International Spectrum Regulation

1

Tomas E. Gergely

urpose of this Presentation

ovide a basic understanding of international spectrum organizati
nd processes:

- The International Telecommunication Union (ITU)
- The Radiocommunication Sector of the ITU (ITU-R)
  - World Radiocommunication Conferences (WRCs)
  - The ITU-R Study Groups
  - Regional Groups

cilitate and *encourage* participation in international spectrum anagement processes

elp to understand and access the resources available through the ebsites of these organizations

Why Is International Regulation Necessary?

ery broadly speaking, in order to understand each other:

- Transmitters and receivers need “to be on the same wavelength"
- Transmitters working simultaneously should not interfere with each other

ach country is sovereign with respect to the use of the radio spectrum ithin its borders, however:

- Radio waves do not stop at national borders and radio waves coming from country A may interfere with transmissions in country B

he goal of international reglamentation is to avoid such problems

nternational Regulation(s)

Bilateral or regional regulation and coordination

- Useful for countries with large common border areas (e.g. USA and Canada or Mexico- Regular bilateral meetings are hel to discuss common issues or problems
  - Also useful for countries in close proximity - E.g. Caribbean nations
  - Also depends on geographical features (e.g. Argentina and Chile have relative few problems of radio interference due to Andes mountains)

International regulation

- Many issues (e.g. Maritime and aeronautical issues, those involving satellites, broadcasting) cannot be satisfied by bi-lateral or regional coordination

he International Telecommunication Union TU)

ernational regulation of the spectrum takes ce (mostly) through the International ecommunication Union (ITU)

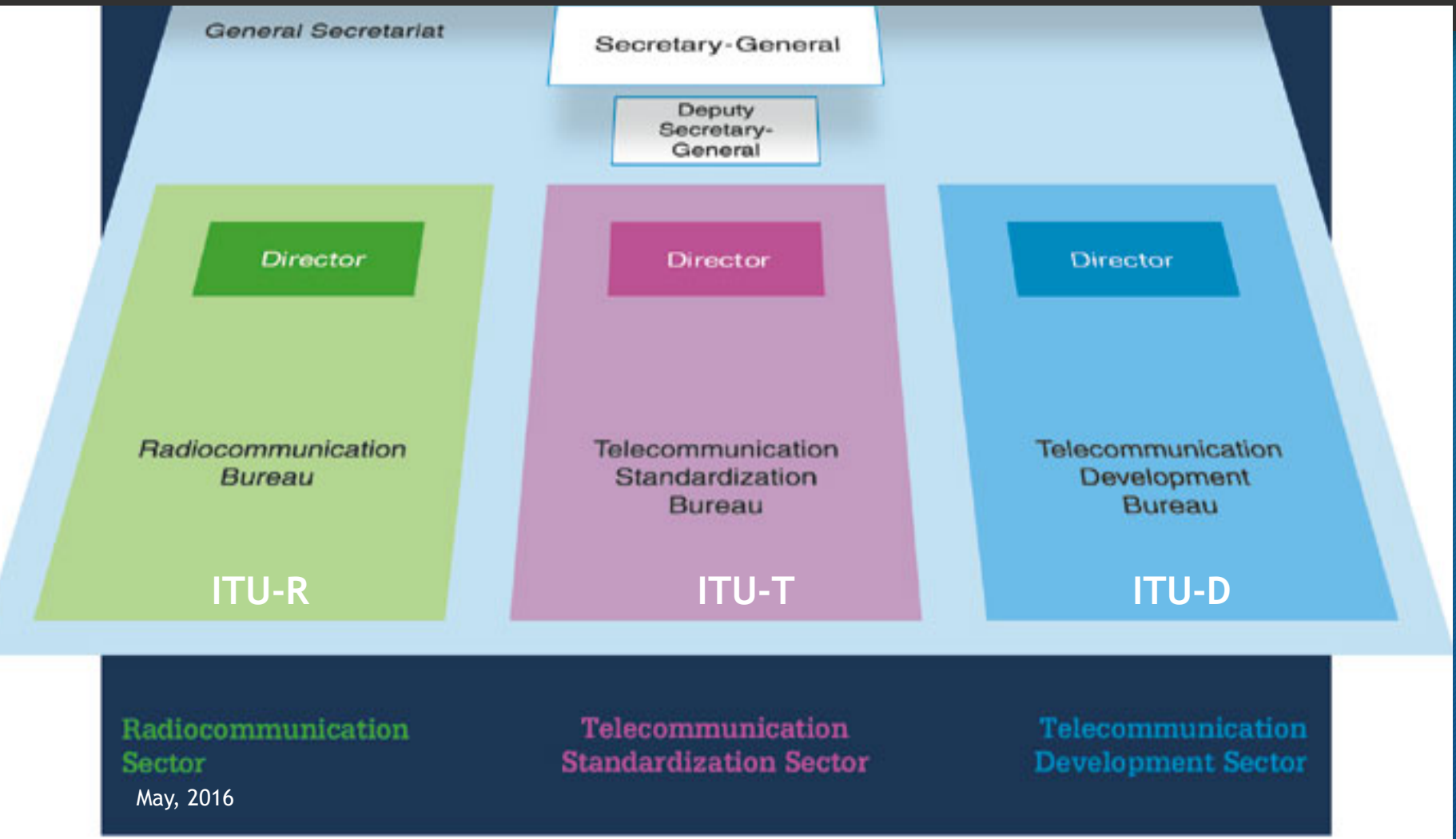
e ITU is a successor of the International egraph Union, and as such is the oldest tinuously existing international organization

based in Geneva, Switzerland and regulates the io spectrum and access to the geostationary it

e ITU is a specialized agency of the United ions (UN)

important to note that the ITU does not make regulations on its own, it follows the consensus of the member states

tructure


General Secretariat
Secretary-General
Deputy Secretary-General
Director
Director
Director
Radiocommunication Bureau
Telecommunication Standardization Bureau
Telecommunication Development Bureau
ITU-R
ITU-T
ITU-D
Radiocommunication Sector
Telecommunication Standardization Sector
Telecommunication Development Sector

overnance

bers and members:

93 Members (Governments or Administrations)

Over 700 members (academic, industrial, scientific organizations)

Constitution and the Convention are the basic governing instruments of the ITU

he Plenipotentiary Conference is the top olicy making body

- Meets every 4 years, to review the Constitution and Convention
- Elects the senior management team

he Secretary General (Mr. Houlin Zhao hina) and Deputy Secretary General r. Malcolm Johnson-UK)

are the senior elected officials

eadquartered in Geneva, Switzerland

The ITU website:

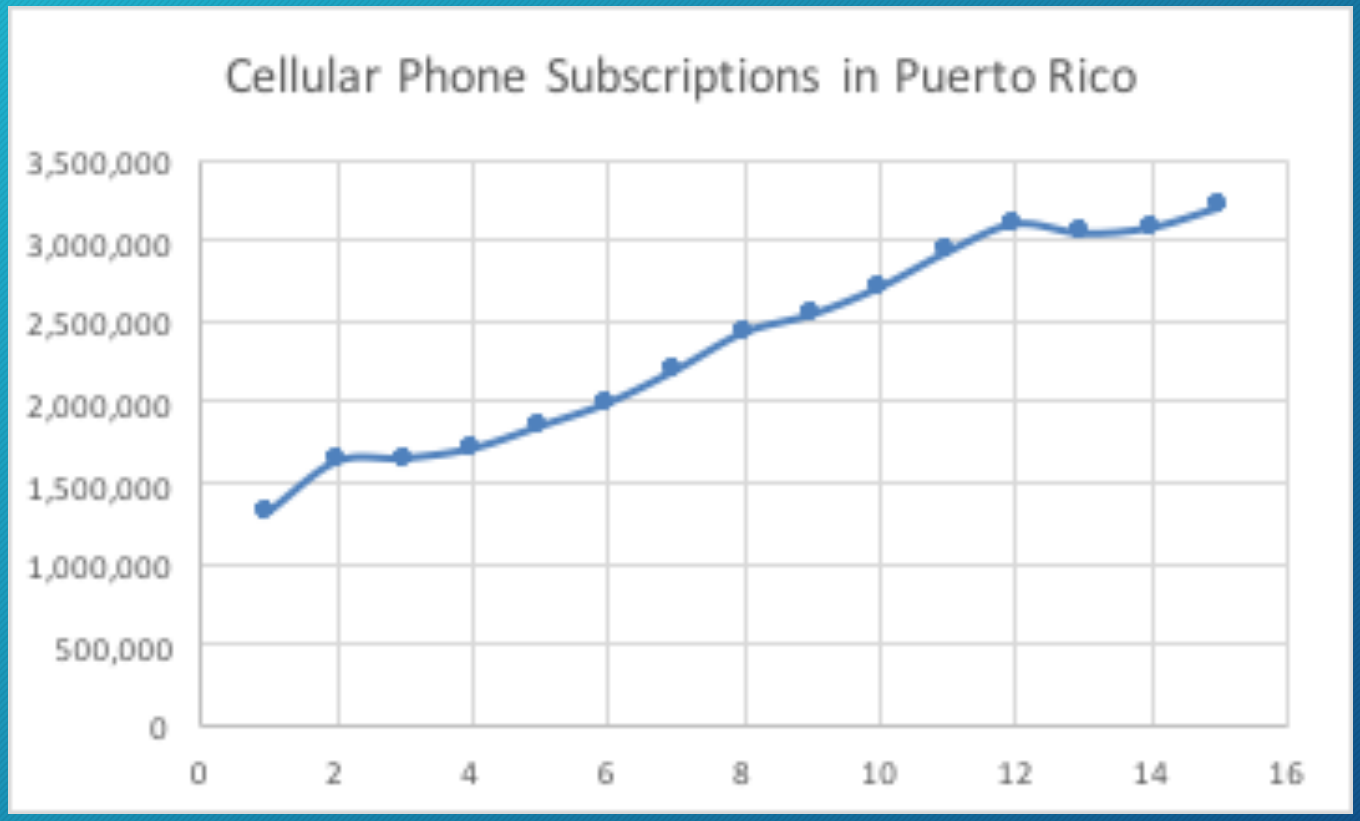
http://www.itu.int/en/Pages/default.aspx
http://www.itu.int/es/Pages/default.aspx

8

Contains a wealth of information, e.g.:

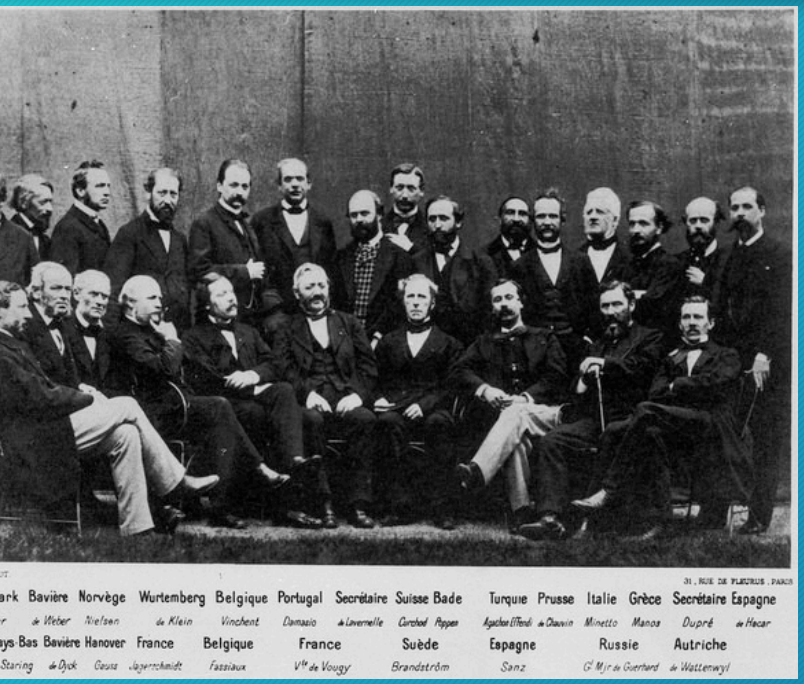
obile phone subscriptions in Puerto Rico 000-2014

ce: ITU website



A Bit of History

e Evolution of the Regulation of Radio Transmissions
w did we get to where we are today?

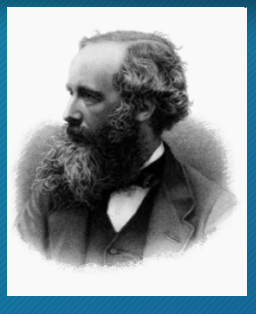


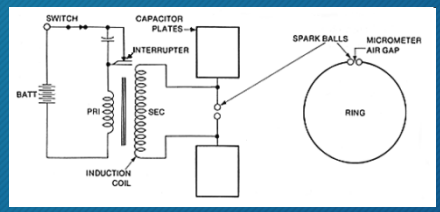
Paris- First International Telegraph
ention - 20 states, ~30 participants

2015, Geneva – World Radiocommunication Conference: 3300 participants, 162 States+ 130 organizations

eginnings of Radio (Not regulated)

- Maxwell's equations predict electromagnetic waves (1865)
- First International Telegraph Convention signed; 20 founding members; International Telegraph Union (ITU) established (Paris, 1865)
- Hertz experiments (1885-1889) show that the waves exist.
- Marconi (1890s) invents the first practical wireless telegraph and develops commercial applications -
- BW: unconfined Data Rate ~ 1bit/s Limited number of telegraphs can operate simultaneously, as they interfere with each other!





900–1920s Beginnings of Regulation

rst Radio stations:

- Maritime Communications

("someday lightships might use microwave beams to overcome the problem of fog interfering with shore communication" - The Electrician (London), 1891)

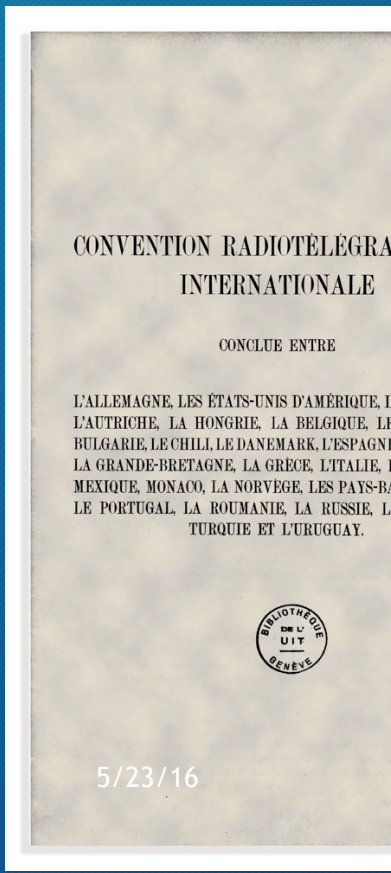
- US Navy among earliest to adopt radio technology (shore telegraph) ~ 1900
- Development of Aeronautical Radio: WW I
- Broadcasting:
  - De Forest invents Audion tube
  - First AM Radio Stations

Long Wavelengths:

- Generally below 1 MHz
- Analogue transmissions

Amateur Radio Begins

- US : 1904 – "Roosevelt Board" set up to recommend how to coordinate US govt. radio activities
- US Radio Act of 1912 restricts amateurs to f>1500 kHz, considered "useless"
- International: 1903 and 1906 Berlin Conferences
- 1906 Berlin Conference: INTERNATIONAL WIRELESS TELE GRAPH CONVENTION
  - First "allocations" - to shipboard stations: λ = 300 m or 600 m


CONVENTION RADIOTÉLÉGRA
INTERNATIONALE

CONCLUE ENTRE

L'ALLEMAGNE, LES ÉTATS-UNIS D'AMÉRIQUE,
L'AUTRICHE, LA HONGRIE, LA BELGIQUE,
BULGARIE, LE CHILI, LE DANEMARK, L'ESPAGN
LA GRANDE-BRETAGNE, LA GRÈCE, L'ITALIE,
MEXIQUE, MONACO, LA NORVÈGE, LES PAYS-B
LE PORTUGAL, LA ROUMANIE, LA RUSSIE,
TURQUIE ET L'URUGUAY.

BIBLIOTHÈQUE DE L'UIT GENÈVE

5/23/16

930s to WW II

2 Radio Astronomy begins
K. Jansky, searching for the
origin of interference in ship to
shore communications,
detects cosmic radio emission.
G. Reber builds first radio
telescope

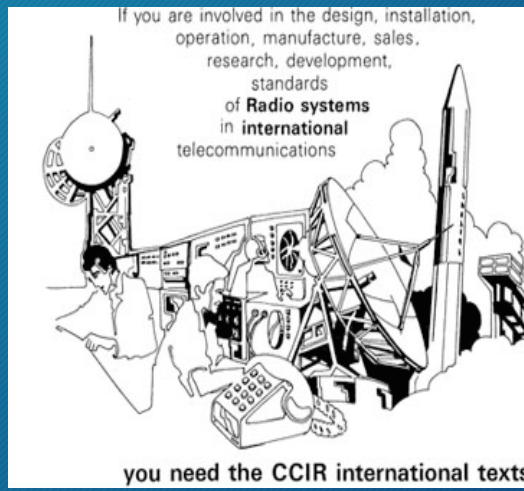
TV transmissions
S, UK, Germany
Upward creep in frequency to
first few VHF channels

rmation theory, concept
hannel capacity (C)
eloped

$$= B \log_2 \left(1 + \frac{S}{N}\right)$$

B = bandwidth; S/N= signal-to-noise ratio

- 1927 Washington D.C.
  - International Radio Consultative Committee (CCIR) established
- 1932, Madrid
  - Frequency allocations up to 300 MHz established in 1932 (experimental only)
  - Name changed to: *International Telecommunication Union*



he Modern Era – WWII to Present

15

velopment of Radar (UK,
A, Germany and many
ers
- Invention of cavity magnetron
- Miniaturized versions developed for ships, airplanes, etc.

io Astronomy develops, as surplus
/ II military equipment (radar dishes)
comes available.
0 - First Communications satellite
no 1) launched
0 – Mass market wireless devices,
uding cell phones become ubiquitous

- 1947 Atlantic City Conference
  - ITU becomes a UN specialized agency
  - International Frequency Registration Board (IFRB) established
  - The Table of Frequency Allocations is declared mandatory
- 1963 Geneva, Extraordinary Administrative Conference
  - allocates frequencies to the various space services for the first time
- 1979-1993 World Administrative Radio Conferences (WRCs)
  - Some general, others restricted to certain frequency range or services
- Since 1993 World Radiocommunication Conferences
  - Broad agendas of unrelated items
- Next WRC: Geneva, November 2019

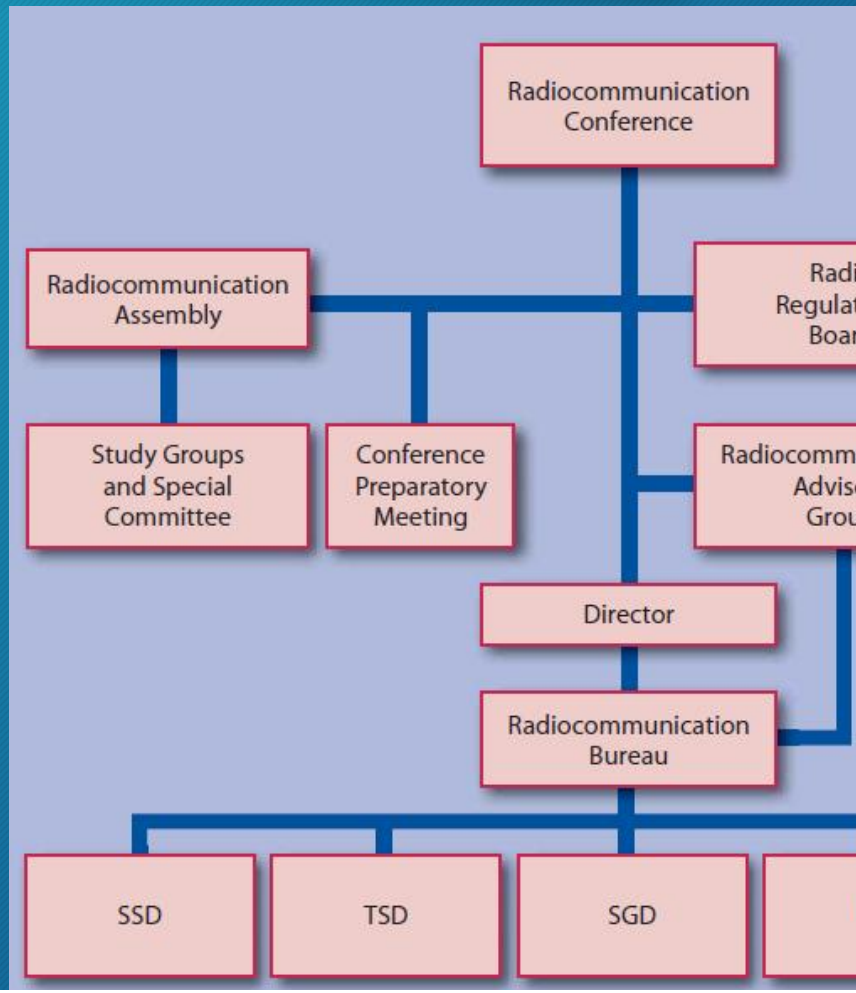
II. The ITU-R

U-R Structure

Director and the Radiocommunication Bureau
) Departments:
pace Services
errestrial Services
tudy Groups
nformatics, Administration and Publications

The Study Groups and the Radiocommunication
ssembly

World Radiocommunication Conferences (WRCs)
nd Conference Preparatory Meeting (CPM)
The Radio Regulations Board (RRB)



he Director and the Departments

e Director of the Radiocommunication Bureau (RB), ordinates its activities

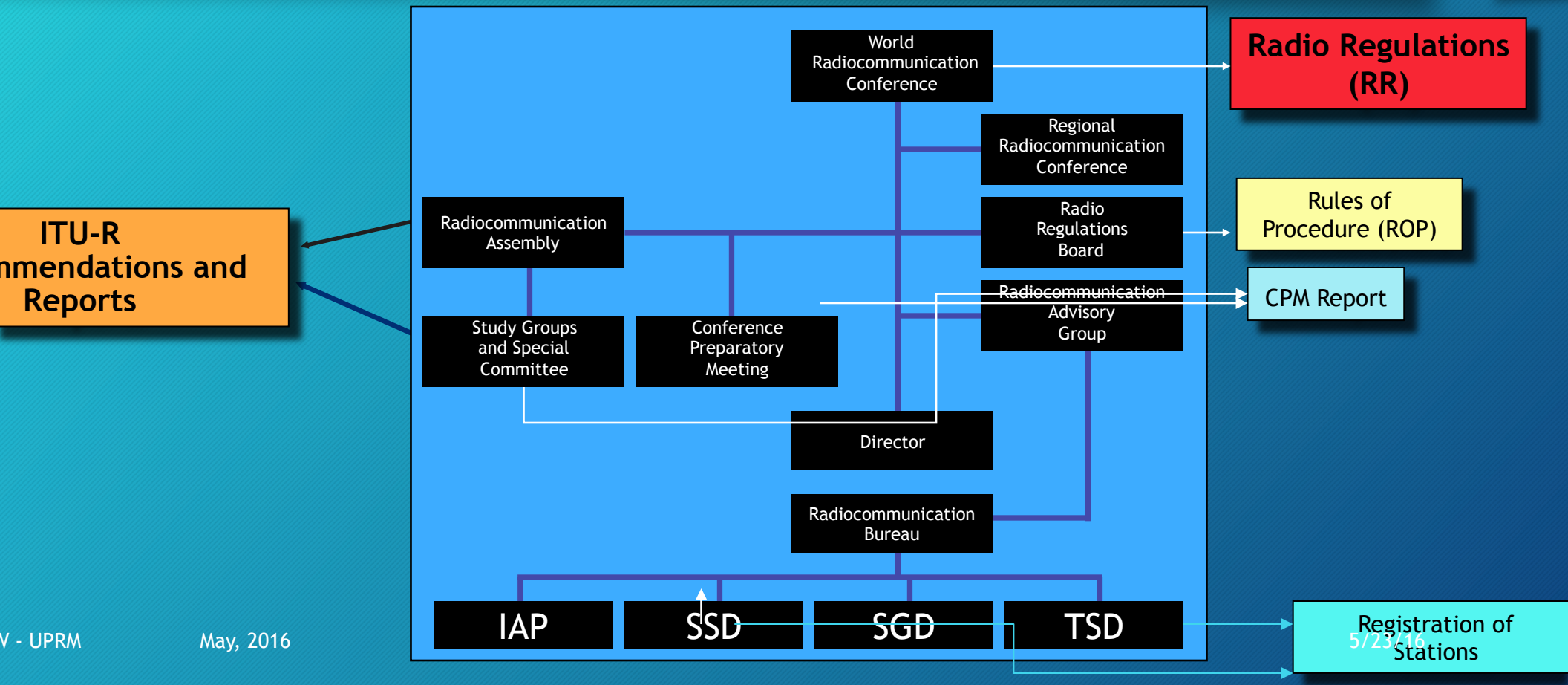
Mr. F. Rancy, France is the current Director

e Space Services Department (SSD) is responsible coordination and recording procedures for space tems and earth stations.

e Terrestrial Services Department (TSD) provides assistance to ministrations with regard to terrestrial services, maintains the ster International Frequency Register (MIFR) and the Regional quency Plans

e Study Groups Department (SGD) provides support to the SGs

utput of the ITU-R



he Hierarchy of ITU-R Output

Radio
Regulations (RR)

International Treaty

ITU-R
Recommendations

Non-mandatory, but generally followed

Rules of Procedure

RRB interpretation of the RR's
Highly changeable

III. The Radio Regulations and World Radiocommunication Conferences (WRCs)

e Radio Regulations

e RRs are an international treaty, that covers all aspects of radiocommunicati
l the efficient use of the geostationary orbit resource

untries are sovereign with regard to the uses of the radio spectrum within th
rders

e International Table of Allocations is part of the Radio Regulations (Article 5)

- Volume 1: Articles
- Volume 2: Appendices
- Volume 3: WRC Resolutions and Recommendations
- Volume 4: ITU-R Recommendations incorporated by reference

sibly the most important function of the ITU-R is to maintain and update the
ough periodically convened World Radiocommunication Conferences (WRCs)

he Radio Regulations -2

The RR can be downloaded free,
in word or pdf format
in the six official languages of the ITU:

https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-REG-RR-2012&media=electronic

The 2012 version is the latest one available

Printed or CD versions may be purchased from the ITU

Vorld Radiocommunication Conferences

onvened periodically to review and revise the RR

he Agenda of a WRC, that strictly limits what can be scussed, is established by the previous WRC(s).

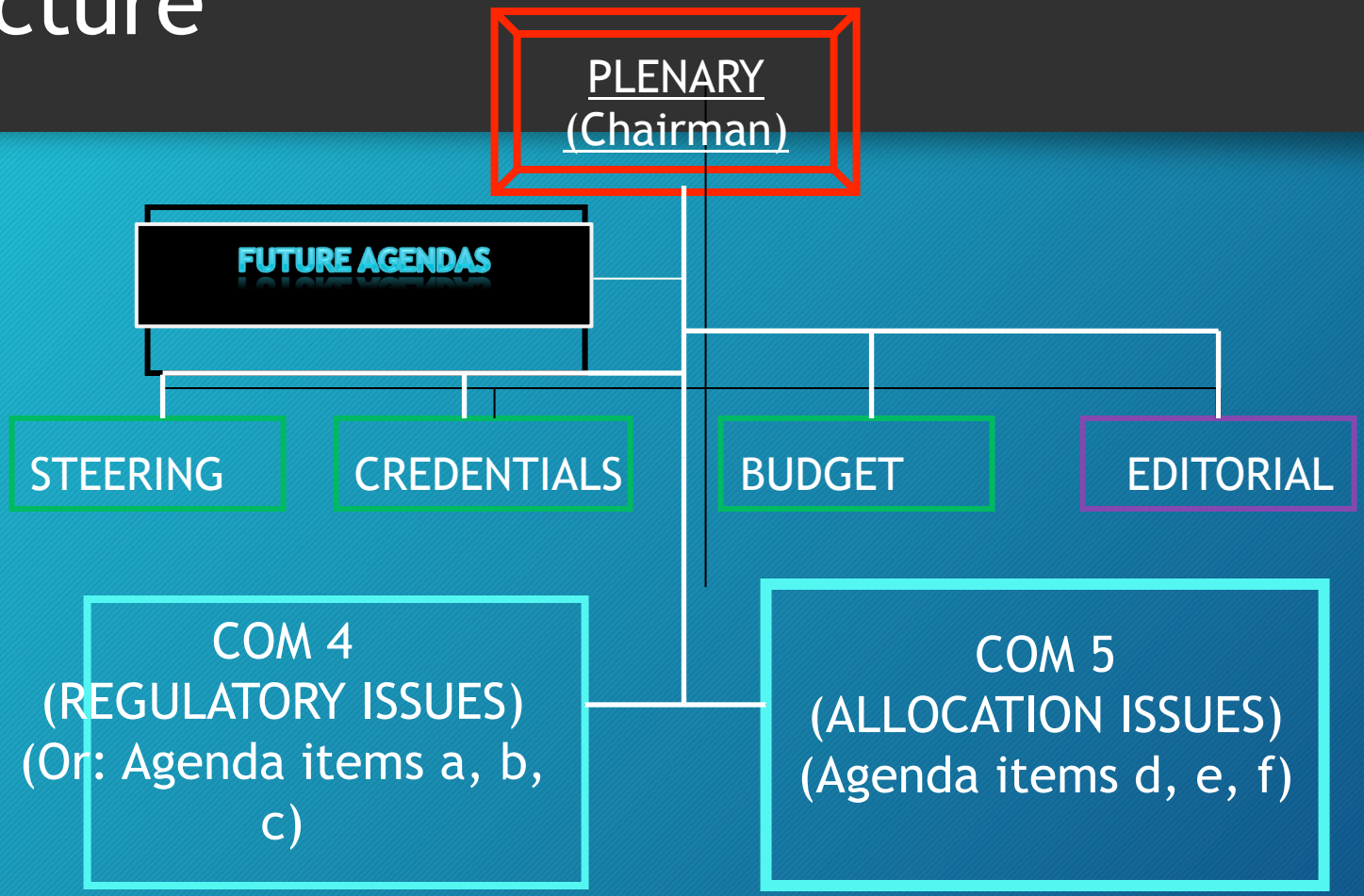
he outcome of a WRC is an international treaty, called e Final Acts of WRC-XX. It contains the revisions to t R that have been adopted.

WRCs: Introduction

WRC-12

ver 3 000 delegates
From 165 countries
over 100 observers from
member organizations
onsidered
- over 850 documents
- over 5 500 proposals
t a cost of over 5 000 000 CHF
(~ $ 5 300 00 US)
urprisingly), somewhat under budget

VRC Structure



VRCs - Proposals

- Agendas may contain unrelated items, AIs 1.1 and 1.18 -15)
- .1 New bands for MT
- .18 Allocate the 7.5-78 GHz band for ehicular radars

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD IAP/10A21/2

15.4-18.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
15.4-15.43	RADIOLOCATIONADD 5.A121 ADD 5.B121 AERONAUTICAL RADIONAVIGATION 5.511D	
15.43-15.63	FIXED-SATELLITE (Earth-to-space) 5.511A RADIOLOCATION ADD 5.A121 ADD 5.B121 AERONAUTICALRADIONAVIGATION 5.511C	
15.63-15.7	RADIOLOCATION ADD 5.A121 ADD 5.B121 AERONAUTICAL RADIONAVIGATION 5.511D	

Reasons This allocation will provide additional spectrum for new advanced radar systems.

Understanding the proposal

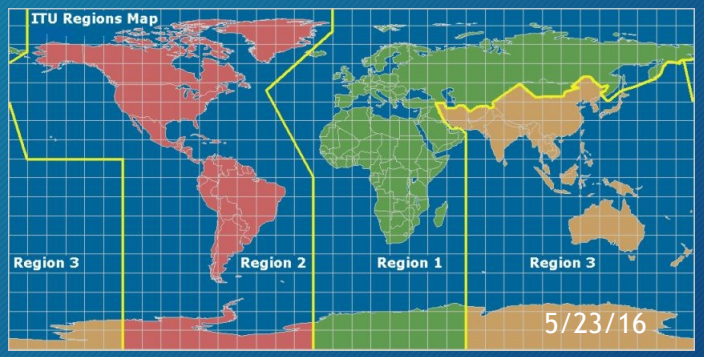
10A21/2 : 2nd Interamerican
posal in Document 10, Annex 21

D A provision of the RR is being
dified

D A new provision is being added
the RR (also indicated by
derlining)

P A provision of the RR is being
pressed (Also indicated by
~~kethrough~~)

- NOC No change!
- [ ]Text that requires further discussion or agreement
- Written across the page:
  The proposal applies to all thr
  ITU regions



The Mechanics of WRCs

- pposals related to a given AI are attributed to the various mmittees (or subcommittees) and are introduced (described ne detail
- bcommittees and/or drafting groups are formed, until a nageable size of interested people is reached (sometimes sted 5-6 levels deep)
- e groups are led by a Chairperson, consensus is sought in the bgroup
- Many meetings may be necessary to resolve an issue.

legations, languages, protocol

- Delegations range in size from the very small to the very large
- Delegations designate a spokesperson to address specific agenda items issues. Only the designated spokesperson can address the issue, other delegates must keep silent
- Debates are conducted formally, according to Roberts Rules of order
- Major committees (to the subcommittee level) must have simultaneous interpretation into the official languages of the ITU (Arabic, Chinese, English, French, Russian and Spanish)
- The availability of teams of interpreters and the desire of smaller delegations to be present at specific meetings heavily influences the d schedule of a Conference

ITU Regional Voting Blocks

VRC Output

The output of a WRC is contained in its

"Final Acts", a treaty level document, that has to be ratified by each country's parliamentary process.

Administrations may exempt themselves from complying with some provisions of the Final Acts, by taking a "reservation".

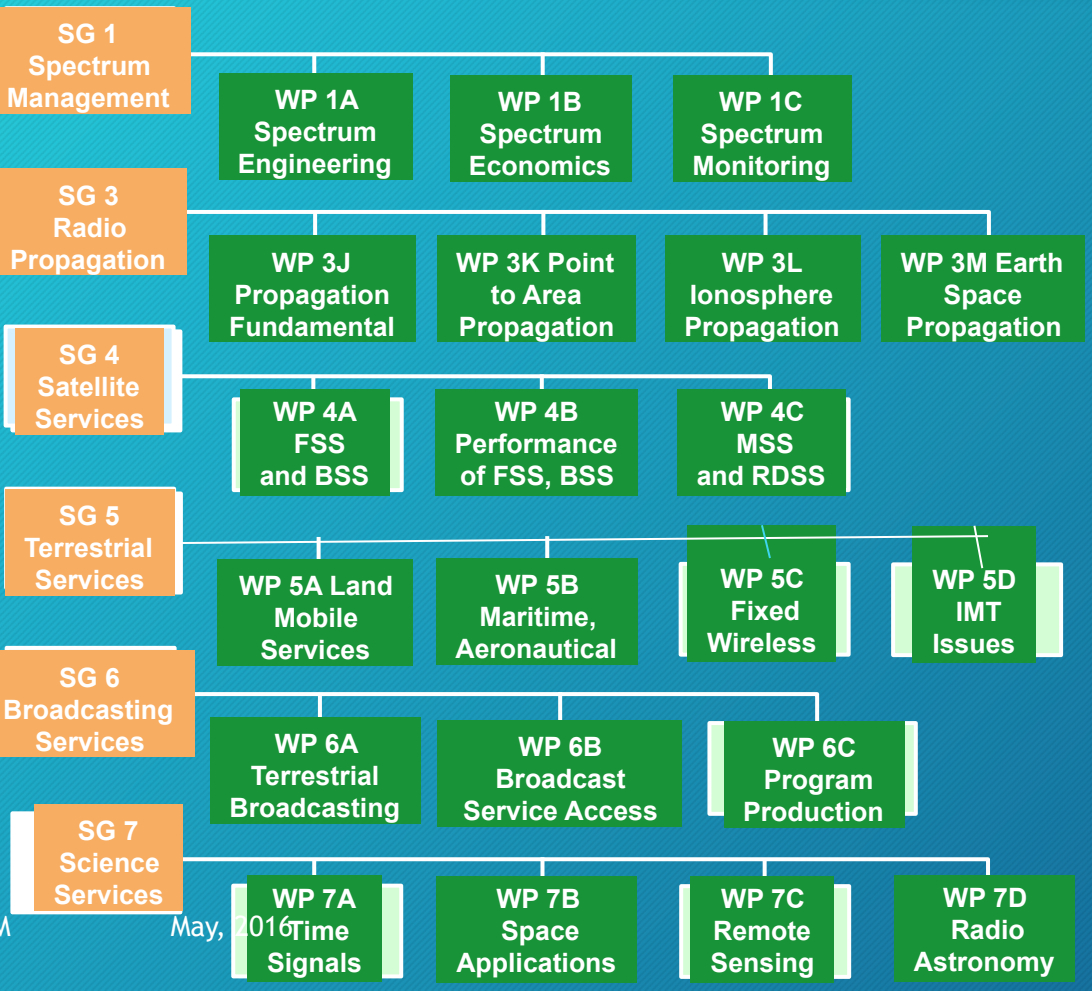
- Reservations are appended to the Final Acts
- Must be deposited (with the Conference secretariat) within 24 hours after the conclusion of the Conference

The Final Acts specify the entry in force date of the new provisions

The Radiocommunication reau

33

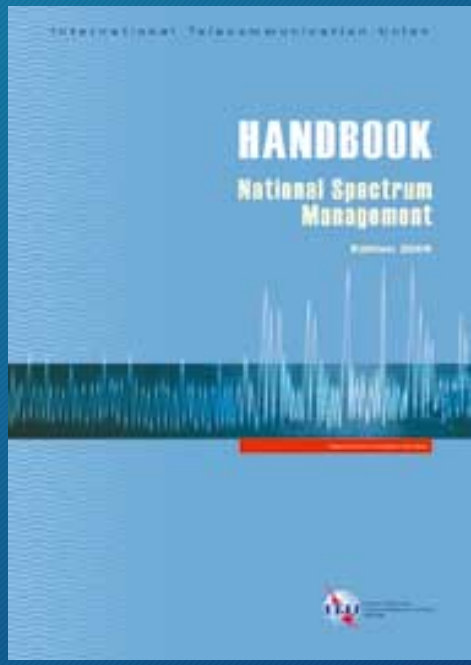
J-R Study Groups



WP = Working Party
FSS = Fixed Satellite Service
BSS = Broadcasting Satellite Service
MSS = Mobile satellite Service
RDSS = Radio Determination Satellite Service
IMT = International Mobile Telecommunications

he Study Groups – What do they do?

- borate (Draft) Recommendations and Reports
  - Draft Recommendations are approved by progressively higher hierarchical groups:
    - The Working Party that drafts them
    - The parent SG of the WP
    - Final approval is by Administrations
- pare the technical bases for WRCs
  - The outcome of this activity is the draft Conference Preparatory Meeting (CPM) Report
- Prepare Handbooks



ow Do Study Groups Work?

For practical purposes, SGs are subdivided in Working Parties (WPs)

- E. g. SG 5 has 4 WPs, dealing with:
  - Land mobile (except IMT) and amateur services (WP 5A)
  - Maritime and aeronautical mobile services (WP 5B)
  - Fixed wireless and HF systems (WP 5C)
  - IMT systems (WP 5D)

As a rule, WPs meet twice, SGs meet once or twice a year

Most work is carried out in the WPs, in response to:

- Questions (subject to approval by the SGs and Administrations)
- WRC Resolutions, usually associated with an upcoming WRC Agenda item

Delegates participate in the work as members of a national delegatio
or as representatives of a member organization

TU-R Recommendations

Set of international technical standards, developed by the ITU-R

- Approved:
  - by consultation of Member States or
  - at Radiocommunication Assembly

Not mandatory, but most countries abide by and implement them

- Some Recommendations, referenced in the Radio Regulations do become mandatory (Incorporation by reference)
- Revised as needed by the SGs

Referred to as:

- Recommendation ITU-R XX.NNNN-RR
  - Where XX indicates the series, NNNN is the number of the Recommendation and RR indicat the revision number

TU-R Recommendations - website

ITU-R Recommendations are available free to downlo

http://www.itu.int/pub/R-REC

(or for purchase in CD or printed form)

natomy of a Recommendation

- ITU-R Recommendation typically consists of:
  - Scope (brief description of what the Resolution is about) - Mandatory
  - A series of considerings, justifying the Recommendation or describing what develop made the Rec. necessary
  - Recognizing or noting with additional considerations (sometimes)
  - One or more Recommends, stating what is recommended
  - One or more Annexes, containing detailed technical information, including tables, f equations, etc.
- ports and Handbooks have a less formal structure
- commendations are published in the six official languages of the ITU (A inese, French, English, Russian and Spanish)

atin American Involvement in the ITU-R

- One measure of involvement of countries or regions in the SG process s the number of documents submitted by the countries/regions
- During the 2007-2012 ITU-R cycle only Brazil, Colombia and Venezuela submitted documents to the SGs
- Latin American involvement in the ITU-R is at a very low level , only Brazil participates consistently in SG activities

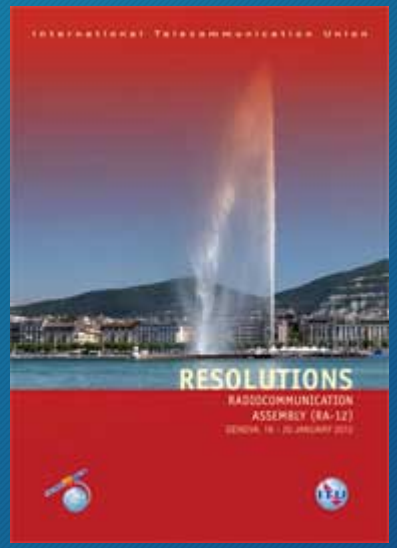
Working Parties	Total Docs	Country	
1A, 1B, 1C	885	Brasil	
3J, 3K, 3L, 3M	683	Brasil	
4A, 4B, 4C	1 485	Brasil	
		Colombia	
6A, 6B, 6C	1 533	Brasil	
		Venezuela	
7A, 7B, 7C, 7D	879	Brasil	
Total	5 465		

e Radiocommunication Assembly (RA)

The Radiocomunication Assembly (RA)
meets for one week, usually immediately
before a WRC

- Assigns work to the SGs, related and/or unrelated to an upcoming WRC
- Reviews the structure of the SGs and WPs
- Elects new authorities
- Approves Recommendations and Questions developed by the SGs

The RA closes the ITU-R cycle and begins a new one



he Radio Regulations Board (RRB)

The RRB consists of 12 members, elected at the Plenipotenti Conference

- Regional balance is sought!

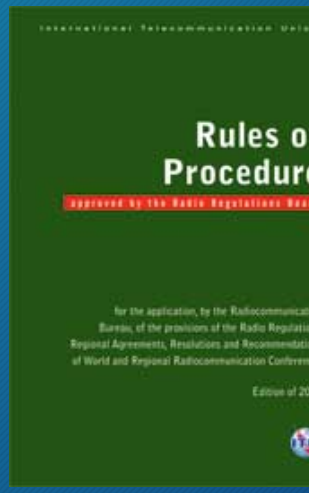
The Director of the ITU-R acts as Executive Secretary of the RRB

Meets up to four times a year, at ITU Headquarters to:

- Approve the Rules of Procedure (ROP),
- Address reports of unresolved cases of interference
- Provide advice to the RA and the WRC

ules of Procedure (RoP)

e Rules of Procedure are established by the Radio gulations Board (RRB) and are circulated Administrations for approval



like the Radio Regulations, they are not eaty level text

ey provide clarification of the application particular articles of the RR, as needed

ey also establish practical procedures that may not provided for in the Regulatory Procedures

V. WRC-19 and 23

/RC-19 Preparations

WRC-19 is planned to have a duration of four weeks, to be h
at ITU Headquarters, in Geneva, Switzerland

Preparations have begun

Responsibility for studies to be carried out by the SGs/WPs h
been assigned:

- http://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/wrc-19-studies.aspx

WRC-19 and WRC-23 Agendas

Resolution 809 (WRC-15) provides some directions (e.g. that WRC-19 shall have a maximum duration of 4 weeks) and establishes a draft Agenda for WRC-19

There are some 20 Items on the draft Agenda, Many are described in other Resolutions and are frequently limited by the terms of these.

Resolution 810 (WRC-15) establishes a (very) preliminary Agenda for WRC-23

xample/1: Additional allocations for IMT

genda Item 1.13 of WRC-19 calls for identification of frequency ba
r the future development of the International Mobile
elecommunications (IMT), including possible additional allocations
e mobile services

one form or another this has been an Item on the Agenda of all
RCs since WRC-2000. It has the potential to have an enormous
npact on the world economy

he call for studies that are needed is contained in Resolution 238
VRC-15)

eparations are conducted in WP 5D and TG 5/1, specially
tablished for this purpose

mple/2: CubeSats

genda Item 1.7 calls for studying the spectrum needs of non-GSO satell
ith short duration missions for TT&C purposes

he use of small satellites with relatively short duration missions (mostly
ubeSats), provide an economic way of getting in space for specific miss

hey do not conform easily to current satellite regulations

udies call for additional regulations and possible additional allocations
he Space Operations Service.

etails of the call are contained in Resolution 659 (WRC-15);

ummary

- Addressed the origins and structure of the International Telecommunication Union
- Addressed in detail the functions and structure of WRCs
- Addressed the Structure and Functioning of the ITU-R and the SGs and WPs
- The goal is to enable the students to participate in the process, through their national organization and facilitate the use of the resources available at the ITU website!

Questions?

tegergely@gmail.com