700MHz Band Plan for Samoa

Prepared by the Office of the Regulator

final draft

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1. Introduction

The Office of the Regulator ("OOTR") under its mandate and the provision of the Telecommunication Act 2005 ("The Act") is required to formulate a National Spectrum Management Plan. The 700MHz Band Plan is part of that national spectrum management plan for Samoa. The idea is to analyze the spectral efficiency and harmonization of this band now that we enter into the Digital World. It is also an initiative to accommodate the new trends and the fast growing world of the new era of mobile technologies. Therefore the OOTR focus is to meet the requirements of the challenges faced during spectrum management allocation and the demand for mobile broadband and digital broadcasting. It also means that it is going to be a challenge to look at the services and the associated spectrum demand but it is also equally important to satisfy the unique needs of the general public who are the users of these services.

OOTR is challenged to accommodate all these demands in a manner that would harmonize Samoa with the rest of the world. The OOTR and the providers do have an obligation to alleviate the usage of spectrum and hence the reason why the plan is being formulated.

Samoa has achieved amazing connectivity across the whole country in terms of its mobile communications by the introduction of the 3G technologies by both mobile providers. This provides access to both voice and data to about 97% of the Samoan population. In addition, the introduction of the Samoa National Broadband Highway Project is expected to significantly improve delivery of services in Samoa. The availability of the 700MHz Band with its capability to provide improved coverage with less base stations will accommodate the transition from analogue to digital broadcasting and improved high speed mobile broadband communications. OOTR hopes that this will also further extend Samoa's connectivity to other countries in the region, as it will help improve regional mobile roaming and allow the countries to meet growing demand for mobile communications. It will likely to attract global take up which results in economies of scale and roaming capabilities.

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2. Background

As part of the analog to digital television broadcasting switchover, OOTR will reallocate 700MHz spectrum for digital broadcasting services and also for the provisions of the IMT- Advanced services based on the available technology. One promising spectrum band which offers large bandwidth of spectrum and hence improves data rates for mobile broadband is the 700 MHz band. 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. Meanwhile, public safety organizations also desire reservation of some spectrum for an emergency services mobile broadband network. This will also been addressed in this plan spectrum management plan.

Demand for spectrum in the mobile broadband services continues to grow not only around the world but in our region. The OOTR continues to monitor the changes of technology and have watched the keen interest of the providers to use this band in mobile broadband services. It is for this reason that the OOTR have developed this Band Plan to provide the appropriate services to the public.

Many countries are using the 700MHz band for digital broadcasting and FDD LTE and TDD LTE mobile broadband services. For FDD and TDD, in Samoa the technology used is based on the needs of the providers. The OOTR is interested in providing more efficient utilization of the spectrum. Considerations for other services are also in the pipeline depend on the evolution of the different technologies. Long Term Evolution (LTE) Advanced and other technologies are allocated based on the ITU Recommendations on IMT – 2000, IMT Advanced and APT Reports.

LTE Technology is a global issue whereby the unavailability of the targeted bands is a problem. ITU-R M.1036-4 specified Frequency arrangements for implementation of the terrestrials' component of International Mobile Telecommunications (IMT) in the bands identified in the Radio Regulations (RR), and the ITU-R M.2012. These include detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunication Advances (IMT-Advance). ITU has recognized the Asia-Pacific and APT Harmonized Plan and Samoa as in Region 3 shall adopt this plan as a guide in developing its 700MHz band plan and policy.

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3. Plan Objectives

The 700MHz Band plan outlines the proposal by OOTR of how the 700MHz spectrum is utilized and allocated for difference services based on the ITU Recommendations and other related plans. It presented the vision of the OOTR on how the band can be efficiently used based on the spectrum allocation for different services. It is also aim to accommodate the user demand for new services and new technological approaches and harmonized it with the current trend worldwide. It will be considered as the guidelines for spectrum utilization that is flexible to apply whenever possible to satisfy user demand in the specific services recognized by OOTR. In doing so the OOTR will review all the options available and decide on the best approach that will not only deliver good quality of services but will efficiently utilize the spectrum. It will also recognize the goals and objectives of the National Spectrum Management Plan by which efficient use and quality of service is measured. The objectives presented will be aimed to implement by OOTR during its roles and responsibilities as stipulated by the Act.

4. Abbreviations/Definitions

The following terms shall have the following meanings unless the context otherwise requires:

700MHz Band Plan – The segmentation of the spectrum from 698 – 806 MHz

Act - means the *Telecommunications Act 2005* including any amendments;

APT – Aisa Pacific Telecommunity

DDTV – Direct Digital Television

DTTV – Digital Terrestrial Television

FDD – Frequency Division Duplex

ITU – International Telecommunication Union

IMT – International Mobile Telecommunication

IMT Advanced – International Mobile Telecommunications Advanced.

ITU-R M.1036-4 – ITU Recommendation for frequency arrangements for implementation of the terrestrial component of IMT in bands identified for International Mobile Telecommunication in the Radio Regulations.

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ITU-R M.2012 – ITU Recommendation on detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced.

LTE – Long Term Evolution

OOTR – Office of the Regulator

RR – Radio Regulations 2012 Edition

TDD – Time Division Duplex

5. 700MHz Band Plan – Current status

5.1 Definition

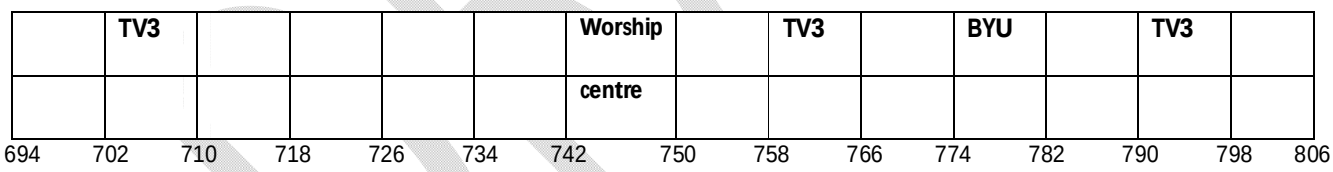
700 MHz band means the following spectrum, in the geographic areas specified in the frequency allocation table.

(a) 698 MHz to 803 MHz

5.2 Current Status of 700 MHz Band

The 700MHz Band is currently occupied by the UHF Television Services mainly for Band V 614MHz to 862MHz. The current allocation will be changed based on the new proposal where it will synchronized with the migration of these services out of this portion of the band to the DDTV allocation which will address later on in this plan.

Figure 1. Current Status of 700MHz Band Plan in Samoa



6. Proposal for reallocation of the 700MHz Band

6.1 Mobile Broadband

The ITU and other organizations including the APT, have looked at the issue of allocation in the 700 MHz Band. They have identified it for the deployment of IMT technologies such as LTE and LTE-Advanced. The 700MHz Band provides extremely favorable propagations conditions and therefore enables operators to roll out an infrastructure capable of providing access to internet for underserved areas. Due to the relatively low cost involved with the deployment, such internet access through mobile broadband at 700MHz will benefit most countries including Samoa. It is therefore important to ensure that the band is used as efficiently as possible.

The mobile broadband growth will affect spectrum needs therefore it is important that Samoa embrace these technological trends. There will be an increasing number of cell sites needed for the demand and that the services will projected a huge increase in its performance. The expected output will definitely address the spectrum need which is likely to help the market growth and of course the improvement of the services to be provided. There is no doubt that the network capacity will be increased with the application of the spectral efficiency of wireless technologies, so too will be the number of cell sites used to provide such services.

The OOTR proposes that the 700 MHz Band be used for the roll out of the new technologies.

6.2 Digital Dividend

The international trend in the provision of broadcast services is to migrate from the use of analog signals to use digital systems. Coinciding with migration from analog to digital systems would be the need for UHF television services to migrate out of 700MHz band.

The migration from the 700 MHz band gives rise to the Digital Dividend. This proposal is to cater for the need to use the 700MHz Band for the Mobile Broadband. The transition from analog to digital television in Samoa is equally important and will be subject of a separate discussion paper to be produced by the OOTR within the next few months.

For terrestrial broadcasting, digital televisions means more available spectrum, improved quality picture and more opportunities for several services in many formats within the same radio frequency channel. In Samoa, the focus is the improved capability of the Digital television to deliver considerable spectrum efficiency benefits of its services with the less amount of spectrum and at the same time provide the excellent service to the end user. This will also give us opportunity to reallocate the substantial amount of spectrum for other useful services such as mobile broadband. The resulting Digital Dividend consists of 184MHz between 510MHz and 694MHz, including the proposed allocation a guard band of 5MHz.

7. Band Plan options

The Office of the Regulator looked at available options based on ITU Recommendations and best practices of other countries. The OOTR then selected three options, (indicated below), for further consideration. These systems are similar in nature but from different regions.

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The focus of the OOTR analysis is to have a fundamental band plan that will not only satisfy Region 3 requirements but also provide maximum benefits to providers and end users. In making the decision on this band plan, OOTR identified a number of criteria relevant to its consideration and assessments of those options. Criteria included the efficiency of the Band Plan, utilization of that spectrum based on the available technology and the opportunity for harmonization in order to achieve economic and technical benefits for the providers and the end users.

7.1 Options for Frequency Allocation

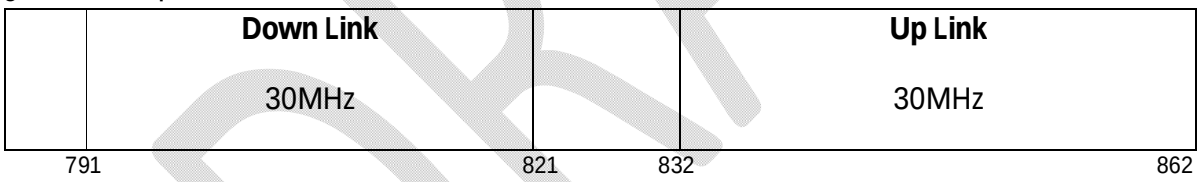
Several options were considered for the frequency allocations in the proposed 700 MHz Band.
Options considered were:

1. The European Band Plan
2. The United States FCC Band Plan and
3. The Asia Pacific Telecommunity (APT) Band Plan

7.1.1 Europe Band Plan

The European Band Plan spans the frequencies 790 – 862 MHz. The downlink frequency range of 30 MHz is from 791 – 821 MHz, a 30 MHz block with uplink frequencies between 832 – 862 MHz. The downlink and uplink frequencies are separated with a 11MHz band, spanning 790-862MHz.

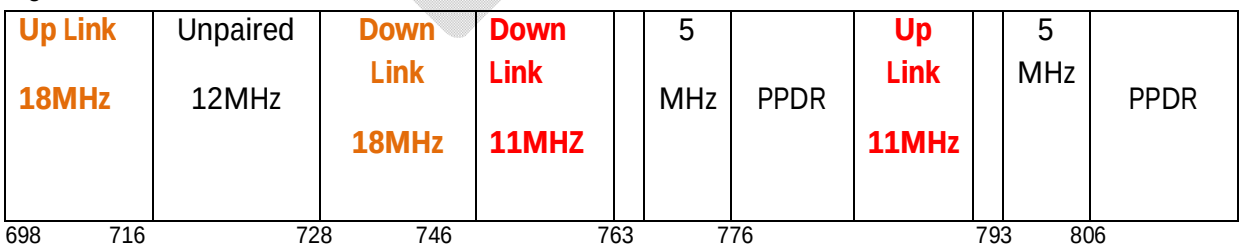
Figure 2. Europe Band Plan for 700MHz



This plan is not compatible with Region 3 and may not provide the best returns for the digital dividend for Samoa.

7.1.2 FCC Band Plan

Figure 3. FCC Band Plan



The OOTR considers that the FCC Band Plan for 700 MHz is an inefficient use of frequencies, with the provision for only two paired blocks of 29MHz and requiring more guard bands rather than having a single block. The

OOTR view is that this would only accommodate limited service. The providers would have unpaired allotments with fragmented regional allocations.

The proposed subdivision is for 6MHz blocks of spectrum, suited for broadcasting but will not align with the expected LTE carrier bandwidths.

7.1.3 Asia-Pacific Telecommunity (APT)

The APT arrangement for 700MHz Band plan[1] is based on two modes of operation for IMT-Advanced radio interfaces which are explained in the ITU Recommendation ITU-RM.2012[2]. They are Frequency division duplex (FDD) and Time division duplex (TDD). Both modes are useful for use in the same band but considerations by the OOTR should be done to minimize the interference problems between the two systems.

FDD requires two separate communications channel where the transmission and reception of signals are achieved simultaneously using two different frequencies. TDD on the other hand uses only a single frequency band for both the transmission and reception. It simply means that it shares a channel between transmission and reception.

The following Table shows major characteristics differences between FDD and TDD

Table 1 : FDD vs TDD

FDD vs TDD		
Characteristic	**FDD**	**TDD**
Spectrum Usage	High Including guard Bands	Less
Complexity	High	Low but needs accurate timing
Cost	Higher	Lower
Latency	Little or None	Depend on Range, Tx-Rx switching times
Range	Unlimited	Shorter depend on Guard time

[1] http://www.pirrc.org/home/index.php?option=com_edocman&task=document.viewdoc&id=95&Itemid=315&lang=en

[2] http://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2012-0-201201-I!!PDF-E.pdf

Comparisons of FDD and TDD

FDD deployments provide greater coverage than TDD

Mobile devices in Frequency Division Duplexing (FDD) system transmit on a continuous basis, which enables devices to achieve cell edge rates farther from the base station. Mobile devices in the Time Division Duplexing (TDD) system transmit periodically (eg ½ or 1/3 of the time compared to FDD); hence, required rates cannot be achieved at similar distances when compared to FDD. The FDD advantage is consistent regardless of the radio technology being used.

FDD needs fewer base stations

Since FDD devices achieve desired cell edge rates farther distances, the number of base stations required to achieve a given area of coverage is reduced. In a coverage-limited system comparison using the same frequency band, the TDD system required 31% more base stations than FDD when using a 1:1 TDD system and 65% more base stations when using 2:1 TDD system. Higher frequency bands required even more base stations.

FDD incurs lower costs

Capital expenditure (CAPEX) and operating expenditure (OPEX) costs are associated with each base station. These costs are independent of the type of duplexing technique used (FDD or TDD). Since FDD requires fewer base stations for the same coverage, it incurs lower deployment and operating costs.

TDD is applicable to unpaired spectrum

While FDD has clear advantages in coverage and costs, TDD is suitable to be deployed when paired spectrum is not available. FDD systems also benefit from better economies of scale since the implementation of TDD systems is limited.

FDD/TDD : Basic Difference

FDD is implemented on a paired spectrum where the downlink and uplink transmissions are sent on separate frequencies. This provides simultaneous exchange of information and reduces interference between the uplink and downlink. TDD is implemented on an unpaired spectrum, implying the usage of only one frequency for both downlink and uplink transmissions. It is suitable for asymmetric transmission demands and in cases where paired frequency is not available.

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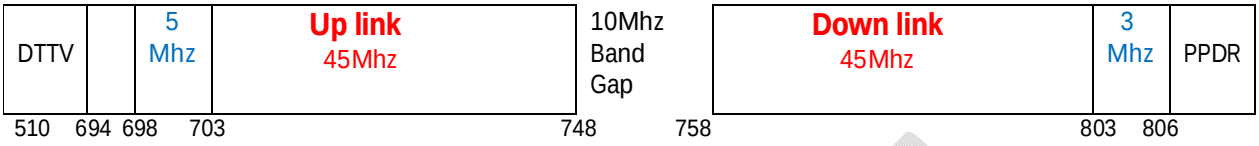
OPTION 1

The FDD arrangement for the 700 MHz (698 – 806 MHz) Band.

Figure 4 : FDD Arrangement



The recent APT Wireless Forum highlighted that there are various interference mechanisms that may impact services in adjacent bands. The OOTR considers that the spectrum should be allocated as follows:

- a lower guard-band of 5 MHz should be allocated between 698-703 MHz; and
- an upper guard-band of 3 MHz should be allocated between 803-806 MHz.

Consideration should be taken of the external 4MHz guard band (694 – 806MHz) and a minimum internal guard band of 5MHz at the lower edge of 698MHz and 3MHz at the upper edge of 806MHz. The 45MHz allocation for uplink and downlink (lower and upper part) will be divided into 2 X 20MHz with a guard band of 5MHz between each block.

OOTR considered using this FDD option as the option for Samoa. But TDD option is also make available and is illustrated below.

OPTION 2

TDD arrangement for 698 – 806MHz Band

Figure 5 : Harmonised TDD Arrangement of 698 – 806MHz Band

7.2 Cap Options for 700MHz

The OOTR proposes to use a cap on the amount of spectrum for each provider thereby ensuring that spectrum is available to allow for available spectrum to potential competitors.

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The options in the table below are for the band plan offering 2x45MHz of the spectrum. The OOTR considers that if the bandwidth provided is too low, this would limit the data speeds and network capacity that operators are able to offer. This would in turn reduce the quality of service and productivity improvements that the service could have offered. The OOTR would seek to prevent any hoarding of the spectrum or of any provider gaining competitive advantage by acquiring major portions of the spectrum and starving other potential competitors from access to spectrum.

Table 2

Cap	Indicative Peak Speeds	Potential No. of Operators	Comment
2x5 MHz	75 Mbps	9	Do not see true benefits of 4G technology. No demand for this number of operators.
2x10 MHz	150 Mbps	4	Minimum to see real benefits of 4G technology. Unaware of presence of fourth or fifth operators, so may not provide an optimal allocation.
2x15 MHz	225 Mbps	3	All existing mobile operators will be able to access spectrum, and provide strong services.
2x20 MHz	300 Mbps	2	Offers greatest technological benefits. May result in a non-competitive outcome.

2 x 45MHz FDD structure including a 10MHz centre band cap is proposed for this application.

The OOTR proposes, noting the above analysis, that the industry considers the option to allow for three providers with allocations of 30 MHz (2 x15) as indicated in table 2 above.

The Asia – Pacific countries are in the process of working towards the implementation of the FDD and TDD band plan for LTE.

7.3 Preferred Band Plan

The OOTR proposes that Samoa should adopt the APT plan which is in line with Region 3 frequency allotment. This is an ideal plan that offers a large spectrum to allocate to new services. FDD-LTE is the technology of choice for this Band and OOTR will based its allocation on the FDD arrangement. The digital dividend spectrum could then be allocated in paired blocks as has been the accepted approach in international allocations.

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The APT band plan has gained acceptance across the Asia Pacific region with a large number of countries committed to considering its adoption. Cambodia, India, Indonesia, Australia, New Zealand, Singapore, Malaysia and Brunei have committed to align with the APT Band Plan. The Pacific Island Countries at the most recent APT Policy & Regulatory Forum (Pacific) held in Fiji on 6-8 August 2013, have committed to working towards the adoption of this Plan.

Some non-APT countries have also shown interest in the APT Band Plan including countries in Latin America.

8. Public Safety

OOTR propose that spectrum in the 700 MHz band be allocated for Public Protection and Disaster Relief (PPDR). The Disaster Management Office (DMO) has upgraded their network for better communication in times of disaster and the OOTR will ensure the availability of spectrum in the 700 MHz Band.

In the 700MHz plan spectrum is also reserved for Public Protection and Disaster Relief (PPDR). The assigned spectrum is 806 – 824MHz paired with 851MHz – 869MHz. This is international allocation and Samoa is adopting the same.

9. Samoa National Broadband

Samoa National Broadband Highway Project has received approval for use of frequencies in the TDD-LTE in the 1800MHz band. This band is being proposed for the TDD-LTE technology.

10. Telecom Provider Applications

Technology is moving rapidly and Telecom Providers are trying their best to cope.

Applications have been made for portions of the band by providers wishing to upgrade to LTE technology. It is not possible to accommodate these requests due to current unavailability of portions of the band. Switching from analogue to digital TV will free up the spectrum for digital dividend.

11. Recommendation

The Asia Pacific Telecommunity (APT) has recommended to Member countries the adoption of the APT 700MHz Band Plan. The OOTR proposes that this APT 700 MHz Plan for FDD be adopted by Samoa.

The Samoan Plan should conform with the international standards and to facilitate FDD Technology. Samoa would adopt the APT 700MHz FDD band plan and there would be 45MHz pairs separated by 10MHz gap in 2x45 MHz blocks allocation

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12. Implementation

Parallel to this consultation process on the 700 MHz Band Plan, television broadcast providers currently in the 700 MHz Band will be required to migrate out of the Band. OOTR will provide discussion paper which will indeed consulted with the occupants including a timeframe for this migration. On completion of the consultation process the agreed plan will be finalized and providers invited to apply for available frequencies.

This 700MHz Band plan once it is approved it will become part of the National Spectrum Plan for Samoa. The Spectrum Allocation Plan for Samoa will be then be updated and revised.

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