EVOLUTION AND TRENDS IN THE POINT-TO-POINT FIXED RADIO SYSTEMS REGULATORY AND STANDARDIZATION ENVIRONMENT

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Abstract: Since the latest ECRR2000 Conference, a number of changes have occurred dealing with point-to-point fixed radio systems, impulsed both by technology/industry innovations, market demands and evolution toward a more harmonized and flexible regulatory environment in Europe.
As some of these changes are quite significant and meaningful, this paper intends to take stock of these evolutions, understand the rationale and aims at identifying trends and possible further steps.

Keywords: Fixed Service (FS), Fixed Radio Systems, Radio Relay Systems, Point-to-Point

1. INTRODUCTION

Recent evolutions and trends of point-to-point fixed radio systems, triggered both by technology/industry innovations and market demands have led to a more harmonized and flexible regulatory and standardization environment in Europe.
These changes are depicted in this paper as a means to identify trends and possible further steps in this domain.

2. ITU-R FIXED SERVICE FROM WRC-03 TOWARD WRC-07

At the global level, point-to-point fixed radio systems are governed by Radio Regulations (RR), World Radio Conferences (WRC) and ITU-R. Within ITU-R, the former Radio Relay systems vocabulary has been replaced by the more general term of Fixed Wireless Systems (FWS)[1].

Point-to-point fixed service (FS) issues are addressed within the ITU-R Study Group 9 within the following WPs: 9A: Performance and availability, interference objectives and analysis, effects of propagation and terminology, 9B: Radio-Frequency channel arrangements, radio system characteristics, interconnection, maintenance and various applications, 9D: Sharing with other services (except for the fixed-satellite service), 4-9S: Frequency sharing between the fixed-satellite service and the fixed service.

The period 2003-2007 has been quite active: main modifications or new Recommendations have taken place [1], those dealing with RF channel arrangements are listed in the here after Table, based on a brief analysis of the evolution of the ITU-R Rec. F.746, the "umbrella" recommendation summarizing all current RF channel arrangements for fixed service systems.

Frequency Band (GHz)	ITU-R Series F Recommendation	Date of latest Modification
4	382-8	04/2006
U6	384-9	04/2006
7	385-8	01/2005
8	386-7	01/2007
10	746, Annex.3 1568-1	02/2006 01/2005
11	387-10	02/2006
18	585-9	02/2006
31	746, Annex 8	02/2003
32	1520-2	02/2003

ITU-R Series F Recommendations recently modified (RF Channel arrangements)

Some other fixed service Point-to-Point documents such as the latest trends toward the revision of the ITU-R Recommendation F.758, the "umbrella" recommendation for sharing between fixed service and other services (containing the main technical characteristics of digital point-to-point fixed radio systems), as well as key reports or other related items (e.g. dealing with propagation issues relevant to point-to-point fixed radio systems planning: evolution of ITU-R Rec. P. 530) are also worth being noted.

F.2047 (2004)	Technology developments and application trends in the fixed service
F.2059 (2005)	Antenna characteristics of point-to-point fixed wireless systems to facilitate coordination in high spectrum use areas
F.2060 (2005)	Fixed service use in the IMT-2000 transport network

Recent ITU-R Reports dealing with Point-to-Point

[1] akin ECRR European Conference on Radio Relay Systems has been renamed over the years European Conference on Fixed Radio Systems and Networks, then European Conference on Fixed Wireless Networks and Technologies

The latest WRC-03 identified several items dealing with fixed service, some of them impacting Point-to Point, which will be addressed and reviewed during the upcoming WRC-07 (e.g.: within Agenda Item 1.2, the sharing issue with Remote Sensing Systems in the 10.6-10.68 GHz band which might lead to further limitations on maximum output transmit power)

3. ETSI STANDARDIZATION LEVEL HARMONIZED STANDARD EN 302 217

In the European standardization domain, the period under consideration has been quite active and fruitful as far as point-to-point fixed radio systems are concerned. Within ETSI [2], point-to-point fixed radio systems are addressed within the Working Group TM4, in charge of fixed radio systems.

At the same time, the complete list of Point-to-Point standards per frequency band was about to be finalized, ETSI/TM4 was mandated by the European Commission - in the context of the "New Approach" and R&TTE Directive- to produce a single harmonized standard.

From a "bunch" of 25+ Point-to- Point Radio Equipment and Antennas ENs to a single multipart one:

Quite a number of significant steps have been achieved, from a first single consolidation/reference entry harmonized Point-to-Point EN (EN 301 751) to a much more rationalized approach present in the multipart harmonized standard EN 302 217 [3-7]. This effort has been triggered by a search for rationalization and harmonization in the standardization process: through key strategic choices within an ad-hoc ETSI Specialist Task Force steered by ETSI/TM4, it has been possible to smoothly migrate from a set of more than 25 "historic" Point-to-Point ENs toward a much more flexible and "future-proofed" standard without disruptive impact on the market and the regulatory environment:

- removal of 10-3 BER
- removal of maximum Tx power
- rationalization of parameters across frequency bands and capacities, where possible
- split between essential (R&TTE Article 3.2) and complementary requirements
- further clarifications on ATPC and RPTC
- introduction of Radio Interface Capacity (RIC)[2] to cope with Packet Data type (e.g. Ethernet) and combination of mixed traffic (Annex F)
- "clusters" of frequency bands (A: 1.5 & 2.5 GHz; B&C: 3 to 11 GHz; D: 13 to 18 GHz; E: 23 to 55 GHz) for frequency bands where frequency coordination is applied

The limiting values for the requirements not common to all of the equipment, but specific to one frequency range, one hierarchy (PDH or SDH), one capacity, etc, are located in annexes with sub-annexes dedicated to one system, described by the association of the range of capacities, frequencies and channel separations.

The "essential requirements" under article 3.2 of the R&TTE Directive are detailed in EN 302 217-2-2 for equipment operating in co-ordinated frequency bands and in EN 302 217-4-2 for antennas. Compliance to all or some "complementary" requirements, not related to the R&TTE article 3.2 essential requirements, is made on a voluntary basis, e.g. when specific deployment conditions or compatibility requirements are present, and are listed in Part 2-1 and 4-1.
To cope with the blurring of the traditional frontier between PDH and SDH capacities and the migration toward data/IP/Ethernet type of traffic, packet data and combinations of interfaces (by means of the RIC concept) and, more recently, flexible adaptive modulation (i.e. "mixed-mode") systems have been introduced.

In parallel, some worthwhile useful ETSI Technical Reports have also been produced dealing with Point to Point systems, helping in the process or paving the way for the future, such as:

TR 101 854 (2005-01)	Derivation of receiver interference parameters useful for planning fixed service point-to-point systems operating different equipment classes and/or capacities
TR 102 457 (2006-08)	Study on the electromagnetic radiated field in fixed radio systems for environmental issues
TR 102 565 (2007-02)	Requirements and bit rates for packet data interfaces, effects of flexible system parameters, use of mixed interfaces

Recent ETSI Point-to-Point Technical Reports

4. CEPT/ECC/SE19 (FIXED SERVICE)

CEPT has traditionally been instrumental and played a key role, in close coordination with ETSI, to pave the way toward more harmonization for point-to-point fixed radio systems. A number of relevant "harmonized" or "preferred" RF channel arrangements for digital radio relay systems/fixed service systems Recommendations have been introduced over the years and implemented in most of the countries members of CEPT.

[2] maximum user net capacity, defined at modem access reference points, that can be transmitted over the radio interface reference point - includes additional capacity for framing and multiplexing / demultiplexing different baseband signals into a transport module, eventually integrated in the baseband processing of the radio system - It does not include other additional proprietary algorithms and signals used for specific radio systems purposes (typically error correction codes and radio system service channels).

Within CEPT/ECC [8], point-to-point fixed service issues are addressed within a relevant Spectrum Engineering Project Team (SE19), which has been especially active, responsive and influential on the market in the period under consideration with respect to implementing an open, reliable regulatory environment in the spectrum engineering domain for point-to-point fixed radio systems.

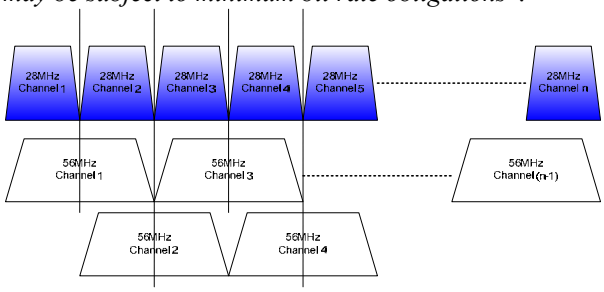
CEPT/ECC has also produced some more "generic" Recommendations, e.g. addressing Point-to-Point parameters used for frequency planning criteria, aiming at a common understanding, in a first step. However, as at the national levels, actual criteria are not harmonized, this issue should be a source of further effort / improvement to achieve more harmonization across Europe, easier coordination and unnecessary burden on the market.

The latest Recommendations and key Reports are listed in the following Table.

ECC/REC 05-02	Use of the 64-66 GHz frequency band for Fixed Service
ECC/REC 05-07	Radio frequency channel arrangements for Fixed Service Systems operating in the bands 71 – 76 GHz and 81 - 86 GHz
ECC/REC02-02	Channel arrangements for digital fixed service systems (point-to-point and point-to-multipoint) operating in the frequency band 31 – 31.3 GHz
ECC/REC 02-06	Preferred channel arrangements for digital Fixed Service Systems operating in the frequency range 7125-8500 MHz
ERC/REC02-01	Preferred channel arrangement for digital fixed service systems operating in the frequency band 31.8 - 33.4 GHz
ECC/REC05 01	List of parameters of digital point-to-point fixed radio links used for national planning
ECC Report 019	Guidance material for assessing the spectrum requirements on the Fixed Service to provide infrastructure to support the UMTS/IMT-2000 networks
ECC Report 003	Fixed service in Europe current use and future trends POST-2002

CEPT/ECC SE19 recent Rec and Reports

More recently, larger channel separations not yet currently depicted in the lower frequency bands (up to 13 GHz) have been proposed, "*considering that frequency reuse techniques, supported by modern techniques such as Cross-polar Interference Cancellers (XPIC) may significantly improve the spectrum usage in dense networks*", and that, "*when very high capacity links are required, further economy may be achieved using wider channel bandwidth associated to high efficient modulation formats*".
Hence, CEPT administrations are invited to consider "*merging any of two adjacent 28[/29.65] MHz channels to create one 56[/59.3] MHz channel, with centre frequency lying in the central point of the distance between the merged channels, this decision may be subject to minimum bit rate obligations*".



ERC/REC 14-01	RF Channel arrangements for high capacity radio relay systems operating in the band 5925-6425 MHz
ECC/REC (02)06	Preferred channel arrangements for Digital Fixed Service systems operating in the frequency range 7125-8500 MHz
ERC/REC 12-05	Harmonised RF channel arrangements for Digital Terrestrial Fixed Systems operating in the band 10.0-10.68 GHz
ERC/REC 12-02	Harmonised RF channel arrangements for Digital Terrestrial Fixed Systems operating in the band 12.75 to 13.25 GHz

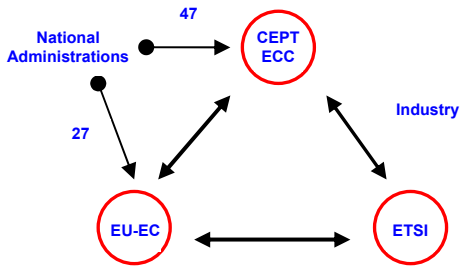
56 MHz / High Capacity proposed revisions of low frequency bands CEPT Rec

In parallel , the creation of the European Frequency Information System Database (EFIS) [9] has also contributed to more transparency and easier public access to key spectrum related information for point-to-point fixed service (applications: Fixed Links /Point to Point).

In a nutshell to date, one could say that most of the point-to-point fixed service systems operate in "quasi-harmonized" frequency bands in Europe, with some variants from one country to another (e.g. frequency band opened or not -typically used by government and/or MoD or some "national" use of guard bands, etc.). Millimetric Point-to-Point bands such as 23 (26 when open to Point-to-Point) and 38 GHz are actually "quasi-harmonized" frequency bands, as well as 13, 15 and 18 GHz bands, and L6, U6 and 11 GHz in the low frequency bands, while 7/8 and 10 GHz band usages are more "fragmented" in EU.

5. EU EUROPEAN COMMISSION (EC) RADIO SPECTRUM ASPECTS

With the EU R&TTE Directive (2001) [10], Electronic Communication & Services Directives and Radio Spectrum Decision (2002), the relationships and the relative roles of CEPT, European Commission and ETSI have been re-stated, while the legal instruments which can be set up at the EU level become an efficient means to speed up the resolution of some of the outstanding issues.



Role and impact of the R&TTE Directive and of the Point-to Point Harmonized Standard:

The major breakthrough brought by the R&TTE Directive (context of the "New Approach" on Technical Harmonization and Standards) lies in the concept of new rules for the "placing of equipment on the EU market" (instead of 27 different national markets) and putting into service. Combined with harmonized standards, giving presumption of conformity with R&TTE requirements, it has abolished national approval regulations.

Articulation between Point-to-Point radio equipment and antennas standards and Radio Interfaces Regulations:

Harmonized standard equipment, operating in non-harmonized frequency bands are covered by Article 6.4 and lead to radio equipment notification and CE marking/label. Nevertheless, some other national measures may still exist at National Regulatory Authority (NRA) or Spectrum Authority levels for Point-to-Point equipment (requirements e.g.: ATPC, antenna classes, minimum length policy or spectrum efficiency classes, licensing regime, and frequency planning assumptions) —this situation should be improved, e.g., it would be highly beneficial if frequency planning assumptions could be made more transparent, more similar or, even better, more harmonized.

This is where the (R&TTE) TCAM Committee and TCAM-Radio Interface Group (RIG), working in close relation with ETSI and CEPT, have been fruitful, e.g.: by first introducing a single format for National Radio Interface, and paving the way toward a future "one-stop shopping." More and more NRAs have been adopting and/or incorporating the Point-to-Point user-friendly radio interface format and linkage with the CEPT EFIS Database has been implemented for some of them. More recently the EFIS role has been re-emphasized at the EU level [3].

[3] in [11]: "*Spectrum information: The main elements for a Commission Decision on a harmonized availability of information regarding spectrum use were discussed and agreed. The aim is to establish an EU single portal providing information on spectrum usage by building upon the current EFIS information system in a Community context. It is planned to submit a draft Decision to RSC for regulatory opinion at the next meeting".*

Parameter	Value (examples)	Filling instructions
Frequency band (GHz)	17,7-19,7	Limits of FS allocated band.
Radio service	Fixed Service	
Application/ System type	Infrastructure PP	Infrastructure, access or other, or combination, etc.; PP, PMP, MPMP.
Channelling	ERC/REC 12-03 27,5 MHz channels only	Either reference to CEPT/ITU recommendation/annex and/or National plan (the latter to be explained or attached). National restrictions/modifications to CEPT/ITU plans to be described.
Transmit power limit	XX dBm EIRP	Should be specified whether it is an output power and/or EIRP; in accordance with RR provisions. For block assignment it may be complemented by additional provisions (e.g. border PFD limits).
Channel occupation rules	Min hop 10 km	May mean transmission capacity (possibly linked to channel width), minimum hop length, equipment class, etc.
Duplex type / spacing	ERC/REC 12-03 FDD	Either reference to the specified channel arrangement or explained, for FDD MP systems the uplink/downlink bands could be specified.
Licensing regime	Link-by-link assignment	Could be Link-by-link assignment, block assignment, and general licence. Other specifics should be mentioned, if any (e.g. geographical limitations).
Frequency planning assumptions	ATPC: XX dB	Could include requirements in accordance with Articles 3.2 and 7.2 of the R&TTE Directive [1]: Antenna radiation pattern (ref EN), Emission spectrum mask (ref EN), Receiver parameters (ref EN), Minimum antenna gain, ATPC. For block assignment additional/alternative provisions may be set: PFD masks/limits, inter-operator co-ordination procedures, block edge mask, etc.
Reference	EN 302 217-2-2	Reference to harmonized standard, selected equipment class, etc.
Remarks		Any relevant remarks, additional info.
Notification number		For administrative reference purposes.

Example of interface requirements for P-P fixed links notification[4]

Although, as noted in ETSI EN 302 217-1 [4], on the one hand such radio interface requirements already allow individual NRAs "*to select parameters in the harmonized standard*", on the other hand "*the list of parameters relevant to national spectrum management functions (e.g. for frequency assignment process) is wider/different, as e.g. described in ECC Recommendation ECC/REC 01-05 "List of parameters of digital point-to-point fixed links used for national planning",* so that some NRAs "*may request those additional parameters from the applicant/licensee during the licensing procedure*".

Some words have also to be said on the positive role and impact of the Electronic Communication Network & Services 2002 "EU Regulatory Framework," and of the Radio Spectrum Decision (through the Radio Spectrum Committee (RSCOM) and Radio Spectrum Policy Group (RSPG) instruments), applied to Point-to-Point, e.g.: we already addressed the role of TCAM-RIG; we might also question to what extent most of the Point-to-Point frequency bands could not be considered, at mid term, as "quasi-harmonized" bands across Europe. When spectrum trading may become a reality for Point-to-Point frequency bands[5], Point-to-Point radio systems experience many different spectrum fees regimes in Europe, and cross-border issues.

It can also be noted that the RoHS (Restriction of use of certain Hazardous Substances) Directive leads to have only new or recent equipment be put on the EU market since July 1st 2006, hence favouring innovation.

[4] such as illustrated in [4] Annex B "Notification of interfaces under Article 4.1 of the R&TTE Directive"

[5] in [12]: "*Fixed links … licenses could be made tradable without difficulty but would in many cases be limited to the existing technical parameters and not be easy subjects for a more flexible approach. It was noted, however, that management of … fixed links … in certain geographical areas, have in some cases been entrusted to commercial managers, which would provide some more scope"*

Lastly, we can anticipate that the on-going "2006 Review," with attached issues such as WAPECS, flexible bands, licensed versus licence-exempt bands, "light" licensing regimes, and risks attached, such as the key issue for Point-to–Point systems of guarantee of protection or not (hence QoS), combined with the IP/Ethernet type of traffic, might lead to some mid–term impact and evolution of the Point-to-Point systems.

6. NEXT STEPS AND CONCLUSION

At a time where a lot of attention has been paid to Fixed Wireless Systems such as FWA/NWA and MWA, it is worth reiterating that point-to-point fixed radio systems still play a key role in most of the major Electronic Communications Networks (e.g. backhauling of cellular network, but also in transport/access network and governmental networks) and securing them in bringing QoS/guarantee of protection of coordinated frequency bands.

Several significant steps have already been taken in the point-to-point fixed radio systems European Regulatory and Standardization Environment, with positive trend towards less fragmentation, more harmonization, rationalization and removal of unnecessary (or no longer necessary) constraints, hence easing access to market and speeding up introduction of innovation.

It is also worth noting that these major changes have taken place in a smooth manner, nicely paving the way for further steps toward more and more flexibility and harmonization.

Further efforts and challenging work still remain. We might advocate toward a "quasi-harmonized" status of most of the Point-to-Point microwave bands in Europe, "one-stop" notification process or no longer notification, spectrum information (EFIS database) improvements as the main repository of radio interfaces, harmonization of planning assumptions and rules across Europe, and thinking about Software Defined Radio.

REFERENCES & LINKS

[1] ITU-R Series F Recommendations & Reports
http://www.itu.int/rec/R-REC-F/e
http://www.itu.int/pub/R-REP-F/en
[2] ETSI European Telecommunications Standards Institute
http://portal.etsi.org/Portal_Common/home.asp
[3] EN 302 217 *European Standard (Telecommunications series)* Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas;
[4] EN 302 217-1: Overview and system-independent common characteristics
[5] EN 302 217-2-1: System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied
[4] EN 302 217-2-2: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for digital systems operating in frequency bands where frequency co-ordination is applied
[5] EN 302 217-3: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for equipment operating in frequency bands where simplified or no frequency co-ordination procedures are applied
[6] EN 302 217-4-1: System-dependent requirements for antennas
[7] EN 302 217-4-2: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for antennas
[8] CEPT European Radiocommunications Office
http://www.ero.dk
[9] European Frequency Information System Data Base (EFIS) http://www.efis.dk/search/general
[10] European Commission, DG Enterprise, R&TTE Directive http://ec.europa.eu/enterprise/rtte/
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BIOGRAPHY

Laurent Bellot joined the Harris Microwave Communications Division (now Harris Stratex Networks) in 2000 with the acquisition of Lucent TRT's Microwave Division. He previously worked for Lucent Technologies, TRT-Philips and Alcatel in Product Management, Sales, Marketing and R&D positions, in Wireless Access Solutions, Internet/Multimedia, Private Mobile Radio, Satellite Communications. He has a degree from Ecole Polytechnique, Paris, in Mathematics, and a graduate degree in Telecommunications as related to Signal Processing and Digital Communications from ENST, Paris, (Ecole Nationale Supérieure des Télécommunications).