Regulatory Aspects of Software Defined Radio

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ETSI Software Defined Radio (SDR) / Cognitive Radio (CR) Workshop

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Regulatory Aspects of SDR

Overview

- ✓ Current situation in Europe
  - R&TTE Directive
  - ECC PT SE 42
- ✓ Global Conformity Assessment
- ✓ Research Project E²R
  - Responsibility chain Concept
  - Flexible Certification Concept
  - Questionnaire concerning the regulatory framework of Spectrum Management

The R&TTE Directive *

*DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 9 March 1999 on radio equipment and telecommunications terminal equipment
and the
mutual recognition of their conformity

The R&TTE* Directive

The R&TTE Directive covers the regulatory framework for the

- placing on the market
- free movement
- putting into service

of radio equipment and telecommunications terminal equipment in the Community.

*Radio and Telecommunications Terminal Equipment (1999/5/EG)

- By Declaration of conformity by the manufacturer with the essential requirements of the R&TTE
  - ✓ By using a Harmonised Standard (if available) or
  - ✓ Consult a Notified Body

The R&TTE Directive

Essential requirements for Radio equipment

"Basic" essential requirement

- the protection of the health and the safety of the user
- the protection requirements with respect to electromagnetic compatibility
- that radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communication and orbital resources so as to avoid harmful interference

"additional" essential requirement

- interworking via networks
- not harming the network
- Protection of personal data and privacy of the user/subscriber
- Avoidance of fraud
- Access to emergency services
- facilitate its use by users with a disability.
  - ✓ Decision by European Commission required!

The R&TTE Directive

Questions concerning SDR e.g.:

- Do we need "additional" essential requirements for SDR - Systems?
- Do we need changes in the operation of the R&TTE Directive?
- Do we need a harmonised standard for *SDR* - Systems to declare compliance with the R&TTE-Directive?
- Regulators have an interest in establishing clear responsibilities in case of non-compliance.
  - ✓ The potential advantages of flexible SDR shouldn't lead to illegal use

Obligations for operators e.g.

- A operator should publish accurate and adequate technical specifications of his public interfaces
- The specifications shall be in sufficient detail to permit the design of equipment for this interface
- Member States must ensure that operators of public telecommunications networks do not refuse to connect telecommunications terminal equipment to appropriate interfaces on technical grounds where the equipment complies with the applicable essential requirements

The R&TTE Directive

TCAM Group on SDR(TGS)

- TGS was set up by TCAM December 2001
  - ✓ First meeting took place in January 2002
- TGS Scope
  - ✓ To examine the regulatory aspects of SDR with respect to the R&TTE Directive and to draft relevant proposals for submission to TCAM
- 11 TGS meeting in total took place
- Final Report was presented from TGS to the restricted TCAM meeting on the 17. November 2004 for Information
- In the full TCAM meeting in March 2005 the TGS Report was discussed.
- Based on this Report and further discussion in TCAM the commission draw their current conclusions to the particular Discussion points.
- TCAM will discuss and may decide on the SDR matter in it's March 2007 meeting

The R&TTE Directive

TGS findings inter alia are :

- Definitions for
  - ✓ SDR
  - ✓ “vertical market”
  - ✓ “horizontal market”

  were developed.
- The responsibility for the product is a key issue
  - ✓ This is heavily dependent on the future structure of the market deploying SDR.
- On early co-operation between industry and regulators may assist in the minimization of the requirement for regulation

The R&TTE Directive

For the time being the commission draw the following conclusions to the particular discussion points:

(Which may be subject to changes in the future)

The R&TTE Directive

Discussion point 1: Intended use

- ✓ Intended use as declared by the manufacturers shall be respected throughout the lifetime of the equipment. Otherwise a new declaration of conformity (DoC) is required.

- ➢ **Comment European Commission**
  - ✓ One should not define intended use as the use for a specific application. This would lead to a situation that a separate DoC would need to be issued for each hardware/software combination.
  - ✓ The hardware can be declared compliant for the aspects of conformity it is handling.
  - ✓ As a component it can thus be declared compliant and intended for use with R&TTE compliant software.
  - ✓ Rather than having DoCs and declarations of intended use for each combination, there would then be a single intended use for the hardware and a single intended use for the software.
- ➢ **Conclusion**
  - ✓ It is possible for a manufacturer to issue a DoC for a combination of hardware and software, but there is no obligation for him to do so.
  - ✓ It is also possible for the manufacturers of the hardware and of the software to issue separate DoCs for their components.

The R&TTE Directive

Discussion point 2: Flexible marking for SDR/reconfigurable radio

- ✓ A digital marking (e.g. CE marking) should be developed to support the hardware and software developers in order to enable a horizontal and vertical market and a flexible and reliable change of the declaration of conformity for the intended use of the equipment

➢ Comment European Commission

- ✓ Where software would be delivered on a physical medium, the provisions of the Directive on marking and labelling can be normally applied.
- ✓ The current provisions of the Directive did not foresee a situation, where a product would not be delivered in a material manner (e.g. software updates over the air interface or downloads through the internet).
- ✓ Since the objective of these provisions is to ensure traceability it would not be illogical to require manufacturers to provide alternative means of labelling and marking, e.g. by using the display of the SDR device. Such could then also be embedded in the harmonised standard.
- ✓ Where hardware could be used either to be programmed as a class 1 or a class 2 device it seems logical for such equipment to be marked as class 2.

➢ Conclusion

- ✓ For software products that are sold on a physical medium there would not be a requirement to implement or use a digital marking or labelling.
- ✓ The proposed digital marking would be an adequate way to fulfil the requirements of the Directive for downloaded products.
- ✓ Industry should reflect on introducing elements in harmonised standards to this end.
- ✓ SDR hardware that can be programmed to function as either a class1 or a class 2 device, by definition is class 2 hardware and should be marked as such.

The R&TTE Directive

Discussion point 3: **History of the software**

- ✓ History of the software changes is required (for market surveillance)

➢ Comment European Commission

- ✓ Although the Commission Services understand the objectives behind this statement, the Directive does not seem to provide a proper legal basis for imposing such a requirement on manufacturers.
- ✓ It thus can only be implemented on a voluntary basis. In the absence of concrete experience with problems in this area, it is probably wise to further reflect upon this matter,

➢ Conclusion

- ✓ TCAM should invite the manufacturing industry to ensure, that market surveillance can adequately exercise their responsibilities.
- ✓ To this end it would be advisable to maintain a history of software changes in devices.

The R&TTE Directive

Discussion point 4: Security requirements

- **Security requirements are needed**
  - ✓ For the specific needs of downloads and their security, security in general, as well as compliance with the radio requirements (secure function of the radio part after a radio software change) a harmonized standard under Article 3.1, 3.2 and 3.3 of the R&TTE Directive as appropriate could be drafted.
  - ✓ It is recommends that ETSI should start to develop or revise harmonized Standards to cover these essential requirements.
  - ✓ A harmonised standard under the R&TTE Directive would ensure a common regulated market for SDR in Europe and could form the base for a global requirement for placing products on the market and a global circulation agreement for SDR terminals similar to the IMT 2000 global circulation agreement.
- **Comment European Commission**
  - ✓ The basic underlying requirement targeted at by this conclusion is the need to ensure, that the downloading of software is secure and is done in a controlled manner, so as to avoid hacks or user reprogramming that would lead to non-compliance with the Directive.
  - ✓ The Commission Services deem that this is a requirement, which can perfectly be seen as covered by article 3.2 of the Directive. If it is foreseeable, that equipment would be reprogrammed, the manufacturer must protect the device against that. There is thus no requirement to refer to article 3.3. If there is no concrete risk (e.g. for GSM base stations), such mechanisms are not required.
  - ✓ Security in general is a separate issue.
  - ✓ Article 3.3.d could be invoked in cases of risk of fraud.
- **Conclusion**
  - ✓ Integrate in a mandate ETSI to ensure, that harmonised standards covering SDR devices, when appropriate, contain elements obliging to protect against illegal programming and hacks for equipment, that are at risk.

The R&TTE Directive

Discussion point 5: Article 3.1

- ✓ No change of the R&TTE is required

  Consider the impact of SDR in the ongoing reviews of the harmonised standards for clause 3.1 under the R&TTE Directive:

  e.g. Impact on the requirements of clause 3.1, e.g. EMC characteristics or SAR of the radio equipment, due to potential failures in the software download process Impact of execution of non-conforming software

- ➢ **Comment European Commission**
  - ✓ The Commission Services agree with the assertion that no change to the Directive is required.
  - ✓ R&TTE compliant software must ensure that equipment would be safe, when operated for its intended purpose.
  - ✓ Harmonised standards lay down, what this translates to in practice and also equipment using SDR technology have to adhere to them.As regards Specific Absorption Rate (SAR) levels, typically generated by hand-held devices. It may be possible to resolve this already at hardware level, by making it impossible to programme emission levels that would lead to a higher SAR.
- ➢ **Conclusion**
  - ✓ Bring the matter to the attention of ETSI.

The R&TTE Directive

Discussion point 6: Article 3.2

- ✓ No change of the R&TTE is required

  Consider the impact of SDR in the ongoing reviews of the harmonised standards for clause 3.2 under the R&TTE Directive:

  e.g.

- ✓ Impact on radio characteristics, e.g. power level of

  the wanted signal of the radio equipment, due to potential failures in the software download process

- ✓ Impact of execution of non-conforming software

➢ **Comment/Conclusion**

- ✓ As Discussion point 5

The R&TTE Directive

Discussion point 7: Article 3.3

- **Security and integrity issues**
  - ✓ The industry is requested to implement appropriate measures to ensure that the specific needs of downloads, their acceptance and their security are fulfilled
  - ✓ It was discussed if one of the existing clauses 3.3a to 3.3f could cover the issue e.g. of security.
  - ✓ EU legal services should be consulted. In the case where legal services hold the view that the existing clauses 3.3a to 3.3f of Article 3 cannot cover issues related to security in SDR equipment, then a new dedicated security/integrity clause should be added to clause 3.3 in a new version of the Directive.
  - ✓ However, the scope of this new clause could be wider than just SDR (it could be more generic).
- **Comment European Commission**
  - ✓ See comments under Discussion point 4.
  - ✓ The need to safeguard the device against inappropriate downloads can be covered under article 3.2.
  - ✓ Whether or not additional clauses should be added to article 3.3 is a general issue to be discussed in the review of the Directive.
- **Conclusion**

  See Discussion Point 4

The R&TTE Directive

Discussion point 8: Article 6.3

- **Amend Article 6.3. Need for more flexibility**
  - ✓ Clause 6.3 refers directly to “packaging” and “instructions for use”, etc.
  - ✓ These terms might be too restrictive in the case of SDR equipment, in particular in the case where software is downloaded from the Internet.
- **Comment European Commission**
  - ✓ See remarks under **Discussion Point 2** above, where it concerns the application of the existing Directive. A precision of the Directive for these cases is indeed to be considered.
- **Conclusion**

  See Conclusion in **Discussion Point 2**. Issue to be included in the topics to be discussed when reviewing the Directive.

The R&TTE Directive

Discussion point 9: Article 12 Annex VII

- **Amend Article 12 Annex VII: Flexible marking**
  - ✓ During the lifetime of software defined radio the radio may change the mode frequency band or other radio relevant parameters and possibly the intended use.
  - ✓ Therefore the radio needs a flexible marking, for example, class mark, CE mark, alert sign and the Notified Body number, when relevant.
  - ✓ To ensure such flexibility, these markings might be presented in a visible form and/or acoustic form.
- **Comment European Commission**
  - ✓ See discussion under **Flexible Discussion Point 2**.
  - ✓ As regards the hardware, a class 2 marking seems appropriate.
  - ✓ As regards the software, manufacturers must ensure traceability.
- **Conclusion**
  - ✓ See Conclusion in **Discussion Point 2**.

The R&TTE Directive

Discussion point 10: Article 7

- **Amend Article 7**
  - ✓ Amend clause 7.5 of the R&TTE-Directive in so far as, for example, the party responsible for the problem is the party having to provide the alternative solution
- **Comment European Commission**
  - ✓ Until now there is no experience with this article as no cases have been notified to the Commission.
  - ✓ The discussion as to the application in case of problems with SDR devices therefore is highly academic.
  - ✓ In substance the matter is not any different from the situation where a normal device complies but causes problems in networks.
  - ✓ Therefore the Commission Services do not see a need for change.
- **Conclusion**
  - ✓ No change in the Directive required.

The R&TTE Directive

The following requirements may be foreseen for SDR to cover the R&TTE Directive:

- Ensure proper working of HW/SW combinations (even when brought to the market as separate entities)
- If a hardware platform can be configured to function either as class 1 or class 2 equipment, it should be marked as class 2 equipment. (Independent of the actual implementation).
- Facilitate traceability of 'declarer of conformity'
- A strong encouragement to provide means to collect device SW history information, but currently no formal requirement
- Provide elements to protect against illegal programming (hacking/etc.) to ensure that Article 3.1/3.2 is met.
- Ensure (in a harmonised standard) that equipment functionality ensure efficient use of spectrum, and equipment can be used only for the intended purpose declared.
- Ensure (in a harmonised standard) that equipment functionality is safe, and equipment can be used only for the intended purpose declared.
- The responsibility for the product is a key issue
- This conclusions above could form the based for the essential requirements for the development of Harmonised Standard in ETSI and are intended to be used for the work in the E2R Project to develop a possible Regulatory framework for reconfigurable Equipment and
- The European Commission should provide ETSI with a appropriate Mandate in order to develop a Harmonised Standard for SDR

The R&TTE Directive

In ETSI:

- Develop a System Reference Document (SRD) for SDR
- Start the work on a Harmonised Standard.
  - ✓ A harmonised standard under the R&TTE Directive would ensure a common regulated market for SDR in Europe
  - ✓ Could form the base for
    - a global requirement for placing products on the market
    - a global circulation agreement for SDR terminals similar to the IMT 2000 global circulation agreement.

Global Conformity Assessment

- The impact of SDR on conformity assessment is under discussion in many countries. Consequently, there is a risk that countries arrive at a wide variety of conclusions without effective communication at international level.

- For example, there is a significant different conformity assessment procedure plan in US and Japan. In the ITU Regions you have different approaches:
  - ✓ ITU REGION 1(e.g. Europe)
    - – The Manufacturer is currently not responsible for un-authorized software.
  - ✓ ITU REGION 2(e.g. US)
    - – The manufacturer must take steps to prevent un-authorized software.
  - ✓ ITU REGION 3´(e.g. Japan)
    - – Under discussion: Certificate authority controls Software download

- If no solution will be found in the future there will be no common market for SDR around the World. That would be a very undesirable situation for the industry

ECC SE 42
Flexible bands, WAPECS and new sharing approaches

SE 42
Flexible bands, WAPECS and new sharing approaches

Terms of Reference SE42

- Identify technical requirements (e.g. spectrum masks, channel plans, mitigation techniques) with a view to ensure the protection of radio services, and obligations emerging from relevant international agreements (e.g. on cross border coordination issues) for the bands identified in document RSCOM 06-09 (discussion on the implementation of WAPECS);
- To continue the work of ECC PT8 on enhancing harmonisation and increasing flexibility in spectrum management, in particular the proposals for 'flexible bands' taking account of ECC Report 80. The studies have to define technical conditions for flexible use of the potential candidate bands identified by WG FM through analysis of the protection requirements of radio services in adjacent bands, and of existing applications sharing the same bands;
- Develop responses to relevant EC Mandates;
- Contribute to relevant ITU-R groups as appropriate.

Expected output:

- ECC Report and advice to policy groups on technical requirements as a part of implementation of proposed regulations for Flexible bands
- ECC Report and advice to policy groups on technical requirements as a part of implementation of proposed regulations for WAPECS bands.
  - ✓ Response to EC Mandate on WAPECS.

European Research Project

E²R

(End-to-End Reconfigurability)

E²R

One part of E²R is dealing with regulatory issues e.g.:

- The "Responsability Chain Concept" (i.e., identify stake holders and responsabilities in a reconfigurable / distributed decision making oriented system)
  - ✓ The “responsibility chain” will be explored, fixing “Who does what and when”,
  - ✓ Defining possible regulatory requirements e.g. including the development of a penalty chain
- Analysis the regulatory framework and proposals on future evolutions if necessary of the R&TTE Directive in order to capture the regulatory needs for reconfigurable / distributed decision making oriented systems.
  - ✓ E.g. to develop a possible extension of the R&TTE Certification Procedures for reconfigurable equipment
- Spectrum management (SM)
  - ✓ Determination of trends in (SM) evolution in Europe in relation to SDR/CR;
  - ✓ Elaboration of medium/long term potential solutions in SM related to SDR/CR (objectives: efficient use of the spectrum; user needs satisfaction;…);
- To identify possible regulatory changes in the European regulatory framework necessary and feasible to facilitate implementation of the various technical concepts proposed
- Support the work in ETSI for the development of a Harmonized Standard to be used under the R&TTE Directive for SDR/reconfigurable Terminal

Regulators in the E2R - Project are:

ANFR (FR)

Agence Nationale des Fréquences

RA (NL)

AGENTSCHAP Telecom

BNetzA (D)

Bundesnetzagentur

Roles of the actors in the End-to-End Reconfigurability
The Responsibility Chain Concept

TCAM models for Reconfigurable Systems

- **Vertical model:** terminal reconfiguration can only be done (and authorised) through the equipment manufacturer (who also takes the responsibility).
- **Horizontal model:** reconfigurations can be authorised by different actors and software only needs a declaration of standard compliance, (responsibility can be taken by different actors).

Roles of the actors in the End-to-End Reconfigurability The Responsibility Chain Concept

Operational Domain:

- **equipment manufacturers:** provide the reconfigurable platform, firmware, and software updates
- **network operators:** have received an authorization to use the spectrum and own the infrastructure; they may also act as service providers
- **software provider:** a third party providing application software and also low level configuration relevant software
- **service provider:** who provides the requested services
- **reconfiguration support service provider:** provides the basic services necessary for reconfiguration, including for example secure software download
- **users/subscribers:** use the equipment and infrastructure and may request installation of new configuration of application software.

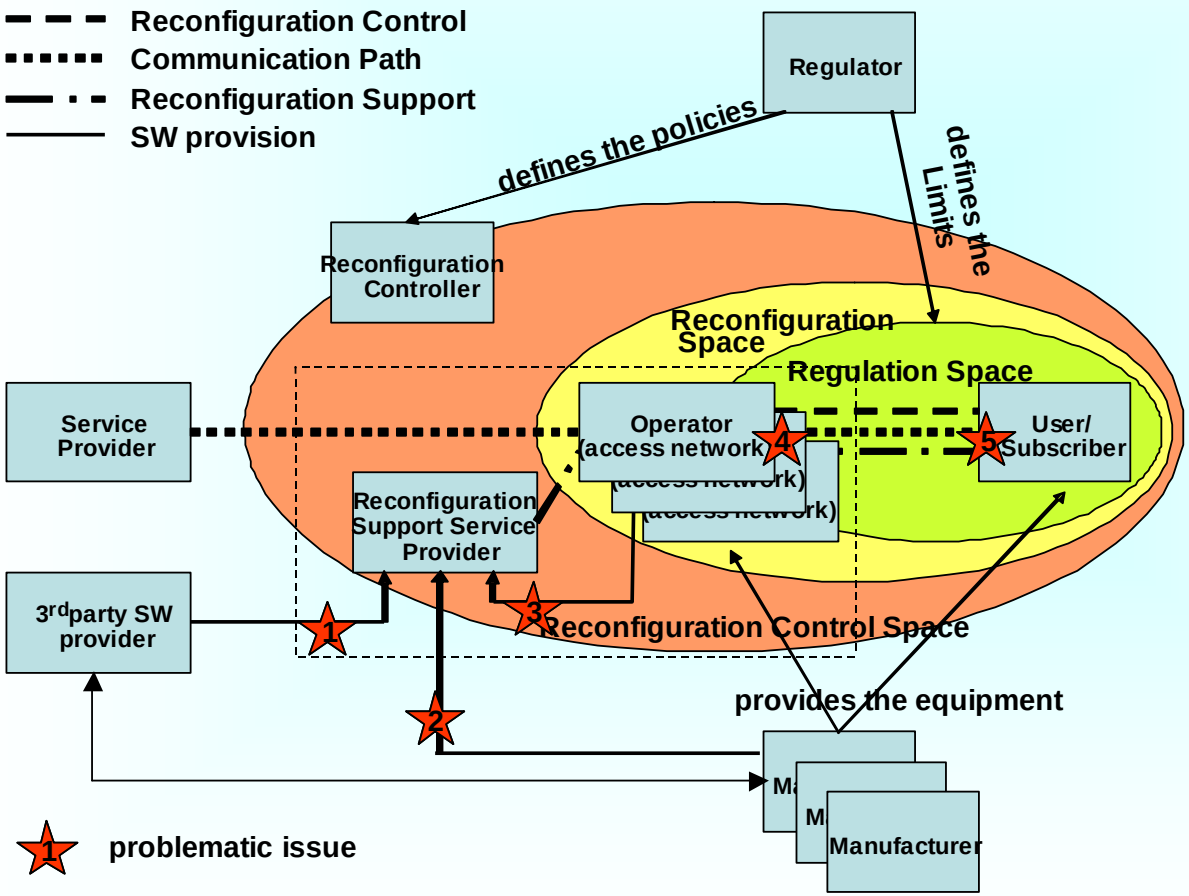
Roles of the actors in the End-to-End Reconfigurability The Responsibility Chain Concept

Administrative Domain

- **regulator:** sets the framework for use of reconfigurable equipment, provides authorization to use the spectrum to lease holders and governs the usage of spectrum and the circulation of reconfigurable equipment (however, in Europe, this latter is mainly governed by EC Directives)
- **reconfiguration controller** (certification entity, security entity, spectrum manager): verifies that intended reconfigurations will comply with given standard or checks that the equipment is prevented from implementing certain configurations; this controller also implements functions like spectrum management according to given policies and certifies the intended configurations of the reconfigurable equipment
- **equipment manufacturer**: arranges and initiates software/firmware updates and patch installation
- **software provider**: provides protocol and application software
- **service provider** may request the reconfiguration of equipment to enable the provision of its services
- **reconfiguration support service provider:** provides the control and security features for the reconfiguration procedure, independent of who may have initiated the reconfiguration process
- **network operator:** provides the radio resources, mobility management and fixed capacities to switch, route and handle the traffic associated with the services offered to users
- **user/subscriber:** may initiate, allow or decline a reconfiguration.

Regulatory Trends for Reconfigurable End-to-End Systems

Roles of the actors in the End-to-End Reconfigurability – The Responsibility Chain Concept



Issue 1:
third party software

Issues 2 and 3:
different administrative domains

Issue 4:
access/use an operator's RAT

Issue 5:
terminal reconfiguration

Regulatory Trends for Reconfigurable End-to-End Systems

➢ Equipment Certification

Current procedure (Europe)
from standard to market

- **Follows the R&TTE directive**
- **Applying self certification**

E2R Procedure with reconfigurable equipment adding flexibility through:

- **3rd party SW provider**
- **location dependent radio configurations**
- **responsibility assignment**
- **flexible marking (CE) and documentation**

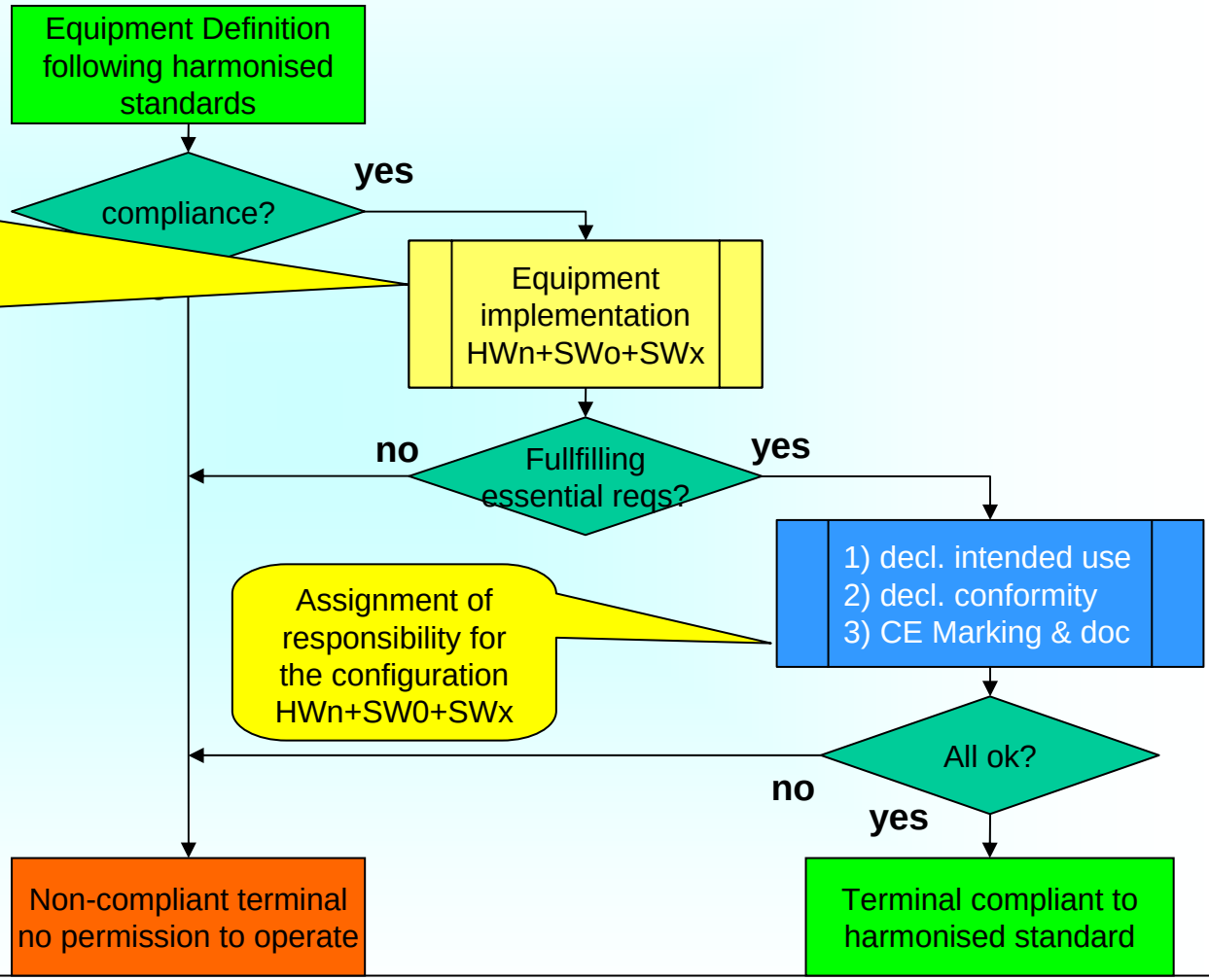
E2R Procedure follows the procedures of the R&TTE directive, aiming at supporting both vertical and horizontal market model

Regulatory Trends for Reconfigurable End-to-End Systems

Regulatory Framework – Equipment Certification based on R&TTE D

Reconfigurable terminals will consist of the execution platform (HWn) some preset software (SW0) and the additional software update/configuration (SWx) the whole configuration (HWn+SW0+SWx) forms the new terminal and needs to fulfil the essential requirements

- R&TTE Directive
  - Functional flexibility
- E²R proposal to extend the R&TTE Directive for certification of reconfigurations



Regulatory Trends for Reconfigurable End-to-End Systems

E²R issued a new regulatory questionnaire in September 2006

- This questionnaire was distributed to regulators who are members of CEPT
  - ✓ Aim to gain understanding of how regulators within Europe see the future of spectrum regulation.
- The questions tackle a number of aspects
  - ✓ Ranging from the current status of regulation and if the capabilities of reconfigurable technology could be exploited in this regime
  - ✓ to the question if regulators would consider the introduction of a support channel to improve dynamic spectrum allocation schemes.
- The responses received from more than 16 European national regulation authorities are currently analyse
  - ✓ The outcome will be published within the consortium in Q1 2007.
  - ✓ Expectation towards this is that
    - a landscape can be drawn outlining where further discussions are required
    - and where further research work into policies as well as into technical means needs to be placed to make dynamic spectrum assignment regulatory feasible.

E2R Regulatory Framework for Reconfigurable Systems

- E2R follows an approach where regulatory (and the related standardization) and technical levels are considered as equally important for reconfigurable systems.

- Identification of harmonized standards is key. These standards enable the fulfillment of the essential requirements that are set out for each individual communication system – and their application is essential for reconfigurable equipment.

Regulatory Trends For Reconfigurable End-to-End Systems

The E2R Regulatory framework

Equipment Regulation:

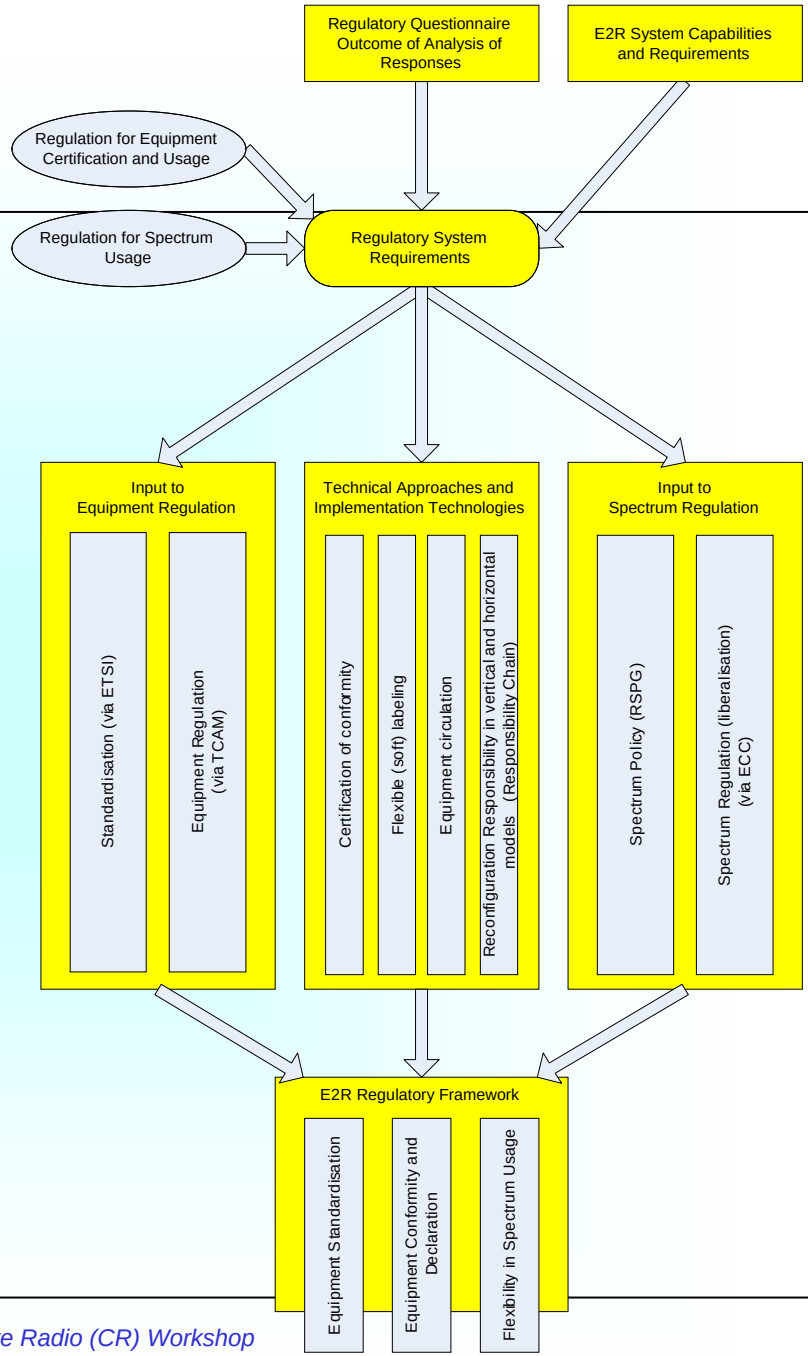
- *Standardization via ETSI for example,*
- *Equipment regulation (via TCAM)*

Technical solutions:

- *certification of conformity,*
- *flexible labeling and documentation,*
- *equipment circulation (reconfiguration prevention)*
- *assignment of responsibility*

Spectrum regulation:

- *Definition of spectrum policies (e.g. by RSPG)*
- *input to spectrum regulation (e.g. ECC)*



Thanks for your attention !

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Adobe Acrobat 7.0
Document

The contents of this presentation has
been published at the IST Mobile Summit 2006

List of abbreviations

- CEPT
  - ✓ Conference Européenne des Administration des postes et des télécommunications
- TCAM
  - ✓ Telecommunication Conformity Assessment and Market Surveillance Committee
- ETSI
  - ✓ European Telecommunications Standards Institute
- ECC
  - ✓ Electronic Communications Committee

List of abbreviations

- RSC
  - ✓ Radio Spectrum Committee
- RSPG
  - ✓ Radio Spectrum Policy Group
- ADCO
  - ✓ Group of Administrative Co-operation under the RTTE Directive
- SAR
  - ✓ Specific Absorption Rate

Backup Slides

Definition for SDR used in TGS

« **SDR** » equipment or « **software defined radio equipment** » is a radio where essential radio parameters - normally subject to regulation - like frequency range, modulation type, maximum output power, etc. can be altered by changing software.

- **Note:** For the purpose of this assessment « software » is defined as the following:
  - Software is a set of computer instructions and data recorded in a device which can be modified technically after placing the equipment on the market.

Definition vertical market

- "**vertical market**" in the context of this report means that all hardware and SDR software which is relevant for the declaration of conformity with the essential requirements for the intended use during the whole life cycle are controlled by one entity.

Definition horizontal market

- "**horizontal market**" in the context of this report means that independent companies placing separately on the market hardware and SDR software which, when used together, are subject to the declaration of conformity with the essential requirements for the intended use of the equipment.