Our Ref.: TG15/211105/0418 (BY FAX 2803 5112)

21 November 2005

Office of the Telecommunications Authority
29/F, Wu Chung House
213 Queen's Road East
Wan Chai
Hong Kong

Attn. Telecommunications Engineer (R21)3

Dear Madam/Sir,

**Second Response to the Consultation paper**
**"Licensing framework for deployment of Broadband Wireless Access" (31 August 2005)**

AsiaSat submitted a response to this consultation paper in accordance with the original deadline in our letter of 31 October 2005. Attached to this letter, please find a submission expanding on our view of this issue.

Yours Sincerely
Asia Satellite Telecommunications Co. Ltd.

S. Barry Turner
General Manager Engineering

SBT/jl
Encls.

**Additional response to OFTA's Consultation paper on**
**"Licensing framework for deployment of Broadband Wireless Access"**
**(31 August 2005)**

## Introduction

As discussed in our first response to the second consultation paper on BWA, AsiaSat is most concerned about the possible implications on C-band FSS operation in Hong Kong should BWA be introduced in the 3.4-3.6 GHz band. Following further investigation and evaluation, where we have found known instances of interference, we have determined to submit the following revised and expanded commentary.

As stated in our previous letter, AsiaSat sees the attractiveness of BWA and supports its introduction in Hong Kong. However, this can not be done in a manner that unduly interferes with current satellite reception in Hong Kong. AsiaSat is fully aware that this band has been used in other countries, including Europe where we note that CEPT ECC Report 33 (2003) concludes that sharing with FSS is an issue and should be taken into account. We also note that in Europe, the 3.4-3.6 GHz band is seen as a phase I of BWA deployment with 3.6-3.8 GHz in phase II.

We would like to point out that C band usage in Asia is quite different from Europe. In Europe, C-band is little used for FSS. The few exceptions are for point-to-point links using large earth stations. Incompatibilities between BWA and FSS therefore will have a limited impact on the FSS operators. Broadcasting, private data networks and internet services are typically provided at Ku band.

In Asia, partly due to the special rain fade conditions in large parts of the region, C-band is the band of choice for a multitude of services, including VSAT networks, internet providers, point-to-multipoint links, TV and data broadcasting to SMATV and DTH receivers. Any adverse impact of BWA on C-band FSS operation therefore would have huge implications in this region.

Based upon AsiaSat's calculations, and confirmed by real incidents in other countries and independent studies, BWA appears to potentially affect FSS reception in three different ways:

- In-band interference of FSS receivers in BWA operating bands
- Out-of band BWA emissions interfering FSS in adjacent frequency bands
- Saturation of FSS receivers

These issues are discussed following.

## 1. Saturation of FSS receivers

To obtain the best possible signal quality, typical FSS receivers have a Low Noise Amplifier (LNA) or a Low Noise Block downconverter (LNB) fitted at the antenna feed. LNB's consist of an LNA followed by a downconverter and IF amplification and filtering in one unit. Minimal filtering will take place at the input of the LNA input to avoid degrading the noise figure.

Because of the large free space losses from the satellite, received satellite signals have very low power densities. The dynamic range of FSS LNA's and LNB's has been designed to take this into account. Typical LNB's are saturated by an input signal of about -50 dBm. About 10 dB below this level, the LNB's will start to show non-linear behaviour which amongst others lead to suppression of small signals and generation of intermodulation products.

Based upon feedback from AsiaSat's customers, the vast majority of installed LNB's for TV reception in Hong Kong are designed to receive the entire 3.4-4.2 GHz band. Since the AsiaSat satellites, just as many other satellites, also have transponders below 3.7 GHz, customers are even less likely to select LNB's only receiving the upper 3.7-4.2 GHz band. Moreover, because of the need to keep the noise figure low, AsiaSat expects that even for LNB's specified for the 3.7-4.2 GHz band, most filtering will be on the IF section and the LNA input will have little or no discrimination of the 3.4-3.7 GHz band. As a result, they would appear to be equally vulnerable to have the LNA input section driven into saturation or non-linear operation.

If the BWA operation has the capability to drive the LNA's into saturation or non-linear operation, this means that even if the BWA and FSS networks do not operate in overlapping bands, the FSS receivers are unable to receive the satellite signals.

Based upon reports from our customers that such incidents has occurred in other cases where BWA has been introduced, analyses by others as well as initial analyses by AsiaSat, we have come to expect that BWA introduction is indeed likely to drive the FSS LNA's into saturation and thus block reception for the majority of all FSS receivers in Hong Kong, operating in any part of C-band.

### 1.1. Reported cases

AsiaSat has been made aware of a case where BWA introduction jammed practically all of the FSS C-band reception in Sydney, Australia. As a result, all antennas had to be rebuilt with special filters before the LNA input to attenuate the BWA band sufficiently. An article describing this problem was published by Silicon Chip magazine in two parts in the December 2004 and February 2005 issues. In these articles, titled "Death by Overload, Part One and Two" the author describes the problem as

"… disrupting the reception of over 100,000 C-band satellite users across the country."

AsiaSat has received an engineering report from one of its data broadcasting clients in Sydney Australia, describing an interference problem from the same Broadband Wireless Access Company referred to in the above article. While this client wishes does not wish this report to be published in conjunction with this response, AsiaSat is prepared to supply it to OFTA under separate cover, in confidence.

Attachment 1 contains references to an analysis provided in conjunction with a consultation by NTIA in USA on the possible introduction of BWA in the 3.4-3.6 GHz band. It may be seen that also this analysis concludes that BWA equipment has the capability to saturate the LNA's thus blocking reception in the entire C-band.

### 1.2. Calculations

AsiaSat has performed an initial analysis of the required exclusion zone around an earth station to avoid saturation or non-linear behaviour of the LNA's. The results are shown in the figure on the next page.

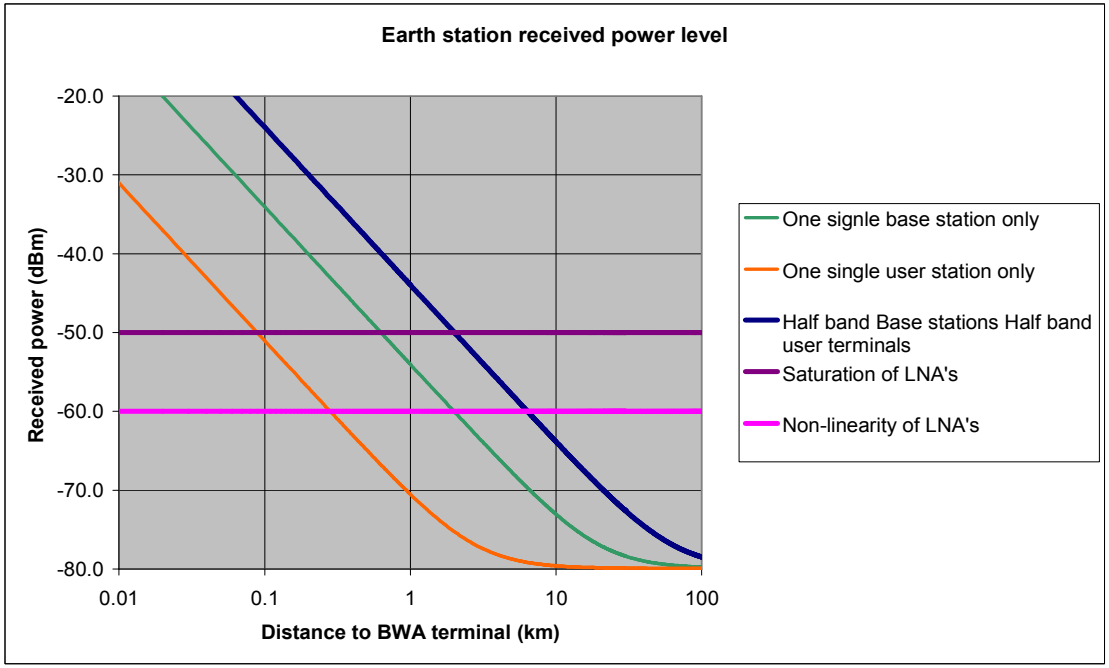
It can be seen that with the assumptions used in these calculations, one single BWA user terminal alone could bring the LNA into non-linear mode if it was within a range of about 300 m. Similarly one single base station alone could bring the LNA into non-linear mode if it was within a radius of about 2 km. If it is assumed that the entire 3.4-3.6 GHz is used for BWA operation with half the band used for user terminals and half the band used for base stations, all terminals and base stations would have to be at least about 7-8 km away from the earth station not to bring the LNA into non-linear mode.

It should be kept in mind that these are initial analyses performed by AsiaSat, based upon a limited understanding of the BWA applications and their parameters. More detailed studies are required to get a better picture of the potential saturation of the FSS LNA's by BWA operation. However, with the results of the analyses, it would appear that within a geographically small area like Hong Kong, BWA operation would be incompatible with commercial C-band FSS operation in any part of the C-band. In addition to this analysis AsiaSat has also carried out some very simple tests to confirm that overloading and signal disruption is possible at signal levels that approximate this analysis.

**Assumptions**

| | Base Station | User terminal |
|---|---|---|
| **BWA transmission characteristics** | | |
| Frequency (GHz) | 3.5 | 3.5 |
| Carrier bandwidth (MHz) | 5 | 5 |
| Bandwidth with operating BWA networks (MHz) | 200 | 200 |
| BWA EIRP (W) | 100* | 2* |
| BWA Tx antenna discrimination towards earth station (dB) | 0 | 0 |
| BWA EIRP (dBW) | 20 | 3 |
| **FSS transmission characteristics** | | |
| Mid C-band frequency (GHz) | 3.8 | |
| Satellite EIRP/36 MHz (dBW) | 41 | |
| Earth station antenna diameter | 4.5 | |
| Antenna efficiency (%) | 70 | |
| On-axis gain (dBi) | 43.5 | |
| Satellite link free space loss (dB) | 195.6 | |
| Received satellite power (dBm) | -79.9 | |
| **Calculation assumptions** | | |
| Earth station gain towards BWA equipment (dBi) | 0 | |
| Propagation | Clear sky, line-of-sight | |
| LNB saturation input (dBm) | -50 | |
| LNB limit for non-linearity (dBm) | -60 | |

* According to report on BWA trial in Hong Kong by Hong Kong Broadband Network Limited (22 Feb 2005), Maximum EIRP authorized by OFTA is 100W per 5 MHz for base stations and 2 W per 5 MHz for user terminals.



## 2. Out-of-band emissions

The 40,000 km distance to a geostationary satellite leads to a large path loss compared to those of terrestrial systems. As a result, a typical received satellite signal will produce a power density at the input of the LNA of about -190 ↔ -200 dBW/Hz. This is about 40 – 50 dB lower than what could be received by a BWA base station 1 km away. If the same BWA base station was 100 m away, the power difference would be 60 – 70 dB.

Following the principles of ITU (e.g. ITU-R Rec. S.1432), in-band interference from BWA should be about 20 – 25 dB lower than the wanted signal. In this conjunction, it is also worthwhile to note that all BWA terminals and base stations will produce out-of-band emissions and that the interference received by the FSS receivers will be an aggregation of all of them. Also taking into account the huge difference in power level produced at the input of the LNA, there will need to be extremely tight limits to out-of-band emissions to avoid interference into the 3.6 - 4.2 GHz bands from BWA equipment in the 3.4 – 3.6 GHz bands.

Since out-of-band emissions will create in-band interference into the FSS receivers in the non-BWA band, there is no way for the FSS receivers to mitigate this interference.

Attachment 2 is seen to raise concerns that out-of-band emissions are likely to interfere with FSS operation in the 3.6-4.2 GHz band.

AsiaSat questions if it is technically possible to obtain the required out-of-band discrimination to avoid interference into the FSS band not used by BWA and wonders if OFTA has included such equipment requirements in their licensing requirements. In particular, BWA operation just below 3.6 GHZ would seem to AsiaSat to have a great potential to interfere with FSS reception just above 3.6 GHz.

## 3. BWA and FSS operating in the same band

Given the very large difference between the power levels produced by the two applications, AsiaSat concludes that any co-frequency operation would require very large exclusion zones around any FSS receiver to avoid interference.

This would seem to be in line with the conclusions of OFTA since it is considered to downgrade FSS to a secondary service to remove the protection of FSS receivers from BWA operation and the right of the FSS community to complain about interference from it.

## 4. Protection of Tai Po earth stations

While not supporting the introduction of BWA operation in the 3.4-3.6 GHz band; should such operation be decided, AsiaSat is grateful for the offer to provide extraordinary

protection to the existing earth stations in Tai Po in this band and will work together with OFTA to determine criteria to ensure the protection. AsiaSat does note that there are other operational major teleports in Hong Kong and thinks that it would be essential to afford this same level of protection.

In AsiaSat's understanding, protection would require exclusion zones around the earth stations. Looking at the huge power imbalance between the BWA and the FSS equipment, these exclusion zones would appear to become very large. This could be a major limitation on the BWA operation and might not be acceptable by the BWA community.

AsiaSat also understands that BWA operation is ultimately planned for mobile or nomadic user terminals. If such terminals are permitted in Hong Kong, AsiaSat questions the possibility of ensuring they are not active inside the exclusion zone.

## 5. Required analyses and tests

AsiaSat has not seen any detailed analyses or tests with respect to any of the very seriously impacts on FSS operation in all of the C-band that AsiaSat foresees. Before making a decision to introduce BWA in the 3.4-3.6 GHz band, it is important that both OFTA and the affected parties have a good understanding of the consequences of such an introduction.

AsiaSat believes that calculations and tests amongst others need to determine:

- The requirements to protect the Existing earth stations in the 3.4-3.6 GHz band;

- If there is a potential to saturate or bring the LNB's into non-linear operation and the requirements to avoid this;

- If there is a potential that out-of-band emissions interfere in the 3.6-4.2 GHz band (In particular the highest BWA channel into the FSS band just above 3.6 GHz) and the requirements to avoid this.

AsiaSat would be prepared to work together with OFTA and other parties to conduct such analyses and tests.

## 6. Alternative frequency bands

As a result of the expected severe impact on FSS operation, AsiaSat encourages OFTA to investigate alternative frequency bands for the introduction of BWA in Hong Kong. AsiaSat understands that BWA equipment already exist in the 2.5 and 5.8 GHz bands. While not having a detailed understanding of the conditions in these bands, AsiaSat would suggest that OFTA in particular study these two bands.

## 7. Conclusions

Based upon its assessment of the impact of introducing BWA in the 3.4-3.6 GHz bands, AsiaSat is of the opinion that:

- Because of its importance in Asia and the lack of spectrum capacity that can offer reliable FSS links in high rain rate regions, AsiaSat would encourage OFTA not to remove 25 % of the available C-band for FSS by introducing BWA in the 3.4-3.6 GHz band.

- If OFTA nevertheless decides to introduce BWA in this band, this must be done in a manner which ensures that current and future FSS receivers operating in the remaining band are not degraded by BWA equipment or interfered by their out-of-band emissions.

- While being skeptical that it is at all possible to provide protection to earth stations in the 3.4-3.6 GHz in the case of BWA operation in the same band, AsiaSat will work together with OFTA to study any possible protection mechanism.

- Detailed calculations and tests in co-operation between OFTA and the affected parties are needed to get a better understanding on the implications of introducing BWA in the 3.4-3.8 GHz band.

Asia is in a unique situation with respect to use of C-band for FSS operation, in particular to provide reliable links in high rain rate regions, and the band is the most important band for most satellite operators in the region. Because of the apparent severe implications on FSS operation, AsiaSat proposes that OFTA consider the other alternative bands for BWA where AsiaSat understands that equipment is also available, i.e. the 2.5 GHz and 5.8 GHz bands rather than the 3.4-3.6 GHz band.

# Attachment 1

**Carol W. Wilner**
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February 10, 2004

Ms. Kathy Smith
Chief Counsel
Office of the Chief Counsel
National Telecommunications and
Information Administration
U.S. Department of Commerce
Room 4713
1401 Constitution Avenue, N.W.
Washington, DC 20230

Re: Rural Wireless Broadband Access in the 3650-3700 MHz Band, Docket No. 040116021-4021-01D

Dear Ms. Smith:

In response to the Federal Register notice published January 28, 2004, AT&T Corp. ("AT&T") submits these comments in the above-entitled Notice of Inquiry. AT&T supports efforts to develop alternative means of accessing customers – for both narrowband and broadband services – and supports the proposed opening of spectrum for use by unlicensed devices, provided that means are established to prevent harmful interference to AT&T's C-band satellite earth stations.

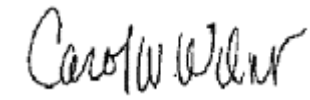
As noted in AT&T's comments to the Federal Communications Commission, filed April 17, 2003 in ET Docket No. 02-380, AT&T operates satellite earth stations, some of which are licensed to operate in the Extended-C band (*i.e.*, 3650-3700 MHz). Unless appropriate measures are employed, operation of unlicensed devices in the Extended-

C band could directly interfere with these earth stations, which are very sensitive to interference. Nevertheless, because these earth stations generally are located in remote locations, AT&T believes that mitigation measures, such as geographic limitations, power limitations, frequency hopping, and/or use of "smart" devices, can be implemented to permit deployment of unlicensed devices in this spectrum, while still protecting these earth stations from harmful interference.

AT&T also operates other C-band earth stations that could be adversely affected by unlicensed devices in the Extended-C spectrum unless mitigation measures are implemented. Although these earth stations are not licensed to receive signals in the Extended-C spectrum band, they are authorized to receive signals in the adjacent C-band (3.7 to 4.2 GHz). Moreover, their antennae actually receive and amplify signals in both the Extended-C and C bands, although only the licensed C-band signals are processed. If interfering uses are permitted in the adjacent Extended-C band, the interference potentially could "overdrive" the earth stations' low noise amplifiers into their nonlinear operating range and degrade C-band signals, thereby disrupting communications received at these earth stations – and those of other C-band earth station operators. AT&T nevertheless believes the interference caused by unlicensed devices could be effectively mitigated through geographic limitations, power limitations, frequency hopping, and/or use of "smart" devices.

In short, AT&T supports the proposed opening of spectrum for use by unlicensed devices, provided that means are established to prevent harmful interference to AT&T's C-band satellite earth stations. AT&T looks forward to reviewing interference mitigation measures proposed by those seeking to use such spectrum.

Sincerely,



Carol Wilner

# Attachment 2


February 23, 2004

Office of the Chief Counsel National Telecommunications and Information Administration (NTIA)
U.S. Department of Commerce1401 Constitution Avenue N.W. Room 4713 Washington, D.C. 20230

Attention: Unlicensed Devices Proceeding

In response to the Notice of Inquiry regarding Rural Wireless Broadband Access in the 3650 to 3700 GHz band, the Satellite Industry Association (SIA)[1] would like to take this opportunity to express concern about Fixed Satellite Services (FSS) services in band and in the adjacent bands which could potentially be affected by the use of unlicensed devices in these frequencies.

As you may know, in the year 2000 the use of these frequencies was grandfathered for certain pre-existing FSS earth stations[2], by way of limiting the terrestrial mobile services to base station operations. Several SIA members are currently authorized to provide FSS services in these frequencies and are particularly concerned with the potential impact on services due to the aggregate power to be radiated by these unlicensed devices, given that the total number of devices is not known. In addition, it is important to ensure that the out-of-band emissions from such unlicensed devices are low enough to guarantee that there will be no interference into FSS systems operating in the adjacent bands.

The SIA requests that the NTIA, in researching the potential effects of unlicensed devices on government services in these bands, also take into account the impact on commercial operations, given that commercial operators may currently, or in the future, utilize these frequencies to provide services to the U.S. government.

Sincerely,

Richard Dalbello President, SIA

[1] SIA Executive Members include: The Boeing Company; Globalstar, L.P.; Hughes Network Systems, Inc.; ICO Global Communications; Intelsat; Iridium Satellite LLC, Lockheed Martin Corp.; Loral Space & Communications Ltd.; Mobile Satellite Ventures; Northrop Grumman Corporation; PanAmSat Corporation; SES Americom, Inc. and Verestar Inc. Associate Members include Inmarsat, New Skies Satellites Inc, and Eutelsat Inc. [2] FCC 00-363- First Report and Order and Second Notice of Proposed Rule Making, October 24, 2000.