Digital Dividend in Samoa

Consultation Paper

Prepared by the Office of the Regulator specifically for use in the Consultation on the Digital Dividend Approach for Samoa

August 2013

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1. Executive Summary

The Office of the Regulator OOTR is the government agency responsible for managing the electro-magnetic spectrum for Samoa. It is responsible for allocating and then assigning spectrum in Samoa.

The Digital Dividend (DD) is term used to refer to the spectrum freed up as a result of the changeover from analog to digital transmission in Broadcasting. Digital Broadcasting is more efficient than analog transmissions and so more television channels can be transmitted with less spectrum, when transmitted digitally. The digital dividend has been an important issue and has been widely discussed by ICT providers; broadcasters as well as operators of telecommunication services. In the Asia Pacific Region, a number of countries have already started the process of migrating from Analog Broadcasting to Digital Broadcasting. Australia has projected the end of 2013 to complete the process. Samoa is one of the countries that have yet to start a process for the switch to Digital Broadcasting.

The Geneva 2006 Agreement (Ge06) establishes that after 2015, there will be no more protection for analog television transmission.

The Office of the Regulator (OOTR) has started the process by working together with the stakeholders, views and comments are now being solicited from all stakeholders on a roadmap for implementation and how best the switch can be achieved. This consultation process continues the planning process for developing the implementation roadmap for migration to Digital Broadcasting. The Regulator expects that this initiative will allow Samoa to be in line with the rest of the world in the field of broadcasting.

The Regulator is of the view that the switch to Digital Broadcasting will have a significant beneficial impact on the broadcasting sector in Samoa. It is therefore important that the consultative process be transparent and involves all stakeholders. Equally important is that all opportunities and challenges are identified and considered by the appropriate stakeholders in a timely manner so as to ensure that the transition from analog to digital will be as smooth as possible. The resulting digital dividend from this change has the capacity not only to support new types of broadcasting services and innovative products but also, in releasing up significant

amounts of spectrum to enable more new and innovative communications products and services for the benefit of the ICT industry and end users.

The ITU has prepared several documents to help countries with the transition with the commitment to continue providing the administrative and technical help needed to implement this change. The Regulator and the OOTR welcomes comments, views and contributions in response to this consultation paper from all stakeholders: the public, spectrum users, broadcasters and the Government.

2. Purpose of the Paper

The Office of the Regulator in collaboration with the Government of Samoa's main objective in relation to the Digital Dividend is to make sure that spectrum as a scarce resource will be available for all ICT Services; telecommunications and broadcasting services. This will ensure maximum benefits to ensure and support innovative ideas that will improve ICT services and in the process support economic growth in Samoa.

This discussion document seeks to address all relevant issues for the digital dividend while focusing on the radiofrequency spectrum in the UHF bands that could potentially be freed up by the termination of analog television transmissions and switch into digital transmissions. The main objective of spectrum management is to ensure the efficient allocation of spectrum, allowing for increased provision of ICT services. The spectrum freed up as a part of this process will be reallocated to allow for more efficient service and most importantly more services can be provided.

In finalization of the process of migration to new modes of transmission and providing the digital dividend, the Office of the Regulator in collaboration with the Ministry of Communication and Information Technology (MCIT) will conduct consultation with all stakeholders: public; providers; and users of spectrum to make sure that a collective agreement is reached. This paper solicits comments, views and submissions on the potential uses of this digital dividend spectrum, the potential benefits of these services to the Samoan community and economy, and the costs involved in creating the digital dividend through the change of Digital Television Broadcasting.

Comments will assist the Regulator in finalizing the process for implementation and the most efficient and productive use of the digital dividend. On completion of the process the identified bands will have amended allocations and be available for assignment.

3. Submission of Comments

All stakeholders are invited as part of this process to participate in the consultation process and provide written or verbal submissions on any relevant issue. Stakeholders are asked to please make known to the office if any part of their submissions are confidential so that OOTR can treat them as such.

OOTR invites submissions from members of the public, providers, sector and the spectrum users and can be sent to the OOTR office to:

Mr Donnie De Freitas

Regulator

Office of the Regulator

Mulinuu Peninsula

Apia.

OR Fax : 30281

OR Email : admin@regulator.gov.ws or ddefreitas@regulator.gov.ws

Submissions are due by 4pm, Thursday 24th October 2013.

4. Acronyms

3G	Third Generation of Mobile Telephony
4G	Fourth Generation of Mobile Telephony
AB	Analog Broadcasting
APT	Asia Pacific Telecommunity
ASO	Analog Switch Off
CDMA	Coded Duplex Multiple Access
DB	Digital Broadcasting
DD	Digital Dividend
DDS	Digital Dividend Spectrum
DSO	Digital Switch Over
DTB	Digital Television Broadcasting
DTTB	Digital Terrestrial Television Broadcasting
FDD	Frequency Division Duplex
GE-06	Geneva Agreement of 2006
GSM	Global Systems for Mobile Communications
MCIT	Information Communication Technology
IMTAdvanced	International Mobile Telecommunications Advanced
IMT2000	International Mobile Telecommunications 2000
ITU	International Telecommunication Union
ITU-R	ITU Radio communication Bureau
LTE	Long Term Evolution
PPDR	Public Protection and Disaster Relief
STL	Studio to Transmitter Link
TDD	Time Division Duplex
TV	Television
UHF	Ultra High Frequency
VHF	Very High Frequency

5. Definitions

TA	Telecommunications Act 2005
BA	Broadcasting Act 2010
Analogue system	A system that represents changing values as continuously variable physical quantities.
Digital Broadcasting	Is the sending and receiving of moving images and sound by digital (discrete) signals in contrast to analogue signal.
Digital system	Uses discrete (discontinuous) values, usually but not always symbolized numerically (hence called "digital") to represent information for input, processing, transmission, storage, etc.
Digital Switch Over	It is the change over from analogue broadcasting to digital terrestrial broadcasting.
Multiplexing	When sending multiple signals or streams of information on a carrier at the same time in the form of a single, complex signal through a single channel and then recovering the separate signals at the receiving end.
Radio Frequency (RF)	A frequency of electromagnetic radiation in the range at which radio signals are transmitted, ranging from approximately 3 kilohertz to 300 gigahertz.
Radio Frequency Spectrum	The entire range of electromagnetic communications frequencies, including those used for radio, radar, and television; the radio-frequency spectrum.
Simulcast period	Is the period during which there will parallel provision/transmission of television programme in both analogue and digital mode.
Terrestrial Broadcasting	A broadcast signal transmitted "over-the-air" to an antenna.
Transition period	The period during which switch over from analogue to

digital broadcasting will take place.

6. Introduction

6.1 Scope

This document provides a backdrop to the major changes in spectrum arrangement and usage involved in the switch from Analogue to Digital televisions. It addresses the issue to be taken into account before implementing the change and categorizes the roadmap to the process for implementation. The document contains activities being undertaken by the OOTR, proposed action and the time lines both for decisions to be made and action to be taken. The paper also documents a number of current working statements used in preparation of this paper. These may be modified following further information provided by stakeholders, and decisions made after consideration of all input.

The proposed dates for completion of switch over would be for 2015 -2017.

6.2 Overall Objectives

The overall objectives of the switch from Analog to Digital are listed below:

- Conversion of current commercial and non commercial television services to use digital technology;
- To determine the amount of spectrum resulting from the digital dividend;
- To facilitate the planning and allocation of the spectrum resulting from the Digital Dividend;
- To decide the appropriate date for the switch from analog to digital broadcasting. OOTR propose 2015 to 2017;
- To facilitate the migration of the existing services in the identified bands to other suitable bands.
- To determine the appropriate policies relating to digital dividend.

7. Background Information

7.1 What is Digital Dividend?

The International Telecommunications Union (ITU) use the term Digital Dividend to describe the spectrum made available by the transition of terrestrial television broadcasting from analog to

digital transmission. In order to accomplish this switch, analog television transmission should be completely turned off to allow for the switchover to digital television transmission. Spectrum would then, as a result of the switch, would be freed up for new ICT services while spectrum would be re-organized to accommodate newer and more efficient digital television services. The propagation characteristics of the frequency bands being freed up would allow for the deployment of a wide range of communication services.

Digital TV has proven to be significantly more spectrally efficient when compared to analog TV. There are two main reasons why Digital TV results more spectrally efficient than analog and allows for the freeing up of additional spectrum.

1. Digital broadcast technology enables more channels to be packed into same RF channel bandwidth used by analog broadcast technology and
2. It enables greater frequency re-use

Digital dividend spectrum is ideally suited to providing cost-effective mobile and broadband wireless services representing a significant and important asset for a country's economic and social development. Digital television systems allow the transmission of several (up to six, depending on the coding and modulation techniques) standard digital television channels of acceptable quality in the radio-frequency spectrum previously used by a single analogue channel. Typically, there are four or five terrestrial analogue services in a given region, so their digitization into a single digital television channel will considerably reduce the overall use of spectrum. In Samoa itself, the proposal will be that a total of 184MHz will be allocated for Digital Television, and will free up 108MHz of spectrum that will be available for use for mobile communications for 4G technologies, this band is known as the 700MHz Band.The 700MHz band is the set of frequencies between 698 and 806MHz and is categorized as Ultra High Frequency (UHF). Currently Samoa is using this band for television channels 39 through 69 (614MHz - 862MHz). OOTR have already released the 700MHz Band Plan to stakeholders for comments and a 700 MHZ Band Plan was proposed on completion of the Consultation process. ITU through the ITU-R made Recommendations for standards which deals with coding, compression and modulation techniques for Digital Terrestrial television broadcasting.

7.2 Determining the Digital Dividend Spectrum and Use.

Globally the amount of spectrum to be used for the Digital Dividend really depends on the technology intended to use to replace analog services. Therefore the size of the Digital Dividend varies from region to region and country to country.

A first step, by the OOTR as part of this consultation, was to identify the amount and the location of the spectrum likely to be made available as part of the Digital Dividend. The OOTR has since released its band plan for 700MHz which also include a blueprint of the spectrum for Digital Television, and the rest for the IMT2000 (3G) and IMT- Advanced(4G) purposes. The amount of spectrum for Digital Broadcasting is less compared to that needed for analog services. Restacking the spectrum will also make available spectrum to other services like mobile broadband services using LTE technologies. Broadcasters will be able to expand their services using more innovative services. Existing mobile providers Digicel and Bluesky are using digital 3G technologies such as HSPA+ to deliver their services. The 700MHz signal propagation is superior to that of higher frequencies. Utilization of the 700 MHz band would require less base stations, (compared to the use of higher frequencies), and infrastructure for the rollout of 4G services.

7.3 Benefits of Digital Dividend

Utilization of the Digital Dividend spectrum can bring about many benefits.

7.3.1 Spectrum Benefits

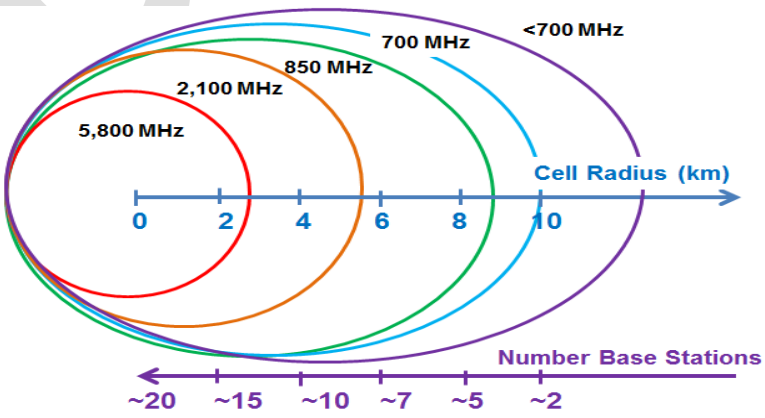
The digital dividend provides the opportunity for the reallocation of a large part of the radio spectrum in more efficient and effective ways. Spectrum will now be available to be used in services like mobile broadband and will no doubt act as an important driver for economic growth. An efficient allocation of this digital dividend is expected to boost the innovation in ICT and help provide new and more affordable services. Harmonization of spectrum in the Region and the rest of the world is also an important issue to consider because Samoa does not want to be left out from the rest of the world in terms of ICT and the Digital World. In addition Samoa as an importer of technology should comply to the International Standards and align its spectrum usage and allocations with as wide a range of technology standards and suppliers as possible and follow the overseas trends in major markets such as New Zealand, Australia, US, Europe, Japan, China they being our main trading partners.

7.3.2 Industry Benefits

Digital Dividend is the key ingredient required for the continued progress of the wireless industry. Consumers are beginning to realize that fast mobile broadband connections anytime and anywhere on any device at a reasonable cost can be experienced. Penetration is ideal for rural area coverage and can help bridge the digital divide, bringing broadband services to the underserved and the un-served remote areas. These wireless services cannot be offered without spectrum. Operators are in the process of upgrading their systems in anticipation of the coming Digital Dividend. Mobile services delivered utilizing the 700MHz Digital Dividend is expected to yield great economic and social benefits. Digital dividend spectrum is ideally suited to providing cost-effective mobile and broadband wireless services representing a significant and important asset for a country's economic and social development. Freeing up globally harmonized spectrum for mobility offers the potential for economies of scale for the production of mobile devices, as well as for easing international roaming.

Digital Dividend is unique with its propagation characteristics for mobile broadband use. Frequencies in the 700MHz band in particular possess propagation characteristics of significant coverage range while still being able to penetrate walls of buildings. Deployment of wireless networks using Digital Dividend spectrum is more economical than spectrum in higher frequency bands. It is approximately 70 percent cheaper to provide mobile broadband coverage over a given geographic area using UHF spectrum than with the high frequency spectrum widely used for mobile broadband today. This benefit of the cheaper cost; means lower equipment capital expense with fewer cell sites to provide blanket geographical coverage as shown in figure 1 below.

Figure 1: Cell site coverage radius at different frequency bands



It is believed that a more unique industry will be established producing lower prices per channel for broadcasters and new receiver devices will be produced. In the case of receiver devices, set top boxes, PC Cards and USB-based recivers have emerged while the new television recievers are more sophisticated with a range of new services integrated in them.

7.3.3 Consumer Benefits

Consumers should also benefit when competition and lowering costs force providers to lower prices. Digital processing and compression will make more efficient use of the network's capacity.

The key benefits of digital broadcasting compared to that of analog broadcasting for the users of the broadcasting services are listed below.

- A wider choice in TV channels for the customers, because providers will be able to broadcast more channels.
- An improved picture and sound quality
- Greater flexibility due to portable and mobile reception
- Enhanced information services. For example electronic programming guide or "teletext" services.
- Increased market competition and innovation.

8. Current Status of Spectrum Utilization for Broadcasting in Samoa

Five designated broadcasting services bands are currently used to provide analog radio and television services and is listed as follows:

- VHF Television Band I : 44-68MHz (Channels 1,2,3)
- VHF Radio Broadcasting Band II: 88–108 MHz (Channels 1 to 200)
- VHF Channel 5A : 137 – 144 MHz
- VHF television Band III: 174 – 251 MHz
- Ultra High Frequency (UHF) television Band IV: 470–614 MHz (channels 21 to 38)
- UHF television Band V: 614–862 MHz (channels 39 to 69).

A total of 64 Channels (15VHF and 49 UHF) are currently used to provide analog television services in Samoa. That is a total of 497 MHz of spectrum used by Analog Broadcasting Services.Channels 1 and 2 of Band I are not in use. Band II is for Radio Broadcasting. The

current licensed television stations are listed below. These stations are transmitting on VHF and UHF bands.

Samoan Broadcasters, (TV3 and TV1included) have channels that are currently operating within the Digital Dividend Spectrum. These frequencies will be re-allocated and providers given time to migrate out of the Band. The issue of who will bear the cost of the migration and reallocation is one that will have to be clarified.

The following table (Table1) shows all the channels that are currently occupied by the broadcasting sector.

Table 1 – Broadcasting Allocation

Television Broadcaster	Band		Frequency	
	VHF	UHF	Vision	Sound
Samoa Quality Broadcasting (TV1)	Ch 4		175.25	180.75
	Ch 5		182.25	187.75
	Ch 6		189.25	194.75
	Ch 7		196.25	201.75
	Ch 8		203.25	208.75
	Ch 9		210.25	215.75
		Ch 28	527.25	532.75
		Ch 40	623.25	628.75
		Ch 43	647.25	652.75
		Ch 48	687.25	692.75
Apia Broadcasting Ltd (TV3)	Ch 3		62.25	67.75
	Ch 5A		138.25	143.75
	Ch 7		196.25	201.75
	Ch 12		231.25	236.75
		Ch 50	503.25	708.75
		Ch 57	759.25	764.75
		Ch 59	775.25	780.75
		Ch 61	791.25	796.75
		Ch 64	815.25	820.75
Worship Centre (KTV)	Ch 14		245.25	250.75
		Ch 55	743.25	748.75
Good News Trust (TV7)		Ch 22	471.25	476.75
		Ch 27	519.25	524.75
		Ch 32	559.25	564.75
		Ch 36	591.25	596.75
		Ch 38	607.25	612.75
		Ch 41	631.25	636.75
		Ch 42	639.25	644.75
TV2 Network (EFKS TV)	Ch 10		217.25	222.75
	Ch 11		224.25	229.75
		Ch 30	543.25	548.75

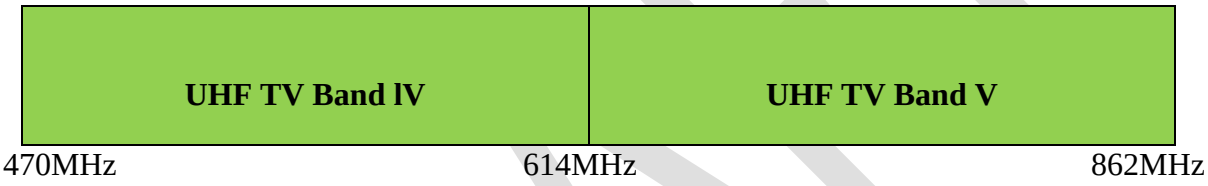
Upumana TV		Ch 23	487.25	492.75
		Ch 31	551.25	556.75
		Ch 35	583.25	588.75
		Ch 25	503.25	508.75
Star TV		Ch 26	511.25	516.75
		Ch 33	567.25	572.75

Consultation is being completed for the 700MHz Band Plan where some of the UHF Band from 698MHz to 806MHz will be allocated for use by mobile services.

8.1 Frequency Allocations

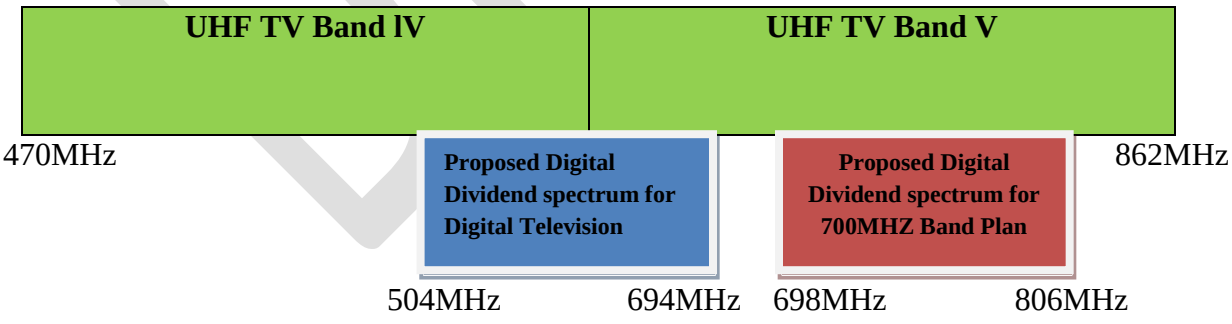
8.1.1 Current Frequency Allocation

The following is primarily the Band currently assigned for Broadcasting UHF Television Channels.



8.1.2 Proposed Frequency Allocation for Digital Dividend Spectrum

Digital Dividend refers to spectrum **698MHz to 806MHz** which is freed up by the rollover from the legacy analog terrestrial TV to digital terrestrial TV technology. Time frame for this transition will be finalised after discussions with the broadcasting service providers and other stakeholders. The current status of this band is shown below.



9. 700MHz Band

As part of the analogue to digital television broadcasting switchover, OOTR will reallocate 700MHz spectrum for digital broadcasting services and also for the provisions of mobile services using the IMT 2000 and IMT Advanced technologies. With the increasing number of mobile

subscribers and the rise of "bandwidth-hungry" applications, mobile broadband data traffic is expected to experience exponential growth in the near future. More radio frequency spectrums would be required to accommodate this increasing demand. The propagation characteristics of the 700 MHz band also enables wider coverage and improved indoor service. Rolling out IMT-Advanced services in Samoa will very much depend on the use of this band. But 1700MHz, 1800MHz, 1900MHz and 2100MHz band are also available. (refer to Annex for more information). Meanwhile, public safety organizations also desire reservation of some spectrum for an emergency services mobile broadband network. As indicated in the 700MHz Band Plan already sends out to stakeholders, the OOTR have adopted and propose the APT Harmonized Band Plan to be use. Harmonizing Samoa's potential Digital Dividend with other economies expands the potential for Samoa to realize economic benefits associated with harmonized frequencies. This allocation basically need spectrum that will be freed from the Digital Dividend Rearrangement. This arrangement is shown in Figure 2 below.

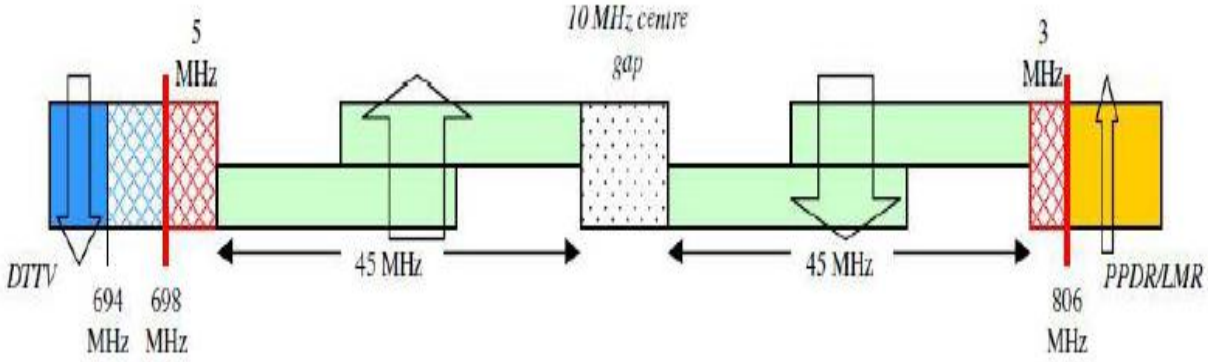


Figure 2 APT Harmonized Band Plan adopted by Samoa.

The above arrangement shows that :-

- A lower guard-band of 5MHz should be allocated between 698-703MHz
- An upper guard-band of 3MHz should allocated between 803-806MHz
- The 2 × 45MHz FDD structure should include a 10MHz centre-band gap
- Lower block 703-748MHz should be allocated for mobile uplink transmissions
- Upper block 758-803 MHz should be allocated for mobile downlink transmissions
- Guard Bands are 5MHz and 3 MHz respectively.

10. Analog to Digital Switchover

Many countries in the region and around the world have already started their process for the switchover from Analog to Digital. Some have completed the switch over, some are in progress and some are set for the switchover in the near future. Tonga and PNG have started consultations, New Zealand is set to start in the near future and Australia is on the final stage of the switch. The OOTR as part of this consultation process will finalize with stakeholders a switchover timetable. The following table indicates the current status of the Analog to Digital switch over timeframes in the Asia and Pacific Region.

Table 2 – Analog Switch Off

Country	ASO Year	Country	ASO Year
Afganistan	UK	Maldives	2020
Australia	2014	Marshall Is	UK
Bangladesh	2016	Micronesia	UK
Bhutan	2020	Mongolia	2014
Brunei	2015	Myanma	2010
Cambodia	2018	Nauru	UK
China	2018	Nepal	2017
Cook Islands	UK	New Zealand	2014
Fiji	2018	Pakistan	UK
Hong Kong	2015	Papua New Guinea	2017
India	2015	Phillipines	2018
Indonesia	2018	Samoa	UK
Iran	UK	Singapore	2015
Japan	2012	Solomon Islands	UK
Kiribati	UK	Sri Lanka	2017
Republic of Korea	2012	Thailand	2020
Laos	2020	Timor Leste	UK
Malaysia	2015	Tonga	2014
Tuvalu	UK	Vanuatu	UK

Source : ITU Regional Office, Asia Pacific, UK - Unknown

11. Digital Radio (Audio) Consideration

Although the provision for digital audio (sound) is also included in the overall Analog Broadcasting to Digital Broadcasting switch-over, it is not considered a major issue at this stage as implementation can be done over an appropriate time depending on the spectrum demand and the broadcasters' requirement and need to do so. In addition, radio broadcasting spectrum is in Band II which will not be affected by the proposed arrangement. It is for this reason that Digital Radio issues are not treated with detail in this paper.

12. Future Consultation Papers

The OOTR would welcome comments on: the draft discussion paper; presentations made at the consultation workshop; and on any other matters considered relevant to the creation and allocation of the digital dividend. Comments can be provided either in writing to the Office of the Regulator at Mulinuu clearly marked "COMMENTS ON CONSULTATION FOR DIGITAL DIVIDEND or by e-mail to admin@regulator.gov.ws. The opportunity would also be provided for oral comments at the workshop.

This is the first step in the process of determining policy on the Digital Dividend and later implementation for the reallocated frequencies.

The OOTR will be following up with proposals for a band plan for the Digital Dividend including the channeling plan for the Digital Broadcasting Spectrum.

13. Consultation Issues

Key Questions

1. What do you think of the proposal for Samoa to convert from analog to digital transmissions for television Broadcasting?
2. Is it your view that the current Analog Transmissions hoards spectrum that could be used for other services?
3. Samoa should convert to Digital Transmissions in Broadcasting so that we are in line with the rest of the world in terms of ICT provision and International Standards. Your views?
4. Is the use of the UHF Band (on the 700MHz portion) by Broadcasters as transmission links an efficient use of the Spectrum?

5. Should the UHF Band (on the 700MHz portion) be used for the rolling out of the IMT-Advanced Technology for mobile broadband?
6. The utilization of Digital Transmission in Broadcasting provides benefits to the Industry and Consumers, do you agree?
7. Should the Digital Dividend spectrum be used for non broadcasting services? For example mobile telephony and broadband services.
8. In light of your views on non-broadcasting services, do you consider that a mixed approach to spectrum allocation in the UHF spectrum band should be adopted? Please provide reasons for your view?**Note** : Mixed approach is whereby spectrum would be assigned to both broadcasting services and other services rather than one use only.
9. Should Digital dividend spectrum be used to allow expansion or enhancement of existing broadcasting services?
10. Is access to digital dividend spectrum required for government purposes? If so for what purpose? What would be the benefits of its use? Arguments should focus on the value this use of spectrum presents for the Samoan Government and Samoan economy.
11. Do you agree with the proposed timeframe for a switch that would commence in 2015 and terminate in 2017?
12. What are issues that the viewers will likely face if the proposed changes are implemented, with Digital Dividend allocated to ICT providers and Broadcasters transmit digitally?
13. What is required in the restacking process for broadcasters? Are there potential spectrum use implications? How much time is required for broadcasters to plan and implement transmissions at new frequencies?
14. How much is it likely to cost broadcasters to provide digital television services using alternative frequencies, both in terms of the purchasing of new transmission equipment or the retuning of existing equipment? It would be helpful if best and worst case scenarios could be presented.
15. Please outline your views regarding (i) the types of applications and services which you consider the digital dividend should be used for; (ii) possible spectrum requirements of those applications; (iii) timeframes for making available rights of use for digital dividend

spectrum; and (iv) the potential levels of competition which may result in existing or new products and services markets.

16. What would you consider other key issues which should be considered in terms of gaining a deeper understanding of the spectrum requirements of new applications and services? If so, what are they and please elaborate?
17. Should Samoa align its configuration of the Digital Dividend Spectrum with the harmonized Region 3 (Asia-Pacific) band plan arrangements? If not, what configuration arrangements should OOTR put into place for the Digital Dividend Spectrum? What are the benefits and risks of OOTR's preferred approach? Is there evidence to support the stated benefits or risks?
18. Should the users, public or Government assist in the relocation cost? What would be the suitable mechanism used to relocate the affected spectrum user?

14. Refrences

1. Banerji C D, 2012, *Roadmap for the transition from analog to Digital Terrestrial Television Broadcasting in Nepal* , ITU- Telecommunications Development Sector Publication, ITU, Geneva.
2. Doeven J, Wallop P, Hwang G, 2011, *Roadmap for the transition from analog to Digital Terrestrial Television Broadcasting in Cambodia* , ITU- Telecommunications Development Sector Publication, ITU, Geneva.
3. Doeven J, Wallop P, Zilles E, Guitot J & Ripley S, 2012, *Digital Dividend, Insights for Spectrum Decisions*, ITU- Telecommunications Development Sector, Geneva.
4. Doeven J, Wallop P, Hwang G, 2010, *Guidelines for the transition from Analogue to Digital Broadcasting* , ITU- Telecommunications Development Sector, Geneva.
5. Gomez C, 2013, *TV White Spaces : Managing spaces or better managing inefficiencies?*, ITU- R, ITU, Geneva.
6. ITU Publication , *Trends in Telecommunication Reform 2013:*, 13rd edition ITU- R, ITU, Geneva.
7. ITU Publication , *ITU-R-Rec-M.1036-4-201203*; ITU- R Radiocommunication Sector of ITU; ITU, Geneva.
8. ITU Publication , *ITU-R-Rec-M.687*; ITU- R Radiocommunication Sector of ITU; ITU, Geneva.
9. ITU Publication , *ITU-R-Rec-M.816*; ITU- R Radiocommunication Sector of ITU; ITU, Geneva.
10. ITU Publication , *ITU-R-Rec-M.1225*; ITU- R Radiocommunication Sector of ITU; ITU, Geneva.
11. ITU Publication , *ITU-R-Rec-M.1456*; ITU- R Radiocommunication Sector of ITU; ITU, Geneva.
12. ITU Publication , ITU-R-Rec-M.1654; ITU- R Radiocommunication Sector of ITU; ITU, Geneva.
13. Office of the Regulator, Draft 700MHz Band Plan 2013, OOTR, Samoa.
14. Office of the Regulator, Comments on Draft 700MHz Band Plan 2013, OOTR, Samoa.

15. Annex

Other Bands are required for IMT Advance to achieve 1Gb reference the ITU-R-Rec-M.1036-4-201203;

- 450 – 470 MHz
- 1710 – 2025 MHz
- 2110 – 2200 MHz
- 2300 – 2400 MHz
- 2500 – 2690 MHz

Options

Table 1.

Frequency Arrangements in the Band 450 – 470 MHz

Frequency arrangements	Paired arrangements				Un-paired arrangements (e.g for TDD) (MHz)
	Mobile station transmitter	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
D1	450.000-454.800	5.2	460.000-464.800	10	None
D2	451.325-455.725	5.6	461.325-465.725	10	None
D3	452.000-456.475	5.525	462.000-466.475	10	None
D4	452.000-457.475	5.025	462.500-467.475	10	None
D5	453.000-457.500	5.5	463.000-467.500	10	None
D6	455.250-459.975	5.275	465.250-469.975	10	None
D7	450.000-457.500	5.0	462.500-470.000	12.5	None
D8					450-470
D9	450.000-455.000	10	465.000-470.000	15	457.5-462.5
D10	451.000-458.000	3	461.000-468.000	10	None

Notes to Table 1:

NOTE 1 – The number of frequency arrangements given in Table 2 reflects the fact that administrations have had to accommodate incumbent operations, while for example maintaining a common uplink/downlink structure (uplink in the lower 10 MHz, downlink in the upper 10 MHz) for FDD arrangements.

NOTE 2 – Arrangements D7, D8 and D9 can be implemented by administrations that have the whole 450-470 MHz band available for IMT. Arrangement D8 can also be implemented by administrations having only a subset of the band available for IMT.

Table 2

Paired frequency arrangement in the band

Table 2.

Frequency arrangements in the band 1710 – 2200 MHz

Frequency arrangements	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex Separation (MHz)	Un-paired spectrum (e.g. for TDD) (MHz)
B1	1920 - 1980	130	2110 – 2170	190	1880-1920; 2010-2025
B2	1710 – 1785	20	1805 – 1880	95	none
B3	1850 – 1910	20	1930 – 1990	80	1910 - 1930
B4 (harmonized with B1 and B2	1710 – 1785 1920 – 1980	20 130	1805 – 1880 2110 – 2170	95 190	1900 – 1920 2010 – 2025
B5 (harmonized with B3 and parts of B1 and B2	1850 – 1910 1710 – 1770	20 340	1930 – 1990 2110 – 2170	80 400	1910 – 1930

Notes to Table 2:

NOTE 1 – In the band 1 710-2 025 MHz and 2 110-2 200 MHz three basic frequency arrangements (B1, B2 and B3) are already in use by public mobile cellular systems including IMT. Based on these three arrangements, different combinations of arrangements are recommended as described in B4 and B5. The B1 arrangement and the B2 arrangement are fully complementary, whereas the B3 arrangement partly overlaps with the B1 and B2 arrangements.

The 2 025-2 110 MHz band is not part of this frequency arrangement.

For administrations having implemented the B1 arrangement, B4 enables optimization of the use of spectrum for paired IMT operation.

For administrations having implemented the B3 arrangement, the B1 arrangement can be combined with the B2 arrangement. B5 is therefore recommended to optimize the use of the spectrum:

– B5 enables the use of spectrum to be maximized for IMT in administrations where B3 is implemented and where the band 1 770-1 850 MHz is not available in the initial phase of deployment of IMT in this frequency band.

NOTE 2 – TDD may be introduced in unpaired bands and also under certain conditions in the uplink bands of paired frequency arrangements and/or in the centre gap between paired bands.

NOTE 3 – If selectable/variable duplex technology is implemented within terminals as the most efficient way to manage different frequency arrangements, the fact that neighbouring administrations could select B5 will have no impact on the complexity of the terminal. Further studies are necessary.

Table 4

Frequency arrangements in the band 2300 – 2400 MHz

Frequency arrangement	Paired arrangements				Unpaired arrangement (e.g for TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
E1					2300-2400

Table 5

Frequency arrangements in the band 2500 – 2690 MHz

(not including the satellite component)

Frequency arrangement		Paired arrangements				Unpaired arrangement (e.g for TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	Centre gap usage	
C1	2500-2570	50	2620-2690	120	TDD	2570-2620
C2	2500-2470	50	2620-2690	120	FDD	2570-2620 FDD DL external
C3	Flexible FDD/TDD					

Notes to Table 5:
NOTE 1 – In C1, in order to facilitate deployment of FDD equipment, any guardbands required to ensure adjacent band compatibility at the 2 570 MHz and 2 620 MHz boundaries will be decided on a national basisand will be taken within the band 2 570-2 620 MHz and should be kept to the minimum necessary, based onReport ITU-R M.2045.

NOTE 2 – In C3, administrations can use the band solely for FDD or TDD or some combination of TDD andFDD. Administrations can use any FDD duplex spacing or FDD duplex direction. However, when administrations choose to deploy mixed FDD/TDD channels with a fixed duplex separation for FDD, the duplex separation and duplex direction as shown in C1 are preferred