Telecom Italia response to draft
" RSPG OPINION ON COGNITIVE TECHNOLOGIES"
(RSPG10-348 Draft)

15th January 2011

1. Introduction

Telecom Italia welcomes the Radio Spectrum Policy Group invitation to express comments and views in relation to the draft opinion on cognitive technologies.

Cognitive Radio is an emerging communication technology that could, in some specific condition, improve frequency spectrum resources efficiency use; cognitive radio systems might have a significant effect on many aspects of communications, including spectrum utilization. However, even if the cognitive radio technology shows promise for specific applications and uses, its technical and commercial viability is **yet uncertain and unproven.**

Cognitive Technology systems are currently under a preliminary phase of study, and the first outcomes suggest severe limits of reliability and affordability in their future applications. Since this technology in not yet mature and reliable, Telecom Italia deems that **further studies on Cognitive Technologies are needed**, also to clearly identify requirements and conditions for practical applicability.

In particular, the reliability of the entire process, impact of possible interference handling as well as viability of the co-existence need to be carefully and in advance evaluated by CEPT and ETSI.

Telecom Italia is **favourable** to the exploitation of Cognitive Technologies only in an **intra-operator scenario** that could allow more flexible and efficient use of the spectrum resources assigned to and managed by a single operator. In fact, TI believes that the intra-operator scenario is the most appropriate candidate to take the full benefit from some Cognitive Radio System (CRS) capabilities since it could enable an efficient spectrum usage by accessing its resources from different systems inside the domain of a single operator.

Considering also regulatory requirements of public mobile services, regarding services availability, quality, reliability and so on**, the secondary use** of a spectrum band primarily allocated to an authorized operator **should be avoided** for the risk of unmanageable harmful interferences with the primary service. The interference could cause a quality degradation provided to the end users of the primary service and, as a consequence, difficulties to respect regulatory prescriptions on quality and availability of public services and a potential economic loss for the operator which has invested in the network.

In general Telecom Italia retains that Cognitive Technologies are an **overestimated technical solution**, above all to improve spectrum use efficiency.

2. GENERAL COMMENTS

2.1 Regulatory consideration

The need for future regulatory measures applicable to Cognitive Technologies use as a tool to improve radio resource management and interference handling can be evaluated just after that the complete set of technical and regulatory evaluations and evidences will be released by recognized European normative bodies.

The knowledge of the potentialities of such systems is important and Telecom Italia is of the opinion that a set of normative studies is needed to investigate this issue, even in preparation of WRC-12 and even in a long term view. The same ETSI, in its Technical Report[1] stated that *"Generally, Cognitive Radio is seen as the technology for […] flexible use of spectrum. However, the full fledged Cognitive Radio encompasses technology in the far future, due to its high complexity. Consequently, in the close future further studies and research activities are needed. Once said studies will demonstrate feasibility and reliability of such technology, in a long term perspective, elaborated standards have to be developed accordingly".*

Telecom Italia believes that the uniqueness of the European regulatory environment should be carefully included in the reflection on the cognitive radio systems due to the fact that the R&TTE Directive regime in force in Europe is based on declaration of conformity and does include neither type approval, nor registration of the equipment, or equipment identifier. Furthermore, TI also considers that generic essential requirements such as "so as to avoid harmful interference" are not appropriate for cognitive radio systems. In particular, impact of possible interference as well as viability of the coexistence need to be carefully evaluated at the CEPT and ETSI levels (producing appropriate Harmonised Standards in accordance with the R&TTE Directive) in close co-operation with existing license holders.

Finally, TI supports that sharing responsibilities in case of malfunction of the cognitive radio based equipment as well as the network connections are key regulatory issues that need to be solved before expecting any deployment. Therefore, cognitive radio systems should not be allowed to operate in licensed bands used by existing networks and infrastructures unless there is the consent of the respective licence holders.

2.2 Access to spectrum by CR and implications on regulations and licensing

Telecom Italia wants to recall its comments made in the past consultation on RSPG CR report[2] (chapter 5) although this topic is not discussed anymore in the current consultation document.

Telecom Italia is strongly concerned with the sharing arrangement that RSPG defines as "vertical sharing"[3] . In our opinion this arrangement is not practically feasible since it is not possible that different terrestrial radio systems operating in the same spectrum portion do not interfere among themselves.

As regard the sharing arrangement that RSPG defines as "horizontal sharing"[4], we consider that:

[1] ETSI TR 102 838 V1.1.1 (2009-10) - Reconfigurable Radio Systems (RRS); Summary of feasibility studies and potential standardization topics
[2] RSPG10-306 Final, Radio Spectrum Policy Group report on "cognitive technologies", February 2010.
[3] "The cognitive radio is only allowed to utilize frequencies within the band as long as the existing user(s) is not affected, i.e. the cognitive radio must not cause harmful interference to the existing users"
[4] An alternative or complementary approach to vertical spectrum sharing is when cognitive radio technologies have the same rights to access the spectrum.

- regarding possible collective use of spectrum model, Cognitive Technologies may help in optimizing the shared spectrum, as for example in a limited area like an airport where different Wi-Fi hotspots, offered by several providers, are operating. Nevertheless, we don't see the possibility that new portions of spectrum will be designated, in the future, for public services provision as "licence exempt use", therefore the cases in which this solution may be applicable are extremely limited;
- regarding tradable or leased spectrum use, Cognitive Technologies may, perhaps, help in managing a limited portion of spectrum shared between different services or technologies but appropriate standardization and normative evolution is needed in advance by the responsible bodies (CEPT and ETSI).

In the case of use of Cognitive Technologies in specific frequency bands, where they are demonstrated as an effective and viable approach, Regulatory Authorities should strictly ensure, also defining in advance appropriate specific regulation for CR application, that any use of such technologies does not decrease service quality, availability and reliability of public mobile (both existing and future) networks and services, taking into real account the Cognitive Technologies intrinsic limits.

2.3 Feature to obtain knowledge of the radio environment

Sensing

Sensing, used by itself, is fundamentally incompatible with the new European regulatory principles for spectrum management and flexible use of spectrum and technology neutrality. The sensing technology must be based on correlation of signals of the primary spectrum user in order to have enough sensitivity to avoid the hidden-node problem. This correlation technique must be specific to the technology of the primary spectrum user. As a consequence, the primary spectrum user could not be able to autonomously change its technology, once cognitive devices using sensing have been deployed in the spectrum and that intrinsically limits the flexible spectrum use for the primary spectrum user. Furthermore, sensing technologies are still under investigation and not mature, even if a huge amount of effort has been spent on them in the last years. Indeed, the hidden node problems, as well as the ability to sense radio signals from other radio transmitters are still to be solved, including reliability of the entire process and terminal power consumption issues.

TI believes that sensing techniques, employed by a stand-alone Cognitive Radio equipment (autonomous operation), appears not to be reliable enough to guarantee a correct identification of available channels at a given location.

Recent decisions, taken by FCC [10-174, "Second memorandum opinion and order", Sept.2010] and by SE43 group [DRAFT ECC Report 159, "Technical and operational requirements or the possible operation of Cognitive Radio Systems in the 'white spaces' of the frequency band 470-790 MHz"], stating that the geo-location and database access method provide adequate and reliable protection for primary services, so that spectrum sensing is not necessary, confirm Telecom Italia's position.

Database / Geolocation

TI also considers that the database combined with geolocation systems could be a solution to provide appropriate information about spectrum availability and associated technical conditions to the cognitive radio device. This solution could theoretically be attractive; however some issues should be carefully analysed before considering its use.

For this specific issue, TI believes that access to the database should be based on a worldwide harmonized and standardized approach. For example, one possible access technique to the database could exploit the in-band concept of Cognitive Pilot Channel described below. In addition, the development of detailed procedure covering all the necessary aspects of the initial and periodic connections to the database would be highly desirable. In addition, TI has the view that database needs to be appropriately designed, managed and correctly updated without transgressing confidentiality.

Cognitive Pilot Channel

The concept of Cognitive Pilot Channel (CPC) has been studied in ETSI in several IST projects for several years. The main purpose of the CPC is to provide access to the information about spectrum availability and associated technical conditions to the cognitive radio device, i.e. the information stored in the Database described above; therefore, the CPC could be seen as an access mean for such Database described above. Two main concepts are foreseen for the CPC: out-band and in-band.

The CPC out-band concept as pilot channel presents some challenges, such as the availability of globally harmonised frequencies for pilot channels and the presumed associated cost of a cognitive pilot channel network deployment. The CPC out-band technique therefore could not seem to be viable in short or medium timeframe.

The CPC in-band concept is conceived as a logical channel within one or some of the technologies available in a heterogeneous radio environment (e.g. mapping the CPC data-stream on a logical channel, reducing meanwhile deployment costs and regulatory impacts).

Both concepts are still under study in both research and standardization fora. However, on the basis of current status, the in-band CPC does not seem to present the same level of challenges identified for the out-band CPC.

3 COMMENTS ON THE OPINION OF THE RSPG

Telecom Italia wants to do some comments on the specific items of chapter 5 of the RSPG document under consultation.

The RSPG notes
1. that in several European countries, licences have been given for the provision of digital terrestrial television in the UHF bands for the next 15 to 20 years;

No comment.

2. that the licensing period, planning requirements and use of the incumbent services in the UHF band (i. e. Broadcast and PMSE) varies between different national administrations. This will have an impact on the timing and amount of white space that could be made available for use by cognitive devices;

Operation of CRS within a number of UHF channels close to the edges of the band 790-862 MHz requires attention to potential interference towards services operating in adjacent bands. Appropriate regulation has to be established in order to limit such interference to acceptable levels. ECC Report 159 highlights a number of areas requiring further study (see section 11 of the report). The report studies but does not conclude on the inference into the band 790 – 862 MHz.

3. that CEPT is, in the first instance, the most appropriate entity to undertake any Europewide studies in order to identify spectrum available and develop sharing conditions in order to implement CR technologies;

CEPT, in cooperation with ETSI, should in particular evaluate the impact of possible interference as well as viability of the coexistence with the other systems.

4. that academia and researchers have already assessed the technical issues related to cognitive radio technologies;

We think that more studies are needed in practical TLC scenarios to identify real technical feasibility and related limits and requirements.

5. that ETSI is the appropriate standardisation body to develop harmonised standard related to devices with CR technologies;

See also answer 3; ETSI has to deepen standardization requirements for possible coexistences among different systems.

6. that, in case of databases, there does not seem to be any European regulatory framework applying to accreditation of databases;

RSPG has highlighted an important point. If cognitive devices are to be used in areas close to a national border, the databases will need to include information about spectrum usage in the neighbouring country. The arrangements under which this information is provided and used are similar in nature to an agreement for cross-border coordination.

7. that harmonisation of CPC at European level should remain on standardisation level until technical and commercial uncertainties have been solved.

The feasibility of a cognitive pilot channel, both out-band and in-band, is still under study. So it is not ready to move past the standardisation level. However, further studies are currently ongoing at both research and standardisation level.

The RSPG considers
1. that the R&TTE Directive covers all of the essential requirements that can be applied to CR devices;

The R&TTE Directive appears to be able to address all of the essential requirements for CR devices, considering also current activities in ETSI and other groups aiming to update it.

2. that the existing regulatory framework already covers devices that implement sensing techniques to enable sharing between different services;

The existing regulatory framework only covers sensing techniques to enable sharing only with certain defined primary services. They therefore do not cover the case where the primary service may wish to change or upgrade its technology, or the primary service may change.

3. that technical and legislative options involved in this transition should not be determined by economic factors alone but ought also to take account of social, cultural and political factors;

The technical and legislative options should take into account the necessity of guaranteeing the quality and continuity of the offered services.

4. that promising new services fostering growth and innovation are seeking access to spectrum;

Cognitive access is set of technologies, not a service. All of the services that have been suggested as possible applications for cognitive radio and TV white spaces can be supported using other technologies and/or frequency bands. It is therefore important that a proper impact assessment is carried out, in order to ensure that spectrum is made available for the most valuable potential uses.

5. that the amount of spectrum available for cognitive radio use is still to be studied and evaluated;

We believe that the collective use of Cognitive Technologies should be restricted to few frequency bands. For the time being we perceive the intra-operator scenario as the only one that could take benefit from the use of CT. TI believes that the intra-operator scenario is the most appropriate candidate to take the full benefit from some Cognitive Radio System (CRS) capabilities since it could enable an efficient spectrum usage by accessing its resources from different systems inside the domain of a single operator.

6. that CR devices may enable and/or improve spectrum sharing in a number of bands;

See the previous comment.

7. that there does not seem to be any discernable support at this time to introduce harmonised frequency allocations to accommodate CPC, but some standard bodies have introduced the possibility of sharing with other services by recognition of beacons which could be part of the incumbent normal protocol;

The beacon is a completely different concept from CPC: the beacon is part of the incumbent protocol and provides the information of existence of a primary user; this solution is unlikely to be viable, due to the associated implications (e.g. on legacy systems).

The CPC is a channel, in-band or out-band, for providing access to the information about spectrum availability and associated technical conditions to the cognitive radio device, i.e. the information stored in a Database as described above.

The cognitive pilot channel, as above, is currently studied at both research and standardisation level. In particular, the out-band option could not currently appear to be a very promising option for cognitive radio in the short and medium term, from either a technical or commercial perspective and the decision of CEPT to propose studies of a cognitive pilot channel as an agenda item for WRC-12 was very premature. This might have displaced a topic that could have delivered real benefit to spectrum users.

The RSPG recommends
1. that implementing measures to introduce the CR technologies in some bands could be left to Member states as long as border coordination issues are addressed and the following recommends are taken into account;

Telecom Italia supports RSPG proposal to leave to Member States the responsibility for possible CR applicability at national level with a harmonization role at European level.

2. that a platform shall be created to allow researchers, academia and regulators to coordinate research activities;

As we said above, further studies are needed for CT, and we think that also the mobile operators or their associations should participate in the research activities.

3. that Administrations, when implementing CR technologies that require to utilise databases should (possibly with guidance developed in the CEPT):
- ***a. indicate how the databases should be certified or accredited, supplied and updated by national regulatory bodies, and to supply relevant information to CR systems;***
- ***b. provide information to database managers on algorithms;***
- ***c. provide information on incumbents directly or through a designated entity;***

Telecom Italia agrees that CEPT should make studies on these topics to give guidance to the member States.

4. that Administrations and the EC should request ETSI to study the relevant means that could be implemented in order to secure the access from CR devices to the relevant database and the exchange of information between them;

Any possible initiative on database and its access shall be defined involving EC and national Administrations and standardization body. In fact such database might for example, provide false information on frequencies that cognitive devices can use, and therefore cause these devices to generate harmful interference to primary spectrum users.

5. that Administrations, in relation with the EC and TCAM, should give to ETSI relevant information on suitable data elements, equipment behaviour and output signal radio characteristics which will allow ETSI to develop harmonised standards;

Telecom Italia supports to deliver, towards relevant ETSI Working Groups, any information and activities to harmonize European technical standards on that matter.

6. that any Cognitive Radio harmonised standard developed by ETSI should include:

- ***a. compliance testing instructions under R&TTE Directive;***
- ***b. relevant information on how CR device could access only certified or authorised databases;***
- ***c. HS information that should be given to CR devices from the database for a given period of time;***
- ***d. information to be supplied by the CR device to the database including appropriate geolocation information;***
- ***e. means needed to secure transmission between the database and the CR device;***

Telecom Italia believes that appropriate EC mandates could be defined to address harmonized standards by ETSI, including any necessary regulatory requirements.

7. that TCAM should keep Notified Bodies up to date regarding specific requirements under the R&TTE Directive for CR devices;

No comment.

8. that in order to provide some confidence to all stakeholders, EC should investigate if JRC facilities can be made available to carry out proof of concept testing on CR devices supplied by industry.

No comment.