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FEDERAL SPECTRUM DEVELOPMENTS

June 2016 – May 2017

CORF Meeting
May 2017

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I. Order and Further Notice on Mobile Services Above 24 GHz

July 2016 Order and FNPRM enacted rules and sought further comments on spectrum for "5G" mobile wireless services in bands above 24 GHz.

CORF previously filed comments in response to the FCC's NOI and NPRM in this proceeding, and the FCC responded to much of what CORF said.

A. Order -- 37 GHz Band (37.0-38.6 GHz)

- Existing allocations for SRS (s-E), EESS (Secondary)
EESS at 35.5-37 GHz (and RAS at 36.4 protected per US342)

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I. Mobile Services Above 24 GHz

A. Order -- 37 GHz Band (37.0-38.6 GHz)

-Allocation added for *unlicensed fixed and mobile*

- In US151/ FCC rule Section 30.205, *coordination zones* established around *Goldstone, White Sands and Socorro*
(Green Bank already protected by Quiet Zone rule)
-FCC *declines* to add 100 MHz *guard band to protect EESS*, rely instead on OOBE limit requiring attenuation by factor of $43 + 10\log_{10}(P)$ per MHz (or an absolute power of -13 dBm/MHz)

-FCC *rejects protected zones for RAS* sites:
500 MHz separation is sufficient

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I. Mobile Services Above 24 GHz

B. Order -- 39 GHz Band (38.6-40.0 GHz)

-Prior allocations included Fixed and MSS (s-E)
-EESS allocation at 40.0-40.5 GHz

FCC adds allocation for *licensed fixed and mobile terrestrial*

C. Order – 42.0-42.5 GHz

-Existing allocations for Fixed, Mobile and Broadcast Satellite services ("BSS").
-Existing allocation of 42.5-43.5 GHz to RAS
Footnote US342 protect by all practicable steps

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I. Mobile Services Above 24 GHz

C. <u>Order – 42.0-42.5 GHz</u>

-NPRM sought comments on use of the 42.0-42.5 GHz band for mobile services, and for FSS downlinks.

CORF opposed.

-FCC *deleted the BSS allocations from the 42 GHz* band to better protect RAS.

BSS will still retain *40.5-42 GHz* allocation

-FCC also *declined* to adopt the proposal to allocate the 42 GHz band for *FSS downlinks*.

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I. Mobile Services Above 24 GHz

D. Order – 57-64 GHz, 64-71 GHz

-Prior allocations to Fixed, Mobile and ISS services, though no rules.
-EESS allocations at 52.6-59.3 and 65-66 GHz
-RAS harmonics at 128-142 and 192-213, with US342 protection

Boeing/Microsoft/Intel WiGig proposal – airplane WLAN
access points in plane transmit to seat backs, consumer devices (and device to device)

I. Mobile Services Above 24 GHz

D. Order – 57-64 GHz, 64-71 GHz

CORF strongly opposed aeronautical usage, due to risk to EESS at 57-59 GHz, used to collect critical weather data.

Order: FCC *allows unlicensed* operations at 64-71 GHz but retained the prohibition of aeronautical use, in order to protect EESS.

(Section 15.255)

FCC also stated that it "expects" manufacturers of WiGIG mobile devices to *instruct end users re prohibition*.

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I. Mobile Services Above 24 GHz

D. Further Notice – 57-64 GHz, 64-71 GHz

FCC seeks more/better data on issue of airborne interference from this band to EESS and RAS.

-fuselage attenuation?
-limit in-plane applications/locations?
-impact of using this band for *wireless avionics*?

CORF:

-support studies/actual testing in this specific band
-outside avionics raises many more issues
-in the absence of better data, prohibit airborne use of WiGig Channel 1 (57.24-59.4 GHz). Operation on *other* WiGIG channels is acceptable.

- *Industry comments* support prohibition on WiGIG Ch. 1, operation on Chs. 2-3 and further testing

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I. Mobile Services Above 24 GHz

D. Further Notice – 57-64 GHz, 64-71 GHz

-Brief meeting with industry at FCC 11/29 re the nature of testing

-Industry agrees to dialogue on testing, but no contact until recently

-Who should participate now for passive science?

-Need to remain mindful re use for avionics

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I. Mobile Services Above 24 GHz

E. Further Notice – 24 GHz (24.25-24.45 and 24.75-25.25 GHz)

-Existing allocations for FSS (E-s) at 24.75-25.25
-EESS secondary allocation at 24.05-24.5
-EESS co-primary (Mobile, Fixed, ISS and SRS) at 25.5-27
- RAS- EESS passive primary allocation at 23.6-24.0 GHz protected by US246

FCC proposes to add:
-mobile allocation @ 24.25-24.45 and 24.75-25.25 GHz
-fixed allocation @ 24.75-25.05 GHz

CORF Comments: nothing below 24.25 GHz, but if added then protect 23.6-24.0 GHz EESS band per ITU-R SA.1029-2.

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I. Mobile Services Above 24 GHz

F. <u>Further Notice – 32 GHz Band (31.8-33.4)</u>

Current:

-Radionavigation (aviation/mapping) and ISS
-SRS/Goldstone (s-E)
-RAS and EESS at 31.3-31.8 – US246 (no trans) and US74

FNPRM: how to use this band (mobile) while protecting EESS and RAS?
Guard band per prior CORF comments?

CORF: Guard band needed for at least current generation of EESS sats
RAS can be protected by geographic coordination

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I. Mobile Services Above 24 GHz

G. Further Notice – 42.0-42.5 GHz

Current: Fixed and Mobile allocations, but no rules
42.5-43.5: RAS (US211), Fixed, Mobile, FSS (E-s)

FNPRM: how to use this band for fixed and mobile while protecting RAS? OOBE and Guard band?

CORF: Mobile unlikely to protect w/o *OOBE limits* per RA.769
Fixed can protect RAS with proper *coordination*

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I. Mobile Services Above 24 GHz

H. Further Notice – 47 GHz (47.2-50.2) and 50 GHz (50.4-52.6)

Current: 47 GHz Fixed (HAPS) FSS (E-s)and Mobile allocations, no rules
50 GHz FS, FSS (E-s), MSS (E-s) and Mobile, no rules

50.2-50.4: EESS (US246) (no trans)
48.94-49.04 RAS (US342) (all prac. steps)

FNPRM: how to use this band for *terrestrial fixed and mobile* while protecting RAS and EESS?

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I. Mobile Services Above 24 GHz

H. <u>Further Notice – 47 GHz (47.2-50.2) and 50 GHz (50.4-52.6)</u>

CORF:

-Protect *VLA, GBT, and Haystack* by equivalent to Footnote 5.555B PFD limit *-151.8 dB(W/m^2)* in any 500 kHz band at the site.

-Protect EESS w *OOBE limit of -33 dBW/100 MHz*, measured at the input of the transmit antenna.

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I. Mobile Services Above 24 GHz

I. 71-76 and 81-86 GHz

-Primarily used for terrestrial fixed

-Existing rules for 71-76 GHz, 81-86 GHz, and 92-95 GHz bands include *coordination* with VLBA, Socorro, Green Bank, Kitt Peak, OVRO, Five Colleges, Haystack, Mauna Kea and CARMA.

-Licensed and unlicensed radars also allocated at 76-81 GHz

-FNPRM seeks comments on complex authorization tool to add *unlicensed mobile and WiFi*.

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I. Mobile Services Above 24 GHz

I. 71-76 and 81-86 GHz

CORF – RAS:

-*Fixed licensed* should use existing coordination.

- *Licensed mobile* should have RAS *protection zones*.

-*Unlicensed* (fixed) should have OOBE limit of *90 pW/cm² @3m*.

-Prohibit *unlicensed mobile* at 81-86 GHz.

- Footnote US246 prohibits transmissions at 86-92 GHz, thus must protect EESS with OOBE limits at ITU-R SA.1029-2 level.

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II. WRC-12 Order

A. Protecting EESS at 86-92 GHz

Following up on WRC-12 action, FCC had proposed to adopt a new footnote US162 with a new unwanted emissions standard to protect EESS from stations in the fixed service:

"In the bands 81-86 GHz and 92-94 GHz, operators of stations in the fixed service are *encouraged* to *take all reasonable steps* to ensure that unwanted emission power in any 100 MHz bandwidth in the band 86-92 GHz, measured at the antenna port, does not exceed the following levels:

Band *Maximum levels (where f in GHz is the center frequency of any 100 MHz)*

81-86 GHz: 41 - 14(f - 86) dBW for 86.05 ≤f ≤ 87 GHz and -55 dBW for 87 ≤ f ≤ 91.95 GHz

92-94 GHz: 41 - 14(92 - f) dBW for 91 ≤ f ≤ 91.95 GHz and -55 dBW for 86.05 ≤ f ≤ 91 GHz

CORF Comments supported this proposal

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II. WRC-12 Order

A. Protecting EESS at 86-92 GHz

FCC Order released 3/29/17 chose not to adopt this proposal "at this time".

-Existing operators have tailored their operations to *existing* FCC Part 101 rules, which have less stringent OOBE rules.

-Even though proposal was non-mandatory, it would have *"confused" operators*, while not providing any *"meaningful"* add'l protection.

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II. WRC-12 Order

B. Passive Use Above 275 GHz

-Prior to WRC-12, the last entry in the International Table read: "275-1000 [GHz] (Not allocated) 5.565."

-In its proposals to WRC-12, *U.S. asserted* that passive and active services can share frequencies above 1000 GHz *without constraints*.

- WRC-12 revised RR 5.565 to state that "Administrations wishing to make frequencies in the 275-1000 GHz range available for active service applications are urged to take all practicable steps to *protect these passive services* from harmful interference *until* the date when the Table of Frequency Allocations is established in the above-mentioned 275-1000 GHz frequency range," but does not impose mandatory protection criteria.

-WRC-12 also extended the International Table from 1000 GHz to 3000 GHz

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II. WRC-12 Order

B. Passive Use Above 275 GHz

-NPRM stated that RR 5.565 should not be "misconstrued as placing a *'reservation'* for future passive service allocations in the U.S. Table, which would *inhibit commercial development* of this spectrum."

Thus, propose to adopt the following U.S. footnote:

"US565 International footnote 5.565 does not establish priority of use in the United States Table of Frequency Allocations, and does not preclude or constrain the allocation of frequency bands in the range 275-3000 GHz to active services at a future date."

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II. WRC-12 Order

C. Passive Use Above 275 GHz

- CORF Reply Comments:

-Text of the Commission's proposed footnote appears to be at odds with RR 5.565's explicit goal of *protecting passive uses*, and it urges the Commission to adopt the text of RR 5.565.

-Shared use possible in many bands, and CORF can help identify those.

Order: FCC *adopts proposed FN*.

> international 5.565 "could be construed as placing a reservation for future passive service allocations in the U.S. Table, which would inhibit development [of other services]"

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II. WRC-12 Order

D. Aeronautical Allocations at 5 GHz

Existing allocations:

4990-5000: RAS

5000-5010: Aeronautical Radionavigation
Radionav-Sat (E-s)

5010-5030:
Aeronautical Radionavigation
Radionav-Sat (s-E)(s-s)

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II. WRC-12 Order

D. Aeronautical Allocations at 5 GHz

ORDER:

-add allocation to Aeronautical mobile at 5000-5030
limited to terrestrial use at airports for AeroMACS

-add allocation to Aeronautical mobile at 5030-5091
intended for control of *large UAS* (both directions)

-add allocation to Aeronautical mobile satellite (R)
at *5000-5150* (upgrade from US367)
(satellite-planes)

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II. WRC-12 Order

E. Other Actions in Order

-Allocate 8.3-11.3 kHz for Metaids – Lightning Detection

-Allocate 22.55-23.15 (E-s) and 25.5-27 GHz for *SRS* (s-E)

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III. Iridium – Modification Application for NEXT

-In December 2013, Iridium filed application to modify its license for its Iridium "NEXT" second generation satellites.

-Operate on *same frequencies* (1617.775-1626.5 MHz) but technical capability to go down to *1616.0*.

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III. Iridium – Modification Application for NEXT

-Iridium proposed to protect RAS via “RAS Protection mode” requiring advanced scheduling, and providing protection only 18 hours per day.

-In March 2016 Letter to FCC, proposes “new and improved” approach:

>*Improved hardware* to improve linearity and filtering in the transmission stages.

>*new network management software* to switch off beams in view of RAS sites.

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III. Iridium – Modification Application for NEXT

FCC Approves Iridium Application in August of 2016:

-"Iridium *shall not produce out of band emissions that cause detrimental interference* to radio astronomy observations (see Section III of Article 29 of the ITU Radio Regulations) and must comply with No. 5.372 of the ITU Radio Regulations and with 47 C.F.R. § 25.213."

-5.372: "Harmful interference shall not be caused to stations of the radio astronomy service using the band 1610.6-1613.8 MHz by [MSS]"

-Order warns Iridium that under Section 25.213 of the FCC's rules, it must take *"whatever steps necessary" to avoid causing harmful interference* to RAS during periods of observation.

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III. Iridium – Modification Application for NEXT

-Iridium's March 2016 *letter* on methods for protection of RAS incorporated as a condition of the authorization.

-No explicit language mandating *coordination* with RAS, but *implicit* in 25.213, if necessary for Iridium to comply with the obligation not to cause interference "during times of observation."

-Issue: no definition in the Order for "harmful interference".

-FCC did <u>not</u> approve expansion down to 1616.0

-10 NEXT satellites launched in Jan. 2017, integration into constellation 5/17
-10 more scheduled for launch in June 2017. Target completion – Mid 2018.

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IV. Channel 37 – Reallocation of TV Band

-FCC previously *reallocated some of the UHF TV band*.

-This new "600 MHz band" has been reassigned from broadcasting to *licensed terrestrial mobile wireless services* by auction. *$$$*

Also allocation to unlicensed devices

-One issue unknown until the end of the auction was what services would be the neighbors of *Channel 37*, which is currently reserved solely for use by *RAS* and the *Wireless Medical Telemetry Service* ("WMTS").

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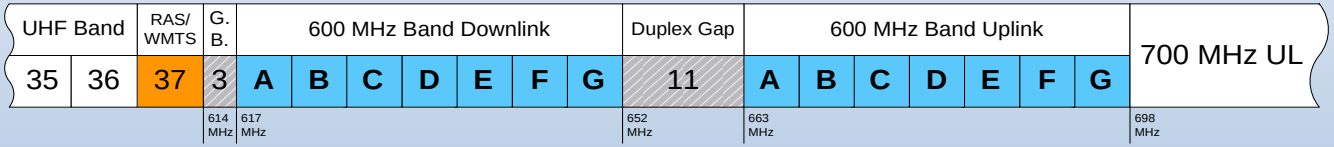
IV. Channel 37 – Reallocation of TV Band

Final Allocations



Light Blue: 5 MHz blocks of paired wireless licenses.
Orange: Channel 37 (608-614 MHz) reserved for radio astronomy and medical telemetry.
Diagonally shaded gray: guard band between wireless downlink channels and Ch. 37, and between uplinks and downlinks.

V. NPRM – Unified ESIM Rules

May 19, 2017 – FCC Issues NPRM on "Earth Stations in Motion" ("*ESIMs*")

ESIMs previously called ESVs, VMEs, ESAA's:

satellite transmit/receive stations mounted on vehicles, boats, aircraft communicating with Fixed-Satellite Service (FSS) geostationary-orbit (GSO) space stations primarily in the *Ku-Band*:

10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz (space-to-Earth) and *14.0-14.5 GHz* (Earth-to-space) frequency bands.

V. NPRM – Unified ESIM Rules

Footnote 113 (203) in the U.S. Table *recognizes RAS observations* in the 14.47-14.5 GHz sub-band but provides only *limited protection*:

-*practicable effort to avoid the assignment*
-*harmful interference remedied to the extent practicable*

- Nevertheless, the FCC's rules *require ESAA, ESV, VMES operations* in 14.47-14.5 GHz sub-band to *coordinate* with RAS facilities. A number of such coordination agreements *already exist*.

-Footnote US133(b) requires 14.47-14.5 GHz ESAA operation w/in LOS of RAS to coordinate through NSF.

V. NPRM – Unified ESIM Rules

Recent NPRM recognizes differences in coordination requirements in different ESV/VMES/ESAA rules:

ESVs: if w/45-120 Km of coastal RAS, coordinate w NTIA

VMES: if w/in "vicinity" of RAS, coordinate w NSF

ESAA: If w/in LOS of RAS, coordinate w NSF

NPRM: eliminate separate requirements, substitute *single unified Section 25.228(j)*

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V. NPRM – Unified ESIM Rules

NPRM proposal:

1. Operation of ESIMs at 14.47-14.50 GHz w/ vicinity (ESV/VME) or LOS (ESAA) must coordinate w NSF.

-*Radius* for coordination:

-50 Km for VLBA sites
-160 Km for Arecibo, GB, VLA, Pisgah, Stinchfield Woods, Owens Valley

-*Future* RAS sites approved by NITA
-ESIMs must use *GPS* to ensure compliance w distances

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V. NPRM – Unified ESIM Rules

NPRM proposal:

2. Allow operation of ESIMs in Ka-Band:

18.3-18.8 GHz and 19.7-20.2 GHz (space-to-Earth)
28.35-28.6 GHz and 29.25-30.0 GHz (Earth-to-space)

Primary EESS at 18.6-18.8
(co-primary w FS, MS and FSS [s-E])

secondary EESS allocation at 28.5-29.5 [*International* Table]
secondary EESS at 29.95-30.0 (s-s)
(FSS/MSS E-s are primary)

Comments due *30 days* after publication in F.Reg. Replies – 45 days.
vicinity = coord distance? LOS?

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VI. Meetings at FCC?

CORF, along with Dr. Joe Taylor and Dr. Tony England, previously met with:

-staff of Wireless Telecom Bureau, and staffs of Commissioners Rosenworcel and Wheeler.
-Commissioner Pai

Possible new outreach:

Staff of *Chairman* Pai
Commissioner O'Rielly

Meet with OET

>Aggregate Interference?
>57 GHz?
>Above 100 GHz?
>Above 275 GHz?

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QUESTIONS?

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THANKS!

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