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## PROPOSED CONTRIBUTION TO WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW REPORT

### **Cognitive radio systems in the land mobile service**

#### **Technical characteristics and functionalities of cognitive radio systems**

#### **1 Introduction**

Question ITU-R 241-1/5 “Cognitive radio systems in the mobile service” addresses several items that the European Project PHYDYAS ( PHYsical layer for DYnamic AccesS and cognitive radio) is dealing with.

Coexistence and sharing (Q6) is a crucial issue for the confidence of the users and their acceptance of the cognitive radio (CR) concepts and techniques. It is the key for successful future deployments.

In that respect, the physical layer is important because it determines a number of parameters which are necessary to guarantee the coexistence. Moreover, the objective of cognitive radio is to improve the usage of a limited resource, which imposes high spectral efficiency in all kinds of situations. In public spaces, CR users compete for the resource and the protection of the other users must be ensured, while high spectral density and efficiency are required to best exploit the available frequency bandwidth. In white spaces of a licensed band, the priority of the primary users must be respected, while full protection of others users must be guaranteed.

The CR physical layer must provide, among others, the following functions:

- high resolution real time spectrum analysis and synthesis;
- large dynamic range of signals and accurate noise temperature estimations;
- fast acquisition of the context information;
- simultaneous operation of several functions, e.g. spectrum sensing and data transmission;
- maximum efficiency of the transmission link, once established;
- quick access and release of the spectrum, without any impact on the users of the adjacent spectrum.

In that respect, the PHYDYAS project has two important contributions:

- 1) It shows how the above functions can be realized efficiently with a filter bank multicarrier (FBMC) transmission technique.

- 2) It has developed a MAC-layer coordinated and decentralized rule-regulated spectrum sharing scenario which exploits the FBMC technique.

Details are available on the project website. ([www.ict-phydyas.org](http://www.ict-phydyas.org))

## 2 Proposal

It is proposed to organize Section 6.1 of the document as follows.

### 6.1 Technical implementation consideration-coexistence and sharing (Q6)

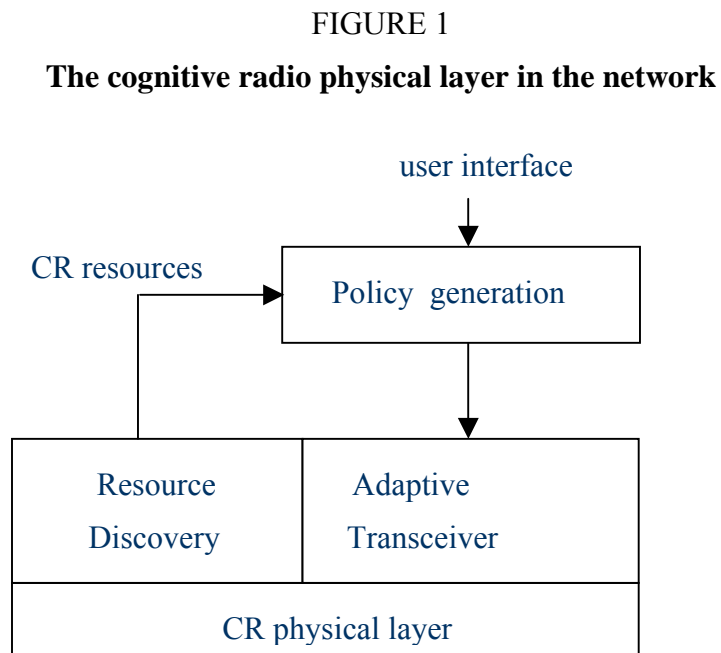
#### 6.1.1 Coexistence

Coexistence is a global issue that must be addressed at the different levels of the protocol stacks and the network. Two cases can be distinguished, namely PHY/MAC layers and upper layers.

##### 6.1.1.1 Coexistence at PHY and MAC layers

*[This section should list the properties and specifications of the PHY and MAC layers which could facilitate the coexistence with existing or other systems.]*

The cognitive radio physical layer has to carry out jointly and coherently two different functions, namely, adaptive transmission/reception and resource discovery as shown in Figure 1.



The specifications of the PHY layer should reflect the above duality and ensure the coherence of the two functions and their efficient joint operation. Moreover, as much as possible, sharing of the implementation should be pursued.

The following items, among others, should be specified:

- spectral mask for transmission (minimum spectral gap between neighboring users, minimum stop-band attenuation, ...);
- cross interference thresholds;
- spectrum sensing characteristics (detection threshold level, spectral resolution, ...);

- strategies for sensing and transmission (time interleaving, frequency domain interleaving, ...);
- simultaneous sensing and transmission;
- limits for latency and reaction time (jointly with the reaction time in the upper layers).

Whenever appropriate, the use of multicarrier techniques for transmission is recommended, not only because of their spectral efficiency but also because they facilitate the joint implementation of both transmission and sensing functions and ensure coherence.

#### **6.1.1.2 Coexistence at upper layers and protocols**

- 1) geolocation capability;
- 2) control or beacon signal;
- 3) cognitive pilot channel;
- 4) spectrum sensing (exploitation of the raw information provided by the PHY layer);
- 5) contention-based access protocol.

#### **6.1.2 Coexistence and spectrum-sharing techniques**

*[This section should consider conventional network topologies, e.g. base station ruled, but also new topologies, such as ad hoc, mesh or peer-to-peer.]*

##### **6.1.2.1 Coexistence with existing systems**

##### **6.1.2.2 Coexistence with other users in cognitive radio systems**

*(The following text could be inserted at the end of the section)*

For maximum flexibility, decentralized dynamic spectrum allocation in unsynchronized CR networks can be considered. A strategy implementing policy-based cooperation rules between spectrum sharing nodes without explicit data exchange between them has been proposed recently (see Phydyas Document D8.1, coordinated by Alcatel-Lucent UK, and related publications).

## **6.2 High level architecture**

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