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# The International Radio Spectrum Management: A Regime Theory Analysis

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# The International Radio Spectrum Management: A Regime Theory Analysis*

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## Abstract

The international radio spectrum management regime is one of the oldest existing regimes with the main treaty of the regime, the Radio Regulations (RR), being 113 years old in 2019. However, there have been calls that the Radio Sector of the International Telecommunication Union (ITU-R) has become irrelevant to today's wireless world.

In terms of regime theory, there are three schools of international regime analysis, namely, liberalism, realism and constructivism. With this in mind, this paper's main research question is quite straightforward, to ascertain which of these three schools applies to modern international spectrum management? To achieve this, the paper adopts a qualitative inductive approach that is based on primary data collected from 58 semi-structured interviews with the main stakeholders from the ITU-R.

The examination of the empirical data supports the existence of a post-positivism perspective in regime theory regarding the international spectrum management regime, where hegemonic countries have a mutual interest in having global harmonized spectrum for their technologies, standards and systems. Accordingly, they utilize their lobbying power to promote their ideas. While the regime decision-making procedures have started not to reflect advances in wireless technology, most of the regime's actors prefer to operate according to those procedures advocated by ITU-R so that they can get their technologies approved and legitimated.

Unlike other international organisation (e.g., Security Council), developing countries feels more powerful in the ITU-R due to the one-vote per country rule. The ITU-R Bureau plays an important role of encouraging and reaching a compromise and providing data on the application of the RR. Finally, the paper shows that none of the three schools of theory can solely capture the essences of the international spectrum management regime. Thus, our analysis provides empirical support to a (tentative) synthesis of these schools.

* The authors are solely responsible for the opinions expressed in this paper.

# 1. Introduction

Radio spectrum is a key component delivering wireless ICT services. The governance of the spectrum used on a global basis is the responsibility of the Radio Sector of the International Telecommunication Union (ITU-R), which aims to achieve efficient and economic use of the spectrum (Cave, Foster, & Jones, 2006).

The roots of the current system of international governance started at the first International Radiotelegraph Convention in 1906, which established the right of states to transmit on unused frequencies throughout air space without disturbing the services of other radio stations (Zacher, 1996). The instrument of the ITU-R is the Radio Regulations (RR). The RR provide the minimum treaty-level agreements required for the function of the global telecommunication system while facilitating the development and application of new technologies (MacLean, 1995).

In terms of regime theory, the international radio spectrum management regime is one of the oldest existing regimes with the main treaty of the regime, the Radio Regulations (RR). There have, however, been calls that the Radio Sector of the ITU-R has become irrelevant to today's wireless world, especially with some countries planning their 5G frequencies without waiting for World Radiocommunication Conference 2019 (WRC-19) decisions.

There are three theories for international regime analysis, namely: liberalism (interest-based), realism (power-based), and constructivism (knowledge-based). While (neo)liberalism focuses on a regime's functions such as reducing transaction costs, (neo)realism studies the influence of a hegemonic power. On the other hand, constructivism analyses a regime in terms of cognitive frameworks that influence how actors define problems and their solutions. The former has been dominant in the literature with respect to the telecommunication industry while envisioning the ITU-R as a technical organisation that is based on mutual interest.

With this in mind, the paper's main research question is 'what is the dominant regime theory that applies to modern international spectrum management?' In order to achieve this, the paper adopts a qualitative inductive approach that is based on primary data collected from 58 semi-structured interviews with the main stakeholders within the ITU-R. The paper is also built on participant observation by the first author, who has followed ITU-R activities for more than a decade.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the main schools of international regime theory, while Section 3 explores the international spectrum management regime. Section 4 focuses on the research method adopted. Section 5 conducts a regime theory analysis of the international spectrum management regime, while Section 6 examines the role of the ITU-R Bureau (BR) as one of the main stakeholders in the regime. Section 7 focuses on the decision-making procedures of the regime. Section 8 is a discussion that reflects on the international spectrum management regime in the light of the empirical data. Conclusions are drawn in Section 9.

## 2. Regime Theory

Regimes can be defined as sets of implicit or explicit principles (beliefs of facts, causation, and rectitude), norms (standards of behaviour defined as rights and obligations), rules (specific prescriptions and proscriptions for action), and decision-making procedures (prevailing practices for making/implementing collective choices) around which actors' expectations converge in a given area of international relations (Krasner, 1982; Zacher, 1996). Zacher (1996) explains that there are hierarchical characteristics associated with principles, norms, rules and decision-making procedures. While principles are general standards of behaviour, norms are the most general prescriptions and proscriptions relevant to an issue area and they are implemented at a lower level by rules and decision-making procedures. International regimes are defined as regimes pertaining to activities of interest to members of the international system (Young, 1982).

There are three main theories when it comes to studying international regimes. Liberalism is based on the cooperation and the role of non-governmental actors (Ratto-Nielsen, 2006). Neoliberals envision that interdependencies and mutual interests of creating international technical standards could motivate increased international cooperation (McCormick, 2007). In such cases, the gains from cooperation grow sufficiently for states to be increasingly willing to trade off policy autonomy for economic welfare (Zacher, 1996).

On the other hand, realism focuses on the state's role and power as the basis of international systems (Ratto-Nielsen, 2006). Neorealists argue that mutual interests are not the crucial foundation on which international regimes are built. Instead, they are built on the dominant state's gains and their power to impose acceptance of the regime and compliance on other states (Zacher, 1996). Neorealism also considers that states, as the main actors within the regime, have as their goal their survival and autonomy and that the distribution of power between states is a major influence on the international regime. It addresses "structural power" which is power over formal and informal institutional structures (Ratto-Nielsen, 2006).

Constructivism seeks to demonstrate how many core aspects of international relations are given their form by the on-going processes of social practice and interaction (Bledsoe, 2012). Wendt (1999) explains that there are two main features of constructivism, writing "*that the structures of human association are determined primarily by shared ideas rather than material forces, and that the identities and interests of purposive actors are constructed by these shared ideas rather than given by nature*".

As explained by Puchala & Hopkins (1983) "*regimes accommodate a set of elites who are he practical actors within it as usually, government of member states are the official member of international regimes*". In our case, this is either of ministry of telecommunications, national regulator, or, in some cases, a specialized agency for spectrum management (e.g., AFNR in France).

The three theories have different approaches with regard to regime analysis. While liberalism focuses on a regime's functions such as reducing transaction costs, realism studies the predominant influence of the state over others. On the other hand, constructivism analyses a regime in terms of cognitive frameworks that influence how actors define problems and frame their solutions (Cowhey, 1990).

While neoliberalism and neorealism embrace different views with regard to regime analysis, both of them adopt a positivist paradigm, which is the dominant paradigm in the field (Lee, 1996). More specifically, they assume that

telecommunications is ruled by scientific logic and that the International Telecommunication Union (ITU) is a technical body. On one hand, neoliberalism assumes that telecommunications regulation is employed to minimise barriers to competitive markets. On the other hand, neorealism argues that the state is the main unit of analysis and that states compete to maximise their own power. This is not the case for the constructivism approach, which is influenced by the interpretivism paradigm. Under such a paradigm, it is argued that state behaviour is shaped by elite beliefs and shared knowledge (Ratto-Nielsen, 2006).

In general, liberalism has been the dominant paradigm in telecommunications since 1945. Since then it is been argued that most international regimes are grounded in the mutual interests of states and have not shaped by the strength of the most powerful states for several reasons. Firstly, states respect the sovereignty of other states and comply with international agreements. Secondly, there are several international regimes governing different issues that are shaped by the mutual interests of the powerful states and the great majority of weaker states (Zacher, 1996). However, although their perspectives may explain how the current regime was created, it does not consider changes in domestic preferences (Ratto-Nielsen, 2006). On the other hand, neorealists explain the change in international telecommunications regime by referring to the gradual withdrawal of USA from interconnection norms (Ratto-Nielsen, 2006)[1]. In particular, till the mid of the 1980s, the ITU recommendations promote monopoly by allowing telecom companies to restrict resale and by prohibiting interconnection of private networks (Cowhey and Aronson, 1991).

Ratto-Nielsen (2006) criticizes employing the neorealism/realism perspective when studying telecommunication international regime, stating that "*The pessimism of the neorealist view can be attributed to the assumption that states are more concerned with relative gains*[2] *than absolute gains*[3] *since international relations are considered as a zero sum game*[4] *where larger gains from other states increase their advantage in future disputes. Evidently, this has not been the case for the creation and maintenance of the ITU*".

On the other hand, liberal and neoliberal approaches to the international telecommunication regime view the ITU as a model of international cooperation that is based on mutual interests. However, although their perspectives may explain the regime creation, it does not consider the changes in domestic preferences (Ratto-Nielsen, 2006). Moreover, both approaches are criticized for failing to take into account the emergence of new policy actors such as NGO and to explain changes within the regime (Ratto-Nielsen, 2006). To this end, knowledge based theories, specifically constructivist, emerged as theories to explain changes in states interests and preferences which trigger changes in the international regime (Ratto-Nielsen, 2006).

Another important theory is the post-positivism theory of international organisations, which tends to overcome the inadequacy of realism and liberalism (Lee, 1996). More specifically, the proponents of such a theory argue that the ITU has

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[1] The three main norms for the international telecom regime are jointly provided services through investment by several countries in a common infrastructure, standardized networks and equipment, and organized global commons (e.g. spectrum).

[2] Relative gain is related to zero-sum game, which states that wealth cannot be expanded and the only way a state can become richer is to take wealth from another state.

[3] Absolute gain is the total effect of a decision on the state or organization, regardless of gains made by others.

[4] A zero-sum game is a mathematical representation of a situation in which a participant's gain (or loss) of utility is exactly balanced by the losses (or gains) of the utility of the other participant(s). If the total gains of the participants are added up, and the total losses are subtracted, they will sum to zero.

existed as a product of hegemony, engendering rules that facilitate the expansion of hegemony. Regarding the decision-making procedures, post-positivists argue that the ITU consensus could be challenged by the existence of barely concealed conflicts between member states. As explained by Lee (1996), who states that "*Indeed, consent to the existing order has been maintained by the ability to issue reservations, serving as a safety valve to diffuse conflict and channel it to statements that do no challenge the existing order*". It is also perceived that the participation of the private sector reaffirms the hegemony of some actors. This is also supported by Krasner (1983), who argued that "*hegemonic distribution of power lead to stable open economic regimes because it is in the interest of hegemonic state to pursue such a policy and because the hegemon has the resources to provide the collective goods needed to make such a system function effectively*" (Krasner, 1983).

## 3. International Spectrum Management Regime

In approaching the international spectrum management regime, it is argued by some that the establishment of the regime at the beginning of the 20th century was mainly intended to resolve the issue of interference between neighbouring countries and to handle the refusal of the Marconi company to relay messages received from competing operators (Anker & Lemstra, 2011).

More specifically, the first radio conference was held in Berlin in 1903 to prevent the Marconi company from achieving a monopoly over radiotelegraphy. Marconi refused to allow its network to communicate with ships or shore stations using other types of radio equipment. Although most of the participants at the conference opposed Marconi's non-interconnection policy, the conference issued only non-mandatory resolutions rather than treaty ones recognizing that the technology is too new to be regulated. In 1906, Germany called for a second international wireless conference at Berlin to discuss the same issue in addition to the issue of spectrum allocation. It was proposed to reserve low frequencies for government and military uses. Eventually, it was decided to end Marconi's non-interconnection policy and to allow commercial use in low frequencies (longer waves). Moreover, the participants signed the convention for the regulations of wireless telegraphy (Headrick, 1992).

The ITU-R is the administrative cooperation body responsible for setting the international spectrum management regime's rules, and its origin could be traced back to the Washington Radio Conference of 1927. This conference established a new committee (International Radio Consultative Committee or CCIR) to undertake technical studies in the periods between radio conferences. The first time that spectrum was allocated in response to a need rather than legalizing existing uses was at the Cairo Radio Conference in 1938. The Cairo Conference also enhanced spectrum utilization efficiency by establishing technical standards and restricting the use of frequency wasteful for radio transmitters (Codding, 1991).

The international radiocommunication arrangements fall into three main categories (Rutkowski, 1983). The first one is the ITU convention and constitution, which accommodate principles that address general issues such as legal relations between member states. In particular, according to the ITU Constitution Article 1, one of the ITU's purposes is to allocate bands of radio-frequency spectrum, allot radio frequencies and register radio-frequency assignments in order to avoid harmful interference between radio stations of different countries (ITU, 2011a). One other important issue is Article 45 of the ITU Constitution, which states that all radio stations must be established and operated in such a manner as not to cause harmful

interference to other stations that operate in accordance with the provisions of the RR (ITU, 2011a).

The second one is the Radio Regulations (RR), which organizes the rules of radio operations. The RR accommodate the international table of frequency allocations in addition to spectrum technical, procedural, and operating rules (Gregg, 2009). The RR have international treaty status and are thus binding on all ITU-R countries (Maitra, 2004). The third category is the ITU-R recommendations, which are provisions that have no obligatory status.

The regime was based on the concept of the common use of common frequencies (Levin, 1971), which can be interpreted as the global harmonisation of spectrum allocation. This allocation could be to one or more radio services with equal or different rights (primary and secondary). Stations of a secondary service cannot cause harmful interference to stations of primary services and cannot claim protection from harmful interference caused by stations of a primary service (ITU-R, 2008a).

The World Radiocommunication Conference (WRC) is held every three or four years to revise the ITU-R RR, which is the international treaty governing the use of radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits. The conference also addresses any radiocommunication matter of a worldwide character. The main issues that the WRC studies are organized in terms of what is called an 'Agenda Item' (A.I.). According to Article 7 of the ITU Convention: "*The general scope of this agenda should be established four to six years in advance, and the final agenda shall be established by the Council preferably two years before the conference, with the concurrence of a majority of the Member States*" (ITU, 2011b).

Consensus on agenda items is usually difficult to reach because excluding an issue from discussion in the forthcoming WRC may lead to the delay of a service or technology. On the other hand, considering new issues may bring about the threat of harmful interference to existing services (Abernathy, 2004). During the WRC, negotiations are conducted between member states of the ITU, which effectively involves them trading support on different issues between one another (Manner, 2003).

Decisions on agenda items are usually reached by consensus. If not, voting is used where each country (Member State) is entitled to one vote. Regional voting has a significant impact on WRC decisions. In addition, each country has the right to make declarations and reservations at the end of the WRC regarding any decision that has been made (Gregg, 2009b).

Observers that are sector members of the ITU-R, that is, from the private sector, can attend WRCs in a non-voting capacity (ITU, 2011b). Regional organizations usually present common proposals to the WRC on behalf of their member states as proposals must have the support of more than one administration to be considered (Contant & Warren, 2003). In general, those countries that do not share the view of the others regarding a WRC decision are expected to agree to the opinion of the majority. Those member states who are unhappy with a decision can record their reservations in the final act of the conference (Jakhu, 2000). Resolving some issue may occur in the final hours of WRCs but if this is not the case the decision is usually postponed for further study at the next conference (Gregg, 2009a).

It is important to note the increasingly role of the private sector in the international spectrum management regime, especially since the ITU Plenipotentiary Conference of 1995 formally recognised the rights of the private sector (MacLean, 1995). The private sector participates in and lobbies the ITU-R to obtain support for

their various interests (Irion, 2009). Furthermore, although national regulators are the decision makers for the treaty instruments in the WRCs, their decisions are developed based on the work of ITU-R study groups where the private sector conducts much of the technical work (McCormick, 2007).

There have been several attempts to examine the international telecommunications regime with a focus on the impact that privatisation and liberalisation has had on international organisations such as the ITU (Drake, 2000; Don MacLean, 2003; Ratto-Nielsen, 2006; Zacher, 1996). However, relatively little of this literature focuses on ITU-R activities in order to examine international spectrum management regime and most of them are out-dated (Rutkowski, 1979; Savage, 1989; Sung, 1992). Below we conduct an analysis of the international spectrum management regime in terms of principles, norms, rules, and decision-making procedures.

The main principles of the international spectrum management regime are twofold. Firstly, the sovereign right of each state to assign its frequencies to any service or station (Lyall, 2011), and, secondly, that all radio stations must not cause harmful interference to other stations which operate in accordance with the provisions of the ITU radio regulations (ITU-R, 2008b). The main norm of the regime is global harmonization of spectrum allocation. The ITU-R is the administrative cooperation body responsible for setting the regime's rules through the RR and the ITU-R resolutions, recommendations and reports. The RR have international treaty status and they are binding for all the ITU-R countries (Maitra, 2004).

The regime's rules include registering national frequencies in the ITU-R Master International Frequency Register (MIFR) in order to acquire international recognition and protection against harmful interference. Such registration requires conformity with the ITU-R service allocation table and not causing harmful interference to existing assignments in other countries (Lyall, 2011). A second rule is that allocating each spectrum band to one or more radio services with equal or different rights (primary and secondary). This is based on the results of compatibility and sharing studies that are usually technology dependent (Louis, 2011). Stations of a secondary service cannot cause harmful interference to stations of primary services and cannot claim protection from harmful interference caused by stations of a primary service (ITU-R, 2008a). A third rule is that of regional allocation, where the ITU divides the world into three regions in terms of spectrum allocation[5].

Examining the ITU from the perspective of different schools of regime theory reveals two distinct views. From the realist perspective, the ITU was controlled prior to 1950 by a small number of developed countries to convey their domestic preferences (Rutkowski, 1979). These countries were using the votes of their overseas colonies to dominate the activities of the ITU. For instance, in 1925, France, Great Britain, Italy, and Portugal all had seven votes in the ITU (Noam, 1989). Additionally, Wallenstein (1977) argues that spectrum allocation is an intensely political exercise of powers where worldwide agreement is not always fully achievable.

Adopting a liberalist stance, the creation of the regime was associated with the mutual interest of the founding countries in enabling international interconnection (Codding, 1991). In addition, although the RR are a matter of international law, there is no record of any case of spectrum management compliance coming before an

[5] Region 1 comprises Europe, Africa, the Middle East west of the Persian Gulf including Iraq, the former Soviet Union and Mongolia. Region 2 covers the Americas, Greenland and some of the eastern Pacific Islands. Region 3 contains most of non-former-Soviet-Union Asia, east of and including Iran, and most of Oceania.

international court (Ryan, 2005). It is also argued that starting from WARC-92, the first international communications conference under the so-called 'New World Order', tensions between the Soviet Eastern bloc and the Western nations no longer existed with the consequence that focus was on international cooperation (Sung, 1992). This was due to the reform of the ITU at the Nice Plenipotentiary Conference in 1989 that completed at the Geneva Plenipotentiary Conference in 1992 and ended an era of dominance by a few countries (Kelly, 2002). In addition, while the technical discussions within the ITU sometimes have a political nature, this has not led to ITU activities being dominated by a handful of states (Savage, 1989).

## 4. Methodology

A qualitative methodology is adopted in this paper that utilises an inductive approach where the theory is developed from the observations or the findings of the research (Bryman & Bell, 2007). The paper is based mainly on primary data collected from 58 semi-structured interviews with the main stakeholders who participate in the different ITU-R activities. These stakeholders include representatives from national regulators, broadcasters, the mobile telecommunication and satellite industries, in addition to the various chairmen of study groups within the ITU-R. The paper also draws on secondary data such as ITU-R publications that illustrate regime theory in general and the international governance of telecommunications in particular. Interview questions were developed to cover three main areas, that is, the dominate regime theory, decision-making procedures and the role of ITU-R BR.

The second step after conducting the interviews was data reduction, which is the process of selecting and simplifying the data included in the transcription of the interviews (Miles & Huberman, 1994). Data reduction has been achieved in this paper through coding, which is defined as breaking data down into component parts which are given names (Bryman & Bell, 2007). Coding is used to link data to ideas and also to ascertain links between different ideas (Bazeley, 2007). NVivo was used for this purpose in order to identify the important themes (Bazeley, 2007), where the final version of the transcription of the interviews was imported into NVivo as MS Word files.

The final stage of the data analysis is the drawing of conclusions. In general, Miles & Huberman (1994) define thirteen tactics for drawing conclusions, and the researcher selected three of them that fit with the research strategy. The strategies adopted were noting patterns and themes, counting, and making contrasts and comparisons. The first technique, that is, noting patterns and themes was used along with coding and mapping processes through organising nodes and concepts respectively. It enabled the researcher also to make sense of the collected data and to note important findings. Secondly, counting was useful considering the large amount of data for each research question. In particular, it was used to clarify proponents and opponents for each concept. Additionally, counting is useful to mitigate researcher bias (Miles & Huberman, 1994). Thirdly, making contrasts was used to compare the different conclusions across the two case studies in addition to between the international interviewees.

As this paper addresses different approaches to regime theory, it is important to highlight the research philosophy adopted for this research. This is because the research philosophy adopted impacts on the researcher's view of the relationship between knowledge and the process(es) through which it is developed. In particular, Saunders, Lewis, & Thornhill (2009) point out that the researcher's philosophical

worldview or paradigm shows the researcher's view of the nature of reality or being (ontology) and of what constitutes as an acceptable knowledge in the field of study (epistemology). Moreover, Scotland (2012) argues that the adopted paradigm would influence the choice of research strategy or plan and also the techniques used to collect and analyse data. Moreover, while the literature accommodates many different philosophical paradigms, this research focuses on four main types: positivism, interpretivism, realism, and pragmatism.

Firstly, the positivist position advocates the use of the methods of natural sciences to the study of social reality (Bryman & Bell, 2007). In particular, it assumes that the social world exists objectively and externally, and that knowledge is only valid if it is based on observations of this external reality (Flowers, 2009). Secondly, the interpretivism stands in contrast to positivism and sometimes referred to as constructivism, anti-positivism, phenomenology, subjectivism, post-positivism or social constructionism (Dissertation Writing Online, 2014; Flowers, 2009; Holden & Lynch, 2004; Mkansi & Acheampong, 2012; Schwandt, 1994; Yuen, 2005). Such a position accommodates the subjective and socially constructed ontology. It also focuses upon the details of a situation and how the subjective meaning motivating actions (Saunders et al., 2009). Thirdly, realism takes aspects from both positivism and interpretivism and holds that real structures exist independent of human consciousness, but that knowledge is socially created (Flowers, 2009). Finally, pragmatism suggests that the most important determinant of the adopted epistemology and ontology is the research question (Saunders et al., 2009).

Having said that, this research adopts the interpretivism paradigm as the philosophical position for several reasons. Firstly, this research embraces the subjective ontological position which holds that social phenomena are created from the perceptions and consequent actions of social actors (Saunders et al., 2009). More specifically, it is argued that the regulatory aspects of spectrum management are socially constructed by the policymaker's views and beliefs where these views are not constant and may change according to the complex and relatively unique circumstances to be found in each country. In addition, these views vary across the different stakeholders. Secondly, with regard to the epistemological position, this research aims to investigate the subjective meanings of a situation where the focus is on the details (Saunders et al., 2009). In other words, it is believed that it is important to focus on the details of national regulations with regard to spectrum management and the particular views of national policy makers towards the international regulations.

## 5. Regime Theory Analysis

Fifty-Eight interviewees answered the question relating to the main regime theory applied to the international spectrum management regime. The question was drafted as follows "Do you consider that the ITU-R system is based on 1-mutual interests 2-dominant states, 3-interaction and shared ideas between policy makers?" A brief and simplified explanation was provided over the different theories of regime theory, and interviewees were also allowed to select one or more of the three theories.

Unsurprisingly, several interviewees (23) were of the views that the regime is mainly based on mutual interest. This is aligned with the main theory adopted in the literature. In particular, the nature of the regime entails a need to have radars, maritime, aeronautical, mobile, and satellite services globally. In such cases, the interest is considered self-interest for each country but also of an international nature.

Therefore, every country is interested in reaching a common solution. Such a solution is quite often needed in the case of international spectrum management regime where protection against interference and reaching a certain level of harmonisation whether it is regionally or globally is of the interest of all countries. Furthermore, the system itself is designed specifically to accommodate each county's interest, especially developing ones.

Regarding the accusations that there are dominant countries, it was explained by interviewees that it depends on the expertise that a country has independently of the country's financial capabilities or political power. During the history of the ITU-R, there have been several experts from countries such as Morocco and Syria whose expertise and seniority was acknowledged by other countries.

Even among dominant countries that experience significant political disagreements, within the ITU-R there is a need to achieve agreement. As one of the interviewees explained "*the Americans and the Russians, at the heart of the cold war, the coordination of the two sides' military satellite systems was done because it has to work. Despite the political difficulties between the two blocks of the world if we're depending on these military Satellites, we don't want anything wrong to happen so we will coordinate and get that sorted very, very, well, So that's an interesting version of how at one political level there is contradiction, but at the technical level there is a clear desire to make it work*".

In addition, during WRC-12 debates surrounding 700 MHz was evidence that even those countries that can be considered dominant or powerful can be forced to adopt a decision initiated by developing countries. Furthermore, there has been a transition where those countries that were previously dominant have realised that they cannot achieve their objectives by forcing decisions on (other) less powerful countries. Another important observation is related to the support of the industry, which was a focus of industrialised countries. As explained by one of the interviewees "*Qualcomm used to pay attention to the market in the US and to a certain extent to Europe. Today all money spent in research in developing what developing countries want, what does China want, what does Brazil want, does Africa want, so the shift is taking place*". One interviewee clarified that the existence of mutual interest does not mean that some countries attempt to dominate the process, but the regime procedures do not allow them to do so.

While only seven interviewees supported the theory of dominant states, their remarks are worth considering. For instance, one interviewee from a developing country argued that dominance is a normal trend within the ITU-R, as there have been always technology leaders and technology followers, stating "*so you are always late, this delay means that you are not driving the car*". In other words, the nature of the telecommunications industry enables some countries to be dominant. Ultimately, the international spectrum regime is related to the telecommunications industry, which is largely a technical field. One example is related to the GE-06 plan, which covers the transition to digital broadcasting. Initially such plan was led by European countries, which were interested in spectrum efficiency and quality of transmission. However, Africa, due to its close (geographical) position to Europe, wanted to join the plan and be part of it. One interviewee noted "*They are not dominant because they are powerful or because they have more money or more things. It is just because they are the industry*".

It was also emphasised that some countries are dominant by nature of their economic development, political power, and strong telecommunications industry. If the regime would have been formalised to decrease the power of these countries, this

would deter innovation in these countries that, in turn, may negatively impact on the telecommunications sector as a whole. Dominance is also related to the power of lobbying within the ITU-R where manufactures and industrial countries usually have the capabilities to create a strong lobby to support their interests. Few interviewees, who acknowledged the existence of dominance, arguing that developing countries with good negotiating capabilities could achieve some of their interests and reach a compromise. One interviewee explained "*single country from developing countries can be effective in changing a decision. So dominance does not necessarily produce dominant decision*".

Another novel remark considers that dominance is not related to the GDP of the country or of its political power. In particular, all of the stakeholders are invited to participate in the ITU-R decision making procedures, and those who can attend the meetings, present contributions, participate in the discussions, have a very big role in formulizing final decisions. As explained by an interviewee "*Any country in the international union, that follows these perspectives, of course will have a role in taking decision that is not less than any other countries*". Accordingly, there are number of countries that are considered dominant and influential within the ITU-R (e.g., France, UAE, UK, USA) irrespective of whether they are dominant in other international organizations. As noted by an interviewee "*In every region there are some states which are more active, they take the leadership position because of their pro-activeness*".

One interviewee raised the point that politics exit within the ITU-R due to the nature of discussion at WRC where there is an exchange of positions. This is the reason why a country such as US usually supports Canada, as hinted at by one interviewee "*Political power is there, affects the number of votes that will help you*". On the other hand, politics could also motivate countries to refuse another's proposal(s) even if it is technically reasonable. Another interviewee highlighted that dominance has always existed but today it is dominant companies rather than dominant countries. More specifically, the industry is actively involved in all of the study group discussions and sometimes they chair meetings as well.

As one interviewee expressed *"It is a bit like the world trade organization, but we pretend that we're they're not, we pretend that we're just talking about technical issues and radio regulations but in fact we're talking about what types of projects technologies and systems we're going to allow to be sold in each of our countries or to sell it to each other's country"*.

Moreover, as politicians are concerned with economic growth and increasing job opportunities, they become more interested with what the industry wants to achieve within the ITU-R. This results in unsurprising alignments, as one interviewee noted "*Finland and Nokia, never seem to disagree, Sweden and Eriksson never seem to disagree, China and Huawei do not disagree a lot, right?*". The industry also has recently changed, lobbying developing countries instead of traditionally coordinating with the developed countries for two reasons. Firstly, it requires much less resources to undertake lobbying in developing countries rather than to do it in developed countries. Secondly, the number of developing countries is much larger than developed ones, and accordingly, the industry can secure large number of votes to support their interests / objectives.

Regarding the third regime theory, constructivism, eight interviewees supported the idea that the international spectrum regime is based on shared ideas among the elite participants. While the regime is contribution-driven, the different experts meet and discuss the different proposals from the beginning of structuring

questions for study groups until WRCs in a way that harmonises the participants' way of thinking. Furthermore, some of the individual delegates have the ability to have influence their country's positions and even other countries. In addition, ideas of a 'solid' nature usually spread among the delegates of different countries. This is because some country's positions are based of misconceptions or the lack of full information. Therefore, conversations or sharing specific ideas can change the position of a country. Individuals or the elites can also block the discussion or deter a specific proposal especially if they chair a meeting by delaying giving the floor to participants. Proof of the importance of sharing ideas is evident during WRC, where there is a considerable opportunity for positions to change following various 'elite' meetings.

One interviewee mentioned an incident where the elites from developing countries faced the UK, which required more UHF frequencies for the BBC. At that time, these individuals were successful in blocking the discussion and declining the allocation. In the words of one interviewee "*All depends mainly on the person who attends the meeting and the conference, and what he has as an argument and as a defence, what are the studies he came back with, and what could be used as a defence! If he had the tools by which he can defend his requirements then he will be able to get the requirements*"

Additional support for such view is that the main decisions taken at WRC are through the inter-regional meetings, which are attended by only a few people. One interviewee argued that sharing ideas occurs only at the level of study groups where the elites have a role in convincing the others, but this is not the case for WRCs. Furthermore, some elites from developing countries were able to defend their interest despite the low participant from these countries and can play an important role in balancing the discussion. These elites usually have a good memory of what has happened in past WRCs, which is important when it comes to building arguments.

15 participants argued that the three regime theories are nonexclusive as the international spectrum management regime accommodates them all at different times. As explained by one "*I think it's more complicated than that because it is an interaction of over 160 countries, and sometimes on some issues a few will be dominant and the other do not care, sometimes they'll have horse trade to come to mutual agreements. I think it's very difficult to characterize it with one description because there are so many agenda items, you get 20 agenda items, you get different things on each one*".

Firstly, there are countries with more resources than the others and that have more power and influence on the discussion. There were instances where these dominant countries forced a decision or introduced an item at WRC without it being on the agenda of the conference. In addition, some discussions are dominated by a few countries due to the nature of these discussions. For instance, few countries are active in the field of data satellite or space research, which inevitably limits the number of contributors.

Secondly, there needs to be mutual interest rather than national self-interest if a common understanding or agreement is to be reached regarding a global standard or harmonised allocation. As suggested by one interviewee *"The elite policy makers spend a lot of time trying to generate mutual interest"*. Thirdly, this common ground is usually reached through interactions and sharing ideas between the elites representing their countries. More specifically, reaching consensus or compromise entails that each country gives up something. This is achieved though the discussion and sharing ideas.

The elites cannot achieve their objectives these elites are usually supported by big countries or companies, with this support encouraging the sharing of ideas. Another argument emerges when regime theory is applied and is related to the context (that is, the study group and subject under discussion). For example, Working Party 5D, which addresses IMT issues, is largely dominated by the telecommunications industry.

Five interviewees made an interesting argument that the international spectrum management regime is a mix between countries attempting to achieve mutual countries, and dominant countries that force their views and interest on the others. One argued that "*Dominants try to gather between the two, to be dominant, and at the same time to have mutual interest between countries…it takes the two of them, it takes the "mutual interest "of people that have a role in the decision, and at the same time, it uses its power that's present in the ITU*".

For instance, while the system looks like it aims to achieve mutual interest, the collective way of discussing things at WRC limits the capability of some countries to participate in the different discussions. One interviewee argued that while countries use their experts to participate in the discussion, what really happens is that they use their capabilities to block the discussion or prevent the proponent of a proposal from actually achieving what they want to achieve. For instance, certain limits of out of band emissions may look as they target protecting a certain service while they would deter the deployment of new services. In other words "*People use their experience to actually exploit the loopholes, people use their experience to manipulate things, and manage to get away with it*".

A complementary view is that these dominant countries attempt to avoid voting as much as possible to show that they are seeking to achieve the benefits for all countries. This is also the reason why it is very rare in the ITU-R to discard one country's proposal or concerns. In addition, countries that have the resources and capabilities, usually work at facilitating the decision-making process because it is believed this will achieve their objective more readily.

## 6. Decision Making Procedures

One of the main elements of the international spectrum management regime is the decision-making procedure. Countries usually reach decisions without the need for conducting a formal vote, thereby recognizing the importance of consensus in, say, reducing manufacturing costs (Frieden, 2008). However, while voting procedures are well defined by the ITU-R, the concept of consensus in not formally defined. In particular, Article 32 of the ITU convention states "*As a general rule, any delegation whose views are not shared by the remaining delegations shall endeavour, as far as possible, to conform to the opinion of the majority*".

On the other hand, according to Article 21 of the ITU convention, the voting procedure entails several details such as expressing reasons for votes by the member states and the rule that no delegation may interrupt the process once a vote has begun, unless it is to raise a point of order in connection with the way in which the vote is being taken. The procedure also accommodates the possibility of member states expressing reservations at the end of the conference according to Article 32 of the convention. Another unique characteristic of the international spectrum management regime is that WRC can partially or, in exceptional cases, completely, revise the RR. WRC can also deal with any question of a worldwide character within its competence and related to its agenda according to Article 13 of the convention.

41 interviewees responded to the question with respect to the efficiency of the decision-making procedures and whether they meet the challenges of advancing technology and the interests of member states. 28 responded that they are satisfied with the current procedures. With respect to the pace of change within the regime, it was explained that the procedures achieve the balance between the hurry of the industry to innovate and the wisdom of the government to regulate. An interviewee stated "*So what is required is that these two brains, and these two ways of though, are to meet through conferences and through studying groups, to mix wisdom with creativity. When the both of them are attached together, you will get the best resolution*". In addition, reaching consensus and agreement between 194 countries is not an easy task that could conceivably take several years. Another interviewee from the industry explained that the current pace of the procedures creates a lot of certainty and it is necessary to have a balance between stability and speed.

Secondly, it was also highlighted that the procedures are one of the most effective and transparent among the UN organizations for several reasons. The procedures are stated clearly and the topics to be discussed are known to all stakeholders. These stakeholders include the private sector, academia, and all interested parties.

Regarding voting, unlike other organisations where decision could be taken immediately subject to voting, the ITU-R allows several other opportunities to reach a decision with the consequence that voting is the last solution. As explained by an interviewee "*Voting is rare to be done, in addition the international union consider voting as a failure, I have never seen that in any other organization*". Furthermore, decisions are taken in a bottom-up approach where all the stakeholders participate in the study groups and working parties. Discussions then continue during the WRC until it is approved by all member states. Therefore, as everyone is involved from the beginning, the decision is accepted and implemented globally.

Transparency is a main advantage of the procedures where meeting dates and places are known and well-planned, and documents are available to all stakeholders. The discussion is contribution driven, as outlined by an interviewee "*the ITU-R is totally driven by the contributions of people, by the flags raised, who raise the flag will take the floor, is the one who will have an action*". Equity is also a unique feature of the procedures, with each country having one vote regardless of its financial or geo-political standing.

Furthermore, the delay in the process is not related to the procedures per se but to the need to reach consensus with neighbouring countries and with other regional groups. The slow pace of the procedures also reduces the risk of reaching a wrong decision, and also provides investment certainty. As articulated by an interviewee "*Suppose there's a risk at each WRC that you are going to change things in a very dramatic way without advance notice, people cannot invest*". Even with such a slow pace, the procedures are able to accommodate any type of technology developments for many years, and does not deter preliminary implementation or developments.

Regarding the definition of consensus, an informal definition is that "*Agreement means nobody objects. Consensus means I don't agree with you but I don't show my rejection*". With respect to the lack of resources for developing countries to participate in the discussion, it was mentioned that these countries' views could be accommodated as part of regional groups. Through this mechanism, all countries are included. This is unlike the case of other UN organisations such as the World Bank or Security Council where developing countries have only a limited opportunity to contribute.

One of the interviewees described the procedures as a protection against the gap between the developed countries, which innovate and produce technologies and developing countries, which adopt such technologies. They stated that "*the present system is I think tailored towards the developing and underdeveloped countries. Because it's a very slow system, and a slow system is always geared towards those countries which do not have resources to go for quick changes. They cannot take off their old networks in a short time and replace them with new networks, because of economic constraints. So a slow system will always be good for those countries which need more time*"

Moreover, ITU is an organization where developing countries have a lot of power within the ITU comparing to other international organization because of their (collective) number of votes. The decision making process has also a regular rather than a random system, as explained by one interviewee "*When you look at the life cycle of conferences in other organization. There is no life cycle. They may spend 10 years without a conference, and then a conference occurs after a year*". Additionally, the procedures enable any country to raise an issue and bring it to a study group. It is worth noting that even if there are deficiencies within the procedures, these procedures are set by the member states themselves.

On the other hand, 13 interviewees criticized the decision-making procedures. While decisions related to spectrum allocations are taken at WRCs, these decisions are formulated by study groups where several countries do not participate. Another deficiency is related to the slow pace of the procedures where, in order to introduce a new agenda item to WRC, a period of eight years is needed. Even if there is an urgent topic that requires holding a conference between two WRCs, it will interrupt the study period and may not be possible due to the need for extensive logistic preparation. In addition, within the four years before WRC, the issue under study could undergo changes that distance it from the original issue.

Several interviewees called for reducing the cycle period to two or three years as there are usually strong internal pressures on national regulators to adapt to advancement in technology yet these regulators are restricted by the international decision-making procedures. Moreover, one country can block another due to political reasons as the procedures enable them to do so through, for example, introducing a country footnote that requires the approval of neighbouring countries.

Furthermore, it seems that countries with access to more resources, in terms of experts, participation and contributions, can make the best out of the decision-making procedures. Therefore, developed countries and large industry players are the main beneficial of the procedures. The procedures per se were described as quite rigid, and cannot accommodate the flexibility needed to meet technological development. An efficient suggestion from one interviewee was not to study issues for four years and then to decide on them in four weeks during WRC. Instead, he suggested finishing urgent issues every year instead of waiting for four year to address all the issues together.

A critical deficiency of the procedures is that non-compulsory documents, which maybe important and influential, such as ITU-R recommendations of IMT frequency arrangements, are approved during the study groups meetings rather than during the WRC and only some countries attend and follow these. Furthermore, those countries home to manufacturing companies possess the financial resources to cope with the extensive schedule of meetings. As explained by an interviewee "*In the ITU everything it is done by how your country is big or how your country is strong. If your country is strong and pushing this agenda item it will be go by the way you want*".

In conclusion, it seems that the views on the regime decision-making procedures depend on where you stand. More specifically, industry and developed countries call for a quicker pace of WRCs to get their technologies adopted by the ITU-R and deployed around the globe. On the other hand, developing countries, which are not leading the discussion, need more time to replace their old equipment with new. Regarding the procedures per se, while they seem fair and inclusive for all, they also are strongly influenced by discussions at the study groups held prior to WRCs, which are held more frequently in Geneva.

This may significantly deter the involvement of countries, which lack the financial resources and technical expertise, in the decision-making process. Another difficulty is related to the way issues are discussed during WRCs where usually there are more than 20 agenda items discussed at the same time. This allows one country to block another for political reasons and also to exchange positions on a non-technical basis. It also limits the efficient participation to those countries that have a large number of delegates.

## 7. Role of the ITU-R Bureau

It is very common in ITU-R meetings to have someone asking the ITU-R consular or the representative of the BR for advice. Therefore, this research aims to explore how the interviewees perceive the role of the ITU-R BR and whether they are viewed as an active entity in the regime or, quite differently, as the secretary to the ITU-R. This is important because the ITU-R BR is one of the main stakeholders in the international spectrum management regime and has several roles. More specifically, according to Article 12 of the ITU convention, the duties of the BR is to "*in relation to radiocommunication conferences, coordinate the preparatory work of the study groups and other groups and the Bureau, communicate to the Member States and Sector Members the results of this preparatory work, collect their comments and submit a consolidated report to the conference which may include proposals of a regulatory nature*".

The BR may participate, as of right but in an advisory capacity, in the deliberations of radiocommunication conferences, and provide assistance to the developing countries in their preparations for radiocommunication conferences. One other key duty of the BR is to assist in the resolution of cases of harmful interference at the request of one or more of the interested administrations. It is, therefore, deemed necessary to investigate such a role in more detail and to examine whether it has an influence on the functioning of the regime.

30 interviewees commented on the issue where twenty-one perceived the role of ITU-R BR to be neutral or passive, and nine viewed the ITU-R BR to be an active and intervening entity.

In particular, the interviews revealed that the ITU-R BR does have an important role especially during the critical times of WRCs. One illustration of this was during WRC-12 where member states asked the BR whether it was legally possible for a group of administration to bring the 700 MHz issue on the table for the discussion at the WRC. Following the conference, the BR provided guidance in terms of assessing the implication on the digital broadcasting plan in the UHF band (GE-06 plan).

The interviews show also that the BR cannot intervene in the discussion but has a role to provide critical information that may influence the discussion (e.g., notification of the assignment and the status of the coordination for a given service).

As explained by an interviewee *"The BR is trying during the WRC to help to clarify certain issues, but in these conferences it is the member states that are leading the discussions"*. One of the interviewees highlighted that member states of the ITU are sovereign, and cannot be forced by the ITU to take a particular decision. Therefore, the role of the ITU-R BR is an advisory one.

It was also emphasised that there may be some confusion regarding international organisations in general where the secretary of these organisations are perceived as a decision maker. Similarly, the ITU-R BR is simply the secretary of the ITU rather than a decision maker. It was stated that "*When it comes to deciding these institutions including the UN itself are very passive, extremely passive. Because you cannot, you never hear Ban Ki-moon takes a decision*".

Another emerging role of the BR in the recent years is the direct participation in the periodic meetings of regional groups, which highlights the increasing prominence of these groups. Another role of the BR is to emphasis the impact of changing a specific footnote or a service definition. More specifically, during WRCs, it may not clear to the member states the sequences of a particular decision, which the BR may clarify due to their historical expertise. A critical role is related to the main instrument of the regime, which is the RR where the BR submits a report each WRC on the difficulties faced by the BR in applying the RR in practice.

One interviewee from a developing countries explained that the BR is sympathetic to the needs of developing countries. The BR has also an important role in supporting the chairmen of the different ITU-R group in organising the discussions. Another function of the BR is to be the institutional memory of the ITU-R. More specifically, they provide the necessary process that may, on occasion, cause trouble for member states. One senior interviewee clarified that in the 'old' structure, which occurred until the 1980s, the BR was more dominant and powerful, and a lot of decisions were made at conferences based on the views of the BR. In other words, the ITU-R BR role seems to be more interventionist in the past, while today it is more neutral.

The other nine interviewees adopted a contrasting view regarding the BR. In particular, it seems that the character of the ITU-R Director largely influences the BR role where each director has his own way of managing. For instance, it was suggested that one director communicated with all the regional organisations, following their activities closely in order to have more impact. Another insight is that one of the interviewees believed that the BR has an influence over the discussion, and without their support it will be difficult to reach an agreement. It was also suggested that the role of the BR is conditioned by the needs of the member states, which may require an active role of the BR especially in the case of interference conflicts. One interviewee asserted "*At the end of the day, it's the administrations who really decide to what extent the bureau can work*".

Another active role identified was encouraging dialogue between the regional groups in order to reach a compromise as well as facilitating exchanges among the different interested parties during WRCs. Several interviewees highlighted the critical role of the ITU-R BR director's report to WRCs, which stimulate the discussion with the participation of the BR. The interviewees also highlighted the particular role of the BR with regard to the developing countries. In particular, as these countries may not have the knowledge to make proposal or to formulize specific opinion, the BR has an important role through guiding them. For example, the BR did play a critical role on re-planning the UHF band in order to accommodate the mobile service in the 700 MHz band historically allocated exclusively to the broadcasting service.

# 8. Discussion

Our analysis has been motivated by calls and events that appear to suggest that the ITU-R is not as important as it previously was. One of the critical incident was the threat by the then FCC chairman, Michael O'Rielly, in 2016, following WRC-15, that the US may consider withdrawing its funding of the ITU. In his own words "*I will not hesitate to advance the United States' technological positions to ensure future successes – with or without the ITU…..global technological leaders, such as the U.S., will continue to innovate outside and without input from the ITU and its many nation states. This will, in turn, make the ITU and the WRC process less relevant"* (O'Rielly, 2016).

Another incident is related to the development of 5G frequency allocation. European countries have already decided to use the frequency band 26 GHz for 5G with certain conditions without waiting for WRC-19 to decide whether the band would be identified for IMT under Agenda Item 1.13. In contrast, the US, Japan and South Korea, following their failure to include the 28 GHz band as one of the potential bands to be identified for IMT in WRC-15, decided to utilize the band for 5G even if the band is not considered or approved.

These incidents force us to reconsider the positions of the main stakeholders in the international spectrum management regime, and whether there have been changes to its main norms and principles. From one side, the US is one of the main contributors of the ITU, and it is very common in WRCs for the US to have the largest number of delegates with an ambassador leading them. On the other hand, the European countries were the ones who created the regime and establish the ITU-R, which has been considered by some in the past to be European organization. There is, therefore, a need to understand how the main stakeholders perceive the regime and to ascertain if it has changed.

To this end, it seems that there has been changes in the power balance within the ITU-R at least when it comes to mobile telecommunication services. This was evident in WRC-12 when the Arab and African countries managed to force the European countries to accept the 700 MHz mobile allocation without it being an agenda item of the conference. It was also evident when significant contributors to the ITU such as the US and Japan failed to include the 28 GHz band as one of the candidate bands for IMT in WRC-15. Two questions arise: what do these incidents indicate and why are these countries eager to participate in ITU-R activities.

Firstly, as indicated during the interviews, regional groups have started to play a more substantial and influential role. Such a role is largely dependent on the number of votes these regional groups have. That was also evident by the change in ITU-R BR activity, both to follow up and even participate in the regional preparation for WRCs. Therefore, the African and Arab regional groups have realised that they have emerging power within the organisation.

Important contributors to the ITU such as Japan and the US may be facing a more difficult situation within their regional groups as the other developing countries within CITEL and APT have also started to be active and contribute more actively to discussions. In addition, while the Arab and African regional groups appear to be more homogenous in terms of GDP and being an importer of technologies, this is not the case for other regional groups, which makes coordination for countries such as the US more difficult.

So why are developed and developing countries keen to participate in the ITU-R? In fact, all the stakeholders have a different reason of being part of the ITU-R. Firstly, with respect to developing countries, the ITU-R is an important place for them where they really feel empowered by one vote for one country, and they act on an equal basis with developed countries. It is not, therefore, a surprise that the ITU has the greatest developing country involvement in terms of their numbers compared to other international organisations (MacLean, Souter, Deane, & Lilley, 2002). Another important factor for developing countries is that they usually only accept standards that have been approved by the ITU-R (e.g., IMT). Otherwise, they risk investing in a technology that could turn out to be a failure.

With respect to the developed countries, if we consider them as the dominant ones within the ITU-R, why they are also keen to contribute financially to the organisation and be part of it? Why, for example, did the US not withdraw from the ITU-R following WRC-15 in accordance with the threats of the FCC chairman's when the US has left UNESCO?

Developed countries are quite keen to be part of the ITU process for several reasons. Firstly, these industrial countries want to push their standards to gain a certification that it has the approval of more than 190 nations. As was explained by one of the interviewees "*That gives the country the confidence that they are investing in something isn't only supported by a single company, but is supported…by the world community"*.

Secondly, as the ITU-R does not have stringent enforcements measures in cases of interference and jamming, it is in the interests of developed countries to comply with a regimes whose rules are widely accepted. This would be achieved by showing how important such compliance is, and how following the RR is part of country's wider obligations. It could also be argued that the developed countries want the developed countries to feel that they are included within the regime. This is why it is very common in the ITU-R to find countries participating in the discussions although it is not related to them. In other words, some participating countries act to demonstrate that they are part of the regime.

Another reason for cooperation between the different countries in the ITU-R is related to the nature of radio spectrum, which imposes cooperation and coordination on countries. This was the reason why the regime emerged at the start of the 20$^{th}$ century when there was a need for interoperability among maritime ships and concerns from cross-border interference. One of the interviewees phrased as follows "*The reason the ITU has survived for 150 years because of it is one of the very few areas of international organizations and meetings where self interest and shared interest actually works. The radio waves do not obey the rules of governments; radio waves obey the laws of physics. So what that means is that for bordering countries and even countries on a much wider scale, it is only a bit of self-interest to cooperate with each other. And it is amazing the results that we've achieved in the ITU just are based on a simple basic, concept. That is, we are all better off if we collaborate."*

Another area for examination is whether the regime is experiencing changes and if these can alter the regime's main principles and rules. One must admit that there is an increasing trend of countries not waiting for the ITU-R, as illustrated by developments such as the 26 GHz mobile identification in CEPT before WRC-19 or as the case of US and Japan operating IMT in bands not identified by the ITU-R. Meanwhile, it appears that forums such as the GSMA annual exhibition in Barcelona and 3GPP meetings have become more popular in the telecommunication sector at the expense of CPM and WRC meetings.

Having said that, it is argued that the international spectrum management regime is still relative to the main stakeholders and it is most probable that it will survive without significant alterations to its main principles or norms for several reasons. First of all, even if some countries decide to act outside of the IMT identification or not to wait for WRC decisions, this is mostly conducted within the limits of a mobile service allocation. In other words, using cellular mobile in a band allocated to the mobile service but not identified to IMT is possible according to the RR, which indicates that IMT identification does not preclude other used to the band.

Secondly, the industry is still in great need of the RR as it is an international treaty that is respected by more than 190 countries and which decides what uses radio spectrum will be put to. Thus, even if countries are sovereign and can act outside of the RR, they prefer not to do so. As explained by Ryan (2005), although the RR are a matter of international law, there has never been a single case of a spectrum management dispute appearing in an international court.

Thirdly, the durability of the regime indicates the common benefits shared by all ITU-R member states. As indicated by Zacher (1996), there are some conditions that indicate the existence of mutual interests: durability of a regime and its norms over a long period of time during which there were significant changes in the international regime; adherence to the regime by states that are hostile to each other in many important international political issue areas; evidence that most or all states gain from the regime and no evidence that one group of states lose a great deal as a result of the regime; no indications that one group of states had to use sanctions to force another important group to join the regime or to comply with its injunctions.

Examining the international spectrum regime shows that all these conditions are valid. Firstly, the regime is one of the oldest managing global common resources and survived two world wars and the collapse of the Soviet Union. Secondly, as was indicated throughout the paper, political conflict does not lead to non-cooperation within the ITU-R. It is very common during WRC to find conversation and coordination between countries that have political conflict among them. Thirdly, no regional group or a country seems to capture the bulk of the benefits that accrue from the regime. Fourthly, complying with the RR is not enforced, but yet accepted and followed by the majority of countries.

But when can the international spectrum regime be altered or changed? Generally speaking, changes to international regimes occur when there is a new coalition that alters domestic regulatory bargains in countries with significant impact on the world market. Those countries are unlikely to accept international regimes that collide with their domestic preferences (Cowhey, 1990). To date, this is not the case for the spectrum regime, as, domestically, spectrum is still mostly managed according to the traditional command and control regime except for measures such as an auction or technology neutrality. These measures do not contradict with the principles and norms of the international regime.

A second cause that may lead to significant alterations in the regime's structures of rights and rules are shifts in the underlying structure of power in the regime as it would be difficult to impose decisions while dominant actor's power declines (Young, 1982). While the balance of power is not as it was at the time of the regime's emergence when the European countries were in dominance, the power is now increasingly exercised through regional groups exploiting one vote per country rule. Such a rule represents a fundamental principle in international relations, namely, a country's national sovereignty where the state is the main actor in UN organisations and cannot be enforced to adopt a specific regulation. In other words, the new global

political economy following the Second World War is based on national sovereignty over states' own territories

In fact, such a principle is essential in the spectrum management realm due to the historical desire of national regulators to control the access to their radio spectrum as a main national resource, and also due to the issue of cross-border interference. (Drake (2008) also argues that the waves of liberalization and privatization have not been able to alter the international spectrum management regime. However, these new approaches have led to the increasing role of the private sector in the ITU study groups and main conferences. Moreover, a country's position in the ITU has also been influenced by their companies.

However, one must admit that there have recently been changes among the main stakeholders in the ITU-R. The first change is related to the emergence of China and India as huge telecommunication markets with large populations. The second one is also related to the rise of the African and Arab regional groups as block of votes within Region 1, and the rise of other countries (e.g., Brazil) within CITEL which has made regional coordination by the USA more difficult. The third possible cause for change is technology development (Young, 1982). While technologies such as CRS and SDR were perceived as altering the way countries manage the radio spectrum, so far this has not been the case (at least internationally).

This is all not to deny that the ITU as evolved as the product of several interests and ideas (Lee, 1996). In particular, the ITU has been through major changes as a reflection to the global political economy and structural changes within the telecommunications industry. This is reflected in the increasing participation of the private sector and empowerment of developing countries. However, focusing on the international spectrum regime, the main norms and principles are still largely the same since the foundation of the regime except for cases such as the increasing use of post-priori planning instead of a priori planning in certain service allocations (e.g., satellite broadcasting).

It is worth mentioning that the examination of the empirical data largely supports the existence of a post-positivist stance in regime theory regarding the international spectrum management regime where hegemonic countries have mutual interest in having a global harmonized spectrum for their technologies, standards and systems, and accordingly, they utilize their lobbying power to promote their ideas. These countries tend to avoid voting because it may negatively influence the regime's strength, which reflects the extent its member states abide by its rules. Consensus is also related to the nature of spectrum, which does not respect the borders of countries, and the lack of ex-post enforcement mechanisms by the ITU-R.

As explained throughout the paper, countries usually reach decisions without the need for conducting a formal vote recognizing the importance of consensus in reducing manufacturing costs (Frieden, 2008). An additional explanation that was revealed during the interviews is that hegemony(s) tend to avoid voting in order not to show their weakness in case the developing countries win a vote. That is why in many instances during WRCs where discussions were moving towards a formal vote, and the regime actors avoided that in order to include everyone the agreement, and not to challenge the regime per se.

In general, this paper has shown that none of the different schools of theory can solely capture the essences of the international spectrum management regime. This provides empirical support to the synthesis between these schools. In particular, there was diversity within the interviewees regarding how they perceive the regime. This largely depends on the background of the interviewee and the context of the

discussion. Certainly, radiocommunication services, such as satellite seems to be dominated by a few players, and the mobile telecommunications industry and their supported countries are quite powerful in any discussion related to IMT within WRC. On the other hand, mutual interest exists within the ITU-R and is an essential element of the discussions.

In addition, the technology development and inadequacy of the ITU-R decision-making procedures could be perceived differently according to which radiocommunication service under consideration. For instance, while the cellular mobile service has been booming in a quite quick pace, this may not be the case for services such as radiolocation or maritime where the development is somewhat slow, and the systems are stable.

An example of the existence of the liberalism and realism schools within the ITU-R is the rivalry between the different radiocommunication services in the same frequency band is based on relative gain which is supported by realism where harmonization between countries for the same service is based on absolute gain as explained by liberalism.

Thirdly, the policy makers have an important role in the discussions especially in meetings towards the end of WRC where the attendance is limited to few representatives from regional groups. Meanwhile, sharing ideas between policy makers is the motivation for changes in developing countries where there is a weak institutional system, because these countries usually lack the resources to participate in the meeting or a clear self-interest to determine their goals within WRC.

Last but not least, it is important to highlight the limitations of the study in order to suggest areas of future research. Firstly, while the paper addresses the different theories of regime analysis which are influenced by different philosophical paradigms, this research and its data collection method was mainly influenced by interpretivism. Such a paradigm is adopted due to its ability to accommodate the subjective views of the different stakeholders. Moreover, the subjective ontology of interpretivism argues that an organisation is a socially constructed product so that it could be explored through the viewpoints of the individuals who work within it (Burrell & Morgan, 1979). This is aligned with our belief that the discussions related to spectrum management internationally are formulated through the perceptions of the main stakeholders. Accordingly, the main data collection method adopted for this research was interviews.

Having said that, interpretivism has influenced the data collection method - personal interviews with a focus on a specific context and limited period (between WRC-12 and WRC-15) were conducted. This may lead to missing the 'big picture' and the historical evolution of the international spectrum management. It is recommended that this research should be complemented with other empirical research that focuses on specific case studies (e.g., US relationship with the ITU) or certain radiocommunication services (e.g., satellite). Furthermore, this research does not target generalisation but instead aims to explore the issue and ascertain different views. Secondly, as the topic of regime theory is complicated, the authors attempted to simplify the interviews questions as much as possible but there is a possibility that they may not fully comprehend the questions asked. Thirdly, as context is perceived critical in this research, at the time of the interviews, the interviewees were inspired by the ability of the African and Arab countries to lead countries in Region 1 to approve the 700 MHz mobile allocation despite of the resistance from the European countries.

# 9. Conclusions

The international radio spectrum management regime is one of the oldest existing regimes with the main treaty of the regime, the RR being 113 years old in 2019. However, it has been suggested that the ITU-R has become irrelevant in today's wireless world.

In terms of regime theory, there are three schools of international regime analysis, namely, liberalism, realism and constructivism. With this in mind, the paper sought to ascertain which of these schools of thought apply to international spectrum management? To achieve this, the paper adopts a qualitative inductive approach that is based on primary data collected from 58 semi-structured interviews with the main stakeholders within the ITU-R.

The examination of the empirical data supports the existence of a post-positivism stance in regime theory regarding the international spectrum management regime where hegemonic countries have a mutual interest in having global harmonized spectrum for their technologies, standards and systems. They, accordingly, utilize their lobbying power to promote their ideas. Besides, these countries tend to avoid voting because it may negatively influence the regime's strength, which reflects the extent its member states abide by its rules. Consensus is also related to the nature of spectrum, which does not respect the borders of countries and the lack of ex-post enforcement mechanisms by the ITU-R.

Furthermore, while the regime's decision-making procedures have started not to reflect advances in wireless technologies, most of the regime's actors prefer to operate according to these procedures to have the ITU-R stamp of approval for their technologies. Such an approach facilitates the acceptance of their technologies in developing countries. Moreover, while the pace of technology may have become faster than ITU-R procedures, the ITU-R system is still able to accommodate these advances. Even those countries that are not satisfied with the performance of the ITU-R have an interest in including their regulations in the RR. Therefore, the regime is still relevant considering the advances in mobile technologies that have occurred (e.g., 5G). Perhaps surprisingly, even that the ITU-R does not have strict enforcement procedures, countries still tend to bind themselves to its rules.

Meanwhile, unlike other international organisation (e.g., Security Council), developing countries feel more powerful in the ITU-R due to its one vote per country rule. Moreover, dominance by the hegemonic power does not necessarily produce dominant decisions. In particular, as decisions are based on consensus, the objections of just a few countries could lead to a compromise. While developed countries cannot force a decision on others, they have the power to lobby and this facilitates the adoption of decisions that support their interests. Lobbying has emerged in recent years in the form of regional groups which play increasingly key role in the ITU-R.

The interviews also reveal that the distribution of the power has changed towards actors from Asia (e.g., China) and regional groups that have majority of votes. Moreover, the telecommunications industry has started to move its lobbying interests and activities towards the developing world. This reflects the changes in the global economy and shifts in the wireless telecommunications industry.

Another area that was highlighted by the interviews is the role of the ITU-R Bureau (BR) as one of the main actors in the regime in recent years. In particular, it was noted that such a role seems to be more interventionist in the past, while today it is more neutral. However, the BR has an important responsibility in encouraging reaching a compromise and providing data on the application of the RR.

Finally, the paper shows that none of the three schools of theory can solely capture the essence of the international spectrum management regime. Thus, our paper provides empirical support for the synthesis of these schools. In addition, context is the main factor that determines which school of regime theory may apply to international spectrum management. More specifically, the rivalry between different radiocommunication services at the same frequency band is based on a relative gain that is supported by realism whereas harmonization between countries is based on absolute gains as explained by liberalism.

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