Our Ref.: TG15/311005/0388

31 October 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,

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

With reference to the captioned consultation paper, please find attached a paper presenting AsiaSat's views to assist OFTA on this issue.

Should you have any questions, please let us know.

Yours Sincerely
Asia Satellite Telecommunications Co. Ltd.

S. Barry Turner
General Manager Engineering

SBT/jl
Encls.

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

Introduction

AsiaSat fully understands importance of BWA services for Hong Kong and supports the search for frequency bands wherein to introduce this service. However, AsiaSat is concerned that OFTA is proceeding with the prospective introduction of BWA terminals in the 3.4-3.6 GHz bands which are today used for Fixed Satellite Services (FSS) (ref. also Hong Kong Table of Frequency Allocations, August 2005). Our concern is that the satellite bands are not compatible with a ubiquitous broadband wireless service and unacceptable interference will inevitably result.

C-band is the by far most popular frequency band in Asia for the fixed satellite services (FSS). Its advantages in high rain rate regions coupled with a large ground infrastructure make C band the preferred distribution medium for broadcast and related telecommunications services. Demand for this band is such that it today is virtually impossible to introduce new satellite networks in this band other than the replacement of an old satellite with a new one.

Based upon our technical assessment, AsiaSat believes that BWA operation in the lower 25% of the FSS band would interfere with any FSS operation in this band. Our analysis indicates that it may also not be possible to provide any FSS services in a reliable manner or with any guaranteed quality in the remaining part of the FSS band if wireless broadband is deployed. As a result use of C-band for FSS services may not be feasible in Hong Kong if this proposal moves forward.

Taking into account the limited geographical size of Hong Kong, AsiaSat also is uncertain if it is possible to control and monitor the satellites in a safe and reliable manner with BWA operation in Hong Kong in the same, or nearby frequency bands.

Taking into account the widespread use of C-band for FSS applications in Hong Kong today, AsiaSat once more urges the TA to search for frequency bands outside the 3.4-4.2 GHz bands for BWA applications.

Technical considerations

In the second Consultation paper, we note that the TA discusses interference into satellite receivers and concludes that the impact on Hong Kong satellite users is marginal. AsiaSat believes that this assessment is inaccurate and based upon over-simplified considerations.

We also note that the TA's proposal is to downgrade FSS to secondary status. AsiaSat sees this as a confirmation that the TA's conclusions also are that the two services are technically incompatible. The service is therefore downgraded to secondary status, meaning that you lose the right to complain about interference from a service with primary status. As a result, the TA does not have to deal with complaints from FSS users who lose their service.

AsiaSat foresees a number of technical problems with the proposed BWA operation for C-band FSS users in Hong Kong. Moreover, AsiaSat cannot see any documentation that all the technical implications on FSS users are fully analyzed by the TA. Before a decision is made, AsiaSat thinks that such a study would be a minimum requirement.

Below is a discussion on some of the major issues as seen by AsiaSat.

The first section discusses some problems seen in using the traditional far field antenna diagrams in performing the analyses in this case.

The following two sections discuss implications on FSS users in the non-overlapping frequency bands (3.6-4.2 GHz) where AsiaSat has seen no assessment whatsoever from the TA.

The remaining part discusses the assessments made by the TA for FSS users in the overlapping band (3.4-3.6 GHz).

1. Near-field behavior

In assessing saturation/non-linearity of LNA's and LNB's, out of band emissions of BWA equipment and in-band interference, AsiaSat has based its assessments on far field antenna behavior. However, if the interfering and interfered antennas are within the near field, these assumptions are not necessarily correct since the near field antenna patterns are different from the far field patterns. In particular the assumption made by AsiaSat that at the far off-axis angles towards the BWA equipment, the antenna will have a very high discrimination (0 dBi) will not always be correct.

For large FSS antennas, the near field region can extend to 2-3 kilometers and even for small SMATV type antennas; it may extend to several hundred meters.

It is seen that many, if not most, cases will involve situations where the interferer is within this range, meaning that calculations using far field assumptions will introduce errors in the analyses and near field antenna diagrams are required to obtain a correct result.

2. Saturation and non-linearity of LNB's

FSS receivers have a low noise amplifier (LNA) or low noise block downconverter (LNB) just after the antenna to amplify the signal. Commercial LNA's and LNB's have a receive band which covers the entire C-band, i.e. 3.4 – 4.2 GHz.

Typical LNA's and LNB's will be saturated by an input signal of about -50 dBm and will reach non-linearity at about 10 dB before that.

When saturation occurs, all signals in the entire receive band (3.4-4.2 GHz) will be damped. When the LNA or LNB operates in a non-linear mode, intermodulation between all the incoming signals will occur and the wanted signal is corrupted at any frequency in the entire receive band.

For this reason, if BWA equipment has the capability to drive LNA's and LNB's into saturation or non-linear mode, FSS operation in the entire C-band is affected, not only the 3.4-3.6 GHz band.

BWA terminals generate signals at significantly higher power levels than an incoming satellite signal. AsiaSat's analyses indicates that with BWA networks in widespread use, exclusion zones in excess of 10 km may be required around FSS receivers to ensure than LNA's and LNB's are not driven into non-linear mode. The analyses also indicate that one single base station can drive the LNA/LNB into non-linear mode if it is within a radius of about 2 km.

It should be noted that these are preliminary analyses performed by AsiaSat and that a better understanding of BWA operating parameters and limitations are required to do a more detailed assessment. The results are however supported by information from other countries where BWA has been introduced in the 3.4-3.6 GHz band and problems have been encountered by FSS receivers in non-overlapping bands.

With the small geographical size of the territory of Hong Kong, this would mean that BWA would have an impact on all FSS receivers in all of C-band, not only the 3.4-3.6 GHz band.

3. Out-of-band emissions

Even if it was possible to avoid driving the FSS LNA/LNB's into non-linear mode, it may be noted that the BWA equipment will produce much higher power levels than the incoming satellite signal. One single BWA base station 1 km from an FSS earth station may for example create power levels at the input of the LNA/LNB of the FSS receiver which are about 40 dB higher than the incoming satellite signals.

For FSS networks, the total C/I from terrestrial networks should be expected to be in the order of 20-25 dB or more using normal principles for interference allocation (e.g. ITU-R Recommendation S.1432). Taking the power difference into account, the BWA network would need to have a discrimination of 60 dB or more at frequencies above 3.6 GHz not to create undue interference into the FSS bands.

It is to be noted that this example is for a single BWA terminal 1 km away. For multiple BWA terminals or terminals closer to the FSS receiver, this requirement would become more stringent.

AsiaSat has not seen any documentation indicating that out-of-band emissions of BWA equipment will not create interference into the remaining FSS bands. Quite on the contrary, AsiaSat suspects that with the huge power differences in question, commercial BWA equipment will not be able to provide the required filtering and interference is bound to occur, in particular in the lower portion of the C-band planned to remain for FSS.

4. Interference

In the band 3.4-3.6 GHz, the consultation paper discusses some aspects of the impact of BWA on FSS users. Below, AsiaSat provides some comments to the assessments made.

4.1. Protection of Tai Po

AsiaSat is grateful for the offer to provide extraordinary protection to amongst others the Tai Po earth stations. As agreed during the information meeting in August 2005, AsiaSat will work together with OFTA and the other affected companies to determine the requirements to provide a satisfactory protection to the earth stations.

These protection criteria will be important limitations that have to be observed by the BWA licensees. To issue a license with a general, unspecified, obligation to protect the named earth stations would put the BWA licensees in a very difficult situation if this obligation is to be honored since they have no guidelines to follow for their deployment. At the same time; if the determined limits, when they are determined, are not met by the BWA licensees because of their deployment in the mean time, this would mean that the protection of the earth stations is only on paper. AsiaSat therefore is of the opinion that these limitations have to be quantified and entered into the license requirements before any licenses are issued.

AsiaSat also notes that the offer is to protect only the Tai Po and Kwai Chung earth stations. AsiaSat would however propose that all the major teleports in Hong Kong is granted the same protection. Specifically, AsiaSat would request that the TTC&M functions performed from the AsiaSat earth station in Stanley is granted a similar protection.

4.2. TTC&M

For satellite operators, it is crucial to be able to reliably perform the TTC&M functions for the satellites. AsiaSat is operating its satellites from Hong Kong and is conducting the TTC&M functions from its two earth stations in Hong Kong. To be able to continue this operation from Hong Kong, adequate protection of these functions is required. Under the satellite licensing obligations of OFTA, there is also an obligation to operate the satellites in a safe and reliable manner.

BWA operation will have an impact on the telemetry and tracking functions as well as the monitoring of the transponders. It is noted that the consultation paper says that "*because of the geographic location of the TTC&M stations*" interference is seen as unlikely for the Tai Po earth stations. AsiaSat's own assessment however is that without clear, quantified, limitations in the BWA licenses, interference is most likely to occur anywhere in Hong Kong, even for TTC&M in bands outside the 3.4-3.6 GHz band.

AsiaSat also notes that the AsiaSat fleet of satellites is controlled from both the Tai Po and Stanley earth stations. The same protection for TTC&M therefore is required at both locations.

Telemetry and tracking

Telemetry and tracking is traditionally performed at selected carriers which are located at the edge of the band, outside the traffic band. This could be at the upper or lower end of the band. Because of rain fade considerations, telemetry and tracking is normally performed at C-band rather than Ku-band (S-band telemetry and tracking requires dedicated antennas on-board the satellite and is not commonly used in commercial satellites). The power levels of these signals are much lower than those of the traffic transponders. Tracking determines the distance to the satellite and is necessary to determine its orbit. Normal tracking is performed by looking at the phase information of the received signal. Because of its importance for the maintenance of the satellite and its specific characteristics, protection of telemetry and tracking requires particular consideration.

There are two operational modes; the regular on-station operation and the emergency mode operation with their own characteristics. Most notably, is that in emergency mode (when control of the satellite is lost), the telemetry and tracking signals are transmitted through an omni directional antenna on-board the satellite and as a result, the power levels drops and the sensitivity to interference increases correspondingly.

Monitoring

Even if the service is not provided in Hong Kong, it is necessary for Hong Kong based satellite operators to be able to monitor the traffic on the transponders to ensure that the customers get the required service quality, to respond to customer queries and to check for interference. Also, AsiaSat, like other satellite operators, routinely perform In-Orbit Testing (IOT) of their transponders to ensure the quality of the satellite throughout its life time. Many of these measurements are at power levels which are lower than normal operating levels. Moreover, monitoring, quality and interference measurements as well as IOT by their nature can tolerate less interference than regular traffic terminals. This again will put more stringent protection requirements on TTC&M stations.

4.3. Earth stations

AsiaSat notes that the TA concludes that only to FTNS licensees operates in the 3.4-3.6 GHz band and that these easily can move their traffic to the 3.6-4.2 GHz band.

AsiaSat's first observation is that it is surprising that only two licensees use the band 3.4-3.6 GHz. It may be that FTNS licensees have failed to include this band in their report or have failed to respond to the first consultation round. This does however not mean that only two earth stations are using this band and that introducing BWA in the band will have no impact on the other FTNS earth stations. On the contrary, AsiaSat expects that the 3.4-3.6 GHz band is received by a number of earth stations in Hong Kong and that BWA in the band will have an impact on far more FTNS earth stations than the two mentioned.

The second observation is that the TA for those affected FTNS earth stations concludes that the licensees use frequencies outside the 3.4-3.6 GHz band and concludes that "*there should be little technical constraint on the changeover*". AsiaSat strongly disagrees with this conclusion.

First of all, all of C-band is very heavily used in Asia and from the various satellite locations, the entire band is normally fully utilized. It is therefore in practice impossible to cut out 25% of the usable bandwidth and move the users into the remaining 75% together with the other customers in this band.

Secondly, FTNS stations often relay signals that are distributed throughout the region. If the 3.4-3.6 GHz band becomes unusable in Hong Kong, FTNS licensees have very little influence over the choice of frequency for the transmissions.

As a result, if BWA is introduced in the 3.4-3.6 GHz band in Hong Kong, this does not mean that the FSS transmissions in this band will cease; it only means that Hong Kong FTNS licensees are precluded from the business of receiving and redistributing them.

4.4. SMATV

Based upon the replies from SMATV operators, the TA concludes that only 20 receivers, or only 1% of the total number of SMATV receivers in Hong Kong, operate in this band. Because of the low number and because only free-to-air signals are affected, the TA concludes that this is acceptable.

Firstly, as discussed above, AsiaSat is convinced that due to saturation of LNB's and out-of-band emissions of the BWA equipment, TV reception in the entire 3.4-4.2 GHz band will be adversely affected, not only the 3.4-3.6 GHz portion.

Secondly, that only 20 SMATV operators reported to be potentially affected, does not mean that the other 99% of the SMATV will not be. AsiaSat thinks it is naïve to think that only those that responded use this band. AsiaSat expects that many SMATV operators have reception in this band, but failed to respond to the TA either because they were unaware of the consideration of introducing BWA in the band and/or because they did not understand the potential impact on their operation. The day BWA operation starts on a large scale, the impact will however become evident to them.

To illustrate the severity of the problem, the field trials that have been conducted caused excessive interference to one of AsiaSat's big customers and caused them to lose the TV signal. Because this was a big professional operator with professional measurement equipment and technical skills, they were able to understand that the problem came from interference and identify the interfering source. AsiaSat has notified the TA about this incident in an earlier letter. Most likely, a number of other less professional SMATV operators have also already experienced interference from the field trials, but have failed to understand the cause of their problems.

Thirdly, AsiaSat is of the opinion that even if the affected signals are free-to-air TV signals, also these should be entitled to a protection in the spectrum planning of the TA. Because they are not pay-TV channels, licensed by OFTA does not mean that it is acceptable to neglect them.

4.5. TVRO

AsiaSat agrees with the TA that it is difficult to assess how many TVRO's are actually installed today and how many may be installed in the future. However, with an introduction of BWA, it may be assumed that TVRO's will jammed by interference and will become virtually impossible in Hong Kong.

5. Conclusions

The preliminary technical analyses by AsiaSat indicates that introduction of BWA equipment in the 3.4-3.6 GHz range will have a adverse impact on FSS reception in three ways:

- LNA's and LNB's of FSS receivers driven into saturation and non-linear operation. This will affect FSS operation in the entire 3.4-4.2 GHz band.

- Out-of-band emissions of BWA equipment interfering with FSS operation in the 3.6-4.2 GHz band. In particular the lower part would appear likely to be affected.

- BWA interference in the 3.4-3.6 GHz band will make it virtually impossible to use this band for any kind of service in Hong Kong.

Based upon its preliminary analyses, AsiaSat's conclusions therefore are that introduction of BWA in the 3.4-3.6 GHz band will make it impossible to guarantee any service quality for C-band FSS users in Hong Kong in any part of the band and that the 3.4-3.6 GHz band will be totally blocked. AsiaSat has noted that already the limited field trials have created significant interference to FSS operation. AsiaSat has not seen any assessment from the TA showing the opposite.

Moreover, AsiaSat is concerned if it is at all possible to provide any protection to TTC&M stations located in Hong Kong and if it is possible to control and monitor C-band satellites from within Hong Kong in a reliable and safe manner in an environment with BWA operation. AsiaSat believes that protection of TTC&M stations has to be clearly quantified upfront in BWA licenses to become effective. AsiaSat will work together with OFTA to determine required protection criteria.

C-band is the by far most popular band in Asia, in the high rain rate regions in particular, and AsiaSat thinks that an allocation to BWA would have an undue impact on FSS operation in Hong Kong and would put Hong Kong based operators at a particular disadvantage.

AsiaSat therefore urges the TA to select other frequency bands for the introduction of the BWA service.