



ITU Regulations for Ka-band Satellite Networks

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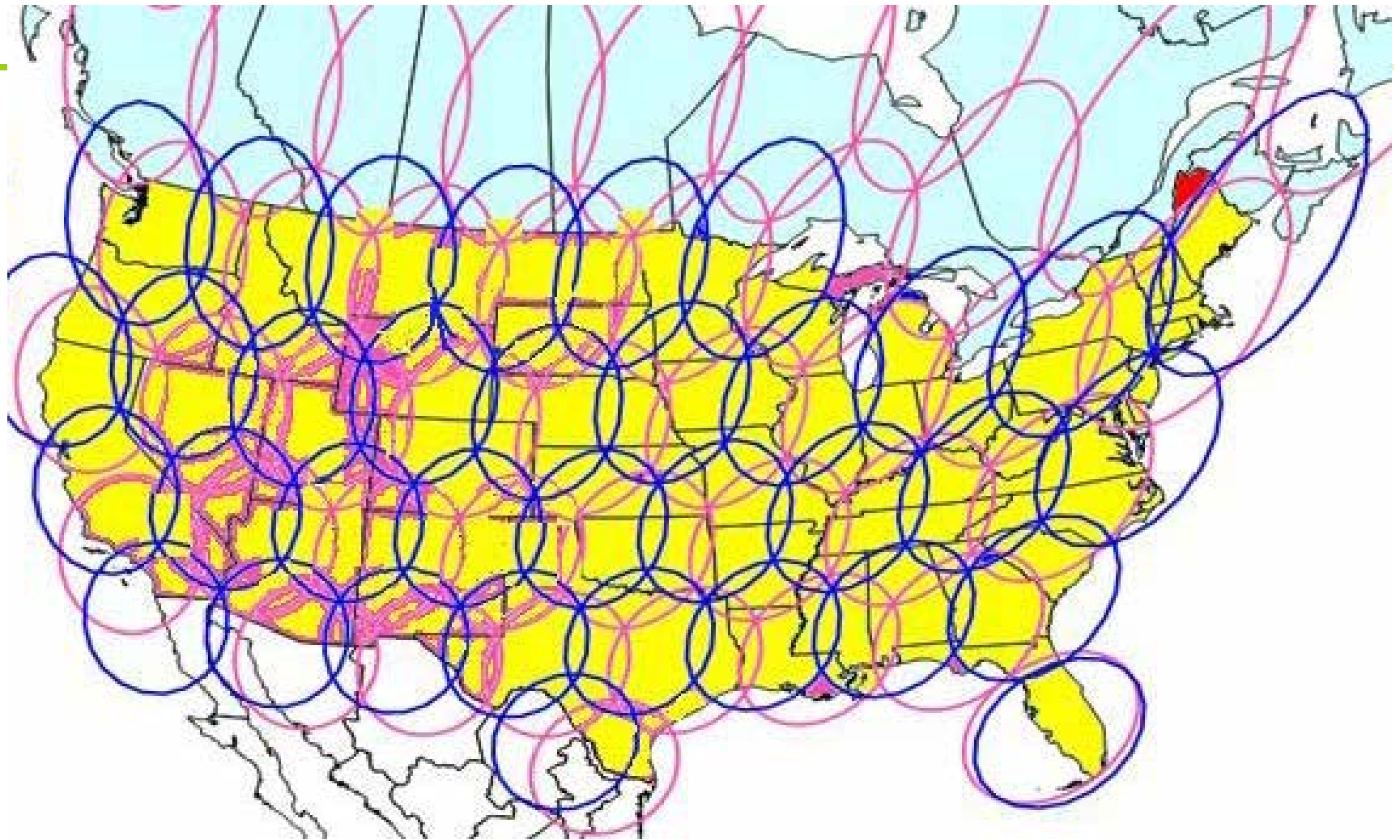
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Ka-band Allocations

- Ka-band not defined in the Radio Regulations
- Will take as Ka-band range 17.3 to 31 GHz.
- Both GSO and NGSO satellites in Ka-band
- Many different services share Ka-band
- Many allocated services do not share well
- For example, terrestrial and satellite services using ubiquitous terminals do not share well
- The administration decides which services to favor on its territory

High Throughput Satellites

- Not only in Ka-band
- Characterized by:
 - many small beams (up to about 200) with high gain
 - high gain of the small spot beams allows for closing the link to relatively small user terminals
 - allows for multiple frequency re-use
- Due to the high frequency re-use factor (up to 20) the resulting throughput of the satellite is in the range of 100s of Gigabits per second (Gbps).



Spot beams of Anik F2 and WildBlue (WB-1)

Ka-band Frequencies for HTS

- Most HTS typically file for 3.5 GHz bandwidth in the following Ka-bands:
 - 27.5 – 31 GHz uplink
 - 17.7 – 21.2 GHz downlink
- This range of frequencies is subject to various regulatory procedures. One way to divide these bands is as follows:
 - a) Bands identified for High-Density FSS
 - b) Bands used by many administrations for FS including LMDS
 - c) Bands where GSO and non-GSO satellites have equal rights
 - d) Bands where equivalent pfd (epfd) applies
 - e) Military bands

Simplified summary of Ka-band satellite allocations

Annex 1 Simplified summary of Ka-band satellite frequency allocations for communication satellite networks

UPLINK	DOWNLINK
27.0 GHz -----	17.3 GHz
FSS uplink in Region 2 and 3 only	In Regions 1 and 3 band 17.3-18.1 GHz limited to feeder links for BSS. However 17.3-17.7 GHz FSS downlink Region 1
27.5 GHz -----	17.7 GHz
epfd limits	on downlink only 17.8 – 18.6 GHz has epfd limits (lower band) GSO FSS (1.1 GHz) in US: lower 600 MHz LMDS and FS (Other countries are also making allocations to the LMDS and FS) in US: GSO FSS: 28.1 - 28.6 GHz, 18.3 – 18.8 GHz (500 MHz) (eg. Spaceway)
28.6 GHz -----	18.8 GHz
9.11A	9.11A
500 MHz non-GSO FSS	
29.1 GHz -----	19.3 GHz
9.11A	9.11A
400 MHz for feeder links for non-GSO MSS (eg. Iridium)	
29.5 GHz -----	19.7 GHz
epfd limits	epfd limits
(upper band) GSO FSS (500 MHz) (eg. Spaceway)	
30.0 GHz -----	20.2 GHz
1 GHz for FSS (government/military)	
31.0 GHz -----	21.2 GHz
24.65 GHz -----	21.4 GHz
BSS in Regions 1 and 3	
25.25 GHz -----	22.0 GHz

a) Bands identified for High-Density FSS

- RR No. **5.516B** gives the bands identified for high-density fixed-satellite service (HDFSS). These bands allow for the deployment of uncoordinated FSS earth stations under a blanket license. The only bands that include all Regions are:
 - 29.5 – 30 GHz (uplink) (500 MHz)
 - 19.7 – 20.2 GHz (downlink) (500 MHz)
- On the downlink the following Regional identifications for HDFSS are made in RR No. **5.516B**:
 - 17.3-17.7 GHz (space-to-Earth) in Region 1,
 - 18.3-19.3 GHz (space-to-Earth) in Region 2,
- In Regions 1 and 3 the band 17.3-18.1 GHz is limited to feeder links (i.e. Earth-to-space) for the broadcasting-satellite service (RR No. **5.516**).
- However, in Region 1 the band 17.3-17.7 GHz (400 MHz) may also be used for FSS downlink
- This is not a serious restriction since there are a very limited number of BSS feeder link stations

b) Bands used by many administrations for FS including LMDS

- In all three ITU Regions in most of the FSS Ka-band the FS is co-primary. Another band preferred for FSS is the 1.1 GHz band:
27.5 – 28.6 GHz
17.7 – 18.8 GHz
- However, many administrations have services such as local multipoint distribution services (LMDS) in this band. This service does not share well with HDFSS.

c) Bands where GSO and non-GSO satellite networks have equal rights

- In general, from RR No. **22.2**:
- **22.2**§ 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)
- However, in the following two bands GSO and non-GSO satellite networks have equal rights:
 - 500 MHz band originally intended for Teledesic:
28.6 – 29.1 GHz (uplink), 18.8 – 19.3 GHz (downlink)
- The O3B non-GSO network is planned to operate in this band.

c) Bands where GSO and non-GSO satellite networks have equal rights

- 400 MHz band for non-GSO feeder links (Iridium):
29.1 – 29.5 GHz, 19.3 – 19.7 GHz
- Iridium operates in the L-band on the service link and in the Ka-band on the feeder link.
- In the 500 MHz and 400 MHz bands above RR No. **9.11A** applies which means that a new network whether GSO or non-GSO must coordinate with earlier filed GSO and non-GSO networks as well as other primary services operating in the band.

d) Bands where equivalent pfd (epfd) applies

- The epfd limits were introduced by SkyBridge at WRC-97 and adopted by WRC-2000. The SkyBridge non-GSO satellite network was intended to operate in the Ku-band but WRC-2000 adopted epfd limits for portions of both the C-, Ku- and Ka-bands. Presently there are no satellites operating using this concept.
- The concept is based on re-using GSO frequencies by a non-GSO constellation outside the GSO by avoiding the GSO by about $\pm 10^\circ$.
- These limits define the maximum *permissible* interference that non-GSO FSS systems can cause to GSO FSS networks i.e. if these limits are met there is no need to coordinate with GSO networks, only other non-GSO network.
- The epfd limits are given in Article **22** for different antenna sizes for different percentages of time.
- The epfd (up and down) values were calculated so that they would increase the unavailability by no more than 10% on the most sensitive links.

e) Military bands

- They are not identified as such in the RR but the following bands are used by the military/government:
 - 30 – 31 GHz (uplink)
 - 20.2 – 21.2 GHz (downlink)
- It may be possible for a commercial operator to provide services to the military
- For example, the Ka-band payload of the Inmarsat *Global Xpress™* satellites can be toggled back and forth between military and commercial frequencies.
- Some administrations do not allow commercial satellite operators to file for these bands

Ka-band HTS Frequency Coordination Challenges

- Large number of filings already submitted making it difficult for newcomers to have good priority
- Several different regulatory regimes increases considerably the coordination work and increases the uncertainty of obtaining the required agreements
- Without some certainty of obtaining required agreements it will be difficult to obtain financing
- Obtaining landing rights in the territory covered by the satellite beam

WRC-12 Decisions Affecting the Ka-band

- **New BSS Ka-band Allocations**
- WARC-92 allocated the 21.4 – 22 GHz band to the broadcasting-satellite service in Regions 1 and 3 with an effective date of 1 April 2007
- Allocation was subject to the interim procedures of Resolution **525 (Rev. WRC-07)** which, inter alia, called for access on a first- come-first-served basis
- Due to the many filings submitted WRC-12 adopted special provisions to be applied only once in order to try to guarantee all administrations access to this spectrum. These procedures include queue jumping and stricter Resolution **49** information.

Planned use of 21.4 – 22 GHz band

- Some of the uses foreseen for the 21.4 – 22.0 GHz band include ultra-high definition television and large-screen digital imagery
- A more likely use is multi-channel DTH TV both HD and SD
- With video compression schemes such as MPEG-4 it is now possible to transmit HD TV directly to the consumer at a reasonable cost
- Drastic reduction in the price of flat screen TVs which are now very popular and more consumers want HDTV
- Presently no operating satellites in the new 21.4 – 22 GHz BSS band but satellites using this band are being planned.
- Due to the proximity in frequency the bands used by the Ka-band HTS satellites and the bands to be used by the new Ka-band BSS, both these bands can more easily be accommodated on the same satellite
- Multi-beam satellite antenna pattern of a HTS could be used for one-way DTH TV to facilitate local-into-local satellite transmissions



Thank You

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