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The Republic
of Vanuatu



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A Consultation Paper on **Fixed Service Spectrum Band Planning in Vanuatu**

Inviting public comment and input
27/06/2014

1 CONSULTATION FEEDBACK INFORMATION

TRR welcomes and invites comments and feedback to this consultation document from all interested parties.

We would appreciate your provision of information to be clear by quoting the corresponding main sections and sub sections when providing your comments.

More general comments on the consultation document should be indicated accordingly.

In the interests of transparency, TRR will make public all or parts of any submissions made in response to this Consultation Document unless there is a specific request to treat all or part of a response in confidence. If no such request is made, TRR will assume that the response is not intended to be confidential. TRR will evaluate requests for confidentiality according to relevant legal principles.

Respondents are required to clearly mark any information included in their submission that they consider confidential. They shall provide reasons why that information should be treated as such. Where information claimed to be confidential is included in a submission, respondents are required to provide both a confidential and a non-confidential version of their submission. TRR will determine, whether the information claimed to be confidential is to be treated as such, and, if so, will not publish that information. In respect of the information that is determined to be non-confidential, TRR may publish or refrain from publishing such information at its sole discretion.

If you have specific questions, please use Section 10 (List of Questions) to provide us with your queries.

TRR will accept comments in English, French or Bislama.

If comments are submitted in printed format, they must be submitted on A4 paper accompanied, wherever possible, by a disk containing the comments, in electronic format.

Comments on this consultation document should be provided to TRR via the following means:

Email address consultation@trr.vu

Faxed to (678) 24470

Posted or hand delivered to:

Public Input – Fixed Service Spectrum Band Planning in Vanuatu

Telecommunications and Radiocommunications Regulator

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The deadline for public Comments is **4pm, 28 July 2014**.

For any phone enquiries regarding this Consultation document, please call the following numbers: (678) 27621 or (678) 27487

All comments will be reviewed by TRR's established industry Advisory Working Groups (AWG), as appropriate. TRR will review the comments. TRR will consider every comment submitted when finalizing its report or decision. For transparency, a record of every comment received will be made available for public information, unless comments are labeled 'In Confidence' (see also dot points 4 and 5 above).

For more information about TRR's Consultation Guidelines, please visit the following website <http://www.trr.vu/index.php/en/public-register/consultations>

You are welcome to visit our website <http://www.trr.vu> for more details on the latest developments in the telecommunication services industry and other related matters.

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3 INTRODUCTION

This Consultation Document presents proposals for planning Vanuatu's fixed service spectrum.

Fixed services, otherwise called microwave fixed point-to-point links, provide essential backhaul to a variety of services including mobile base stations, air traffic control radar, electricity distribution systems and internet connectivity.

Planning of these bands is important to ensure that operating systems can be identified and protected and also to ensure the spectrum dedicated to fixed services is used efficiently.

Within ITU Region 3, where Vanuatu is situated, a number of services share bands allocated to fixed services. In some cases these are bands that support mobile broadband services and in other cases satellite services. As Vanuatu develops, mobile broadband will become an important economic enabler; because of this, some potential mobile bands have not been planned for fixed services and these are identified in the paper.

Satellite services are also important in Vanuatu, although less so with the recent landing of a submarine cable. Satellite, however, can distribute many services such as television, internet and telephony services as well as offer stand by services in the event of cable failure. Thus, the paper proposes that some satellite service bands be protected from interference from fixed services, and in other bands fixed services will not receive protection from satellite services.

A report on this consultation will be published and will include a list of stakeholders, summary of comments received and explanations on how such comments were taken into account (as well as, if applicable, reasons as to why certain comments/suggestions were rejected).

4 INTERPRETATIONS AND DEFINITIONS

This section provides interpretations or definitions of terms used in the document.

Term	Definition
dB	Deci Bel. A unit of radio measurement.
FS	Fixed Service
FSS	Fixed Satellite Service
GHz	Giga Hertz
Grid Pak	A microwave antenna constructed as a grid of tubular aluminium.
ITU	International Telecommunications Union
LTE	Long Term Evolution (a 4 th generation mobile standard)
MHz	Mega Hertz
PFD	Power Flux density
VRFSP	Vanuatu Radio Frequency Spectrum Plan

Telecommunications and Radiocommunications Regulator: Vanuatu

Consultation on Planning for Fixed Service Spectrum Bands

5 PURPOSE

This consultation paper presents options for the planning of Vanuatu's fixed microwave (point to point) services.

The paper presents options for planning including suggested bands for fixed microwave systems, bands that should be set aside for the provision of ubiquitous satellite services, and bands that should be set aside for future mobile telephony and mobile broadband services.

The paper seeks input from industry, carriers and vendors on the proposals made herein. Questions are posed at appropriate points throughout the paper; however, these are simply some suggestions or requests for feedback. Industry is requested to provide feedback on any issue they feel is important.

6 FIXED POINT TO POINT MICROWAVE SYSTEMS; SOME BACKGROUND

6.1 Purpose

The fixed microwave radio service (the fixed service) provides medium to high capacity connectivity between two points or between a central point and stations within a given area where access to cable or fibre is not available or economically viable.

The fixed service also provides connectivity over long distances where the inherent time delay associated with satellite connections makes these less attractive.

The fixed service is used in a number of ways. For example, it may transmit data over long distances (referred to as trunk services) between two towns or cities. It may also serve to interconnect numerous base stations within a cellular network. The fixed service is also used in a number of non-telecommunications networks. Some examples are the connection of a civil or military radar installation to an aircraft control tower, the transmission of supervisory control and data signals (SCADA) associated with the operation of an electricity transmission network and the interconnection of a private data network between two buildings.

Generally speaking, certain bands are suited to certain applications. For example, the 1.5 GHz microwave band is considered to be 'low frequency' in terms of fixed systems while still having the capacity to transmit large amounts of data. Other advantages of the 1.5 GHz band are low attenuation over distance, very little susceptibility to fade during heavy rain and the ability to use light 'grid-pak' type antennas on relatively light tower structures or supports. This means the 1.5 GHz band provides an economically viable method of transmitting data over relatively long distances (up to around 80 km) and is thus viable on many over water paths typical of Vanuatuan geography.

Higher bands are suited to different purposes. For example the 10 GHz band still retains good rain fade characteristics and can provide high data rates over distances of up to 40km. This means it is useful for the interconnection of electricity substations, telephone exchanges or radar systems using solid antennas of about 1 metre diameter.

Higher bands, such as 15 GHz can carry high data rates and use much smaller solid antennas which allow integrated radio and antenna systems to be deployed. While these and higher bands are more susceptible to rain fade they are useful when interconnecting mobile base stations or for short hop length systems within cities.

6.2 Propagation and systems design at microwave frequencies

This section of this paper is not intended to serve as a fixed service design guide. However, some background may be useful to those not involved in fixed service design and aid when considering input to this paper.

6.2.1 Microwave antennas

Antennas used at microwave frequencies are usually parabolic reflectors. The gain of an antenna is frequency dependant; for example a 1.2 metre Grid-Pak at 1.5 GHz has a gain of

around 23 dBi while a 1.2 metre parabolic antenna at 15 GHz has a gain of around 42 dBi. While the 1.5 GHz Grid-Pak design offers lighter weight and lower wind loading the higher gain at 15 GHz means much smaller antennas can be used making the higher bands viable for short hop deployment.

Microwave antennas also have very narrow beam widths, around 10 degrees for the 1.5 GHz Grid-Pak and around 1.5 degrees for the 1.2m 15 GHz parabolic. This means sharing the same frequencies within the same area is possible provided careful coordination is undertaken.

Sharing with other systems is also possible, again provided careful coordination is undertaken. Where systems are 'ubiquitous', a term used to mean deployed without the need for licensing and registration into a common database, coordination is not possible. In these cases it is prudent spectrum management to avoid conflict by restricting the band to a certain service type.

6.2.2 Propagation at microwave frequencies

Radiowave propagation through the atmosphere is a complex science, but some basic rules of thumb are provided to aid the reader not familiar with fixed service design.

The power loss of a system over a line of sight path between two points can be calculated from:

$$FSL = 32.5 + 20 \text{ Log}(D \times F)$$

where:

FSL is Free Space Loss

F is frequency in MHz

D is distance between the two points in kilometres.

For example, the free space loss at 1.5 GHz over a 50 km path is 130 dB.

Over very long paths the surface of the earth (or Earth bulge) can block a straight line path. This is overcome by using high towers, but the atmosphere also assists by bending (refracting) the radio waves around the earth thus increasing the horizon visible to the system (the radio horizon).

Attenuation by rain is also a problem for designers of systems in tropical areas. For example a rain event of 40 mm per hour can reduce a usable 20 km path length by a factor of two to 10 km. This means rain fade in tropical regions must be taken into account by the system designer and when coordinating interference between systems. It is important to note that rain fade may not be the same on both the wanted and unwanted path.

A final and important consideration, especially on overwater paths, is atmospheric multipath or ducting. This happens when a signal is refracted when passing through a change in the atmosphere, returning to the receive antenna out of phase with the wanted signal causing a fade. Another mechanism occurs when an interfering signal is trapped within a duct and arrives at a much higher power than line of sight calculations suggest causing interference and a systems failure.

All of these mechanisms are taken into account when deciding which bands to plan for the fixed service and which to preserve for other services. If the reader would like more information on digital fixed service design the International Telecommunications Union (ITU) produces an excellent manual called the 'Handbook on Digital Radio-Relay Systems'.

6.2.3 Fixed service availability

Fixed services are designed for a specific error performance or availability depending on the service they provide. Examples of a high grade of service are a trunk network servicing a large town or a link between a radar and an airport control tower. Cellular systems are able to tolerate a lower grade of performance depending on how many cells the actual link services.

Fixed service availability is also a complex topic covered by a number of ITU publications. For more information the reader is directed to ITU Recommendations ITU-R F.634, ITU-R F.557, ITU-R F.697, ITU-T G.821 and ITU-T G.826 which can be found by searching the ITU site at www.itu.int.

As an example, the unavailability over time of a fixed, two-way link over 40 km should not exceed 0.0048% (ITU-R F.557) and that of a short hop system, such as that servicing a cellular mobile network should not exceed between 0.001% and 0.01% depending on the system parameters (ITU-R F.697).

7 BANDS THAT WILL BE PRESERVED FOR FUTURE MOBILE BROADBAND SERVICES

7.1 Future mobile broadband services

The availability of broadband data enabling fast and reliable access to the internet is recognized globally as an economic enabler. The recent announcement of 'the (US)\$25 smart-phone' will empower the people of Vanuatu and enable them to improve existing industries such as agriculture, fishing and tourism and to develop new industries thus improving the GDP of Vanuatu.

As Vanuatu develops, the community and visitors will come to expect the same mobile broadband services that are available elsewhere in the region. This means TRR needs to set aside these bands now to both preserve them for future mobile broadband services but to also ensure the designers of fixed networks are not faced with large bills to replace systems displaced by mobile broadband in the future.

There are a number of bands used for or set aside for mobile broadband within the ITU's Region Three (Asia and the Pacific) and some of these are also flagged in the Vanuatu Radio Frequency Spectrum Plan (VRFSP).

There are also some bands that are under investigation within the ITU and the Asia-Pacific Telecommunity (APT) that have been suggested for planning for the mobile service. Where this occurs and TRR makes a proposal other than that under consideration in the APT an explanation will be provided.

7.2 Bands for mobile broadband services

TRR proposes to exclude the bands below from the fixed services plan and preserve them for mobile broadband services until a thorough review of Vanuatu's mobile broadband service can be undertaken along with an estimation of the spectrum needs of mobile broadband.

7.2.1 The 1800 MHz band

Within the VRFSP this band encompasses the range 1710 MHz to 1930 MHz. Footnote 19A of the VRFSP states:

Requirements for further cellular system spectrum to support the continued deployment of GSM systems can be accommodated in this band. This can happen once the current 900 MHz allocations have been fully utilized.

While in some neighboring countries such as Australia GSM has been phased out in this band and replaced with 4th Generation (4G) Long Term Evolution (LTE) systems, the intent of VTU-19A remains and this band will continue to be preserved for mobile broadband and telephony services.

7.2.2 The 1930 MHz to 1980 MHz band paired with 2110 MHz to 2170 MHz band

This band is not identified within the VRFSP for mobile broadband and telephony services. However in some neighboring countries such as Australia the band already supports 3rd Generation (3G) services.

The bands used for 3G services are 1920 MHz – 1980 MHz paired with 2110 MHz to 2170 MHz which continues on from the 1800 MHz band above.

These services may become important to Vanuatu in the future to support domestic needs and the needs of visiting tourists and business travelers. It is therefore considered prudent to limit fixed service deployment by not planning the band for the fixed service.

7.2.3 The 2300 MHz to 2450 MHz band

This band is allocated in Australia to a Time Division Duplex (TDD) 4th Generation LTE technology. TRR notes that this band is already being used by licensees in Vanuatu for fixed links and other services. Given this band's use in some countries for mobile broadband, TRR does not propose to plan the band for the fixed service at this time. This could be reviewed after a full determination of the future mobile broadband spectrum requirements in Vanuatu is undertaken.

7.2.4 The 2500 – 2690 MHz band

This band has recently been allocated in Australia for 4th Generation LTE services. The band is set aside in the VRFSP by way of Footnote VTU-22 for such services. However, the band is currently being used by Telsat for the delivery of microwave television services (although Telsat is planning to migrate these services to another band). TRR is currently undertaking a planning exercise for the APT 700 MHz plan for 4th Generation (4G) services and this band is a complimentary high capacity band to that service. As such the band should be preserved for future mobile broadband services.

8 BANDS THAT COULD BE PRESERVED FOR SATELLITE SERVICES

8.1 Satellite services in Vanuatu

Vanuatu was, until recently, heavily dependent on satellite for interconnection with other countries, access to the internet and delivery of television services. With the arrival of a submarine cable in January 2014 many of these services no longer require access to satellite systems. Many other services, such as feeds for broadcasting, do rely on satellite and satellite provides an emergency back-up in the case of disruption to cable services.

Because of this dependence, bands that support essential satellite services are important and TRR considers they should be protected from interference from other systems such as the fixed service.

Vanuatu currently utilises the satellite C and Ku Bands for international connectivity. Parts of the C Band have already been re-planned for terrestrial services in some countries and the entire band is under consideration in the ITU for terrestrial mobile broadband services. This means the delivery of satellite services in the band may not be viable at some time in the future and while it remains an important satellite band for Vanuatu alternatives should be preserved until the outcome of ITU deliberations is finalized.

Bands other than C band have the potential to offer an expanding range of services to the people of Vanuatu. As rain fade amelioration technologies develop, higher bands will become viable potentially expanding the availability of high speed broadband, telecommunications and additional television services throughout Vanuatu.

TRR proposes that the following bands will either not be planned for fixed microwave services or restrictions will be placed on fixed services for the reasons given.

8.2 Satellite band special considerations

8.2.1 The Band 3400 to 4200 MHz. The Satellite 'C Band' Downlink

This is the Space to Earth or downlink band for the C band Fixed Satellite Service (FSS) used in Vanuatu. Telecommunications services into Vanuatu are provided by way of the submarine cable backed up by the Intelsat and other Satellite Service gateways in Port Vila. There is potential for the installation of additional gateways should demand dictate and therefore this band is considered vital for the delivery of telecommunications and broadcasting services into Vanuatu and should be protected. TRR notes that 3400 -3450 MHz is currently being used by an operator for fixed wireless broadband services.

Direct To Home (DTH) television services in both English and French are also provided in these bands and due to their ubiquitous nature cannot be coordinated with other services so as to prevent interference.

These bands will therefore not be planned or further made available for the fixed service.

8.2.2 The Band 5850 MHz to 7075 MHz. The 'C Band' Uplink

This is the C Band Earth to Space uplink band paired with the downlink band discussed in section 8.2.1. While interference from the fixed service into uplink transmitters is impossible should fixed satellite systems become ubiquitous in the future to enable local internet connections, interference from the satellite uplinks into the fixed service receivers will be an issue. TRR therefore recommends that any fixed services using this band do so on the basis of 'no protection' from satellite uplinks.

8.2.3 The Band 10.7 – 11.7 GHz. The Ku Band Downlink Gateway

The band 10.7 to 11.7 GHz is used for both Ku band gateways (space to Earth) and fixed links. There is high potential for a fixed link in this band to interfere with a Ku band gateway receiver or to preclude the installation of a KU gateway receiver where a fixed link is present.

Given the number of alternative fixed service bands and the potentially available services in the Ku band, TRR proposes to restrict fixed service deployments to operations on a 'no interference' basis with existing and future Ku band services.

8.2.4 The Band 11.7GHz to 12.2 GHz. The Broadcasting Satellite Services Band

The band 11.7 to 12.2 GHz is used in ITU Region 1 (Europe) and Region 3 (Asia Pacific) for the delivery of space to Earth (downlink) DTH Broadcasting Satellite Services (BSS). DTH BSS are usually ubiquitous uncoordinated services.

Vanuatu does not yet utilize these bands for DTH BSS. However given the services available, improving rain fade performance and the availability of other bands for the fixed service, TRR proposes that these bands not be planned for the fixed service at this stage.

8.2.5 The Band 12.2 GHz to 13.25 GHz. The 'Ku' Fixed Satellite Service Band Downlink

The band 12.2 GHz to 13.25 GHz is allocated in ITU Region 3 and partially in Regions 1 and 2 (Europe and the Americas) to the Fixed Satellite Service (FSS) space to Earth. The band is also known as the FSS Ku Downlink Band.

Ku FSS has the ability to deliver DTH television, telephone and internet connections and in some countries is a ubiquitous and uncoordinated service.

Improving rain fade amelioration technologies mean that this band has become a viable alternative to C Band for the delivery of satellite services to Vanuatu and may present an alternative to or a backup for existing C Band services.

The same evolving rain fade technologies may also deliver additional services to the people of Vanuatu. Given the services potentially available in the future, improving rain fade performance and the availability of other bands for the fixed service, TRR proposes that these bands not be planned for the fixed service at this stage.

8.2.6 The band 13.75 to 14.8 GHz. The 'Ku' Fixed Satellite Service Band Uplink

This is the Ku Band Earth to Space uplink band paired with the downlink band discussed previously. While interference from the fixed service into uplink transmitters is impossible should these systems become ubiquitous in the future to enable local internet connections,

interference from the satellite uplinks into the fixed receivers will be an issue. TRR therefore recommends that fixed services operating in this band do so on a 'no protection' basis until the viability of Ku Services in Vanuatu can be thoroughly investigated.

8.2.7 The Band 17.3 GHz to 21.2 GHz. The 'Ka' Fixed Satellite Service Band Downlink

The band 17.3 GHz to 19.3 GHz is allocated in all three ITU Regions to the Fixed Satellite Service (FSS) space to Earth. The band is also known as the FSS Ka Downlink Band.

Ka FSS has the ability to deliver DTH television, telephone and internet connections and in some countries, such as Australia, parts of the band support a ubiquitous and uncoordinated service.

Within this band some countries use the pair 20.2 GHz to 21.2 GHz for Defence systems.

Improving rain fade amelioration technologies mean that this band has become a viable alternative to C Band for the delivery of satellite services to Vanuatu and may present an alternative to or a backup for existing C Band and Ku Band services.

The same evolving rain fade technologies may also deliver additional services to the people of Vanuatu. Given the services potentially available in the future, improving rain fade performance and the availability of other bands for the fixed service, TRR proposes that these bands be planned for fixed services now but reviewed in five years to determine the need for Ka band services.

8.2.8 The band 27 GHz to 30 GHz. The 'Ka' Fixed Satellite Service Band Uplink

This is the Ka Band Earth to Space uplink band paired with the downlink band discussed in section 8.2.7. While interference from the fixed service into uplink transmitters is impossible should these systems become ubiquitous in the future to enable local internet connections, interference from the satellite uplinks into the fixed receivers will be an issue.

Within this band some countries use the pair 30 GHz to 31 GHz for Defence systems.

TRR therefore proposes that fixed services in this operate on a 'no protection' basis until the viability of Ka Services in Vanuatu can be thoroughly investigated.

8.2.9 Higher bands

While there are bands set aside higher in the radiofrequency spectrum for satellite technologies that also have an ITU Region 3 fixed services allocation, TRR does not propose to plan above this range for fixed services and therefore these bands will be considered when the TRR Fixed Services plan is reviewed. Any requests received by the TRR for the use of these higher spectrum bands prior to a review of the Fixed Services plan, will be dealt with on a case by basis, and in accordance with any ITU Recommendations for the particular band or bands for Region 3.

9 BANDS PROPOSED FOR THE MICROWAVE FIXED SERVICE

9.1 Bands available to the Fixed Service (FS)

In this paper TRR proposes only to consider bands that have an allocation to the Fixed Service within Region 3 and in the VRFSP. Bands that have an allocation to FS but are mentioned in the chapters on mobile broadband and satellite services will not be planned until a review of the needs of the Vanuatu people and the services themselves can be undertaken.

TRR initially proposes only to plan bands between 1500 MHz and 22 GHz for the fixed service because these encompass a range that is able to support the requirements of a range of services. Should plans for bands in higher frequency ranges be needed, these will be planned when the Fixed services Plan is reviewed.

Examples of individual Fixed Service Band Plans are attached as Annex A.

9.2 Channel aggregation

Often the services supported by the fixed service evolve to provide or require more data. An example is the 4th Generation Mobile Service known as LTE. In order to provide flexibility for such services, spectrum managers have allowed channel aggregation in most bands (with some restrictions depending on the band). Channel aggregation may only be feasible where channels are unencumbered and coordination with other services is possible.

9.3 Bands proposed for planning to accommodate the fixed microwave (point to point) service

9.3.1 The band 1427 MHz to 1535 MHz; the 1.5 GHz band

This band is capable of supporting low to medium capacity fixed point to point links. The 1.5 GHz band is shared with the Broadcasting Satellite Service (Sound) (BSS-S). This service has restrictions on the PFD achieved at the ground which will protect the fixed service. There are no restrictions on the fixed service. In Vanuatu, the 1.5 GHz band is being used by TVL for fixed links.

Portions of the 1.5 GHz band are also under consideration in the ITU and APT for future mobile broadband systems. These systems will most likely be used to augment existing systems in areas of high population density and high data demand. Given the number of bands proposed by TRR for consideration for mobile broadband in Vanuatu and considering the need for robust long distance fixed communication in Vanuatu, TRR considers that the greatest economic benefit to Vanuatu will be achieved by planning this band for fixed microwave point to point links. TRR welcomes comments on the best future use of the 1.5 GHz band in Vanuatu.

A proposed planning arrangement for this band is given in Annex A.

9.3.2 The band 4400 MHz to 5000 MHz; The 5 GHz band

The band 4400 MHz to 5000 MHz is capable of supporting high capacity fixed point to point microwave links. This band is used for Aeronautical Mobile Telemetry (AMT) in ITU Region 2 and in Australia on the condition that this service causes no interference to the fixed service.

In Australia and some other Administrations this band is set aside for defence use and may be used in the future for Network Centric Warfare (NCW).

It is unlikely that this band will be required for AMT or defence purposes in Vanuatu. The band is already being used for fixed services in accordance with ITU recommendation (ITU-R F. 1099-2). Given its value as a high capacity band with hop lengths of 40km or greater, TRR proposes to plan this band in accordance with the 5 GHz fixed services plan shown in Annex A.

9.3.3 The band 7128 MHz to 7422 MHz; the 7.2 GHz band

This band is allocated to the fixed service in ITU Region 3 with one caveat; the band 7250 MHz to 7375 MHz is allocated on a co-primary basis. The band is shared with the primary fixed satellite service and the primary mobile satellite service. Operations of fixed services in this band shall not cause interference to these services.

As there are no known fixed or mobile satellite services in this band in Vanuatu, this band is proposed for fixed services in this paper.

The band has good rain fade characteristics and is capable of supporting high capacity digital systems. The ITU through Recommendation ITU-R F.385-10 provide a number of channel bandwidths ranging from 7 MHz to 56 MHz. This paper proposes a 14 MHz channel structure which may be aggregated to achieve 56 MHz channels where needed.

Proposed planning arrangements are given in Annex A as the 7.2 GHz band.

9.3.4 The band 7425 – 7725 MHz; the 7.5 GHz band

This band is allocated to the fixed service in ITU Region 3. The band is shared with the primary fixed satellite service and the primary and secondary (depending on band segment) mobile satellite service. The band 7450 – 7550 MHz is also allocated to the Meteorological Satellite Service on a world wide basis, which must be protected from interference. Operations of fixed services in this band shall not cause interference to these services.

As there are no known fixed or mobile satellite services in this band in Vanuatu, this band is proposed for fixed services in this paper.

The band has good rain fade characteristics and is capable of supporting high capacity digital systems. The ITU through Recommendation ITU-R F.385-10 provide a number of channel bandwidths ranging from 7 MHz to 56 MHz. This paper proposes a 7 MHz and 14 MHz channel structure.

Proposed planning arrangements are given in Annex A as the 7.5 GHz band.

9.3.5 The band 7725 MHz to 8275 MHz; The 8 GHz band

This band is allocated to the fixed service and the fixed satellite service (space to Earth) as well as the mobile service. The band is used heavily throughout the region for fixed services. The fixed satellite service is used in some countries for defence purposes.

The band has good rain fade characteristics and is capable of supporting high capacity digital systems. The ITU through Recommendation ITU-R F.386-9 provide a number of channel bandwidths ranging from 10 MHz to 30 MHz and portions of those.

TRR initially proposes to adopt a raster used within the region of 14.825 MHz and 29.65 MHz which is also capable of supporting 14 MHz and 28 MHz channels.

These channel arrangements for the 8 GHz band are given in Annex A.

9.3.6 The band 10.55 to 10.68 GHz; the 10 GHz band

This band 10.55 GHz to 10.6 GHz is allocated to the fixed and mobile services in ITU Region 3. The band 10.6 GHz to 10.68 GHz is also allocated to the Earth exploration service. This sub-band is used extensively for space based weather measurements including but not limited to wind speed determination, tropical rainfall measurement and microwave radiation imagery.

These services are important to Vanuatu's Meteorological Service and aid in the prediction of severe tropical storms.

ITU-R Resolution 751 (Res. 751) defines measures to ensure the continued viability of space based sensors and these will be applied by TRR so as to protect these systems.

Res. 751 defines the maximum antenna pointing elevation for fixed services in the band to be 20 degrees above the horizon. The maximum power at the antenna port is to be -15 dBW (14 mW) except where automatic transmitter power control (ATPC) is used when the power to the antenna port may be -3dBW (500 mW). TRR proposes to implement these protections in the 10 GHz fixed services plan available in Annex A.

9.3.7 The band 12.75 – 13.25 GHz; the 13 GHz band

This band is allocated to the fixed service in ITU Region 3 and used in some Region 3 countries for Television Outside Broadcasting. The band is shared with the primary fixed satellite service and the primary mobile service. Operations of fixed services in this band shall not cause interference to these services.

As there are no known fixed satellite or mobile services in this band in Vanuatu, this band is proposed for fixed services in this paper.

The band has good rain fade characteristics and is capable of supporting high capacity digital systems. The ITU through Recommendation ITU-R F.497-7 provide a number of channel arrangements. This paper proposes a 28 MHz channel capable of supporting 34 Mbit systems.

Proposed planning arrangements are given in Annex A as the 13 GHz band.

9.3.8 The band 14.5 - 15.35 MHz; the 15 GHz band

This band is allocated to the fixed service in ITU Region 3. The band is shared with the primary fixed satellite service and the primary mobile service. Operations of fixed services in this band shall not cause interference to these services.

As there are no known fixed or mobile satellite services in this band in Vanuatu, this band is proposed for fixed services in this paper.

The band has good rain fade characteristics and is capable of supporting high capacity digital systems. The ITU through Recommendation ITU-R F.636-4 provide a number of channel arrangements. This paper proposes a 7, 14 and 28 MHz channel structure all of which may be divided or aggregated in 7 MHz lots.

Proposed planning arrangements are given in Annex A as the 15 GHz band.

9.3.9 The band 17.7 – 19.7 MHz; the 18 GHz band

This band is allocated to the fixed service in ITU Region 3. The band is shared with the primary fixed satellite service and the primary mobile service. The band 18.6 – 18.8 GHz is also allocated to the earth Exploration Satellite Service (passive). Operations of fixed services in this band shall not cause interference to these services.

As there are no known fixed or mobile satellite services in this band in Vanuatu, this band is proposed for fixed services in this paper.

The band has good rain fade characteristics and is capable of supporting high capacity digital systems. The ITU through Recommendation ITU-R F.595-10 provide a number of channel arrangements. This paper proposes a 7.5, 13.75, 27.5 and 55 MHz channel structure. There are however many other possible structures and the TRR is interested in any comment industry may have on this band.

Proposed planning arrangements are given in Annex A as the 18 GHz band.

9.3.10 The band 21.2 GHz to 23.6 GHz; the 22 GHz Band

This band is allocated to the fixed service in ITU Region 3. While susceptible to severe rain fade the band supports a number of options for short range high capacity fixed links. Other services using the band include the radio Astronomy Service, but no restrictions have been placed on the deployment of fixed links. This band is therefore proposed for fixed services in this paper.

A set of proposed channel arrangements are available in Annex A.

10 LIST OF QUESTIONS FOR INDUSTRY

The TRR welcomes industry comment on the following questions. While feedback is directly solicited on these topics industry may provide comment on any issue they feel is relevant to the planning of Vanuatu's terrestrial fixed service.

10.1 Spectrum preserved for mobile broadband planning

TRR has specifically set aside some spectrum in the VRFSP for cellular mobile services. This paper builds on that work and suggests a number of bands be set aside and not planned for fixed services. This will allow TRR to properly consider Vanuatu's mobile broadband needs into the future.

- Has TRR correctly identified bands that should be set aside for future mobile broadband?

- Has TRR set aside too much, too little or the right amount of spectrum given that the majority of these bands are simply being preserved until Vanuatu's future needs can be properly identified?

10.2 Spectrum preserved for current and future satellite services

TRR has proposed the reservation of some bands capable of providing current and future satellite services to Vanuatu. There are also proposals to give priority to future satellite systems by making the fixed service secondary via a no protection clause. This is because Vanuatu is heavily reliant on satellite connectivity and as technology improves services from the Ku and Ka bands may become viable.

The Ku and Ka bands proposed to be protected in this paper are also capable of supporting fixed links. In some cases if both fixed and satellite services were deployed there would be potential for interference to the satellite service in the satellite downlink bands or to the fixed service in the satellite uplink bands.

- Has TRR proposed too much spectrum for satellite services?
- Should bands set aside for Ku Band satellite services be instead planned for the fixed service?
- Should bands set aside for the Ka Band satellite services be instead planned for the fixed service?
- In the above cases should portions of the bands, i.e. the uplink bands, be planned for the fixed service with a no protection clause?

10.3 Planning for the fixed service

TRR has limited this planning activity to the range 1.5 GHz to 23 GHz. This is because there are a large number of channels available in this range and through proper allocation significant re-use is possible.

Bands above 23 GHz are highly susceptible to rain fade making them useful only for very short paths.

In addition the making of a fixed services plan is a time consuming endeavor; to plan above 23 GHz would take additional time and TRR feels this can be undertaken at a later date when need dictates.

- TRR has not proposed planning the fixed service above 23 GHz at this stage. Is planning of higher bands needed as an immediate priority?
- TRR has not proposed to plan UHF fixed services below 1.5 GHz. This is because these bands are highly sought after for television services, mobile broadband and land mobile. Is there a requirement to consider the planning of other fixed point to point systems below 1.5 GHz?
- TRR has not proposed to plan the 1.5 GHz band for fixed point-to-multipoint (area) systems because it believes the band would be better utilized for fixed point-to-point links. Is this view justified?
- Is there a need for point to area services in the 1.5 GHz band in Vanuatu?

10.4 The proposed fixed service plans

Annex A contains some proposed fixed service band plans. Each plan is based upon a relevant ITU Recommendation along with information on similar plans in the region. There are various other possible arrangements in the ITU Recommendations. Any comments on these bands are welcome including comment on but not limited to:

- The information within the plans.
- The channel rasters proposed.
- The channel bandwidths proposed.
- Proposed protection ratios.
- Proposed minimum path lengths.
- Proposed minimum antenna sizes.
- Proposed channel aggregations strategies.

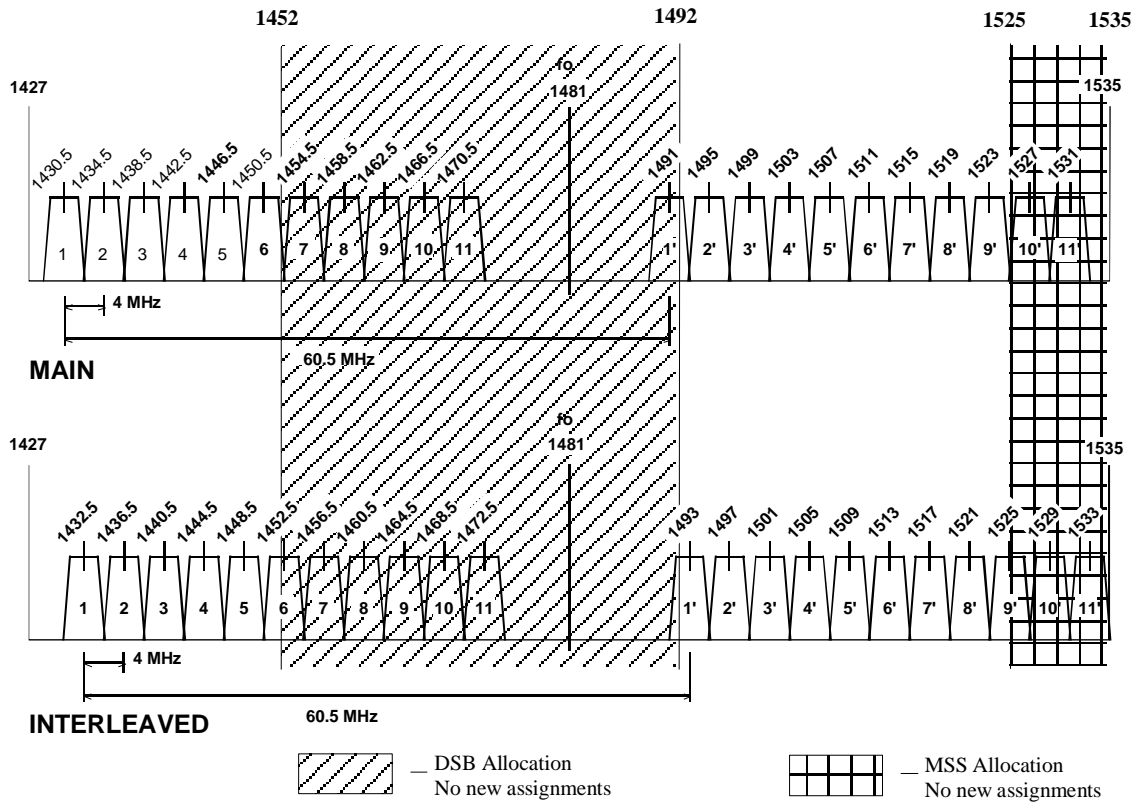
- Are the proposed fixed service band plans in Annex A appropriate for Vanuatu? Do you have any amendments to the proposed parameters in the plans?

11 ANNEX A. SAMPLE FIXED SERVICES PLANS.

11.1 The 1.5 GHz band

THE 1.5 GHz BAND (1427-1535 MHz)

RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by low to medium capacity fixed point-to-point links.

Typical Use : >2 Mbit/s data

Minimum Path Length : 20 km

Antenna Requirements : Minimum 1.2 m grid-pak style antenna or minimum 21 dBi gain.

Channel Aggregation : Channel aggregation up to 20 MHz (5 channels) is permitted providing coordination can be achieved and only for paths exceeding 20 km. In order to preserve the band for longer hops channel aggregation is not permitted for any path below 20 km.

Notes:

1. The use the minimum antenna type preserves the band for future users.

2. Due to evaporation ducting coordination for an over water path shall use the actual path length or 20 km **whichever is the lesser**.

PROTECTION RATIOS

1. Protection ratios required between digital systems operating on 2, 4 and 8 MHz and greater aggregated bandwidth channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)				Aggregated Channels	Greater
	Digital Interferer Tx → Digital Victim Rx					
	2 MHz → 2 MHz	2 MHz → 4 MHz	4 MHz → 2 MHz	4 MHz → 4 MHz		
0	60	60	60	60	8 MHz → Any width	> 8 MHz into any other channel
2	30	55	50	55		
4		25	20	30		
6				8		

2. Protection ratios required by digital systems operating on 2 and 4 MHz channels against interference from analogue systems operating on 2 and 4 MHz channels. No aggregation of legacy analogue systems is permitted.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Analogue Interferer Tx → Digital Victim Rx			
	2 MHz → 2 MHz	2 MHz → 4 MHz	4 MHz → 2 MHz	4 MHz → >=4 MHz
0	60	60	60	60
2		30	30	60
4				40

3. Protection ratios required by analogue systems operating on 2 and 4 MHz channels against interference from digital systems operating on 2 and 4 MHz channels. No

aggregation of legacy analogue systems is permitted. Analogue systems receive maximum protections specified below from any digital system whether greater than 4 MHz bandwidth or otherwise.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Interferer Tx → Analogue Victim Rx			
	2 MHz→ 2 MHz	2 MHz → 4 MHz	4 MHz → 2 MHz	4 MHz → 4 MHz
0	60	60	60	60
2	10	10	10	30

Notes:

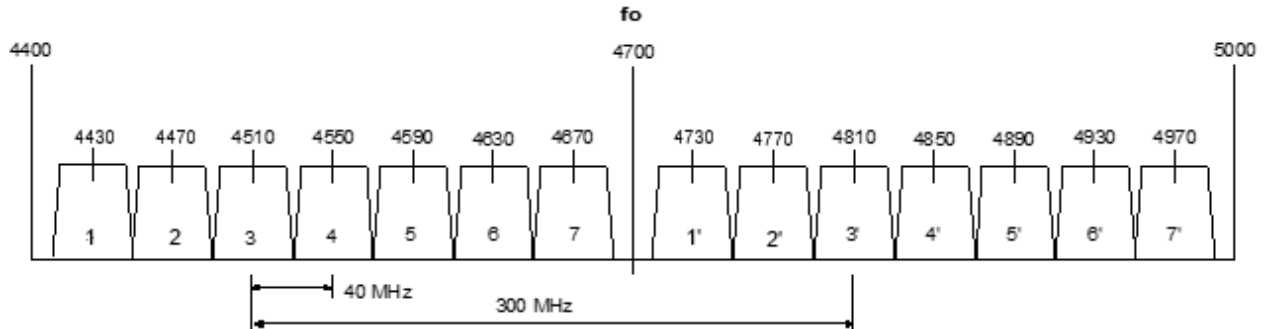
1. Protection ratio for digital systems are based on a 60 km path length and P_L (*Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km*) of 20. Currently path length correction is not deemed necessary.

11.2 The 5 GHz band

This plan provides radio-frequency channel arrangements for fixed services operating in the 5 GHz band (4 400-5 000 MHz), which may be used for high- and medium-capacity fixed systems, based on a 10 MHz common pattern.

THE 5 GHz BAND (4400 - 5000 MHz)

RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

Typical Use	: 155 Mbit/s (STM-1) or equivalent.
Assignment Priority	: Assign from Channel 1.
Minimum Path Length	: 20 km
Antenna Requirements	: 1.2 m parabolic dish minimum.
Protection Requirements	: Protection ratios required between digital systems operating on the same channel raster.
	Co Channel: 60 dB
	1st Adjacent Channel 30 dB
	2nd Adjacent Channel 0 dB

Orthogonal polarization may be used to achieve coordination; allow 20dB.

Channel aggregation

Channels may be aggregated to form 80 MHz channels or split to form 20 MHz channels in line with ITU-R F1099. Where aggregation is used the term '2nd adjacent channel' refers to a channel separated by the bandwidth of the aggregated channel.

References:

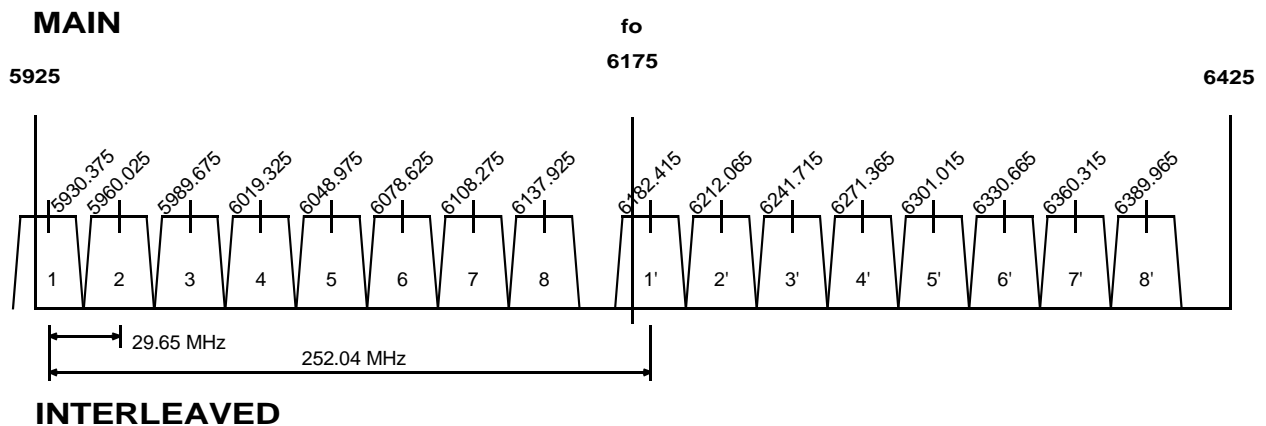
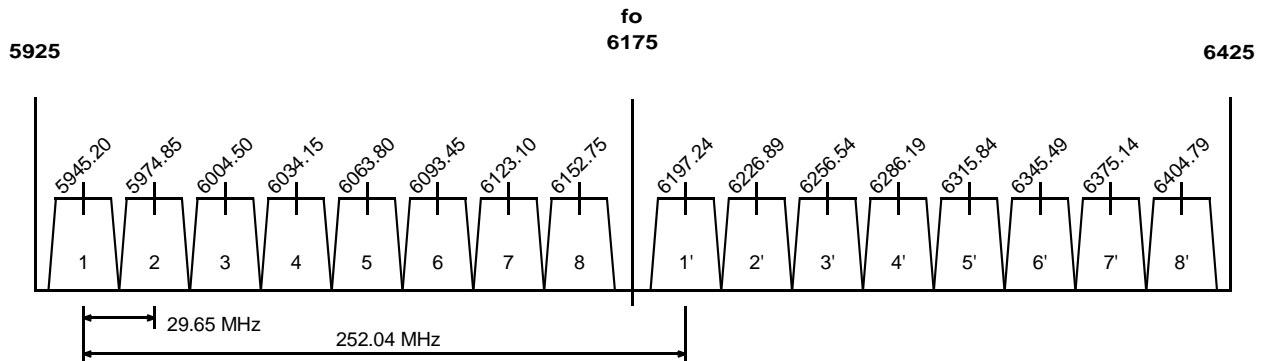
1. Rec. ITU-R F.1099-3, "Radio-frequency channel arrangements for high-capacity digital radio-relay systems in the 5 GHz (4400-5000 MHz) band", 2013.

11.3 The 6 GHz band

This plan provides radio-frequency channel arrangements for fixed services operating in the 6 GHz band (5925 - 6425 MHz), which may be used for high- and medium-capacity fixed systems, based on a 29.65 MHz common pattern.

THE 6 GHz BAND (5925 - 6425 MHz)

RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by medium and high capacity fixed point-to-point links.

Typical Use : 34 Mbit/s data, FM Video

Assignment Priority : not specified

Minimum Path Length : 20 km

Antenna Requirements : refer to Appendix 11

Note:

1. Proposed links need to be coordinated with licensed earth stations operating in this band.
2. All terrestrial fixed services in this band operate on a no protection basis from interference from uplinks in the Fixed satellite Service (FSS) except where those services are aboard visiting ships or aircraft.

Reference

1. Rec. ITU-R F.383-5, "Radio-frequency channel arrangements for high capacity radio-relay systems operating in the lower 6 GHz band".

THE 6 GHz BAND (5925 - 6425 MHz)

PROTECTION RATIOS

1. Protection ratios required between digital systems.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Interferer Tx → Digital Victim Rx			
	14.825 MHz ↓ 14.825 MHz	14.825 MHz ↓ 29.65 MHz	29.65 MHz ↓ 14.825 MHz	29.65 MHz ↓ 29.65 MHz
0	60	60	60	60
14.825	30	45	55	57
29.65		23	20	30

2. Protection ratios required between digital and analogue systems.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Analogue Interferer Tx ↓ Digital Victim Rx		Digital Interferer Tx ↓ Analogue Victim Rx	
	29.65 MHz ↓ 14.825 MHz	29.65 MHz ↓ 29.65 MHz	14.825 MHz ↓ 29.65 MHz	29.65 MHz ↓ 29.65 MHz
0	60	60	60	60
14.825	42	55	40	58
29.65		21	0	30

3. Protection ratios between analogue systems.

Frequency Offset (MHz)	PROTECTION RATIO (dB) Analogue Interferer Tx → Analogue Victim Rx 29.65 MHz → 29.65 MHz
0	60
14.825	50
29.65	20

Notes:

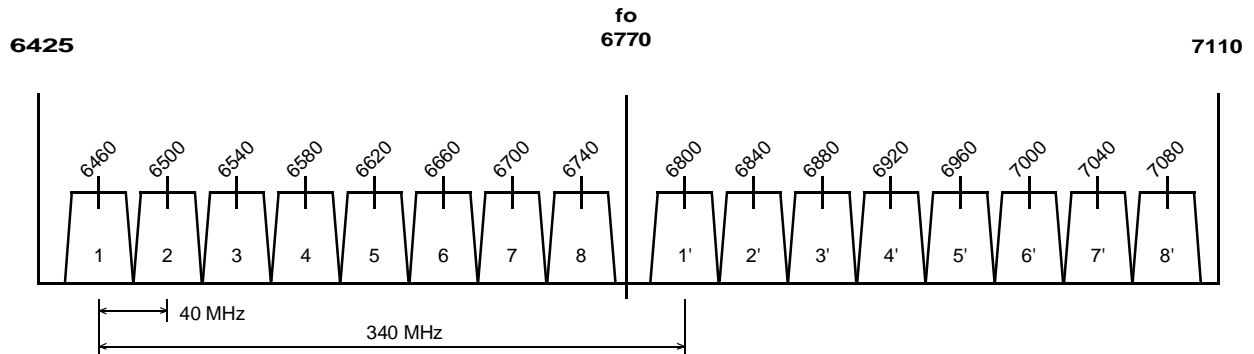
1. Protection ratio for digital systems are based on a 50 km path length and P_L (*Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km*) of 20.

11.4 The 6.7 GHz band

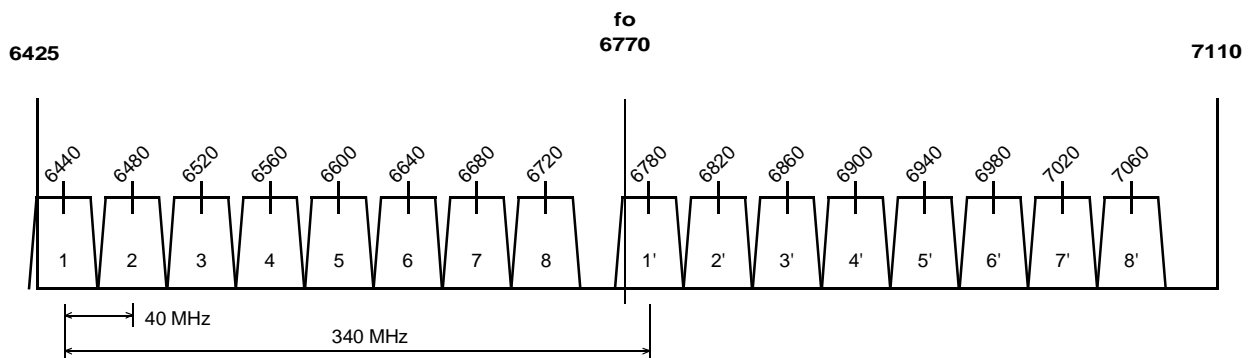
The 6.7 GHz band is designed to offer high capacity channels capable of supporting 140 Mbit throughput.

THE 6.7 GHz BAND (6425 - 7110 MHz)

RF CHANNEL ARRANGEMENTS



MAIN



INTERLEAVED

ASSIGNMENT INSTRUCTIONS

This band is designated for use by digital high capacity fixed point-to-point links.

Typical Use : 140 Mbit/s data

Assignment Priority : not specified

Minimum Path Length : 20 km

Antenna Requirements : refer to Appendix 11

Note:

1. Proposed links need to be coordinated with licensed earth stations operating in this band.
2. All terrestrial fixed services in this band operate on a no protection basis from interference from uplinks in the Fixed satellite Service (FSS) except where those services are aboard visiting ships or aircraft.

Reference

1. Rec. ITU-R F.384-5, "Radio-frequency channel arrangements for medium and high capacity analogue or high capacity digital radio-relay systems operating in the upper 6 GHz band".

THE 6.7 GHz BAND (6425 - 7110 MHz)

PROTECTION RATIOS

Protection Ratios are:

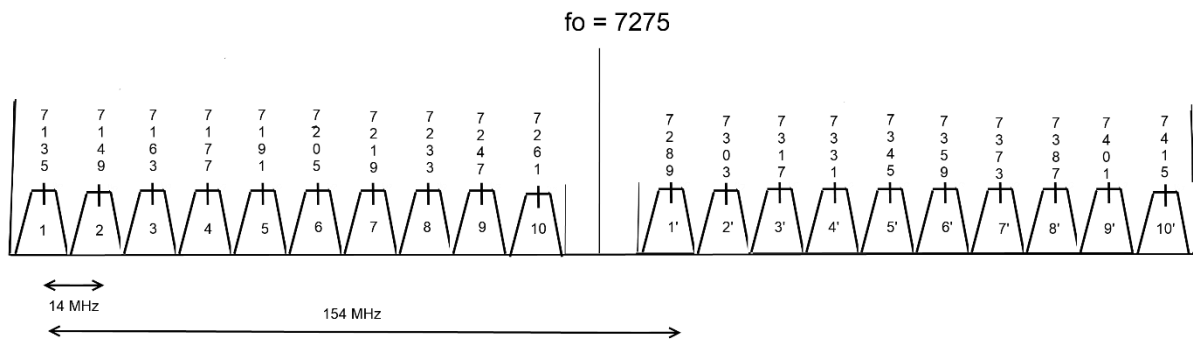
Co-channel:	60 dB
1st adjacent channel:	30 dB
2nd adjacent channel:	0 dB

Note:

1. Protection ratios for digital systems are based on a 50 km path length and P_L (Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km) of 20.

11.5 The 7.2 GHz Band

The 7.2 GHz band is designed to offer flexible arrangements capable of supporting channel bandwidths of 14MHz, 28MHz and 56 MHz through aggregation of 14 MHz channels.



ASSIGNMENT INSTRUCTIONS

Typical Use	: flexible high capacity data links.
Assignment Priority	: Assign from Channel 1.
Minimum Path Length	: 20 km
Antenna Requirements	: 1.2 m parabolic dish minimum.
Protection Requirements	: Protection ratios required between digital systems operating on the same channel raster.
	Co Channel: 60 dB
	1st Adjacent Channel 30 dB
	2nd Adjacent Channel 0 dB

Orthogonal polarization may be used to achieve coordination; allow 20dB.

Channel aggregation

Channels may be aggregated to form up to 56 MHz channels in line with ITU-R F.385-10. Where aggregation is used the term '2nd adjacent channel' refers to a channel separated by the bandwidth of the aggregated channel.

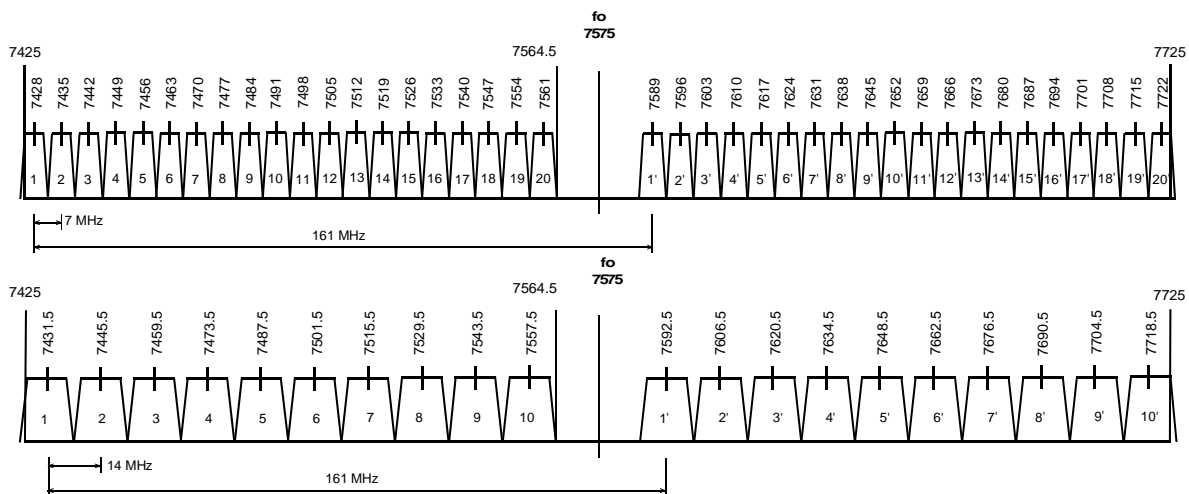
Note: Protection ratio for digital systems are based on a 50 km path length and P_L (Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to $-100 N$ units/km) of 20.

References:

1. Rec. ITU-R F.385-10, " Radio-frequency channel arrangements for fixed wireless systems operating in the 7 110-7 900 MHz band ", 2012.

11.6 The 7.5 GHz band

THE 7.5 GHz BAND (7425 - 7725 MHz) RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by low-medium capacity fixed point-to-point links.

Typical Use : 2-20 Mbit/s data

Assignment Priority : See Note 1.

Recommended Minimum Path Length : 20 km

Minimum Antenna Requirements : 1.2m Parabolic.

Notes:

1. Assignment priorities are defined as follows:

14 MHz channels - from the highest channel downward;

7 MHz channels - from the lowest channel upward.

2. Assignments on the 7 MHz Ch1 must coordinate with services in the 7.2 GHz band using the same protection ratios defined below.

3. Channel aggregation is permitted. Where aggregation is used the term '2nd adjacent channel' refers to a channel separated by the bandwidth of the aggregated channel.

References

1. Rec. ITU-R F.385-6, "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".

PROTECTION RATIOS

1. Protection ratios required between digital systems operating on the same channel raster.

Co Channel:	60 dB
1st Adjacent Channel	30 dB
2nd Adjacent Channel	0 dB

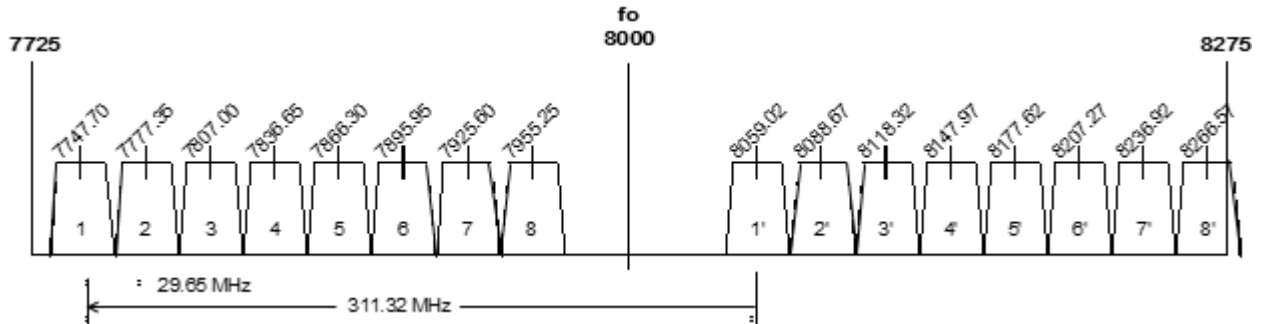
Notes:

1. Protection ratio for digital systems are based on a 50 km path length and P_L (*Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km*) of 20.

11.7 The 8 GHz Band

THE 8 GHz BAND (7725 - 8275 MHz)

RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by medium and high capacity fixed point-to-point links.

Typical Use : 34 Mbit/s data or greater

Assignment Priority : from the lowest channel upwards.

Minimum Path Length : 10 km

Antenna Requirements : 1.2 m parabolic minimum

Reference

1. Rec. ITU-R F.386-9 (2013), "Radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7725 to 8500 MHz) band".

PROTECTION RATIOS

1. Protection ratios required between digital systems.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Interferer Tx → Digital Victim Rx			
	14.825 MHz	14.825 MHz	29.65 MHz	29.65 MHz
	↓	↓	↓	↓
	14.825 MHz	29.65 MHz	14.825 MHz	29.65 MHz
0	60	60	60	60
14.825	30	45	55	57
29.65		23	20	30

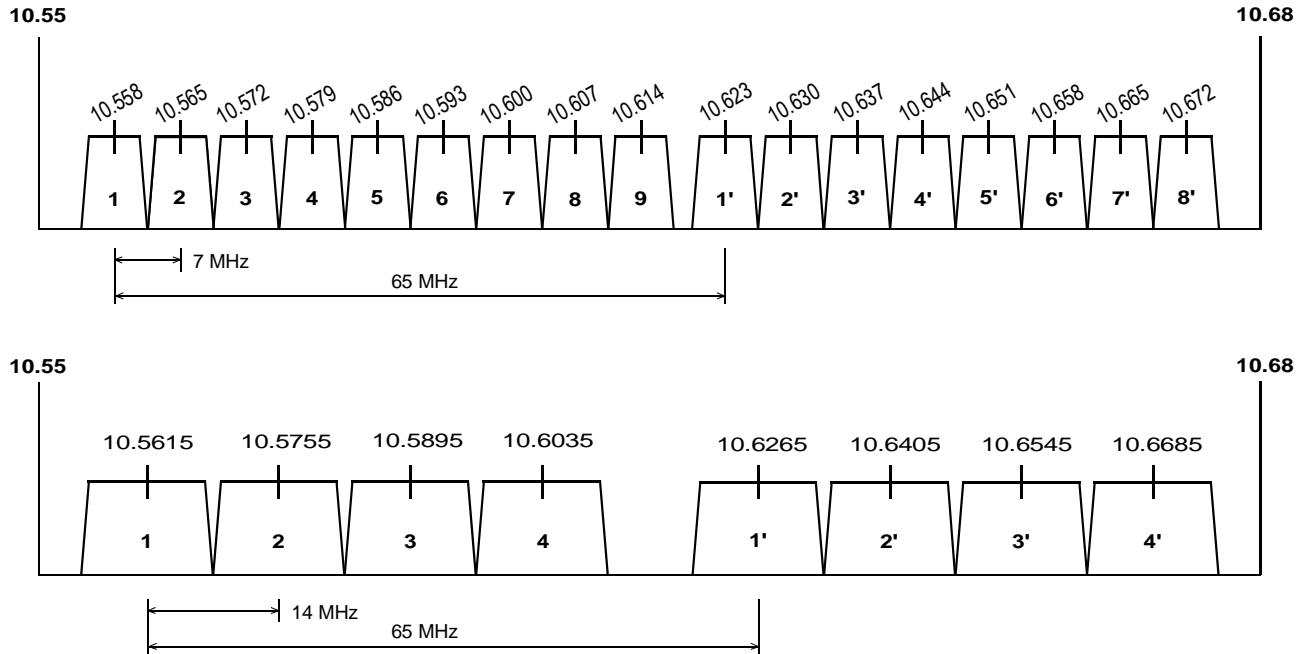
Notes:

1. Protection ratio for digital systems are based on a 50 km path length and P_L (*Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km*) of 20. For other path lengths and P_L values refer to the appropriate protection ratio correction factors graph on the following page.
2. These arrangements are based upon the 29.65 MHz channel bandwidths specified in ITU-R F.386-9. Channels of 14 and 28 MHz are also supported within these arrangements. If these channels overlap any portion of another channel then the protection ratio for a 0 MHz offset must be used. If there is a 14 MHz separation the 14.825 MHz protections may be used and if there is a 28 MHz separation then those for 29.65 may be used.

11.8 The 10 GHz band

THE 10 GHz BAND (10.55 - 10.68 GHz)

RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by low and medium capacity fixed point-to-point links.

Typical Use : 2 Mbit/s data or greater

Assignment Priority : See Note 1.

Minimum Path Length : 1 km

Antenna Requirements : 0.8 m parabolic minimum

Maximum Antenna Elevation : < 20 degrees above the horizon. See Note 2.

Maximum power to the antenna port : -15 dBW. See Note 3.

Notes:

1. Assignment priorities are defined as follows:

7 MHz channels - from the lowest channel upward;

14 MHz channels - from the highest channel downward; and

for one-way links using the 7 MHz channels - channel 9 should be utilised first.

2. When feeding towers from low structures such as buildings designers must ensure a maximum elevation of 20 degrees is not exceeded.

- Where automatic transmitter power control is used to overcome rain fade the power to the antenna port may be increased to -3 dBW.

References

Rec. ITU-R F.747, "Radio-frequency channel arrangements for radio-relay systems operating in the 10 GHz band".

PROTECTION RATIOS

- Protection ratios required between systems operating on 7 and 14 MHz channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Interferer Tx → Digital Victim Rx			
	7 MHz ↓ 7 MHz	7 MHz ↓ 14 MHz	14 MHz ↓ 7 MHz	14 MHz ↓ 14 MHz
0	60	60	60	60
3.5		60	60	
7	35	60	55	60
10.5		55	45	
14	20	30	20	55
17.5		10	10	

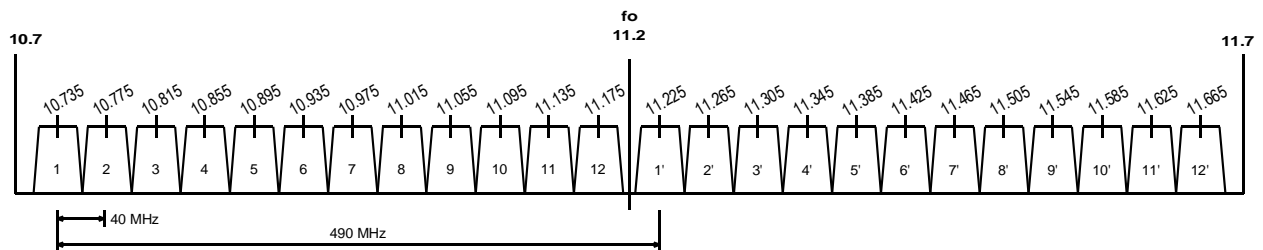
Notes:

- Protection ratio for digital systems are based on a 30 km path length and P_L (Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km) of 20. The protections above take into account a fade into the victim receiver of 5dB. Designers are advised to properly design systems for rain depending on system availability requirements.

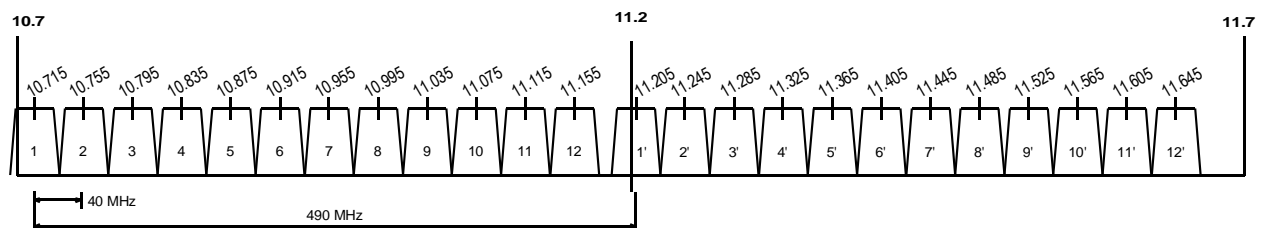
11.9 The band 10.7 – 11.7 GHz; the 11 GHz band.

11 GHz BAND (10.7 - 11.7 GHz)

RF CHANNEL ARRANGEMENTS



MAIN



INTERLEAVED

ASSIGNMENT INSTRUCTIONS

This band is designated for use by digital high capacity fixed point-to-point links.

Typical Use : 140/155 Mbit/s data

Assignment Priority : not specified

Minimum Path Length : 1 km

Antenna Requirements : refer to Appendix 11

Note:

1. Assignments made on interleaf channel 1 must coordinate with systems using the 10 GHz plan due to adjacent band considerations.
2. Proposed fixed links need to be coordinated with earth stations operating in this band.
3. All terrestrial fixed services in this band operate on a no protection basis from interference from uplinks in the Fixed satellite Service (FSS) except where those services are aboard visiting ships or aircraft.

Reference

1. Rec. ITU-R F.387-6, *“Radio-frequency channel arrangements for radio relay systems operating in the 11 GHz band”*.

11 GHz BAND (10.7 - 11.7 GHz)

PROTECTION RATIOS

Protection ratios for systems operating in the 11 GHz band are:

Co-channel or overlapping channels:	60 dB
1st adjacent channel:	30 dB
2nd adjacent channel:	0 dB

Notes:

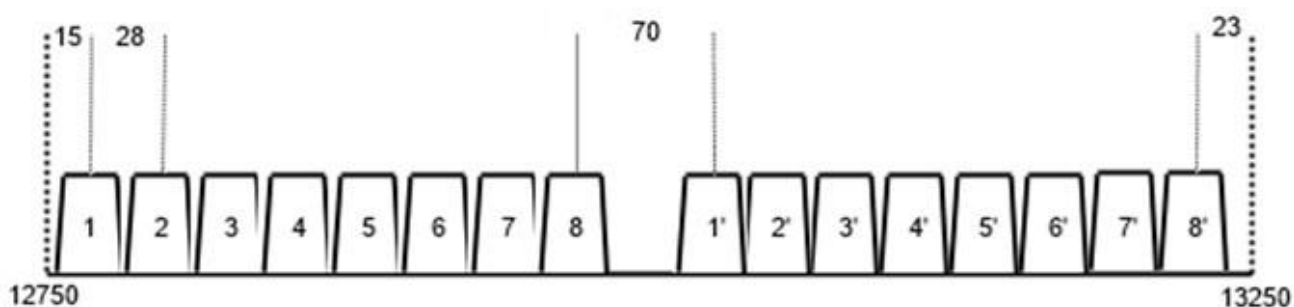
1. The “co-channel” protection ratio shall apply in cases where any portion of the interfering and victim channels overlap.
2. The “1st adjacent channel” protection ratio shall apply in cases where the interfering and victim channels do not actually overlap but are immediately adjacent to each other.
3. Protection ratios for digital systems are based on a 30 km path length and P_L (*Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km*) of 20.

11.10 The 13 GHz Band

The 13 GHz band provides channels capable of supporting data rates of up to 34 Mbits over short paths.

THE 13 GHz BAND (12.75 - 13.25 GHz)

RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by medium capacity fixed point-to-point links.

Typical Use : FIXED - 34 Mbit/s data

Assignment Priority : not specified

Minimum Path Length : not specified

Antenna Requirements : 0.6 m standard parabolic dish

Notes:

1. Each channel may be subdivided into 14 MHz or 7 MHz channels within a 28 MHz channel maintaining the duplex spacing of 266 MHz.
2. Proposed fixed links need to be coordinated with earth stations operating in this band.
3. All terrestrial fixed services in this band operate on a no protection basis from interference from uplinks in the Fixed satellite Service (FSS) except where those services are aboard visiting ships or aircraft.

References

1. Rec. ITU-R F.497-7, "Radio-frequency channel arrangements for fixed wireless systems operating in the 13 GHz frequency band".

THE 13 GHz BAND (12.75 - 13.25 GHz)

PROTECTION RATIOS

1. *Protection ratios required between digital systems.*

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Interferer Tx → Digital Victim Rx			
	14 MHz	14 MHz	28 MHz	28 MHz
	↓	↓	↓	↓
	14 MHz	28 MHz	14 MHz	28 MHz
0	50	50	50	50
14	20	35	45	47

2. *Protection ratios required between digital and analogue systems.*

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Analogue Interferer Tx		Digital Interferer Tx	
	↓		↓	
	Digital Victim Rx		Analogue Victim Rx	
	28 MHz	28 MHz	14 MHz	28 MHz
	↓	↓	↓	↓
	14 MHz	28 MHz	28 MHz	28 MHz
0	50	50	60	60
14	35	45	40	55

3. *Protection ratios between analogue systems*

Frequency Offset (MHz)	PROTECTION RATIO (dB) Analogue Interferer Tx → Analogue Victim Rx 28 MHz → 28 MHz
0	60
14	50

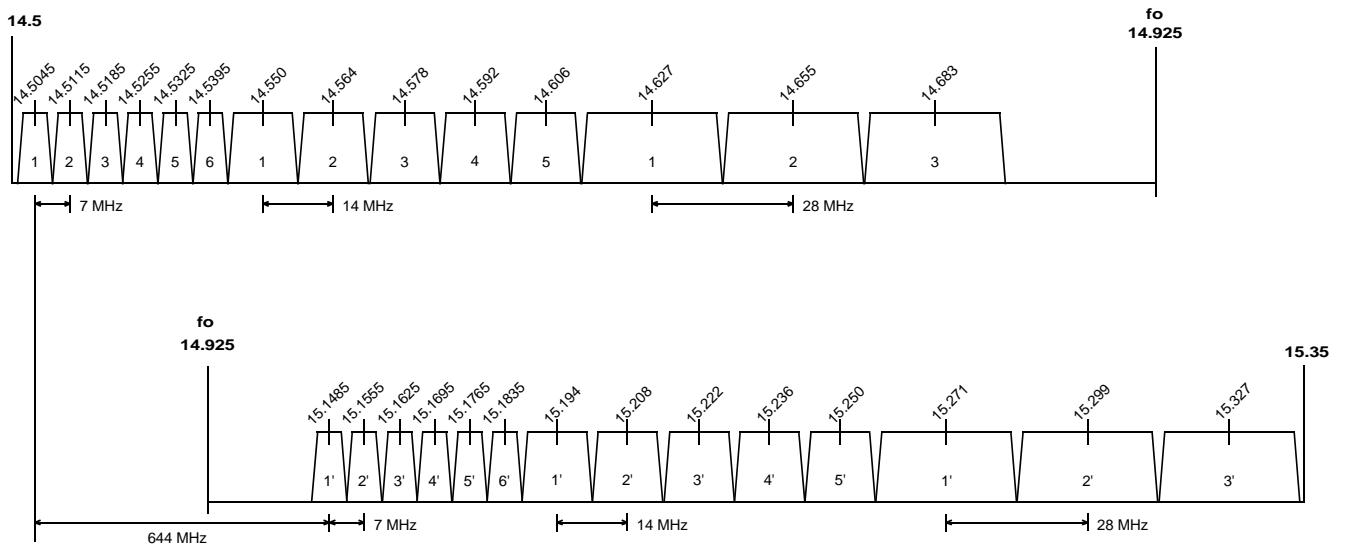
Notes:

1. Protection ratios for digital systems are based on a 20 km path length and R (*Rainfall rate in mm/hr for 0.01% of the worst month*) of 80 mm/hr.

11.10 The 15 GHz Band

The 15 GHz band (14.5 – 15.35 GHz) is designed to provide channels for low and medium capacity fixed links over short path lengths.

THE 15 GHz BAND (14.5 - 15.35 GHz) RF CHANNEL ARRANGEMENTS



ASSIGNMENT INSTRUCTIONS

This band is designated for use by low and medium capacity fixed point-to-point links.

Typical Use : low capacity - 2/8 Mbit/s
: medium capacity - 34 Mbit/s

Assignment Priority : See Note 1.

Minimum Path Length : Not specified.

Antenna Requirements : Not specified.

Note:

- Assignment priorities are defined as follows:
 - 28 MHz channels - from highest channel downward;
 - 14 MHz channels - from lowest channel upward; and
 - 7 MHz channels - from lowest channel upward.

References

- Rec. ITU-R F.636-4, "Radio-frequency channel arrangements for fixed wireless systems operating in the 15 GHz band".

THE 15 GHz BAND (14.5 - 15.35 GHz)

PROTECTION RATIOS

1. *Protection ratios between digital systems operating on the same channel arrangements.*

Co Channel	60 dB
1st Adjacent Channel	30 dB
2nd Adjacent Channel	0 dB

2. *Protection ratios between digital systems requiring 7 and 14 MHz channels.*

Frequency Offset (MHz)	PROTECTION RATIO (dB)	
	Digital Interferer Tx → Digital Victim Rx	
	7 MHz → 14 MHz	14 MHz → 7 MHz
7	60	59
10.5	58	49
14	44	37
17.5	32	26
21	23	13
24.5	15	

3. Protection ratios between digital and analogue systems requiring 14 and 28 MHz channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Tx ↓ Digital Rx		Analogue Tx ↓ Digital Rx	Digital Tx ↓ Analogue Rx
	14 MHz ↓ 28 MHz	28 MHz ↓ 14 MHz	28 MHz ↓ 14 MHz	14 MHz ↓ 28 MHz
0	60	60	60	60
7	60	58	60	60
21	35	33	30	30

4. Protection ratios between digital and analogue systems requiring 28 MHz channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)		
	Analogue Tx ↓ Analogue Rx	Analogue Tx ↓ Digital Rx	Digital Tx ↓ Analogue Rx
0	60	60	60
28	20	21	30

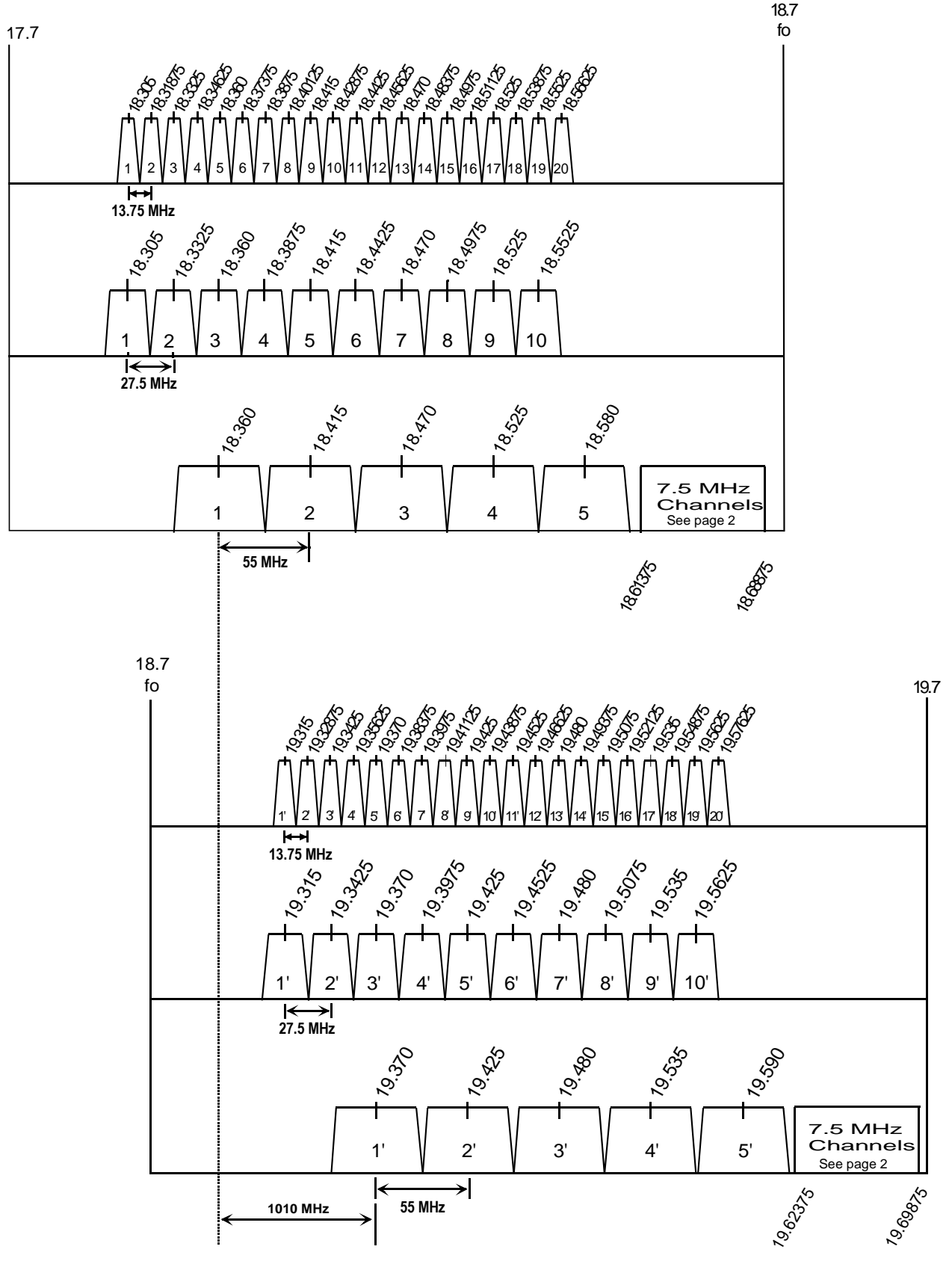
Notes:

1. Protection ratio for digital systems are based on a 20 km path length and R (*Rainfall rate in mm/hr for 0.01% of the worst month*) of 80 mm/hr.

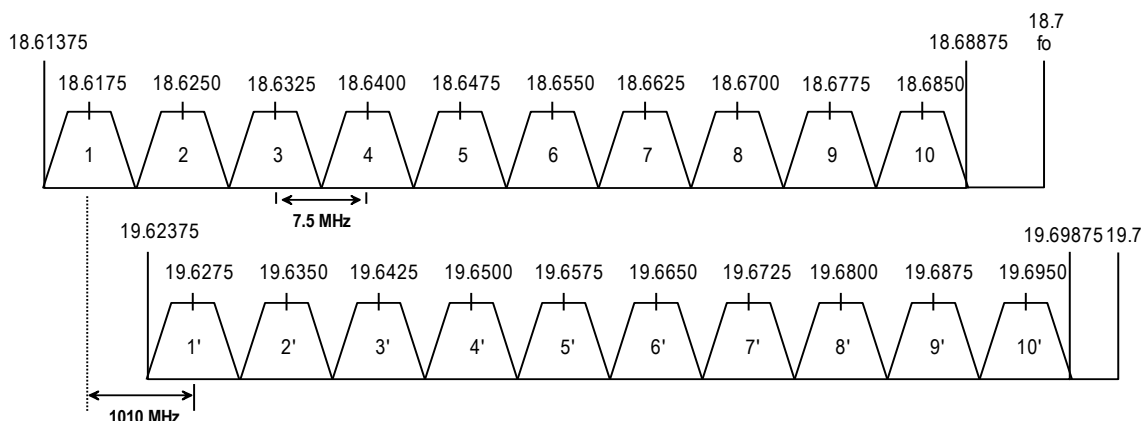
11.11 The 18 GHz Band

The 18 GHz band (17.7 – 19.7 GHz) provides highly flexible arrangements for data systems operating over short paths.

THE 18 GHz BAND (17.7 - 19.7 GHz) RF CHANNEL ARRANGEMENTS



RF CHANNEL ARRANGEMENTS
Sub-Bands 18.61375 - 18.68875 GHz and 19.62375 - 19.69875 GHz
(7.5 MHz Channeling)



ASSIGNMENT INSTRUCTIONS

This band is designated for use by small, medium and high capacity fixed links.

- Typical Use** : 8/16/34/155 Mbit/s data
- Assignment Priority** : 55 MHz channels - from highest channel downward;
:27.5 MHz channels - from lowest channel upward;
:13.75 MHz channels - from channel 10/10' downward then from channel 11/11' upward;
:7.5 MHz channels - from highest channel downward.
- Minimum Path Length** : Not specified.
- Antenna Requirements** : Not specified.

Notes:

1. Assignments made which would overlap the frequency range 18.8 -19.3 GHz may be required to cease operation in the future.
2. The output power of transmitters (measured at the antenna connection) operating in the band 18.6-18.8 GHz is not to exceed +27 dBm (0.5 Watts). It should be noted that multiple transmitters operating on different RF carrier frequencies individually respecting the above output power limit can be connected to a single antenna. See Reference 4.

References

1. Rec. ITU-R F.595-10, "Radio-frequency channel arrangements for radio-relay systems operating in the 18 GHz frequency band".
2. Article 21.5A, ITU Radio Regulations, Edition of 2001.

3. Resolution 802 (WRC-03) Agenda of the 2007 World Radiocommunication Conference, Agenda item 1.2.
4. Resolution 746 (WRC-03) Issues dealing with allocations to science services.

THE 18 GHz BAND (17.7 - 19.7 GHz)

PROTECTION RATIOS

Protection ratios required between systems operating in the 18 GHz band:

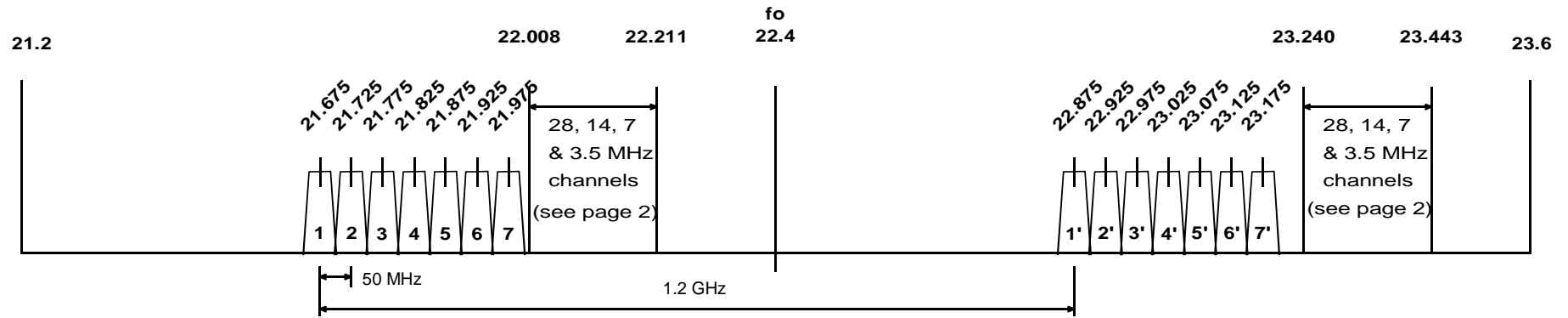
Co-channel or overlapping channels	60dB
1st Adjacent Channel	30dB
2nd Adjacent Channel	0 dB

Notes:

1. The "Co-channel" protection ratio shall apply in cases where any portion of the interfering and victim channels overlap.
 2. The "1st Adjacent Channel" protection ratio shall apply in cases where the interfering and victim channels do not actually overlap but are immediately adjacent to each other.
 3. Protection ratios for digital systems are based on a 10 km path length and R (*Rainfall rate in mm/hr for 0.01% of the worst month*) of 80 mm/hr.
-

11.12 The 22 GHz band

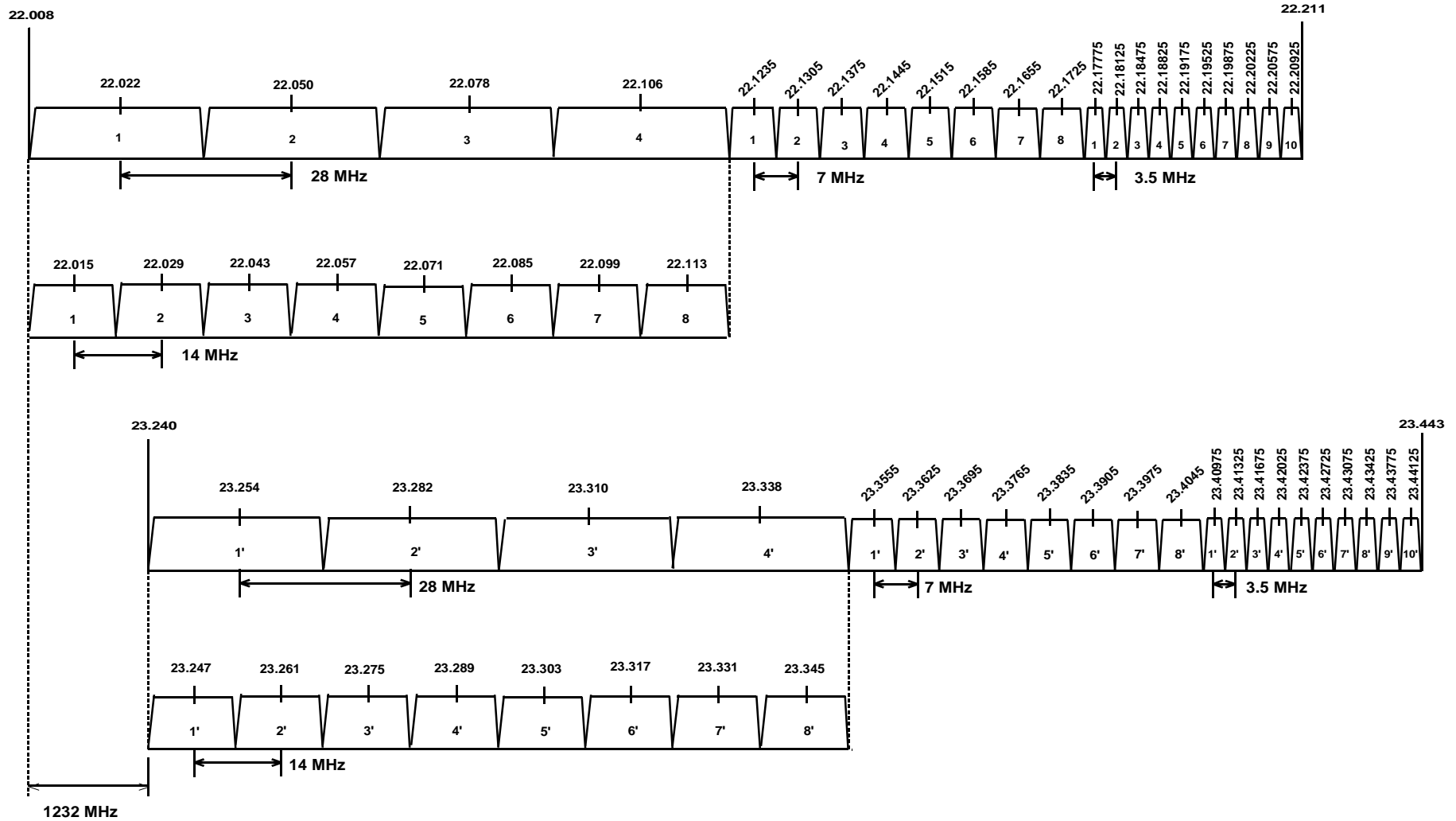
THE 22 GHz BAND (21.2 - 23.6 GHz) RF CHANNEL ARRANGEMENTS



CHANNEL CENTRE FREQUENCIES (GHz)											
Channels		50 MHz Channels		28 MHz Channels		14 MHz Channels		7 MHz Channels		3.5 MHz Channels	
1	1'	21.675	22.875	22.022	23.254	22.015	23.247	22.1235	23.3555	22.17775	23.40975
2	2'	21.725	22.925	22.050	23.282	22.029	23.261	22.1305	23.3625	22.18125	23.41325
3	3'	21.775	22.975	22.078	23.310	22.043	23.275	22.1375	23.3695	22.18475	23.41675
4	4'	21.825	23.025	22.106	23.338	22.057	23.289	22.1445	23.3765	22.18825	23.42025
5	5'	21.875	23.075			22.071	23.303	22.1515	23.3835	22.19175	23.42375
6	6'	21.925	23.125			22.085	23.317	22.1585	23.3905	22.19525	23.42725
7	7'	21.975	23.175			22.099	23.331	22.1655	23.3975	22.19875	23.43075
8	8'					22.113	23.345	22.1725	23.4045	22.20225	23.43425
9	9'									22.20575	23.43775
10	10'									22.20925	23.44125

THE 22 GHz BAND (21.2 - 23.6 GHz)

SUB-BANDS 22.008-22.211 and 23.240-23.443 GHz



THE 22 GHz BAND (21.2 - 23.6 GHz)

ASSIGNMENT INSTRUCTIONS

This band is designated for use by fixed point-to-point links and offers a wide variety of channel bandwidths to support a number of requirements.

Typical Use : 2/8 Mbit/s data or greater.

Assignment Priority : none

Minimum Path Length : none

Antenna Requirements : Parabolic. No requirements on diameter. See Note 2.

Notes:

1. Assignment priorities for point-to-point services are defined as follows:

50 MHz channels (4/4'..7/7') - from the lowest channel upward;

28 MHz channels - from the lowest channel upward;

14 MHz channels - from the highest channel downward;

7 MHz channels - from the lowest channel upward;

3.5 MHz channels - from the highest channel downward.

2. This band is highly susceptible to rain fade. While no antenna size is specified to enable the use of compact equipment designers are advised to ensure there is sufficient margin to ensure availability targets are met.

References

1. Rec. ITU-R F.637-4, "Radio-frequency channel arrangements for radio-relay systems operating in the 23 GHz band".

PROTECTION RATIOS

1. Protection ratios required between digital systems operating on the same channel arrangements.

Co channel	60 dB
1st Adjacent Channel	30 dB
2nd Adjacent Channel	0 dB

2. Protection ratios required between digital systems operating on 3.5 and 7 MHz channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)	
	Digital Interferer Tx → Digital Victim Rx	
	3.5 MHz → 7 MHz	7 MHz → 3.5 MHz
5.25	55	48
8.75	18	20
12.25	0	

3. Protection ratios required between digital systems operating on 7 MHz channels and digital systems operating on 14 and 28 MHz channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)			
	Digital Interferer Tx → Digital Victim Rx			
	7 MHz → 14 MHz	14 MHz → 7 MHz	7 MHz → 28 MHz	28 MHz → 7 MHz
10.5	58	49		
17.5	32	26	45	35
24.5	15		10	20

4. Protection ratios required between digital systems operating on 14 and 28 MHz channels.

Frequency Offset (MHz)	PROTECTION RATIO (dB)	
	Digital Interferer Tx → Digital Victim Rx	
	28 MHz → 14 MHz	14 MHz → 28 MHz
7	58	60
21	33	35

Notes:

1. Protection ratio for digital systems are based on a 5 km path length and R (*Rainfall rate in mm/hr for 0.01% of the worst month*) of 80 mm/hr.

1.2 REGULATORY IMPACT ASSESSMENT OF THE PROPOSED PLANNING ARRANGEMENTS FOR FIXED SERVICE PLANNING IN VANUATU.

1. As identified in TRR's 2014 and Onwards Work Program, this consultation addresses the methodology for identifying how the fixed service bands may be planned to ensure efficiencies of use and protection for services. It sets out TRR's preferred approach to planning for fixed services in Vanuatu. Under the Work Program, consultation on fixed service planning is due to be completed by the third quarter 2015.
2. The arrangements are in line with the provisions of the Telecommunications and Radiocommunications Regulation Act No.30 of 2009. Section 7 (2) (e) of that Act gives the TRR the power to allocate, assign and manage the radio spectrum.
3. Implementation of the planning arrangements will support the Telecommunications and Radiocommunications Regulation Act No. 30 of 2009 and the Government's National ICT Policy and its Universal Access Policy. In particular, it will promote the spread of efficient and affordable communications services throughout Vanuatu.
4. TRR is undertaking this public consultation, including with existing and possible future users of fixed services, in order to ensure that the planning arrangements do not impose unnecessary burdens on spectrum users and industry. TRR will take into account the views of responders to this consultation paper in making decisions about the most appropriate regulatory arrangements for the band, and when considering how the band might be allocated to spectrum users. In particular, the paper seeks the views of responders about how best to plan fixed services in order to meet the needs of users and of the community generally.
5. The planning for the fixed service bands when finally adopted will safeguard and promote the interests of Vanuatu residents and business by:
 - Helping to promote the provision of efficient and affordable communications and essential services.
 - Helping to lower the costs of providing mobile services through better planning of feeder links, and thus to reduce the costs of mobile services to users.
 - Providing certainty of operation of fixed services in Vanuatu through proper planning and allocation.
 - Implementing arrangements consistent with those of a large number of countries, and thus helping to ensure that there is access to equipment at a reasonable price.
 - Allowing scope for possible future satellite services.
 - Permitting better reuse of spectrum throughout Vanuatu.
6. The proposed planning arrangements will have a positive effect on Vanuatu by ensuring all fixed services operate in accordance with a defined plan using up to date coordination and protection criteria.
7. There are likely to be very few negative impacts of the proposed planning arrangements. Planning of the fixed services will ensure they can be protected from interference and also ensures maximum spectral efficiency ensuring services are not denied assignments in the future.
8. One specific type of user that might be adversely affected are existing users who have not registered fixed links or who have used channels that are different to those proposed in the

plans. The impact on these users can be minimized by “grandfathering”¹ the systems, providing they are registered they can continue to operate and can be coordinated with new systems. Upon replacement TRR would expect these systems to be reassigned to a channel within a specific plan.

9. Because very few existing users will be impacted by the proposed measures, TRR believes that the time allowed for consultation on this process should be sufficient to enable smooth implementation. TRR remains of the view that implementation of the new arrangements by the fourth quarter of 2014 are achievable and appropriate.

¹ Allowing them to continue as an exception to the proposed new rules.