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Rethinking the Assessment of the Value of Spectrum

1. Electromagnetic spectrum – a shared and finite resource for telecommunications

A coordinated access to and utilisation of frequencies is an essential prerequisite for various means of telecommunications, including those enabled by satellites. Every space system utilises radio or microwave frequencies (usually in between 300MHz and 80+GHz) for uplink and downlink communication. A plethora of terrestrial means of telecommunication and land-based or aerial alternatives to satellite-enabled connectivity operate simultaneously in same or adjacent frequency bands and potentially in overlapping locations. In order to prevent interferences between different systems (space-based and terrestrial), this requires operational coordination and international regulatory harmonisation and sometimes results in the need for:

- spectrum sharing arrangements by different users in same frequency, when feasible; and
- protective measures from harmful interference (intentional as well as unintentional).

2. Fiercer competition for access to spectrum

The demand for access to spectrum is rapidly growing, reflecting the emergence of new spectrum-hungry connectivity concepts, such as the awaited 5G mobile networks. This leads to spectrum shortage and creates profound competition, despite increasing optimisation of the spectrum usage (frequency sharing, usage of higher bands, satellite payload digitalisation…). The increasing demand for spectrum brings about new competitors (i.e. large tech companies, start-ups) and is expected to squeeze various novel types of services (high altitude platforms, intelligent transport systems…) into the existing regulation. This leads to multiple competing candidates for the same spectrum rights and contributes to serious concerns of interferences, even among very different types of applications.

Within the space sector specifically, the commercial deployment of new generations of satellites also impacts spectrum allocation. GEO networks are increasingly complemented by large non-GEO constellations, some of which are already in operational phase. Interestingly, GEO satellite operators are also exploring these new non-GEO avenues. Some examples include, e.g.:

- SES, which already operates and is currently upgrading its O3b MEO network, or
- Eutelsat, which has started a nanosat LEO constellation project (ELO) aiming for the IOT market.

These different challenges eventually require arbitrations that are difficult to decide upon on the basis of one key indicator. Some spectrum-enabled applications have a tremendous societal value (e.g. scientific objectives), which is, however, hardly evaluated by direct economic benefits.

3. New spectrum developments relevant to the space sector

In late 2019, the ITU's quadrennial World Radio Conference (WRC-19) took place in Egypt, to adjust the rules of global coordination of spectrum utilisation and accommodate them to new global realities. The WRC-19 agenda extensively addressed the anticipated rollout of 5G mobile networks and in this sense, allocated more than 17GHz of new spectrum for cellular 5G. Additionally, frequency bands were identified for High Altitude Platforms (HAPS), which can become yet another competitor for satellite in some applications. Thanks to the intense and successful work achieved by the satcom community,

these new spectrum allocations have not come at the cost of drastic reduction of spectrum rights that are essential to commercial satellite operators. Satcom providers, as a matter of fact, collectively praised the WRC-19 outcomes (see, e.g., press releases by GSC, GVF, ESOA, AsiaSat, SES or EchoStar).

In particular, space-related WRC-19 decisions have led to, e.g.:

- new regulatory arrangements facilitating the conduct of short duration satellite missions,
- new spectrum and definition of deployment milestones for non-GEO satellite constellations,
- new spectrum for the operation of Earth Stations in Motion (e.g. internet access on-board planes, ships or trains, which is becoming a viable market for satcom providers),
- new millimetre wave frequencies (51.4-52.4GHz) for fixed satellite services.

WRC decisions and related updates to the Radio Regulations (international treaty formally codifying the rules agreed at WRCs into a written law) are not easily enforceable if not adhered to. Concrete regulatory arrangements and enforceability remain with states. States might also create national spectrum regulations irrespective of WRC decisions or before ITU / WRC actually deals with new issues. The recent clearance of the 280MHz portion of the C-band in the USA for 5G, or a similar process in South Korea in the 28GHz band in 2018 are but few examples of this trend. It raises the question of compatibility between individual national approaches and global harmonisation of spectrum allocations.

4. Concerns of the space sector and the way forward

Potentially leaving spectrum management exposed to diverging and uncoordinated regulation by states poses risks for the space sector. Satellite communications is by its nature transboundary, requiring globally harmonised rules for spectrum usage to be efficient. It is in the vital interest of space actors to reaffirm the necessity of continuation of global harmonisation of spectrum usage. Despite tremendous efforts, spectrum shortage might result in arbitrations that are not always consensual among the space community. In particular, one of WRC-19 outcomes disturbed meteorologists, which expressed grave concerns with new 5G spectrum allocation in the 26GHz band, arguing it may lead to unwished-for interference to space sensors operating in an adjacent band (and hence also to degradation of weather forecasting precision).

> *The agreement reached* (at WRC-19) *falls far short of ensuring 5G applications do not interfere with weather observations at 24 GHz... It is worrying and disheartening to watch history repeat itself and science losing to other societal pressures.*
>
> Extract from the ECMWF statement on the WRC-19 outcomes

Such struggle calls for adequate processes for assessing the value of spectrum in situations requiring arbitrations, which will most likely upsurge in the future. The international community ought simultaneously to protect both the commercial perspectives of the existing and new concepts and the non-commercial, but still highly beneficial applications. Space will probably continue to face difficulties competing with terrestrial on commercial terms, despite its essential role in addressing some markets (e.g. connectivity to air and sea or acceleration and extension of global 5G coverage). Similarly, space systems continue to play an indispensable role in universal provision of public services to the society (such as in science, meteorology, connectivity in disaster management when terrestrial networks go down or coverage of rural and less inhabited areas), although it might not be particularly profitable.

When allocating spectrum rights, economy is certainly an important factor as it fosters growth and prosperity. The value of the space-based services and applications is very quickly increasing to a point that a Morgan Stanley study speaks of a trillion USD value of space-based services by 2040 (against USD 350 billion in 2019). In that respect, space-based services will be as much needed as terrestrial services because of their social and societal leverage. However, arbitrating between economy-led and societal-oriented applications requires political vision and decisions. As a common good, the spectrum will have to serve all applications, space-based and terrestrial, fixed and mobile, and regulations will have to make it accessible.

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