Photo courtesy of Dynamic Spectrum Alliance

Satellites and Dynamic Spectrum Access

Spectrum has been a tricky issue for many years now, and it's a difficult problem to solve. Spectrum is limited by definition, but an increasing number of people require access to it. Regulation takes time, and change is difficult. Kalpak Gude, President of the Dynamic Spectrum Alliance (DSA) outlines today's current spectrum model, and how it might be changed in the future.

In a line that might sound unduly dire, but nonetheless true - the satellite industry must either adopt a dynamic approach to spectrum access or risk a future with limited opportunity and growth, and marginalization to serve areas where no one else will or wants.

Communications satellites have had a distinguished history in building greater connectivity. Whether it was in delivering the first voice calls from around the globe, sharing video from the Olympics, or allowing mankind to share the moment a man first set foot on our moon; satellites have been at the heart of the communications revolution. To accomplish these feats, the industry has led in innovative technology developments and spectrum sharing, within the industry and with terrestrial services. The industry has however, in some sectors, fallen on harder times. With more fibre and terrestrial wireless communications deployments, demand for some satellite communications services has stalled and legacy industry players today more often play a niche role in our networked communications architecture. The industry is in a significant phase of innovation to change that perception, but the view among many regulators has been harder to move.

The diminished role of legacy satellites has forced regulators and policy makers to rethink satellite spectrum policy. The momentous contributions to the development of communications and global connectivity by communications satellites were built on a spectrum allocation model that required an enormous block of spectrum (e.g., 1000MHz or even several thousand megahertz) to be made available to satellite services. The spectrum was shared, but generally in a limited manner between satellite operators through the spacing of satellites, or with point-to-point terrestrial microwave systems. The sharing was effective, but was static and limited.

Today, those large blocks of satellite spectrum have become an almost irresistible target for governments, policy makers, and others in the communications industry looking for new spectrum to meet growing demands for broadband wireless services. Large blocks of contiguous spectrum are

Kalpak Gude, President of the Dynamic Spectrum Alliance (DSA)

the holy grail for new broadband services, particularly the gigabit services that the market and consumers are demanding. Gigabit broadband demands large channel bandwidths (e.g., 80MHz or 160MHz, or more) that current satellite spectrum could make available.

The spectrum allocation strategies of the past have now created a risk to the long-term access to that very spectrum, as well as made it more difficult for the satellite industry to justify new spectrum opportunities for future growth. For example, there is virtually no chance for the satellite industry to obtain the 1000–2000MHz or more of spectrum in V-band or Q-band under the old model. A more intensive sharing approach will be required by regulators. Those that cling to the 'not in my backyard' approach in the satellite industry could be staring into the abyss if they do not embrace these growing terrestrial requirements.

New models

It is clear that a new regulatory model for satellite spectrum is coming. There are two likely scenarios for the next generation of spectrum management approaches, both for satellites and terrestrial systems. One approach is a continuation of the static model, using frequency separation (I operate in one band or sub-band, and you operate in another) or geographic separation (I operate here, and you operate there) to enable sharing. This approach has led to a gradual loss of access to spectrum the industry uses or could use, or loss of access to markets (often lucrative urban and suburban areas) where customers and services, including broadband, are most in demand. For terrestrial systems, the cost of this approach has also been counterproductive, as the zero-sum game has yielded only a portion of the potential spectrum and only after years of spectrum battles and delay.

An alternative path, in bands where sharing is possible, is a dynamic approach where parties use technology (databases, location identification, sensing, and more) to identify who is using spectrum at a given location and time, and opportunistically enable additional use. In spectrum where the satellite industry is already operating, the opportunity to have current and future services protected would provide a very attractive scenario; an opportunity to share that would put few constraints on satellite services and ensure long-term access to the spectrum. This approach, of course, provides respect for incumbent services and creates the possibility of opening vast amounts of new spectrum for broadband services.

The Federal Communications Commission (FCC) in the US has already embraced this type of solution for the lower portion of the C-band, where satellites are one incumbent (albeit with limited use) along with the US Government. Under the FCC's Citizens Broadband Radio Service (CBRS) rules, the US Government's Navy radar services, along with the limited satellite service deployments in the band, are protected from interference from terrestrial broadband. The CBRS band will enable deployment of broadband services including densification opportunities for wireless operators, opportunities for companies, campuses, and organizations to improve their own connectivity solutions with their own cap-ex investment, or neutral-host opportunities for both wireless operators and third parties.

CBRS is called by many as the 'Innovation Band' because it uses a three-tier approach to spectrum access between the incumbent, a Priority Access Licensee (PAL), and a General Authorized Access (GAA) user. The US Government and satellite services are fully protected, all the time. PAL tier users will receive rights through an auction process and will be protected against GAA use, but must protect incumbents. GAA users have the benefit of not having to participate at auction, but can use the spectrum subject to provide protection to the other two tiers. In the future, the CBRS approach could be applied to other bands (e.g, C-band uplink and downlink bands) to give satellites services incumbency rights and protections.

Sharing in existing and future satellite bands

Some bands are more compatible for sharing than others, based on the mobility of incumbent services or complex power budgets. The C-band, however, provides an excellent example of a possible sharing band and highlights the current challenges the satellite industry faces in incumbent bands. The industry has opposed efforts from mobile carriers to 'share' the lower portion of the down link band (3.4–3.8GHz) for more than a decade. Regulators have, however, moved incrementally to evict or limit satellite services from portions of the band. At the ITU's World Radio Conference in 2015, the Conference decided to open the 3.4–3.6GHz portion of the band to mobile services, consistent with limited protection of existing incumbent satellite services. Europe has already introduced 3.6–3.8GHz for mobile services as well. In addition, Japan and Korea have given the entire 3.4–4.2GHz band for mobile services. All indications are that the US will start to look at the entire band, as will others. Although there are regions in the world such as Africa, Latin America, and parts of Asia that have supported satellite use of the C-band, the overall trend line is not favourable for the satellite argument for status quo.

For the satellite industry, dynamic access solutions may be even more important in future bands for which they do not have the benefits of incumbency. Dynamic access solutions could provide satellite services access to spectrum that they are unlikely to get otherwise. The FCC's decision last year in

its Spectrum Frontiers Order was a bell weather for what the satellite industry is likely to face in the future. Despite strong efforts by the industry, and even evidence that operators were already building satellites and ground networks to operate in the portion of Ka-band at issue in the rulemaking, the FCC decided that the band would be opened for 5G terrestrial wireless services. The FCC decided that potential interference from terrestrial services into satellites would have to be studied further and that satellite gateways would be permitted only in small areas throughout the country until it is known how 5G will deploy in the decade ahead.

A dynamic approach to sharing could revitalize the satellite industry's spectrum opportunities. In existing bands, the industry could gain more long-term certainty to spectrum that would protect existing infrastructure and enable additional future investment. In future bands, sharing will enable access to spectrum currently occupied by terrestrial fixed and mobile services, including 5G, that are suitable for sharing, as well as to higher frequency bands, for example V-band and Q-band, which are generally without significant incumbent services, but are long-planned satellite expansion bands.

Spectrum sharing for NGSOs

Dynamic sharing opportunities for satellites are not restricted to inter-service sharing with terrestrial mobile. The non-geostationary satellite operator (NGSO) world raises another spectrum risk and opportunity for the satellite industry. NGSOs are among the most celebrated new satellite projects, promising to bring new methods of delivering broadband connectivity to the globe. The FCC's processing round, which was kicked off by the recently approved OneWeb application, received more than ten competing NGSO applications, all seeking to operate in the same Ku- and/or Ka-bands. Although no one expects that all the applicant projects will succeed, it is very likely that more than one will become operational, requiring complex spectrum sharing through coordination and network controls.

Spectrum sharing in a NGSO context raises many of the same issues as between GEOs and terrestrial services. Static approaches to sharing are inefficient and may be even more

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harmful in an NGSO context, as the multibillion dollar business plans for these global systems often require access to full-band and global coverage. A dynamic access regime, however, could provide a sharing methodology that would enable more intensive use of spectrum and the deployment of more NGSO systems delivering more broadband connectivity. It could further stimulate a greater investment and growth in the entire satellite ecosystem – satellite manufacturing, launch, antenna design, and, of course, services.

Embracing sharing drives greater opportunity

Some players in the satellite and terrestrial wireless industries have thus far not been proactive participants in identifying real sharing solutions. Some satellite operators have held fast to a 'No Change' mantra that looks more dated and out of touch with each passing day. The satellite sector too often finds itself without a seat at the table as regulators create the spectrum management policies for the future.

The terrestrial wireless industry also has often refused to embrace new sharing models that would protect incumbents while still opening spectrum for terrestrial broadband services. This has resulted in decade long fights for spectrum access that yielded either no, or only limited, access to new spectrum. WRC-15 was the first time that the terrestrial wireless industry faced a broad rejection of the traditional spectrum clearing model that had been favoured in the past.

If the satellite and terrestrial wireless industries were to embrace and promote a dynamic sharing approach, however, there is an opportunity to build new coalitions necessary to lead the global spectrum debate forward, and enable all of the many broadband technologies that will be necessary to build the next generation networks.

Conclusion

Technologically, and counter to the impressions of many, the satellite industry is in the middle of a wave of new innovations intended to bring the capabilities and economics of the industry in line with the expectations and demands of the marketplace. High throughput satellites (HTS) are lowering the cost per bit to terrestrial levels; NGSO systems are lowering latency; and satellite antenna technology is moving towards cheaper, smaller, and flatter antennas that will change deployment opportunities. These innovations have not, however, changed the general view of regulators or policy makers, whether warranted or not, regarding the relative importance of satellite services.

To change the perception of government officials of an industry staring at its own feet, satellite operators must follow the lead of those in the industry ready to take bold steps forward. New technology and leadership, the roots from which the space industry began, can again spur unimagined innovation.

Dynamic sharing, viewed not as merely a defensive strategy intended to guard the wall, but rather as a sword capable of opening new vistas, is an approach that can enable satellites to return to a role of prominence in the communications fabric of tomorrow.