INTERFERENCE TO C-BAND SATELLITE TERMINALS FROM WIRELESS DEVICES: WHAT IS THE STATUS AND WHAT CAN BE DONE?

Prepared by
Satellite Spectrum Initiative and GVF
May 14, 2014

Background

Testing has confirmed what a growing number of telecom service providers already know: that terrestrial wireless services (such as Wi-Max systems) can cause severe interference to satellite services when operated in the same, or even in an adjacent, frequency band.

Throughout the world, satellite services are being severely disrupted by interference from new Broadband Wireless Access (BWA) networks operating in the "extended" C-band frequencies. Further, there is an effort underway by the terrestrial-wireless industry to introduce new mobile phone networks like International Mobile Telecommunications (IMT) advanced and 4G services in 'standard' C-band frequencies. These have also been shown to interfere with VSAT services.

In some cases, VSAT installers can mitigate this situation by installing precision waveguide filters before the LNB, engineering a specially-designed high wall around the antenna, or relocating the antenna far away from the interference source. Often, however, these techniques are insufficient or impractical.

GVF is helping address the issue by reporting issues to governments. You can facilitate this process by providing feedback through the online survey at [link TBD].

It is essential that the telecommunications sector come to a better understanding of the implications of this problem. In particular, customers of VSAT and other services should recognize the potential for massive disruptions to C-band satellite communications, radar systems and domestic microwave links, if spectrum is inappropriately allocated to, and frequencies inappropriately assigned for, terrestrial wireless applications in the C-band (specifically 3.4 – 4.2 GHz).

Test Results and Implications

The coordinated effort to confirm whether Wi-Max and other BWA systems would cause severe interference to satellite systems operating in an adjacent frequency band began in 2007 and, more recently, was continued with sharing studies on the latest wireless systems.

The satellite systems that operate in the 3.4-4.2 GHz band (C-band) are suffering substantial interference, to the point of system failure, in places where national administrations are allowing Broadband Wireless Access systems like Wi-Max to share the same spectrum bands already being used to provide satellite services. The same will happen if 3G and the planned 4G mobile systems (also referred to as IMT systems) are allowed to use the frequencies used in the C-band for satellite downlink services as is being permitted by some administrations.

To eliminate this harmful interference, operators of satellite earth stations and users of satellite communications services have united to communicate their positions and technical requirements to national and international telecommunications regulators. Regulators and radio frequency managers need to allocate spectrum in ways that recognize the reality of harmful interference and validate the right of incumbent operators to operate, and their customers to enjoy their services, without disruption by new users.

C-band satellite, and the Broadband Wireless Access (BWA) and IMT mobile services are all important services, and there are ways to find suitable spectrum for all of them to operate.

The problem

Several national administrations have designated portions of the frequency band 3.4 – 4.2 GHz for terrestrial wireless applications such as BWA and future mobile services ("IMT advanced", Beyond 3G, 4G). This band is already in use by satellite services, radar systems, and domestic microwave links. This band is commonly referred to as the C-band.

In places where administrations have allowed BWA services to use the C-band, there have been massive interruptions of satellite services. Interference with radars and microwave links, which also operate in these frequencies, is likely. Satellite operations in places including Australia, Bolivia, Fiji, Hong Kong, Indonesia, Pakistan and sub-Saharan Africa have already been negatively affected. Other national administrations can and should avoid repeating this costly mistake. Alternative approaches are available.

Importance of the C-band

Use of the C-band for satellite communications is widespread throughout the world. It is particularly vital for many developing countries, particularly in South and Central America, Asia, and equatorial Africa because of its resilience in the presence of heavy rain. C-band earth stations are also used extensively in many developed countries. C-band (“Standard C-Band” and “Extended C band”[1]) frequencies have been assigned for satellite downlinks since the industry was inaugurated more than 40 years ago.

C-band services cover large areas. They facilitate intercontinental and global communications, and provide a wide range of services in developing countries. Services in this band now provide critical applications such as distance learning, telemedicine, universal access, disaster recovery, and television transmission in many tropical regions.

Technical explanation

Antennas which receive satellite downlink signals in the C band are by necessity extremely sensitive devices. They are designed to receive a low-power signal emitted by small transmitters located in orbit 36,000 kilometers above the equator. In the C band, satellite services have co-existed with domestic microwave links and radars for many years, because the latter systems operate via tightly focused beams from fixed points, and de-confliction can take place when necessary.

By contrast, terrestrial wireless applications are by definition ubiquitous and increasingly mobile/nomadic. Mobile and base stations for terrestrial wireless applications emit signals from many locations, in all directions, simultaneously that are powerful enough to saturate the sensitive C band satellite receiving systems, causing a potential for total loss of service in the C band. Recent operating experience in Australia, Fiji and Indonesia, and field trials in Hong Kong have confirmed this interference. (In the Hong Kong experiments, television signals feeding 300,000,000 households throughout Asia were inadvertently knocked off the air!)

The sensitivity of C band satellite receiving systems also means that they may be disrupted by mobile terrestrial use of frequencies in immediately adjacent bands. Field tests by the Office of the Telecommunications Authority in Hong Kong concluded that use of frequencies for terrestrial wireless services in the Extended C and Standard C bands was not practical.

A Particular Problem for Developing Countries

C-band services are especially important for developing countries. The supporting equipment is relatively inexpensive and the signals easily cover large areas. Such services are well adapted to provide voice, data services and internet connectivity in remote areas underserved by other communications means. They are an essential component in the ITU’s push to bridge the “digital divide” between the developed and developing world. Because they cover wide areas with minimal susceptibility to rain fade, they have proven to be exceptionally useful for disaster recovery in tropical areas – for example, C- band based services were vital in facilitating clean up and recovery after the recent Philippine cyclone and other natural disasters. Other growing applications in developing-country use include distance learning and telemedicine.

[1] The bands 3.4-3.7 GHz and 3.7-4.2 GHz are usually referred to as Extended C-Band and Standard C-Band, respectively.

Growing recognition of the problem

It was thought by governments which assigned broadband wireless frequencies in the extended C-band that the problem could be limited by frequency segmentation. This has proven to be ineffective in real-world tests. Large-scale disruptions of services operating in non-overlapping frequency bands have taken place in several countries, and as a result, governments, intergovernmental bodies, and the satellite industry have begun to recognize the threat that ill-considered assignment of standard C-band and extended C-band frequencies to terrestrial wireless services poses.

- Even in the case where BWA and satellite earth stations operate on different frequencies in the same portion of the C band, geographic separation is necessary. The Hong Kong Telecommunications Authority Working Group conducted an extensive series of field tests, concluding that "BWA equipment within an area of several kilometers around existing licensed earth station operating in the same frequencies may cause interference to the latter….protection by separation distance is only meaningful for fixed access but not for mobile access….Based on the assessment in this paper, there are interference problems caused by the proposed allocation of BWA in the 3.4 – 3.6 GHz band to the reception of satellite signals by FSS systems in the 3.4 – 4.2 GHz band. For the coexistence of the two services in the same territory, some technical constraints must be observed. The technical constraints would imply significant costs to be incurred by both BWA operators and FSS users and they may make it difficult for a wide and cost-effective deployment of BWA systems in a dense urban environment."

- In South America, the Bolivian Superintendencia de Comunicaciones (SITTEL) approved the usage of the 3.4 to 3.8 GHz band for telecommunication as the primary allocation for usage for the WiFi industry. During the short testing period prior to the planned May 2006 roll-out, satellite signals carrying television channels in Bolivia were severely interrupted and major interference was reported. Viewers were missing World Cup games. SITTEL issued an administrative resolution mandating that wireless access system deployments in the 3.7-3.8 GHz band be suspended in the entire territory of Bolivia for a period of 90 days, so that SITTEL could adopt measures to solve this matter. The resolution also instructs the spectrum planning department of SITTEL to propose a new norm for channels in the 3.4-3.8 GHz band. More recently, SITTEL has indicated that it intends to accommodate the BWA operators in the band 3.4-3.5 GHz and had initiated the required procedures to finalize such arrangement.

- The Asia-Pacific Telecommunity (APT – a regional intergovernmental organization) in a report from the APT Wireless Forum (AWF) has warned "… BWA systems within **several kilometers** of an FSS receive earth station operating in the same frequency band, but on a non-co-channel basis, would need to carefully conduct coordination on a case-by-case basis. Moreover, to avoid interference in non-overlapping frequency bands…a minimum separation distance of **2 km** needs to be ensured with respect to all FSS receivers, even where BWA and FSS operate on different non-overlapping frequencies This distance can be reduced to about 0.5 km if an LNB bandpass filter is fitted at all FSS receivers, the BWA base station has additional filtering of spurious emissions and outdoor

BWA user terminals are prohibited. The effectiveness of any mitigation technique is dependent on its application to individual site situations and can be applied only when FSS earth stations are confined to a limited number of specific known locations.

- In Europe, CEPT prepared a ECC Report on Compatibility Studies In The Band 3400-3800 MHz Between Broadband Wireless Access (BWA) Systems And Other Services (Draft ECC Report 100). The studies have shown that to meet all relevant interference criteria, for a representative FSS earth station, the maximum distances required for BWA central stations are between 270 km and 320 km. These distances are referred to as “mitigation distances” in the report, to indicate that smaller distances may be achievable through coordination of each BWA central station. However, even with coordination it is clear that the necessary separation distances are at least tens of kilometres and may be hundreds of kilometres. The feasibility of the use of mitigation techniques by BWA systems to reduce the separation distances has not been demonstrated.

- The Asia-Pacific Broadcasting Union (ABU -- a regional organization grouping government and non-government entities) has warned that “BWA is a promising technology. However, if 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.”

It is important to understand that satellite transmissions in the 3.4 – 4.2 GHz band are received by a large number of stations worldwide. Many of these stations are “receive only”, and are therefore not registered at the ITU (or generally even with the local administrations) since such registration is not required. Co-frequency operation of BWA systems severely disrupt reception of satellite transmissions.

Alternatives to C-band

Fortunately, this is not an insoluble problem. Many other candidate bands have been identified for IMT during the course of ITU studies. The merits of these have been documented at length and the alternatives will be presented to the ITU.

It is critical that governments and spectrum management authorities recognize the very real damage caused, and tremendous threat posed, to satellite services by use of the Standard C and Extended C-bands for terrestrial wireless systems.

A real effort to use alternatives must begin immediately.

For More Information

Please explore the Satellite Spectrum Initiative website at **www.satellite-spectrum-initiative.com** In particular, be sure the browse the presentations, information sheets, white papers, letters to regulators, and videos available on the Resources page. To participate, please email info@satellite-spectrum-initiative.com.