Efficient spectrum usage, ITU and satellite systems

A subjective perspective by
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What is efficient spectrum usage by satellite systems?

- **Many satellites?**
  (requires use of large, expensive antennas which will lead to fewer earth stations for a limited number of applications)
- **Many users (earth stations)?**
  (requires use of small, inexpensive antennas which requires larger orbital separation, hence fewer satellites)
- **Many countries with access to orbit resources and/or operational satellites?**
  (consolidation into fewer larger satellite operators, serving multiple countries, seems to be a trend and this appears to lead to more efficient and profitable operation)
- **Maximum capacity (Mbit/s provided globally)?**
  (requires small spotbeams and large earth station antennas, leading to fewer users and fewer applications and more unused spacecraft capacity resulting in less profitable operation)

Spectrum shared between multiple services

- **How to compare spectrum usage efficiency between services?**
  - Localized, small-cell applications will, when aggregated over a large area provide more Mbit/s (and generate more revenue) than large cell applications
  - Broadcast networks serving many users vs. point-to-point data networks
  - Low-cost networks with modest throughput vs. expensive networks with high throughput

- **Efficient spectrum for whom?**
  - Efficient spectrum usage by one country can be at the expense of another country
  - Efficient spectrum usage by one service can be at the expense of another service
  - Efficient spectrum usage by one operator can be at the expense of another operator

Shall ITU foster efficient spectrum usage?

ITU, constitution

ARTICLE 44

Use of the Radio-Frequency Spectrum and of the Geostationary-Satellite and Other Satellite Orbits

- ***195*** *Member States shall endeavour to limit the number of frequencies and the spectrum used to the minimum essential to provide in a satisfactory manner the necessary services. To that end, they shall endeavour to apply the latest technical advances as soon as possible.*

- ***196*** *In using frequency bands for radio services, Member States shall bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations,* ***so that countries or groups of countries may have equitable access to those orbits and frequencies****, taking into account the special needs of the developing countries and the geographical situation of particular countries.*

⇒ **Is efficient spectrum usage an objective in itself or is it just a means to achieve the objective of equitable access?**

The objectives of the Radio Regulations

From the preamble of the Radio Regulations (2004 edition):

- ***0.5*** *With a view to fulfilling the purposes of the International Telecommunication Union set out in Article 1 of the Constitution, these Regulations have the following objectives:*
- ***0.6*** *to facilitate* ***equitable access*** *to and rational use of the natural resources of the radio-frequency spectrum and the geostationary-satellite orbit;*
- ***0.7*** *to ensure the availability and protection from harmful interference of the frequencies provided for distress and safety purposes;*
- *0.8* *to assist in the prevention and resolution of cases of harmful interference between the radio services of different administrations;*
- ***0.9*** *to facilitate the* ***efficient and effective operation*** *of all radiocommunication services;*
- ***0.10*** *to provide for and, where necessary, regulate new applications of radiocommunication technology.*

The various objectives of the Radio Regulations may in some cases be in contradiction with each other

The role of ITU

What are the current practices and difficulties in getting access to orbit / spectrum capacity?

- Formally, access to spectrum capacity is obtained through application of the procedures of the Radio Regulations
- As of today, these procedures are generally seen to be applied
- As the orbit resources becomes more and more congested, getting access to spectrum capacity becomes more and more difficult
- In a congested situation, practical, detailed coordination is conducted;
  - only with respect to really affected networks
  - formally affected networks and “paper satellites” are less taken into account
  - some networks brought into use interfere with operational systems
- “Unreasonable” requirements of the Radio Regulations and the need to protect “paper satellites” may complicate rather than facilitate access to spectrum resources while providing little gain for satellite operators

Future coordination outside ITU?

- Satellite operators may see themselves forced to set aside the Radio Regulations and conduct coordination directly between practical satellites
- Established satellite operators are fully capable of conducting coordination directly between themselves
  - would seem to lead to efficient use of orbit/spectrum resources by satellite systems
  - no guarantee that such coordination will be in line with the objectives of ITU or will take the needs of other services into account
  - Unreasonable provisions of the Radio Regulations, as seen by the satellite operators, would be disregarded
  - could be exclusive to those having operational satellites and could exclude newcomers trying to enter the arena
  - those who are established and knows the game at a great advantage compared to new comers (e.g. developing countries)
- “Understanding” administrations could authorize such practical coordination to take place outside the ITU procedures while the formal ITU coordination becomes a paper exercise with no impact on real spectrum usage

How can ITU retain control of spectrum usage?

- To ensure that spectrum usage is in line with the objectives of ITU, it should be in the interest of ITU to ensure that the Radio Regulations are such that;
  - The procedures are seen as facilitating and assisting satellite operators
  - It is possible for satellite operators to implement commercial, profitable, satellite networks following the provisions of the Radio Regulations

Do we want an “ITU police” and “ITU courts”?

- Some ITU Member States are cheating in applying the Radio Regulations
  - Submitting “paper satellites”
  - Submitting incorrect Resolution 49 information and incorrectly claiming filings as brought into use
  - Submitting incorrect parameters in filings
- Complicates access for other ITU Member States
- Today, ITU can act like a mediator, but will normally not have the authority to question or overrule a statement made by a Member State
- Tempting to wish for a “big brother”
- Might require ITU Member States to give up some of their sovereignty
  - Would ITU Member States be prepared to do so?
  - Would ITU Member States be prepared to accept decisions by this “super-national” body if it goes against them and what if not?
- Maybe it is better to keep the current situation, despite its weaknesses?

Commercializing/ pricing spectrum access

Will auctioning foster efficient spectrum usage?

- Auctioning of spectrum
  - for a given service/application or
  - “technology neutral” auctioning of spectrum
- Big operators may buy spectrum to block competitors
- “Technology neutral” auctioning of spectrum
  - ⇒ administrations give up their right to regulate the use of the spectrum within their country?
  - ⇒ bidder can resell the spectrum to other operators and for whatever application that he sees fit?

What to auction in the case of satellite systems?

- Access to ITU filings?
  - with service area encompassing other countries?
- Landing rights?
  - Prohibit reception of other satellites?
  - Prohibit uplinks to other satellites?
- Right to operate uplink earth stations?
- Protection of earth stations?
- Auctioning of capacity in competition between terrestrial and satellite applications?

Auctioning of satellite spectrum

- Bidders have an expectation of obtaining some kind exclusive rights
- Satellite systems normally needs to serve multiple countries to be economically viable
- There are normally a large number of satellites at different orbit locations serving any given country
- Some few very large countries can have satellite systems operating only domestically while providing an economically viable operation
- Will auctioning of spectrum for satellite capacity encourage more efficient spectrum usage or is it just a way for administrations to try to get more money?

Is trading of satellite spectrum resources a viable option?

- Gives satellite spectrum a commercial value
- Encourages overfiling, “paper satellites” and cheating (e.g. incorrect Res 49 information)
- May force satellite operators to conduct real coordination outside the procedures of ITU
- May encourage buyers of spectrum to use it more efficiently to reduce overall costs (if buying spectrum access becomes a significant part of the cost of the operation)
- Also enables big operators to buy spectrum and lay it dead to block competition
- Trading of spectrum could be seen as going against the objectives of efficient spectrum usage and equitable access

Filing fees (1)

- Introduced to provide for the Bureau to hire additional engineers to process the queue of filings
  - Current filing fees cover expenses beyond this (e.g. activities by the ITU General Secretariat)
  - Little or no transparency in the justification for the level of the fees, what they are used for and if they are used efficiently
- Filing fees have reduced the number of filings (even though this was not the motivation for introducing the filing fees)
- Should the level of the filing fees and what they are meant to cover be revisited?
- If filing fees are part of the general funding of ITU, is it fair that only satellite spectrum usage is subject to filing fees?

Filing fees (2)

- Filings can contain significant spectrum resources and still be subject to the same fees
  - ⇒ Filing fees has no impact on the efficiency on the spectrum usage

- Countries have one free filing per year
  - Countries with only one satellite operator at an advantage
  - Countries without a satellite operator can submit a free filing and sell it to the highest bidder
  - ⇒ Free filings are against the principle of equitable access
  - ⇒ Free filings are encouraging commercialization of access to satellite spectrum resources
  - ⇒ Remove free filings?

Should ITU fees for satellite spectrum usage be considered?

- Could help funding ITU
- All spectrum usage should then be subject to ITU fees, not just satellite spectrum usage
- How for ITU to control and enforce domestic spectrum usage?
- Would encourage coordination outside ITU
- Could endanger ITU's capability to impact on access to and use of spectrum resources
- Big, rich operators could buy spectrum to block competition
- "Financial due diligence" considered by WRC-97, but rejected

The Radio Regulations

and procedures for obtaining access to and protection of spectrum capacity for satellite networks

Why do we have overfiling?

- Congestion in the arc
  - ⇒ uncertain outcome of coordination
  - ⇒ Multiple filings to enhance chance of success
- Commercial value for administrations leads to more filings
- Filings to block coordination of competitors

Is overfiling a problem?

- Because of the overfiling, many satellite systems operate without having completed the coordination
- Satellite operators will, disregarding the ITU filings, discuss directly between them and find ways to operate in a mutually satisfactory manner
- Satellite operators have learned to live with overfiling
- Overfiling may be a serious threat to ITU's capability to influence and control access to and use of the spectrum resources

Does Resolution 49 help against “paper satellites”?

- Some countries cheat
- Most countries don’t
- Res 49, although not perfect, is helping against “paper satellites” and is helping in removing old unused filings

Is the time ripe for a convergence of satellite services / applications?

- Current “standard” communications satellites can and are providing a multitude of services
  - VSAT and other types of two-way data networks for fixed and mobile terminals
  - Direct-To-Home one-way services (BSS or FSS)
  - One- or two-way services for mobile applications
- Merging e.g. BSS/FSS/MSS into one “satellite service” could facilitate more efficient use of satellites and satellite spectrum
- Somewhat homogeneous technical parameters facilitate more efficient spectrum usage in a given band
- Some satellite applications have significantly different technical parameters than others (e.g. earth station antennas with low directivity)
- Coordination procedures and protection criteria needs to be such as to encourage homogenous networks and avoid the possibility of over protection

⇒ **Convergence of satellite services / applications would seem to have the potential to enhance efficiency of spectrum usage, but careful consideration is required in respect of determining procedures and protection criteria**

Can a greater transparency in the ITU databases be expected or achieved?

- ITU filings normally are of an “envelope” type, encompassing all possible foreseen emissions, coverages etc.
- Coordination agreements and operational limitations contained therein are closely related to the competitive situation between satellite operators
- Coordination agreements are therefore treated as confidential information
- Satellite operators would not like to see the details of the agreements published
- Today, unless the notifying administration at its own accord submits the coordination limitations in its notification submission, the ITU databases do not provide such information
- **It may be naïve to believe that it will ever be possible to have the details of coordination agreements reflected in the ITU databases**

Should there be an expiry date for filings that are in use?

- Building, launching and operating a satellite is a significant financial commitment
- Building up a satellite location takes several satellite generations
- The typical life of a satellite is around 15 years
- Today, Appendix 30 and 30A sets a maximum life time of 15 (+ 15) years for a satellite system that is in use
- After that date, all filing rights are lost, even if the satellite is operational
- Even if the filings are lost, the satellite will still be there and it is highly unlikely that a commercial operator will cease operation
- Satellite operators are forced to make arrangements outside the provisions of the ITU
- Since the satellite is still operational, other countries cannot bring in other satellites to use this capacity
- The ITU databases will not reflect the actual situation

- **Applying hard expiry dates for filings that are in use will:**
  - **Be detrimental for commercial satellite operation**
  - **Not provide access to spectrum for other users**
  - **Be a threat to ITU's ability to observe, control and regulate use of spectrum resources for satellite networks**

Should filings that have been brought into use be cancelled at the end of their regulatory life if coordination has not been completed?

- Coordination is a time consuming process
  - Overfiling, “paper satellites”, over protection, speculative filings, ...
  - Satellites are often seen to be brought into use without having yet completed the coordination
- The requirement to having completed the coordination at the expiry date of the filing (like in the case of the planned bands) could leave operational satellites without a valid filing
- The satellite will not disappear together with the filing and ITU will lose track of the real situation
- To enable ITU to observe and control real satellite usage and provide satisfactory operating conditions for satellite operators,
  - entitle administrations to continue the coordination of operational satellite systems after the expiry date of the filing
  - no status or recognition in respect of those networks with which the required coordination is not completed

Should there be a requirement for explicit agreements for inclusion of a country in the service area?

- To be economically viable, satellite systems needs to be able to provide services in several countries
  - connections between widely separated areas using large beams sometimes covering the entire visible landmasses
  - countries where services are to be provided will change over time
- It is practically impossible to obtain the explicit agreement of each and every administration within a large coverage area
- Even being included in the service area, there is no obligation to license operation within its country or protect such services
- Requiring explicit agreements for inclusion in the service areal
  - is against the objective of enabling efficient use of the spectrum resources
  - while providing no apparent benefit for the administrations concerned

Is there any value in "planning" frequency bands and what is the impact on spectrum efficiency?

- All countries have guaranteed access
- A lot of spectrum resources are tied up in the Plans
- Plans are limited to national coverage and service area
- It is not economically feasible at any given time to have one satellite for every country in the world
- Multinational operation is required to enable profitable operation
- Multinational operation by any country cannot be done within the national assignment/allotment and requires coordination of additional filings
- Assignments/allotments in a Plan will have no value in respect of equitable access to spectrum capacity that enables commercially viable operation
- The Plan will complicate coordination of filings for multinational operation
- **Planning a frequency band (as it is done today);**
  - **Is going against allowing equitable access to commercially viable spectrum capacity**
  - **Leads to significantly reduced spectrum use efficiency**

Is there room for improvement for the procedures for use of the “planned” bands to enhance more efficient usage?

- Removing the Plans is unrealistic for the time being
- Real operation will be outside the Plans
- Procedures should ease and facilitate coordination of networks beyond the assignments/allotments in the Plans

Improvement of procedures for use of “unplanned” satellite spectrum?

- Remove API for networks subject to coordination to avoid speculative APIs aimed at blocking access for other satellite networks
- Remove the possibility to use speculative parameters to block coordination
  - No way to enter into coordination outside the coordination arc
  - pfd limits to get out of coordination inside the coordination arc if the power levels are insignificant

Improvement of procedures for use of the “planned” bands?

- Implicit coordination agreements
- No agreement for inclusion in the service area
  - Removal of RR 23.13C?
- No time limitations for assignments in the List
- Allow coordination to continue beyond expiry date in the case of operational networks
  - Entering into the List with outstanding coordination agreements (both with respect to the List and the Plan)
  - Expiry of filings not associated with entering into the List
  - Notification submissions accepted at the same time as submissions for entering into the List
- pfd limits to get out of coordination inside the coordination arc if the power levels are insignificant