Usage tendency and regulation specifics of Ka-band frequencies for the communication and broadcasting satellite systems

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Almaty, 5-7 September 2012

The considered issues

1. The tendency of frequency usage by the satellite networks in the GSO

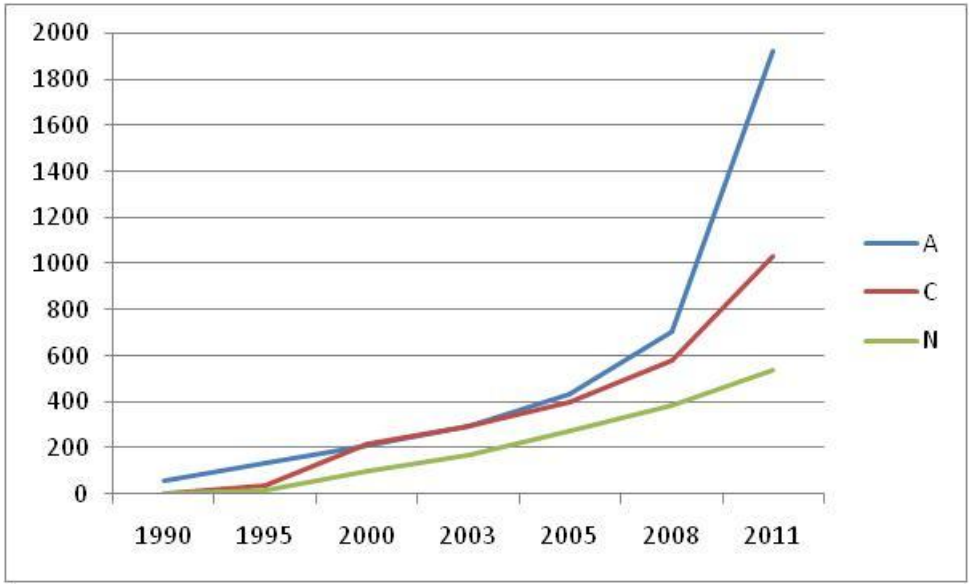
2. The development progress of the Ka-band by the satellite networks in the GSO

3. regulation specifics and practical usage of the frequencies in the Ka-band by the satellite networks in the GSO

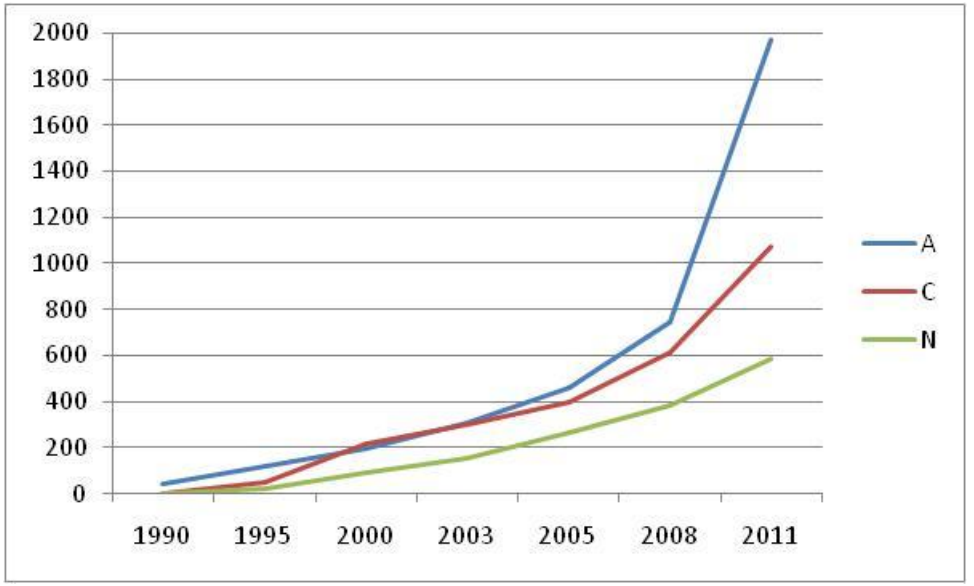
4. Improvement progress of the international rules of frequency usage in the Ka-band

Frequency usage tendency by networks in the GSO (1/3)
The occupation of the typical frequency bands

C-band



Ku-band



The number of satellite networks notified in ITU reached:

- around 2000 networks – in the C-band;
- around 2000 networks – in the Ku-band.

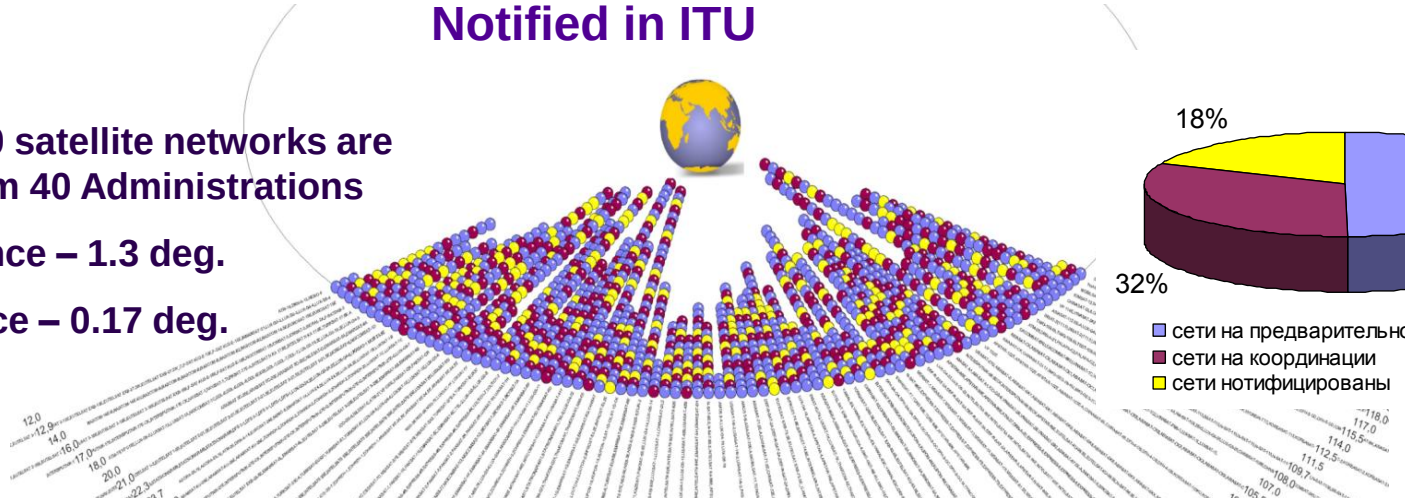
Tendency of frequency usage by networks in the GSO(2/3) Occupancy of the Ku-band on GSO arc from 10E to 120E

Notified in ITU

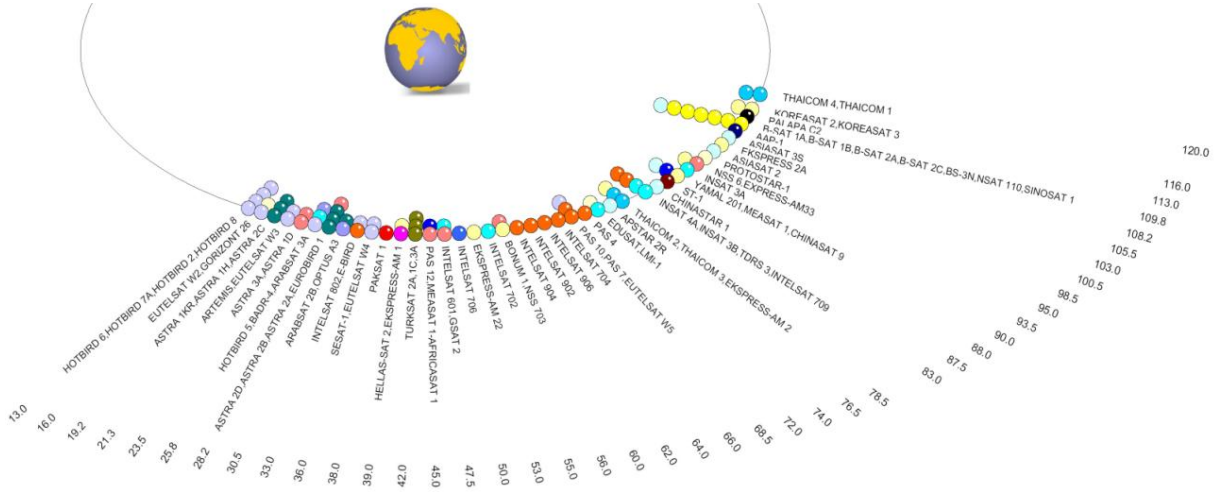
Totally more than 1240 satellite networks are notified in ITU BR from 40 Administrations

Max. separation distance – 1.3 deg.

Average separ. distance – 0.17 deg.

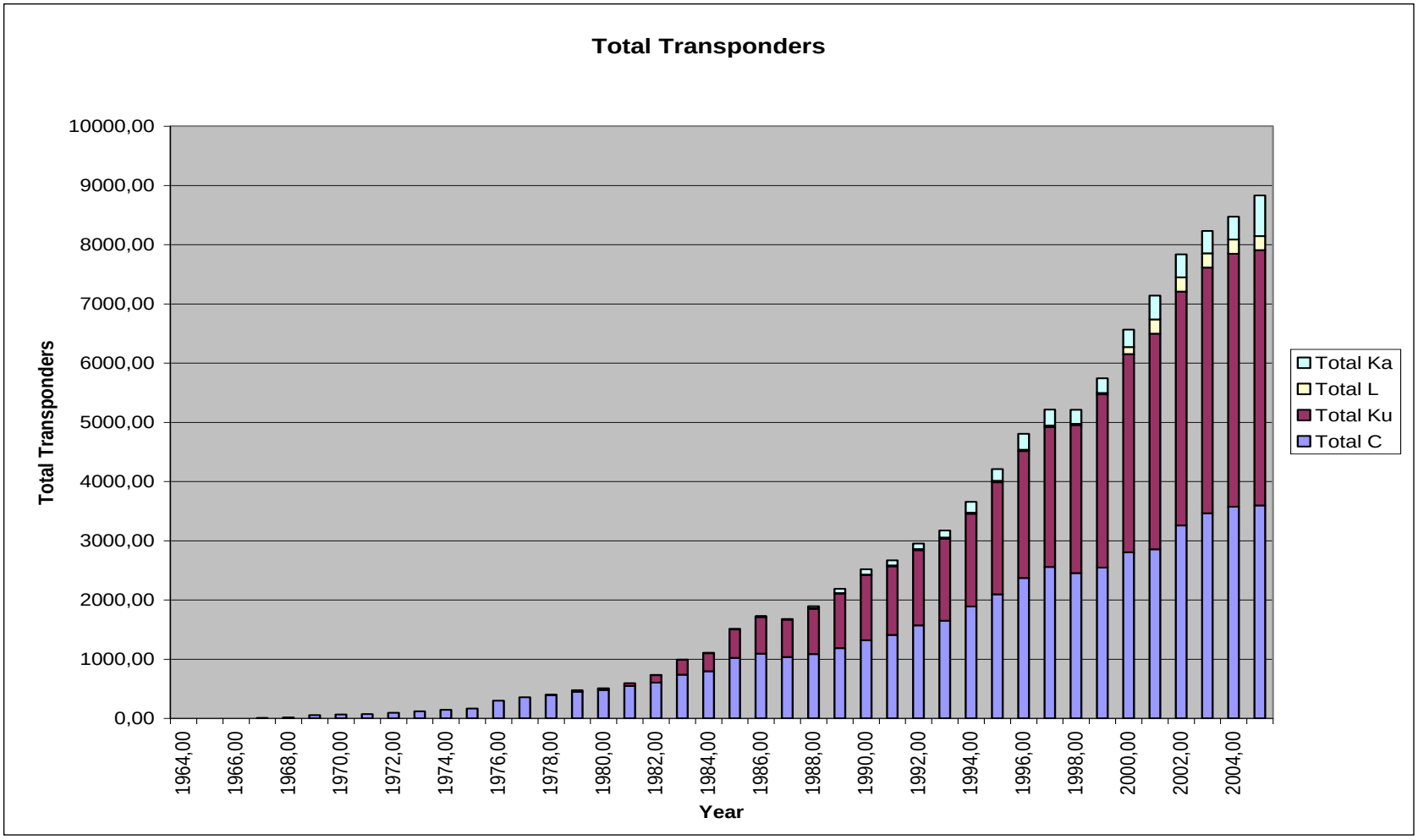


Implemented



Orbital separation distance between actual satellites does not exceed 2.5 deg.

Tendency of frequency usage by networks in the GSO (3/3)
Start of the frequency usage in the Ka-band



Source: Article «HISTORICAL ANALYSIS OF THE OCCUPANCY OF THE GEOSTATIONARY ORBIT, GEO»
Joaquín Restrepo Ph.D., Helena Vargas José V. Valencia, Gustavo Ahumada
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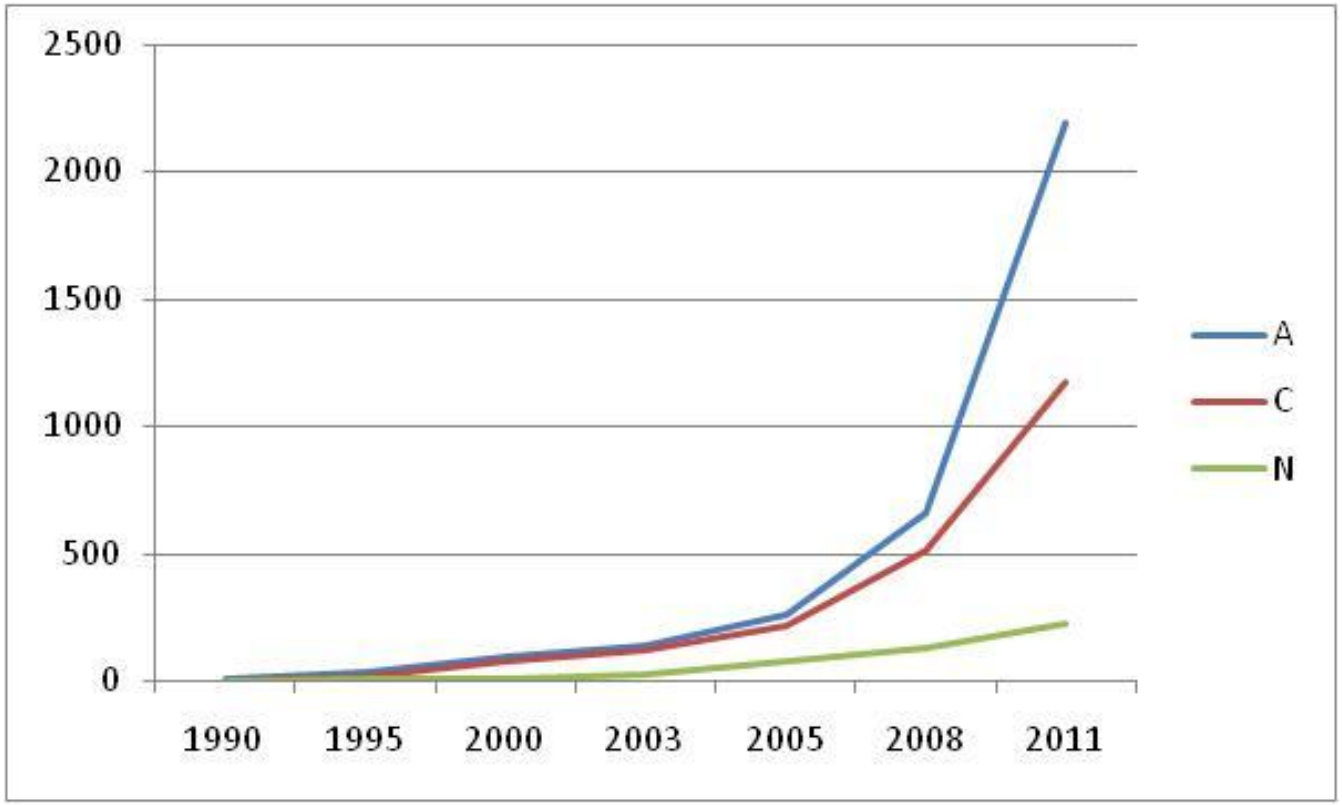
Progress usage of the Ka-band by the GSO networks (1/4)
Notification of the GSO satellite networks in the Ka-band



The number of the satellite networks notified in ITU in the Ka-band

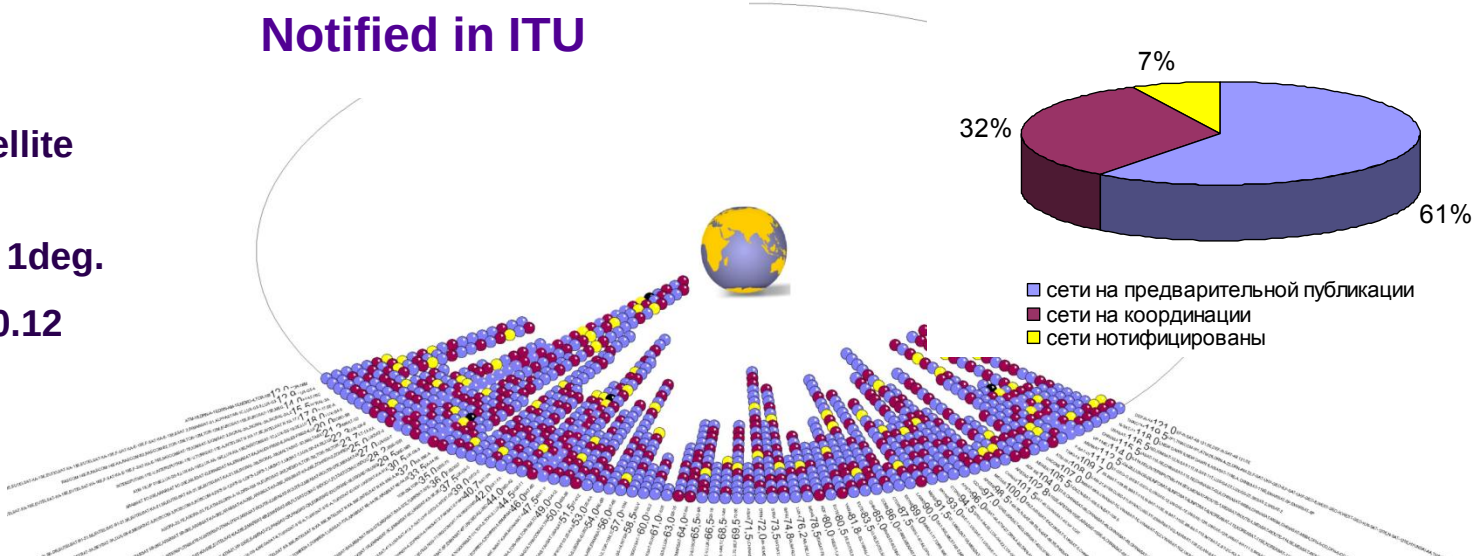
Progress usage of the Ka-band by the GSO networks (2/4)
Occupancy of the Ka-band on GSO arc from 10E to 120E

Notified in ITU

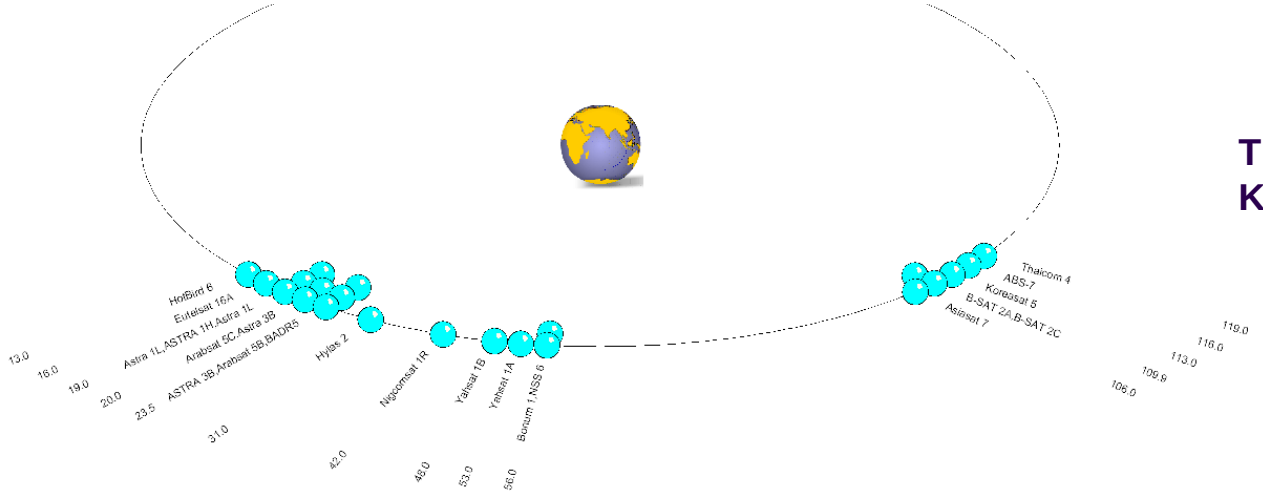
Totally more than 1750 satellite networks

Max. separation distance – 1deg.

Average separ. distance – 0.12 deg.

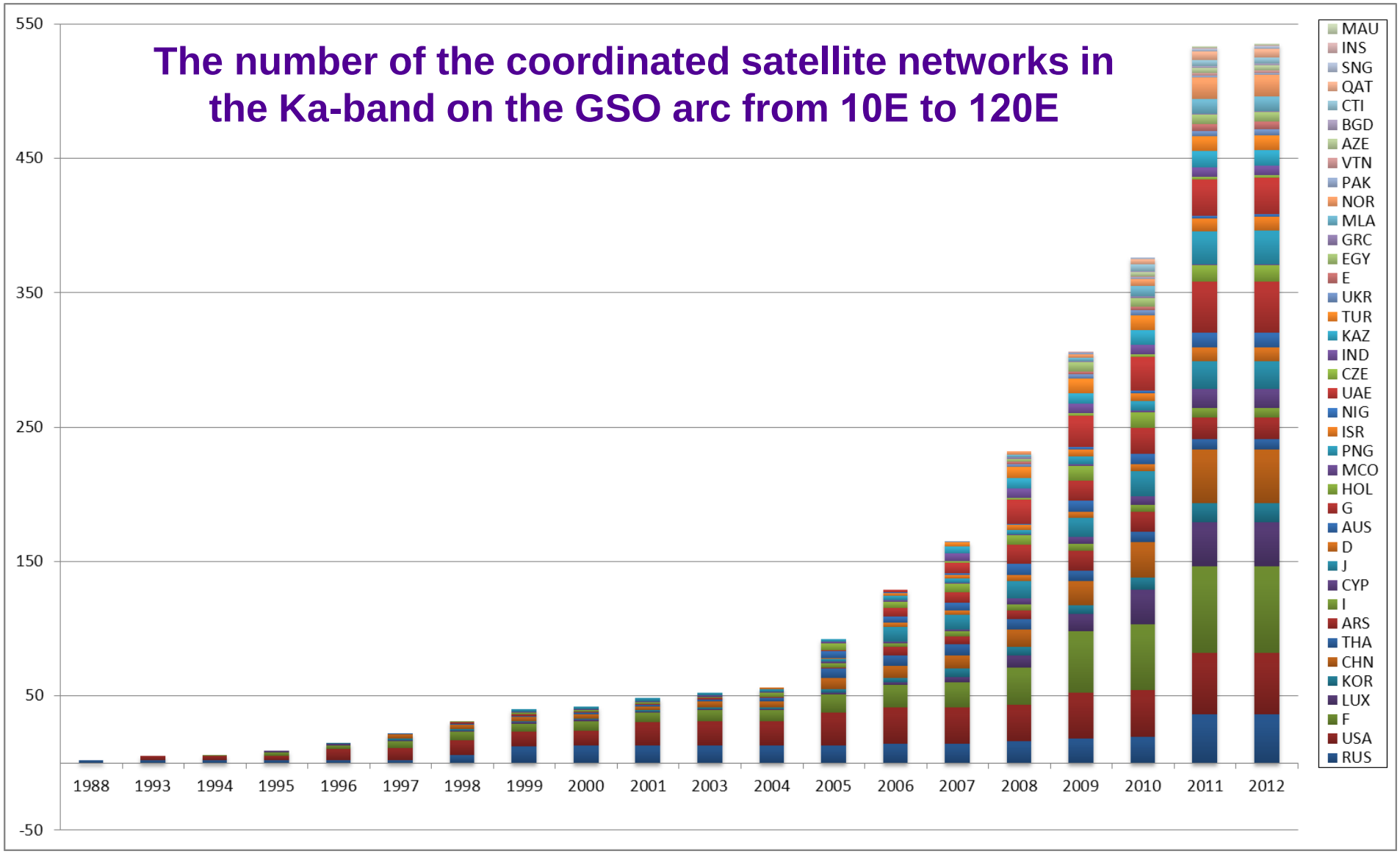


Implemented (commercial networks)

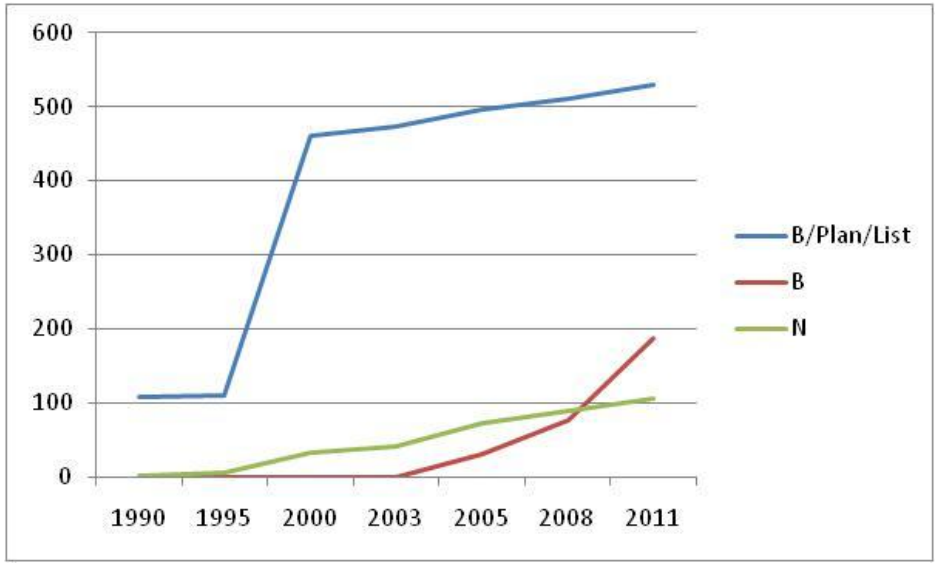


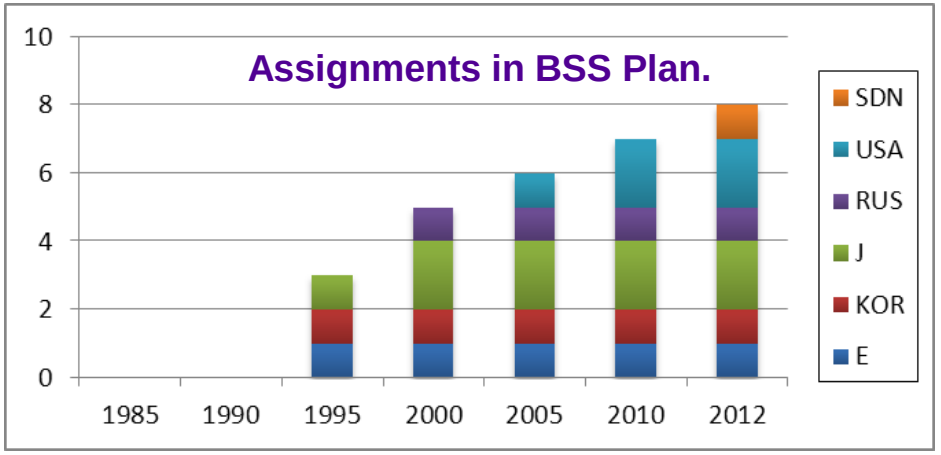
The number of the actual satellites in the Ka-band is very few

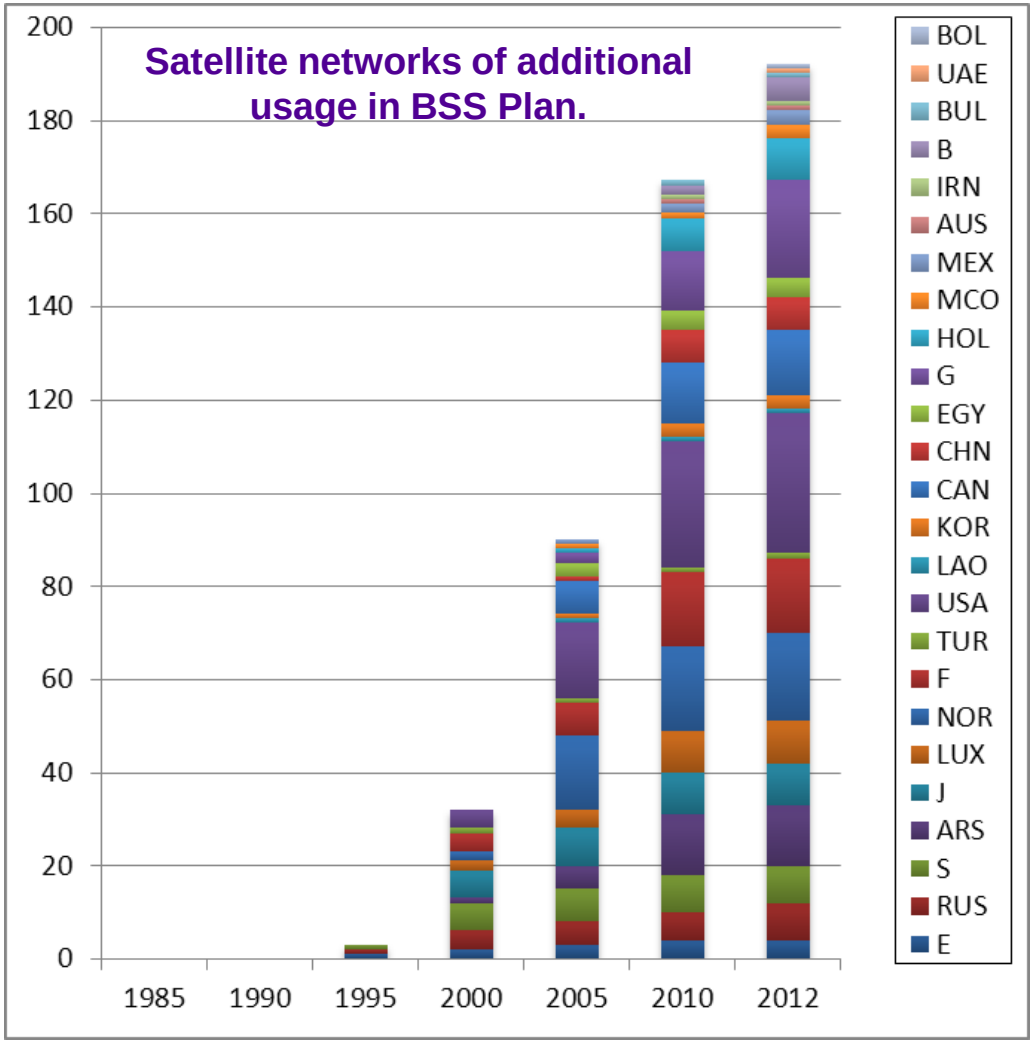
Progress usage of the Ka-band by the GSO networks(3/4)
The coordinated networks on the GSO arc from 10E to 120E



Progress usage of the Ka-band by the GSO networks (4/4)
Usage of the Ka-band in BSS Plan







Regulation features of the Ka-band (1/3)
Frequency allocation in the Ka-band in Region 1

Service	Link	17,3	17,7	18,1	18,4	18,6	18,8	19,3	19,6	19,7	20,1	20,2	21,2	21,4	22
FSS	up	FL BSS	FL BSS	FL BSS				FL MSS NGSO							
	dn	[s]													
MSS	up														
	dn									S					
BSS	dn														
FS															
MS				s	S										
EESS															
SRS						S									
RLS		S													
STFS												s			

Total amount of spectrum for GSO satellite networks on downlink - 4500 MHz
Out of it: 3500 MHz (FSS); 400 MHz (FSS secondary to BSS); 600 MHz (BSS);

Service	Link	24,65	25,25	27,5	28,5	29,1	29,5	29,9	30	31
FSS	up									
	dn									
MSS	up						S			
	dn									
BSS	dn									
FS										
MS										
EESS					s	s	s	S		
SRS										
RLS										
STFS									B	

Total amount of spectrum for GSO satellite networks on uplink - 5300 GHz
Out of it: 4100 MHz + 100 MHz (FSS); 400 MHz (Feeder link BSS App.30A); 700 MHz (Feeder link BSS)

Regulation features of the Ka-band(2/3)
Conditions for the frequencies in the Ka-band in Region 1(1/2)

Service	Link	17,3	17,7	18,1	18,4	18,6	18,8	19,3	19,6	19,7	20,1	20,2	21,2	21,4	22
FSS	up	9.7, App.30A RR, EIRP		9.7				9.11A	9.7						
	dn	9.7	9.7 , PFD				9.7; 9.11A , PFD			9.7					
MSS	up														
	dn									s	9.7				
BSS	Dn													9.7, PFD, Res.553 Res.554	

Pfd limitations

Frequency band	Pfd limit dB(W/m2), at angle of arrival (δ)			Reference bandwidth
	0°-5°	5°-25°	25°-90°	
17,7-19,7 GHz 21,4 - 22 GHz	–115	–115 + 0,5(δ–5)	–105	1 MHz

Limitations for special networks

Frequency band	Max.EIRP SS, dBW/MGz	Off-axis EIRP SS, dBW
21.4-22 GHz	43.2 – 58.2	Res. 553

Pfd limitations - threshold coordination levels

Frequency band	Pfd limit dB(W/m2), for different separation distances (θ)						Reference bandwidth
	0°-0.6°	0.6°-1.05°	1.05°-2.65°	2.65°-4.35°	4.35°-12°	>12°	
21,4-22 GHz	–149.88	$-153,2+9,3\theta^2$	$-143,5+27,2\log\theta$	$-141,1+1,3\theta^2$	$-133,2+26,1\log\theta$	–105	1 MHz

Frequency band	Antenna diameter ES
21.4-22 GHz	45 – 120 cm

1500 MHz on downlink do not have power limitation

Regulation features of the Ka-band(3/3)
Conditions for the frequencies in the Ka-band in Region 1 (2/2)

Service	Link	24,65	25,25	27,5	28,5	28.6	29,1	29,5	29,9	30	31
FSS	Up	9.7, Ant.		9.7, EIRP		9.7; 9.11A, EIRP		9.7, Ant.		9.7	
	Dn										
MSS	Up							s	9.7	9.7	
	Dn										
BSS	Dn										

Max. EIRP limitations ES

Frequency band	Elevation angle, deg.	Reference bandwidth, kHz	Max. EIRP, dBW
> 15 GHz	$\theta \leq 0$	1000	+64
	$0< \theta \leq 5$	1000	$+64+3\theta$

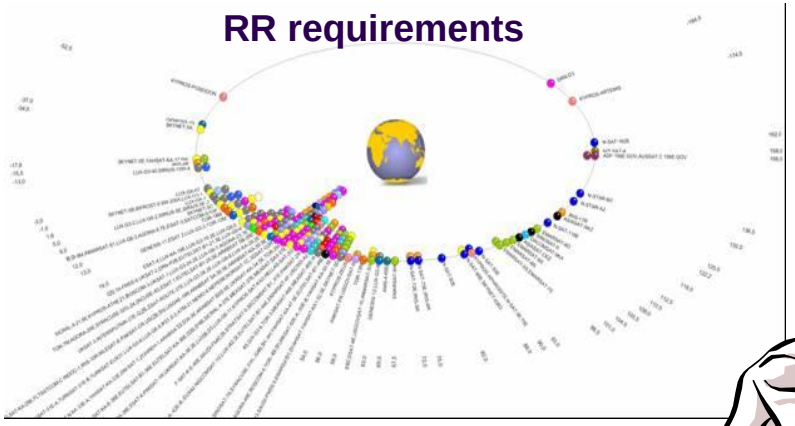
Limitations of antenna ES

Frequency band	Off-axis angle	Off-axis EIRP
29.5-30 GHz	$3° \leq \varphi \leq 7°$	$28 – 25 \log \varphi$ dB(BW/40 kHz)
	$7° < \varphi \leq 9{,}2°$	7 dBW(W/40 kHz)
	$9{,}2° < \varphi \leq 48°$	$31 – 25 \log \varphi$ dBW(W/40 kHz)
	$48° < \varphi \leq 180°$	–1 dBW(W/40 kHz)
24.65-25.25GHz	Min. antenna diametr ES - 4.5 м	

1500 МГц MHz on uplink do not have maximum power limitation

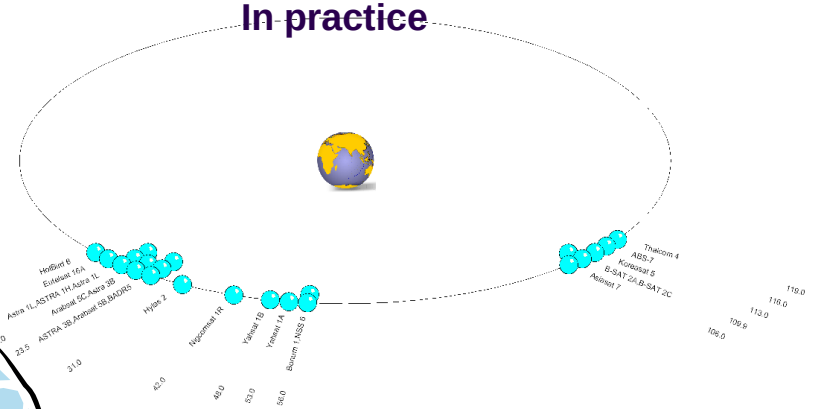
Improvement progress of the international rules of frequency usage in the Ka-band

RR requirements



Coordination is required with 200 networks of 29 countries

In practice



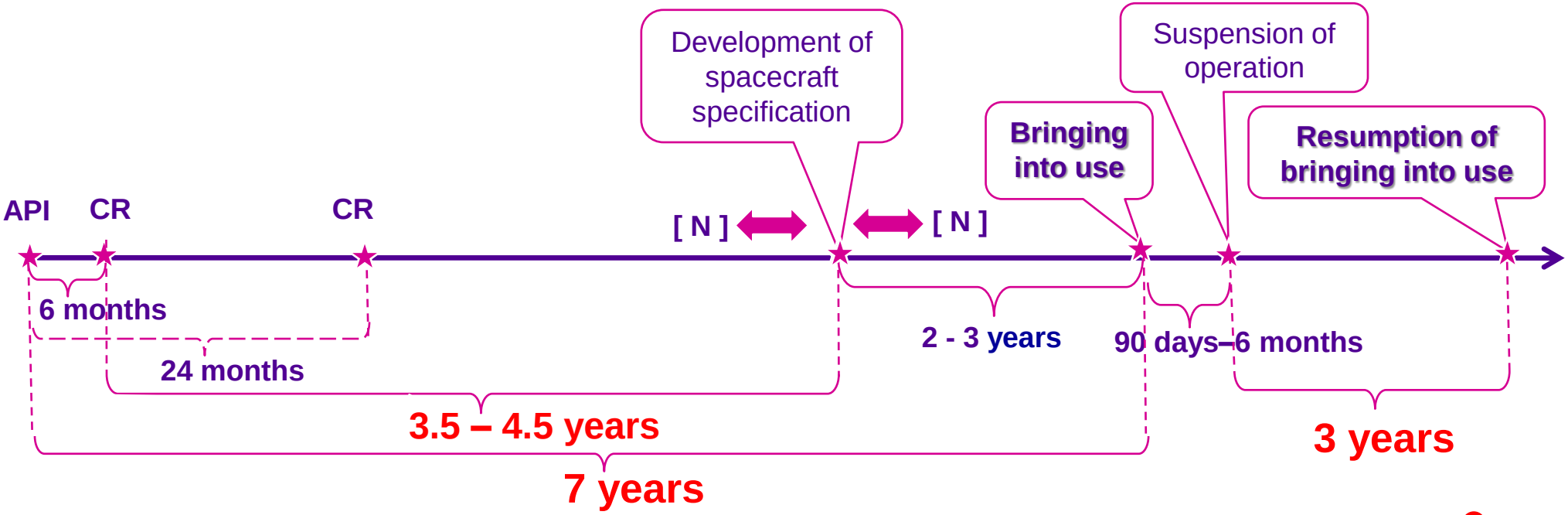
In practice not more than 20 networks are affected of 5…8 Administrations

Deficient RR procedures lead to considerable constraints and risks in implementation of new satellite communication and broadcasting networks

Possible directions towards to international rules improvement :

- updating of criteria for defining a coordination request;
- adoption of the conditions motivating to submit homogeneous networks;
- adoption of the conditions to limit antenna size of earth stations;
- adoption of the conditions motivating to notify networks with actual parameters.

International rules improving prospective in Ka - band



Procedures improvement for implementation of networks notified with actual parameters within 7 years period

- Improving Resolution 49 and other RR provisions;
- Possibility to extend or suspend of date bringing into use in case of availability «hard» contracts on satellite building;
- Fee implementation for frequency resource reservation and so on.

Questions?

Thank you for your attention!

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