Observations on Increasing Interference to Satellite Services and

Recommendations to Ensure Signal Integrity

Proposed for Adoption by the World Broadcasting Unions – International Satellite Operations Group (WBU-ISOG)

Position Statement: National administrations 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).

Executive summary:

Satellite communications technology in the C-band is used extensively for broadcasting television signals to hundreds of millions of consumers worldwide. 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 (BWA) like Wi-MAX and other 3G and 4G mobile systems (also referred to as IMT systems) to share the same spectrum bands already being used to provide satellite broadcasting services.

To eliminate this harmful interference, the global broadcasting community has united to communicate its position 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 broadcasters to operate, and their customers to enjoy their services, without disruption by new users.

C-band satellite and the 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…).

In places where administrations have allowed BWA services to use the C-band, there have been massive interruptions of satellite broadcasting services. Satellite broadcasting operations in places including Bahrain, Bolivia, Tanzania, Angola, the U.S. and other nations have already been negatively affected. Other national administrations can and should avoid repeating this costly mistake. Alternative approaches are available.

Addendum

Importance of the C-band:

Use of the C-band for satellite broadcasting is widespread throughout the world. It is not only vital for many developed countries, but also in emerging regions such as in South and Central America, southern Asia, and equatorial Africa because of its resilience in the presence of heavy rain. 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 satellite services are uniquely well suited to broadcasters because they are inherently able to cover large areas. They facilitate intercontinental and global communications, and provide a wide range of broadcasting services in developed and developing countries. Services in this band now also provide critical broadcasting applications such as distance learning, telemedicine, universal access, disaster recovery and television transmission in many tropical regions.

Technical explanation:

Broadcasting 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 broadcasting 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 which are powerful enough to saturate the sensitive C-band satellite receiving systems, causing a potential for total loss of broadcasting 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 broadcasting 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 access to vital information in remote areas

[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.

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 – for example, C- band based services were vital in facilitating assistance and recovery after the 2004 Asian tsunami, the 2010 Haiti earthquake and other major disasters. Other growing applications include distance learning.

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 broadcasting 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 kilometres 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… 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… 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 Wi-MAX 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 kilometres** of a 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 satellite receivers, even where BWA and satellite services 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 satellite 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 satellite earth stations are confined to a limited number of specific known locations.

- In Europe, CEPT has prepared an *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 satellite 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 noted 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."

- Sharing studies conducted by ITU-R Working Party 8F have shown that a minimum distance separation of approximately 35 to 75 kilometres must be maintained between an IMT transmitter (a 4G mobile system) and a satellite earth station receiver. There is no practical way to maintain such large separations between these two systems. Moreover, given the large number of satellite receive stations currently receiving in the 3.4 – 4.2 GHz, it is highly unlikely that the requisite separation can be maintained with respect to all of these stations.

It is important to understand that satellite transmissions in the 3.4 – 4.2 GHz band are received by many millions 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 would severely disrupt reception of satellite transmissions.

Alternatives to C-band:

Fortunately, this is not an insoluble problem. Other bands have been allocated for IMT during the course of ITU WRC 2007. 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.

Adherents: This paper has been adopted by the World Broadcasting Unions-International Satellite Operations Group, whose membership includes the following major broadcasters worldwide and whose membership serves hundreds of millions of users with broadcasting services.