Quality Of Service and MObility driven cognitive radio Systems

Towards managed QoS and mobility in shared spectrum

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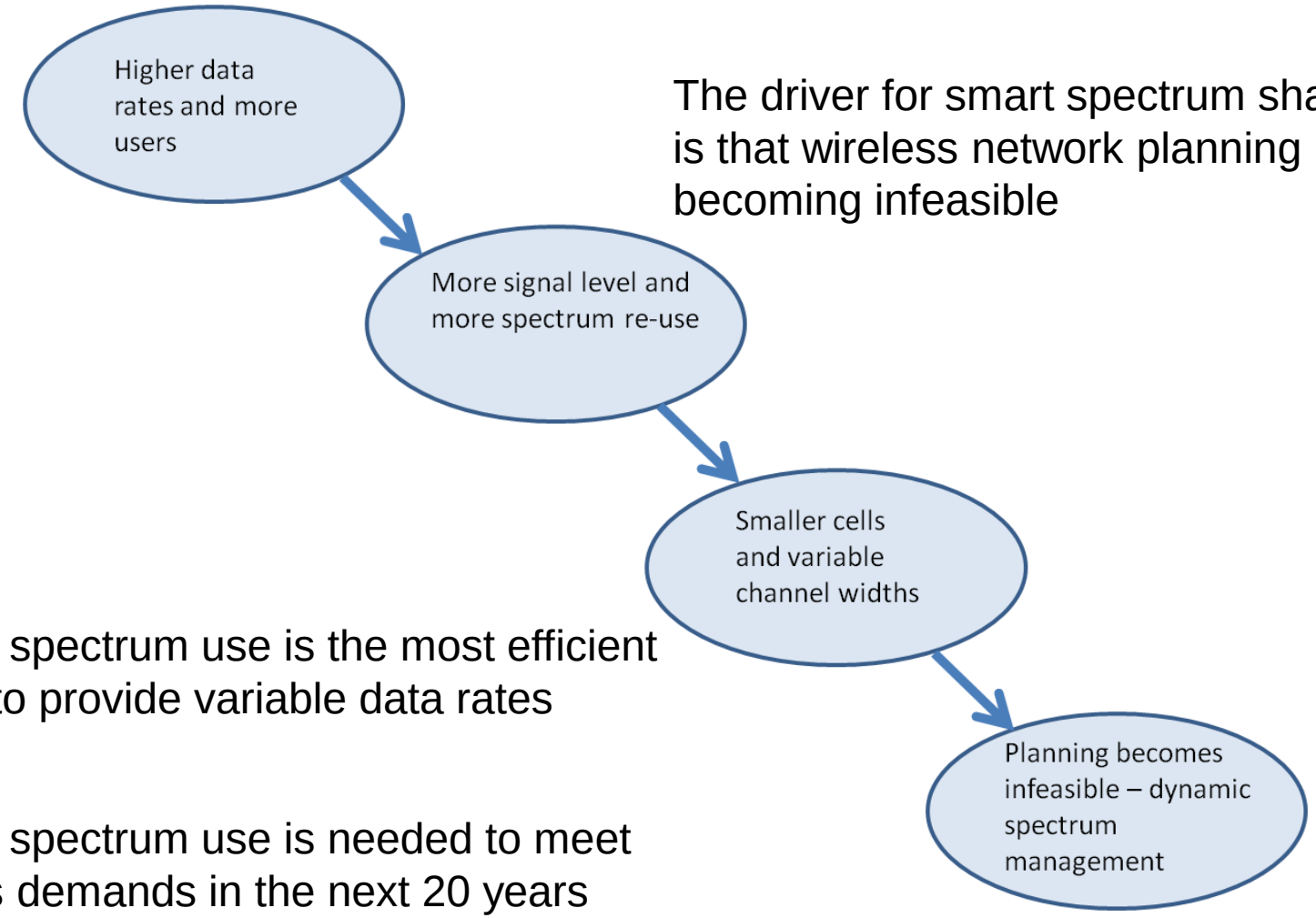
Outline

- Why do we need spectrum sharing (vision)
- QoSMOS project and challenges
- QoSMOS holistic approach
- QoSMOS scenarios
- QoSMOS reference model
- Flexible PHY for WS
- Conclusion

Vision



The driver for smart spectrum sharing is that wireless network planning is becoming infeasible

Flexible spectrum use is the most efficient means to provide variable data rates

Flexible spectrum use is needed to meet wireless demands in the next 20 years

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QoSMOS project

- QoSMOS - *Quality of Service and MObility driven cognitive radio Systems*
  - A research project in EU's 7th framework program
  - Call objective "Efficient Radio Access to Future Networks"
  - Runs from 2010 – 2012 (3 years)
  - 15 partners, including operators, equipment vendors and research institutions
  - An External Advisory Board (EAB) consisting of regulators, broadcasters, pre-standardisation committees and certification organizations
- QoSMOS' focus is on mobile services and QoS, which introduces new challenges and possibilities:
  - More dynamic frequency situation when moving
  - Handover with no dedicated spectrum
  - Handling of QoS when the frequency resource varies
  - QoS class can be linked to frequency choice and can be input to the spectrum management process

QoSMOS will research and develop the tools and techniques that allow opportunistic use of radio spectrum where users are moving, while receiving a managed QoS

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Some challenges

Wireless spectrum will be fragmented in many geographical areas and flexible PHY layer techniques will be required to deal with this.

Fairness between sharing users will need to be encouraged, perhaps through a brokerage or co-operation agreement. Etiquette for sharing, is being considered,

Protection of primary users, but also fairness amongst secondary requiring a mix of database and sensing technologies

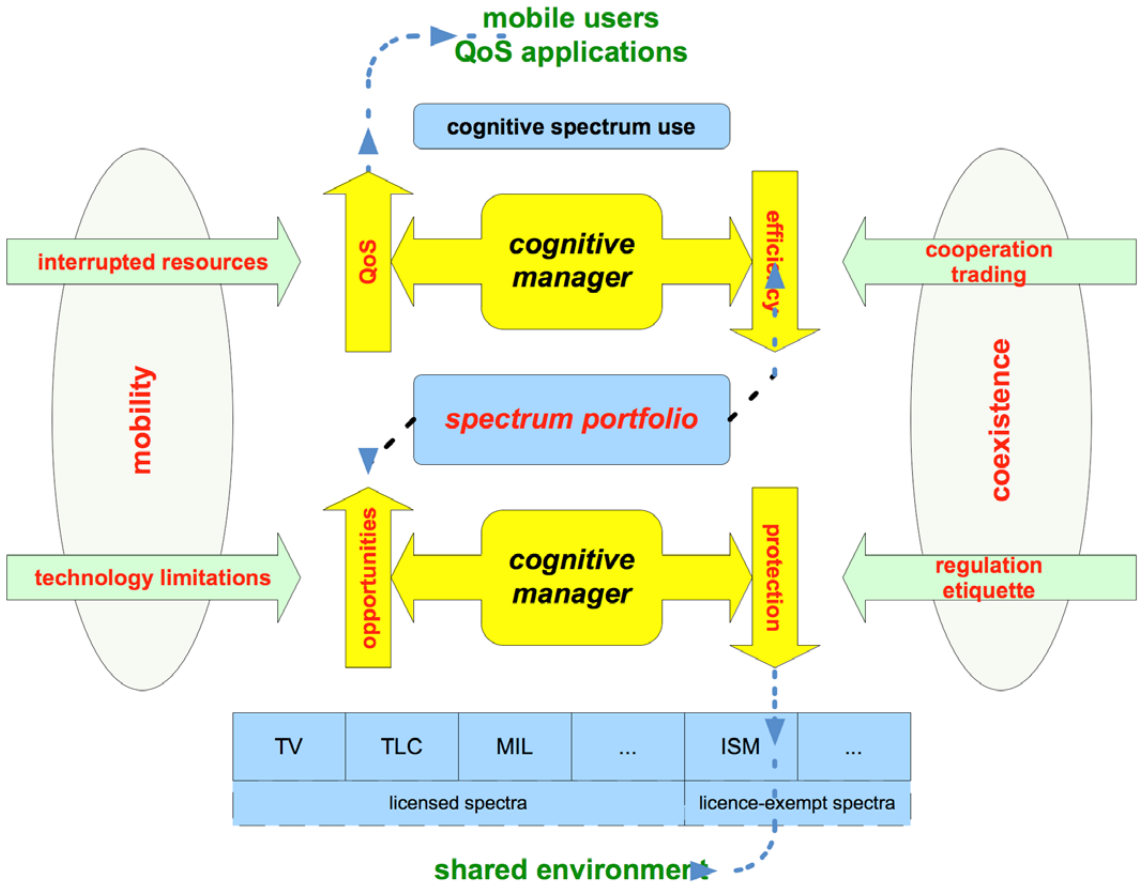
Managed QoS and mobility will require integration of the control and management planes from the radio access network to the core networks of the network operators.

From there, interworking to the service providers will be needed, which is complicated by wholesale relationships. Work on value chain reference models and economic analyses is ongoing.

A two-tier approach is used for wireless resource management

The upper manager is distributed and allocates resource to wireless systems (more short term)

The lower manager is centralised and contains the spectrum portfolio (long term or slow changes)



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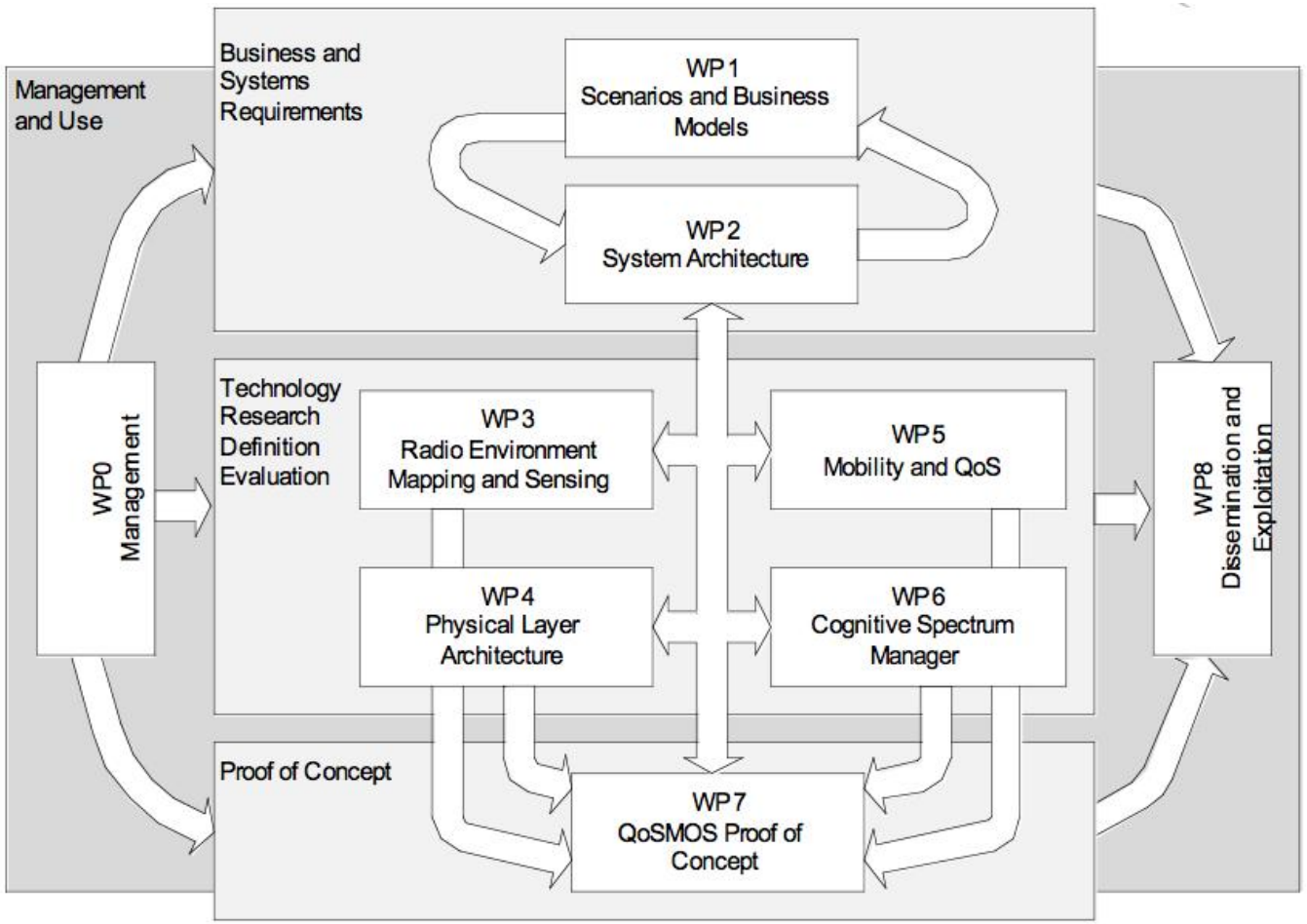
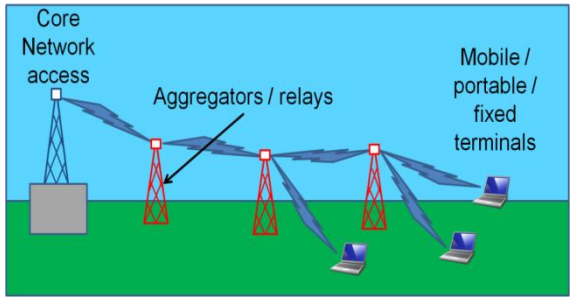
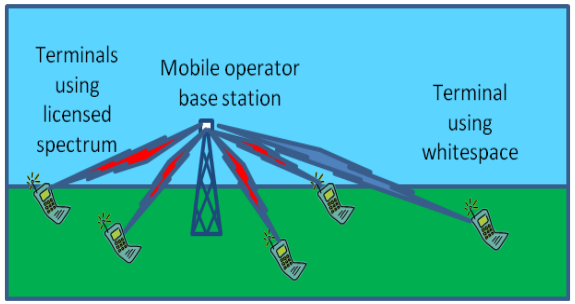
Workplan



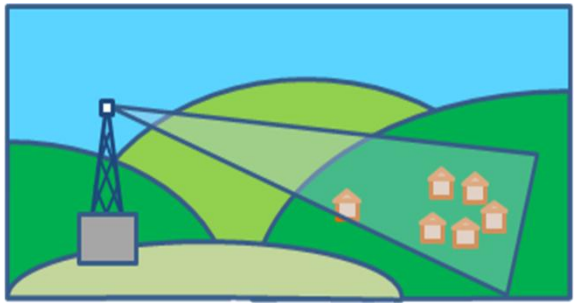
QoSMOS scenarios



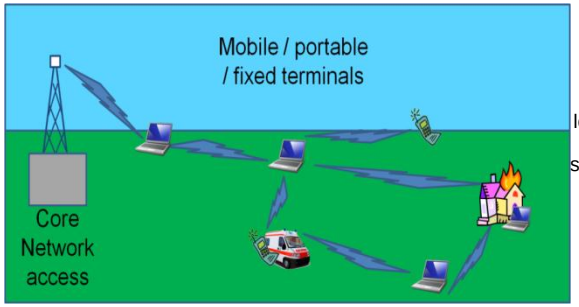
Dynamic backhaul



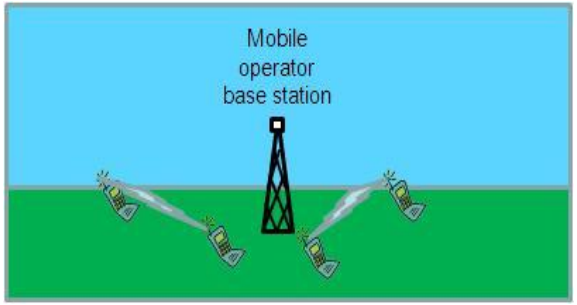
Cellular extension



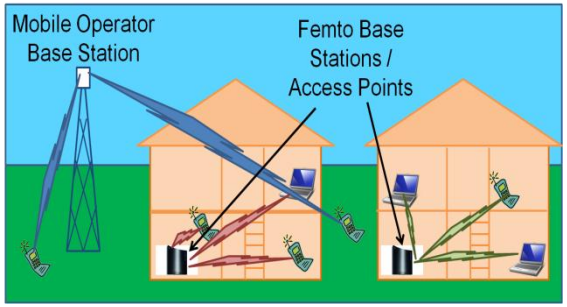
Rural broadband



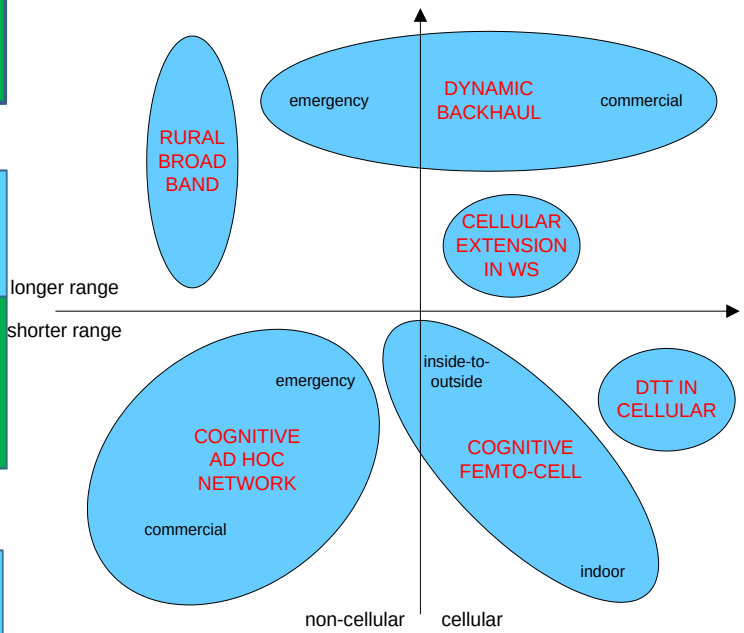
Cognitive ad hoc network



Direct terminal-to-terminal



Cognitive femtocell



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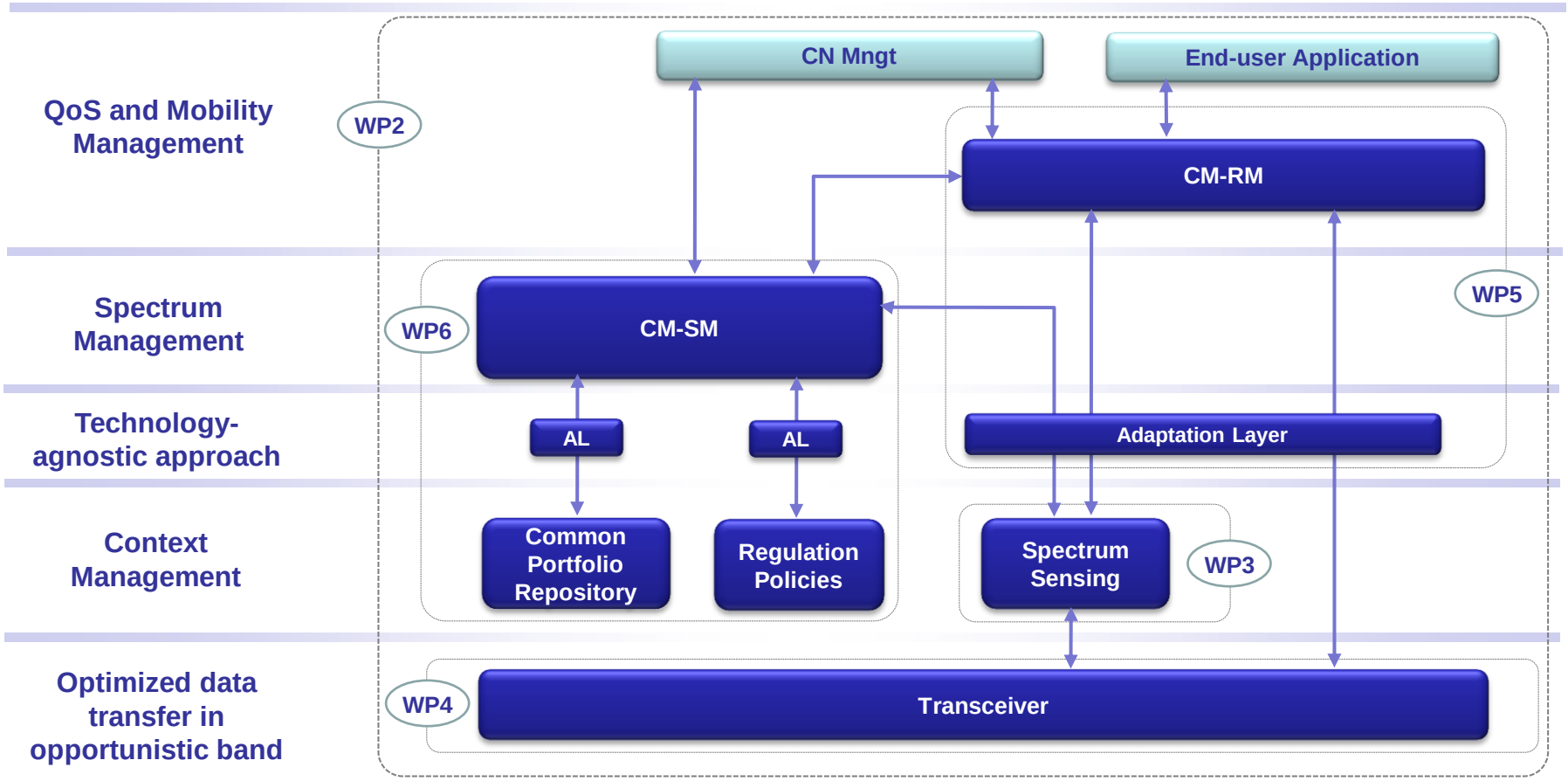
Reference model

QoSMOS CHALLENGES

REFERENCE MODEL



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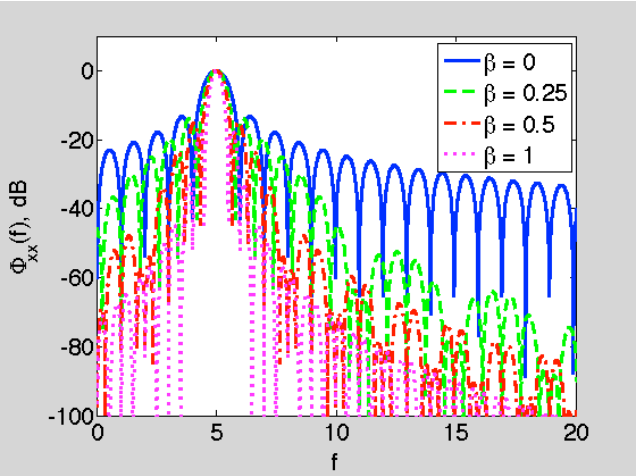
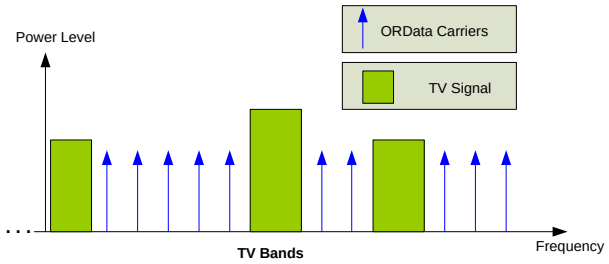
Motivation for looking Beyond OFDM

- Fragmented White Space
- Flexible MC approach
- Extremely low out-of-band radiation
- Digital Implementation
- Spectrum pooling



OFDM signal with square window
⇒ first side lobe at -13dB
⇒ requires additional filtering

- Multi-branch filter bank approach
- Adjustable out-of-band radiation
- Less CP compared to OFDM
- Reconfigurable RF front – end for flexibility



IA-PFT, FBMC and GFDM

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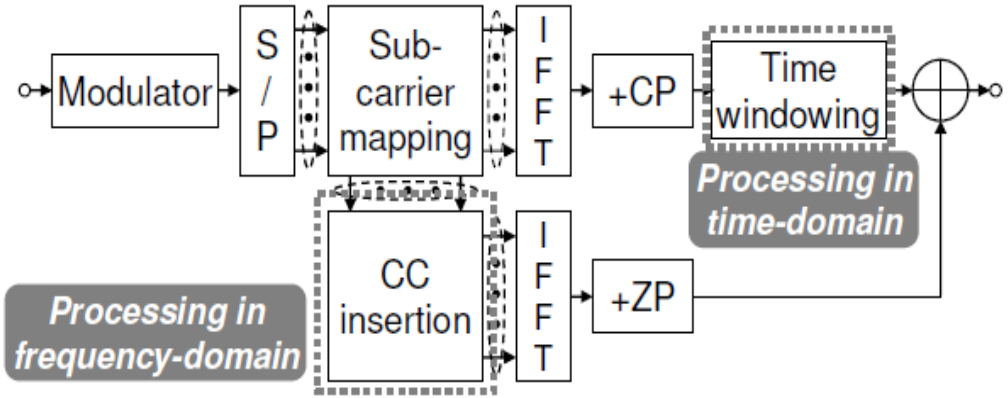
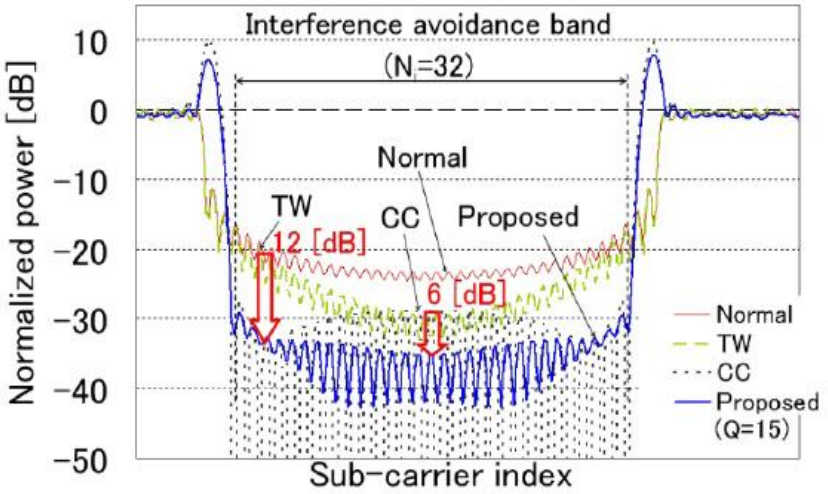
Interference Avoidance Transmission (IA-PFT)

- An OFDM-based-transmitter capable of suppressing out-of-band emission for opportunistic spectrum access in White Space
- Parallel concatenation of partitioned frequency-domain (Cancellation Carriers) and time-domain (windowing) processing
- 6-12 dB of suppression gain in power spectral density



IA-PFT transmitter

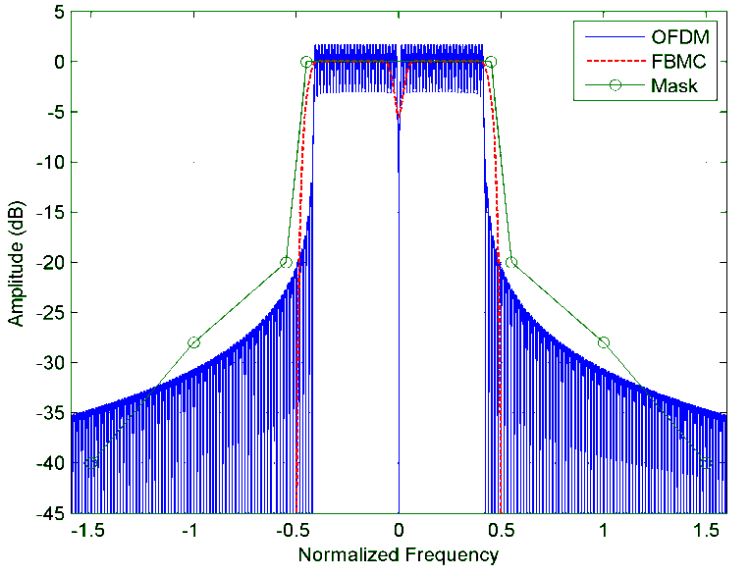


Power spectral density

Low leakage / high spectrum efficient PHY

- FBMC (OFDM OQAM) relax constraint on orthogonality
- Trades off frequency and time domain localization
- Higher spectrum efficiency
- Higher complexity compared to OFDM, but similar to filtered OFDM

Standard	Spectral Efficiency Gain relative to OFDM		
	Frequency Domain	Time Domain	Total Gain
DVB-T	10 %	3 %	13 %
IEEE 802.11a/g	3.8 %	15.8 %	19.6 %



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Summary

- QoSMOS address key challenges of future DSA networks
- A holistic approach is used and developed in a reference model
- Spectrum and resource management is proposed in a 2 tier system vision
- QoSMOS propose technical enablers and also look at buisness perspectives
- Flexible radio approaches for scalable spectrum aggregation is proposed
- QoSMOS is active in standardization (ETSI, IEEE)

Acknowledgement

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More information from www.ict-qosmos.eu.

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