

ITU Regional Workshop
“Practical use of Radio Regulations”
Yerevan, Armenia, 14-15 December 2017

Session 2: Software and databases for terrestrial services

14 December 2017

The essential RF parameters of modern wireless terrestrial applications

Dr. Haim Mazar (Madjar)
ATDI- RF spectrum and licensing
ITU-R Study Group 5 (terrestrial services) vice chairman



ATDI



Presentation outline and structure

1. Introduction
2. 5G technologies requiring new data parameters
3. Specifying current RR Appendix 3 and Rec ITU-R SM.329-12;
AP 4, Annex 1; Preface to BRIFIC
4. Summary and conclusions



ATDI



ITU-R publications specifying relevant databases for terrestrial services

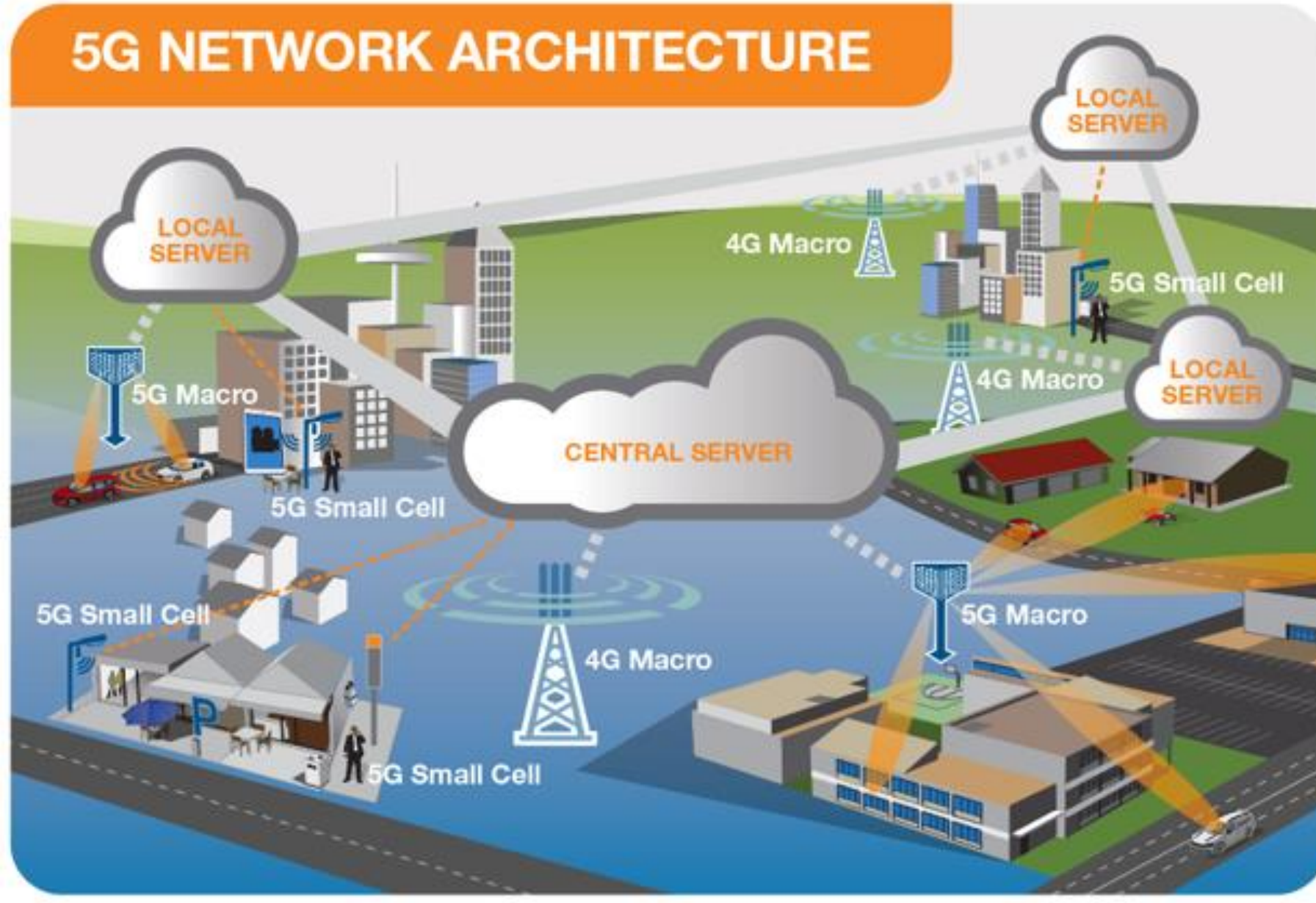
1. Spurious domain (RR Appendix 3 and Rec ITU-R SM.329-12)
2. Power and antenna characteristics (AP 4, Annex 1)
3. Preface to the BR International Frequency Information Circular (BRIFIC)



ATDI



5G NETWORK ARCHITECTURE



Radio Access Network - small cells, towers, masts & dedicated in-building and home systems that connect mobile users and wireless devices to the core network

Core Network - mobile exchange and data network, manages mobile voice, data and internet connections



ATDI

by Mike Wood
Telstra Australia



BASE STATIONS



4G Macro



(>100 elements)

5G Macro
(Massive MIMO)

- Multiple Input, Multiple Output antenna elements
- “Massive” number of send/receive elements (difficult to implement at UE)
- Provide multiple simultaneous connections

4G

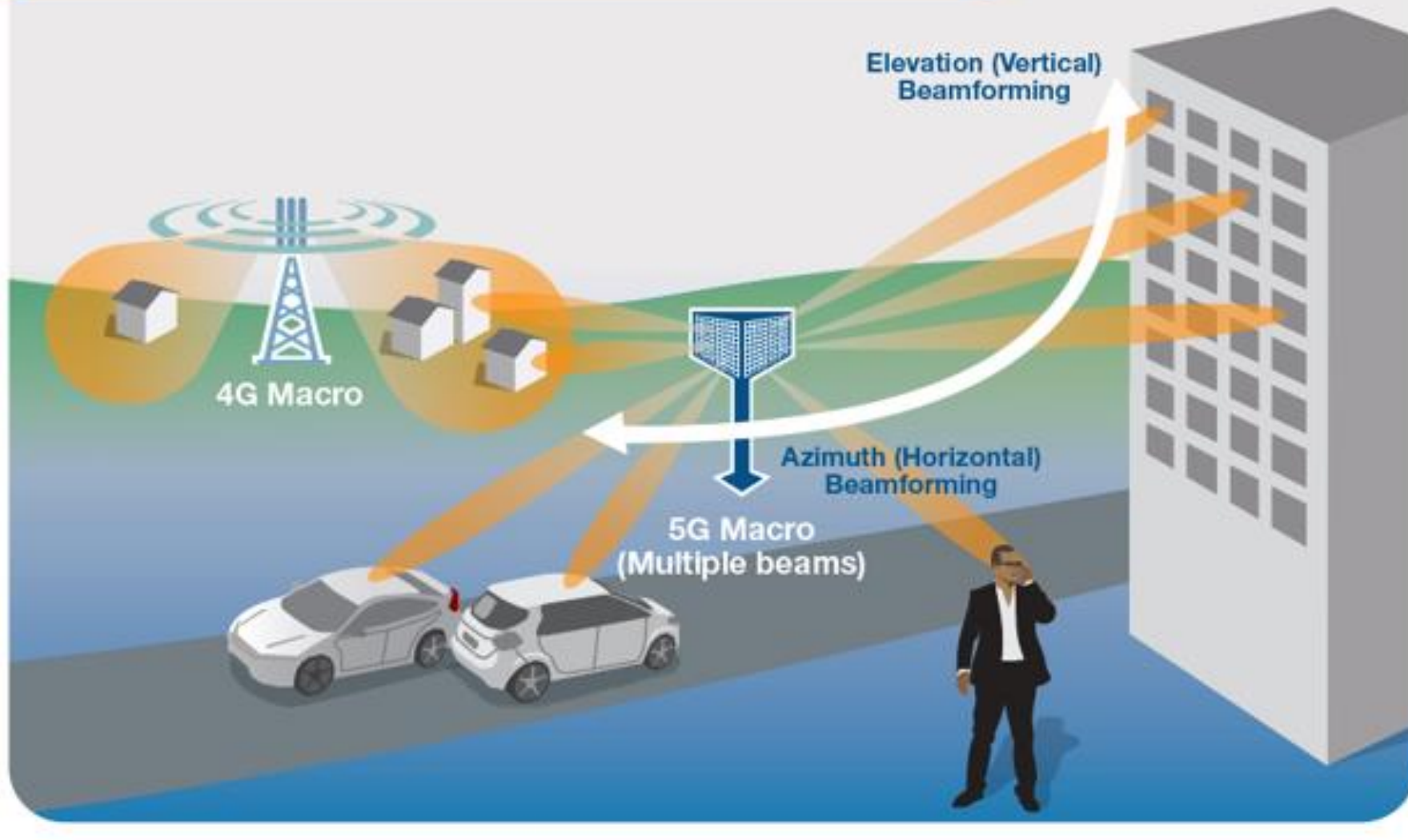
Typically 2-8 antenna ports

5G

Large number of antenna elements (>100)



MIMO BEAMFORMING



- Dedicated radio signal towards the user. 4G signal is typically spread across a wide area
- Enabled by Massive MIMO technology
- Identifies most efficient signal path
- Improves connection reliability
- Reduces interference (unwanted signals)
- Efficient use of spectrum and power
- Allows more simultaneous data streams

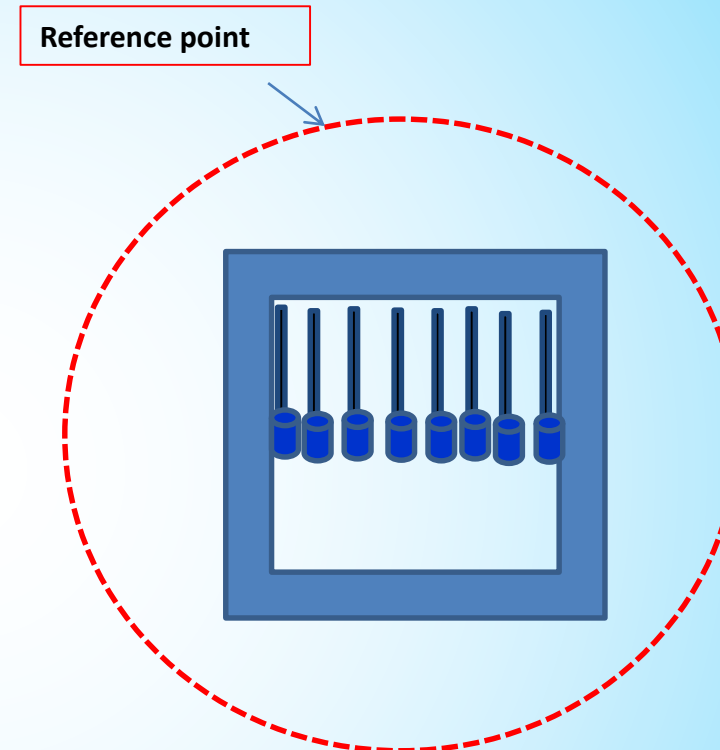
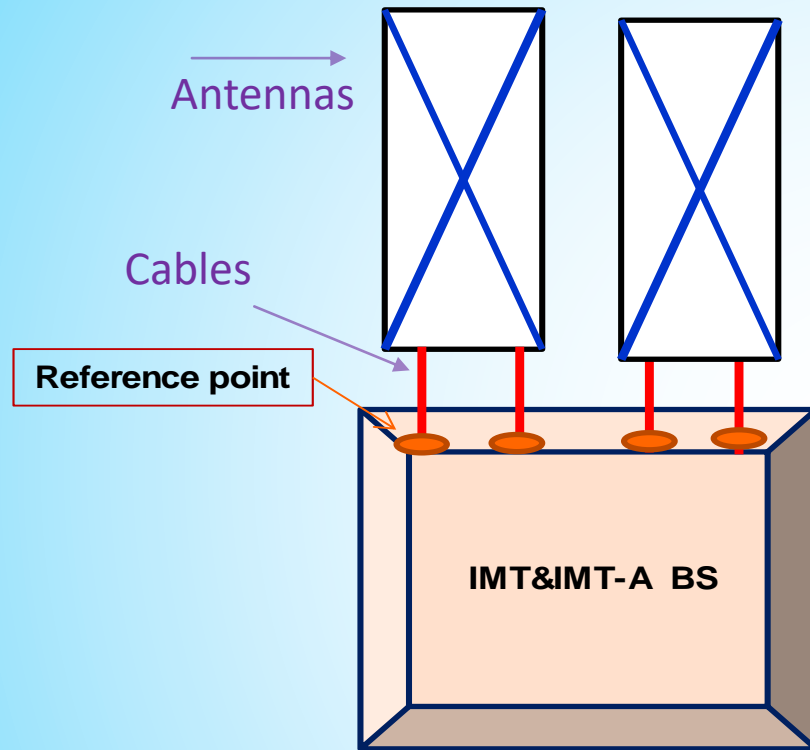


ATDI

by Mike Wood
Telstra Australia



IMT antenna configuration & schematics



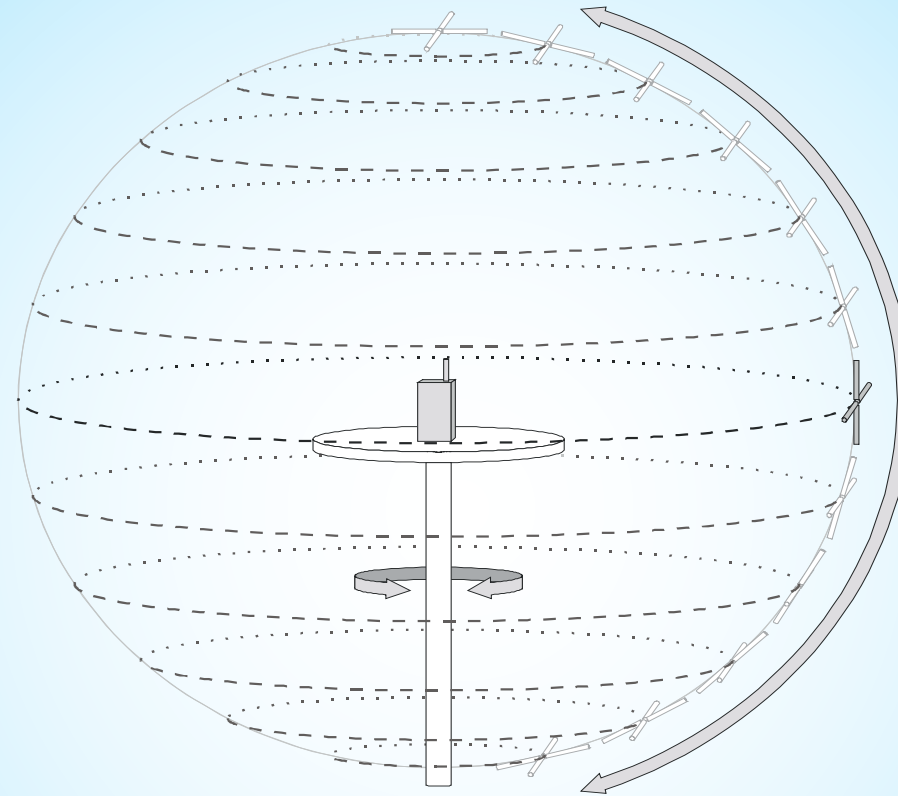
a) IMT-2000 & IMT-Advanced BS antenna structure.
Base station connected to sectoral antennas,
for example, 4 antennas (2 cross-polar antennas).
No conducted power at the antenna connector

b) IMT-2020 base station and user equipment antenna array
configuration envisaged at 24.25-86 GHz
IMT-2020 designed with ant. arrays integrated with the transceiver
inside the BS and UE ant. connectors are no longer exposed



Radiated power measurement

Active Antenna Systems (AAS) may provide also vertical sectorization



unwanted emission mask for an IMT-2020 system utilizing AAS will need to be measured over the air
unwanted emissions will need to be assessed using a radiated measurement, TRP (Total Radiated Power)



ATDI



IMT-2020 includes new parameters improving coverage & capacity

These parameters influence also coordination & unwanted emissions;

see liaison statement WP 5D to WP 1A Document [1A/217](#) 17 October 2017 on unwanted emissions of IMT-2020 systems utilizing active antenna systems & total radiated power

Missing (?) parameters:

1. Active Antenna Systems (AAS), due to massive MIMO and Beamforming
2. Total Radiated Power (TRP), as no conducted power at the antenna connector



ATDI



Appendix 3 (Rev. WRC-12) Maximum permitted power levels for unwanted emissions in the spurious domain

Table I, Attenuation values used to calculate maximum permitted spurious domain emission power levels for use with radio equipment

Service category in accordance with Article 1, or equipment type	Attenuation (dB) below the power supplied to the antenna transmission line
All services except those services quoted below:	$43 + 10 \log (P)$, or 70 dBc, whichever is less stringent

P: mean power in watts supplied to the antenna transmission line, in accordance with No. 1.158.

PEP: peak envelope power in watts supplied to the antenna transmission line, in accordance with No. 1.157.

The solution in AP 3 10 is 'The e.i.r.p. method should be used when it is not possible to accurately measure the power supplied to the antenna transmission line. ... Additionally, the e.i.r.p. method may need some modification for special cases.'



ITU-R SM.329 Table 2 Spurious domain emission limits – Category A

Service category in accordance with RR Article 1, or equipment type)	Attenuation (dB) below the power (W) supplied to the antenna transmission line
All services except those services quoted below	43 + 10 log P, or 70 dBc, whichever is less stringent

Unwanted emissions should be measured, at each antenna connector

The term TRP may miss when 'power **supplied to the antenna transmission line**', doesn't exist

3.2 Method 1 – Measurement of the spurious domain emission power **supplied to the antenna port**

Solution: *Considering* that in dealing with emissions on the centre frequencies, administrations customarily establish the power supplied to the antenna transmission line, and may alternatively or in addition measure the **field strength or pfd at a distance...**, consistent procedure would be helpful in dealing with spurious domain emissions (see Article 15, No. 15.11 of the RR).

And p. 9 note 2: Use the e.i.r.p. method shown in Annex 2, § 3.3, when it is not practical to access the transition between the transmitter and the antenna transmission line.

1.2 **Field strength** is a value that is usually measured on a test site, at a given distance.



Appendix 4 (Rev.WRC-15): consolidated list & tables of characteristics for use in the application of the procedures of Chapter III

Power

- 8.2 8A the power delivered to the antenna transmission line, in kW
- 8.3 8AA the power delivered to the antenna, in dBW
- 8.4 8AB the maximum power density (dB(W/Hz)) ... **supplied to the antenna transmission line**
- 8.6 8B the radiated power, in dBW, in one of the forms described in Nos. 1.161 to 1.163
- 8.7 8BA the range of power control, in dB
- 8.8 8BH the maximum effective radiated power, in dBW, of the horizontally polarized component
- 8.9 8BV the maximum effective radiated power, in dBW, of the vertically polarized component
- 8.10 8BT the maximum effective radiated power, in dBW, in the plane defined by the beam tilt angle

The term TRP may miss when the 'power **supplied to the antenna transmission line**' doesn't exist



ATDI



Appendix 4 (Rev.WRC-15): consolidated list & tables of characteristics for use in the application of the procedures of Chapter III

Antennas

- 9.2 For a directional transmitting or receiving antenna:
 - 9.3 For a transmitting antenna:
 - 9.3.4 9G the max. antenna gain (isotropic, relative to a short vertical antenna or relative to a half-wave dipole)
 - 9.3.6 9S the beam tilt angle, in degrees
- The beam tilt angle is measured from the horizontal plane towards ground and the sign of the angle is negative



ATDI



Preface to the BR International Frequency Information Circular (terrestrial services)

The standard symbols, additional information on the items and explanation of the symbols listed in Appendix 4 (Rev.WRC-15) Annex 1 are found in the Preface to the BR IFIC (Terrestrial Services).

An Index of the notices published in Parts I, II and III as well as those in Parts A, B and C of the Special Sections of the Terrestrial Plans can be viewed in the Circular (DVD-ROM) using TerRaQ software and sorted by fragment, assigned frequency, etc. with other minimum essential details to identify the assignments. This list of index for notification under Article 11 and the complete information in respect of Special Sections are also posted at the following ITU website and distributed on paper to those administrations requesting it: <http://www.itu.int/ITU-R/go/terrestrial-brific>

1. Part A contains particulars of proposed additions and/or changes to the characteristics of recorded assignments;
2. Part B contains particulars of additions and/or changes to the characteristics of recorded assignments on which agreement has been reached and
3. Part C contains particulars of recorded assignments in the Plan which are cancelled



ATDI



Summary and Conclusions

1. New parameters specific to IMT-2020 are introduced
2. Current ITU regulatory situation is detailed
3. Need to define
 1. What is required to improve the power for TRP and antenna parameters for AAS
 2. Need to clarify the measurement procedure for assessing TRP & the AAS
4. May be a need to revise ITU Radio Regulations Appendix 4

U may visit my website <http://mazar.atwebpages.com/>, Dr. Haim Mazar (Madjar)
h.mazar@atdi.com



ATDI



Contents...

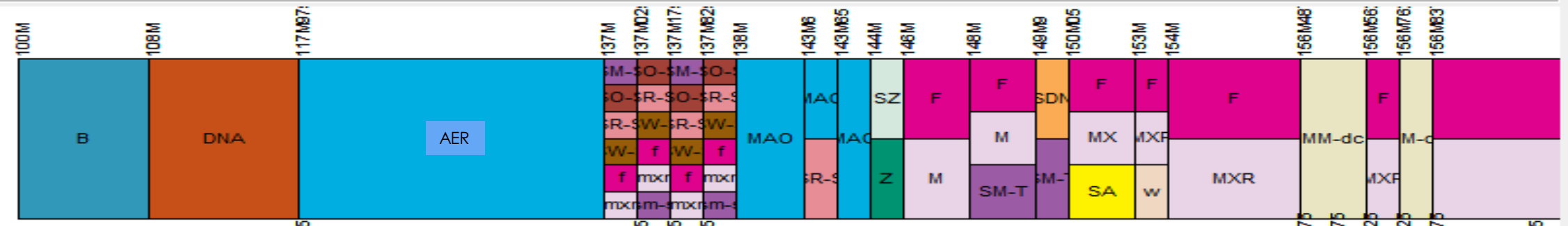
Zoom 0

Refresh

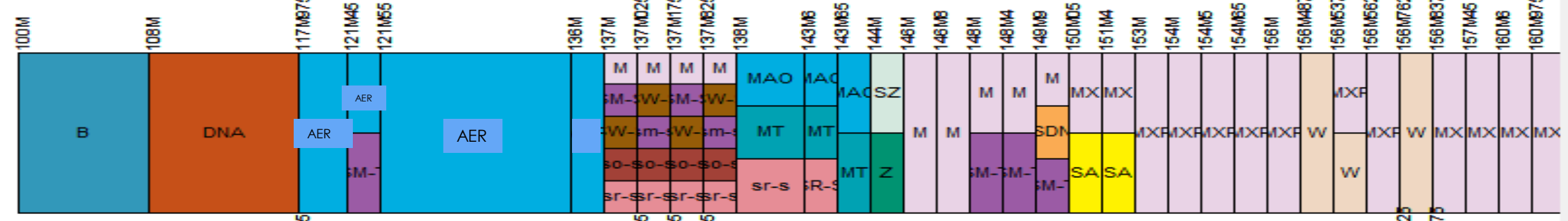
(G=Government exclusive, C=Civilian exclusive, S=Shared)

Quit

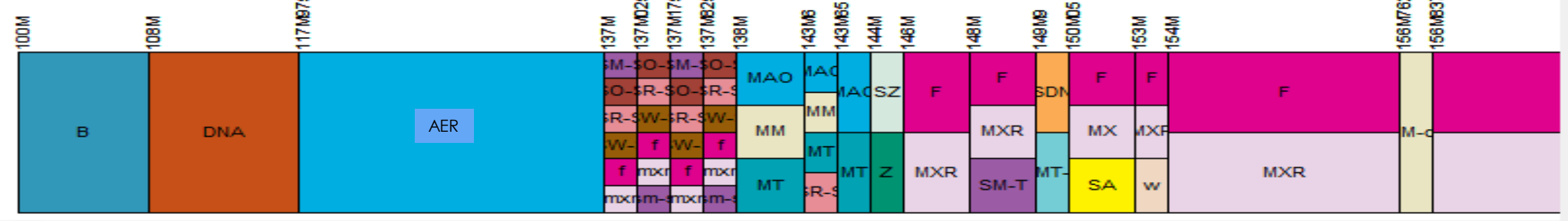
ITU 1



EUR 1



S 1



Selected band
No band selected

Selected service
No service selected

Possible National Allocation Table Swiss web portal <https://www.ofcomnet.ch/#/fatTable>

Workshop
"Radio Regulations"
15 December 2017
Issues for terrestrial services
12 December 2017
wireless terrestrial applications
[Madar]
and learning
[Madar] (Madar)



Nikolay Vassiliev



Haim Mazar

