Broadcasting Frequency Management
National, Regional and Global Issues

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Chair : Australian Radiocommunications Study Group 6 (Broadcasting)
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Outline

• ITU-R Broadcast Bands
  – Current
  – Future
• Country Analysis
• Benefits of Each Band
• Spectrum Planning
• Standards
ITU Regions

REGION 1

REGION 2

REGION 3
## VHF Band III

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<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>174-223 BROADCASTING</td>
<td>174-216 BROADCASTING</td>
<td>174-223 FIXED</td>
</tr>
<tr>
<td>Fixed</td>
<td>Mobile</td>
<td>MOBILE BROADCASTING</td>
</tr>
<tr>
<td>5.234</td>
<td></td>
<td></td>
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<tr>
<td>216-220 FIXED</td>
<td>MARITIME MOBILE</td>
<td>5.233 5.238 5.240 5.245</td>
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<td>Radiolocation 5.241</td>
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<td>5.242</td>
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<tr>
<td>220-225 AMATEUR</td>
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<tr>
<td>MOBILE</td>
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<tr>
<td>5.235 5.237 5.243</td>
<td>Radiolocation 5.241</td>
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</tr>
<tr>
<td>223-230 BROADCASTING</td>
<td>225-235 FIXED</td>
<td>223-230 FIXED</td>
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<tr>
<td>Fixed</td>
<td>MOBILE BROADCASTING</td>
<td>MOBILE</td>
</tr>
<tr>
<td>Mobile</td>
<td>Aeronautical</td>
<td></td>
</tr>
<tr>
<td>5.243 5.246 5.247</td>
<td>Radiolocation</td>
<td>RADIONAVIGATION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.250</td>
</tr>
</tbody>
</table>
5.233  Additional allocation: in China, the band 174-184 MHz is also allocated to the space research (space-to-Earth) and the space operation (space-to-Earth) services on a primary basis, subject to agreement obtained under No. 9.21. These services shall not cause harmful interference to, or claim protection from, existing or planned broadcasting stations.

5.238  Additional allocation: in Bangladesh, India, Pakistan and the Philippines, the band 200-216 MHz is also allocated to the aeronautical radionavigation service on a primary basis.

5.240  Additional allocation: in China and India, the band 216-223 MHz is also allocated to the aeronautical radionavigation service on a primary basis and to the radiolocation service on a secondary basis.

5.245  Additional allocation: in Japan, the band 222-223 MHz is also allocated to the aeronautical radionavigation service on a primary basis and to the radiolocation service on a secondary basis.

5.250  Additional allocation: in China, the band 225-235 MHz is also allocated to the radio astronomy service on a secondary basis.
# UHF Bands IV and V

## Allocation to Services

<table>
<thead>
<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>470-790 BROADCASTING</strong></td>
<td><strong>470-512 BROADCASTING</strong></td>
<td><strong>470-585 FIXED</strong></td>
</tr>
<tr>
<td>Fixed</td>
<td>Mobile</td>
<td>MOBILE</td>
</tr>
<tr>
<td></td>
<td>5.292 5.293</td>
<td>BROADCASTING</td>
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<tr>
<td><strong>512-608 BROADCASTING</strong></td>
<td></td>
<td><strong>585-610 FIXED</strong></td>
</tr>
<tr>
<td>5.297</td>
<td></td>
<td>MOBILE</td>
</tr>
<tr>
<td><strong>608-614 RADIO ASTRONOMY</strong></td>
<td></td>
<td>BROADCASTING</td>
</tr>
<tr>
<td>Mobile-satellite except aeronautical mobile-satellite (Earth-to-space)</td>
<td></td>
<td>RADIONAVIGATION</td>
</tr>
<tr>
<td><strong>614-698 BROADCASTING</strong></td>
<td></td>
<td><strong>610-890 FIXED</strong></td>
</tr>
<tr>
<td>Fixed</td>
<td>Mobile</td>
<td>MOBILE 5.313A 5.317A</td>
</tr>
<tr>
<td>5.293 5.309 5.311A</td>
<td></td>
<td>BROADCASTING</td>
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<tr>
<td><strong>790-862 FIXED</strong></td>
<td><strong>698-806 MOBILE 5.313B 5.317A</strong></td>
<td><strong>5.149 5.305 5.306 5.307</strong></td>
</tr>
<tr>
<td>MOBILE except aeronautical mobile</td>
<td>BROADCASTING</td>
<td></td>
</tr>
<tr>
<td>5.316B 5.317A</td>
<td>Fixed</td>
<td></td>
</tr>
<tr>
<td><strong>806-890 FIXED</strong></td>
<td><strong>806-890 FIXED</strong></td>
<td><strong>5.149 5.305 5.306 5.307</strong></td>
</tr>
<tr>
<td>MOBILE 5.317A</td>
<td>MOBILE 5.317A</td>
<td></td>
</tr>
<tr>
<td>BROADCASTING</td>
<td>BROADCASTING</td>
<td></td>
</tr>
<tr>
<td><strong>862-890 FIXED</strong></td>
<td><strong>862-890 FIXED</strong></td>
<td><strong>5.311A 5.320</strong></td>
</tr>
<tr>
<td>MOBILE except aeronautical mobile</td>
<td>MOBILE except aeronautical mobile</td>
<td></td>
</tr>
<tr>
<td>5.317A</td>
<td>5.317A</td>
<td></td>
</tr>
<tr>
<td>BROADCASTING 5.322</td>
<td>BROADCASTING</td>
<td></td>
</tr>
</tbody>
</table>
Footnotes

5.291 Additional allocation: in China, the band 470-485 MHz is also allocated to the space research (space-to-Earth) and the space operation (space-to-Earth) services on a primary basis subject to agreement obtained under No. 9.21 and subject to not causing harmful interference to existing and planned broadcasting stations.

5.149 In making assignments to stations of other services to which the bands: ..... 608-614 MHz in Regions 1 and 3, ...... are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 4.5 and 4.6 and Article 29). (WRC 07)

5.298 Additional allocation: in India, the band 549.75-550.25 MHz is also allocated to the space operation service (space-to-Earth) on a secondary basis.

5.305 Additional allocation: in China, the band 606-614 MHz is also allocated to the radio astronomy service on a primary basis.

5.306 Additional allocation: in Region 1, except in the African Broadcasting Area (see Nos. 5.10 to 5.13), and in Region 3, the band 608-614 MHz is also allocated to the radio astronomy service on a secondary basis.

5.307 Additional allocation: in India, the band 608-614 MHz is also allocated to the radio astronomy service on a primary basis.
Footnotes

5.311A For the frequency band **620-790 MHz**, see also Resolution **549 (WRC-07)**. (WRC-07)

5.313A The band, or portions of the band **698-790 MHz**, in Bangladesh, China, Korea (Rep. of), India, Japan, New Zealand, Pakistan, Papua New Guinea, Philippines and Singapore are identified for use by these administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. In China, the use of IMT in this band will not start until 2015. (WRC-12)

5.317A Those parts of the band 698-960 MHz in Region 2 and the band **790-960 MHz in Regions 1 and 3** which are allocated to the mobile service on a primary basis are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) – see Resolutions **224 (Rev.WRC-12)** and **749 (Rev.WRC-12)**, as appropriate. This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-12)

• RESOLUTION 224 (REV.WRC-12) Frequency bands for the terrestrial component of International Mobile Telecommunications below 1 GHz

• RESOLUTION 749 (REV.WRC-12) Use of the band **790-862 MHz** in countries of Region 1 and the Islamic Republic of Iran by mobile applications and by other services
Views and Proposals

ASIA-PACIFIC TELECOMMUNITY
The 5th Meeting of the APT Conference Preparatory Group for WRC-15 (APG15-5)
27 July – 1 August 2015, Seoul, Republic of Korea

Palau (Republic of), Papua New Guinea (Independent State of), Samoa (Independent State of), Solomon Islands (Independent State of), Vanuatu (Republic of), Tuvalu (Independent State of)

VIEWS AND PROPOSALS ON WRC-15 AGENDA ITEMS 1.1

2. Views and Proposals

470-698 MHz

It is proposed that the APT support the identification, for use by IMT, of the frequency band 470-698 MHz.

698-960 MHz

For the band 698-960 MHz, planned for use for IMT systems in the Pacific Islands and consistent with the Asia-Pacific Telecommunity (APT) 700 MHz plan, the contributing countries support the amalgamation of Radio Regulations Article 5 Table of Frequency Allocations footnote Nos. 5.313A and 5.317A to facilitate a Regional IMT identification from 698-960 MHz. Furthermore, contingent on outcomes of Agenda item 1.2 the contributing countries support the amalgamation of footnote Nos. 5.313A and 5.317A into a revised No. 5.384A to facilitate a global IMT identification from 698-960 MHz.

Should it be necessary, the contributing countries, in accordance with Resolution 26 (Rev.WRC-07), intend to identify the band 698-790 MHz for IMT by adding their country names to footnote No. 5.313A of the Radio Regulations Article 5 Table of Frequency Allocations. In response to an invitation issued by Australia (APG15-4 /INP-63) the contributing countries would propose to join in a multi-country proposal to WRC-15 for this purpose.

Dangerous for broadcasters as this potentially will lead to loss of the whole UHF band for broadcasting
Band Sharing

• Can Mobile phone services share with Broadcasting?

• In the same area, only by band segmentation
  – BUT, guardbands are needed, spectrally inefficient

• In different areas, yes
  – BUT, separation distances mean no services in some areas, waste of spectrum capability.
### UHF Bands IV, V

<table>
<thead>
<tr>
<th>6 MHz</th>
<th>7 MHz</th>
<th>8 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan, South Korea</td>
<td>Australia</td>
<td>NZ, Pacific Is</td>
</tr>
</tbody>
</table>

#### Australia
- **Digital 174 MHz**
- **Dividend 126 MHz**

#### Papua New Guinea
- **Digital 224 MHz**
- **Dividend 112 MHz**

#### APT 700 MHz Plan

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**Analogue**

**Digital**

**Mid band Gap**

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**Consultants Pty Ltd**

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# Comparing VHF and UHF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>VHF (Band III)</th>
<th>UHF (Band IV)</th>
<th>Benefit of VHF</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received Field Strength</td>
<td>44 dBUV/m</td>
<td>50 dBUV/m</td>
<td>6 dB</td>
<td>Value may vary between administrations, but difference the same</td>
</tr>
<tr>
<td>Transmit Antenna Gain</td>
<td>8 dBD</td>
<td>11.9 dBD</td>
<td>3.9 dB</td>
<td>Comparing similar pattern antennas, RFS 655 and PHP</td>
</tr>
<tr>
<td>Feeder Loss</td>
<td>1 dB</td>
<td>1.5 dB</td>
<td>0.5 dB</td>
<td>Relative amount varies depending on length</td>
</tr>
<tr>
<td>Net VHF Benefit</td>
<td></td>
<td></td>
<td>2.6 dB</td>
<td></td>
</tr>
</tbody>
</table>

- VHF requires **2.6 dB** LESS transmitter power than UHF in this example.
- VHF power only **55%** of UHF power needed.
- Translated to Tongan example saving of **12.5 MWh** annually (2 digital txs).
Considering VHF and UHF

• Transmit power saving at VHF
  – Saving logistics of power generation / reliability (backup genset, supply of diesel, etc)
  – Cost savings for broadcasters

• Many existing services are on VHF
  – Possible re-use of transmit antenna
  – Viewers antennas already VHF
  – But, needs available spectrum to simulcast both analogue and digital

• Better propagation at VHF
  – Particularly when vegetative clutter considered
  – Better diffraction over hills
A New VHF Band Plan for Digital?

- For Digital, wider bandwidth carriers are more efficient
- Wider Bandwidth = More useable bits in the multiplex
- More bits means more capability for statistical multiplexing of different video services
- Allows more services in the fixed channel
- Better accommodates future television developments such as UHDTV (with HEVC coding)
- UHF plans in Pacific are already 8 MHz
- Changing VHF to an 8 MHz plan (where possible) allows for simpler “gap filler” repeaters of VHF onto UHF
- Trade-off is the number of multiplexes required for the country
  - If planning 4 muxes, two channel “sets” are possible in a 7 MHz raster plan

*Australian Channel numbers shown, other nations may use different channel identifiers*
Spectrum Planning

• Broadcast spectrum allocated for a number of broadcasters / mux operators in each area / town

• Need to consider spectrum for:
  – Adjacent areas
  – Adjacent other radio systems
  – Adjacent countries

• Consider broadcaster network topology, e.g.:
  – main tx / infill system (e.g. Australia / NZ)
  – satellite feed to all transmitters
Standards

- Transmission System Standard
  - E.g. ATSC, DTMB, DVB-T / T2, ISDB-T
- Service Information Standard
- Encoding Standards
  - E.g. SD, HD, UHD, audio, captioning, etc
- If Pacific Islands select the same transmission standard, consider the benefits of a common equipment standard
  - Common standard = larger market
  - Common standard = lower cost supply
  - Common standard = likely more competitors
  - Some differences can be accommodated by making standard inclusive
- Spectrum, Standards and Equipment all inter-related
- Consider product development lead-times
## Neighbouring Country Digital Transmission Systems

<table>
<thead>
<tr>
<th>Country</th>
<th>Australia</th>
<th>New Zealand</th>
<th>Singapore</th>
<th>Possible Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Broadcast Bands</td>
<td>VHF &amp; UHF</td>
<td>UHF</td>
<td>VHF &amp; UHF</td>
<td>VHF &amp; UHF</td>
</tr>
<tr>
<td>Channel Bandwidth</td>
<td>7 MHz</td>
<td>8 MHz</td>
<td>7 MHz (VHF) &amp; 8 MHz (UHF)</td>
<td>7/8 MHz (VHF) &amp; 8 MHz (UHF)</td>
</tr>
<tr>
<td>Modulation System</td>
<td>DVB-T</td>
<td>DVB-T &amp; DVB-T2</td>
<td>DVB-T2</td>
<td>DVB-T2</td>
</tr>
</tbody>
</table>
Summary

• VHF and UHF bands are used for broadcasting across Pacific Nations
• The broadcast bands are being reduced to allow for more mobile services
• Broadcasters should retain an active dialogue with their regulators / governments to retain adequate spectrum for broadcasting and allow for future broadcast services
• The VHF band offers benefits to Pacific Nations and should not be overlooked
• Spectrum Planning and Standards selection are key to the success of a digital transition
• Consider developing a regional standard
Thank You for your attention

Questions?