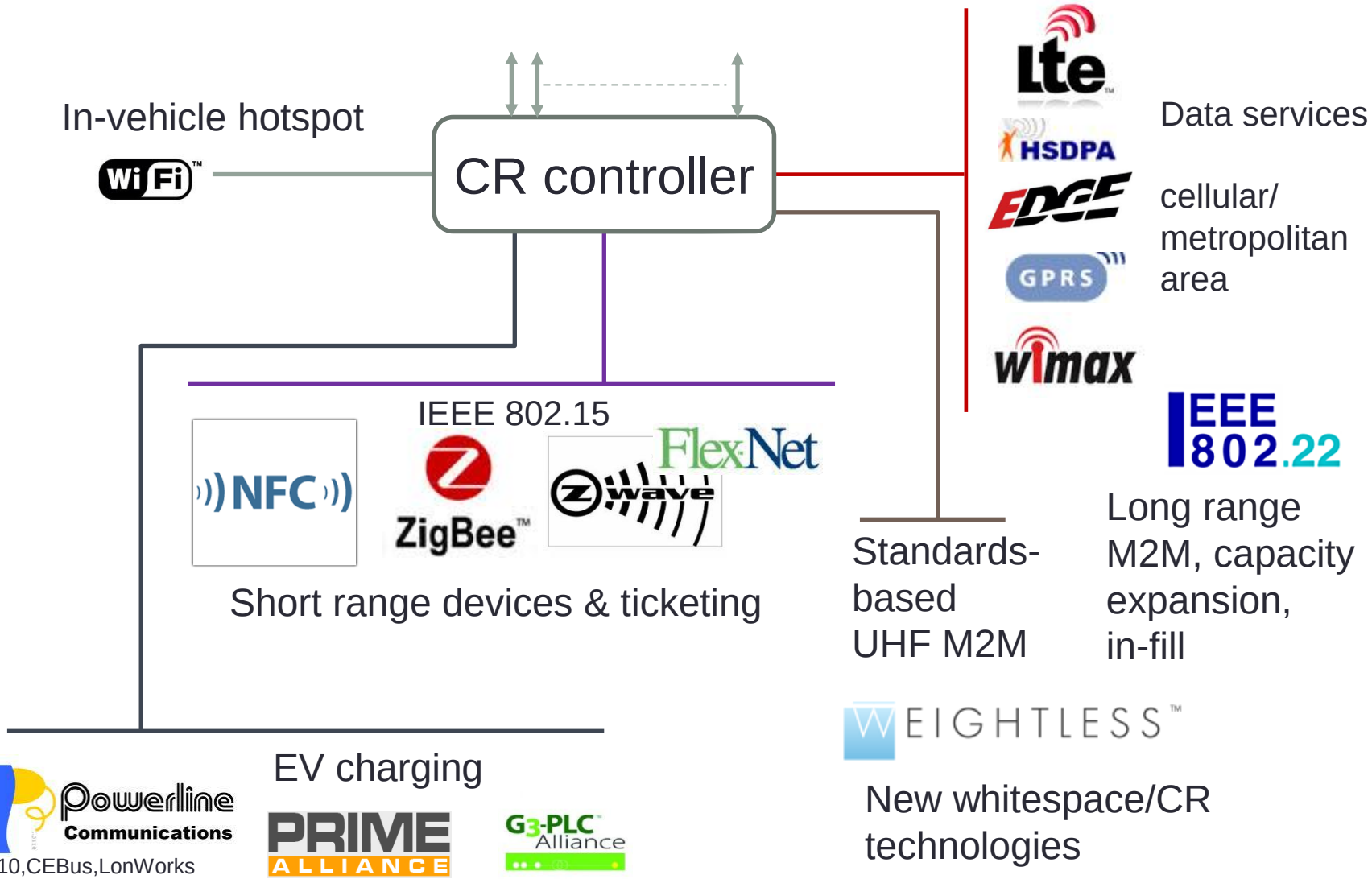
Potential CR Application Area 4

- Medical body area networks (MBANS)
  - Wireless medical sensors within the healthcare market
  - Market increasing from $7 billion in 2008 to > $11 billion in 2013
  - Currently, MBANs are being used in licence-exempt and congested frequency bands
  - How to address reliability – use CR/geolocation

Potential CR Application Area 5

- Intelligent transportation systems
  - Energy efficiency improvements, carbon and cost reductions, and enhanced safety
  - Plethora of communications and vehicular management systems in new vehicular designs creates a complex mobile data server
  - Use CR techniques to reduce the complexity from a user perspective and for automatic management

In-vehicle communications



Questions?

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