Service discovery: CPC or database?

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ISART 2010, 27-30 July, Boulder (CO)

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Overview

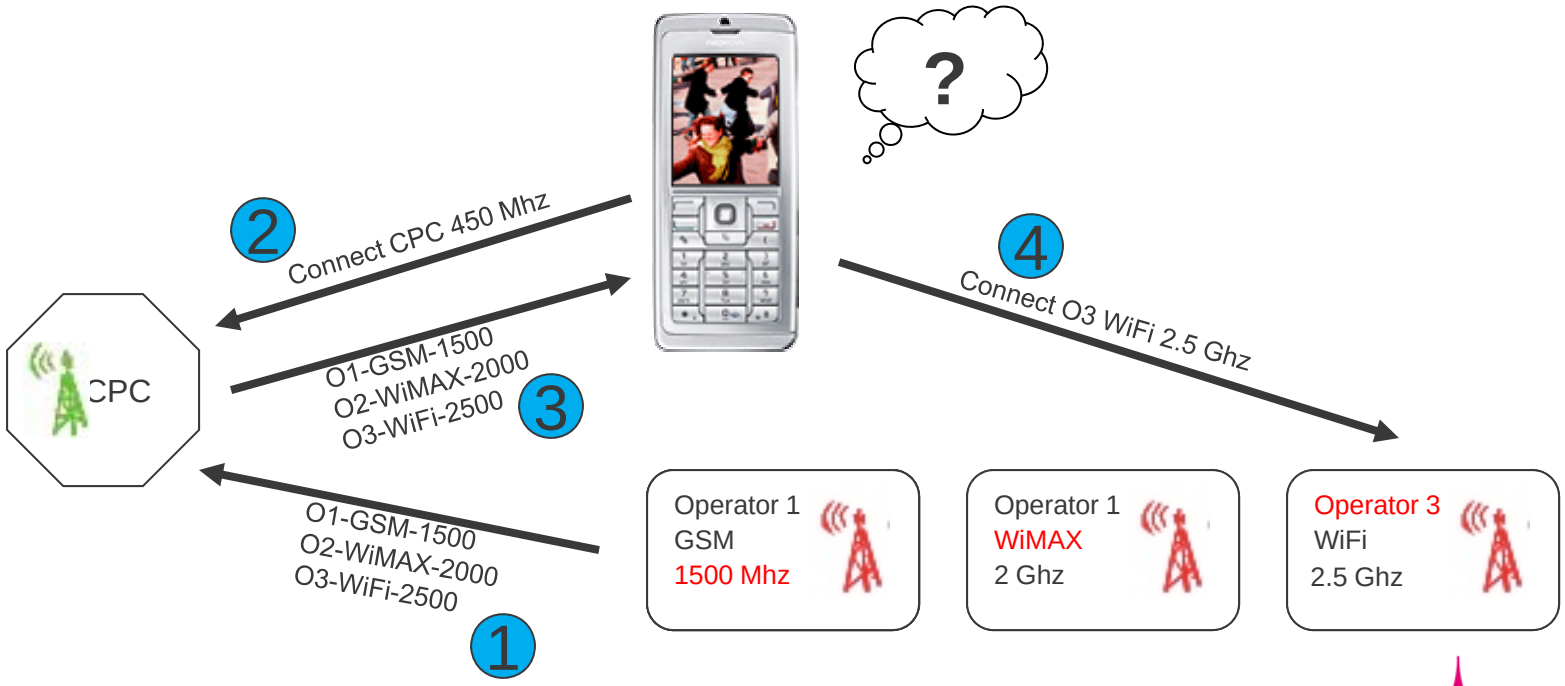
- Cognitive Pilot Channel
- (White Space) Database
- Which will prevail?
- Some considerations

CPC genesis

- Signalling is not new
- Research
  - E^2R project (2006-2007)
  - E^3 project (2008-2009)
  - OneFIT project (ongoing)
- Standardization tracks set up
  - IEEE SCC41
  - ETSI RRS
- Regulatory effort: WRC

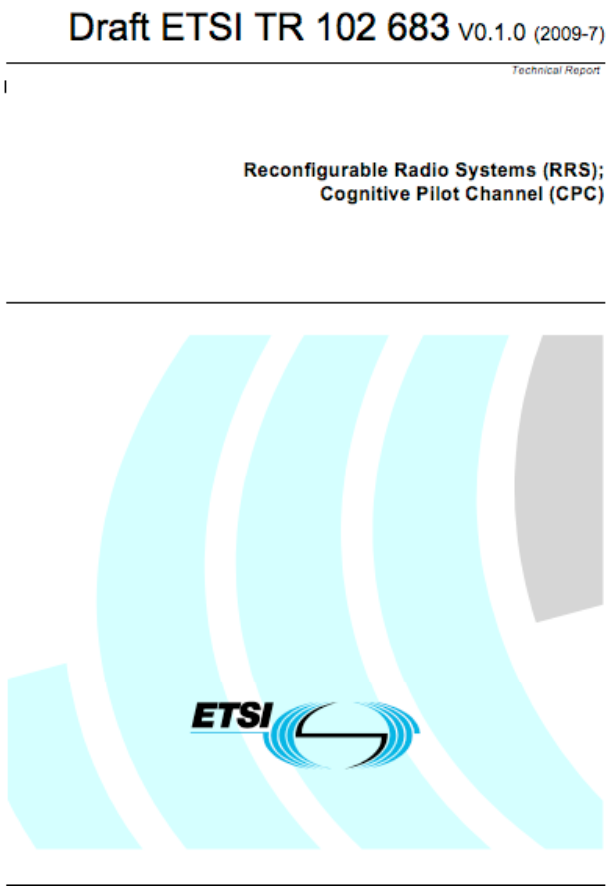
CPC functionality

In-band vs out-band
Start-up vs ongoing
Broadcast vs on-demand
Physical vs IP-based
Mesh composition
...



CPC Standardization: ETSI RRS (1)

- ETSI: European Telecommunications Standardization Institute
- TC RRS, WI on CPC, TR 102 683



CPC Standardization: ETSI RRS (2)

- Report contains
  - Scenarios
  - (Possible) functionalities
  - (Possible) advantages
  - Information model
  - Two ways of organising geo info
  - Out-band and in-band solution
  - Some info on GSM and WiFi as possible RATs
  - Broadcast vs on-demand

CPC Standardization: ETSI RRS (3)

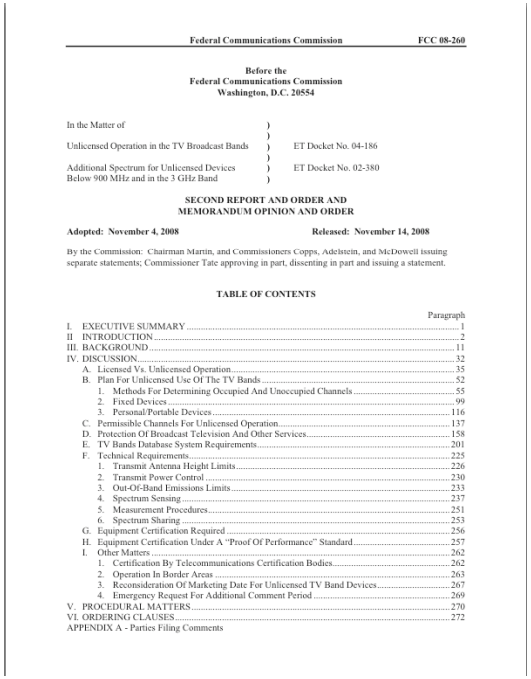
- Report recommends “possible standardization” of “certain topics”:
  - Definition and specification of physical and data link layer (L1 & L2) technologies and protocols for the out-band CPC in both downlink only and bidirectional operation. This should include the definition of the message structure and delivery procedures for cases like using the CPC concept for speeding up the start-up procedure in the context of a full DSA environment, for using the CPC as a support for secondary spectrum usage and for using the CPC as a support to radio resource management optimisation.
  - Definition and specification of message structure and delivery procedures for the in-band CPC for example to support radio resource usage optimization in the context of heterogeneous wireless environments.

CPC Standardization: IEEE

- IEEE SCC41 1900.4
  - Established February 2007 (decision 12/06) as WG 1900.4
  - Objective: to standardize the architecture and protocols enabling a network-device distribution of decision-making in order to optimize radio resource usage.
  - Functional requirements, functional architecture, information model, scenario examples
  - CPC included as a crucial enabler for communication between terminals and networks
  - Chicago meeting October 2008: ballot successfull
  - 27 February 2009: 1900.4 baseline document published
  - Work continues in two subgroups (4.1: interfaces/protocols, 4a DSA in White Space frequencies)

Database: genesis

- TV White Space debate ← broader digital dividend discussion



Federal Communications Commission FCC 08-260

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Unlicensed Operation in the TV Broadcast Bands) ET Docket No. 04-186
)
Additional Spectrum for Unlicensed Devices) ET Docket No. 02-380
Below 900 MHz and in the 3 GHz Band)

SECOND REPORT AND ORDER AND MEMORANDUM OPINION AND ORDER

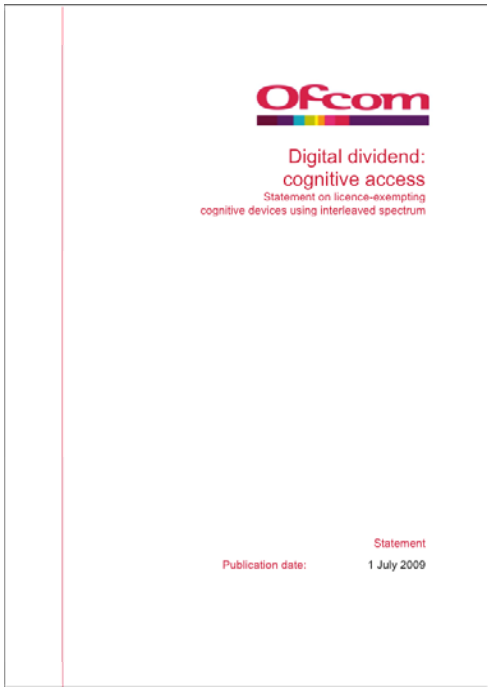
Adopted: November 4, 2008 **Released: November 14, 2008**

By the Commission: Chairman Martin, and Commissioners Copps, Adelstein, and McDowell issuing separate statements; Commissioner Tate approving in part, dissenting in part and issuing a statement.

TABLE OF CONTENTS

Paragraph

I. EXECUTIVE SUMMARY 1
II. INTRODUCTION 2
III. BACKGROUND 11
IV. DISCUSSION 32
A. Licensed Vs. Unlicensed Operation 35
B. Plan For Unlicensed Use Of The TV Bands 52
1. Methods For Determining Occupied And Unoccupied Channels 55
2. Fixed Devices 99
3. Personal/Portable Devices 116
C. Permissible Channels For Unlicensed Operation 137
D. Protection Of Broadcast Television And Other Services 158
E. TV Bands Database System Requirements 201
F. Technical Requirements 225
1. Transmit Antenna Height Limits 226
2. Transmit Power Control 230
3. Out-Of-Band Emissions Limits 233
4. Spectrum Sensing 237
5. Measurement Procedures 251
6. Spectrum Sharing 253
G. Equipment Certification Required 256
H. Equipment Certification Under A "Proof Of Performance" Standard 257
I. Other Matters 262
1. Certification By Telecommunications Certification Bodies 262
2. Operation In Border Areas 263
3. Reconsideration Of Marketing Date For Unlicensed TV Band Devices 267
4. Emergency Request For Additional Comment Period 269
V. PROCEDURAL MATTERS 270
VI. ORDERING CLAUSES 272
APPENDIX A - Parties Filing Comments



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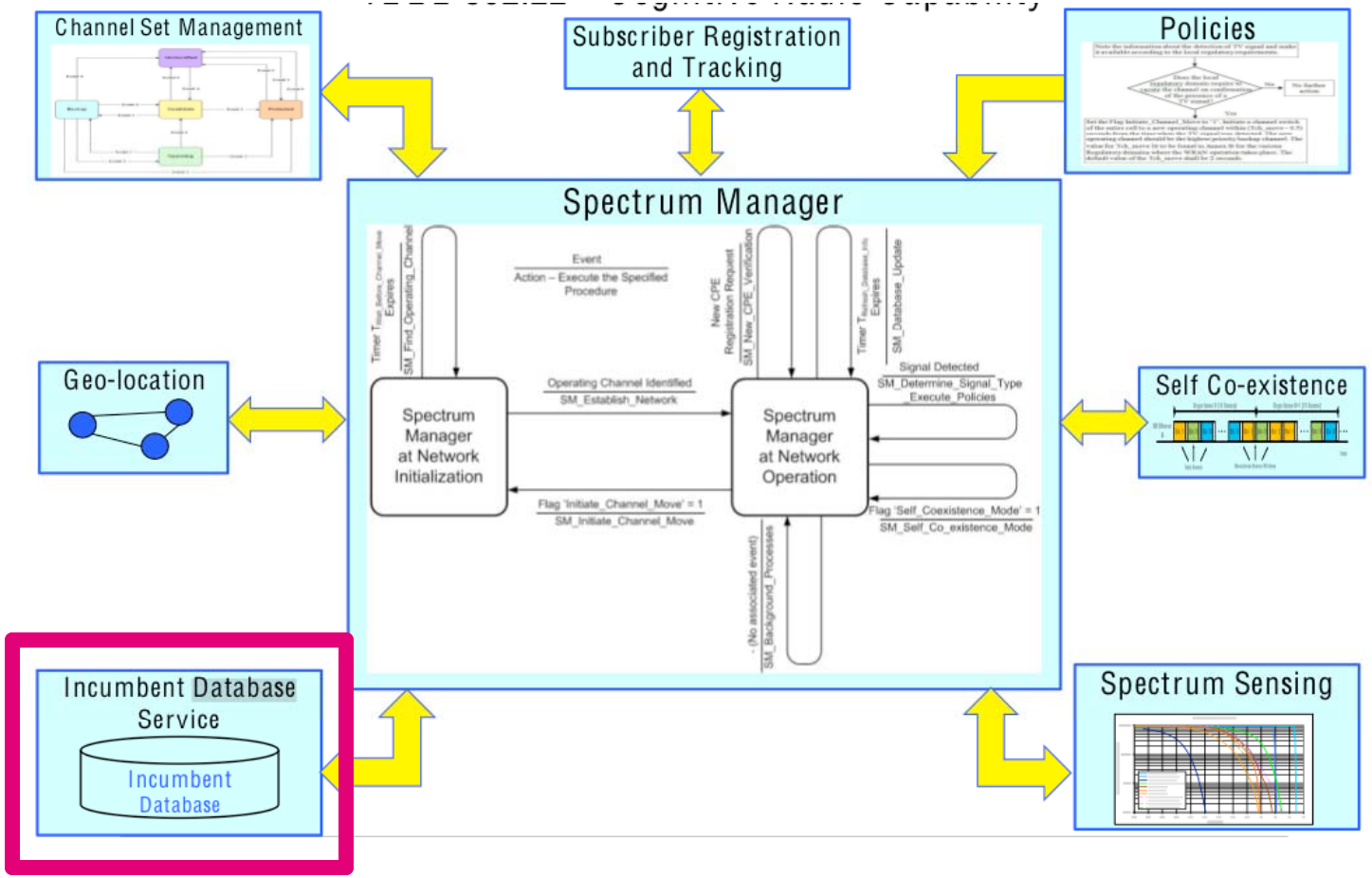
Digital dividend:
cognitive access

Statement on licence-exempting cognitive devices using interleaved spectrum

Statement

Publication date: 1 July 2009

Database: variety of forms



Source: Mody, A.N. & Chouinard, G. (2010). IEEE 802.22 Wireless Regional Area Networks. (doc. IEEE 822.22-10/0073r03

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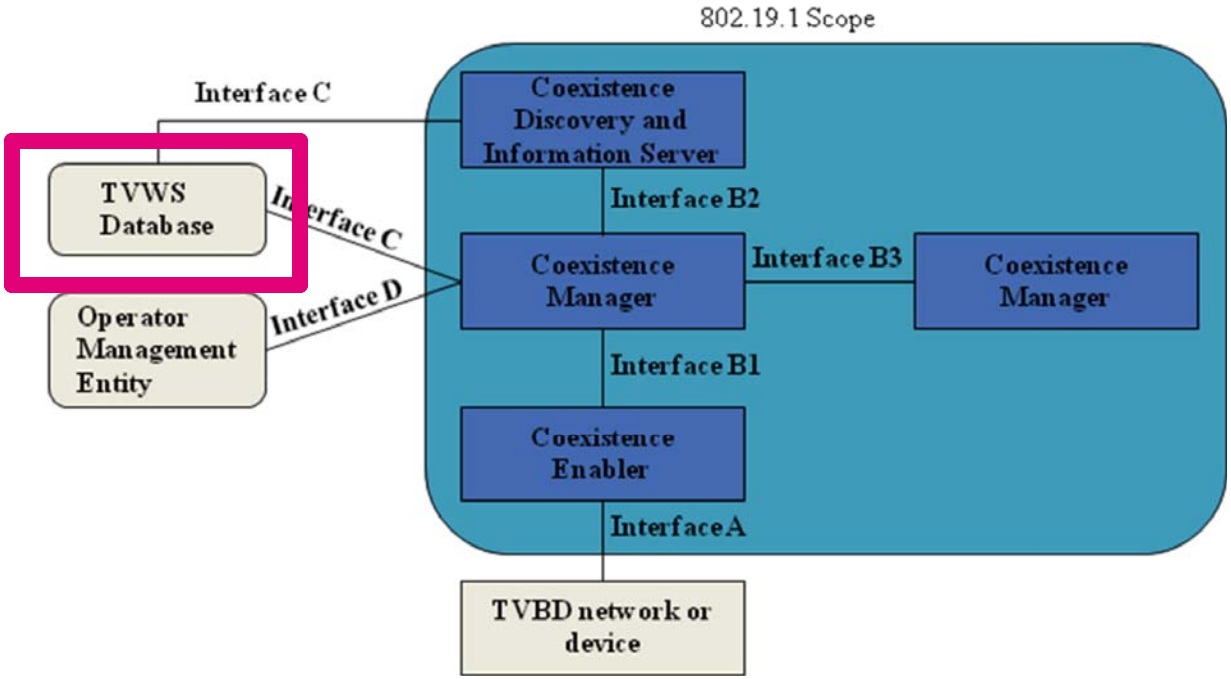
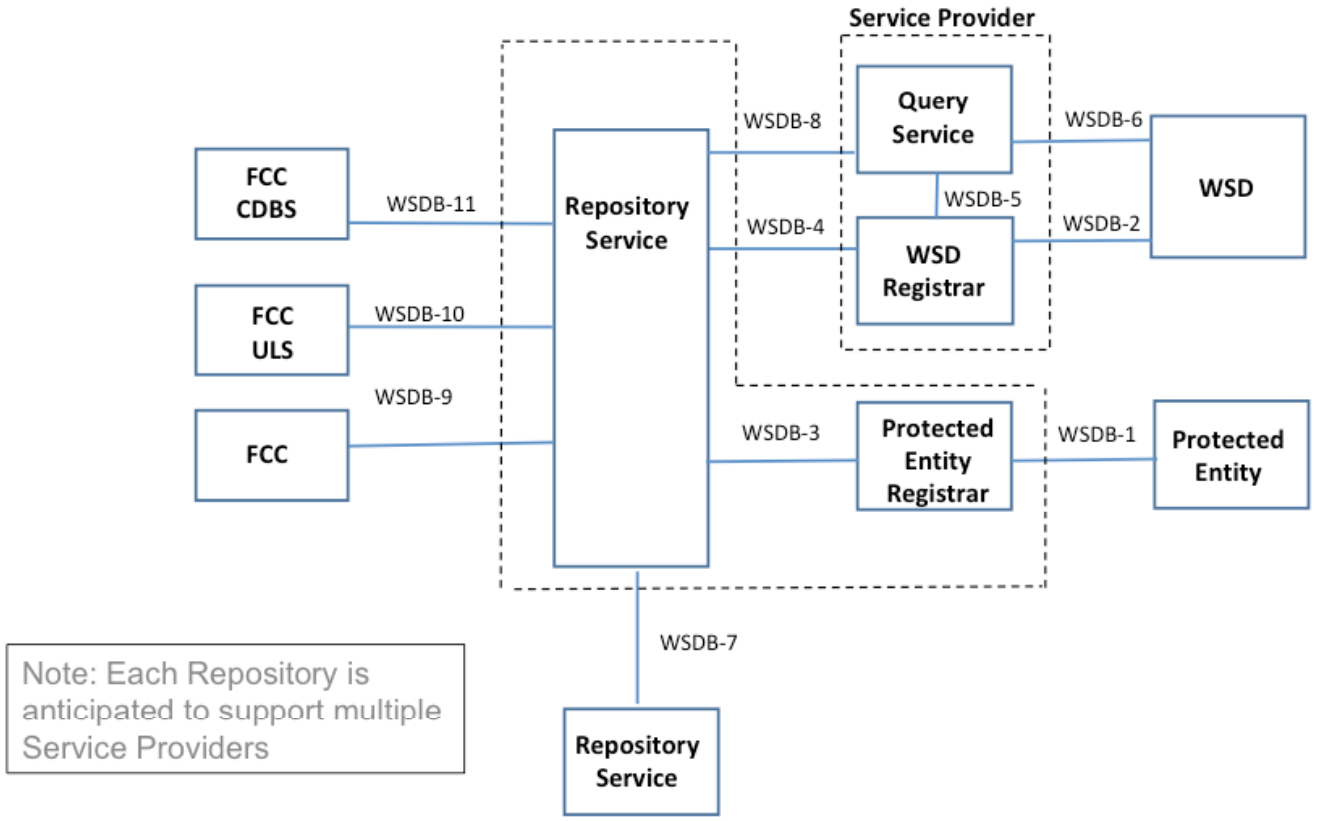


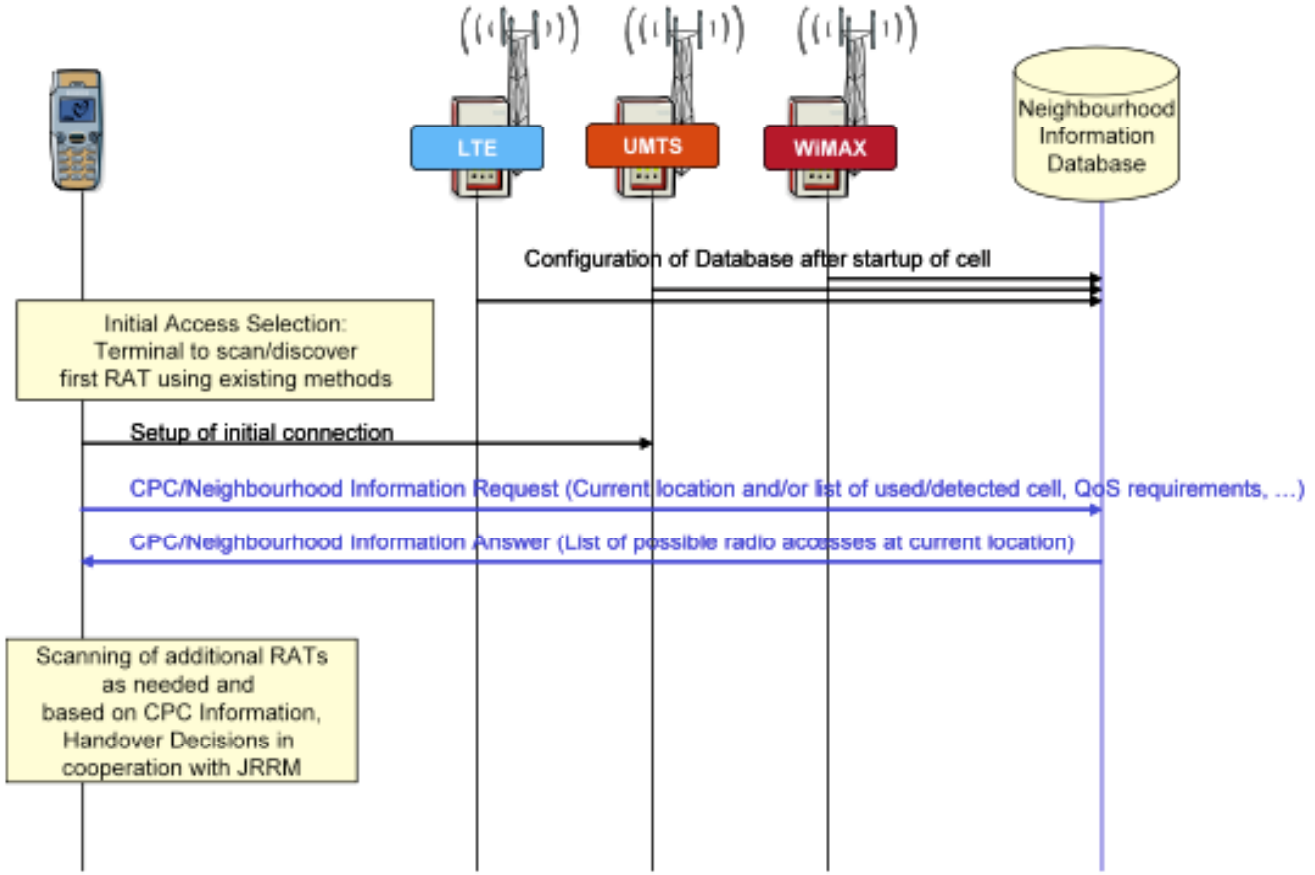
Source: Baykas, T. et al., Developing a Standard for TV White Space Coexistence: Technical Challenges and Solution Approaches, http://www.ieee802.org/19/arc/stds-802-19list/docrnXZz7qdyI.doc

Database: variety of forms



Source: White Spaces Database Group *ex parte* submission dd. April 10, 2009 – Unlicensed Operation in the TV Broadcast Bands (ET Docket N° 04-186)

Database: variety of forms



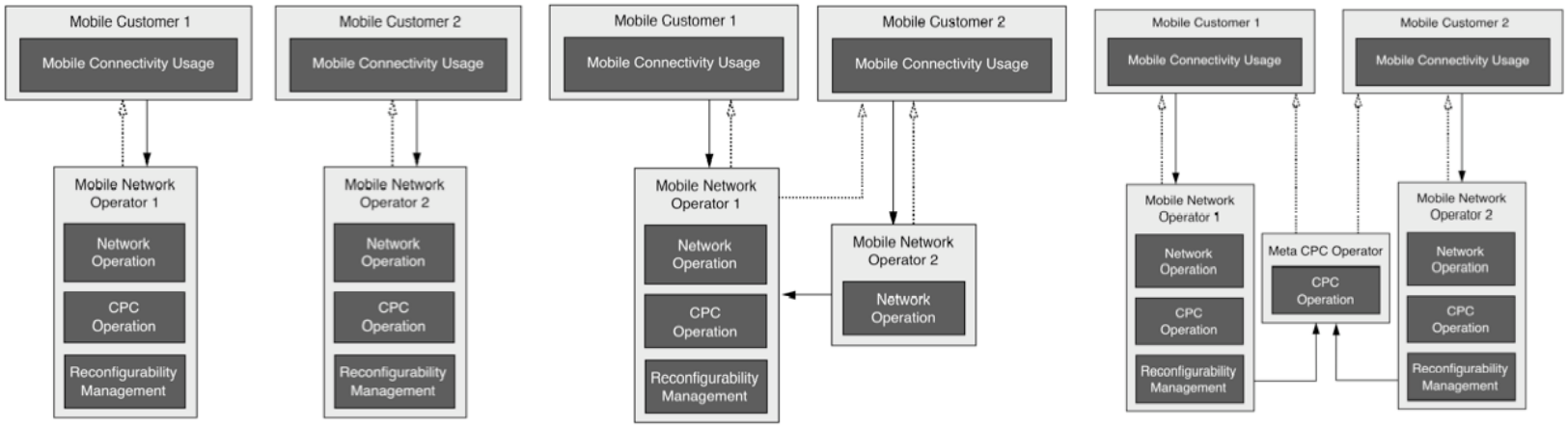
Source: ETSI TR 102 683: Reconfigurable Radio Systems (RRS); Cognitive Pilot Channel (CPC).

Which system will prevail?

- Claim: CPC is stillborn – database alive & kicking
- Why? Combination of factors
  - Scope
    - generic DSA with cellular focus vs TVWS
    - difference in technical complexity, cost, regulatory roadmap, geography
  - Driving stakeholders + evolutions over time
    - Telcos vs IT companies: interests and expertise
    - The fate of MOTO → Alcatel Lucent introduces IP-based CPC
  - Regulatory impact
    - Links to EU regulators established, then left unused
    - Worldwide harmonization: antagonisms return (⇔ database: support in US and UK)

CPC – Business constraints

- Architectural re-design → business transformation
- Much of our work has focused on this
- Stakeholder interviews showed (EU) operators' reluctance for inter-operator CPCs → general reluctance towards extra-domain spectrum flexibility



Source: P. Ballon & S. Delaere (2009). A Central Gatekeeper for Flexible Spectrum Management: Is there a Fit between Operator, Vendor and Regulator Views? Paper presented at the 37th Research Conference on Communication, Information and Internet Policy (TPRC), Arlington (VA), 25-27 September 2009

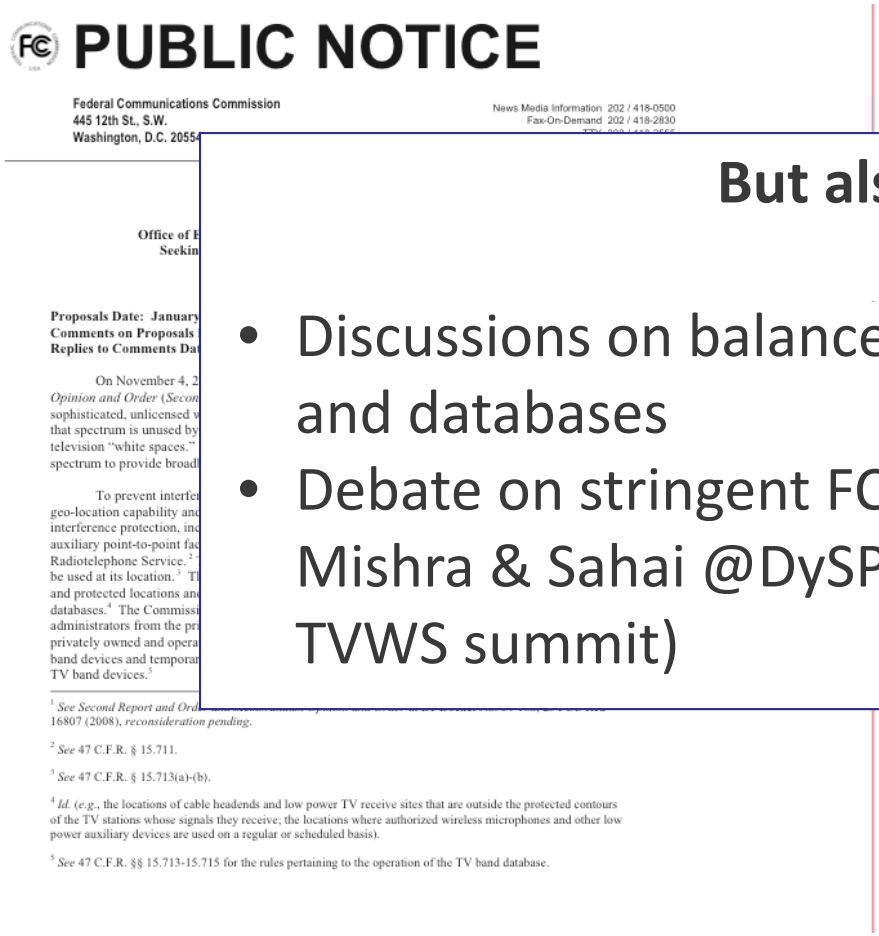
Consequence: CPC standardization

- ETSI RRS WG3 Cognitive Management & Control
  - Currently working on scenarios and use cases
  - “future WG3 work items may focus on cognitive management protocols like the Cognitive Pilot Channel (CPC) and Cognitive Control Radio (CCR) or may be related to databases for the UHF White Space frequency usage.” (May 2010)
  - Out-band scenarios currently frozen, in-band further researched ⇔ reality: no activity, little interest

Consequence: CPC regulation

- ITU-R WRC11: agenda item 1.19: “to consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, based on the results of ITU-R studies, in accordance with Resolution 956 (WRC-07)”
- Driven forward by European regulators, following research activities
- Outlook: no support for change

Meanwhile, database progresses



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Proposals Date: January
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Opinion and Order (*Secon*
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TV band devices.[5]

[1] *See Second Report and Ord*
16807 (2008), *reconsideration pending*.

[2] *See* 47 C.F.R. § 15.711.

[3] *See* 47 C.F.R. § 15.713(a)-(b).

[4] *Id.* (*e.g.*, the locations of cable headends and low power TV receive sites that are outside the protected contours of the TV stations whose signals they receive; the locations where authorized wireless microphones and other low power auxiliary devices are used on a regular or scheduled basis).

[5] *See* 47 C.F.R. §§ 15.713-15.715 for the rules pertaining to the operation of the TV band database.

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Discussion document

Publication date: 17 November 2009

Closing date for responses: 9 February 2010

But also

- Discussions on balance between sensing and databases
- Debate on stringent FCC rules (cf. Harrison, Mishra & Sahai @DySPAN, Motorola @ WIF TVWS summit)

Databases pose issues as well

- Application- versus radio-oriented solution
  - Pre-supposes available data link
  - Will not work in ‘foreign’ environments
- Limited application
  - RATs involved
  - Geographical scope
  - Information conveyed
  - Real-time updates (do they allow for ‘real’ DSA?)
- Business aspects
  - Who will fund the database?
  - Will telecom stakeholders allow expansion into their domain?
  - Will database not become the same external gatekeeper role the CPC is?

So, to work as general CR enablers...

- ...databases might have to meet CPC half way
  - Robust access: DSA environment, SDR terminals, international roaming
  - Multi-RAT service discovery: information model, propagation characteristics, possibly conditions of use
  - International agreement required?
- ...databases will need to confront similar business issues
  - Multiple commercial databases viable?
  - In case of one database, will operators trust it?
    - Cf. intermediary CPC solution discarded in our earlier research: introduces single point of failure, does not have necessary control over data, no strategic fit between stakeholders, control of customers not aligned with control of gatekeeping roles, continuous customer choice in terms of mobile access decreases instead of increases customer value
    - Debate with TV operators has already been heated, what about telcos?
  - Can TVWS operator be database operator? (cf. Google proposal)

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