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Radio Navigation Satellite Service and the ITU Radio Regulations

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Committed to connecting the world

RNSS and the ITU Radio Regulations (1)

➢ Definitions from the ITU Radio Regulations (RR) - 1

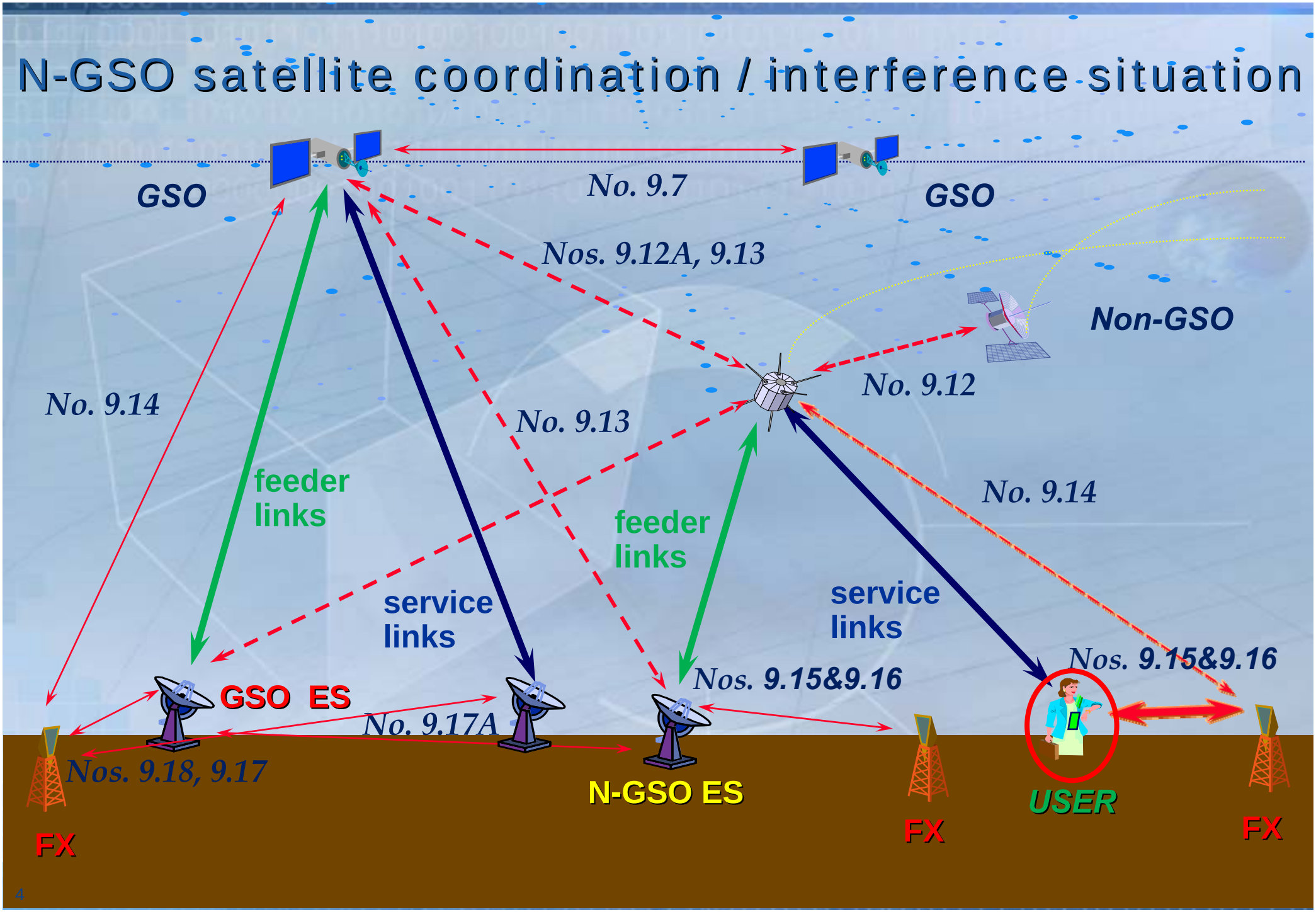
- No. **1.43** ***radionavigation-satellite service (RNSS):***
  A radiodetermination-satellite service used for the purpose of *radionavigation*
- No. **1.59** ***safety service:***
  Any radiocommunication service used for the safeguarding of human life and property
- No. **4.10** Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies.

RNSS and the ITU Radio Regulations (2)

➢ Definitions from the ITU Radio Regulations (RR) - 2

- No **1.166** *interference:* The effect of unwanted energy due to one or a combination of *emissions*, *radiations*, or inductions upon reception in a *radiocommunication* system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.
- No **1.167** *permissible interference:* Observed or predicted *interference* which complies with quantitative *interference* and sharing criteria contained in these Regulations or in ITU-R Recommendations or in special agreements as provided for in these Regulations.
- No **1.168** *accepted interference: Interference* at a higher level than that defined as *permissible interference* and which has been agreed upon between two or more administrations without prejudice to other administrations.
- 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 Radio Regulations (CS).
- No **1.170** *protection ratio* (R.F.)*:* The minimum value of the wanted-to-unwanted signal ratio, usually expressed in decibels, at the receiver input, determined under specified conditions such that a specified reception quality of the wanted signal is achieved at the receiver output.

N-GSO satellite coordination / interference situation



RNSS Allocations

before WRC-2000

RNSS (L2)

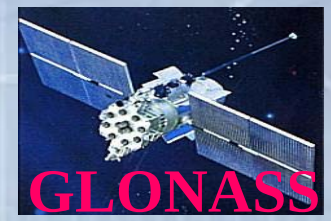
1215 MHz – 1260 MHz

RNSS (L1)

1559 MHz – 1610 MHz

NAVSTAR GPS

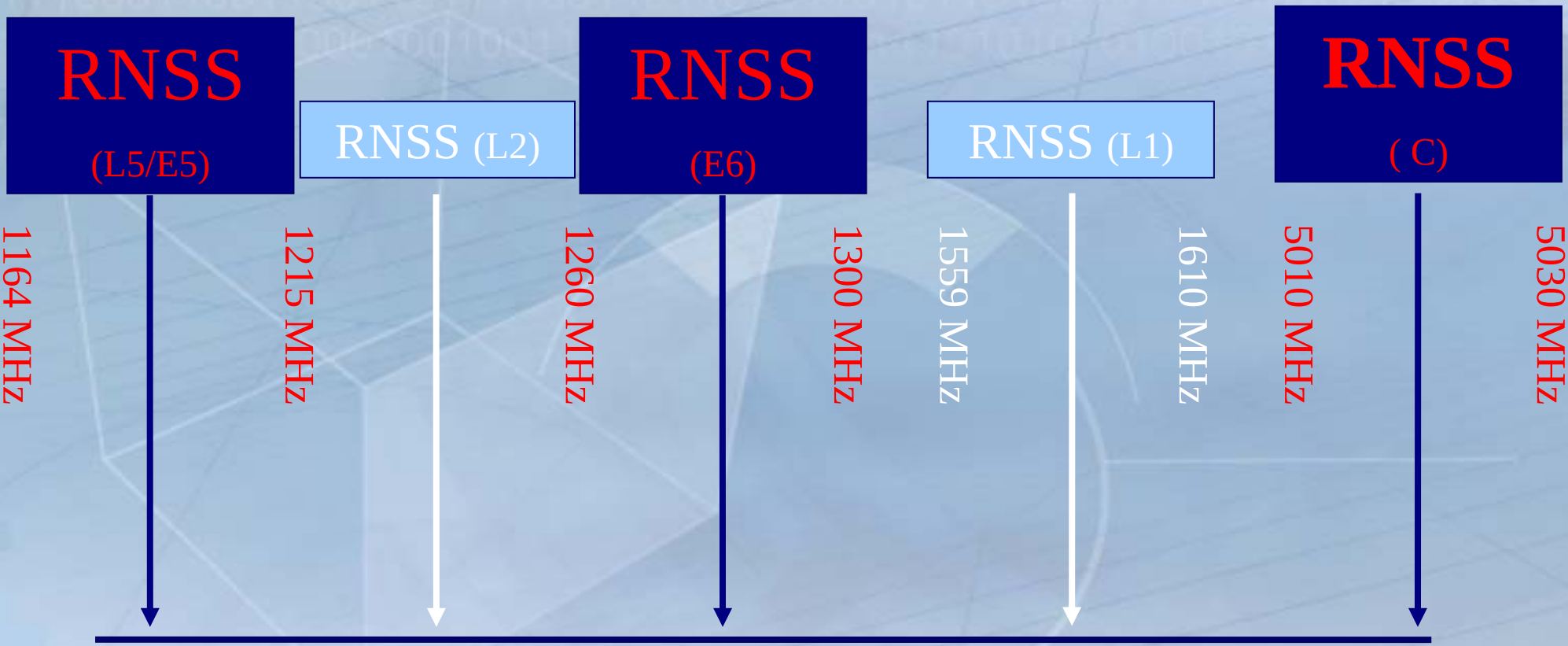
and



GLONASS

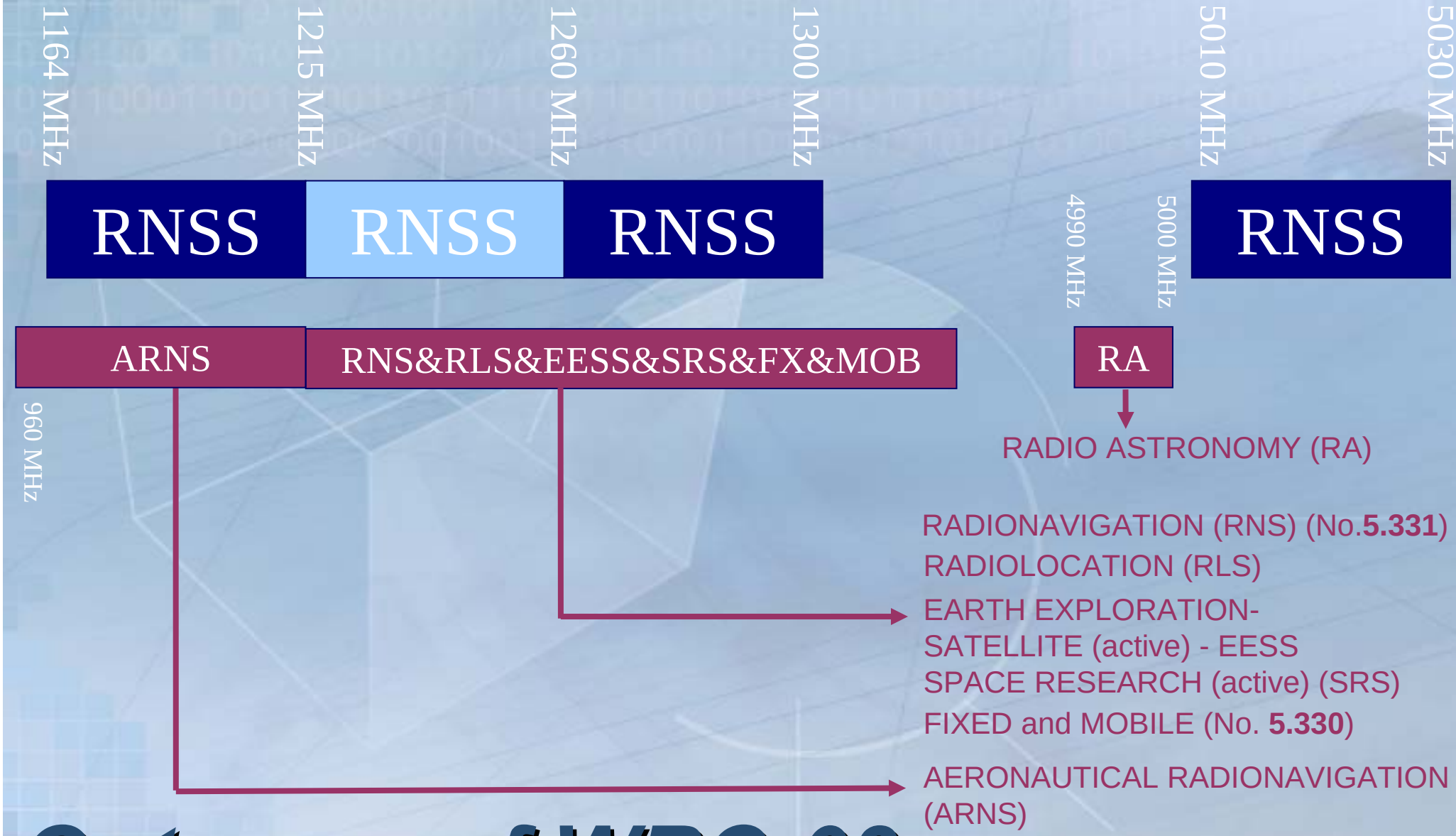
Both bands used by

WRC-2000 Added …



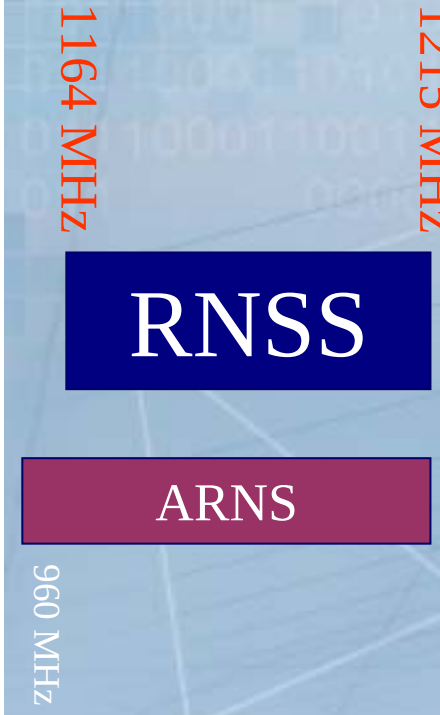
and ***ENHANCE*** existing RNSS systems
(NAVSTAR GPS and GLONASS)

For new RNSS systems



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

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
- ***09.2011*** - 8th RES 609 Consultation Meeting - calculations of the aggregate equivalent PFD (epfd) for ***24*** GSO and ***8*** N-GSO
- ***12.2011*** - **216** satellite filings representing ***130*** RNSS networks (**22 N-GSO** and **108 GSO**) from ***19*** administrations (ARG, ARS/ARB, B, CHN, D/GLS, EGY,F,F/GLS,G,I,I/GLS,IND,J,LUX,NIG,PNG,RUS,TUR,USA)

8th RES 609 Consultation Meeting ***results*** (1)

21-23 September 2011, Geneva, Switzerland

- 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)
- USA **LM-RPS-133W, 107.3W** (GSO)
- CHN **COMPASS-M, MEO, 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, -MEO, 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.

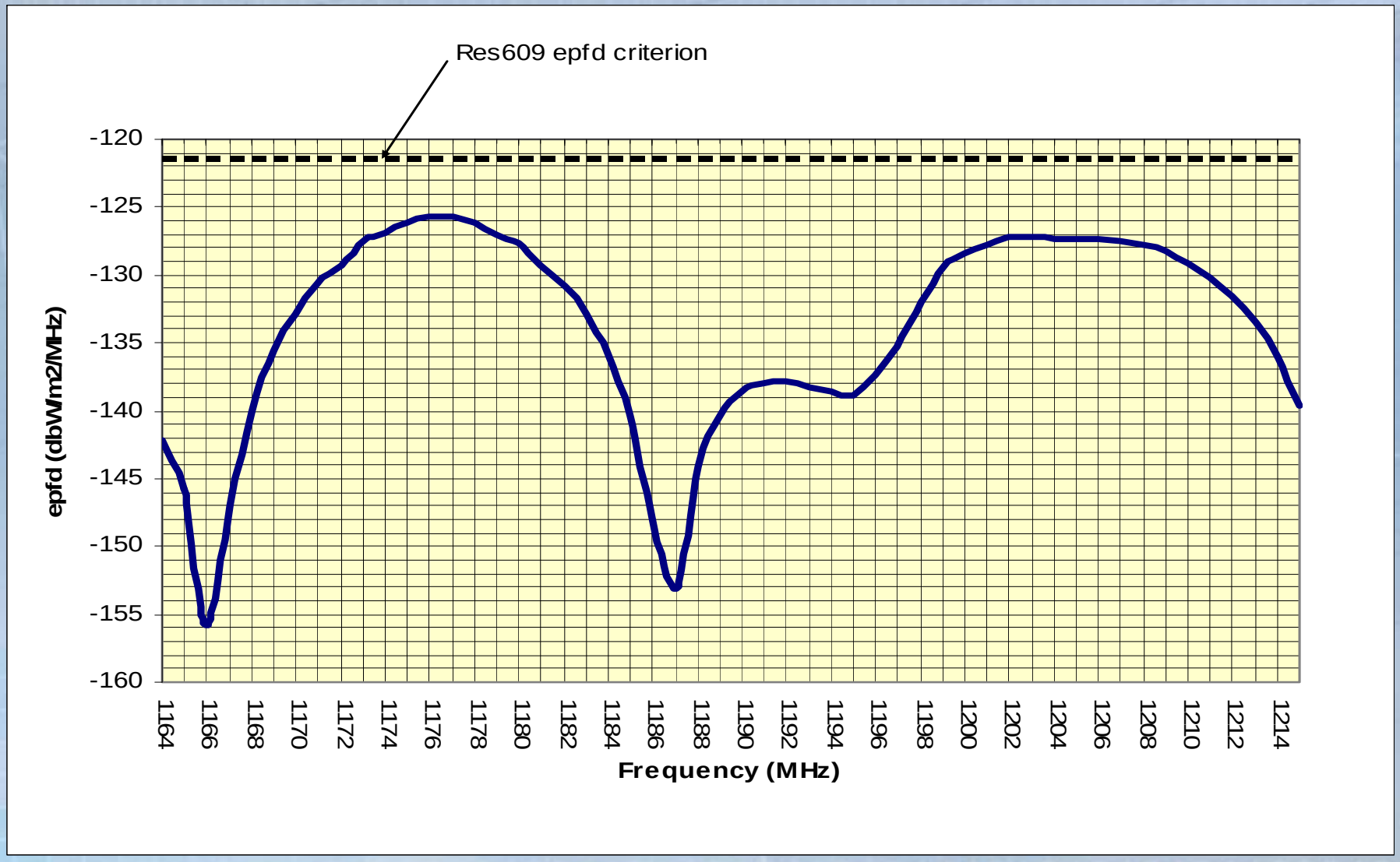
4 - QZSS system shall be treated with the N-SAT-HEO2 as a single planned RNSS system for purposes of performing the epfd calculations.

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

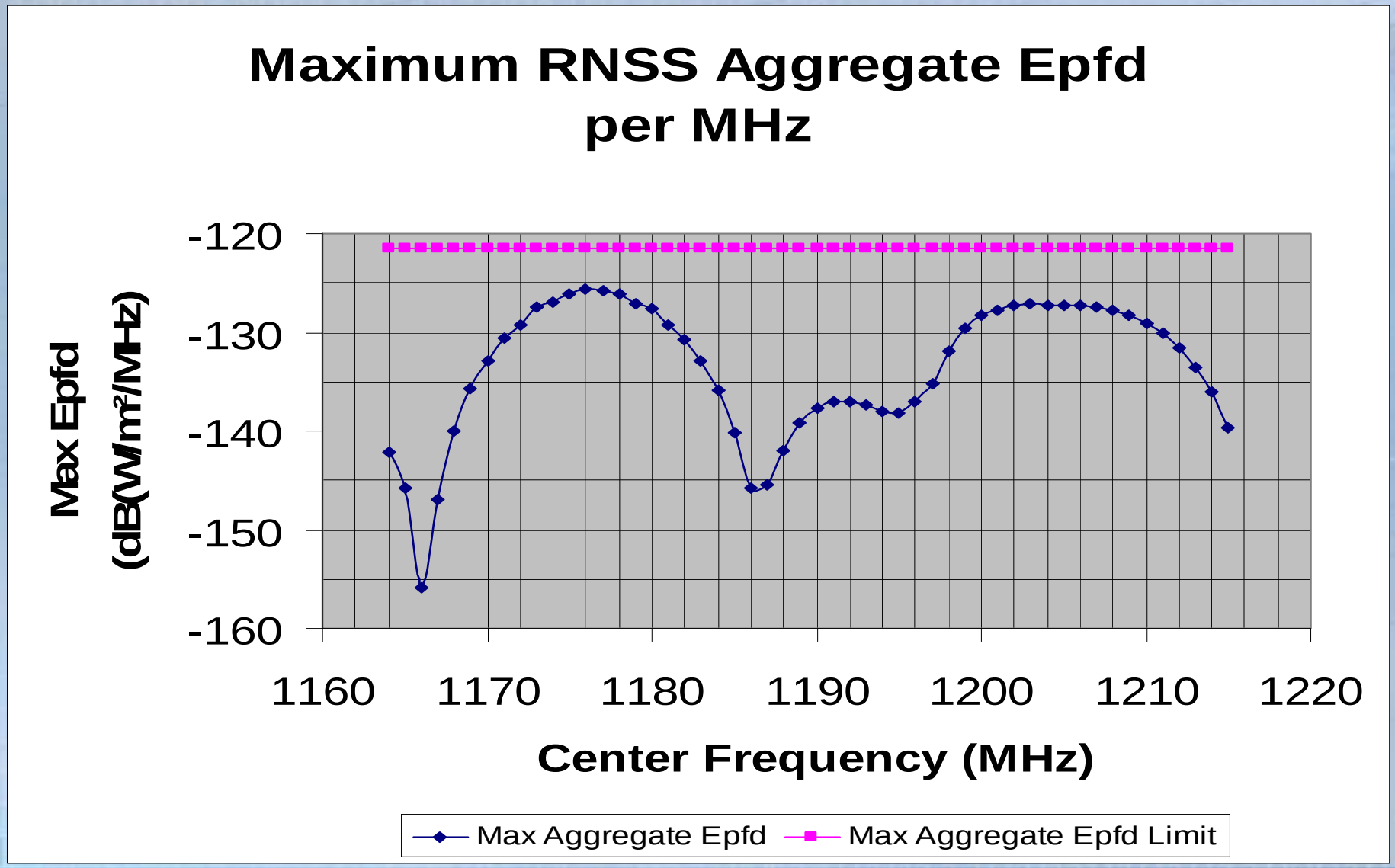
8th RES 609 Consultation Meeting ***results*** (2)

- The maximum epfd of all satellites associated with the referenced RNSS systems (presented on the 7th RES-609 Consultation meeting) was
  –122.64 dB (W/m^2/MHz) i.e. **1.14 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

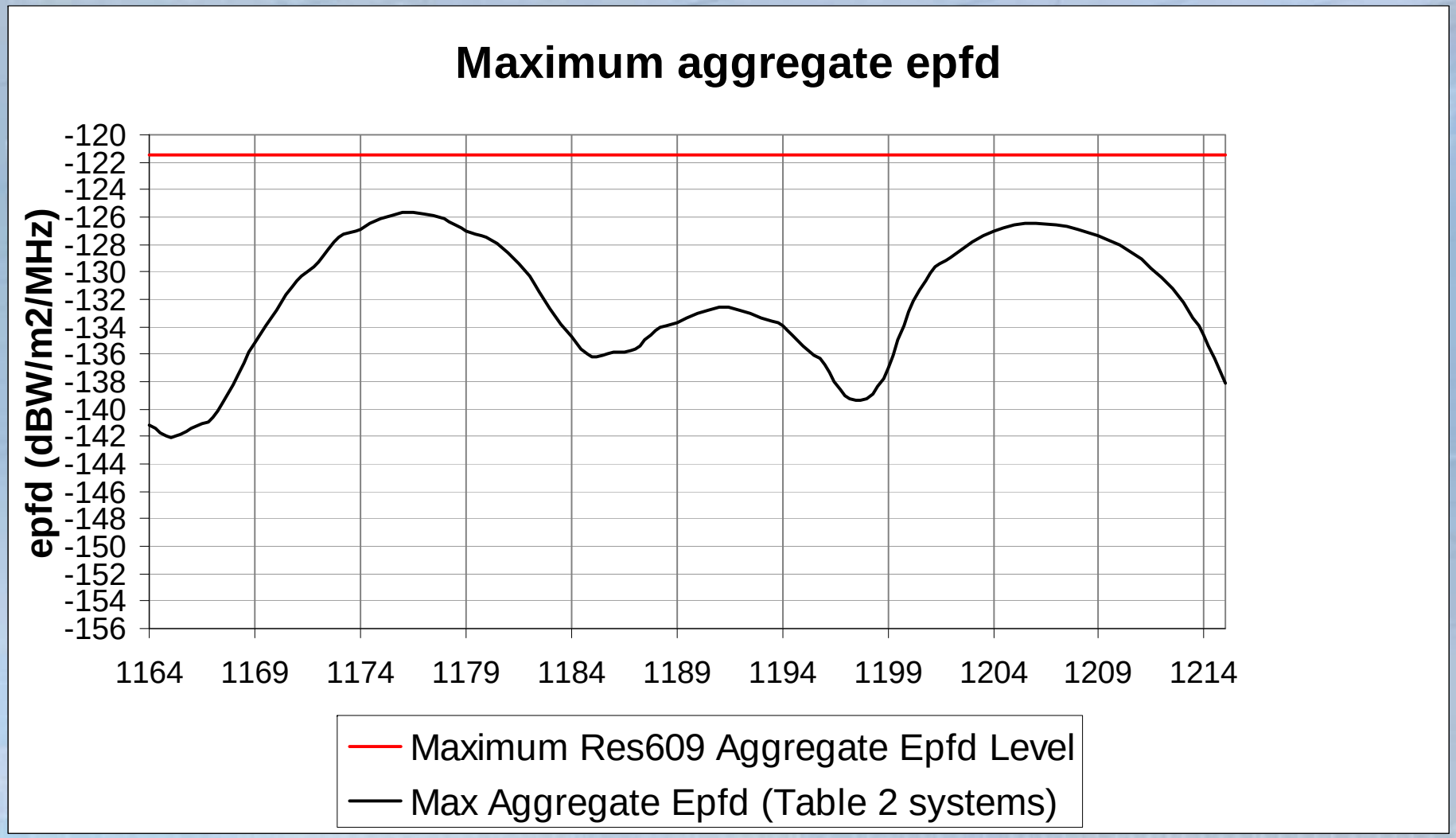
2nd RES 609 Consultation Meeting *results*



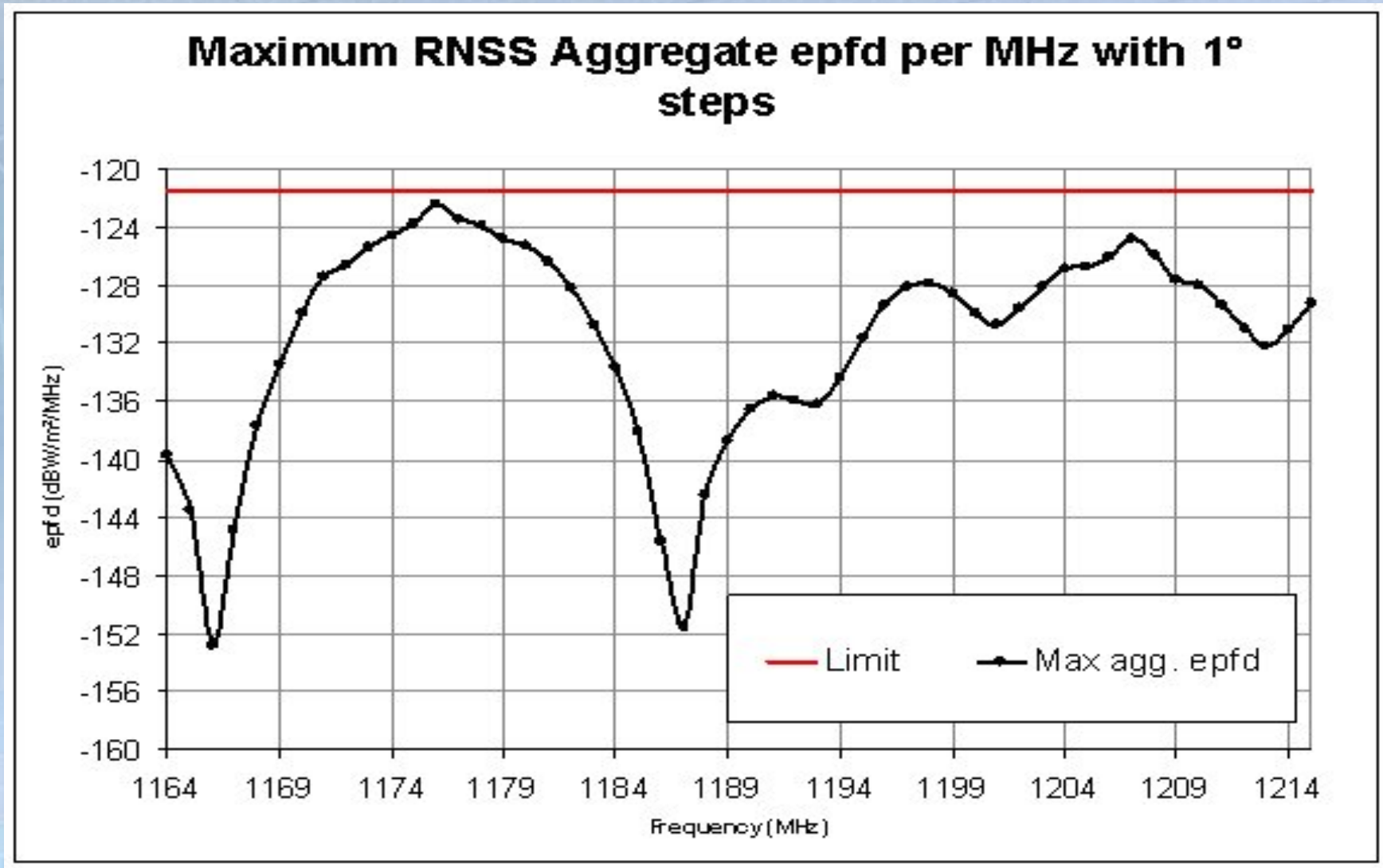
3d RES 609 Consultation Meeting *results*



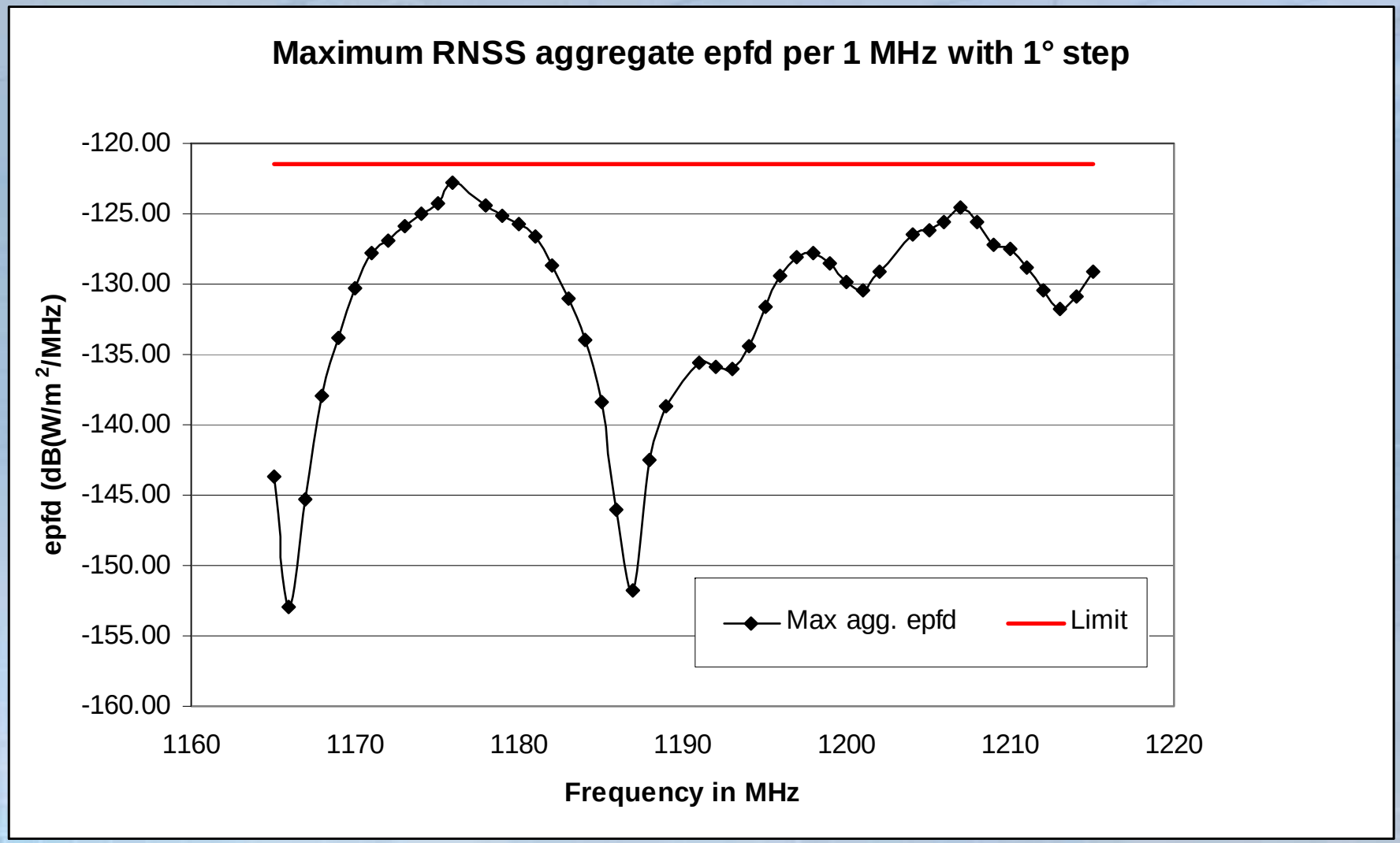
4th RES 609 Consultation Meeting *results*



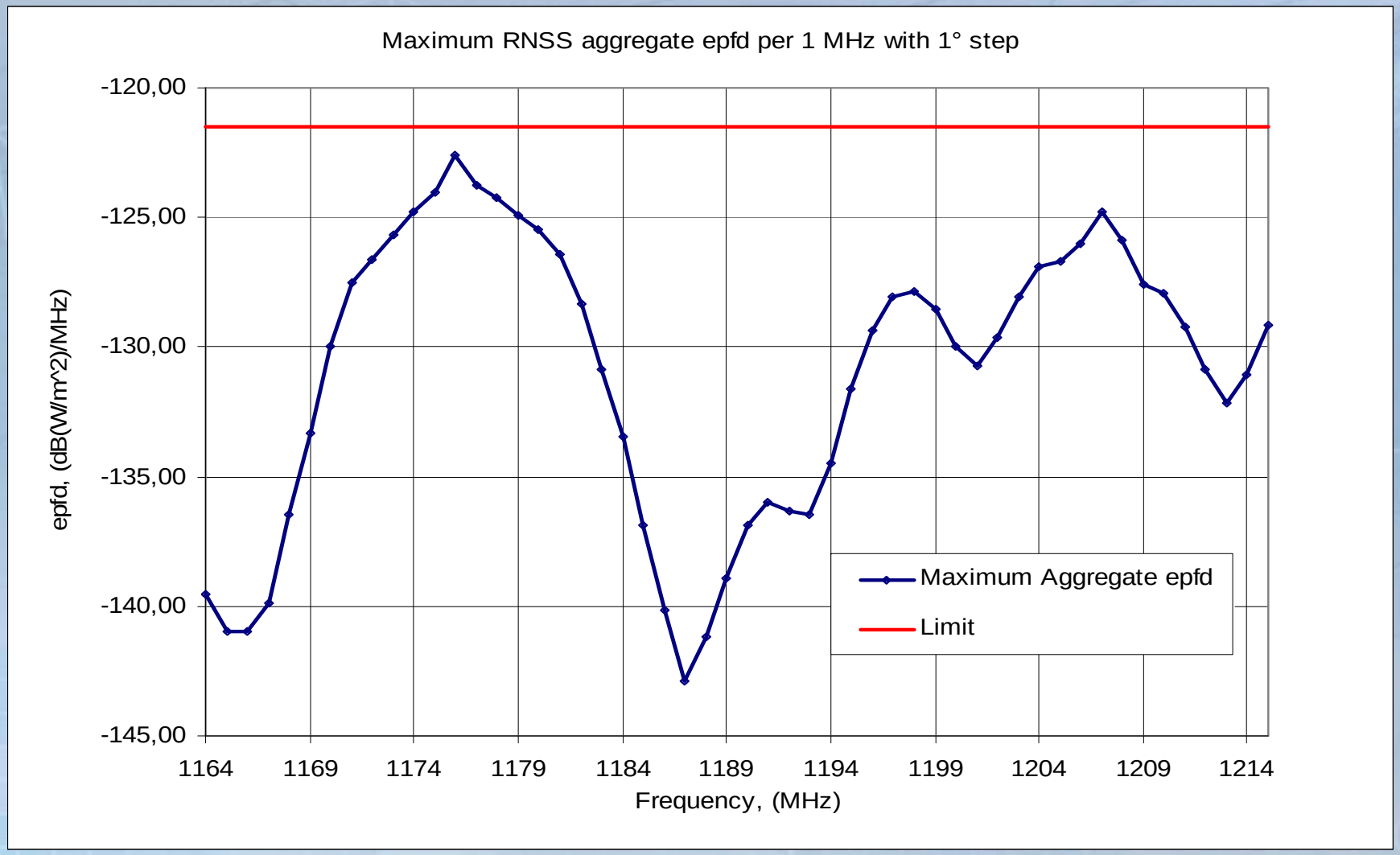
5th RES 609 Consultation Meeting *results*



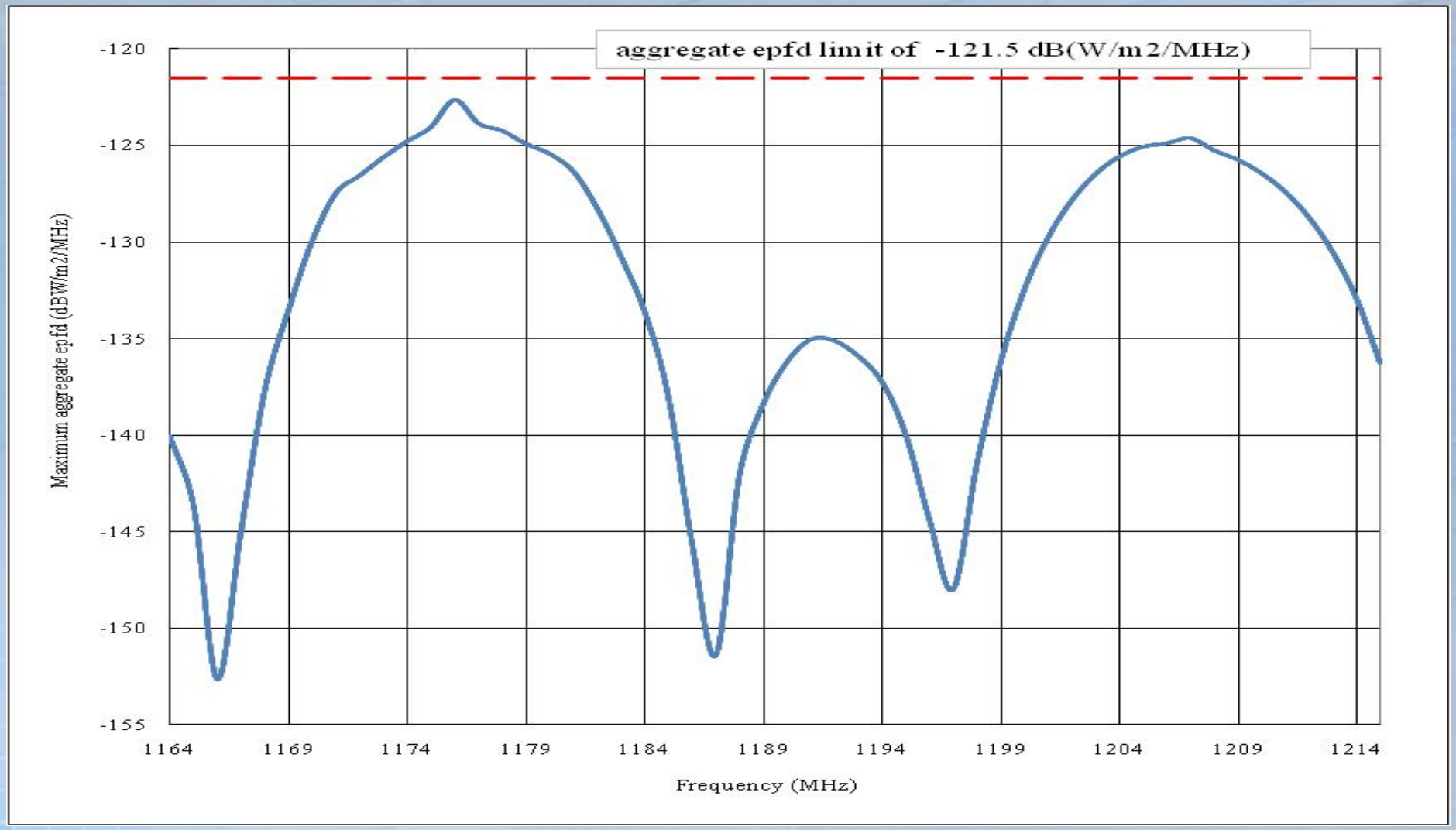
6th RES 609 Consultation Meeting *results*

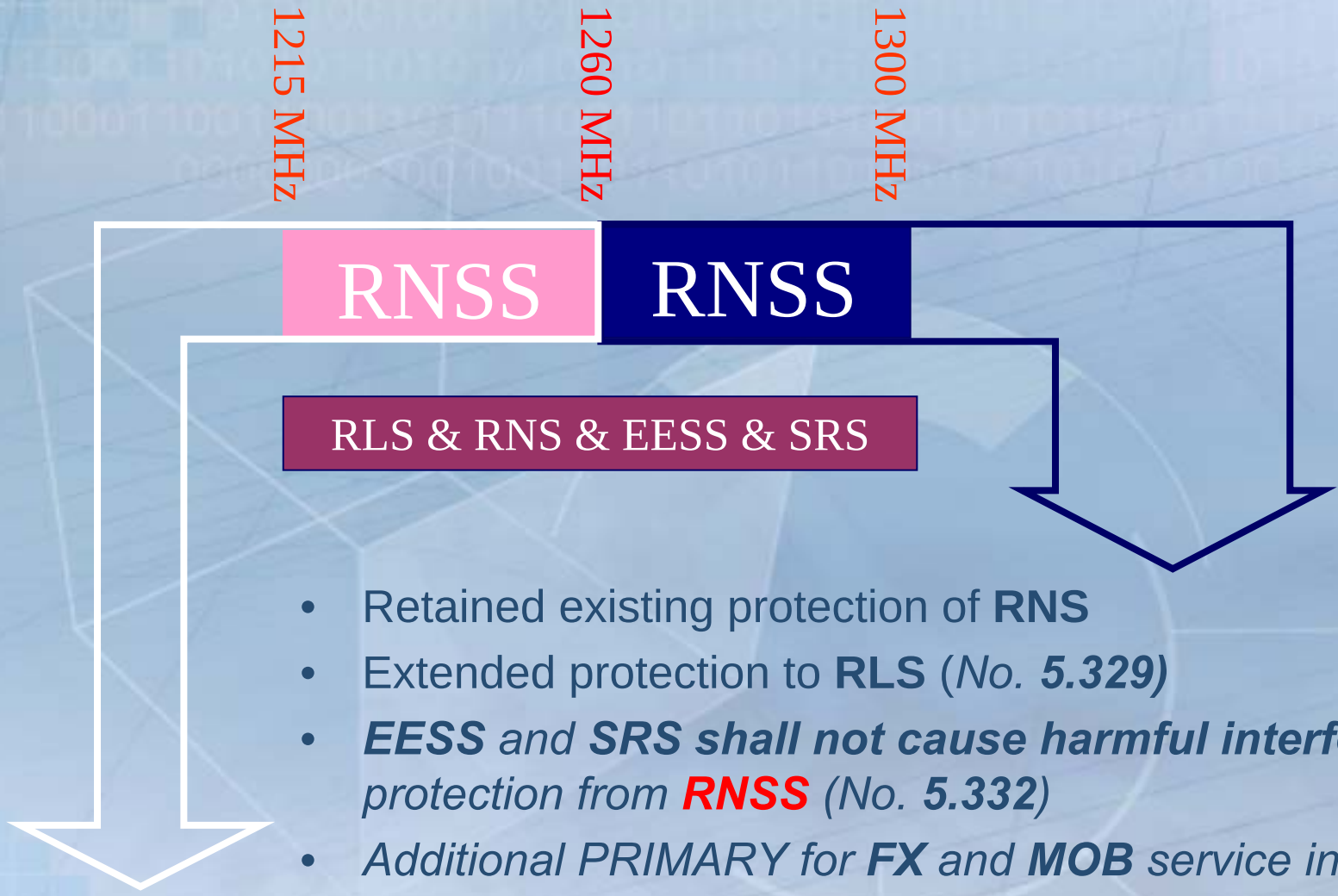


7th RES 609 Consultation Meeting *results*



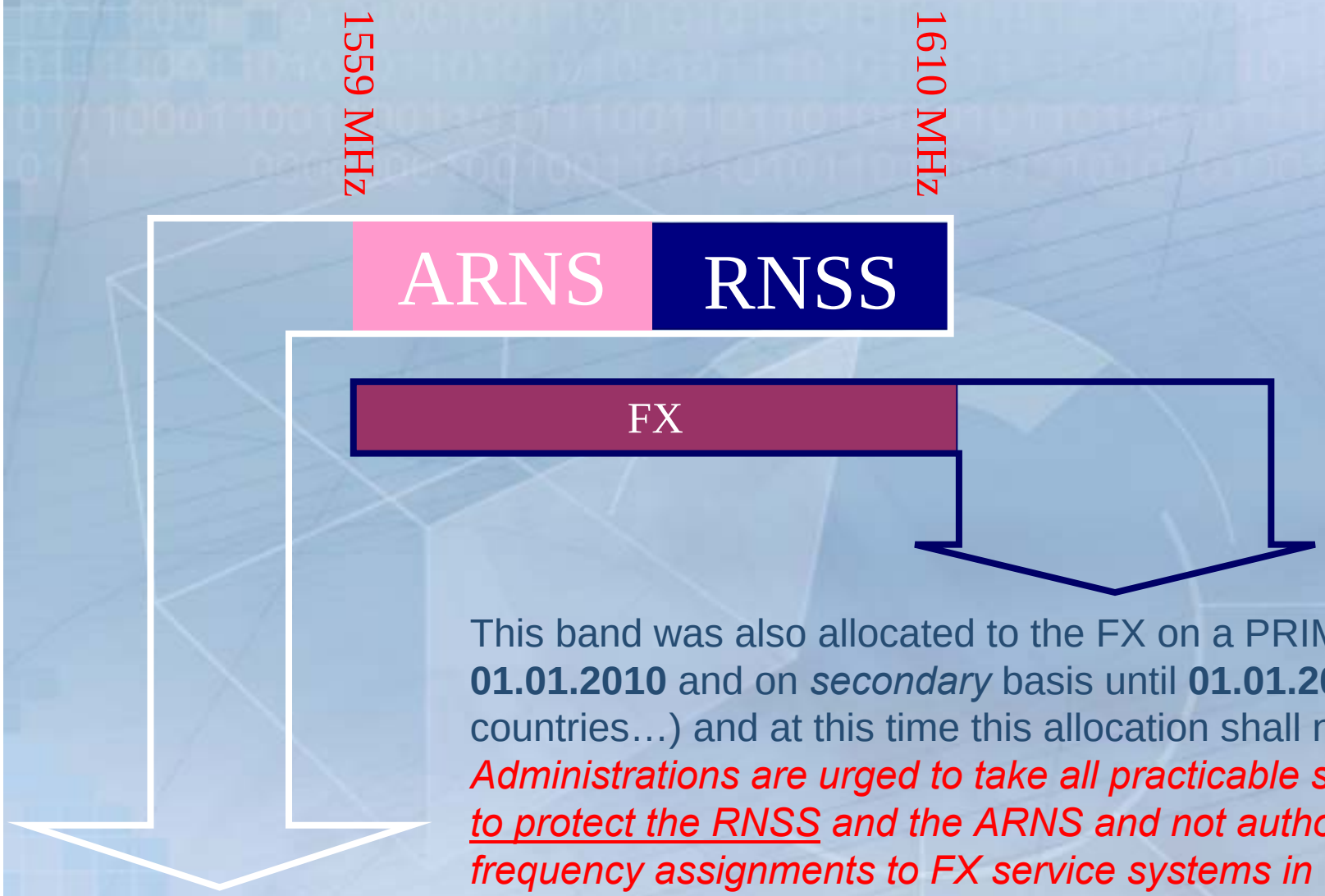
8th RES 609 Consultation Meeting ***results*** (3)





- 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**)*

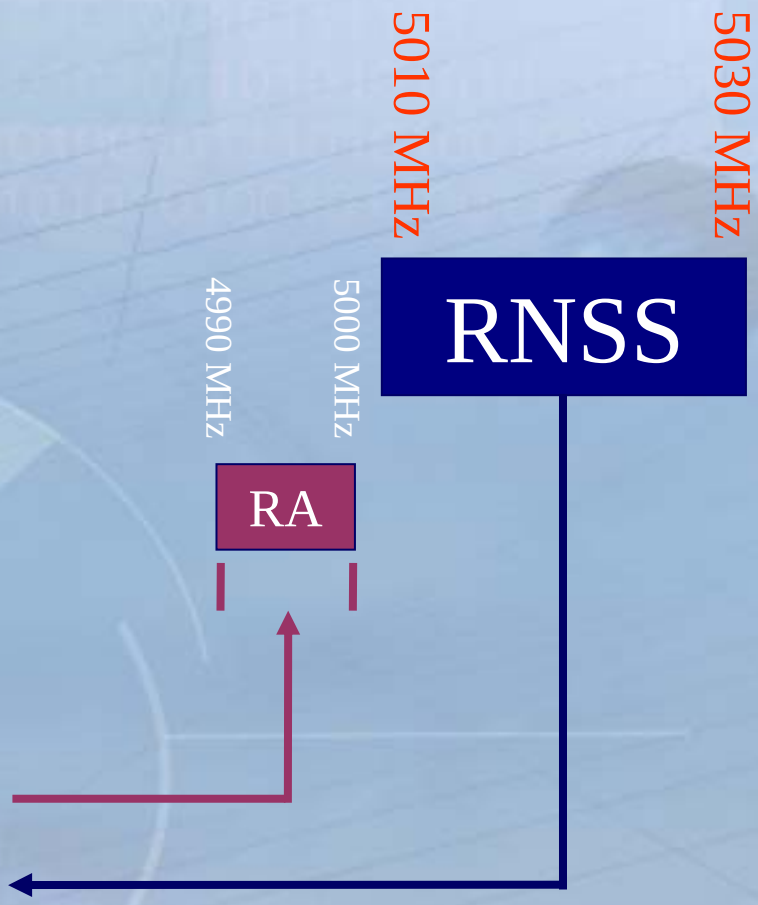
- No additional constraints for RNSS in 1215-1260 MHz, if brought into use prior WRC-2000 *(RES-608 (WRC-03))*



This band was also allocated to the FX on a PRIMARY basis until **01.01.2010** and on *secondary* basis until **01.01.2015** in (list of countries…) 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*

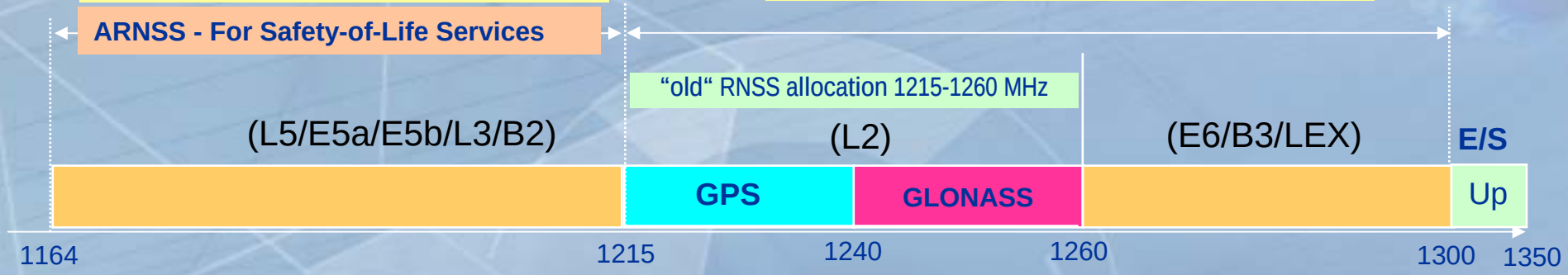
- ***RES-741 (WRC-03)***
- *RR No. **5.443B** also no interference to the MLS*

Frequency Spectrum for the RNSS

Regulatory situation summary

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

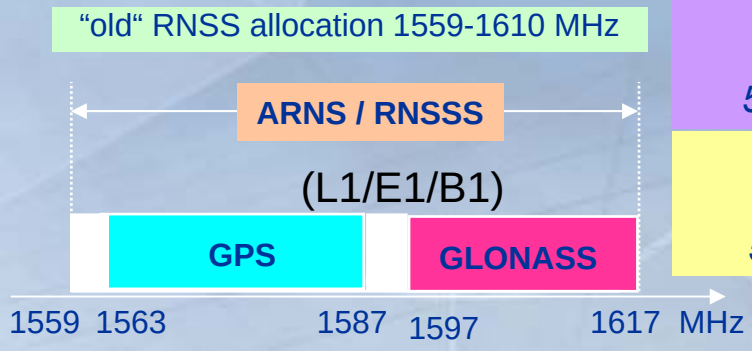
RES-608 (WRC-03)
No constrains on use of "old" RNSS
in the band 1215 – 1260 MHz



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***

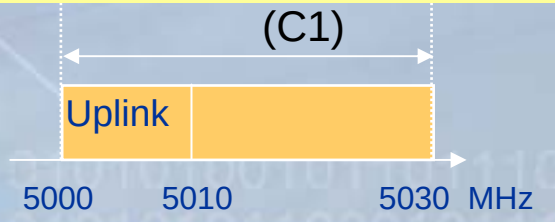
RES-610 (WRC-03)
Coordination and bilateral resolution of technical compatibility issues for RNSS networks



(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 to all users at:
    http://www.itu.int/publ/R-REC/en

RNSS info 3

- There are ***659*** contributions for the WP 4C activities covering the study group period from December 2007 (after WRC-07) up to December 2011

- ***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

Radio Navigation Satellite Service

and the ITU Radio Regulations

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Questions ?