Spectrum Harmonization: how the regional organisations and industry associations can complement African harmonisation efforts

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About the Author

1. Ex Spectrum Manager of Israel
2. Engineer & Economist
3. PhD thesis on how culture & geography influence wireless regulation
4. Wiley book on spectrum-management
5. 49 years of RF experience
6. Acquainted with all wireless communications: cellular, broadcasting, point to point, radars, satellites…
7. Very active in Cameroon, Zambia, Togo communications' market
8. What Is worth-knowing if you don't share it (based on 1973 David R. Olson)

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Sources of the presentations

- 49 years of RF experience at all radio communications services
- 29 years of RF Spectrum Licensing and Monitoring
- Development of two Computer Aided Techniques for National Spectrum Management
  - Spectrum Management 'Shraga'
  - Spectrum Management System 'Iris' and ICS Manager
- ITU Spectrum Monitoring Handbook 1995, 2002, 2011
- Contributed to
  - ITU Computer-aided Techniques for Spectrum Management (CAT) 2015
  - Recommendation ITU-R SM.1370 Design guidelines for developing automated spectrum management systems
  - ITU Handbook on National Spectrum Management 2015

Main ITU-D activities of the Author

Contributes and participates actively at the two ITU-D Study Groups:, specific to this training

Resolution 9: Participation of countries, particularly developing countries, in spectrum management

Question 1/1	Strategies and policies for the deployment of broadband in developing countries
Question 2/1	Strategies, policies, regulations and methods of migration and adoption of digital broadcasting and implementation of new services
Question 4/1	Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks
Question 5/1	Telecommunications/ICTs for rural and remote areas
Question 6/1	Consumer information, protection and rights: Laws, regulation, economic bases, consumer networks
Question 7/1	Access to telecommunication/ICT services by persons with disabilities and other persons with specific needs
Question 1/2	Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development
Question 2/2	Telecommunications/ICTs for eHealth
Question 5/2	Utilizing telecommunications/ICTs for disaster risk reduction and management
Question 6/2	ICTs and the environment
Question 7/2	Strategies and policies concerning human exposure to electromagnetic fields

Main ITU-R activities of the Author

1. Since 1991, around **250** technical contributions to all ITU-R WPs
2. VC ITU-Radio SG 9 - Fixed service 2000-2007; ITU-T (standardization) Workshop "All Star Network Access" 2004, Chair of Regulatory session; co-chaired ITU-R JRG 8A-9B. VC of ITU-R SG 1- Spectrum Management since October 2007 (elected by 92 countries at Radio Assembly 2007), re-elected by 102 countries at the RA 2012
3. Since October 2015, VC of ITU-R SG 5- Terrestrial Services (elected by 88 countries at RA 2015). VC since May 2016 of ITU-R WP 5C - Fixed wireless systems; HF systems in the fixed and land mobile services
4. Chair ITU-R Working Group 5C-3 'Systems above 86 GHz & interdisciplinary topics'
5. Contributed two training modules- 'Fixed Service' and 'Short Range Devices'- to 'Wireless Telecommunications Technologies', for the ITU Academy, Spectrum Management Training Program (SMTP); now the advanced EMF module

ITU-T activities of the Author

1. ITU-T (standardization) Workshop "All Star Network Access" 2004
2. Rapporteur to the World Health Organisation (WHO) and International Commission on Non-Ionizing Radiation Protection (ICNIRP) of ITU-T Study Group 05 (ICT and climate change), to assess exposure from Electro Magnetic Fields, Question 3/5
3. Prepared the ITU intersectoral response to the public consultation of the Draft ICNIRP 'Guidelines on limiting exposure (100 kHz to 300 GHz)'.
4. Nominated by ITU R SG1 (spectrum management), SG5 (terrestrial services) and SG6 (broadcasting) on June and November 2014 and ITU RAG, to represent them on EMF
5. ITU Workshop on "5G, EMF & Health" (Warsaw, Poland, 5 December 2017), Warsaw EMF Dec 2019 IEEE95.1 ICNIRP guidelines 3 Dec2019
6. 'ATDI Coverage & EMF contours, around 5G base stations' see also.
7. More details on Author http://mazar.atwebpages.com/CVMazarEN.pdf

Theories and Policies

1. So begins Leo Tolstoy's Anna Karenina : ‘All happy families are alike; each unhappy family is unhappy in its own way’
2. Between 2 points in planar geometry there is only one simple line, but indefinite curves
3. 'Great minds think alike' (Michaelian)
4. ‘Stand on the shoulders of giants‘ (also I. Newton)
5. 'Okham’s Razor': ‘if you have to choose between competing theories, choose the simplest theory- it is most likely to be true’

Demand the duty with each one can perform

Antoine de Saint-Exupéry 'Little Prince'

1. "One must require from each one the duty with each one can perform," said the king
2. "Accepted authority rests first of all on reason. If you ordered your people to go and throw themselves into the sea, they would rise up in revolution. I have the right to require obedience because my orders are reasonable"

Strategies

1. Follow RR Allocations
2. To reduce interference: lower-power, lower-altitude Above Sea Level, lower-altitude Above Ground Level
3. No discrimination; Fairness, transparency & efficiency
4. Unused RF is a waste to economy
5. For cellular efficient usage consider to oblige active RF sharing
6. There is available RF: never say I have no time, I have no money I have no RF
7. Penetration is relatively high and technologies improve b/Hz/second
8. Market-Dynamics: Intervene only when market-failure: lack of competition
9. Efficient use of spectrum: assign spectrum to those that will generate the greatest socio-economic benefit from its use
10. Promote investment & innovation in the sector
11. Does not undermine effective competition
12. Convergence of mobile, fixed & broadcasting services ; Internet Service Providers mainly use fixed stations
13. Try not to allocate RF when the Transmitter & the receiver are fixed
14. Put most attention on Short Range Devices
15. Focus on long term policy objectives rather than short term gains (not *Carpe Diem*, seize the day)

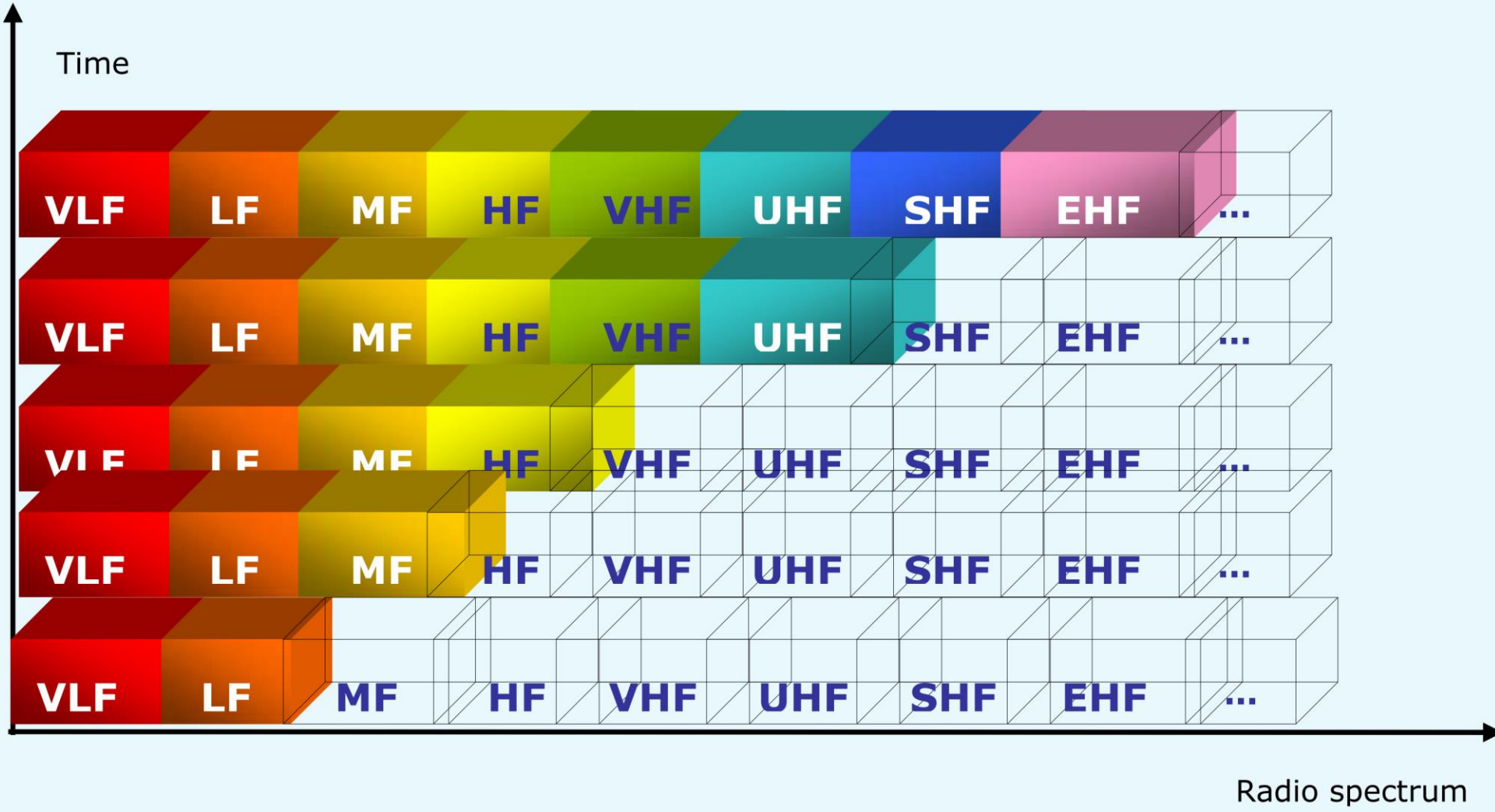
Where you sit is where you stand; auctions as example

1. Ministry: QoS, remote areas coverage, investments & better infrastructure
2. Ministry of Finance max revenue
3. Incumbent Operators may pay for more Spectrum
4. Public interest: min. prices, max. coverage & capacity, including rural and remote areas, Public Protection and Disaster Relief (PPDR)
5. Other players?
6. Administration should integrate all interests

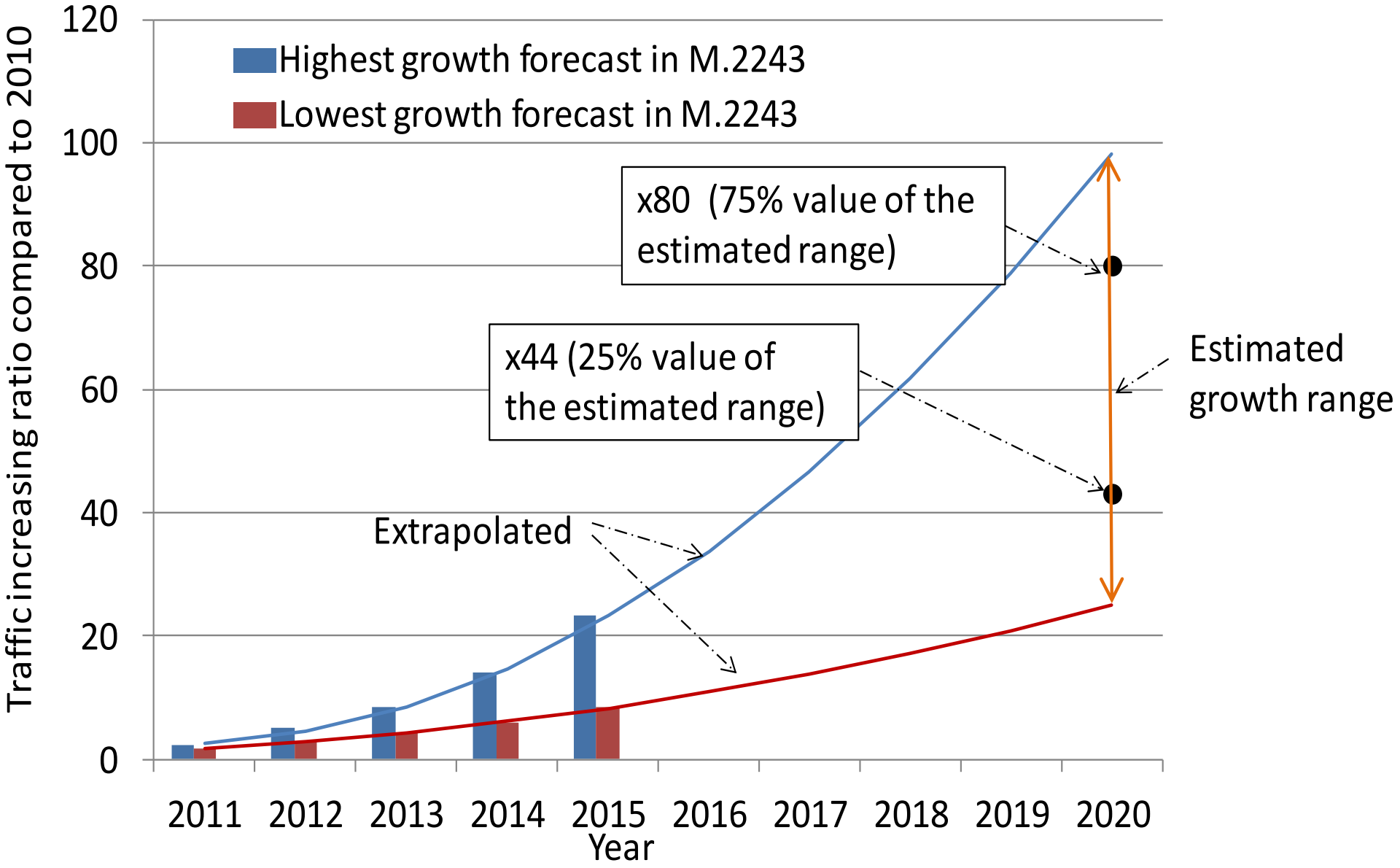
Figure 1: Scarcity of radio frequencies

Scarcity of Radio Frequencies

ITU-D Resolution 9 Final Report; 2014 Fig. 1



Mobile traffic forecasts toward 2020 by extrapolation ITU-R Working Party 5D



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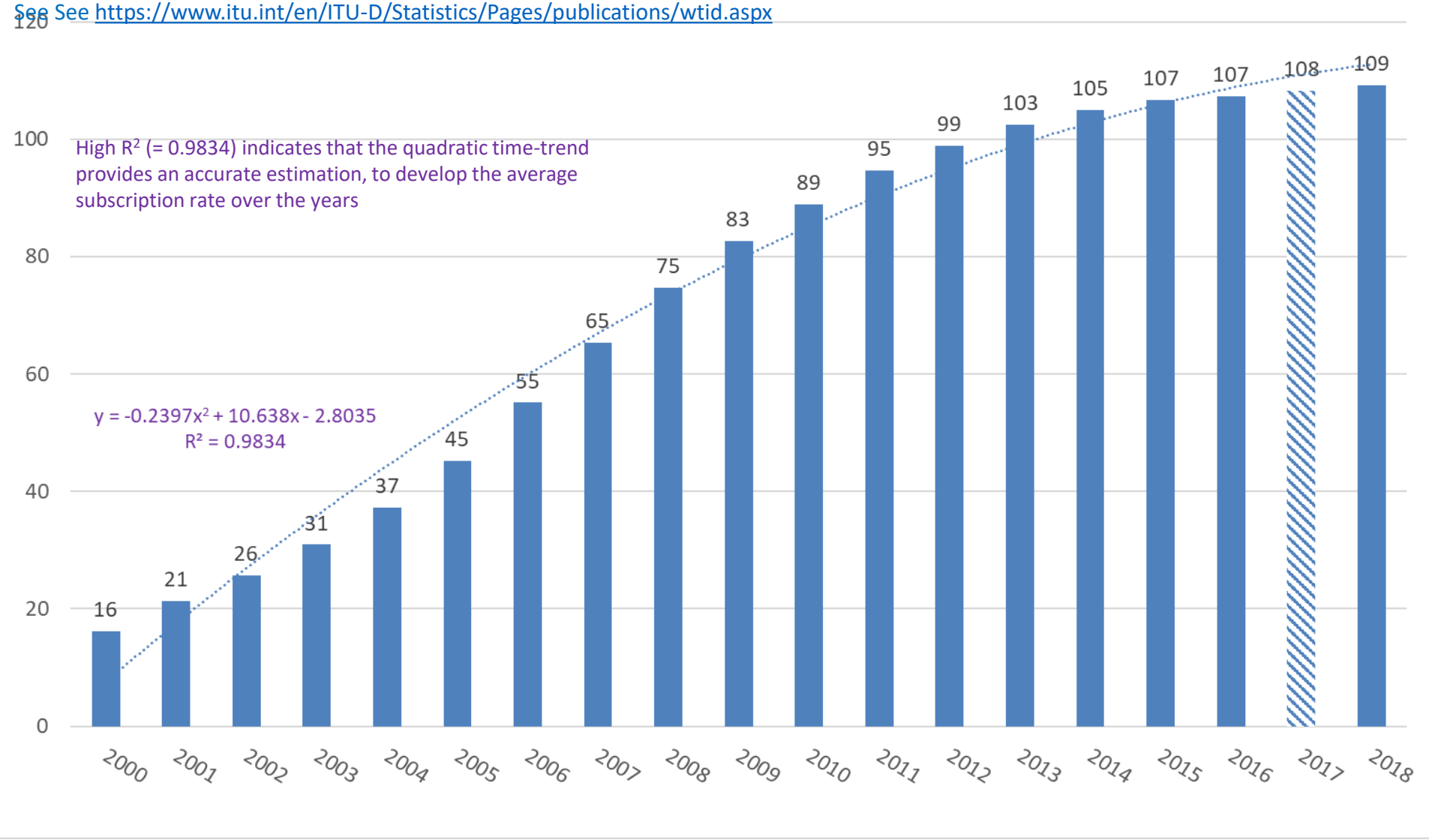
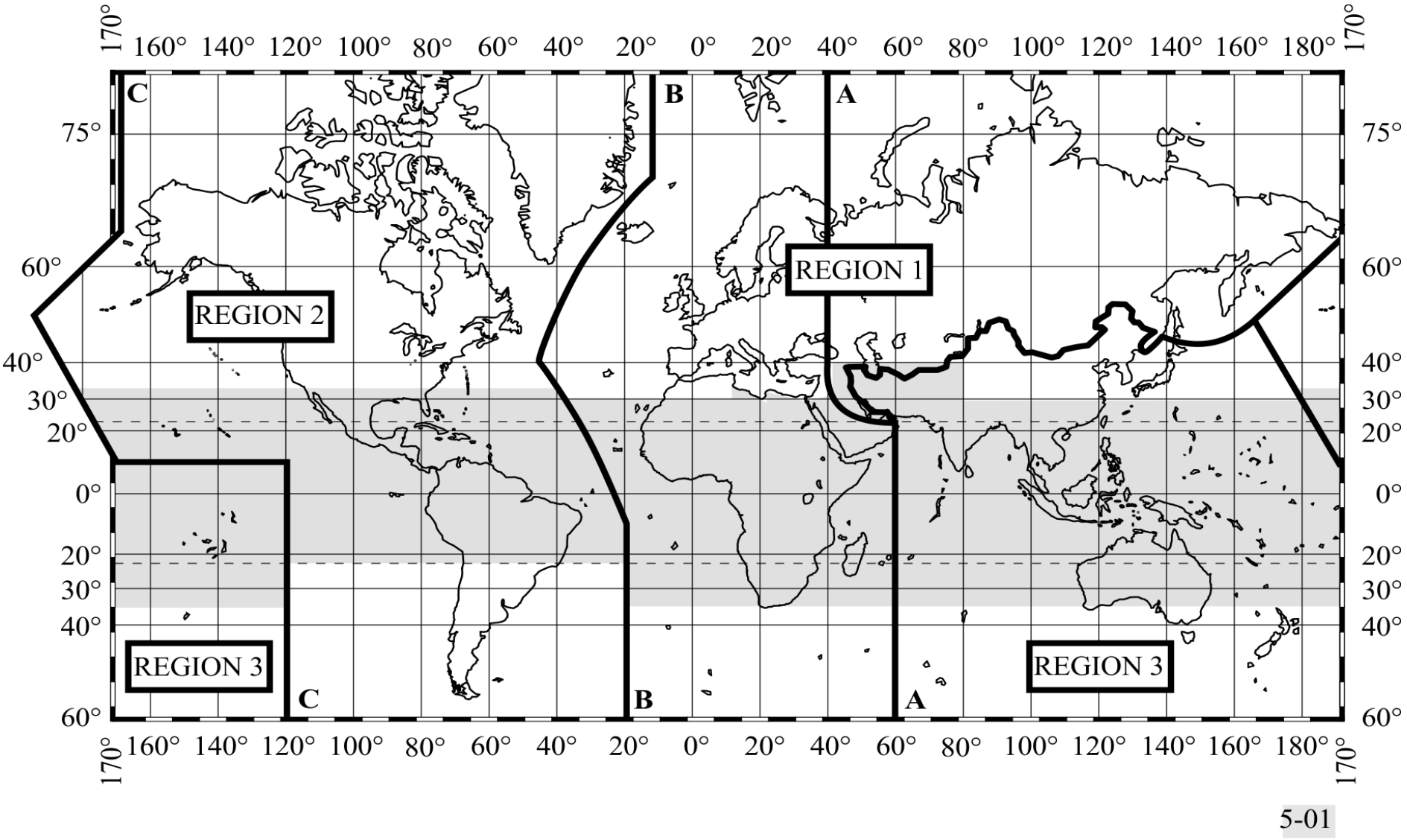
Global mobile-cellular telephone subscription rate

Source- 2019 ITU Indicators
See See https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx



International Harmonization: Three ITU RF Allocation Regions



Radio Frequency Co-ordination; Europe experience

1. Avoiding RF interference
2. ITU RR do not meet all practical requirements
3. Each country obliged to take account of other stations before putting own into operation
4. Procedures agreed in the Agreement
5. Bilateral preferential frequency agreements for frontier zones: who can operate what and with which interference ranges

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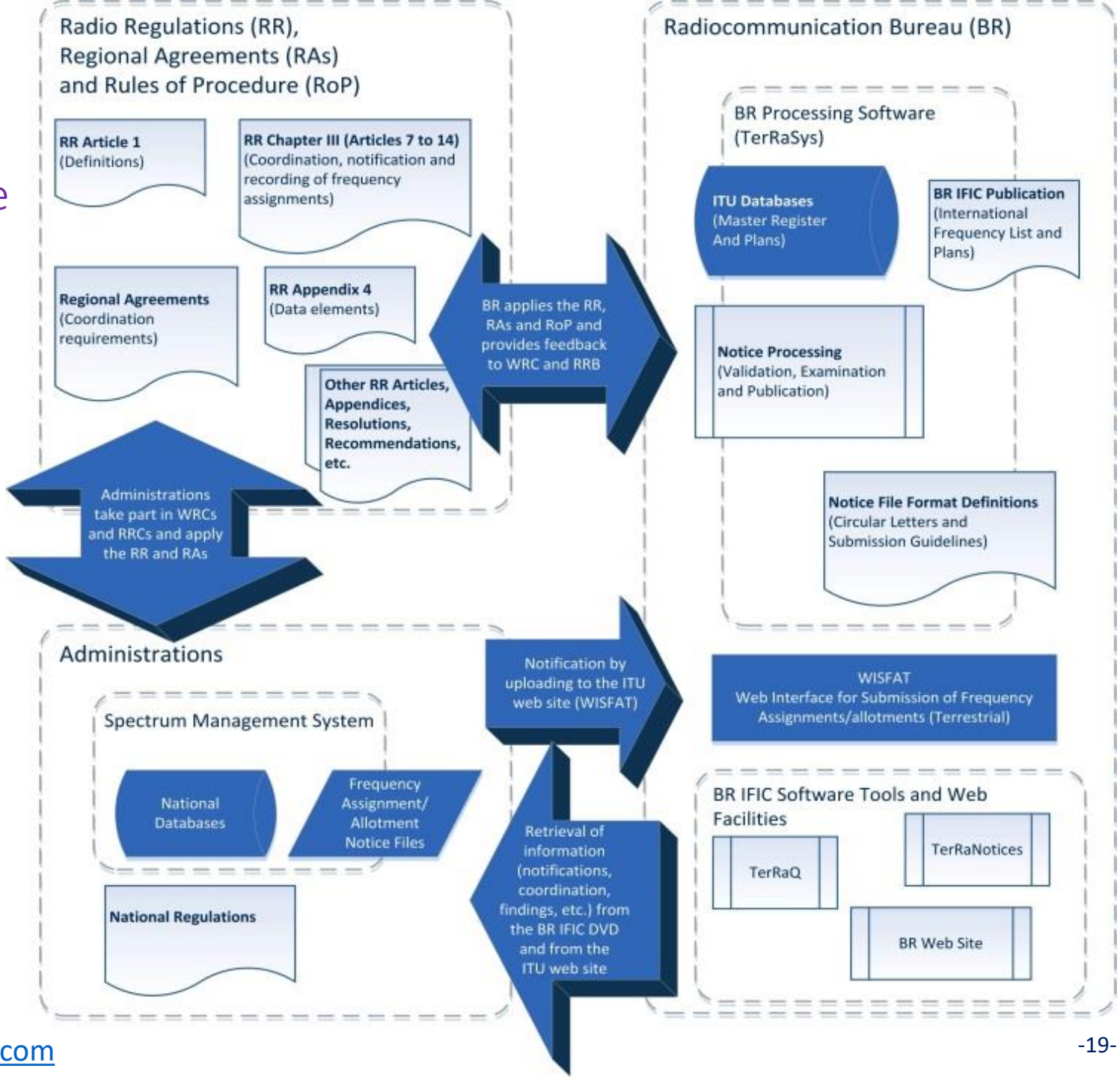
Radio Frequency Co-ordination; Advantages

1. Aim: Optimise spectrum usage
2. Administrations obliged to co-ordinate frequencies before assigning them
3. Administrations obliged to ensure harmonised application of technical provisions
4. Quick assignment of preferential frequencies
5. Transparent decisions through agreed assessment procedures
6. Quick assessment of interference through data exchange

Radio Frequency Co-ordination; Disadvantages

1. Hurt sovereignty
2. Increase in administrative work and costs (complex procedures, longer turnaround times, topographical database)
3. Detailed input data required from operators (geographical data, antenna parameters)
4. Complex operational conditions, assignments subject to diverging conditions
5. Customers affected by changes in usage rights: Various consequences
6. Limits also to preferential frequencies, limits may vary from case to case
7. Restrictions in frequency assignment
8. More work in application processing

Terrestrial data exchange



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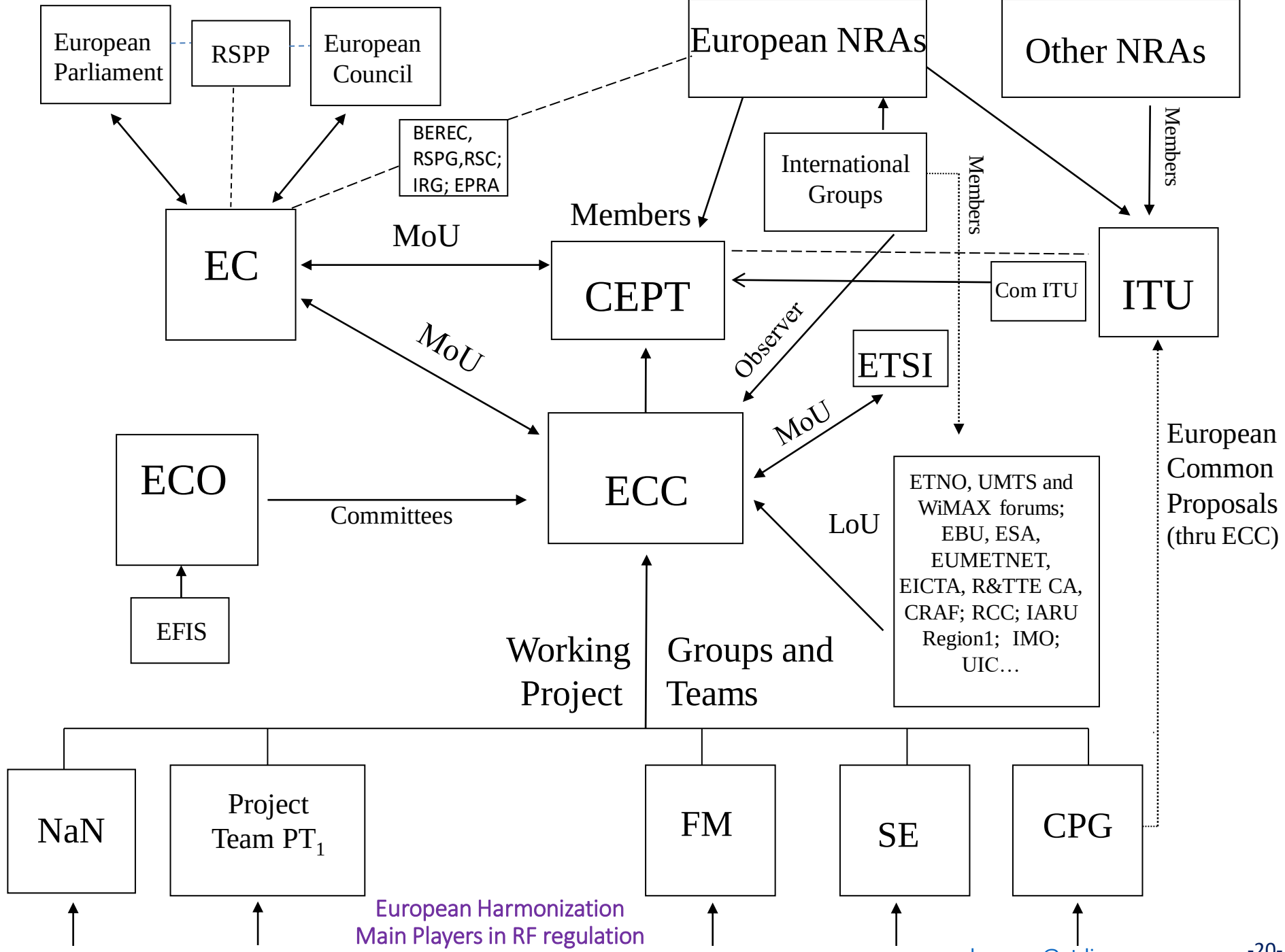

European Harmonization
Main Players in RF regulation

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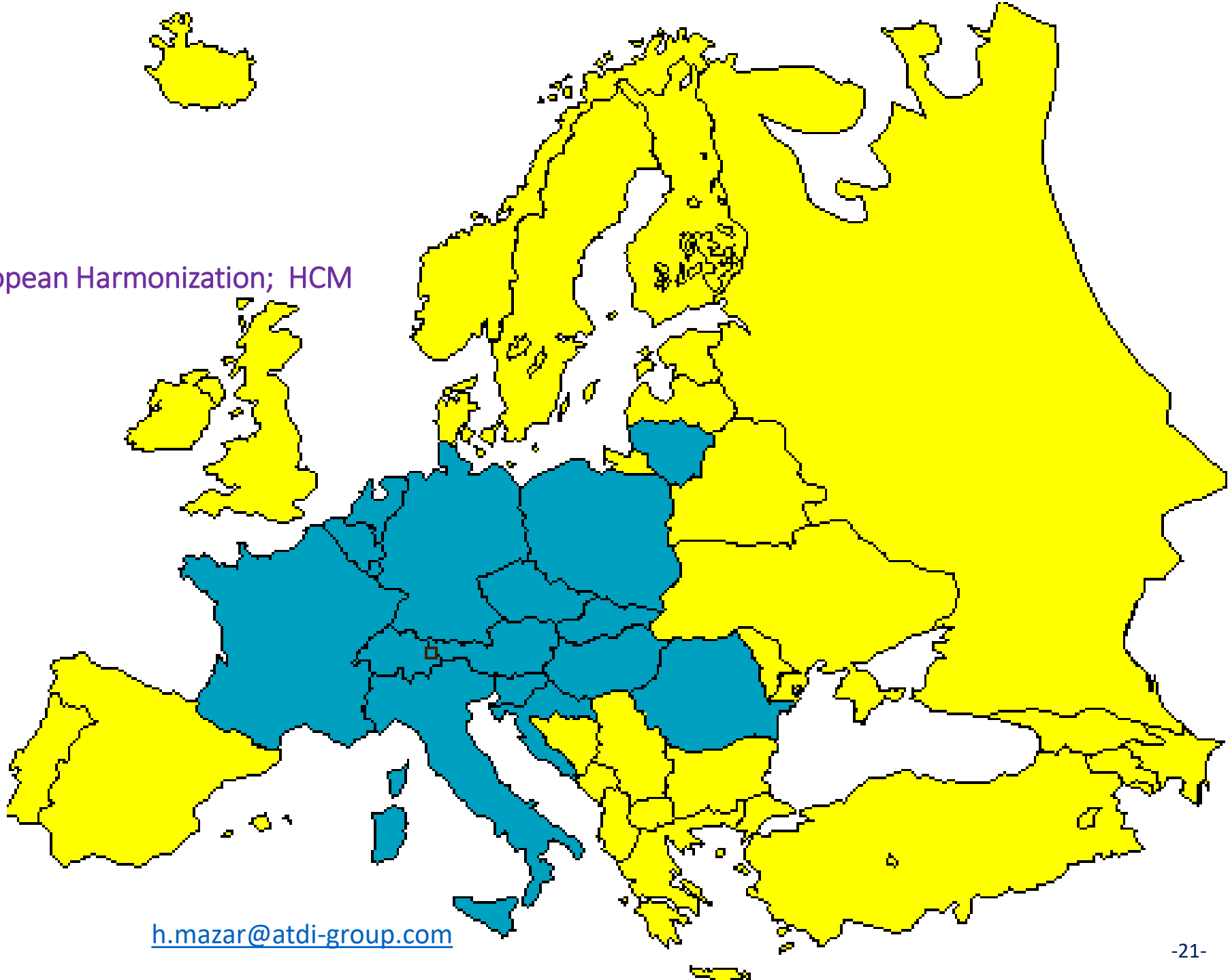
European Harmonization; HCM



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European Harmonization; HCM (Harmonised Calculation Method)

1. *HCM Agreement is the official designation of the Agreement between the Administrations of Austria, Belgium, the Czech Republic, Germany, France, **Hungary**, the Netherlands, Croatia, Italy, Liechtenstein, Lithuania, Luxembourg, Poland, Romania, the Slovak Republic, Slovenia and Switzerland on the Coordination of frequencies between 29.7 MHz and 43.5 GHz for fixed service and land mobile service*
2. Agreement 2019
3. The **European rulings**, such as the European table of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz (ECA TABLE), are first-rate guidelines

ITU African Countries Grouping it is different than The African Union grouping see next slide

Northern Africa
Managed by Cairo Office (Egypt)

Algeria, Comoros, Djibouti, Egypt, Libya, Mauritania, Morocco, (Saharawi), Somalia, Sudan, Tunisia

Area Office Western Africa
Dakar (Senegal)

15 countries

Benin
Burkina Faso
Cap Vert
Cote d'Ivoire
Gambie
Ghana
Guinée
Guinée-Bissau
Liberia
Mali
Niger
Nigeria
Senegal
Sierra Leone
Togo

Area Office Southern Africa
Harare (Zimbabwe)

12 countries

Afrique du Sud
Angola
Botswana
Lesotho
Malawi
Maurice
Mozambique
Namibie
Seychelles
Swaziland
Zambie
Zimbabwe

Area Office Central Africa
Yaoundé (Cameroon)

11 countries

Burundi
Cameroun
Congo
Congo (RDC)
Gabon
Guinée Equatoriale
Madagascar
République Centrafricaine
Rwanda
Sao Tome et Principe
Tchad

Area Office For Eastern Africa
Addis Ababa (Ethiopia)

6 countries

Erythrée
Ethiopie
Kenya
Ouganda
Tanzanie
South Sudan

English **French** **Portuguese** **Spanish** **Bilingual**

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African Union (AU) Grouping; see https://au.int/en/member_states/countryprofiles2

The AU is made up of 55 Member States which represent all the countries on the African continent. AU Member States are divided into five geographic regions. which were defined by the OAU in 1976 (CM/Res.464QCXVI). The following list shows all members states grouped by region, in alphabetical order, and their date of joining the AU or its predecessor the OAU.

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	Central Africa	Eastern Africa	Northern Africa	Southern Africa	Western Africa
1	Burundi	Comoros	Algeria	Angola	Benin2
2	Cameroon	Djibouti	Egypt	Botswana	Burkina Faso
3	Central African Republic	Eritrea	Libya	Eswatini	Cabo Verde
4	Chad	Ethiopia	Mauritania	Lesotho	Côte d'Ivoire
5	Congo Republic	Kenya	Morocco	Malawi	Gambia
6	DR Congo	Madagascar	Sahrawi Republic	Mozambique	Ghana
7	Equatorial Guinea	Mauritius	Tunisia	Namibia	Guinea
8	Gabon	Rwanda		South Africa	Guinea-Bissau
9	São Tomé and Príncipe	Seychelles		Zambia	Liberia
10		Somalia		Zimbabwe	Mali
11		South Sudan			Niger
12		Sudan			Nigeria
13		Tanzania			Senegal
14		Uganda			Sierra Leone
15					Togo

RF Regulation in Africa (1)

The African Telecommunications Union (ATU); ATU is a continental partnership between public and private stakeholders in the ICT sector to foster the development of ICT technologies, infrastructure and services. ATU formulates policies and strategies, represents the interests of its members at global decision-making conferences, promotes integration of regional markets, advances universal access and inter-country connectivity, attracts investment, builds institutional and human capacity and supports active participation in the global information and knowledge society. ATU has 44 Member States and 16 Associate Members (comprising fixed and mobile telecom operators). Figure 7.7 depicts the ATU Members.

West African States

The Economic Community of West African States (ECOWAS) is a regional group of fifteen countries, founded in 1975. Similar to the EU model, ECOWAS promotes economic integration including telecommunications matters, and fosters cooperation and integration of West African telecommunications and information technology activities. The West African Economic and Monetary Union (UEMOA) undertook telecommunications regulation harmonization project, aimed at designing a strategy for the harmonization of telecommunications policies in ECOWAS. The West Africa Telecommunications Regulators Assembly (WATRA) was established in November 2004. WATRA consists of the 15 independent National Regulatory Authorities (NRAs) and departments for regulation of telecommunications services established by governments of ECOWAS and Mauritania. Benin, Burkina Faso, Cabo Verde, Cote D'ivoire, Gambia, Ghana, Guinee, Guinee Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

RF Regulation in Africa (2)

East African Community: EAC and EACO

The East African Community (EAC) and East Africa Communications Organization (EACO) are the regional intergovernmental organization of the Burundi, Kenya, Rwanda, Tanzania and Uganda to widen and deepen also economic integration, in order to increase competitiveness in East Africa. EACO was established by ICT regulators of East Africa and licensed communications operators within the East Africa region, to co-ordinate all the ICT activities and initiatives in the region. EAC also does have an arm dealing with development of ICT sector within the region which is not member of EACO.On 30 December 2014 EACO is not yet part of EAC.

South-African Region: Regulatory Framework

Two main Southern-African regulatory groups: the Southern African Development Community (SADC) and Communication Regulators' Association of Southern Africa (CRASA); CRASA is the renamed TRASA. SADC is the regional economic community comprising fifteen Member States, established in 1992. SADC is committed to regional integration within Southern Africa through economic development. The focus of the thirteen countries forming the CRASA is the harmonization of ICT and Postal regulatory environment, in order to improve the business environment and investment climate in SADC. Telecommunications Regulators' Association of Southern Africa (TRASA) was established in 1997. TRASA co-ordinates regulatory matters, promotes operation of efficient telecommunications networks and services, and maximises the utilisation of scarce resources.

Importance of Frequency Allocation Tables; 694-862 MHz; Ref. [ITU-D Resolution 9]

Frequency band	Allocations	Applications
694 MHz - 790 MHz (5.300) (5.311A) (5.312)	•BROADCASTING •MOBILE EXCEPT AERONAUTICAL MOBILE (5.312A) (5.317A)	•PMSE •Radio microphones and ALD •MFCN •PPDR •Broadcasting (terrestrial)
790 MHz - 862 MHz (5.312) (5.316B) (5.317A) (ECA13)	•MOBILE EXCEPT AERONAUTICAL MOBILE	•Radio microphones and ALD •MFCN
862 MHz - 870 MHz (5.323) (ECA13) (ECA36)	•MOBILE (5.317A)	•Radio microphones and ALD •- •RFID •Tracking, tracing and data acquisition •Wideband data transmission systems •Land military systems •Maritime military systems •Alarms •Non-specific SRDs

Importance of Frequency Allocation Tables; 2900-3400 MHz,Ref. ITU-D Resolution 9]

Query in the EFIS database (ECO Frequency Information System; See Resolution 9 Fig. 14

Frequency Range: 2900 to 3400 MHz Frequency Table: France Search

Results from the ERO Frequency Database:

FREQUENCY BAND	ALLOCATIONS	APPLICATIONS
2900.0 - 3100.0 MHz	RADIOLOCATION RADIONAVIGATION	Maritime navigation Primary radar
3100.0 - 3300.0 MHz	EARTH EXPLORATION-SATELLITE RADIO ASTRONOMY RADIOLOCATION SPACE RESEARCH (active)	Maritime radar
3300.0 - 3400.0 MHz	RADIO ASTRONOMY RADIOLOCATION	Defence systems

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Region 1

470-694

BROADCASTING

5.149 5.291A 5.294 5.296
5.300 5.304 5.306 5.311A
5.312

694-790

MOBILE except aeronautical mobile 5.312A 5.317A

BROADCASTING

5.300 5.311A 5.312

790-862

FIXED

MOBILE except aeronautical mobile 5.316B 5.317A

BROADCASTING

5.312 5.319

862-890

FIXED

MOBILE except aeronautical mobile 5.317A; BROADCASTING 5.322

Region 2

470-512

BROADCASTING

Fixed

Mobile

5.292 5.293 5.295
512-608

BROADCASTING

5.295 5.297
608-614

RADIO ASTRONOMY

Mobile-satellite except
aeronautical mobile-satellite
(Earth-to-space)

614-698

BROADCASTING

Fixed

Mobile

5.293 5.308 5.308A 5.309 5.311A

698-806

MOBILE 5.317A

BROADCASTING

Fixed

5.293 5.309 5.311A
806-890

FIXED

MOBILE 5.317A

BROADCASTING

Region 3

470-585

FIXED

MOBILE 5.296A

BROADCASTING

5.291 5.298
585-610

FIXED

MOBILE 5.296A

BROADCASTING

RADIONAVIGATION

5.149 5.305 5.306 5.307
610-890

FIXED

MOBILE 5.296A 5.313A
5.317A

BROADCASTING

ITU RR 460-890 MHz

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Factors contributing to the scarcity of RF & increased spectrum access costs; Reference Resolution 9

1. Deregulation & liberalization of communication markets
2. Privatization & "merchandizing" of the public domain
3. Awareness of the value of the spectrum
4. Worldwide competition between multinational operators

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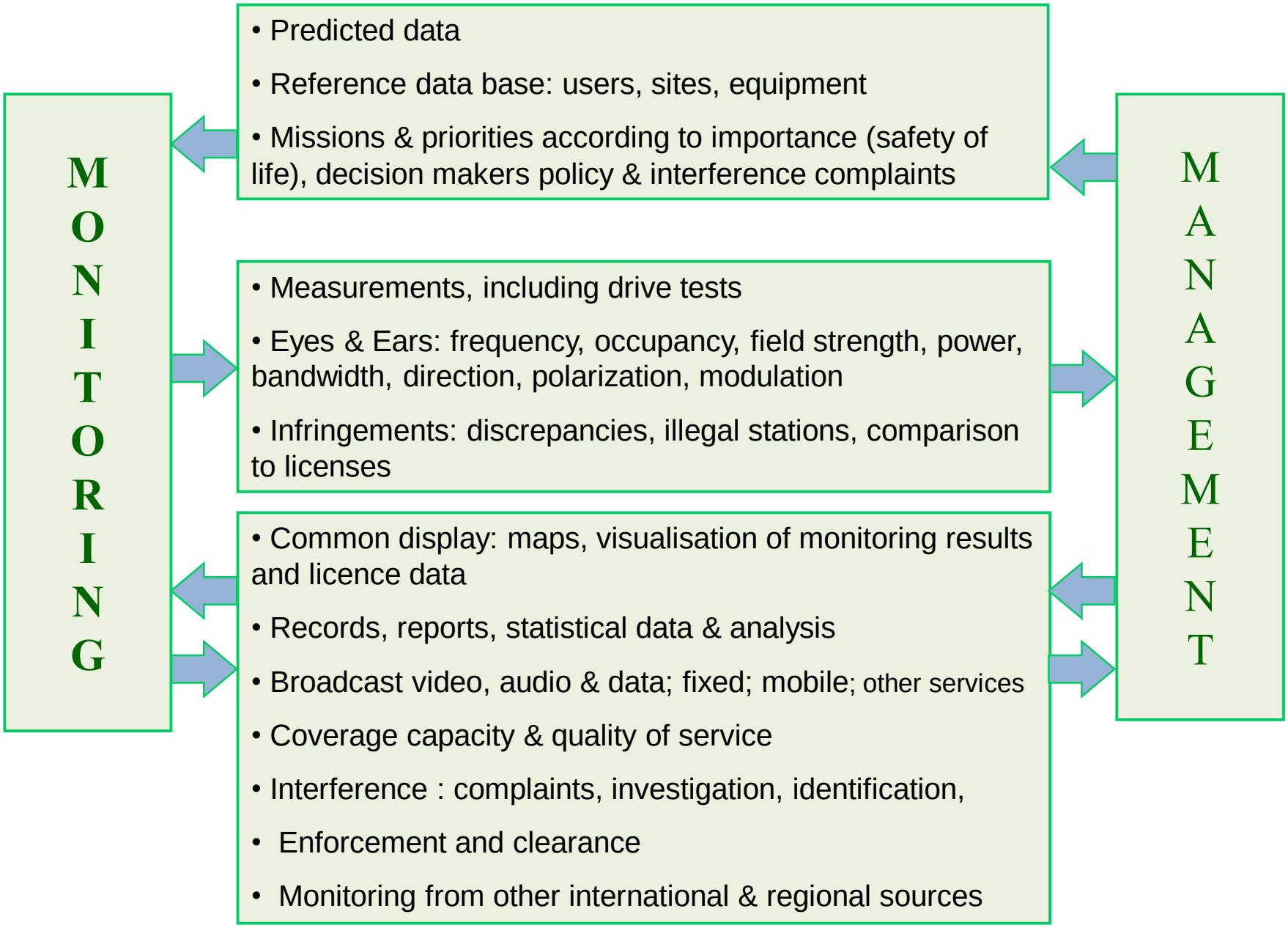
Interrelation of national spectrum management & monitoring functions



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Roles of RF monitoring

1. Ensuring operation of transmitters in conformity with national and international regulations and licence conditions
2. Verification of proper technical and operational characteristics of authorized transmitters
3. Detection and location of unauthorized transmitters and interference
4. identification and resolution of interference problems
5. Measuring spectrum occupancy
6. Validation of propagation and sharing models

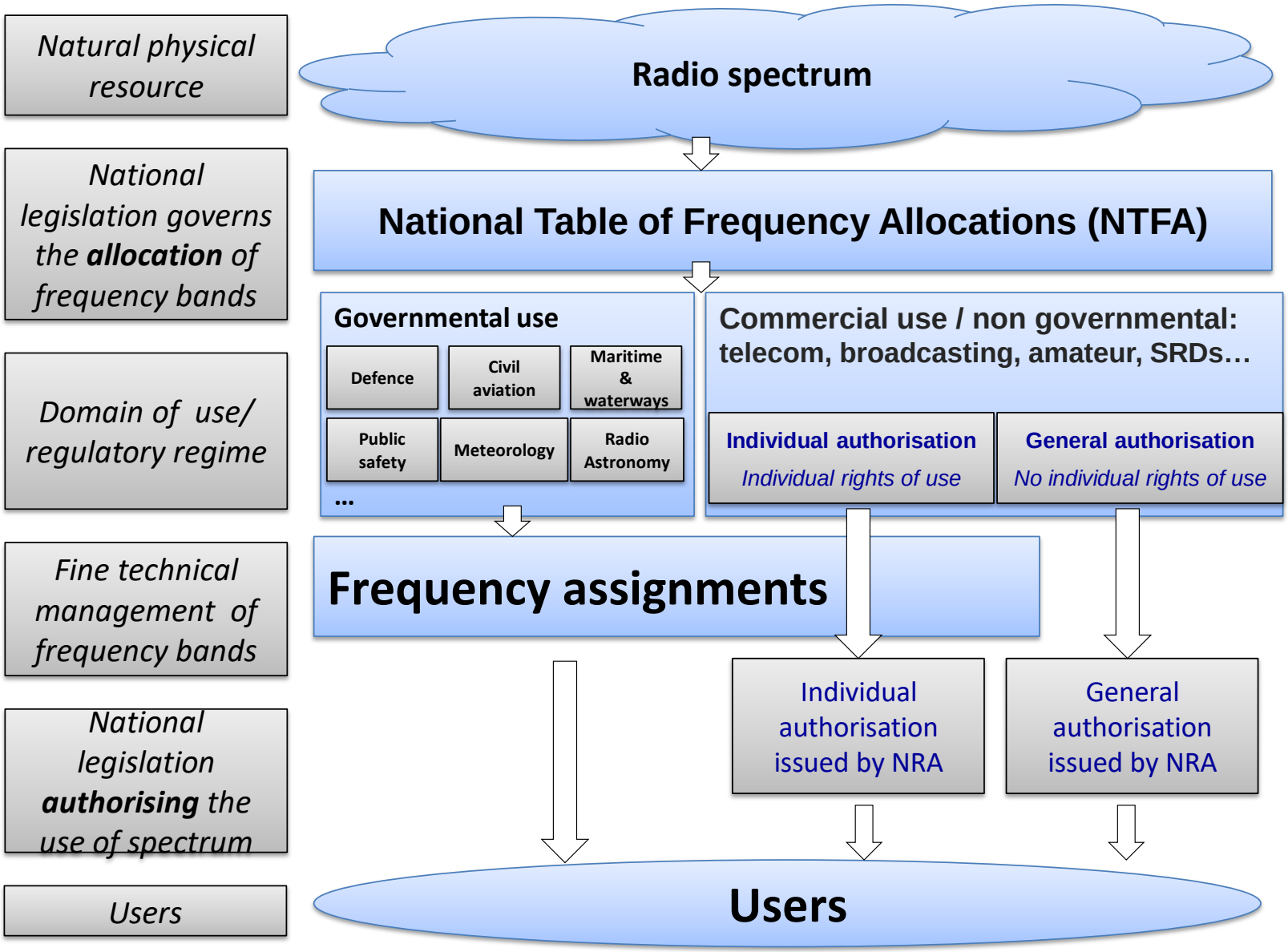
Items which need to be regulated

1. RF allocations to radio services; follow ITU Radio Regulations
2. Assignment of licence and RF to Tx Stations
3. Fee collection: RF License & annual fees
4. Equipment Type approval; EU R&TTE is liberal
5. Coordination with neighbour countries (no borders to the ElectroMagnetic waves)
6. Notifying ITU to the Master International Frequency Register (MIFR) e.g. http://www.itu.int/ITU-R/eBCD/ePub.aspx
7. External relations: toward ITU, International and Regional orgs see http://eprints.mdx.ac.uk/133/2/MazarAug08.pdf p. 179

Main Roles of National Spectrum Management

1. Avoid and solve interference
2. Design long and short range RF spectrum
3. Support Engineering: propagation, coverage…
4. Coordinate with military wireless services
5. Advance new wireless technologies (such as cognitive radios; digital audio and video)
6. Coordinate with other Administrations
7. Advance new technologies & efficient import
8. Serve your clients, the public: be transparent
9. Reduce RF human hazards

National legislation in Europe from the radio spectrum to users ECC Report 205



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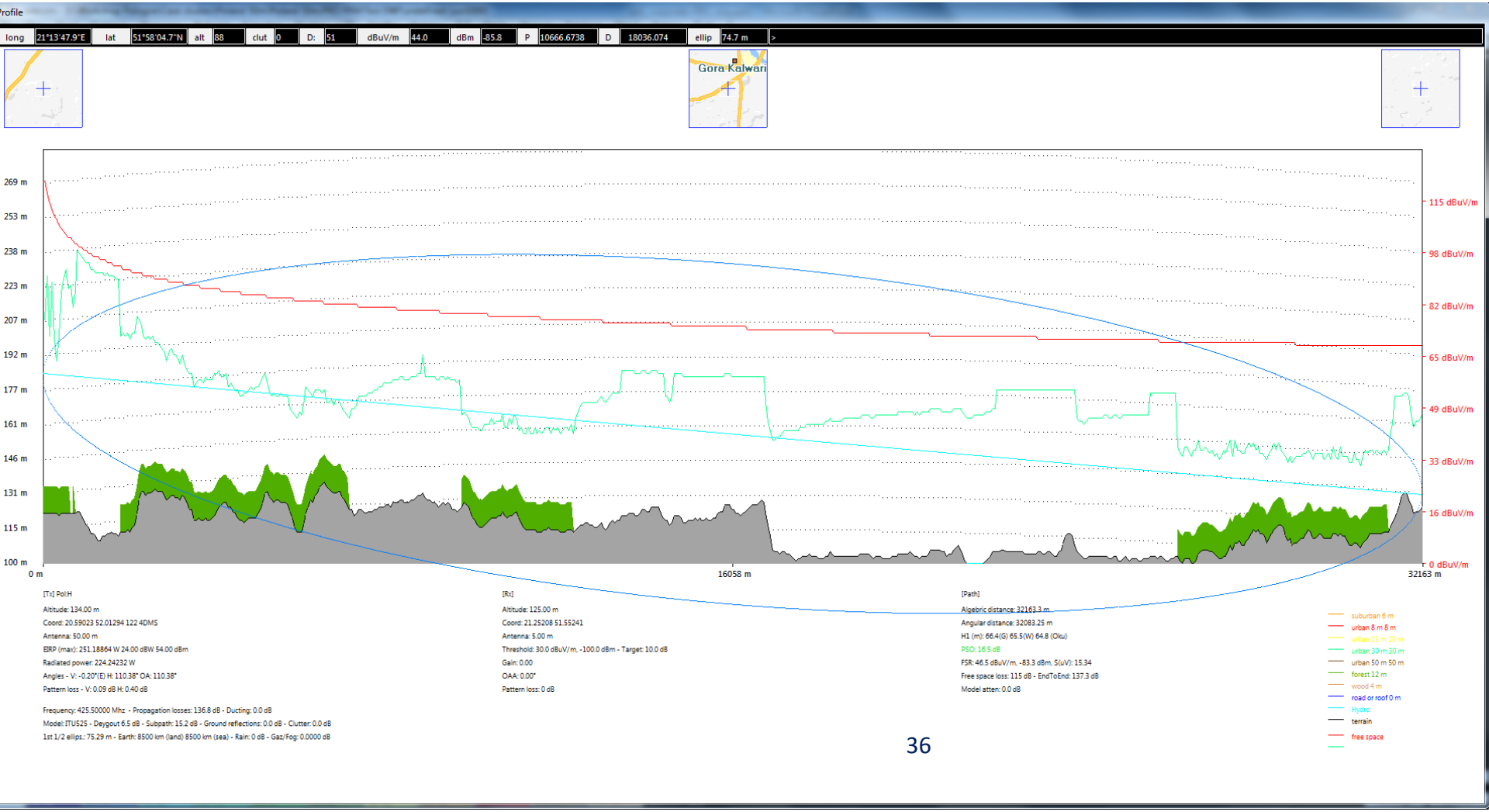
Profile analysis window
the basics of all engineering work; ATDI profile



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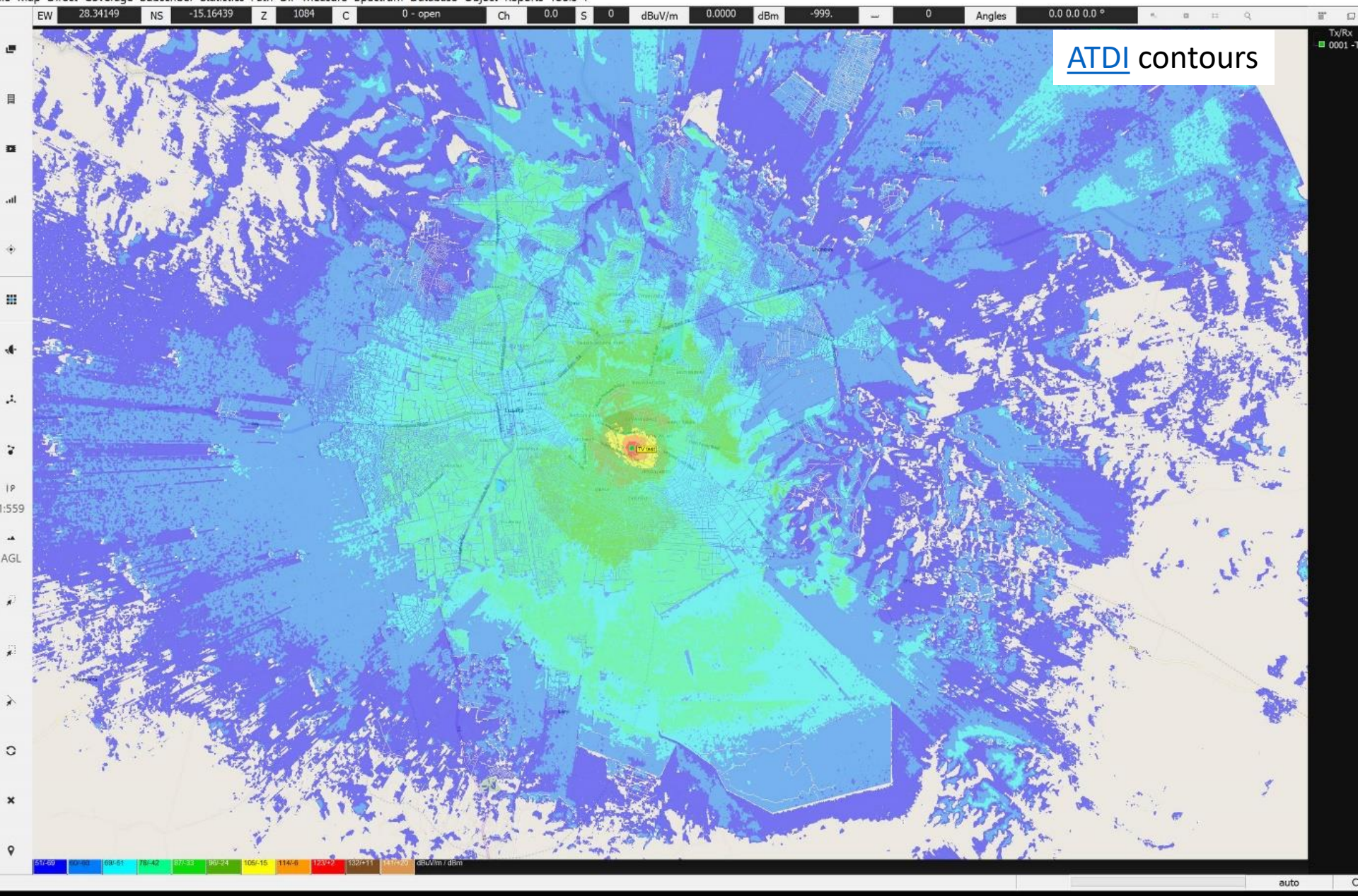
Coverage of Lusaka TV UHF channel the basics of all engineering work



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Relevant Material from Dr. Haim Mazar presentations (1); see http://mazar.atwebpages.com/Downloads

1. Academic_Course_Advanced_Wireless_Communications_Mazar1_Engineering_2020.pdf
2. Academic_Course_Advanced_wireless_communications_Mazar2_Services_2020.pdf
3. Academic_Course_Advanced_Wireless_Communications_Mazar3_Regulation_EMC_HumanHazards_2020.pdf
4. Cameroon_EconomicModels_African_RF_Spectrum23Aug19French.pdf
5. Cameroon_Yaounde_Commonwealth_SM Forum_Mazar_Nov16_Spectrum re-farming.pdf
6. CamerounCellulaires_affectation_bande_470 694_21Dec18_French.pdf
7. CamerounSolutions_techniquesDTTV_MPT_UHF_21Dec2018_French.pdf
8. China_Beijing_SRMC 9July15_National Spectrum Control.pdf
9. China_Beijing_SRMC 9July15_SRD.pdf
10. China_Chengdu_National Spectrum Control Xihua University.pdf
11. Delft_Univ_Cultural_Factors_Shaping_RF_Spectrum_Governance_24Sept2010_Mazar.pdf
12. European vs North American Wireless Regulations_Mazar_ITU world telecom 2011_2633.pdf
13. Geneva_ITU-RSG1SG5-IoT-Workshop_Mazar_22Nov16.pdf
14. Heron5G_RF_regulations_6June19_Mazar.pdf
15. How_Geography_and_Culture_influence_RF_regulation_NZL_case_Wellington_4Feb2010_Mazar.pdf
16. IMT_5G_frequencies_HERON_ATDI_Mazar.pdf
17. ITUD_Gambia_Optimised_Ways_to_Transmit_the_Video_Signals_16July2010_Mazar.pdf
18. ITUD_Gambia_Policies_and_Strategies_to_Optimise_RF_Spectrum_Use_14July2010_Mazar.pdf
19. ITU_regional_SM_conference_connecting_Yerevan13Dec2017.pdf

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Relevant Material from Dr. Haim Mazar presentations (2); see http://mazar.atwebpages.com/Downloads

20. ITU_regional_SM_workshop_parameters_Yerevan14Dec2017.pdf
21. ITU_workshop_international_regional_and_national_regulation_of_SRDs_Mazar.pdf
22. International_Regional_National_RF_Regulation_Standardisation_Ruppin_Mazar.pdf
23. International_Regional_National_RF_Spectrum_Management_13Dec2011_Afeka_Tel_Aviv_Academic_College_of_Engineering_Mazar.pdf
24. January 2016_National Spectrum Control_China@SRTC&XHU.pdf
25. January 2016_SRD_Mazar_SNG&SRTC&XHY&GDRTC.pdf
26. Lusaka_ZICTA_Auctioning_Training_30Sept-4Oct19_Mazar.pdf
27. Paper WT11 Technical Symposium TS11 Haim Mazar_A Comparison between European and North American Wireless Regulations.pdf
28. Presentation WT11 Technical Symposium TS11 Haim Mazar_A Comparison between European and North American Wireless Regulations.pdf
29. Regulating_SRD_Israel_MoC_28Jan2019_Mazar.pdf
30. Regulation of SRDs_Mazar_TCBC_Baltimore_15April2015.pdf
31. Regulation_and_Standardization_of_Wireless_Communications_Israel_Europe_America_22Dec09_Ort_Braude_College_Mazar.pdf
32. WarsawEMF2019_Mazar_WRC19_5G_IMT2020_ITU4Dec19.pdf
33. Webinar_International_GoGlobal_Haim_Mazar_UHF_RFID_global_and_regional_ruling_19Feb13.pdf
34. Wireless_Communications_Coexistence_between_Israel_and_Neighbors_Ashdod_17May2010_Mazar.pdf
35. Wireless_Telecommunications_training_program_Nepal_Kathmandu_24_28Nov08_Mazar.pdf
36. ZICTA_CEPT&UK_9Jan17_Mazar.pdf
37. ZambiaZICTA_PricingModel19April2017Mazar.pdf
38. ZambiaZICTA_RF_Audit19Apr2017Mazar.pdf

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