

World Radiocommunication Conference 2019

items of interest to ITSC

WRC-19
Geneva
28 October to 22 November 2019

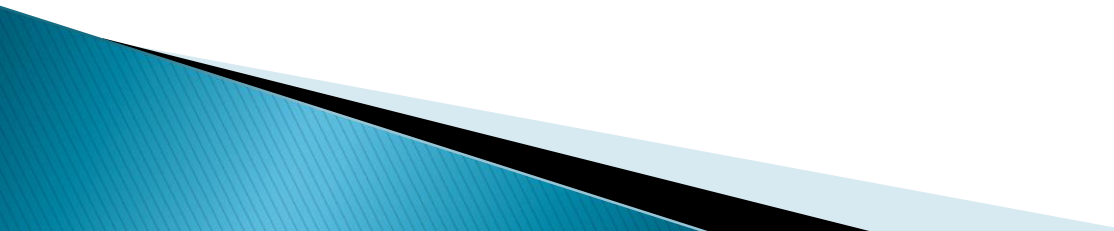
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29 Nov - 5 Dec 2017



This talk

- **discusses spectrum concerns faced by ITSC membership between now and 2019.**
 - **covers WRC- 19 agenda items of concern in passive bands and one major new active downlink**
 - **describes rfi detection and suppression methods**
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Why should I care about rfi into data from all countries?

Data from CMA, DoD, EUMETSAT, NOAA and Roshydromet

Distributed via WMO Information System (WIS)

EUMETCast and/or GTS,

Most are also available on DBNet (re-distribution of locally received data).

All are available in real time and are considered part of the backbone of the global observing system

If one system is exposed to rfi, this problem propagates to all users.

Satellites and agencies possibly affected by WRC-19 decisions

Satellite	agency	Satellite	agency
Aqua	NASA	Meteor-M N2	RosHydroMet
Coriolis	DoD	Meteor-M N2-1	RosHydroMet
DWSS-1	DoD	Meteor-M N2-2	RosHydroMet
DWSS-2	DoD	Meteor-M N2-3	RosHydroMet
FY-3B	CMA	Meteor-M N2-4	RosHydroMet
FY-3C	CMA	Meteor-M N2-5	RosHydroMet
FY-3D	CMA	Meteor-MP N1	RosHydroMet
FY-3E	CMA	Meteor-MP N2	RosHydroMet
FY-3F	CMA	Metop-A	EUMETSAT
FY-3G	CMA	Metop-B	EUMETSAT
FY-3H	CMA	Metop-C	EUMETSAT
FY-3RM-1	CMA	Metop-SG-A1	EUMETSAT
FY-3RM-2	CMA	Metop-SG-A2	EUMETSAT
GCOM-W1	JAXA	Metop-SG-A3	EUMETSAT
GPM Core Observatory	NASA	Metop-SG-B1	EUMETSAT
HY-2A	NSOAS	Metop-SG-B2	EUMETSAT
JPSS-1	NOAA	Metop-SG-B3	EUMETSAT
JPSS-2	NOAA	NOAA-15	NOAA
JPSS-3	NOAA	NOAA-18	NOAA
JPSS-4	NOAA	NOAA-19	NOAA
Megha-Tropiques	ISRO	SNPP	NOAA

WRC 19 agenda items of interest

Agenda item	spectrum addressed
1.5	17.7–19.7 GHz (space-to-Earth) and 27.5–29.5 GHz (Earth-to-space)
1.6	37.5–39.5 GHz (space-to-Earth), 39.5–42.5 GHz (space-to-Earth), 47.2–50.2 GHz (Earth-to-space) and 50.4–51.4 GHz (Earth-to-space)
1.7	spectrum requirements for telemetry, tracking and command in the space operation service for the growing number of non-GSO satellites with short duration missions (small satellites/microsats/picosats)
1.13	24.25–27.5 GHz (data downlink for JPSS/MetOp) 31.8–33.4 GHz 37–40.5 GHz 47.2–50.2 GHz (passive use only) 50.4–52.6 GHz (passive use only) 81–86 GHz
1.14	regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations
Issue 9.1.9	51.4–52.4 GHz

n.b. The WMO position paper on WRC 19 agenda items is at <http://wis.wmo.int/file=3379>.

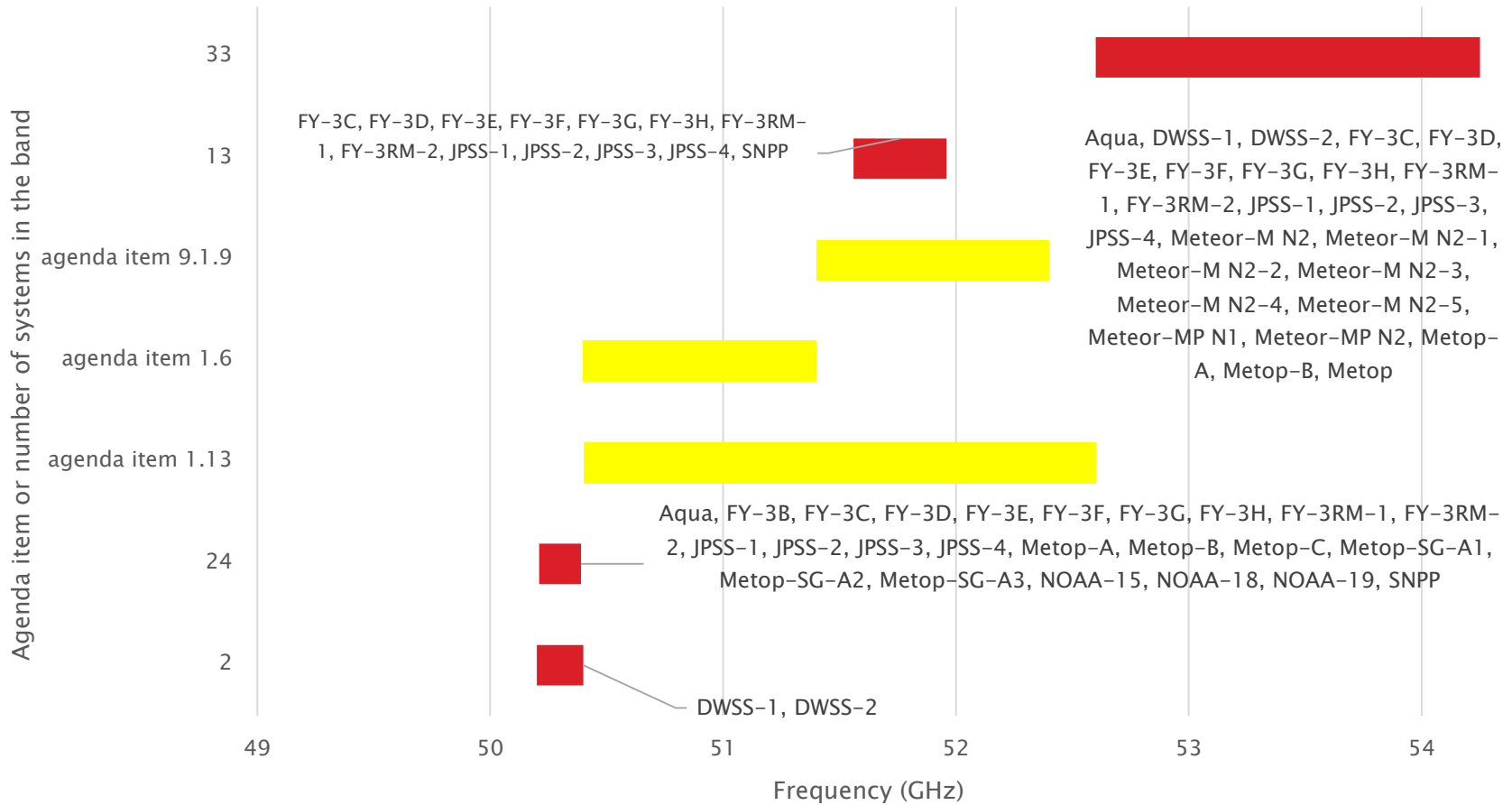
Agenda item impacts

- Passive microwave sensors
- Interference into major new data downlink at 26 GHz

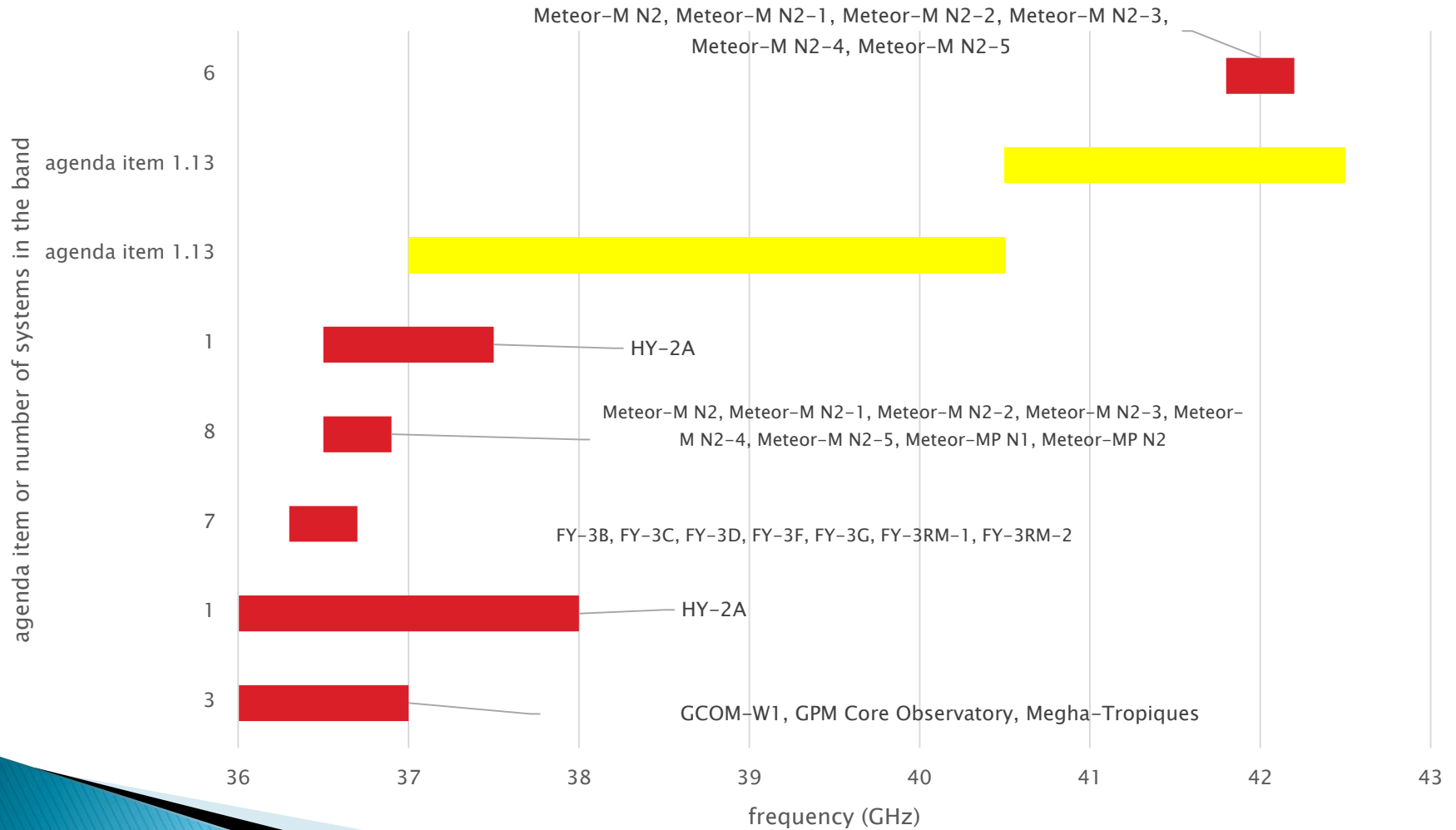
Agenda item impacts

- ▶ Passive bands of concern
 - 50.2 – 54.25 GHz the major concern
 - 36 – 42.2 GHz a major concern
 - 41.8 – 50.2 GHz a major concern
 - Lesser concern
 - 17.425 – 23.935 GHz
 - 23.55 – 31.7 GHz
 - 31.3 – 38 GHz
 - 60 – 93 GHz

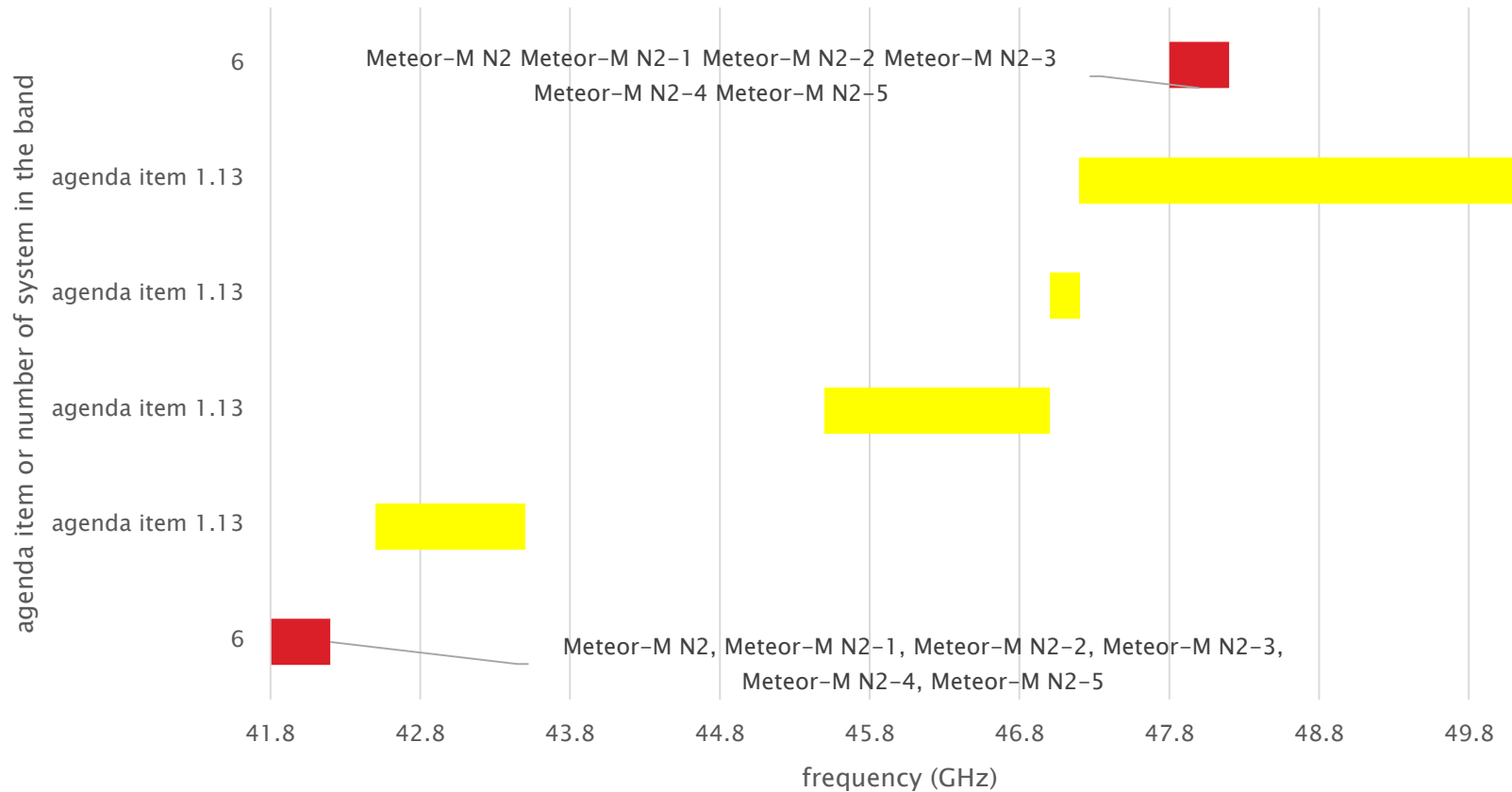
spectrum use, WRC-19 agenda items and EES/Metsat systems 50.2 – 54.25 GHz



spectrum use, WRC-19 agenda items, 36 – 42.2 GHz



spectrum use, WRC-19 agenda items and band use 41.8 – 50.2 GHz



Impact on new 26 GHz downlink band for MetOp-SG and JPSS

- ▶ The band 25.5–27 GHz will be used by systems with bandwidth requirements for raw data transmission and stored mission data.

Satellite	JPSS	MetOp-SG	High Resolution Radar Satellite	Copernicus Evolution, and other commercial LEO
Earth stations	Fairbanks, McMurdo, Svalbard, Troll	McMurdo, Svalbard	Svalbard, Troll, earth station in central Europe	Kiruna, Svalbard, Troll, ES worldwide
Carrier frequency	26 703.4 MHz	26 295 and 26 700 MHz	26 000 MHz	26817 and 25875
Necessary bandwidth	300 MHz	2 x 366 MHz	680 MHz	2 x 750

- ▶ **IMT has targeted this band to be their primary interest**

Interference Detection Techniques¹

- ▶ **Tests for Gaussianity:**
 - Instead of attempting to detect particular RFI signals, it is possible instead to detect whether observed voltage appears to have originated from a thermal noise (i.e. Gaussian) field distribution
 - If nature of the RFI is not known beforehand – tests for Gaussianity have been found to be robust RFI detector.
- ▶ **Pulse Detectors:**
 - an “acceptable” range for the received data amplitude as a function of time is defined, and points outside this range are deemed as corrupted.
- ▶ **Narrowband Source Detectors:**
 - analogous to pulse detection methods but suited to signals which can be resolved in frequency; i.e. search for “outliers” among data in multiple frequency channels.
 - designed to detect interference localized in frequency
 - performance is improved by matching the frequency resolution of the radiometer channels to that of expected RFI sources.
- ▶ **Polarization Based Algorithms:**
 - Geophysical and astronomical sources have polarization properties that, in many cases, can be predicted a priori to within a reasonable uncertainty.
 - RFI sources that are highly polarized can create power differences among polarizations that can be recognized as anthropogenic.
 - success depends on the extent to which the RFI source emissions appear polarized to the radiometer
- ▶ **Multiple Antenna Algorithms:**
 - For instruments using multiple antennas, RFI detection algorithms can be developed based on relationships among the waves received at the antennas.

¹<https://www.nap.edu/catalog/12800/spectrum-management-for-science-in-the-21st-century>

Interference Suppression techniques¹

▶ Filtering

- Design receiver filters so that corruption from RFI sources outside a band of interest is minimized.

▶ Excision

- partial loss of radiometry data as well as possible distortion of non-excised radiometry data due to artifacts of the detection and excision process.

▶ Cancellation

- subtraction of RFI from the radiometer output.
- potentially superior to excision in the sense that the RFI is ideally removed with no impact on radiometry, tradeoff with respect to excision is usually that suppression is limited. A further limitation of canceling techniques is that they tend to degrade into excision-type behavior when conditions are not optimal; for example, in low interference-to-noise ratio scenarios. ...

- ▶ Suppression methods other than simple excision of RFI-contaminated data are not widely used in EESS/RAS, mainly because they are not easy to devise or implement and may require the development of extensive special hardware, software, or instrument modifications that potentially degrade performance. Furthermore, cancellation techniques typically lead to significant increases in the required computing power relative to that needed in interference-free conditions.

¹<https://www.nap.edu/catalog/12800/spectrum-management-for-science-in-the-21st-century>

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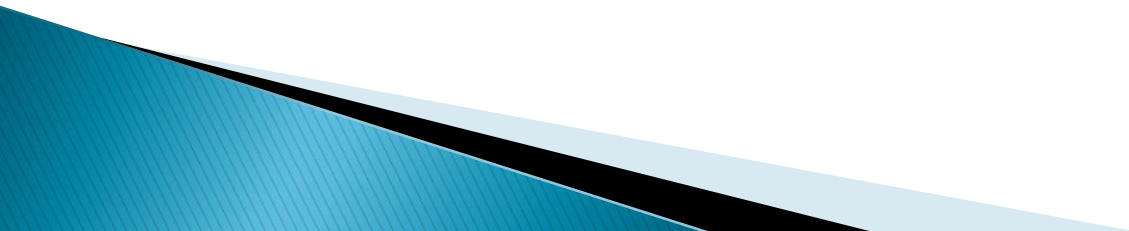
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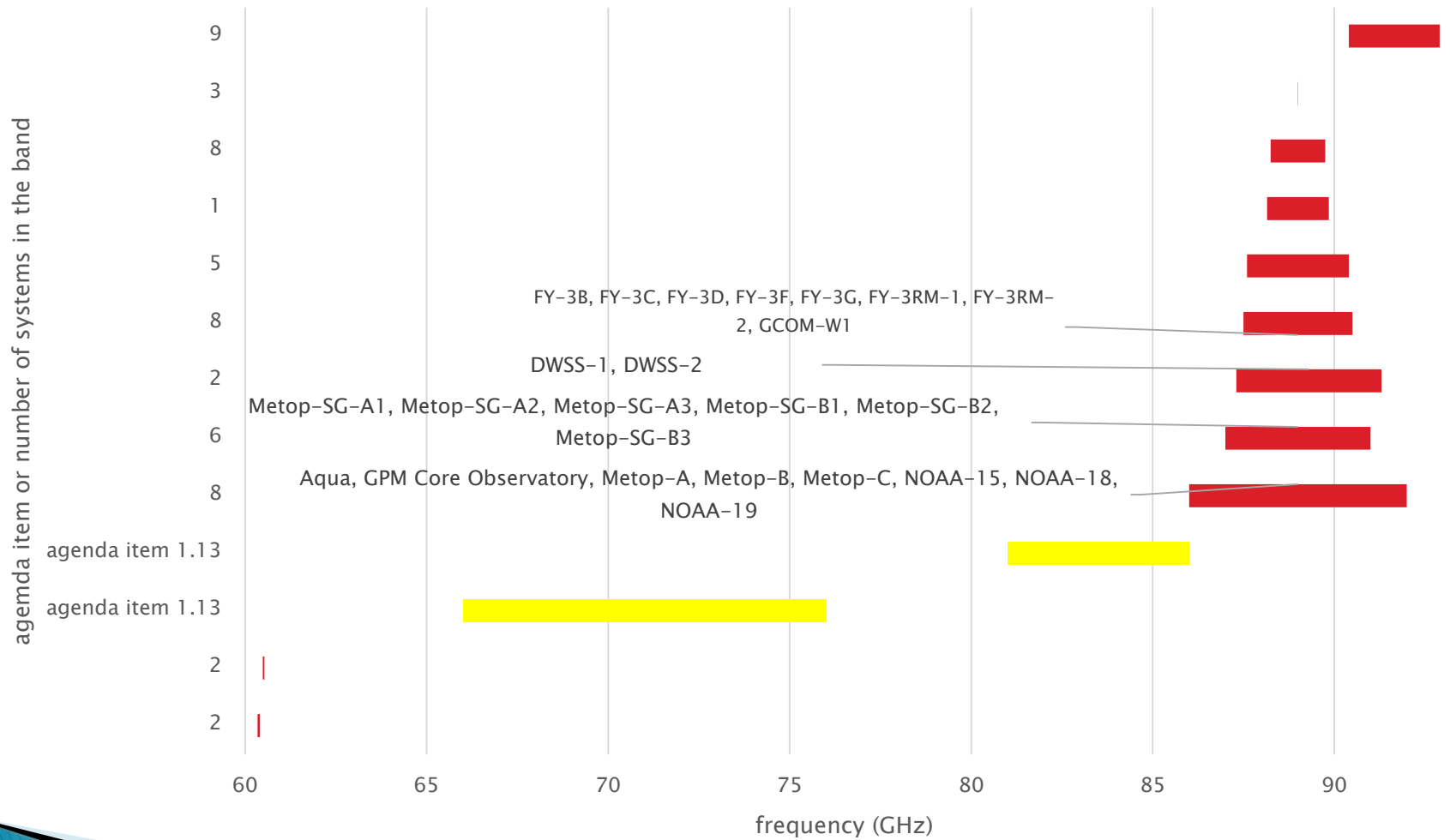
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Backup material

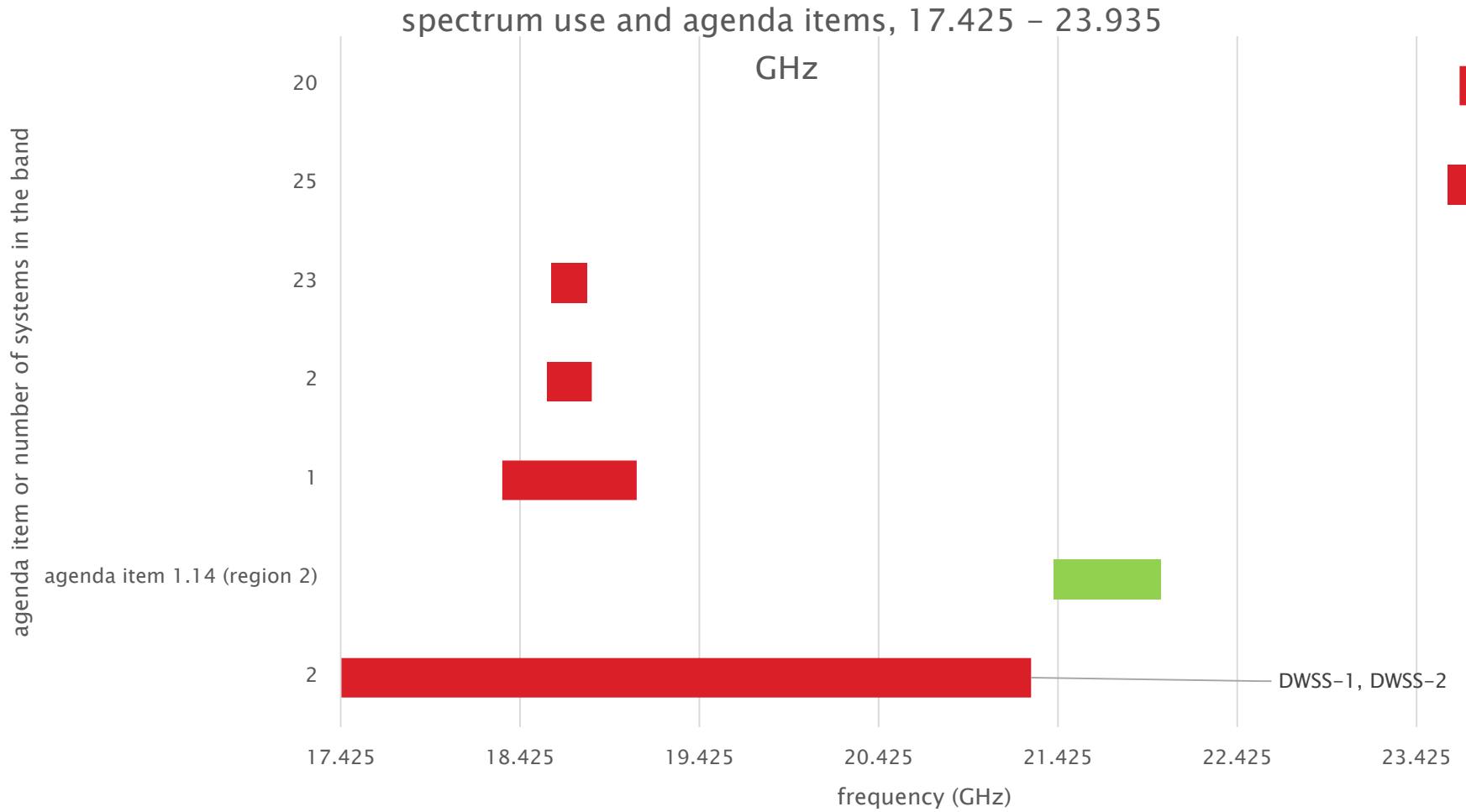


Lesser concern

spectrum use, WRC-19 agenda items and EES/MetSat systems, 60 – 93 GHz

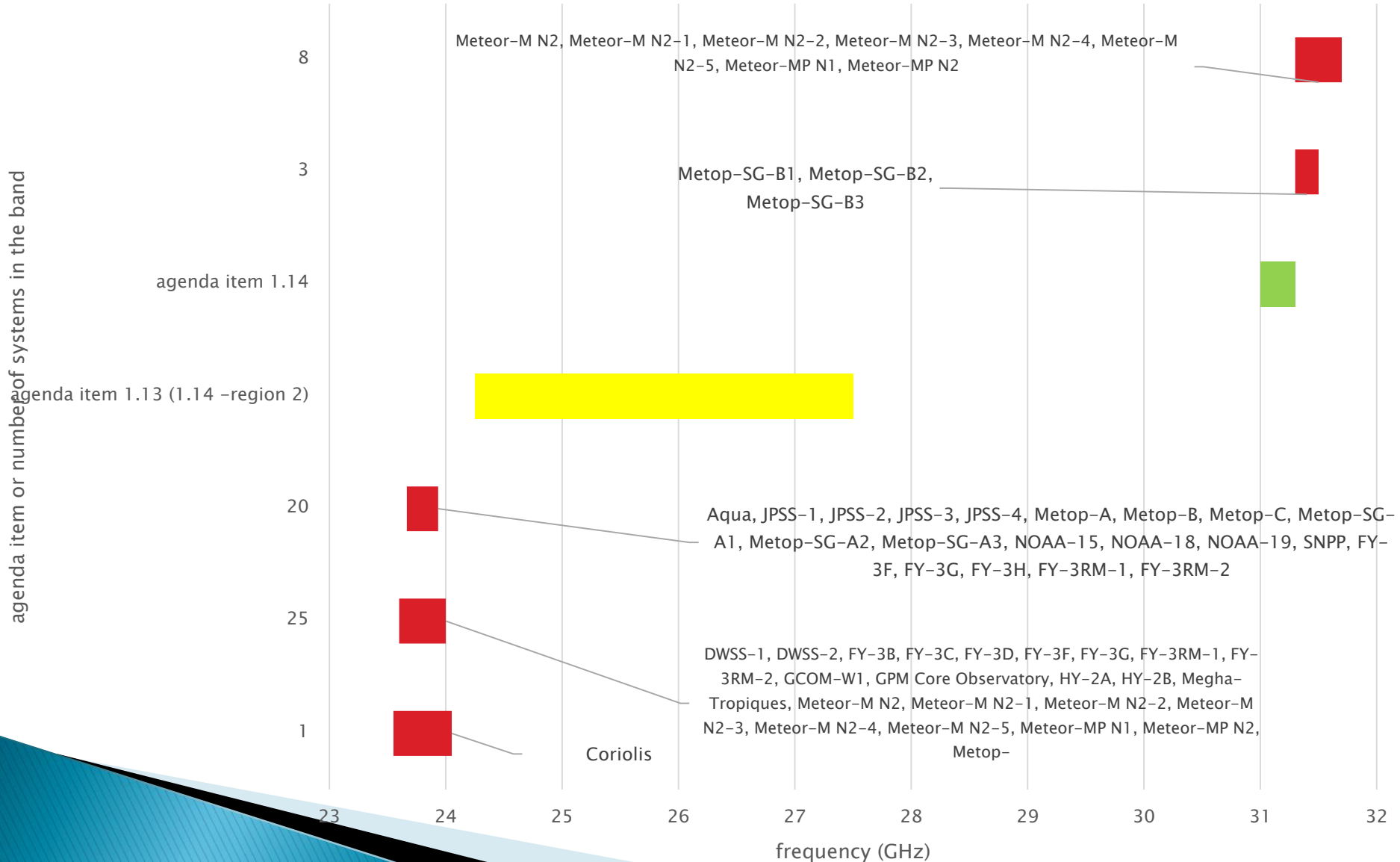


Lesser concern



Lesser concern

spectrum use and agenda items, 23.55 – 31.7 GHz



Lesser concern

spectrum use, WRC-19 agenda items, 31.3 – 38 GHz

