# Challenges facing the satellite community

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# Agenda

This presentation will look to the past (WRC-03, WRC-07 & WRC-12) and to the future (WRC-15), and consider practical issues facing satellite operators and their customers.

The focus is on three main areas:

- Terrestrial interference issues in C-band
- Limited Ku band uplink spectrum
- Expansion of satellite systems into Ka band

# Services provided by satellites

| | |
|---|---|
| **C Band** | • Cable video distribution (e.g., NSS-806 video neighborhood)<br>• OU video distribution (e.g., NSS-806)<br>• VSAT networks (e.g., NSS-806/703)<br>• GSM Backhaul (e.g., NSS-806/703) |
| **Ku Band** | • DTH services (e.g., SES-6/AMC-3/AMC-4)<br>• Aeronautical and maritime connectivity (e.g., SES-4/SES-6/AMC-3/AMC-4)<br>• GSM backhaul (e.g., SES-4/SES-6/AMC-3/AMC-4)<br>• VSAT networks (e.g., SES-4/SES-6/AMC-3/AMC-4) |
| **Ka Band** | • Satellite broadband<br>• GSM/4G backhaul<br>• Potentially DTH in the near future.<br>• Aeronautical and maritime connectivity |

# Terrestrial interference in C-band

Issue

- WRC-15 Agenda Item 1.1 will consider additional spectrum generally for International Mobile Telecommunications (IMT) and other mobile broadband applications
  - Numerous input documents to the ITU already seek consideration of C-band

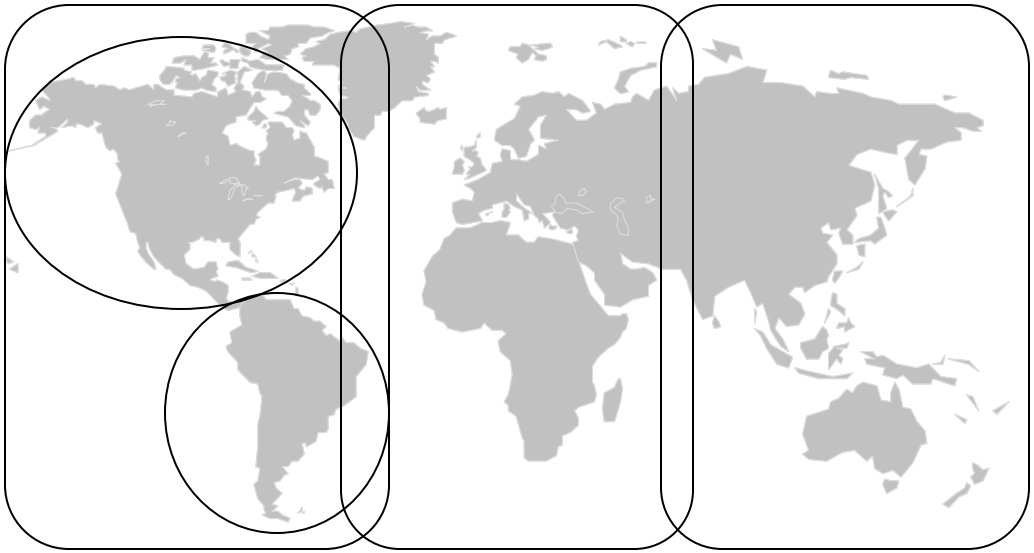
- The problem is that such use is not compatible with the existing operations in C-band, including FSS, radar systems and fixed point-to-point links
- In particular, C-band is heavily used by FSS systems around the world, and its use is continuing to grow
  - Around 169 C-band satellites are in geostationary orbit today
    - 32 of these satellites cover Latin America
  - There is substantial ongoing investment in C-band satellite capacity worldwide:
    - At least 52 satellites with C-band payloads have been launched in 2007-2012, representing $12-15 billion in investment
    - At least 35 satellites with C-band payloads are under construction and are scheduled to be launched in 2012-2015, representing $9-10 billion in investment

# Key Services Supported by C-band Satellites

- **Media Distribution**
  - C-band is used to distribute media content around the world, including, e.g.
    - Cable distribution to 7038 cable headends around the United States, serving 60 million U.S. households
    - In 2010, 18.7 million cable homes in Latin America served by SES C-band satellites
    - 20 million receive-only C-band television dishes in Brazil alone
- **Media Contribution**
  - Special events coverage (e.g. Olympics)
  - Satellite news gathering
- **Feeder Links for mobile-satellite services (MSS)**
  - Supporting public safety and emergency relief missions around the world.
- **Rural and remote communications**
  - Internet and basic connectivity in remote areas (remote villages, external territories, maritime platforms, etc.)
  - Cellular backhaul applications
- **Mobility**
  - 3510 C-band Earth Stations on Vessels (ESVs) in 2012, providing video distribution, Internet and mobile backhaul services
- **Other C-band services, including**
  - Disaster recovery and emergency preparedness
  - Tracking, Telemetry & Command (TT&C) for many satellite systems in other frequency bands, for example, for launches

# Unique Attributes of C-Band Satellite Services

- C-band satellite services cannot easily be replicated at other satellite bands or via terrestrial means
  - Geographic reach. C-band easily covers entire continents and oceans and offers an economically viable way of providing intercontinental and global communications
    - Smaller or hard-to-reach markets and low density regions are covered as easily as metropolitan areas
    - Particularly ideal for point-to-multipoint applications (broadcast, widely-dispersed networks), and remote/rural deployment
  - Resistance to rain-fade
    - C-band is less susceptible to signal interruptions from heavy rains than higher bands (Ku, Ka), making it better suited for tropical or high-rain areas at high availabilities



# Sharing between FSS and BWA/IMT is not feasible

- ITU studies have concluded that protection distances of between **51 – 430 km** are necessary to allow co-frequency sharing between BWA/IMT systems and FSS earth stations
  - Adjacent band protection distances to avoid LNB overload of FSS receivers are between **10 – 31 km**
  - Considering that a typical city has a radius of 15 to 30 km, sharing between BWA/IMT systems and FSS receive earth stations is not realistic
  - See Reports ITU-R M.2109 & S.2199
- Government, strategic, and commercial FSS services in the C-band will suffer:
  - Signal delays; Synchronization loss; Blackout periods; Blackout areas; Total loss of transmission
  - Many countries – Bolivia, Hong Kong, Indonesia, Fiji, to name a few – have experienced interference when deploying BWA systems in C-band
    - WiMAX testing led to 30% of TV households in Bolivia missing some of World Cup 2006
    - Similar testing in Hong Kong led to 300,000 households across Asia to lose their TV service

# Sharing between FSS and BWA/IMT is not feasible

- Sharing is exasperated by a large number of receive only earth stations already deployed – many are unregistered
  - Shielding, for example, requires knowing where all earth stations are
  - Further, site shielding is expensive and infeasible on a regional or worldwide basis

# WRC-15 Agenda item 1.1 & C-band

Possible solutions?

- Clearly there is a strong demand for terrestrial mobile broadband communications
- However, it is important to balance that demand with the need for countries and citizens to have access to other means of communications as well, such as critical satellite services in C-band
- Many other frequency bands are available for IMT, and more desirable from a coverage perspective:
  - 410-430 MHz – Cost effective
  - 450-470 MHz – Cost effective and widely favored
  - 470-806 MHz – Cost effective and widely favored
  - 806-862 MHz – Cost-effective and widely favored
  - 2500-2690 MHz – UMTS extension band, well-suited to offering these services
  - 3300-3400 MHz – Similar to 3400 MHz+ but less impact to C-band satellite services
- The WRC-15 studies are now starting → We seek your support in maintaining the ability to use C-band for satellite services!

# Limited Ku band uplink spectrum

Issue

- In ITU Region 2, there is 200 MHz more downlink fixed-satellite service (FSS) spectrum than uplink spectrum

**The unplanned FSS bands in the 10-15 GHz range in ITU Region 2**

| Frequency bands (GHz) | Bandwidth (MHz) |
|---|---|
| **Earth-to-space direction (uplink)** | |
| 12.7-12.75 | 50 |
| 13.75-14.5 | 750 |
| **Total spectrum in the uplink** | **800** |
| **Space-to-Earth direction (downlink)** | |
| 10.95-11.2 | 250 |
| 11.45-11.7 | 250 |
| 11.7-12.2 | 500 |
| **Total spectrum in the downlink** | **1 000** |
| **Uplink and downlink spectrum difference** | **200** |

- Lack of sufficient Ku band uplink spectrum makes it difficult to design satellite systems that maximize use of the available downlink spectrum.

- This issue will be a problem for any entity seeking to launch a new satellite system, as the prime Ku band uplink spectrum – 14-14.5 GHz – is very congested over Region 2.

# Limited Ku band uplink spectrum

Let's consider an example:

- We are designing a satellite with two beams – one over South America & one over North America
- We want to be able to re-use all of the available downlink spectrum in each beam
- To provide DTH services in the North American beam using all available downlink spectrum, we need 1000 MHz of uplink spectrum
  - 14-14.5 GHz & 13.75-14 GHz are available
  - For the other 250 MHz, we have to find other spectrum → Planned FSS? BSS feeder link spectrum? Ka band?
  - Then these bands cannot be used for other satellites at the same location, and will create a frequency shortage in other bands
  - Or, we could provide the uplink in a geographically isolated beam; however, that means you cannot use that uplink spectrum in the South American beam
- If we were providing VSAT services, it would be difficult to use 13.75-14 GHz for small return earth stations because of ITU minimum earth station size limitations

# Limited Ku band uplink spectrum

Possible solutions?

- WRC-15 is coming to our rescue!
- Pursuant to its agenda item 1.6.2, it will address this issue:

  "to consider possible additional primary allocations to the fixed-satellite service (FSS) (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 within the range 13-17 GHz and review the regulatory provisions on the current allocations to the fixed-satellite service within this range, taking into account the results of ITU R studies, in accordance with Resolution **152 (WRC 12)**"

- All countries/companies planning to launch Ku band satellite systems will be affected by this uplink spectrum shortage
- We encourage countries and companies to participate in this effort
  - ITU studies already underway in ITU-R Working Party 4A

# Expansion of satellite systems into Ka band

- Many new satellite systems are have been launched or are planned for Ka band, many of which we will hear about in other presentations this week – Global Xpress, O3b, EchoStar 17, Spaceway 3, AMC-15, AMC-16, WildBlue-1, Viasat-1, to name a few
  - These systems are focused on providing broadband, DTH and mobile services
- From a regulatory perspective, there are several key issues facing their expansion in Region 2:
- User terminals need access to sufficient spectrum that is not encumbered by terrestrial interference or the need to coordinate on a site-by-site basis with terrestrial systems
  - In this regard, WRC-03 adopted a footnote to the ITU Table of Frequency Allocations, the so-called HDFSS concept, which specified certain bands for high density deployment of earth stations
  - Specifically, No. 5.516B specifies 18.3-19.3, 19.7-20.2 GHz (space-to-Earth) and 28.35-29.1, 29.25-30 GHz (Earth-to-space) for Region 2 HDFSS earth stations (user terminals)
- At the same time, other types of earth stations, including gateway or hub earth stations, need access to large amounts of spectrum, and can be successfully coordinated with terrestrial stations.

# Expansion of satellite systems into Ka band

- Finally, both GSO and non-GSO (e.g., O3b) satellite systems are planned in Ka band.
  - In order to allow consumers in Latin America to take advantage of both types of services, it is important for administrations to consider how to accommodate both types of systems
  - Mechanisms can be drawn from the ITU Radio Regulations – Article 22 epfd limits in certain bands & coordination between GSO & non-GSO systems in other bands under No. 9.11A

# ¡Gracias!

# Thank you!