Radio Navigation Satellite Service

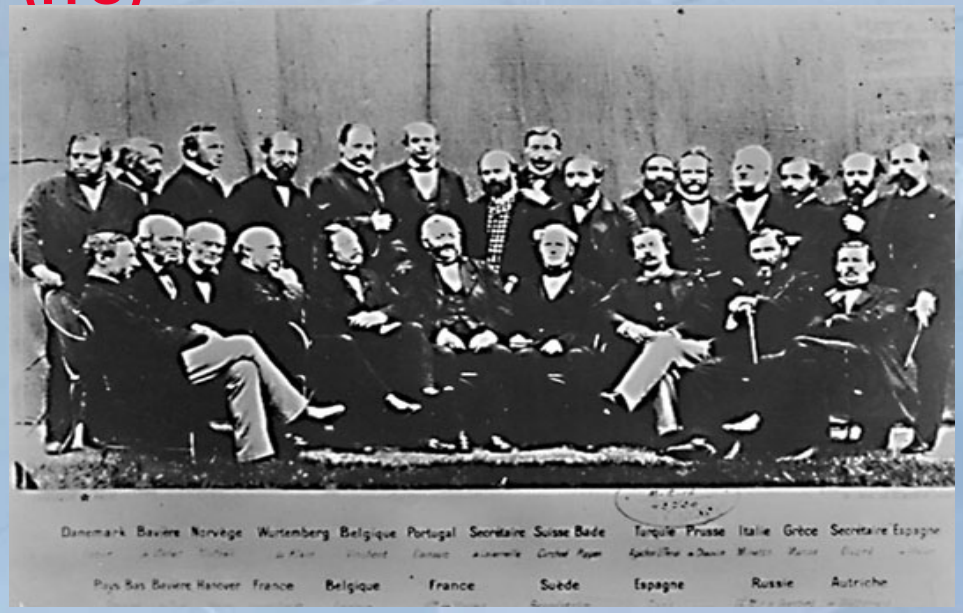
ITU Progress Report 2010

(After the 7th RES-609 meeting)

Attila MATAS, ITU-BR, Space Department

ITU in brief

- ✓ 20 countries founded on 17 May 1865 the **International Telegraph Union (ITU)**



- ✓ Today : **192** Member States
  > 700 Sector Members & Associates
- ✓ 750 staff / 71 nationalities
- ✓ Annual budget = 140 mil. USD

- ✓ http://www.itu.int

ITU is the leading UN agency for information and communication technologies

ITU Key priorities

- **radio spectrum**

  (stewardship of the radio spectrum through global treaties)

- **international standards**

  (adopting international standards to ensure seamless global communications and interoperability)

- **emergency communications**

  (to develop early warning systems and provide access to communications during and after natural disasters)

- **climate change monitoring**

  (promoting the use of ICTs to combat climate change)

- **digital divide**

  (bridging the digital divide, through infrastructure projects, capacity building and assisting to Member States in developing an enabling regulatory environment)

- **cybersecurity**

  (to build confidence and security in the use of ICTs)

RNSS and the ITU Radio Regulations

➢ RNSS definition from the ITU Radio Regulations (RR)

- No. **1.43** ***radionavigation-satellite service (RNSS):***
  A radiodetermination-satellite service used for the purpose of *radionavigation*
- No. **1.59** ***safety service:***
  Any radiocommunication service used permanently or temporarily for the safeguarding of human life and property
- No. **1.169** ***harmful interference:***
  Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a *radiocommunication service operating in accordance with the RR*
- No. **5.28 Stations of a secondary service**:
- No. **5.29** *shall not cause harmful interference to stations of primary services to which* frequencies are already assigned or to which frequencies may be assigned at a later date
- No. **5.30** *cannot claim protection from harmful interference from stations of a primary* service to which frequencies are already assigned or may be assigned at a later date

RNSS Allocations

before WRC-2000

RNSS (L2)

1215 MHz – 1260 MHz

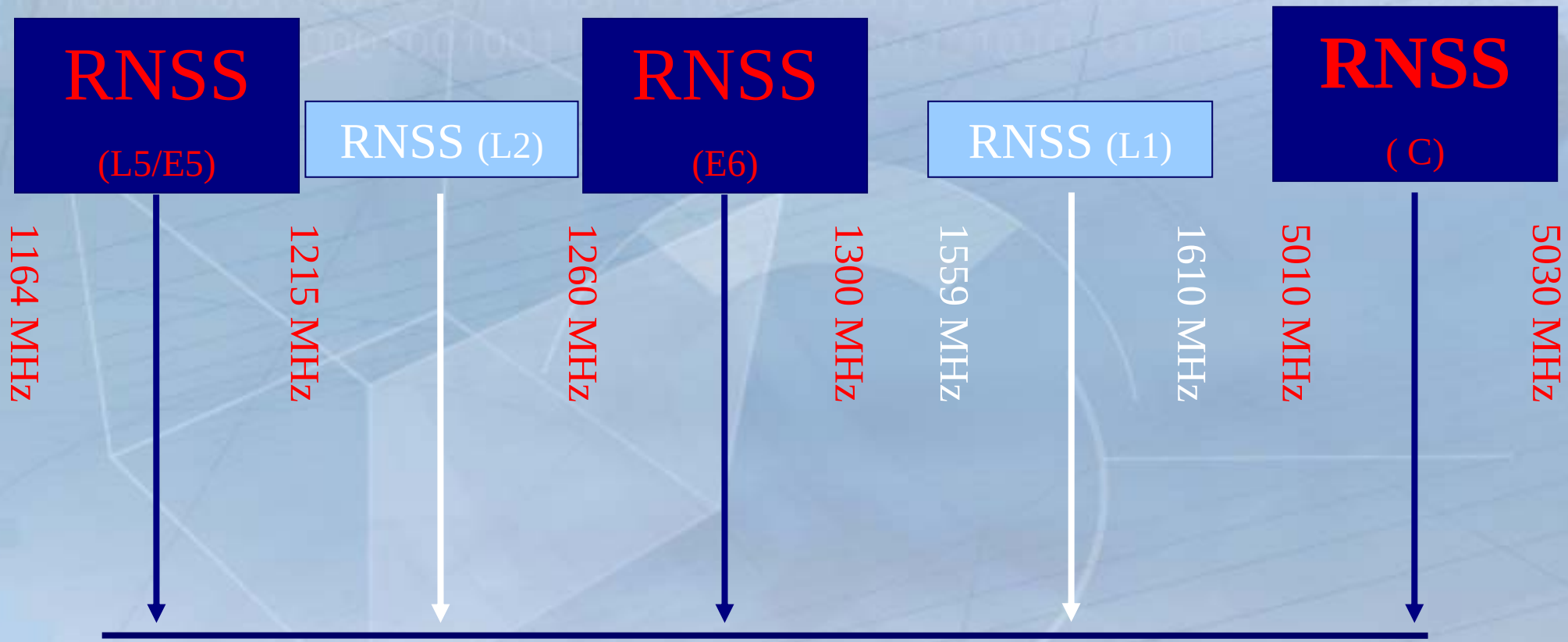
RNSS (L1)

1559 MHz – 1610 MHz

Both bands used by 

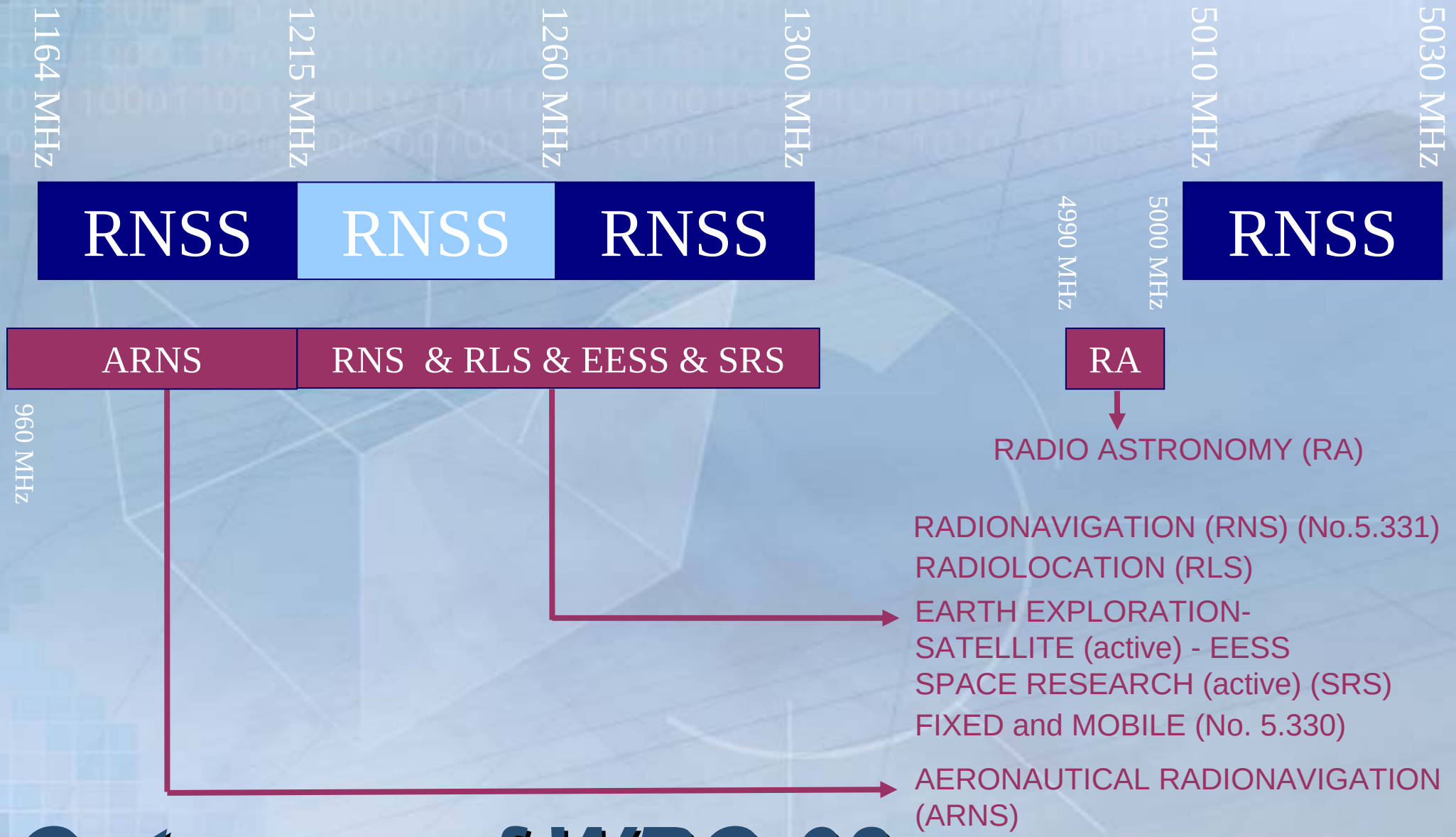
and 

WRC-2000 Added …



New RNSS systems

and ***ENHANCE*** existing RNSS systems
(GPS and GLONASS)



Outcome of WRC-03...

Outcome of WRC-03…

- epfd limit shared by **all** RNSS

  *≤ -121.5 dB(W/m²-1MHz) (No. **5.328A** / RES-609 (r.WRC-07))*

How to share this limit ?

‘Real’ RNSS systems only

*Satisfy **milestone** criteria annexed to*
RES-609 (r.WRC-07)

PFD limit per RNSS space station

≤ -129 dB(W/m²·MHz)
REC-608 (r.WRC-07)

Consultation Meeting

The Bureau participates / observes / publishes results in the BR IFIC

RES 609 Consultation Meeting (1)

- All ADMs operating or planning to operate RNSS systems shall, *in collaboration*, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems, to ensure that the aggregate interference into ARNS systems caused by such RNSS systems operating in these frequency bands is ***shared equitably among the systems and does not exceed*** the **aggregate equivalent power flux-density** (epfd) protection criterion
  ≤ -121.5 dB(W/m^2)in any 1MHz band

RES 609 Consultation Meeting (2)

- **Definition of epfd**

- The definition of equivalent power flux-density (epfd) is based upon RR No. **22.5C.1** and **Rec. ITU-R M.1642**

- ***Method for calculating the maximum aggregate epfd from all RNSS systems***

- Each GSO and non-GSO RNSS system will, having followed the methodology of **Rec. ITU-R M.1642**, provide a consultation meeting with a list of maximum epfd versus latitude (applicable at all longitudes) and a signal spectral shape.
- The determination of aggregate epfd of RNSS systems may be achieved using steps following the methodology of **Rec. ITU-R M.1642**

RES 609 Consultation Meeting (3)

- that all potential RNSS system operators and ADMs are given full visibility of the process
- **no single RNSS system** shall be permitted to use up the entire interference allowance
- ADMs operating or planning to operate RNSS systems will need to **agree cooperatively** to achieve the level of protection for ARNS
- ADMs participating in this process of epfd calculation should hold Consultation meetings on a regular basis
- ADMs participating in the Consultation meeting shall designate one ADM that shall **communicate to the Bureau the results of any aggregate sharing determinations**

RNSS progress

- ***Before 2000*** - ***2*** RNSS systems (NAVSTAR-GPS and GLONASS)
- ***WRC-2000*** created new allocations for the RNSS
- ***2000 – 2003 period*** - ***70*** new satellite filings (51 GSO and 19 N-GSO)
- ***12.2003*** – 1st RES 609 Consultation Meeting – NO epfd calculation
- ***01.2004*** - ITU BR identified **117** satellite filings representing ***66*** RNSS networks (**18** N-GSO and **48** GSO) from ***11*** administrations (CAN, CHN, D, F/ESA, F/GLS, G, I, IND, J, RUS, USA)
- ***06.2004*** - 2nd RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***5*** GSO and ***4*** N-GSO
- ***06.2005*** - 3d RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***14*** GSO and ***6*** N-GSO
- ***09.2006*** - 4th RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***15*** GSO and ***8*** N-GSO
- ***05.2008*** - 5th RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***20*** GSO and ***6*** N-GSO
- ***09.2009*** - 6th RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***18*** GSO and ***6*** N-GSO
- ***06.2010*** - 7th RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***21*** GSO and ***6*** N-GSO
- ***09.2010*** - **204** satellite filings representing ***124*** RNSS networks (22 N-GSO and 102 GSO) from ***18*** administrations (ARG, ARS/ARB, B, CHN, D/GLS, EGY,F,F/GLS,G,I,I/GLS,IND,J,LUX,NIG,RUS,TUR,USA)

7th RES 609 Consultation Meeting ***results*** (1)

- G **INMARSAT-4 25E, -4A 25E, XL1, -4 143.5, -4A 143.5, -4 98W, -4A 98W** (GSO) **(3)**
- CHN **COMPASS-160E, 140E, 110.5E, 80E, 58.7E, -B-84E,-B-144.5E** (GSO)
- IND **INSAT-NAV(34), (55), (82), (83), (132)** (GSO)
- J **MTSAT-C-140E, -145E** (GSO)
- LUX **LUX-G6-2-E** (GSO)
- NIG **NIGCOMSAT 1G, 1R** (GSO)
- USA **LM-RPS-133W, 107.3W** (GSO)
- CHN **COMPASS-M, MG, H** **(2)** (N-GSO)
- J **N-SAT-HEO2** (N-GSO) **(4)**
- RUS **GLONASS-M** (N-GSO)
- USA **NAVSTAR GPS IIRF** (N-GSO) **(5)**
- F/GLS **MSATNAV-2** **(1)** (N-GSO)
- IND **INSAT-NAV-GS** (N-GSO)

1 - The following filings remain available for Galileo and shall be treated with MSATNAV-2 filing as a single planned RNSS system for purposes of performing the epfd calculations - MSATNAV-3 and 4 (F/GLS), GALILEO-NAV-2004 (D/GLS), GALILEO-M-NAVSTAR (I/GLS), and SNS (G))

2 - Compass-M, -MG, and -H represent a single system for purposes of the Res 609 consultation process

3 - INMARSAT filings represent a single network for the purposes of the Res **609** (Rev.WRC-07) consultation process.

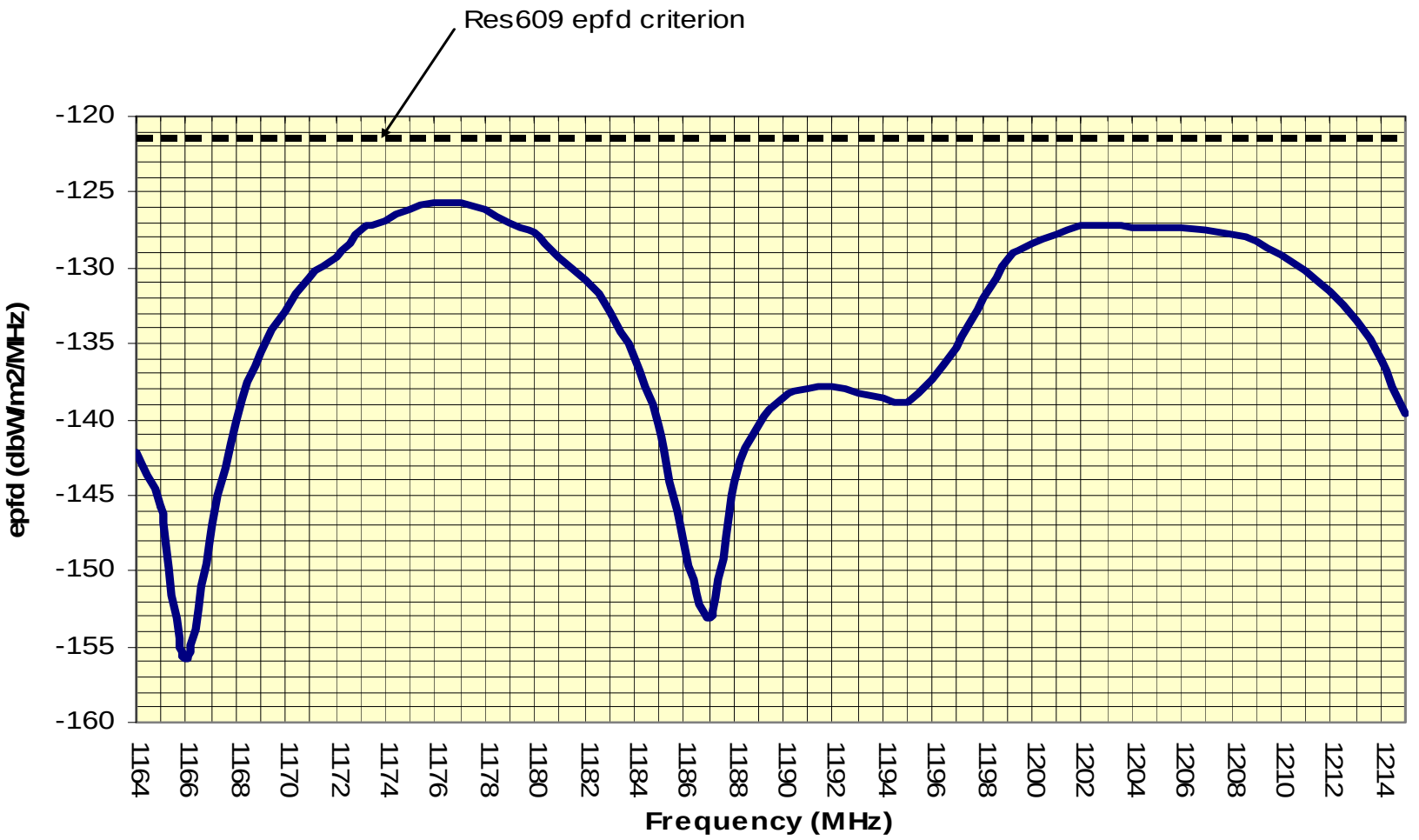
4 - QZSS system shall be treated with the N-SAT-HEO2 as a single planned RNSS system for purposes of performing the epfd calculations.

5 - USRSR system shall be treated with NAVSTAR GPS-IIRF as a single planned RNSS system for purposes of performing the epfd calculations.

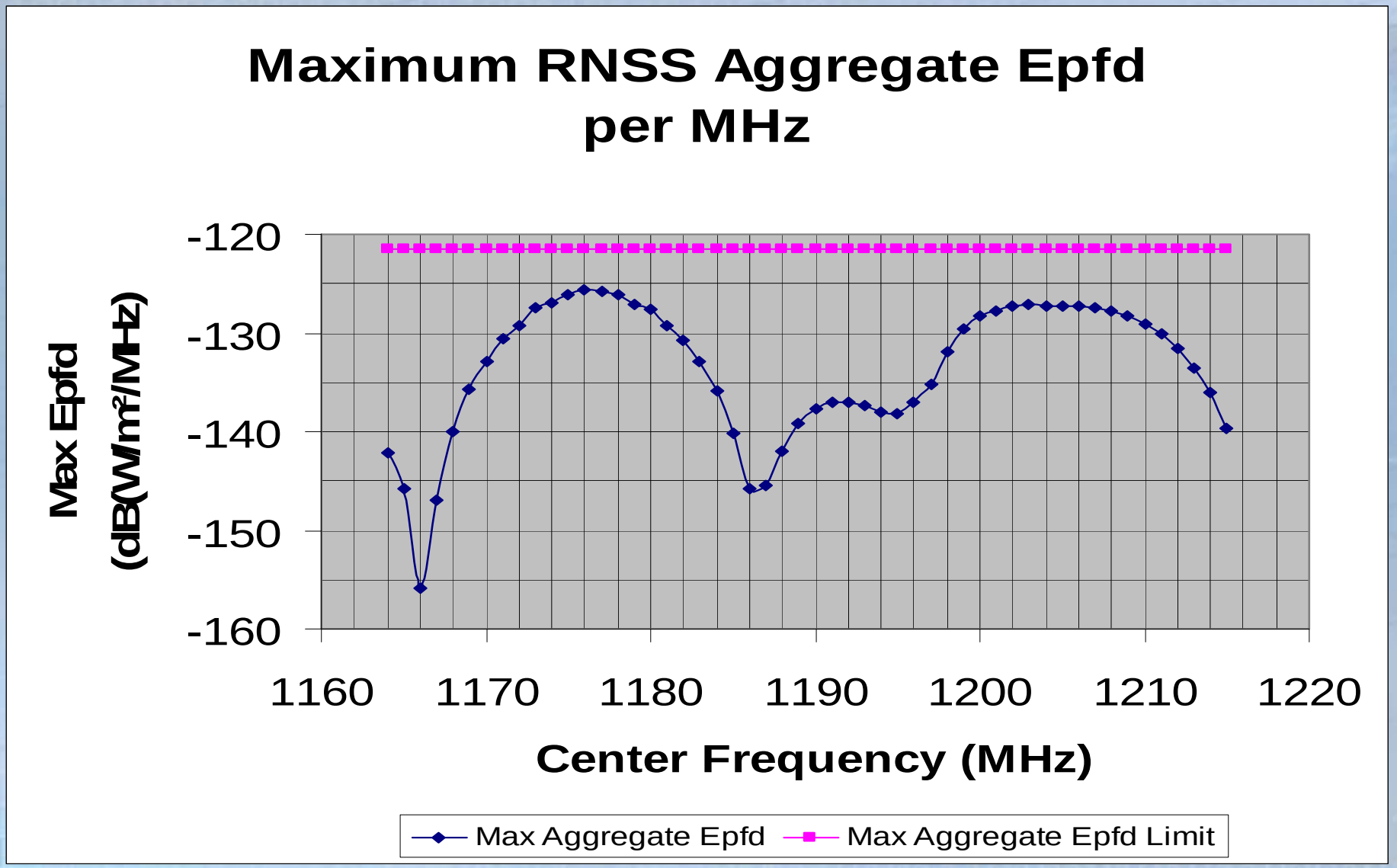
7th RES 609 Consultation Meeting ***results*** (2)

- The maximum epfd of all satellites associated with the referenced RNSS systems (presented on the 7th RES-609 Consultation meeting) was
  –122.58 dB (W/m^2/MHz) i.e. **1.08 dB below** the RES-609 limit of -121.5 dBW/ m^2/MHz
- It is noted that the results are based on the use of worst-case assumptions in terms of interference from RNSS into ARNS

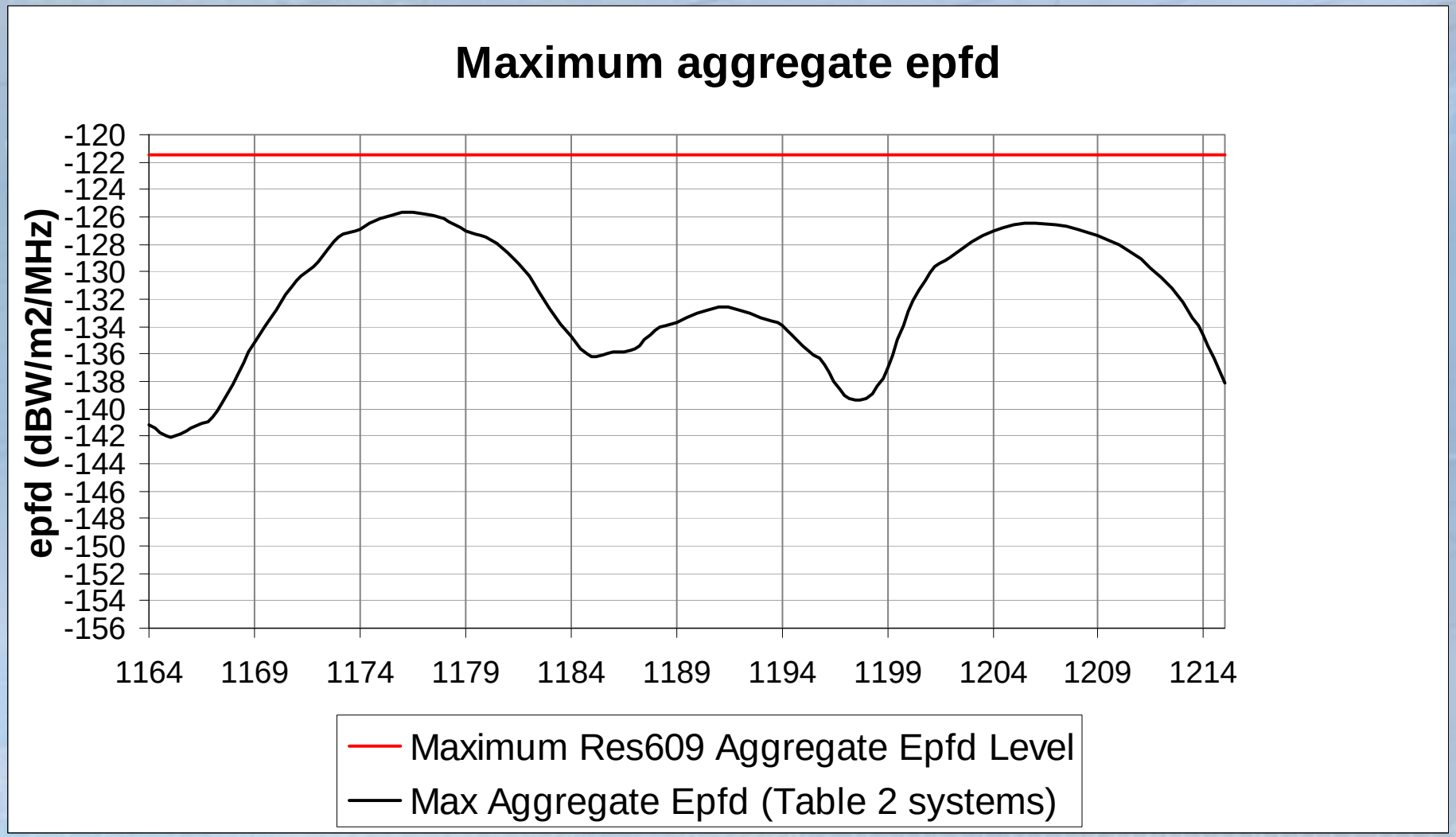
2nd RES 609 Consultation Meeting *results*



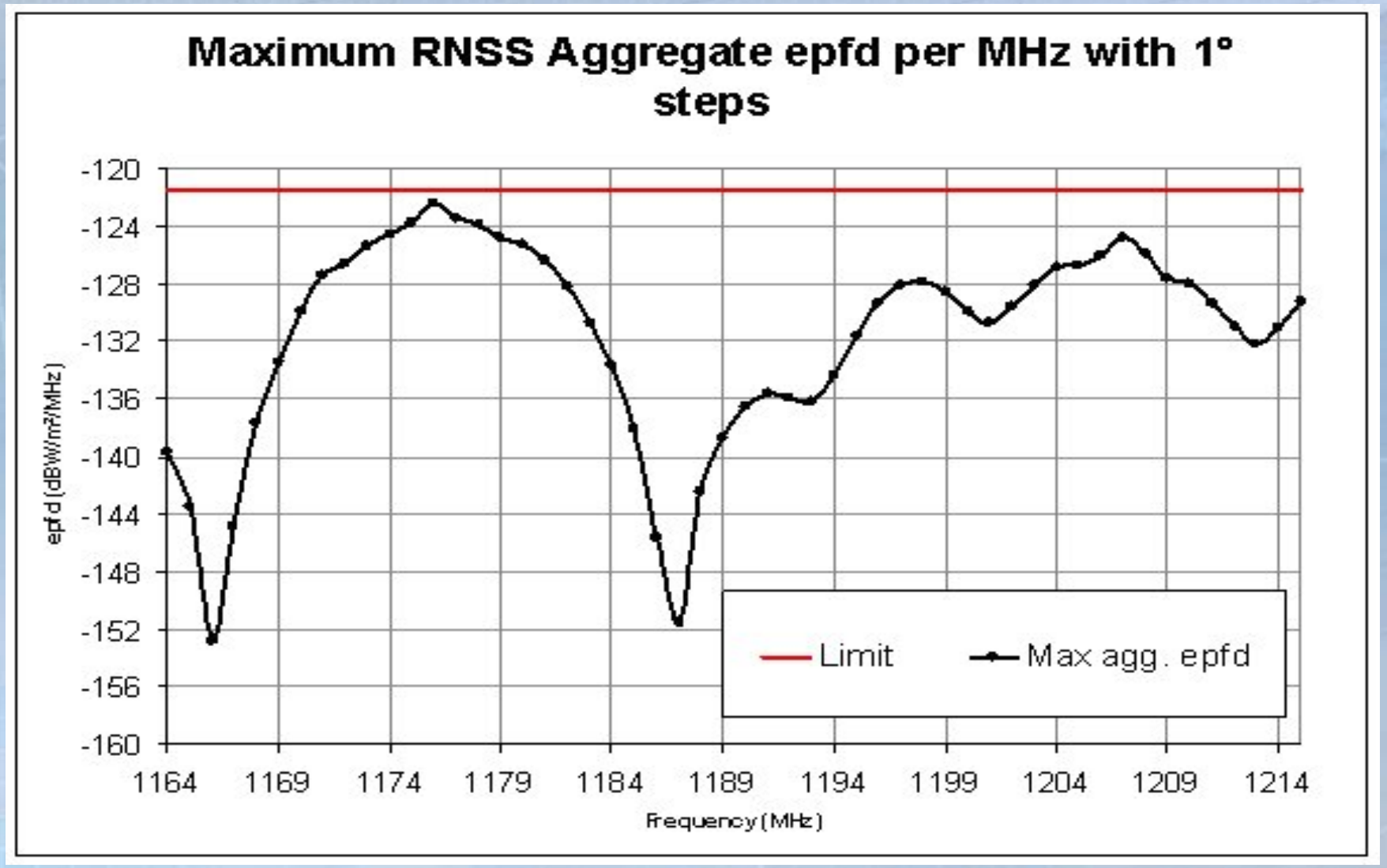
3d RES 609 Consultation Meeting *results*



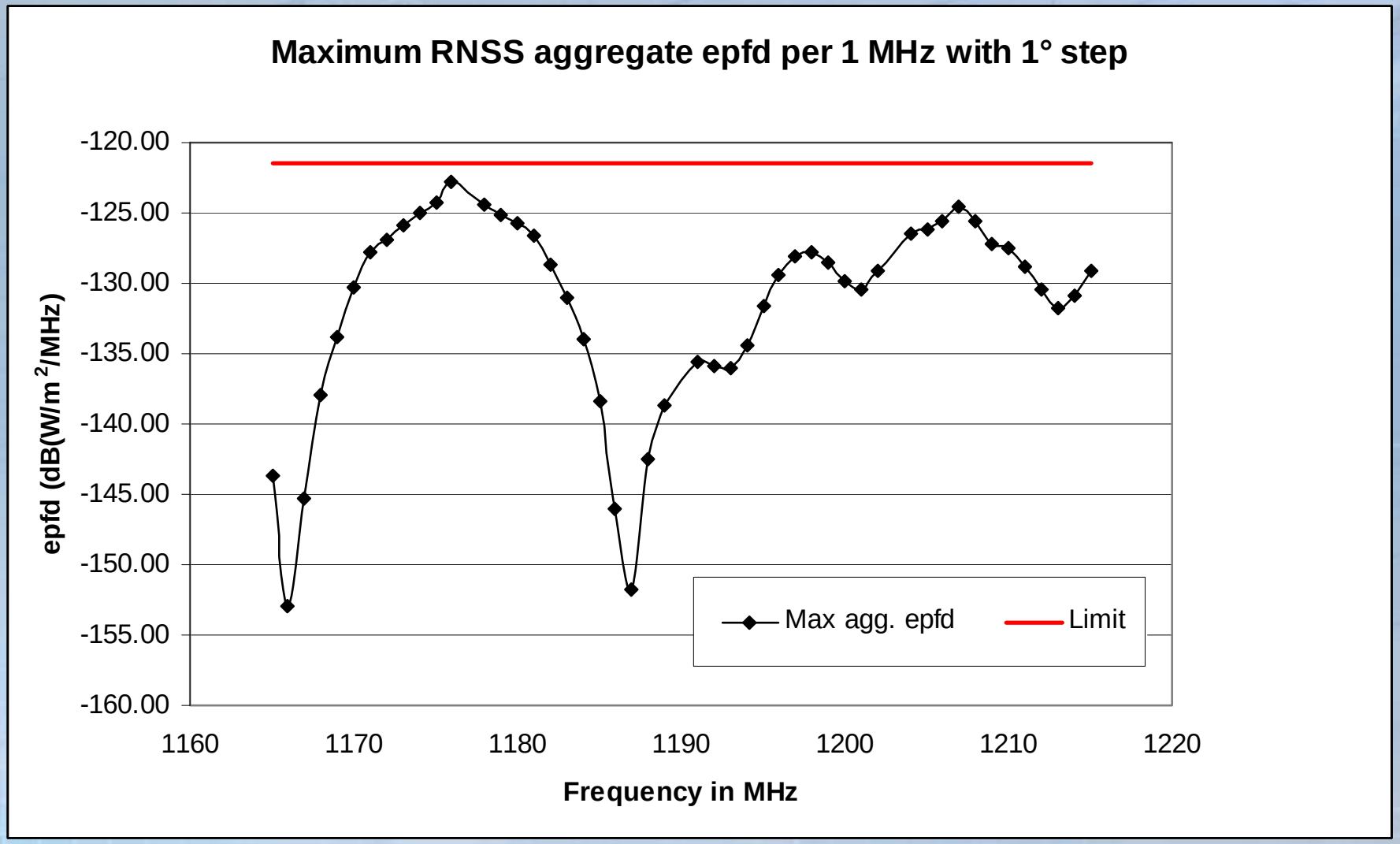
4th RES 609 Consultation Meeting *results*



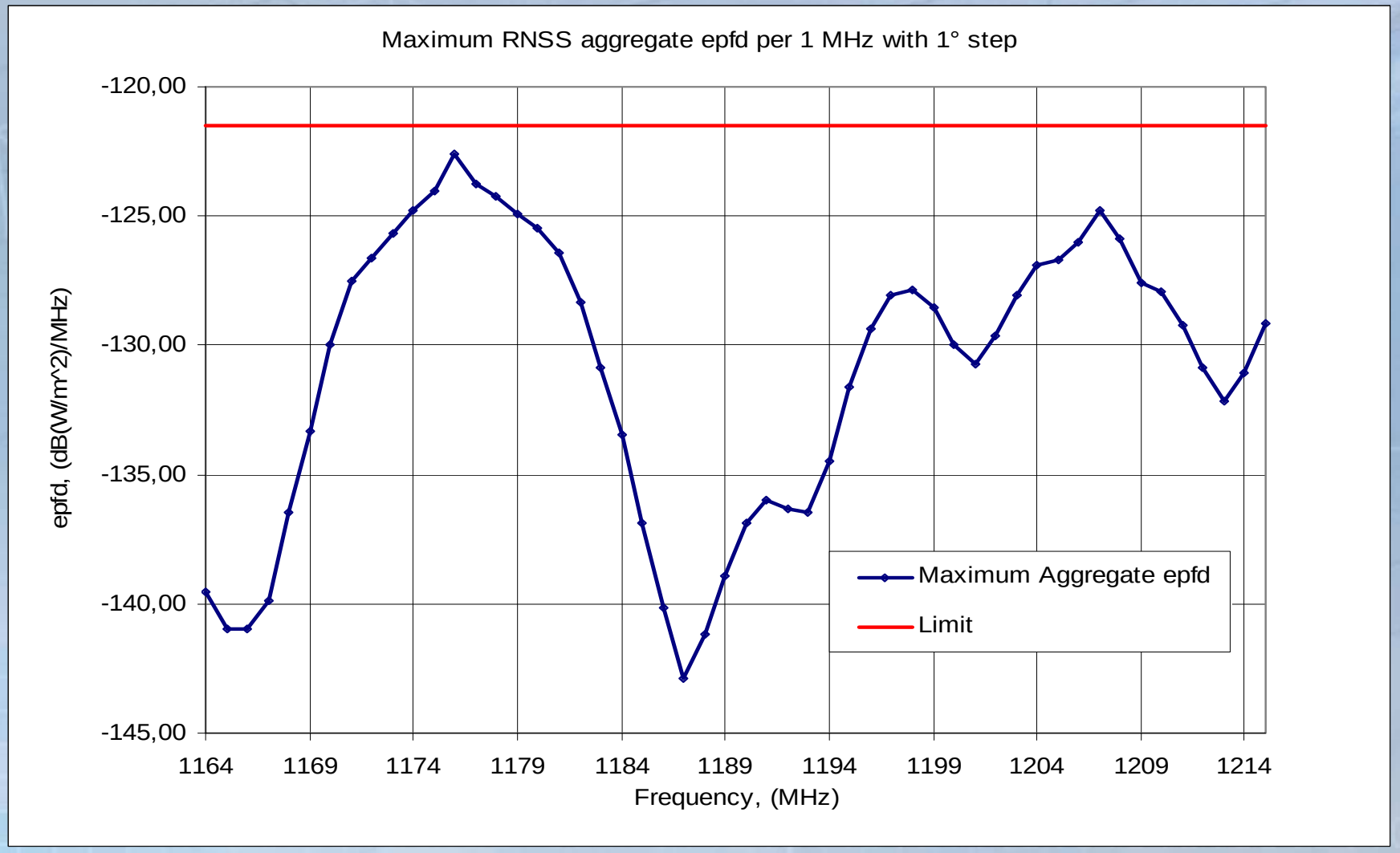
5th RES 609 Consultation Meeting *results*

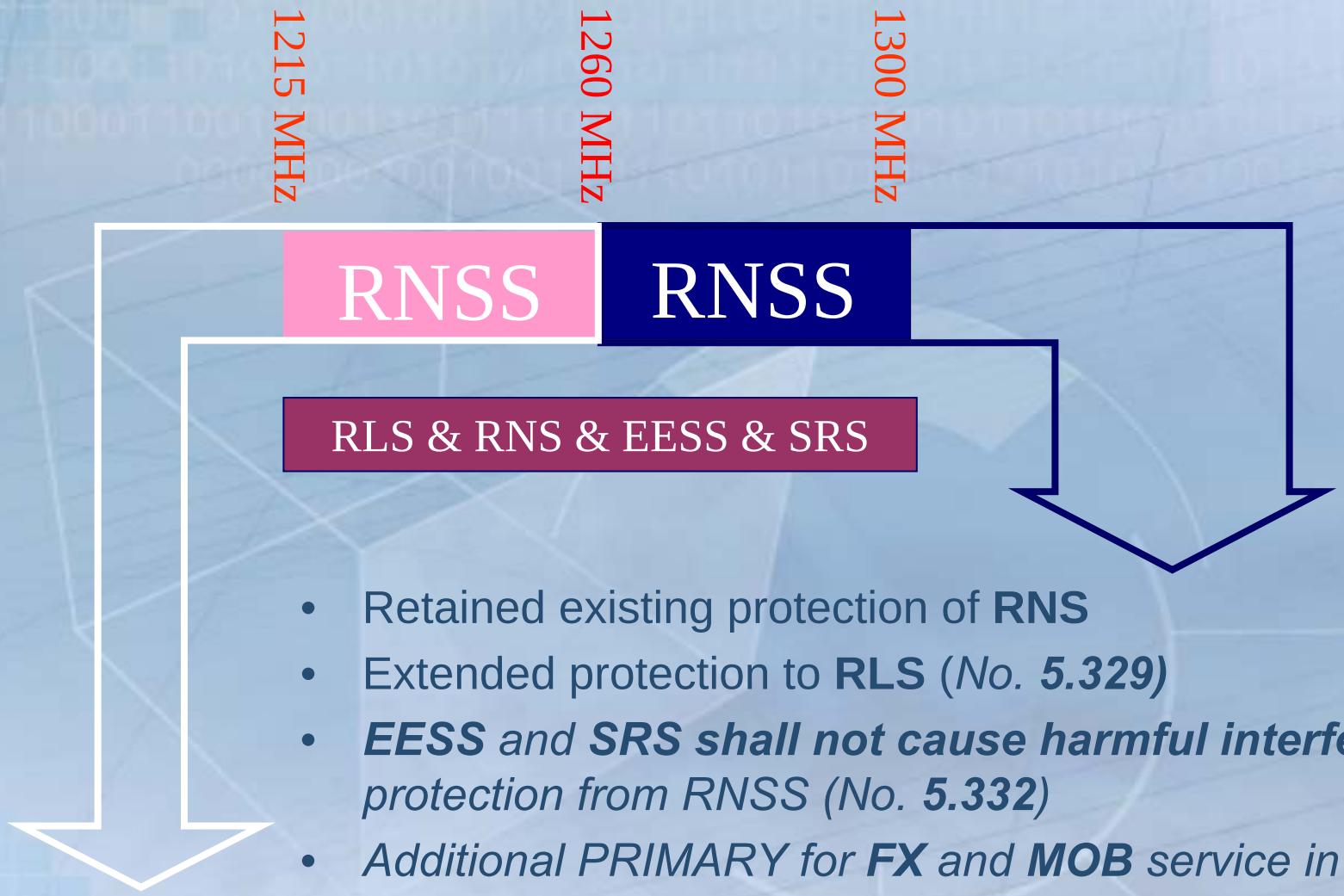


6th RES 609 Consultation Meeting *results*



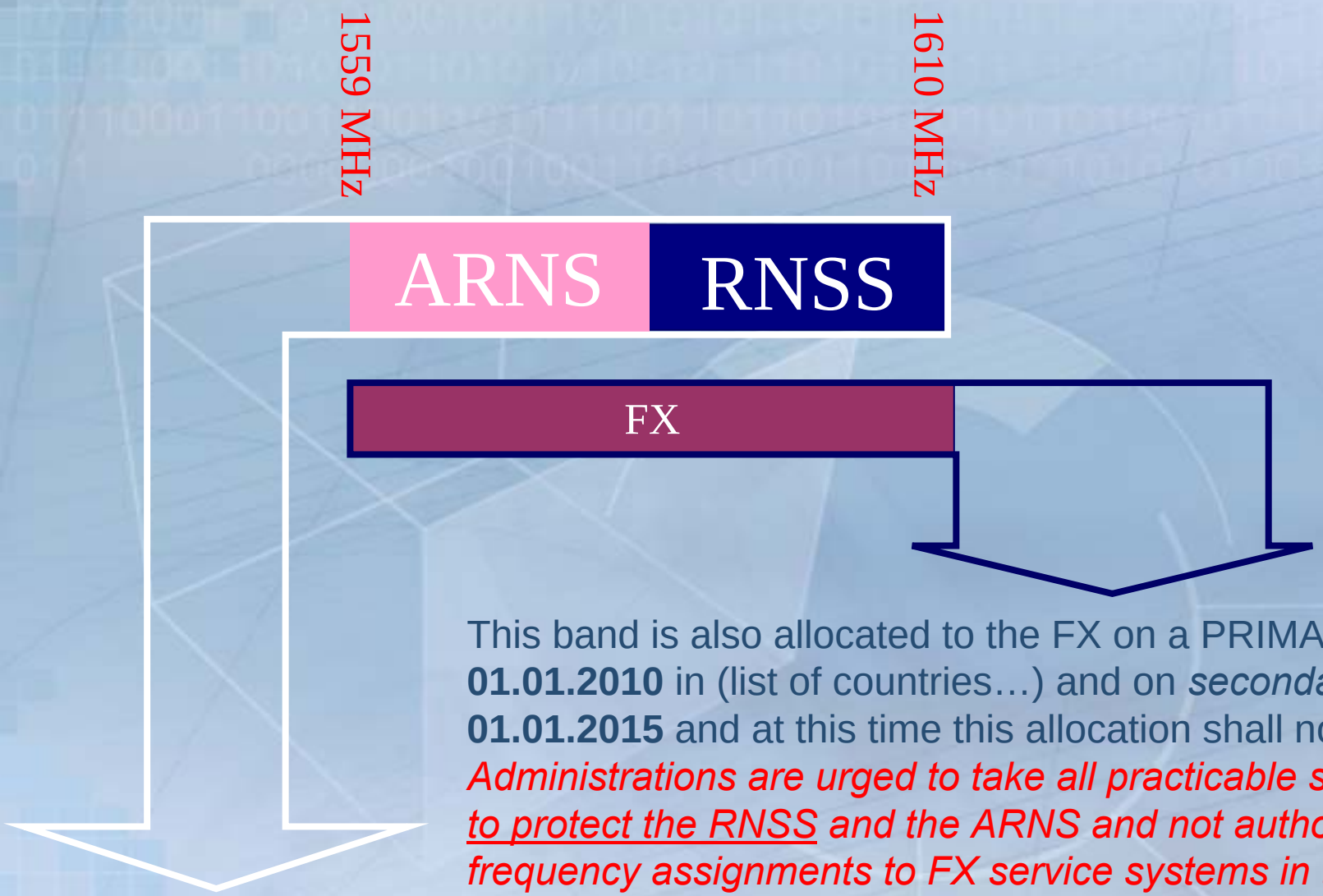
7th RES 609 Consultation Meeting *results*





- Retained existing protection of **RNS**
- Extended protection to **RLS** (*No. **5.329**)*
- ***EESS** and **SRS shall not cause harmful interference** or claim protection from RNSS (No. **5.332**)*
- *Additional PRIMARY for **FX** and **MOB** service in certain countries (No. **5.330**)*

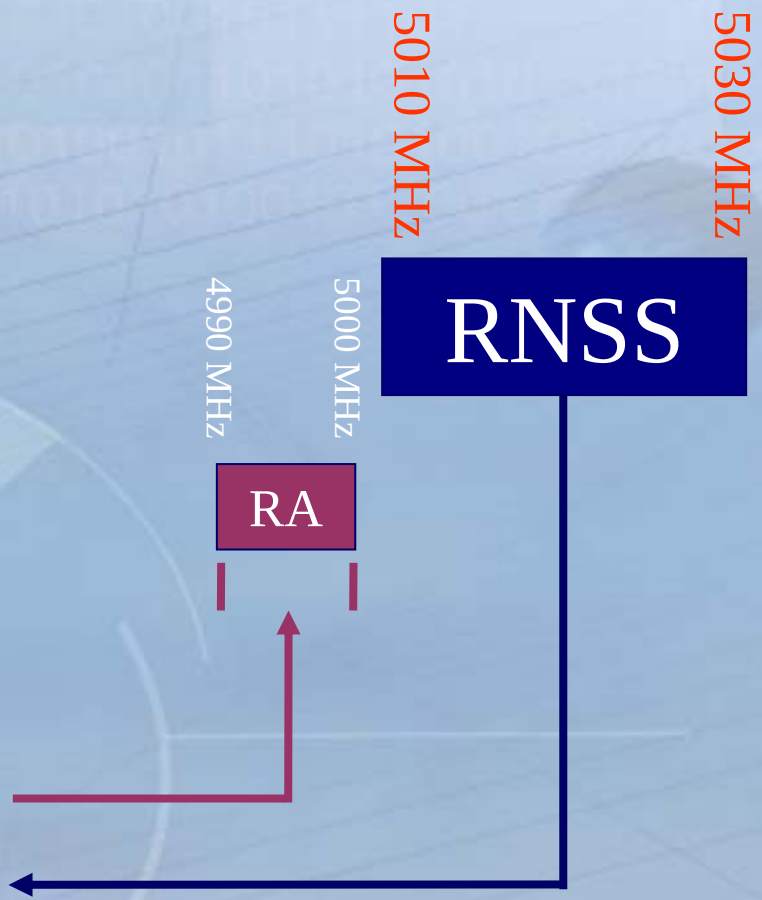
- No additional constraints for RNSS in 1215-1260 MHz, if brought into use prior WRC-2000 *(RES-608 (WRC-03))*



This band is also allocated to the FX on a PRIMARY basis until **01.01.2010** in (list of countries…) and on *secondary* basis until **01.01.2015** and at this time this allocation shall no longer be valid. *Administrations are urged to take all practicable steps to protect the RNSS and the ARNS and not authorize new frequency assignments to FX service systems in this band.* (*Nos.* ***5.362 & 5.362C)***

- **No additional constraints for RNSS & ARNS in 1559-1610 MHz**

PFD limit (GSO RNSS) & EPFD limit (NGSO RNSS)



*PFD ≤ -171 dB(W/m^{2}·10MHz) for **any** GSO RNSS*
*EPFD ≤ -245 dB(W/m^{2}·10MHz) by **all** NGSO RNSS 2% of time, over 5deg elevation; over RA band*

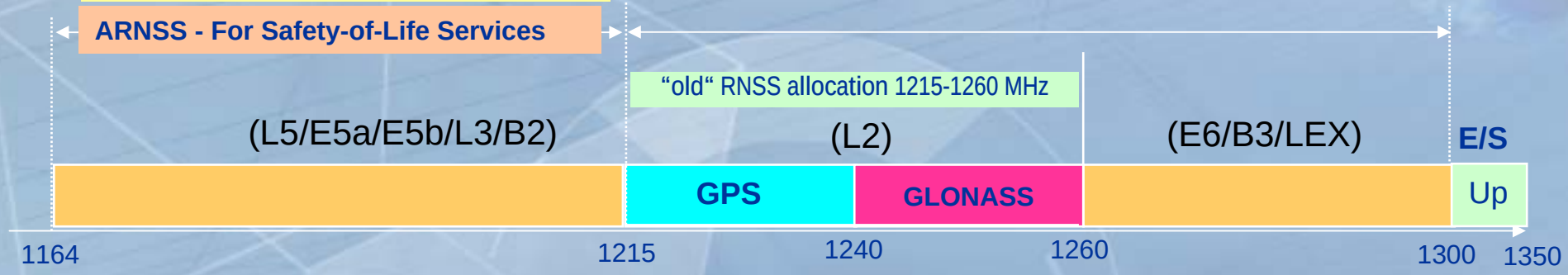
- ***RES-741 (WRC-03)***
- *RR No. **5.443B** also no interference to the MLS*

Frequency Spectrum for the RNSS

Regulatory situation summary

RES-609 (r. WRC-07)
RNSS-ARNS Compatibility
(960)1164 - 1215 MHz

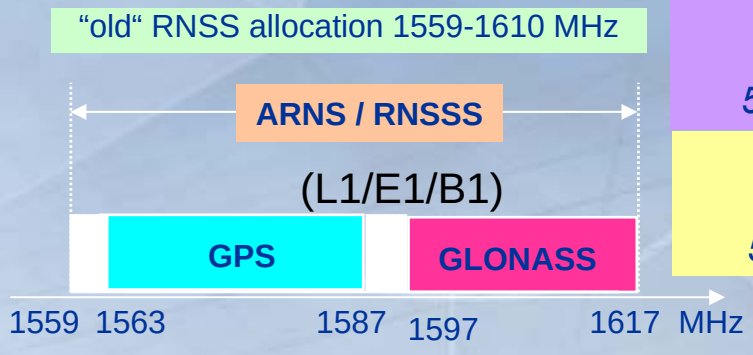
RES-608 (WRC-03)
No constrains on use of "old" RNSS
in the band 1215 – 1260 MHz



ARNSS protection
EPFD -121,5 dBW/m² in 10 MHz for all sats in view

RLS/ EESS/SRS+ (FX+MOB) - *RR Nos.* ***5.329, 5.330 & 5.332***

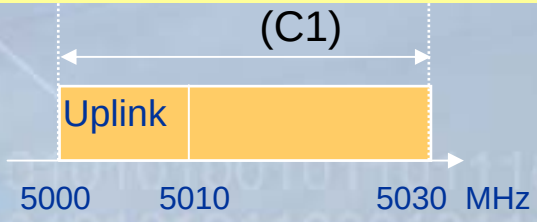
RES-610 (WRC-03)
Coordination and bilateral resolution of technical compatibility issues for RNSS networks



(FX – *secondary until 01.01.2015***)**
RR Nos. ***5.362B & 5.362C***

RR No. ***5.443B***
RNSS-MLS Compatibility
5000-5010MHz => 5030-5150MHz

RES-741 (WRC-03)
RNSS-RAS Compatibility
5010-5030MHz => 4990-5000MHz



RNSS info 1

- The ITU BR is maintaining a special web site and web forum – **RES-609 Consultation meeting**
  - posting of required information from administrations
  - exchange of information
  - posting the results of the epfd calculation from the participants of the RES-609 Consultation meeting
  - Posting the results of all RES-609 Consultation meetings

http://www.itu.int/ITU-R/space/res609/

RNSS info 2

- **WP 4C** is responsible for studies related to all mobile-satellite services including ***RNSS***

  - Studies on the RNSS are very active
  - Sharing and protection criteria have been intensively investigated for existing spectrum allocation for RNSS
  - Studies are also on-going for newly allocated bands for future enhancements and newly planned RNSS systems, addressing frequency sharing with other services
  - These studies contribute not only to the development of ITU-R **M** Series Recommendations but also to WRC-12 preparation
  - *Free online access to current ITU-R Recommendations* is provided on a trial basis to ITU Member States administrations, Sector Members and Associates of all Sectors via **TIES** until further notice

    http://www.itu.int/publ/R-REC/en

RNSS info 3

- There are ***523*** contributions for the WP 4C activities covering the study group period from December 2007 (after WRC-07) up to October 2010

- ***List of most important ITU-R Recommendations related to RNSS (1)***

- **ITU-R M.1088** - Considerations for sharing with systems of other services operating in the bands allocated to the radionavigation-satellite service
- **ITU-R M.1318-1** - Evaluation model for continuous interference from radio sources other than in the radionavigation-satellite service to the radionavigation-satellite service systems and networks operating in the 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz bands
- **ITU-R M.1463-1** - Characteristics of and protection criteria for radars operating in the radiodetermination service in the frequency band 1 215-1 400 MHz
- **ITU-R M.1477** - Technical and performance characteristics of current and planned radionavigation-satellite service and aeronautical radionavigation service receivers to be considered in interference studies in the band 1 559-1 610 MHz

RNSS info 4

- ***List of most important ITU-R Recommendations related to RNSS (2)***

- **ITU-R M.1479** - Technical characteristics and performance requirements of current and planned radionavigation-satellite service receivers to be considered in interference studies in the frequency bands 1 215-1 260 MHz and 1 559-1 610 MHz
- **ITU-R M.1582** - Method for determining coordination distances, in the 5 GHz band, between the international standard microwave landing system stations operating in the aeronautical radionavigation service and stations of the radionavigation-satellite service
- **ITU-R M.1642-2** - Methodology for assessing the maximum aggregate epfd at an aeronautical radionavigation service station from all radionavigation-satellite service systems operating in the 1 165-1 215 MHz band
- ***ITU-R M.1787*** *- Description of systems and networks in the radionavigation-satellite service and technical characteristics of transmitting space stations operating in the bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz*
- ***ITU-R M.1831*** - A coordination methodology for RNSS inter-system interference estimation

RNSS info 5

- ***List of ITU-R Questions related to RNSS***

- **QUESTION ITU-R 217-2/4** - Interference to the radionavigation-satellite service in the ICAO GNSS

- **QUESTION ITU-R 288/4** - Characteristics and operational requirements of radionavigation-satellite service

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Questions ?