ICTP School on Applications of
Open Spectrum & White Spaces Technologies
12 March 2014 – Trieste, Italy

Dynamic Spectrum Access

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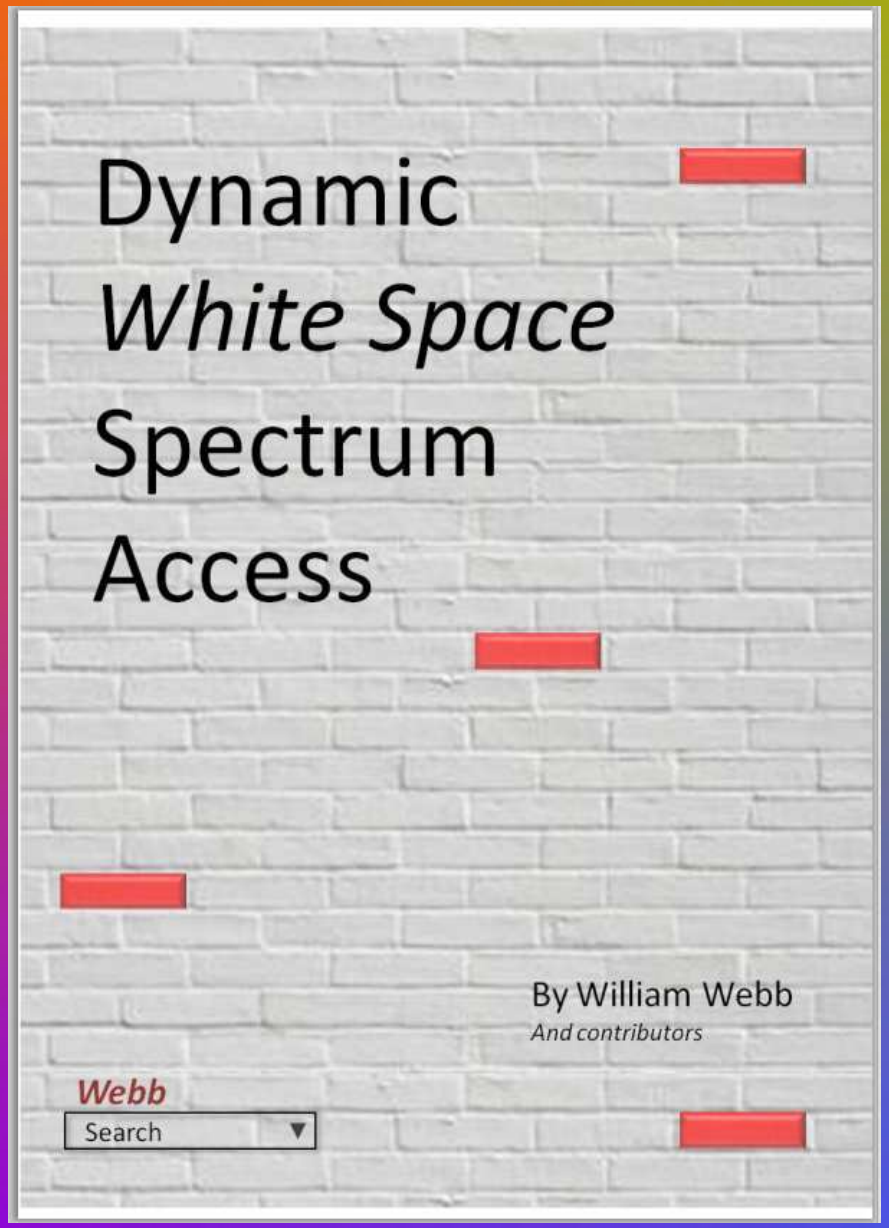
Menu

- TVWS in Europe (or not)
- Dynamic Spectrum Access
- Authorised Shared Access
- Public Safety use of LTE
- Dynamic Spectrum Arbitrage
- Get involved with DSA
- EC spectrum sharing study

http://www.webbsearch.co.uk/?page_id=24



Good free download!

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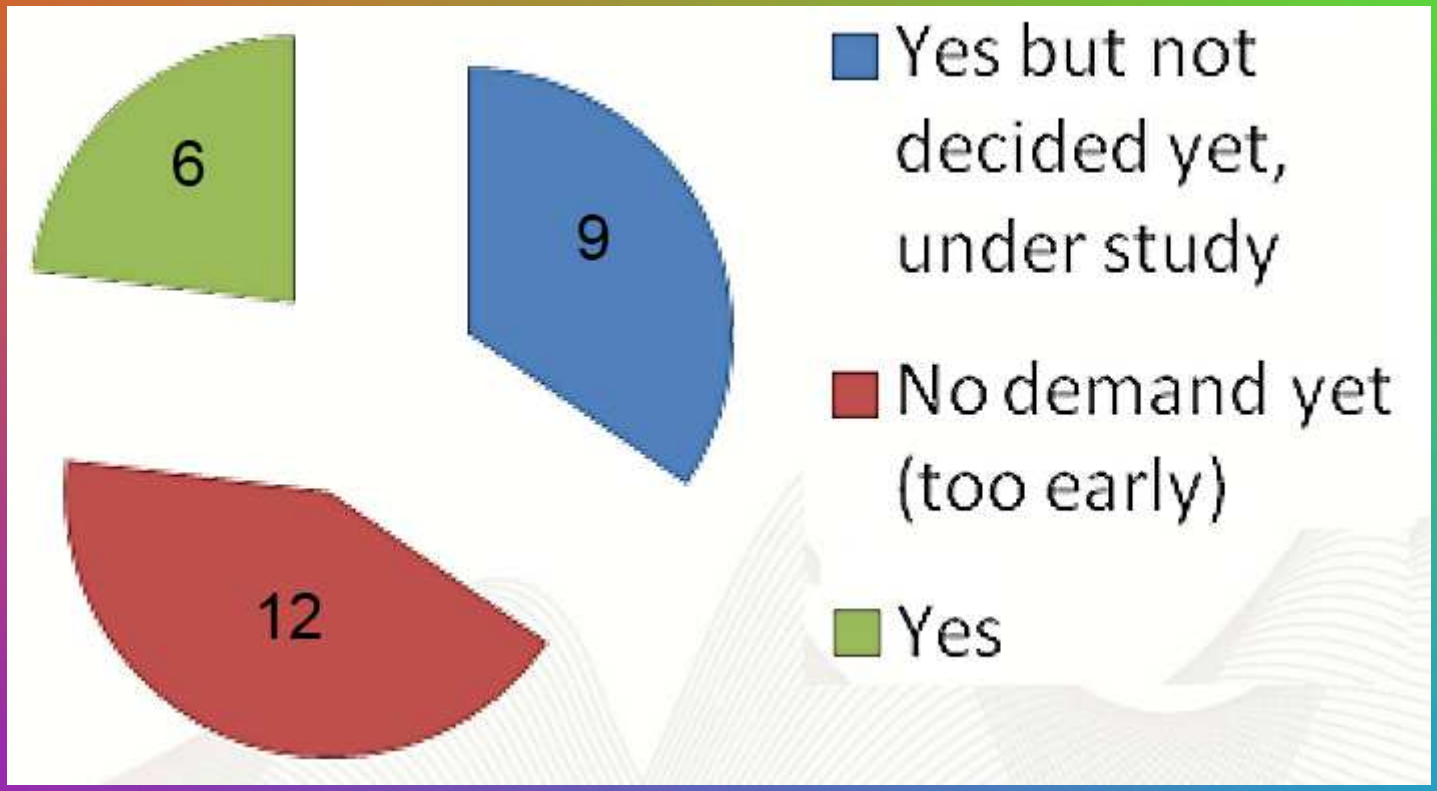
ECC questionnaire to EU regulators (May 2011): "Do you envisage the introduction of white space devices in the 470-790 MHz band"?



From "Deployment of TV White Space Devices: A survey among European Regulators 2011," by Thomas Weber (ECC)

"… Belgium, Denmark, Finland, Latvia, Poland, Slovakia & the UK said they now plan to authorize WSDs…"

---Perspectives on the Value of Shared Spectrum Access: Final Report for the European Commission
(Forge, Horvitz & Blackman, 2012)

What about GERMANY???

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Missing from TVWS discussions

The role of "connected receivers"?

Digital TV Research: "There will be more than 759 million televisions connected to the Internet worldwide by 2018" = 26.8% of all TVs in the world.

Ellingsæter, M. & Bezabih, H., *et al.* (2012) "Using TV Receiver Information to Increase Cognitive White Space Spectrum" - http://arxiv.org/abs/1202.3018

Europe is going its own way

ECC Task Group 6: "Working document towards ECC Report on Long Term Vision for the UHF Broadcasting band" (draft of 6 March 2014)

- http://www.cept.org/Documents/ecc/16365/ECC(14)021-Annex01_Working-document-towards-ECC-Report-on-Long-Term-Vision-for-the-UHF-broadcasting-band

TG6 Terms of Reference

- http://www.cept.org/ecc/groups/ecc/tg6/page/terms-of-reference

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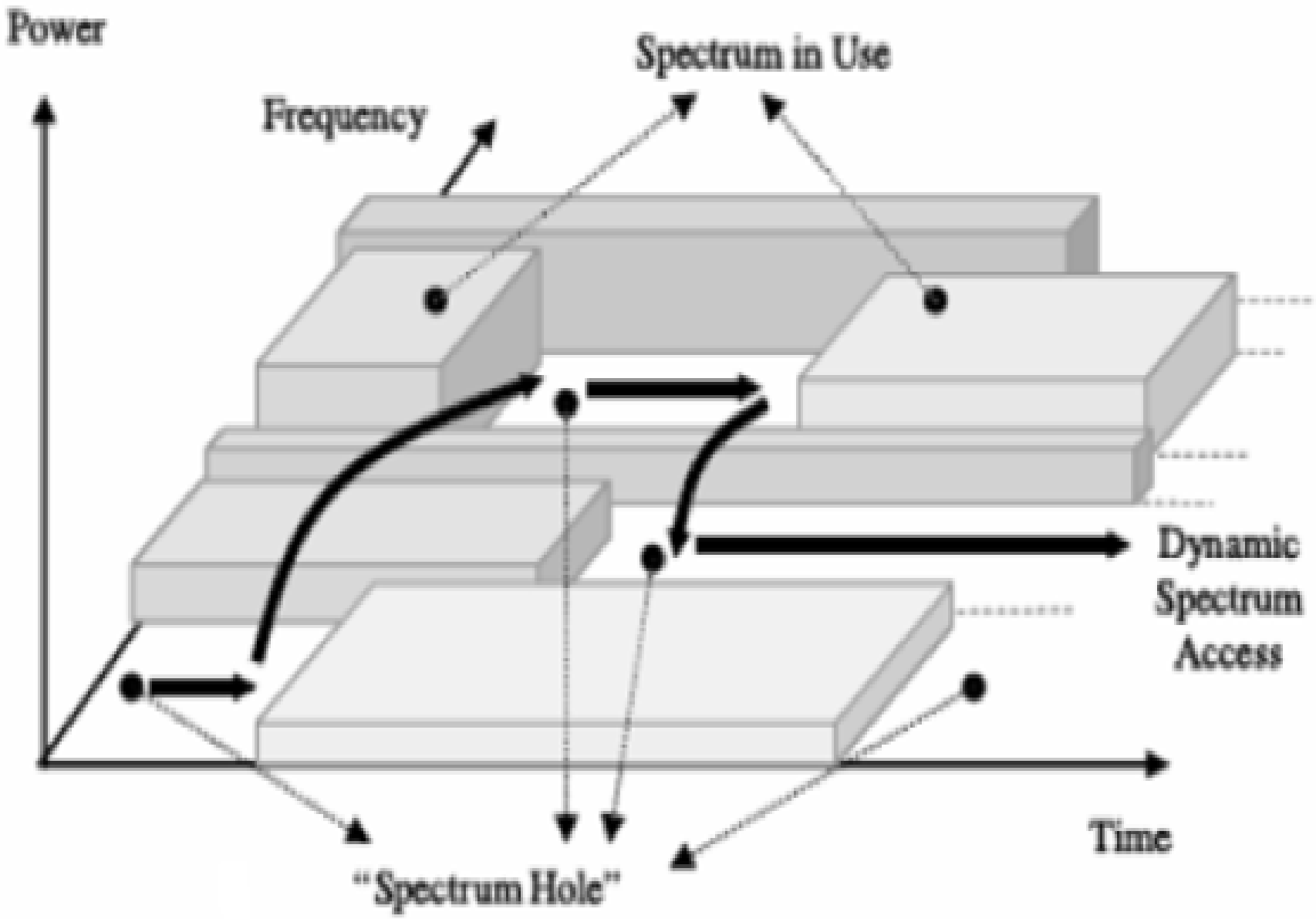
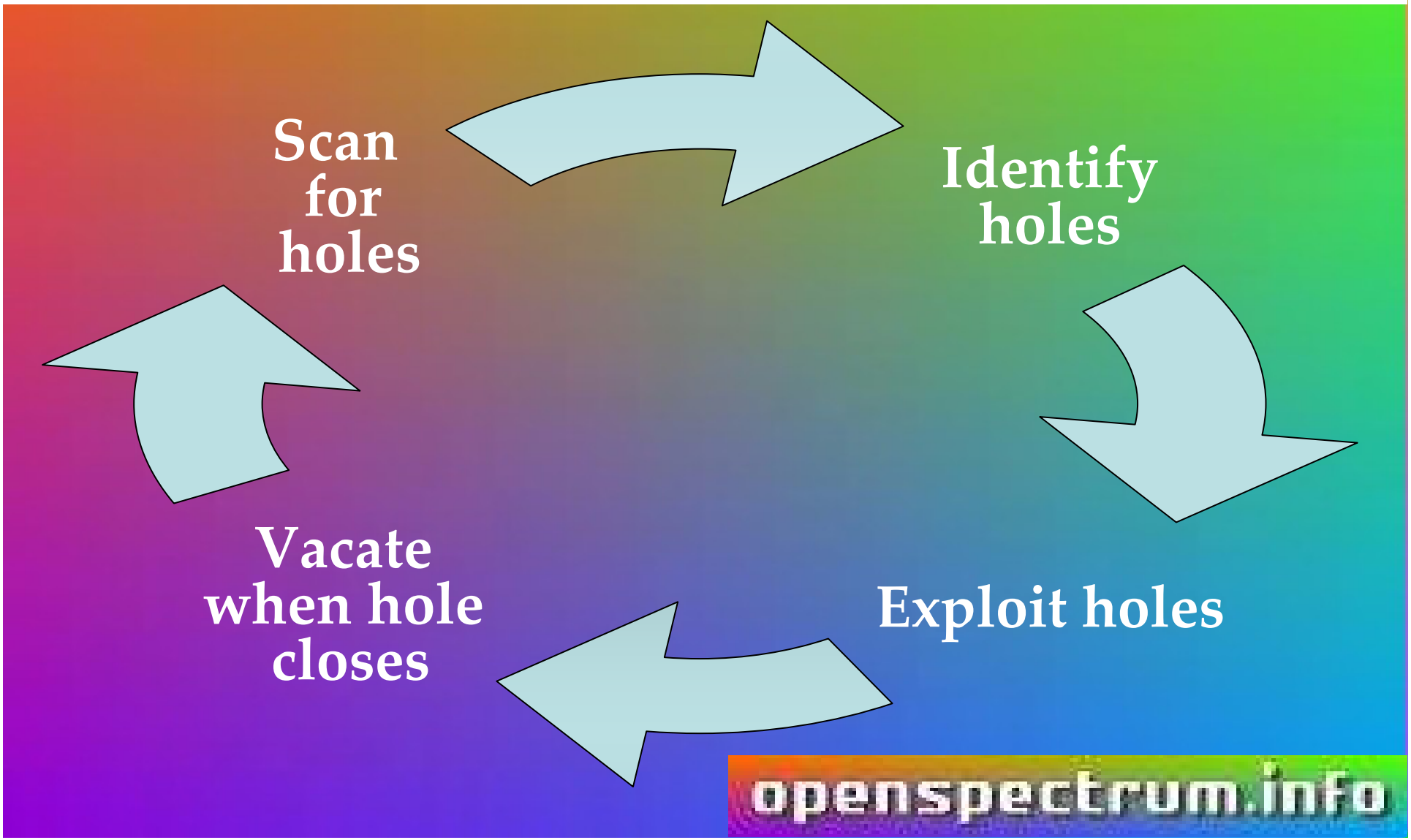
European Commission: "High Level Group on the future use of the UHF band (470-790 MHz)"

- http://openinterests.eu/entities/5bbe8cd49f80c6718

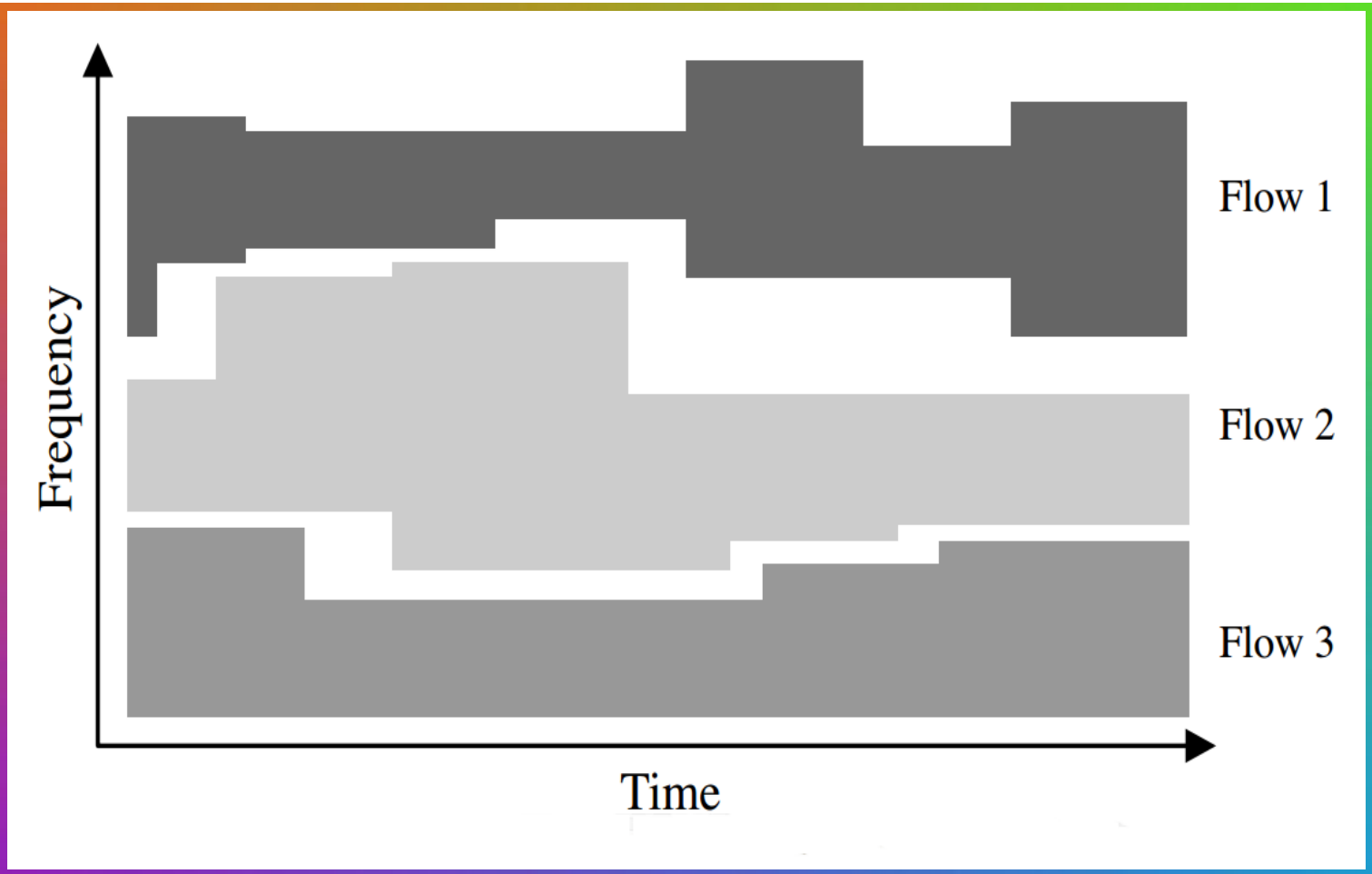


From: UCLA (2009), Opportunistic Spectrum Access research page

Opportunist, know your spectrum needs, then…



Dynamic band sharing among 3 networks in 1 area, each with varying bandwidth



From: Yang, *et al.* (2010) "Supporting Demanding Wireless Applications with Frequency-agile Radios", U. of California Santa Barbara & Tsinghua University

Authorised Shared Access

Proposed by Qualcomm and Nokia in 2011.

Combines traditional spectrum management principles with cognitive techniques & market orientation.

Pre-negotiated agreements among licensees for temporary spectrum sublets.

- Could include guaranteed minimum availability at certain times & places.

Cognitive techniques (e.g. beacons) used to signal availability of & need for resources.

Authorised Shared Access

Well-suited to formerly exclusive bands, bands in transition:

- Cellular networks starting to use new allocations not yet cleared;
- Commercial secondaries accessing a government/military band.

Degree of regulator involvement?

In Europe: Licensed Shared Access (LSA)

- Regulator approval needed.
- Regional harmonisation of sublet rules.
- Agreements become license conditions.

Public Safety use of LTE?

"Callable/Interruptible Spectrum"

- Proposed by Bykowsky & Marcus, 2002

First large-scale test: FirstNet in the US

- 20 MHz + USD 7 billion
- "Ruthless pre-emption"

European PPDR debate: dedicated/private LTE networks or (hardened) public cellular? Dedicated or shared spectrum?

Dynamic Spectrum Arbitrage

US Patent No. 8,279,786: "Methods & Systems for Dynamic Spectrum Arbitrage" - Clint Smith & Declan Ganley (Rivada Networks, Llc)

- https://www.google.com/patents/US8279786

"The Future Of Wireless Is Dynamic" Rivada Networks Declares, Following New Patent Approval" (press release, 24 January 2014): "For the first time, a technology exists that will allow for wireless broadband spectrum to be traded like any other commodity – bought & sold in real time," said Rivada CEO Declan Ganley…

- http://rivada.com/press-release-the-future-of-wireless-is-dynamic/

Eli Noam's concept of "Open Spectrum" (1995)

"…all users of those spectrum bands pay an access fee that is continuously and automatically determined by the demand & supply conditions at the time... The system is run by clearinghouses of users…. Because demand for transmission capacity varies, the access fee would also vary – a high fee where demand is high, and zero when there is excess capacity…"

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A global, cross-industry alliance focused on increasing dynamic access to unused radio frequencies.

Who are the founding members?

6Harmonics, Adaptrum, BSkyB, Carlson, Communication Research Center - Taiwan, The Council for Scientific and Industrial Research (CSIR), Indigo Telecom, InterDigital, Microsoft, MediaTek, Network Startup Resource Center (University of Oregon), Neul, National Institute of Information and Communications Technology – Japan (NICT), RealTek, Ruckus Wireless, Singapore Institute for Infocomm Research (I2R), StarHub, Strathclyde Center For White Space Communications, Tanzania Commission for Science and Technology (COSTECH), Taiwan Institute for Information Industry, UhuruOne, WaveTek and White Space Technologies Africa.

"The IEEE Dynamic Spectrum Access Networks Standards Committee (DySPAN-SC) is seeking proposals for standards projects in the areas of dynamic spectrum access, cognitive radio, interference management, coordination of wireless systems, advanced spectrum management, and policy languages for next generation radio systems…"

Dr. Hiroshi Harada, IEEE DySPAN-SC Chair,
email: harada@nict.go.jp

Subscribe to IEEE P1900.7 email list at:
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IEEE DySPAN-SC

IEEE 1900.1 – DSA terminology & concepts

IEEE 1900.2 – Interference & coexistence

IEEE 1900.3 – Conformance of SDR software

IEEE 1900.4 – Distributed decision-making

IEEE 1900.5 – Control arch. & policy lang.

IEEE 1900.6 – Spectrum sensing & databases

IEEE 1900.7 – White Space

Ad hoc on DSA-VE – DSA for vehicles

"I can't imagine a radio in the future that doesn't have DSA… There really are no hard technical challenges… the FCC is going to start conservatively, but we're going to wear them down. In a few years, we're going to be at 10w all over the place."

---Mark McHenry, CEO of Shared Spectrum Company,
speaking at the Google Policy Forum on
"Open Airwaves, Open Networks, Pervasive Connectivity,"
21 October 2008, quoted in *Communications Daily*.

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Perspectives on the Value of Shared Spectrum Access

by Simon Forge, Robert Horvitz & Colin Blackman

http://ec.europa.eu/digital-agenda/sites/digital-agenda/files/scf_study_shared_spectrum_access_20120210.pdf

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