Satellite Interference Mitigation: Global Trends and Implications

David Hartshorn
Secretary General
Global VSAT Forum
Satellite RF Interference

• Problems:
  1. Improper Installation
  2. BWA Interference
  3. Poor Equipment Standards
  4. Unidentified Carriers
  5. Lack of Incident Coordination

• Solutions:
  ✓ GVF Installer Certification (i3)
  ✓ Satellite Spectrum Initiative
  ✓ GVF Type Approvals (i3)
  ✓ Carrier ID (SUIRG, i3 & GVF)
  ✓ Data Sharing (SUIRG, GVF, i3)
Problem #1: Poor VSAT Installations

Solution #1: Certifying & Promoting Installers

Level 1: Introduction to VSAT Technology
- On-line or classroom

Level 2: VSAT Installation Fundamentals
- On-line or classroom

Level 3: Advanced VSAT Installation and Maintenance
- Classroom
- On-line

Level 3i: iDirect Remote Installation
- On-line

Future specific Level 3 courses
- On-line

Hands-On Skills Test
- Classroom

GVF Advanced VSAT Installer Certification

GVF iDirect Installer Certification

Future additional GVF Certifications

Database maintained at www.gvf.org
At gvf.coursehost.com:

- Student log-in
- Self registration
- Tuition payment
- Course catalog
- Classroom schedules
- Newsletter archives
- Guided tour
- Brochures
- Certificates
In this simulation, the student walks through all the steps of operating the antenna az-el mechanism to peak the signal. The meter simulates the exact behavior of the iDirect terminal to the downlink. In a later page, the student performs the exercise without the hints and “sky view.”

**Azimuth peaking**

We are now close to the satellite, but locking the coarse azimuth probably moved the beam. Click the green **NEXT** button to step through the procedure for peaking with the fine azimuth control.

**Click here to take the wrench off the antenna around**

1. Loosen the fine azimuth locks.
2. Back off the forward az adj nut by about 5 turns.
3. Look for the signal by scanning CCW (rear adjuster).
4. Back off the rear az nut by about 10 turns.
5. Find the peak by scanning CW (forward adjuster).
6. Back off the forward adjuster
7. Return to the peak, scanning CCW (rear adjuster).

Because we went past the peak, we must go back the other way. To do that, we will use the rear adjuster, but first we must back off the forward adjuster to make room.
GVF Training Centres Established

- At Least One Per Region
- Certified GVF Master Instructors
- Providing Full Range of VSAT Training
- Delivery of Capacity Building Anywhere
- Other Training Centres to be Established
GVF Hands-On Training in Thailand
GVF Hands-On Training in Thailand: Fault Isolation and Maintenance
GVF Hands-On Training: BER vs Eb/No, SSPA Back-off, Intermodulation
GVF Certification: Next Steps

- 18 Satellite Operators Support GVF Certification
- Endorsement and Material Support
- Moving To Require Basic Certification for Installers
- Your Organisation is Invited to Participate!
- Visit: http://gvf.coursehost.com
Problem #2: BWA Interference

• The Asia-Pacific Broadcasting Union (“ABU”) has warned that…

“… if [BWA is] implemented in the same frequency bands as the satellite downlinks, it will have an adverse impact … and may make satellite operation in the entire C band impracticable. These bands are by far the most important frequency bands for satellite communication in Asia.”
The Inherent Advantage of C-band Footprints
Example: AsiaSat 4 (122.2ºE) C & Ku-band
IMT/BWA in C-band Downlinks

Is currently being introduced country by country worldwide

Future mobile phone networks (IMT Advanced, 4G, ....)

Additional band (FSS, feederlinks for MSS, ...)

Band commonly used by FSS satellites

3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2

Was considered at ITU WRC-07
The Findings*

• BWA or IMT in a part or all of the FSS C-band downlink will be incompatible with general FSS reception in any part of C-band in the same geographical area

• BWA or IMT in a part of C-band may be compatible with FSS reception by a small number of earth stations if:
  – Appropriate exclusion zones around each of the earth stations are established
  – User terminals are designed not to emit any signals when not in contact with a base station

• Introduction of BWA or IMT by one country can block FSS reception in another country

* Source: ITU, Satellite/Wireless Industry, Regulators (e.g. OFTA)
Overdrive of LNB

Example of gain compression and intermodulation of LNB by single BWA base station (BWA signal at 3.505 GHz (bandwidth 3.5 MHz), spectrum plots 3.775-3.675 GHz)
Example of calculated exclusion zone around an earth station to counter interference from a single IMT base station in each cell (From French study to ITU Working Party 8F (Document WP 8F/868))
Sample Exclusion zone

Example of exclusion zone with a radius of 20 km around an earth station in Singapore
RF Waveguide Bandpass Filter a Solution?

- Only helps against overdrive of LNB
- Cannot mitigate in-band interference
- Cannot mitigate unwanted emissions
- Only provides limited reduction of overdrive effects
- For many antennas, in particular receive only antennas, LNB and antenna feedhorn are molded together in one unit and no filter can be inserted in between
- Expensive (~ USD 1000.-). Inserting such in all receive installations becomes a significant cost
Was WRC-07 a Solution?

- No global identification for IMT, But…

- Individual countries can take a different position to the international community and sign up to ‘country footnotes’ that offer…

  – In Region 1: 3 400 – 3 600 MHz is allocated to mobile services and identified for IMT for some countries
  – In Region 2: 3 400 – 3 500 MHz is allocated to mobile services
  – In Region 3: 3 400 – 3 500 MHz is allocated to mobile services and identified for IMT for some countries, as is 3 500 – 3 600 MHz
No Change in ITU Radio Regulations Table on 3400-4200 (victory?)

Post WRC-07 ‘Opt-In’ Foot Noted Countries (Mobile 3.4-3.6 GHz)

3400-3500 Mobile
3400-3600 Mobile
3400-3600 Mobile
3400-3500 Mobile

* Primary U.S. by Footnote 5.433
How C-band Will be ‘Protected’

• Any deployment of IMT services in the C band must fulfil strict criteria laid out in the country footnote:
  
  – Careful limits are placed on the power flux density allowed at the border between countries that choose to allow the deployment of IMT services and countries that follow the norm
  
  – Existing rules governing sharing between services are reaffirmed to make sure they are applied when necessary - to help protect both existing and future satellite services

• There are no future agenda items to revisit this issue in the years to come; case closed…
With Caveats

- WRC-07 Protections Focus Only on Cross-Border Protections
- National-Level Domestic Interference Still Major Issue
- Regulatory Administrations Often Unaware of Problem
- Faced with Mounting Interference Some are Forced to Shut Down BWA Services
- Problem is Spreading Worldwide
Solution #2: The “Satellite Spectrum Initiative”

• Seeking Enforcement of WRC-07 Decision

• Pursuing Technical/Commercial/Regulatory Solutions

• GVF Co-ordinating with Wireless Industry

• We Invite Your Support

• Contact: David.Hartshorn@gvf.org
Problem #3: Poor Equipment Standards

- Reduced Satellite Operator Provision of Type Approvals for VSAT Earth Station Equipment
- Increasing Attempts by TVRO Manufacturers to Try Production of Transmitting VSAT Antennas
- Now, Auto-Deploy Are Being Added to the Mix
- Vacuum in Technical Know-How and Deployment of Systems That Spray Orbital Arc with Interference
Solution #3: GVF Type Approvals

• GVF Now Offers Outsourced Type Approvals Service

• Intelsat First to Embrace the Solution

• GVF ‘Authorized Test Entities’ Available to…
  • Assist Antenna Manufacturers with Design
  • Conduct Type Approval Testing
  • Using Satellite Operator Specs
  • Provide Type Approval for Compliant Systems

• Maintaining Higher Product Quality Standards
• Thank You!
  – Contact David.Hartshorn@gvf.org