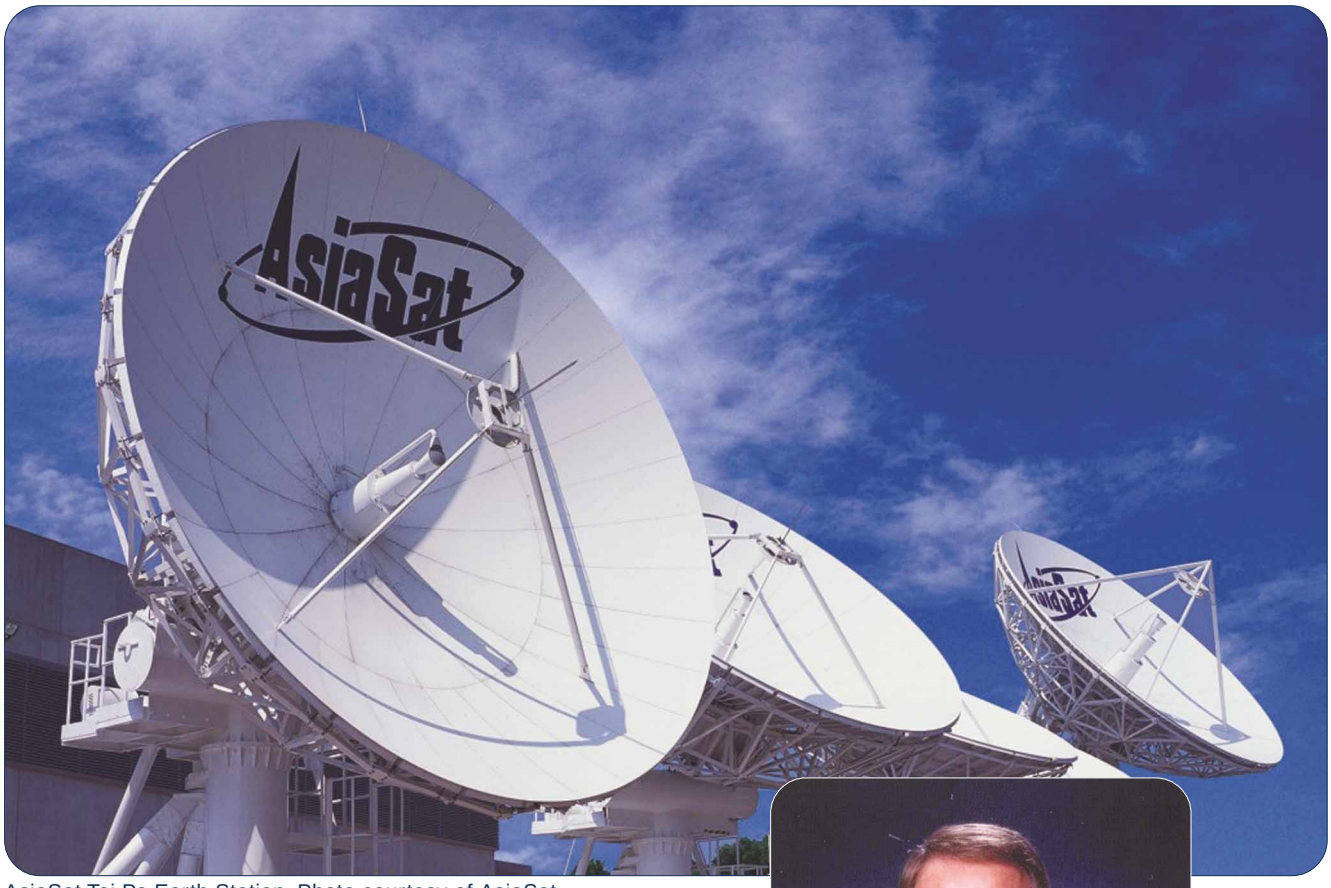

AsiaSat Tai Po Earth Station. Photo courtesy of AsiaSat.

The insatiable appetite

Barry Turner, General Manager Engineering at Asia Satellite Telecommunications Company Limited (AsiaSat), offers an interesting insight into the issue of BWA, WiMax, IMT and the grab for satellite spectrum.

Working Groups at the ITU studying future mobile phone systems have identified frequency bands in current use by satellites, radars and microwave systems as candidate bands to be reassigned for new mobile services. Pressure is being applied to use these bands for unproven or 'to be developed' mobile services while totally disregarding the technical incompatibility with existing users. One of the key problem areas is the band 3400 to 4200MHz which is allocated on a worldwide basis for satellite downlinks.

The push for using this portion of C band is primarily driven from Western Europe where this band is less used than in Asia, Africa and the Americas.

Satellite C-Band

There are currently more than 160 geostationary satellites using the band 3400-4200MHz for global, regional and national coverage. Nearly two-thirds of all commercial satellites currently under construction will operate within the FSS allocation in this part of the spectrum.

This band is used, amongst other applications, for television programme distribution to cable head-ends and radio/TV broadcast stations, rural and remote telephony, telemedicine, distance education, private data networks, satellite news gathering, weather data distribution to airlines and pilots, aircraft navigation and control. Another key role is in the event of natural disasters that leave terrestrial telecommunication systems destroyed or so damaged that they are unable to meet critical communication demands. Satellite networks are the technology of choice for first line restoration needing little or no local infrastructure.

The lower atmospheric absorption in this frequency band enables a high degree of reliability and regional coverage particularly in geographical areas with severe rain fade conditions. In addition to its

"Satellites also share with other satellite systems. While that seems obvious it is worth noting that in Hong Kong, for example, there are six major teleports accessing upwards of 20 satellites on a daily basis and sharing the same frequency band. Additionally, in Hong Kong there are thousands of TV antennas, either privately installed..."

long-standing use as the first commercial FSS band, the band 3400-4200MHz is in practice the only alternative for high-availability links. In developing countries, it is often the only choice because the user density is too low to justify dedicated spot beams in other frequency bands.

Sharing the C Band

Satellites currently share this band with terrestrial microwave networks. This successful sharing is predicated on the fact that these services are point to point services between a limited number of stations at well defined locations, using highly directive antennas that rarely have their antennas oriented towards satellite earth stations.

Satellites also share with other satellite systems. While that seems obvious it is worth noting that in Hong Kong, for example, there are six major teleports accessing upwards of 20 satellites on a daily basis and sharing the same frequency band. Additionally, in Hong Kong there are thousands of TV antennas, either privately installed or at cable head-ends receiving signals from a large number of satellites. Provided the satellites are coordinated under ITU rules there is no practical limit to the sharing of satellite spectrum among earth station operators even in a confined area like Hong Kong. In contrast BWA and related services are intended to be point to multipoint and inevitably will interfere with these satellite earth stations. Based on tests and trials conducted by the Office of the Telecommunications Authority in Hong Kong, a handful of BWA base stations would destroy all satellite services operated from Hong Kong.

The technical problem is straightforward. Satellite receive systems are extremely sensitive since they need to amplify signals that originate at distances averaging 38,000 kilometres out in space. Signals from BWA base stations and/or user terminals originate at locations much closer to the earth station and are subsequently several orders of magnitude stronger. They therefore have the capability to generate high interfering levels to the satellite receivers and can also overdrive them. The only solution for a high power transmitter and a sensitive receiver operating in the same, or adjacent, bands is to separate the transmitter and receiver by tens to hundreds of kilometres. Indeed, preliminary results for in-band operation show that significant separation distances between existing systems and IMT systems are required; 360km with respect to airborne radars, 45 km with respect to ship borne radars, several hundreds of kilometres with respect to satellite receivers. These large separation distances cannot realistically be enforced, especially when nomadic or portable devices are taken into account. There is no dispute between the mobile proponents and the satellite industry as to the existence and seriousness of the interference. Indeed the ITU Study Group for future mobile phone systems (Working Party 8F), a group dominated by Mobile systems Operators and Manufacturers, has reported that (FSS as used below is the ITU designation for Fixed Satellite Service):

"It is expected that these distances can be reduced in specific cases, taking into account site shielding and other interference mitigating measures. However, it is recognized by WP 8F that 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 specific known locations."

For the general case, WP8F concludes that: "ubiquitously deployed IMT-Advanced systems can not share in the same geographical area with FSS, when the FSS is deployed in a ubiquitous manner and/or with no individual licensing of earth stations, since no minimum separation can be guaranteed."

Working party 8F has not completed any sharing studies with terrestrial microwave which is still in common use in Eastern Europe, Asia, Africa and South America. However, WP8F concludes, in a somewhat cavalier fashion, that;

"With respect to co-existence between ubiquitously deployed IMT-Advanced and the ubiquitously deployed FSS, it has been suggested that it will be unlikely that both services could be deployed within the same geographic area in the same country".

One can be forgiven for assuming that Working Party 8F is solely focused on the potential markets in the developed world and is ignoring the regions with lesser infrastructure.

Solutions

Mobile systems proponents believe that common worldwide frequency identification is essential to worldwide market success. Given the multiple frequency bands in use for GSM services on a worldwide basis it is not clear that a worldwide allocation is all that essential for market success as I happily transport my tri band phone around the world. Not all users of these new mobile services will be world travellers in any case.

There is already 749MHz of spectrum allocated for future mobile applications:

- World Administrative Radio Conferences -92 (WARC-92), in footnote 5.388 to the Radio Regulations, identified the 1885-2025MHz and 2110-220MHz bands (230MHz of spectrum) allocated to the mobile service for possible use on a worldwide basis by administrations wishing to implement IMT-2000 systems; and
- WRC-2000 further identified the 806-960 MHz band in footnote 5.317A and the 1710-1885MHz and 2500-2690MHz bands in footnote 5.384A for possible IMT-2000 use (519MHz of spectrum).

Additionally, one would expect that by the time these mobile systems become operational, other older mobile systems will have been phased out and spectrum refarming should make even more spectrum available.

It should also be noted that while the entire 1700-2690MHz band as well as several other lower frequency bands are allocated globally to the mobile service, the 3400-4200MHz band is NOT. Operation in several lower frequency bands therefore should be possible. The lower frequencies will also be attractive because of the better propagation characteristics, better indoor penetration etc. It is also possible for new mobile applications to share the satellite transmit bands (5850 to 6700MHz) with little mutual interference.

Conclusion

We are now faced with the decision that existing satellite systems that are part of the world's core communications infrastructure and representing billions of dollars of investment are to be damaged or destroyed in favour of unproven mobile systems that may or may not have a significant market. ■