

RADIO FREQUENCY SPECTRUM, THE OUT OF SIGHT, OUT OF MIND NATIONAL STRATEGIC RESOURCE

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Abstract

Radio frequency spectrum, a scarce national strategic asset, has not enjoyed the necessary attention and protection it deserves. Spectrum has been managed by the same approach over the last two decades and it is only recently that attention has been given to it due to the pressure of increased competition and technological advancements. The purpose of this study was to explore the policy and regulatory approaches to the management of radio frequency spectrum prevalent in South Africa today. Internationally there is a shift from the traditional command and control spectrum management approaches to more market-based mechanisms, such as auctions and spectrum trading. The South African approach has been marked by delays in the usage of spectrum as a result of the current institutional arrangements where there is an apparent overlap between the policy and regulatory function. The study concludes that the delays could be circumvented by separating the spectrum allocation and assignment into policy and regulatory functions respectively. Efficient spectrum management policy and regulation is important for the next stage of electronic communications revolution because of the advances in the technology such as broadband and agile radio.

Declaration

I declare that this research report is my own, unaided work. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Information and Communications Technology, Policy and Regulation at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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Dedication

I dedicate this study to wife, friend, and soul mate, Mrs Anita Zimri, for her self-sacrificing support to make this possible in often trying times. The so often absent long weekends and lonely evenings must have been challenging for you and my three lovely daughters Shantel, Sharné and Carla.

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List of Abbreviations

| | |
|-------|--|
| 3G | Third Generation |
| ANC | African National Congress |
| ACMA | Australian Communications and Media Authority |
| ABA | African Broadcasting Area |
| AFNR | Agence Nationale des Fréquences |
| AGA | Astronomy Geographic Advantage Act |
| ATU | African Telecommunications Union |
| AU | African Union |
| BDMP | Broadcasting Digital Migration Policy |
| CDMA | Code Division Multiple Access |
| DAB | Digital Audio Broadcasting |
| DD | Digital Dividend |
| DST | Department of Science and Technology |
| DTT | Digital Terrestrial Television |
| DMWG | Digital Migration Working Group |
| DOC | Department of Communications |
| DOH | Department of Health |
| ECA | Electronic Communications Act |
| ECS | Electronic Communications Service |
| ECNS | Electronic Communications Network Service |
| FCC | Federal Communications Commission |
| FDD | Frequency Division Duplexing |
| FSD | Frequency Spectrum Directorate |
| GE | Geneva |
| GHz | Giga Hertz |
| GMDSS | Global Maritime Distress and Safety System |
| HDI | Historical Disadvantage d Individual |
| IBA | Independent Broadcasting Authority |
| IC | Industry Canada |
| ICASA | Independent Communications Authority of South Africa |
| ICT | Information and Communications Technology |
| IMT | International Mobile Telecommunications |
| IRAC | Independent Radio Advisory Committee |
| ITA | Invitation To Apply |
| ITU | International Telecommunication Union |
| JLC | Joint Liaison Committee |
| LAN | Local Area Network |
| LTE | Long Term Evolution |
| kHz | Kilo Hertz |
| MHz | Mega Hertz |
| GHz | Giga Hertz |

| | |
|----------|--|
| NTIA | National Telecommunications and Information Administration |
| NRFSP | National Radio Frequency Spectrum Plan |
| NZ MOED | Ministry of Economic Development |
| Ofcom | Office of Communications UK |
| OECD | Organisation for Economic Co-operation and Development |
| PAPU | Pan-African Postal Union |
| PFMA | Public Finance Management Act |
| PPDR | Public Protection and Disaster Relief |
| RRC | Regional Radiocommunication Conference |
| RF | Radio Frequency |
| RSA | Republic of South Africa |
| RFI | Radio Frequency Investigations |
| SABC | South African Broadcasting Corporation |
| SABRE-1 | South African Band Re-planning Exercise |
| SABRE-2 | South African Band Re-planning Exercise 2 |
| SABS | South African Bureau of Standards |
| SACAA | South African Civil Aviation Authority |
| SADC | Southern African Developing Community |
| SADC FAP | SADC Frequency Allocation Plan |
| SAMSA | South African Maritime Safety Authority |
| SANSA | South African National Space Agency |
| SATFA | South African Table of Frequency Allocations |
| SATRA | South African Telecommunications Regulatory Authority |
| SKA | Square Kilometer Array |
| SRD | Short Range Device |
| STB | Set-top Box |
| TETRA | TErrestrial TRunked RAdio |
| SNO | Second National Operator |
| SOS | Save Our SABC |
| TDD | Time Division Duplexing |
| VANS | value added network service |
| VHF | Very High Frequency |
| WLL | Wireless Local Loop |
| WiMAX | Worldwide Interoperability for Microwave Access |
| WTO | World Trade Organisation |
| UK | United Kingdom |
| UHF | Ultra High Frequency |
| UPU | Universal Postal Union |
| USA | United States of America |
| USGAO | US General Accounting Office |

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1. Chapter One: Background: Short History and Complexities of Spectrum Management

1.1. Background

Radio frequency spectrum management, commonly referred to as “spectrum management,” has been practiced around the world since the 1920s (Mueller, 1982). The principles on which spectrum is managed in the United States of America (USA) is still based on the 1927 Radio Act (Coase, 1959, p. 4). Earlier techniques of spectrum management may have been effective when dealing with radiocommunication systems but more recent technological progress and innovative applications of radio frequency channels make the spectrum management process so much more complex.

The emergence of new technologies in the 1990s put the spectrum management processes under severe tension especially in the area of the so-called the “sweet spot” or “prime region” (Cave, 2002). The introduction of what is generally referred to as “disruptive” technologies is complicating current spectrum management policy and regulatory environments. New electronic communication technologies are considered disruptive, as they entirely change policy and regulatory mechanisms, which must be more flexible than the historical command and control mechanisms and should be carefully planned and executed. The command and control mechanism means that natural persons and electronic communications network operators are not allowed to transmit signals without getting approval from the regulatory authority such as the Independent Communications Authority of South Africa (ICASA). This method has been described by the FCC chairperson as authoritarian “*The Mother May I*” relationship (Ryan, 2004, p. 7). In a South African context the phrase that many of our forefathers were using “*Asseblief Baas*” (“Afrikaans for please boss”) may be better understood.

Disruptive technologies for wireless broadband and mobile communications and the growing demand for enhanced terrestrial television services are fuelling the demand for radio frequency spectrum licensing. The demand for spectrum generated by the latest technologies outweighs the supply in certain spectrum bands. These bands have propagation characteristics that are

conductive for transmission of electronic communications and for the production of conveniently dimensioned transportable radiocommunication devices. It has been realised that the same services can be provided through many competing technologies and platforms, but are constrained through centralised planning and related exhaustive licence conditions (Oliver & Ohlebaum & DotEcon, 2008).

A market-based spectrum management mechanism is an alternative approach that can potentially be used to manage spectrum and ease the pressure on the policy and regulatory structures. These mechanisms would put spectrum resources in the hands of those who value spectrum the most (Coarse, 1959). There are numerous market-based spectrum management mechanisms, such as technology neutrality, auctions, spectrum trading, and administrative incentive pricing.

In light of the new demands for spectrum policy, regulation and management, the response of South African electronic communications policy and regulatory institutions has typically been one of two options – either a reliance on quick-fixes and short term strategies, or a deferment to the outcomes of protracted consultative public regulatory and policy processes. Currently, the national spectrum management and planning function is not centrally controlled, but is fragmented across more than one statutory institution, namely the Department of Communications (DOC) and the Independent Communications Authority of South Africa (ICASA) (RSA, 2005). In the South African communications technology sector, the DOC sets policy and the regulator implements what it is mandated to do in terms of the legislation (RSA, 2005).

The South African approach and the associated legal and institutional framework, conflicts in several ways with approaches considered necessary to achieve the objectives of the ECA, which include encouraging investment, innovation, universal service, and access for socio-economic development. The current approach appears to generate inefficiencies which is detrimental to the electronic communications industry, hence to the country's economy. The current approach additionally constructs numerous delays in the implementation and the eventual licensing and award of radio frequency spectrum.

In assessing the overall policy and regulatory spectrum management approach, the challenges regarding the apparent duplication in the responsibilities between policy maker, the Department of Communications, and the regulatory authority, ICASA, give rise to ambiguity in the electronic communications policy and regulatory environment.

1.2. Spectrum Management in General

1.2.1. What is Radio Frequency Spectrum?

Radio frequency spectrum is a finite scarce resource which is critical to the delivery of electronic communications services and the building out of mobile networks. There are limits to the simultaneous transmission on a particular radio frequency channel, which could affect the physical signal characteristic and the usage conditions. Thus, spectrum must be managed and planned accurately to avoid harmful interference to authorised users of the airwaves (Melody, 1980).

Figure 1, below, illustrates the usable electromagnetic waves. It shows the radio frequency portion which is contained in the International Telecommunication Union (ITU) radio regulations (ITU, 2008). The radio regulations contain the frequency allocations which apportion the electromagnetic waves into blocks of specific radiocommunication services. While these frequency allocations are comparatively consistent across the world, they include some region-specific variations. These region specific variations are slowly disappearing with harmonisation of radio communications usage globally. Harmonisation ensures economies of scale which translate into cheaper devices and services.

Radio Frequency “Sweet Spot” or “Prime Region”



The management of radio frequency spectrum involves technical and regulatory mechanisms that are designed to achieve the optimal use of the radio frequency spectrum. Spectrum management is a complex discipline with a unique blend of international politics, policy, regulation, economics and engineering (ITU, 2005, p. 14).

1.2.3. The International Spectrum Management Environment

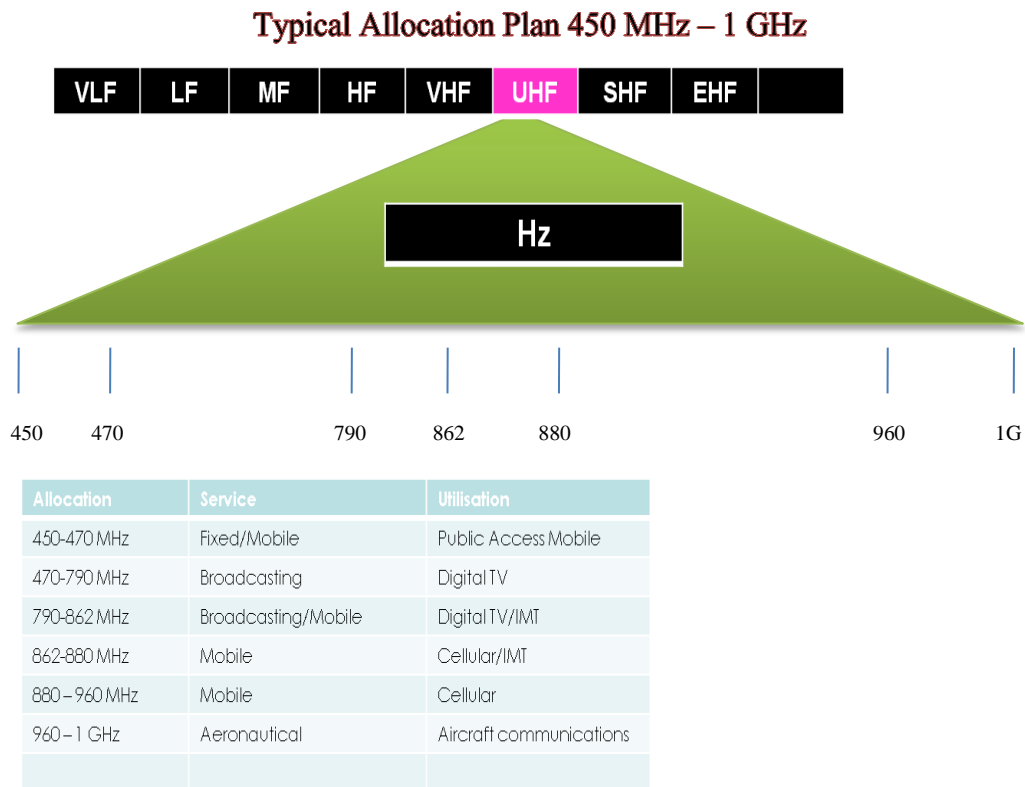
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and relevance of relevant standards bodies associated with the radiocommunication sector. This is important in that this international framework forms the basis for radio frequency coordination amongst nations.

For traditional spectrum coordination purposes, the world is divided into three ITU Regions of which the usage of radio frequency spectrum differs from region to region (ITU, 2004, p. 34). According to the ITU Region 1, includes Europe parts of the Middle East and Africa, Region 2 North and South America and Region 3 Asia and Australasia. Since spectrum must be shared by all users, it is necessary to manage this process through planning, technical and operational conditions affecting the usage of radio frequency assignments.

Radio frequency planning is generally the primary level allocation of bands for specific radiocommunication services based on clearly specified sharing criteria, see figure 2 below. Radio frequency spectrum assignment on the other hand follows from planning and is the detailed identification and coordination of specific radio frequencies channels to individual users with very specific technical conditions to avoid harmful interferences. Spectrum band plans are regarded as legal instruments by providing detailed instructions on the usage of the specific parts of the spectrum. These spectrum band plans are often captured in regulations or policy and capable of enforcement. The channel arrangements, on the other hand, are more of an administrative nature, see Figure 2 below. The arrangements are the detailed transmit and received frequencies and also capture the go and return legs which equipment operates on.

Figure 2: Radio Frequency Spectrum Allocations



Source: Zimri, 2010 adapted from ITU Radio Regulations, 2008

1.2.4. The National Spectrum Management Framework

In South Africa, as in many countries around the world, the use of radio-frequencies has been determined by centralised planning by a national government agency. National agencies generally make decisions on: “allocations - what type of services and technology is deployed in a particular band? Assignments - which entities are granted licences to use the frequencies?” (Oliver *et al.*, 2008, p. 9)

In addition to a national allocation and assignment role, the role of administrations and national agencies in terms of harmonising spectrum across borders has historically been very critical. This function made economic sense to minimise interference costs and lower the costs of equipment due to the economies of scale in production of radiocommunication devices, particularly in a geographic region. Initially, this approach worked well and is still working well in areas where there is little demand for spectrum.

Currently in South Africa, the spectrum management arrangements, like in some countries around the world, are a shared responsibility between the policy maker and the regulatory authority and some instances, still the incumbent operator. In some cases, such as in the United States of America, spectrum managed separately for public and commercial users. The National Telecommunications and Information Administration (NTIA) regulate federal government spectrum usage, while the Federal Communications Commission (FCC) regulates commercial usage (Mazar, 2008). Similarly, in South Africa, the Department of Communications (DOC) coordinates spectrum for government services, which include usage for security services, while the Independent Communications Authority of South Africa (ICASA) regulates all other spectrum requirements. In the current regime, ICASA manages and plans all spectrum and licenses and monitors it accordingly (RSA, 2005).

In the UK, spectrum management is the sole responsibility of the Office of Communications (Ofcom). These different scenarios are examined in the research to establish how effectively these institutional arrangements are working in these countries (Cave, 2002).

1.2.5. Spectrum Management Reform in South Africa

The reform in spectrum management commenced in earnest in 1995, with the DOC embarking on the first detailed spectrum investigation, which culminated in the first national spectrum allocation plan, the South African Band Re-planning Exercise (SABRE-1). This radio frequency plan covered spectrum allocations from 20 MHz to 3400 MHz and was followed-up by SABRE-2 which culminated in the South African Table of Frequency Allocations (SATFA). SATFA was finalised in 2004 and included an increase of the spectrum band allocations up to 70 GHz.

In April 2010 the DOC published the radio frequency policy setting out a framework for the management and planning of spectrum in the country. In July 2010 ICASA and the DOC finalised the National Table of Frequency Allocations which cover the radio frequency allocations from 9 kHz to 3000 GHz. ICASA subsequently finalised the radio frequency spectrum fees regulations providing a bases for Administrative Incentive Pricing (AIP) in March 2011.

In September 2010, ICASA embarked on a public process to review the existing radio regulations established under the Post Office Act and the Radio Act of 1952 of which certain provisions are still enforced. These regulations attempted to introduce more market-based spectrum management approaches and move away from the existing command and control mechanisms. The draft radio regulations introduce a platform for spectrum reselling and leasing to third party licensees. However for some mysterious reason these provisions were withdrawn in the final radio spectrum regulations (ICASA, 2011).

In June 2010 the Department of Communications introduced the ICASA Amendment Bill in Parliament. This controversial Bill, amongst others issues, seeks to remove the spectrum planning functions from ICASA (DOC, 2010, p. 7). This ICASA Amendment Bill was envisaged to be finalised in the first quarter of 2011 but was subsequently withdrawn due to the controversial issues in the Bill.

Table 1 below offers a brief overview of significant spectrum events, but is not an exhaustive list. The events are based on information obtained from the policy maker, regulators and spectrum interest groups and individuals. These events will be scrutinised in more detail to establish the extent to which the spectrum management framework was influenced by various players and what lessons can be learnt to ensure the optimum utilization of this scarce national strategic resource.

Table 1: Key Events towards Spectrum Management Reform

| Period | Documented Event | Spectrum Matter |
|-----------------|--|--|
| October, 1993 | Independent Broadcasting Authority Act 153 of 1993 | Independent Institution Managing Broadcasting Spectrum |
| August, 1995 | Notice by P & T on SABRE | Invitation of the Development of the National Spectrum Allocation Plan |
| November, 1996 | Telecommunications Act (Act 103 of 1996) | Spectrum Mandate awarded to the Authority |
| April, 1997 | Final South African Band Replanning Exercise (SABRE) | Publication of Band Plan and Migration Strategy |
| May, 1997 | Amendment to SABRE | Inclusion of 3400 - 3600 MHz |
| April, 1999 | Broadcasting Act | Establishment of Frequency Spectrum Directorate MOC. |
| September, 1999 | Feasibility Study into Common Public Safety System | Licensing and award of spectrum available for a common Public safety network |
| May, 2000 | ICASA Act | Reform of the Regulators, IBA and SATRA |
| August, 2001 | SABRE 2 | Covering Spectrum 3 to 70 GHz |

| Period | Documented Event | Spectrum Matter |
|-----------------|---|---|
| November, 2001 | Telecommunications Act Amendment | Award of 1800 and 3G spectrum to the 5 Major Operators |
| July, 2004 | Final SATFA | Revision of frequency band Plan to consolidate SABRE 1 and 2 spectrum from 20 MHz to 70 GHz. |
| December, 2005 | Broadcasting Frequency Plan 2004 | Publication include Spectrum for DTT |
| April, 2006 | Electronic Communications Act (Act 36 of 2005) | Spectrum Mandate split between the DOC and ICASA |
| May, 2005 | Ministerial Task Team | Develop Digital Migration Report |
| June, 2006 | Regional Radiocommunication Conference | GE-06 plan for Digital Terrestrial Broadcasting |
| December, 2006 | Policy Directions | Finalisation of the Bandplan till after 2007 |
| September, 2007 | World Radiocommunication Conference 2007 (WRC-07) | ITU Spectrum Allocation for Mobile (IMT) |
| September, 2008 | Broadcasting Digital Migration Policy | Transition Period to migrate from Analogue to Digital technologies |
| 2010 | ICASA DTT Regulations | Allocation of Spectrum Channels/Multiplexers to incumbents |
| July, 2010 | South African Table of Frequency Allocations | A revised bandplan was published taking into account the Ministerial Policy directions |
| April, 2010 | Radio frequency spectrum Policy | Seek to outline policy spectrum usage and processes |
| June, 2010 | ICASA amendment bill | Take away the frequency planning function from the Authority |
| August, 2010 | Radio frequency spectrum fees regulations for ECS/ECNS Licensees | Ensure effective and efficient usage of spectrum through the administrative incentive pricing (AIP) |
| September, 2010 | Review of radio frequency spectrum regulations | Consolidate all spectrum regulations to allow envisaged market based approach and trading and leasing of spectrum |
| April, 2011 | Publication of the final radio frequency spectrum regulations | Revised final radio frequency regulations to allow market-based approach to be introduced |
| March, 2011 | Spectrum Audit Tender Published | DOC published spectrum audit request for proposals 500 MHz to 30 GHz |
| December, 2011 | Draft Policy Directions for spectrum in high demand bands and exploiting the Digital dividend | The DOC issued policy directions to ICASA |
| December, 2011 | Draft Band plan and Invitation to Apply for spectrum in High Demand | ICASA issues 2.6 MHz and 800 MHz radio frequency combinational licences and a migration plan |
| February, 2012 | Final Broadcasting Digital Migration Policy | Amendment to the STB Standard and subsidise of the USF for STB |
| July, 2012 | EC Amendment Bill | Proposed establishment Spectrum Management Agency (SMA) |

Source: Zimri, 2010, Government Gazettes

Despite these reforms, the problems of the delays from allocation of radio frequency spectrum bands to specific electronic communication services to the assignment or licensing of radio frequency channels to respective licensees have not been resolved. The introduction of new electronic communications technologies designated for these respective bands lag implementation due to constant inconsistencies in approaches employed between the policy maker and the authority.

1.3. Problem Statement

Before 1994, the incumbent operators Telkom and South African Broadcasting Corporation (SABC) performed the spectrum management function in the telecommunications and broadcasting sectors respectively. The spectrum management activities were governed until recently under the Radio Act no 3 of 1952. Around the same time the country saw the establishment of the first independent spectrum management function for broadcasting services, with the promulgation of the Independent Broadcasting Authority (IBA) Act No 153 of 1993. It took as much as two years thereafter that the Telecommunications Act No 103 of 1996, established the South African Telecommunications Regulatory Authority (SATRA), mandated to manage radio frequency spectrum for the telecommunications sector (Horwitz, 2001).

Greater demand has been placed on spectrum resources by the bandwidth-hungry applications and disruptive radiocommunication standards such as digital terrestrial television (DTT) broadcasting, WiMAX and LTE. The spectrum management responsibility is primarily split between the DOC and ICASA, the policy maker and the regulator respectively. However, on a secondary level there is other mission critical such as aeronautical and maritime spectrum assignments that are partly performed by parastatals such as Civil Aviation Authority and the South African Maritime Authority. Both these entities report to the Department of Transport. Radio frequency quiet zones created under the Astronomy Geographic Advantage Act are governed by the SKA project under the Department of Science and Technology.

It is inevitable that there are competing interests which may lead to duplication in spectrum management processes, especially in light of the high

demand that wireless communications standards now places on spectrum resources, which in turn hinders effective policies and regulation in this sector.

In 2006, with the intensified demand due to the commencement of the digital terrestrial broadcasting migration process, controversies surfaced. The DOC, through a comprehensive consultative process, agreed internationally on electronic communications standards and a spectrum plan for digital broadcasting, thereafter the regulatory authority embarked on a similar protracted public process to develop a digital frequency plan.

Conflicts over responsibilities and uncertainty of roles has led to court cases such as Altech vs. the DOC and etv vs. ICASA, where the management of radio frequency spectrum had been central to the outcomes of these cases. Similarly the conflict and concerns discussed above have impacted on the licensing of the spectrum bands for high demand 2.6 GHz and 3.5 GHz, i.e. WiMAX/LTE) and have delayed the rollout of critical wireless broadband technologies (ICASA, 2008). Later the ITA and Policy Directions on high demand spectrum in the 800 MHz and 2.6 GHz has not been finalised since the WRC-07. The award of the 1800 MHz and Third Generation spectrum to Vodacom, MTN, CellC, Telkom and the Second National Operator (SNO) was astonishingly done through an amendment of the Telecommunications Act (RSA, 2001) The end result of these delays is the emergence of major obstacles in rolling out electronic communications networks hence the provision of new services – this directly impacts on the achievement of the universal service and access goals for wireless broadband and the Internet.

Despite the increased interest in spectrum management over the last decade and the impact of wireless communications on universal access and services, it is alarming that so little empirical research has been conducted on the impact that these institutional relationships have on allocation and assignment of spectrum resources. Moyo and Hlongwane (2009) have analysed the independence of ICASA with respect to public interest and the influence the Minister of Communications has on decisions taken by ICASA. They alluded to the fact that the Minister of Communications had major influence on the regulatory authority to fulfil its mandate.

It is therefore evident that the dual role of spectrum management shared between the DOC and ICASA and other institutions related to the centralised command and control system creates inefficiencies from allocation to the eventual award of spectrum assignments to licensees. These inefficiencies create major delays in the rollout of new wireless technologies and hence the introduction of infrastructure competition to foster socio-economic development.

1.4. Goals and Purpose of the Study

The aims and objectives of this study are to examine what spectrum management arrangements exist and to what extent they contribute to achieving the objectives of the Electronic Communications Act or undermine achievement of these objectives. This requires a detailed analysis of the legal, regulatory, and institutional spectrum management framework in the country. The research considers, what is effective; what is not working in terms of the South African approach; and lastly it explores possible alternative approaches to spectrum management. The study reviews national spectrum management in the context of the international framework. It examines the evolution in the approach of spectrum management between 1992, before the Telecommunications Act was promulgated, when the South African Band Re-planning Exercise (SABRE-1) was embarked upon and quarter two of 2012, six years after the implementation of the ECA. In addition local institutional arrangements, technological factors such as innovative applications for spectrum and social factors such as the increase in demand for spectrum have been considered. These are factors that highlight recent international trends away from the historical command and control to more market-based spectrum licensing approaches.

1.5. Research Questions

The primary research question is:

How do varying policy and regulatory approaches create an enabling environment for radio frequency spectrum to be efficiently and effectively managed in South Africa in the context of increasing demand?

In order to respond to this main question, the following sub-questions will be answered:

- a. How do policy, legal and institutional frameworks influence the South African approach to spectrum management?
- b. How do the strategies that the DOC and ICASA currently employ expedite or fail to expedite the implementation of radio frequency allocations and assignments?
- c. How should policy and regulation deal with alternative approaches to spectrum management (e.g. beauty contest, auction, etc.) as a means to alleviate inefficiencies which delay the licensing of radio frequency channels?

This study addresses the South African approach to radio frequency spectrum policy, regulation and management and its effectiveness in meeting stated electronic communications sector objectives. In the absence of a broader national ICT strategy, sector policy objectives can be deduced through an examination of the Electronic Communications Act (ECA) and specifically the objects thereof. This research moves from the premise that spectrum management, one of the core functions mandated by the ECA to the electronic communication sector regulator, should support the objects of the Act. In order to meet these objects, a policy and regulatory environment which is conducive for effective and efficient spectrum management is required.

In conclusion, this introductory chapter provides a brief overview of what spectrum management is and it describes the approach to the policy, regulation and management of the radio frequency spectrum. A main motivational factor of this study is to supplement the limited amount of country specific spectrum management literature that exists in the public domain. This report sets out the issues identified in the literature review in chapter two with respect to the institutional arrangements, independence of the regulator, management of scarce natural resources, alternative approaches to spectrum management.

2. Chapter Two: Literature Review A & Theoretical Framework: Managing the Invisible Resource

2.1. Introduction

This study includes two literature review sections due to the multifaceted nature of the field of spectrum management. The two literature review sections are presented due to the limited published research in the field of spectrum management in South Africa. Literature review A (LRA) sets the theoretical basis for principles of policy and independence of regulatory authorities and the management of scarce natural resources. Literature review B (LRB) sets the basis for discussion with respect to the spectrum allocation and assignment methods and the various approaches to spectrum management institutional arrangements.

The early occurrence of the use of wireless electronic communications can be traced back in South African history for military purposes in the Anglo Boer War, 1899 to 1902 (Austin & Baker, 1995; SACF, 2010). Traces of the management of the radio frequency spectrum are found worldwide since the 1920s and extensive studies have been conducted on the principles of utilising the electromagnetic spectrum (Rosston & Steinberg, 1998; Ryan, 2005 & 2004, p. 299). This is evident in that, the establishment of the USA 1927 Radio Act which created the Federal Radio Commission which later transformed into the Federal Communications Commission (FCC), still exists today (Mueller, 1982). Various institutional and legal frameworks have been introduced globally to ensure the efficient use and protection of this scarce natural strategic resource. The ITU's Constitution and Conventions and its related radiocommunications resolutions and recommendations provide the basis for utilisation and management of spectrum nationally and cross-border. The radiocommunication regulations adopted by Member States of the ITU underpins how the radio frequency spectrum is utilised and governed.

The policy and regulatory environment for spectrum management in South Africa, appears to be a challenge in light of the major delays between the allocation and the eventual awarding of radio frequency channels to prospective users and licensees.

2.2. The Regulatory State

According to Braithwaite (1999) there is a new major development from the historic Keynesian welfare state to a phenomenon of the regulatory state. In the Keynesian welfare state, control is primarily within government and is characterised by nationalised industries, legislature, ministries and its related line departments. “Under the welfare state the government does most of the rowing and less steering, whereas under the regulatory state the government does less rowing and more steering” (Lodge, 2004, p. 14).

The notion of the ‘regulatory state’ is grounded on a neo-liberal combination of market competition, privatisation of industries, and decentralisation, arms-length of state regulation. When the United Kingdom deregulated the telecommunications sector in 1984, a body called Oftel was established to regulate that sector. Similarly when Austel was privatised a new regulatory authority was created in Australia (Braithwaite, 1999).

In the mid-1990s, the South African government embarked on a similar process with its managed liberalisation of the telecommunications and broadcasting sectors. This managed liberalisation process in terms of the White Paper on Telecommunications reform had major impediments with too much power remaining in the hands of the policy maker (Horwitz, 2001). As stated by Gillwald (2003) this managed liberalisation process delayed the introduction of competition, hence achievement of national network coverage was slow, which rendered the perceived monopoly state of affairs of the incumbent operator ineffective.

Lodge (2004) argued that there are three partly overlapping discussions of accountability and transparency in the regulatory state. These features of the regulatory state are:

Re-arranging government structures, control methods and relationships amongst players; progression from the welfare state entail transformation of the quality of citizenship from a socialist political formation to an economic agency; visibility of governments is hidden behind regulation by imposing penalties on the regulated actors and allows for regulatory capture (Lodge, 2004).

The characteristics of a regulatory state are generally the existence of parliamentary committees and regulatory bodies. While the major function of the state is to address market failures by legislation and policy directions (Thatcher, 2002).

South Africa falls within the realm of the regulatory state. Whether the South African electronic communications market is ready for the regulatory state has to be further evaluated due to the various independence challenges with regard to the communications sector regulatory authority. The independence of the communications sector regulator, ICASA, once again resurfaced in the latest drafting of the ICASA Amendment Bill (DOC, 2010). In the regulatory state, there is a conscious shift from the historical direct provision of public services to a role whereby the public service positions itself to direct others to expedite delivery.

2.3. The Independence of Regulatory Authorities

One cannot examine spectrum management and planning without considering the notion of the independence of the regulatory authority. Many arguments exist about independence, a term which cannot be easily defined in this context. According to Moyo and Hlongwane (2009), Majone viewed “independent regulatory authorities (IRA) as specialised agencies, operating at arms-length from central government.” They further argue that the key to the sustainability of independence is the delegation of powers to an agency separate from government. “This distinct separation of powers will bestow the necessary credibility to regulatory strategies and policy” (Moyo & Hlongwane, 2009, p. 294). It is further advocated that the regulatory role has to be maintained with appropriate budgets which are required to perform the regulatory function effectively and efficiently without fear and favour and free from political interference.

In the United States of America (USA), regarded as the inventors of the concept of independence, it is not as clear cut as it should be, but the Federal Communications Commission encourages these principles globally as quoted:

An effective regulator should be independent of those it regulates, protected from political pressure, and given the full ability to regulate the market by making policy and enforcement decisions. The regulator should

have the authority and jurisdiction to carry out its regulatory and enforcement functions effectively and unambiguously. And the regulator must be adequately funded from reliable and predictable revenue sources (Samarajiva, 2001).

Independence of regulatory authorities is regarded by many scholars as a myth. Jamison (2005) cited numerous cases where regulators, independent by law, made decisions that were not well received by politicians who appointed them into power. In many of these cases regulators were marginalised or removed from office due to possible unintended, unpopular outcomes of the policies which were made by the political actors. He went as far as to state “to be an independent regulator is dangerous work,” Jamison (2004, p. 3). It is dangerous in a sense that those decisions, made by regulators, can adversely influence businesses of operators, behaviour of end-users, private interest groups, and political authorities.

Jamison (2005) appropriately remarked that for an independent regulator to survive, absolute independence is not desirable. He further remarks “that there are trade-offs between independence and accountability, certainty and flexibility and between long-term goals and short-term viability.” The absence of absolute independence is justified as it will prevent regulatory authorities from pursuing their own individual ambitions.

The ‘partial’ independence of the regulatory authority in South Africa has been debated over more than a decade by scholars Cohen (2001), Melody (1997), Gillwald (2003), and Moyo *et al* (2009). This debate is now further fuelled by the introduction of the ICASA Amendment Bill, which envisages conferring more regulatory influence on the policy maker. It also reflects a tendency to ignore various governance principles. As mentioned, potentially this creates a situation where ICASA will be encouraged to operate as an extension of the DOC (SOS, 2010).

The case of regulatory independence in South Africa is further convoluted by regulating of the broadcasting sector, which enjoys greater independence within section 192 of the Constitution than the telecommunications or postal sectors (RSA, 1996a). Moyo and Hlongwane (2009) argued that ICASA under the constitutional review should be included as one of the Chapter 9 associations and

institutions as it fosters the democracy process. The independence of institutions in Chapter 9 of the Constitution of the Republic of South Africa is guaranteed and they are subjected only to the Constitution and the law. These state institutions enjoy a great degree of autonomy with the objective of enhancing constitutional democracy in the Republic.

As pointed out by Moyo and Hlongwane (2009), the general distrust of the autonomous organs of state in the ICT sector surfaced in 2006 with the DOC objecting to the placement of the communications regulatory authority under Chapter 9 of the Constitution. This is a clear indication that the administration of the day wished to have some control over regulatory bodies such as ICASA hence curtailing its decision making power.

Melody (1997) strengthens Moyo and Hlongwane's (2009) argument for the inclusion of ICASA as a chapter 9 institution. ICASA is responsible for strategic national scarce natural resources such as the radio frequency spectrum, numbering and rights of way (Melody, 1997). Managing this indestructible invisible resource, combined with the regulation of broadcasting, public and commercial, should hold enough argument to motivate to place ICASA under the Chapter 9 institutions to enhance its independence to perform its function without "fear, favour or prejudice" as mandated by the ECA.

Cohen (2001) pointed out that the Republic of South Africa is also a signatory to various international administrative instruments such as World Trade Organisations' (WTO) basic telecommunications agreement. These agreements generally ensure that WTO Member states initiate activation of competition in basic telecommunications services. This agreement contains three documents namely, the Annex on Telecommunications (the Annex), the fourth Protocol of Basic Communications (Fourth Protocol) and the Telecommunications Reference Paper. South Africa has signed up to the Reference Paper on regulatory principles which is an additional undertaking. These undertakings contains six sections of which an Independent Regulator and the allocation of scarce national resources are included (Cohen, 2001). In 2000 it was already mooted that South Africa was transgressing its WTO commitments when the USA government wanted to lodge

action against the country on behalf of one of its domestic operators wishing to enter the South African Telecommunications market at the time.

Under the ICASA Amendment Bill the DOC proposed removing radio frequency spectrum planning and ultimately the allocation of spectrum from the functions of the regulator, and place that function under the direct control of the Department of Communications. Similarly the proposed creation of a Tariff Advisory Council to advise ICASA and the Ministry on pricing issues affects one of ICASA's core functions. Additionally the restructuring of the Complaints and Compliance Committee and the appointment of a full time Chairperson, who does not have to be a member of ICASA Council, creates challenges in terms of independence and governance. Various other provisions of the Bill tend to give the Minister direct control over the activities of the Authority. Specifically, section 4, subsection 3 (o) reads as follows ICASA "must implement policy and policy directions made by the Minister in terms of the Electronic Communications Act (ECA) and the Postal Services Act" (RSA, 2005). The ECA currently provides ICASA with some discretion and states that the Authority "must consider" policy directions issued by the Minister of Communications (RSA, 2005).

It is obvious that the independence of the ICASA is under threat which heads onto a collision path with the additional commitments in Reference Paper of Regulatory Principles of the WTO. There is a common belief that this behaviour creates anxieties among the shareholders of multinationals which are regulated by the ICASA. This ICASA Amendment Bill polarised the industry, with labour and groups such "Save Our SABC" (SOS) mobilised to vehemently oppose the Bill.

Regulators must on the one hand be independent from these various actors, political influences and the industry it regulates. On the other hand it does not mean that regulators 'answer to no one' (Jamison, 2005). It is therefore important that regulatory authorities must be accountable in a transparent manner.

2.4. Accountability and Transparency of Regulatory Authorities

Regulatory authorities in reality are constrained by the political environment, legislation, funding, public opinion and conditions conferred in licences. Braithwaite (1999) points out that the notion of the new regulatory state

introduces a new set of challenges with regard to regulatory accountability and transparency.

Lodge (2004) defines accountability as “the obligation to account for regulatory activities to another body or person whereas transparency relates to imposed values of making regulatory activities participatory and accessible”. He also sets out the three fundamental elements of systems of control as “standards-setting, behaviour-modification and information-gathering.” It is of utmost importance that regulators be held accountable and transparent for any control system.

In the traditional welfare state accountability of public entities was primarily to the executive, legislature and the judiciary. The phenomenon of the regulatory state brought about a new governance structure with fragmented responsibilities and extended delegation of powers to public and private institutions (Braithwaite; 1999; Lodge, 2004; Scott, 2000). These delegations of power create fundamental challenges for accountability. The major challenge for governments generally is the amount of autonomy versus sufficient control of the various actors’ responsibilities (Scott, 2000).

Scott’s (2000) illustration in Table 2, below emphasises the three fundamental questions of “who is accountable,” and “to whom” and “for what.”

Table 2: Examples of Linkages between Values and Accountability Institutions

| | | For what? | | |
|----------|-----------------------------|---|---|---|
| | | Economic Values | Social/Procedural Values | Continuity/Security Values |
| To Whom? | ‘Upwards’ accountability | Of Departments to Treasury for expenditure | Of administrative decision-makers to courts/tribunals | Of utility companies to regulators |
| | ‘Horizontal’ accountability | Of public bodies to external and internal audit for probity and value for money | Review of decisions by grievance-handlers | Third-party accreditation of safety standards |
| | ‘Downwards’ accountability | Of utility companies to financial markets | Of public/privatised service providers to users | Consultation requirements re: universal service Requirements. |

Source: Scott (2000) adapted

Scott's illustration, in Table 2, presents a complex mesh of hybrid accountability in contrast to the traditional formal duties of public entities such as regulatory bodies who account for their activities to the policymaker, the legislature and the judiciary. This further illustrates that the new regulatory state has on the one hand fragmented the mechanisms of service delivery but on the other introduced various accountability mechanisms.

In the Republic of South Africa, in the context of the regulatory state, one has seen the introduction of accounting bodies such as Parliamentary Portfolio Committees who play an oversight of role in the electronic communications sector on behalf of the Executive; and the Office of the Auditor General which sets expenditure standards for public institutions in terms of the Public Finance Management Act (PFMA).

As illustrated in Table 2 these accountability mechanisms create models of interdependencies and redundancies. This phenomenon, Scott (2000) defines as "extended accountability" which creates a hybrid map of reporting links by the regulatory authority (Lodge, 2004). It is therefore important that regulatory authorities have to be well resourced to deal with the complexities and that the necessary firewalls and police patrols are in place.

Interdependent bodies account for some of the actions of primary actors and are dependent on the actions of others for crucial resources such as proficiency, information and capacity, to legitimise the actions of these respective bodies. This invariably presents a prerequisite for continued transparent and accountable conduct of all the principle actors which to a large extent creates bureaucracy but enhances transparency (Scott, 2000)

For example ICASA and the Competition Commission have been bestowed concurrent jurisdiction over ex-post competition matters. In terms of the ECA and the Competition Amendment Act, the Authority and the Competition Commission may request assistance and advice from each other on competition matters and the activities specified in the Chapter 10 (same numbering in both Acts) of the respective pieces of legislations. According to Scott (2000) the redundancy model of accountability is a method by which independent entities are established to ensure that systems can still operate as a failsafe measure if one of

the systems is unsuccessful. These redundancy models are a characteristic of the public service and are under severe pressure by privatisation, which can deliver the same services more efficiently and effectively.

Scott (2000) argues that in a typical hybrid accountability regime, the respective components of that system operate in their own policy domains but inevitably introduce 'checks and balances' which either constrain or encouraged behaviour depending on the balance of the overall system at instance particular time. The overall balance of a regime is affected by the distinct institutions that hold each other responsible to behave rationally and in the context of the service that needs to be delivered.

The harnessing of 'extended accountability' provide a mechanism to implement strategic interventions by shifting balances to ensure corrective measures where a system that is destined to fail. The courts and in particular the law are essential mechanisms to shift the balance of accountability in the electronic communications sector. The fact that there is an opportunity for the review of a particular decision made by the regulatory authority by the courts, ensures that regulations and policy are made in such a way that it can stand in a competent court of law. This in itself inhibits the inappropriate behaviour of regulatory authorities and there is a belief that it is not a bad thing as it creates range of checks and balances to advance transparency. Generally, the mobilisation of consumer interest groups in the electronic communications as well other sectors is constantly enhancing the balance of accountability. Similarly, more aggressive oversight roles by legislatures will definitely improve accountability of Ministries.

Scott (2000) argues that in this hybrid web of fragmented responsibilities, the challenge to public lawyers is now to introduce strategic interventions to ensure shifting the balance of accountability to achieve the desired outcomes and structures. "The process of collibration, which is regarded as a stratagem to change the behaviour of such control mechanisms of accountability" (Dunsire, 1993). It is believed that that this mechanism creates tensions, good or bad, amongst respective reporting domains within a hybrid accountability system. This inevitably creates cross functional conflict amongst domains (general competition authority and sector regulatory authority) and the idea is not to resolve these

conflicts but to hold the regime at a balanced unease to ensure that the principles of accountability are foremost.

According to Scott (2000) and Lodge (2004) dense hybrid accountability networks also have their disadvantages. In traditional dense accountability regimes there is an evident lack of transparency and in the proposed new arrangements with its tendency to outsource responsibilities, delegation of authority results in a lack or decrease in broad sector participation in decision making.

2.5. Principles and Approaches Managing Scarce Natural Resources

Radio frequency spectrum is regarded as a scarce natural resource with unique scientific characteristics. Levin (1971) refers to electromagnetic spectrum as the “invisible resource” which, unlike other natural resources, is inexhaustible and cannot be destroyed or recreated over a period of time. Levin additionally made an elementary comparison between spectrum and the reference between national highways and domestic airspace. These mediums of transport, the roads and the airspace, are always available even when they are not in use for the carrying of aircraft or freight vehicles (Levin, 1966). The Ministry of Communications in South Africa in its recent radio frequency spectrum usage policy defined spectrum as a natural virtual resource (DOC, 2010). The African National Congress (ANC), the ruling party, in its communications discussion document, regard radio frequency spectrum as a public asset (ANC, 2012).

Although spectrum is regarded globally and by the International Telecommunication Union as a scarce natural and national resource, it does not enjoy the same protection as minerals, land, water and air. Many high level government and policy sources affirm that spectrum is a natural resource, but economic models for mineral extraction, fisheries and forestry have not been adopted to spectrum at an international and national level (Ryan, 2005). The contrasting fact is that although spectrum is proclaimed the world-over as this scarce natural resource, international trends show that it is managed by entities which have nothing to do with the management of scarce resources. Spectrum is instead managed by independent government authorities who regulate content and deal with consumer complaints. Radio frequency spectrum can however be

depleted when overused, but can be dormant and wasted if not in use. As much as spectrum may be indestructible, it can be polluted with harmful interference sources, which can make communication on the electromagnetic waves impossible (Ryan, 2004).

Mueller on the other hand argues that radio frequency spectrum is not a natural resource and that the “scarce” characterisation of radio-frequencies is a myth. He further argues that there is no spectrum but only transmitters and receivers of electromagnetic energy which can be generated by many sources such as the sun and neon lights (Mueller, 1982). Mueller believes that interference sources give rise to scarcity. He states that therefore it is the electronic compatibility between transmitters and receivers and the ability of receivers to discriminate between different modulations on the same radio frequency channel that establishes whether there will be scarcity or not.

Radio frequency spectrum as a scarce national resource is at the centre of debates as it applies to the public-trust doctrine, which is seen as the cornerstone of environmental law applications. The debate is now with regard to these environmental laws on the protection of scarce natural resources such as clean air and water, is argued to be extended to spectrum. In environmental legislation, such as laws regulating air pollution, the centralised command and control type of management of these critical scarce resources have proven to be successful. Ironically these principles of command and control, such as inflexible rules and high degree of centralisation in decision making, contradict the introduction of market-based property rights approaches which are advanced as more efficient methods of spectrum management (Ryan, 2004).

The traditional “command-and-control” model, which is regarded by some as best suited to fulfilling public interest policies. The model can also provide for the harmonization of spectrum use leading to the development of economies of scale and falling costs for equipment manufacturers and customers (ITU, 2012).

A “market-based property rights” model involving exclusive usage rights and spectrum trading and pricing. The market-based model should stimulate further technological change in spectrum-based applications and

usage, which may not lead to the same degree of harmonization and falling costs of production of equipment (ITU, 2012).

As the spectrum management approach worldwide moves towards more market-based property rights mechanisms, there appears to still be elements of centralised command and control in spectrum planning. The question is to what extent the validity of either approach holds in the policy and regulatory context in South Africa.

2.6. The Relationship between the Policy Maker and the Regulator

Countries the world over are currently in the process of re-evaluating their spectrum management policies. This re-assessment is necessitated due to the host of new spectrum hungry electronic communications technologies that are being introduced. These new technologies place greater demand on spectrum resources (Levin, 1966).

The roles of the policy maker, the DOC and the regulator, ICASA, have been unclear since the inception of an independent regulatory body in spectrum management in 1996. This is particularly evident in, for example, the allocation of 1800 MHz and third generation (3G) or 2100 MHz spectrum to the major spectrum licensees through legislation (RSA, 1996b). The award of spectrum in terms of the legislation is a firm function bestowed on the regulator. Yet, the policy maker was petitioned to amend the telecommunications law to award radio frequency spectrum to the major operators.

South Africa had, in line with international trends, established independent regulatory authorities, namely the Independent Broadcasting Authority (IBA) in 1993 and the South African Telecommunications Regulatory Authority in 1995 (SATRA). These two regulatory authorities were later merged into the Independent Communications Authority of South Africa (ICASA), in response to convergence of technologies (Moyo & Hlongwane, 2009). Moyo and Hlongwane (2009) further highlight various issues which provide indications that the policy maker desired to have the regulatory authority under its control. The Telecommunications Act, 103 of 1996 contained various provisions where the Minister of Communications had to prescribe regulations at various stages of the

managed liberalisation process, rather than to leave the matter to the independent regulator, see sections 38(1) and 40 (4)(i) of the Telecommunications Act, 1996.

This phenomenon of the political control of agencies surfaces in many countries. Amongst others, in the revision of the United States of America's Clean Air Act and establishment of the Environmental Protection Agency (McCubbins, Noll & Weingast, 1989). McCubbins *et al* (1989) identified how structure and process were used to tailor politically desirable agendas. This type of outcomes is generally achieved through constant delays in policy making developments and makes the regulatory authority responsive to electorates of representation in favour certain office-bearers.

Regulatory independence and institutional arrangements moreover have an enormous amount of effect on the performance of entities that have been privatised and the confidence investors have in the investment climate in a particular country. A weak judiciary in country jurisdictions will have foremost challenges in sustaining a regulatory system that can bear privatisation, hence investment opportunities (Levy & Spiller, 1996). A strong judiciary give radio frequency spectrum users an alternative possibility to appeal if regulators make adversarial decisions which could have a negative impact on the business of especially those of wireless and mobile network operators who are entirely dependent on spectrum to run their networks.

It is generally accepted that regulatory authorities, such as ICASA, are better equipped with skills and have greater access to information than the policy maker. This perception exists because regulators are generally financially better resourced than the policy maker and can therefore access several experts in the industry under their control (McCubbins, Noll & Weingast, 1989). This appears to be the opposite in the case of the DOC and ICASA. In 2008, ICASA, as mandated by legislation, went through a process of adopting digital broadcasting standards. However, before it could officially adopt these standards, the policy maker chose to investigate and to adopt a different standard. These were apparent instructions issued by the then Director General and Minister of Communications in 2010 during their tenure in office.

A brief analysis of the draft radio frequency spectrum policy suggests that the spectrum management function of the regulatory authority appears to be limited to radio frequency spectrum licensing with the policy maker, the DOC, to take over responsible for planning thereof (DOC, 2010b). This policy is not consistent with the ECA in terms of the definition of the roles of DOC and ICASA. The DOC appears to have assumed the spectrum planning role of the regulator to a large extent. The ECA cannot be amended through policy but only through an Act of Parliament, hence the proposed legislative revisions (DOC, 2012a).

The national spectrum management approach made its first appearance when the DOC established a spectrum management directorate arising from the broadcasting legislation (RSA, 1999). The ICASA Amendment Bill has a clear provision that the radio frequency spectrum planning function is intended to be the domain of the policy maker. This research report will consider the principal-agency relationship (Braun & Guston, 2003) reflecting on the DOC aspirations to capture the radio frequency planning function which ICASA has been tasked with.

2.7. Spectrum policy and regulation in South Africa

Very few sources, which document spectrum management in the country, exist in the public domain. Song (2010) in his South African case study “Open Spectrum for Development” is one of the few resources which provides for a reasonable overview of the spectrum management landscape. Other scholarly publications that exist are focussed on regulation development and engineering publications. Ngwenya (2011) focussed on an analysis for spectrum identification for broadband wireless access. The review of legal documents indicates that there has been a chronological sequence of events that shaped spectrum management since the commercialisation of the monopoly operator in 1992 and the establishment of an independent regulatory authority. These piecemeal events have had a major influence on what the South African spectrum management approach is today. Table 1 lists this sequence of spectrum events and developments.

The White Paper on Telecommunications sets the framework for managed liberalisation to reform the telecommunications sector in South Africa (Horwitz,

2001). Hence, published documentation starting with the White Paper on Telecommunications was closely studied to establish the sequence of events that influence the South African spectrum management approach. In order to better analyse spectrum management approaches in South Africa, processes in five other countries will be reviewed by analysing the ITU documentation and other literature. The spectrum management arrangements for each country will be explored, which ranges from spectrum management located in more than one entity for government and commercial purposes; or the independent regulatory authority and policy maker balancing act; or arrangements located solely with the policy maker; or the arrangements located entirely in a single spectrum management agency. The countries selected for review are the USA, the UK, Australia, Canada, France and New Zealand which also give a good perspective of approaches in the three different ITU Regions. These countries are renowned leaders in spectrum management internationally and have made extensive contributions towards the international spectrum management debate. These countries additionally have already ventured into alternative approaches to spectrum management.

3. Chapter Three: Literature Review B: Country Perspectives on Spectrum Policy and Regulation.

There are essentially two schools of thought advocating radio frequency spectrum management approaches namely the centralised command and control method and the market-based property rights approach. The study draws on the theories and principles of management of scarce natural resources which is currently the corner stone of the laws of environmental protection. In terms of institutional arrangements, the principal-agency theory will be interrogated to provide insight into the relationship between policy-maker and regulator and related issues of regulatory independence. The regulatory strategies of command and control and market-harnessing controls will be analysed to consider a more effective and efficient method of radio frequency spectrum management. This theoretical and conceptual framework will be used to consider the most appropriate approach for the South African electronic communications industry.

3.1. Radio Frequency Spectrum Planning

The terms allocation and assignment of radio frequency spectrum is often used interchangeably. There is however a distinct difference between the two spectrum management processes. Spectrum allocation and allotments are terms that are associated with radio frequency spectrum planning. The ITU uses the following definitions:

Allocation (of a frequency band): Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned (ITU, 2008, p. 8).

Allotment (of a radio frequency or radio frequency channel): Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions. (ITU, 2008, p. 8)

According to the OECD (2005, p. 14) “spectrum allocation refers to the division of the spectrum into bands for particular services (such as fixed link,

mobile communications and broadcasting). Once services are allocated decisions on how to assign usage rights for radio frequency channels to particular users must be taken. The terms allocation and allotment from a spectrum holders point of view are frequently used where regulatory authorities assigns a block or a range of radio frequency channels to a licensee who in turn will make assignments to their individual radio base stations.. Spectrum license holders often also refer to their licensed block assignment as an allocation at operator level. From this licensed so-called “block allocation” the licensees will then make detailed assignments of channels to their transmitting stations.

Hazlett & Monuz (2008) in their analysis of spectrum allocation policies draw a clear distinction between the allocation and assignment function. These allocation policies are proposed in Table 3 the following stages in the award process in a profits focused approach.

Table 3: Allocation and assignment stages

| Stage 1 | Stage 2 | Stage 3 |
|--|---|-----------------------------------|
| Spectrum Allocation | Assignments methods | The retail market |
| International and Regional Bodies Policy Makers allocate services in the Table of frequency allocations Regulatory Authority creates wireless licenses | First-come, First serve Comparative, Lotteries, Action rules | Prices Outputs, Tax savings |

Source: Adapted from Hazlett & Munoz (2008)

Table 4: Elementary features of spectrum management regimes

| | Exclusive Rights | | | Non-Exclusive Rights |
|------------|------------------------|---------------------|---------------------------------|---------------------------------|
| | Command & Control | Market-based | Ownership | Commons |
| Allocation | Government Planning | Government Planning | Endogenous Owners Government | Endogenous Owners Government |
| Assignment | Administrative Process | Auction | Auction, Market Transactions | Auction of Usage right or users |

Source: Adapted from Bauer (2006)

Bauer (2006, p. 3) has also illustrated that spectrum allocation is a function of government. This function could however be located within the regulatory authority or with the policy maker. According to Melody (2001) inappropriate consideration to spectrum allocation could affect the assignment of this valuable natural scarce resource. Pogorel (2007) in the analysis of the “nine regimes of

spectrum management” also draws a distinction between allocation and assignment. Arnbak (1997) further questions the validity of national governments in radio frequency spectrum management. Arnbak (1997) admits that in an International Telecommunication Union context, mutual coordination and avoidance of harmful interference there is a role which sovereign states have to play (Melody et al, 2001, p. 135). In this context a radio frequency band therefore is allocated to a specific service such as mobile, fixed, fixed satellite and broadcasting services. The services in the respective allocated band can provide with technology standards such as WiMAX, LTE and DVB-T for example.

Agreements on the ITU table of frequency allocations are reached through an international treaty whereby an allocation is agreed at a global level through World Radiocommunication Conferences. Allocations or sub-allocations could also be agreed at a regional level at a dedicated Regional Radiocommunication Conferences or at a national level by the Regulatory Authority. These allocations at all spheres of the spectrum management could be modified by adding footnotes to suit a particular situation for an ITU member state.

3.2. Spectrum Management Policy and Regulatory Approaches

There are various policy and regulatory approaches to spectrum management. Spectrum management is an area which generally consists of combinations of complex features of a combination of technical, political, and the related administrative matters. There is a common understanding worldwide and has been encouraged the world over that whatever spectrum management approach be adopted, it must have goals to optimise use of radio frequency spectrum (Bauer, 2006). Policy makers and regulators are consistently antagonised with challenges of technological developments and market forces. The availability and access to spectrum is paramount to wireless operators but regulators and policy makers must balance their decisions between efficiency and interference free radio frequency spectrum channels as well as meeting the demand for spectrum.

There are three primary spectrum management regulatory models which are deployed globally and are presented in the Table 5 below:

Table 5: Primary spectrum management regulatory models

| Model | Who decides? | When used? |
|---|--------------|---|
| Command and control / Administrative | Government | Scientific, military, radio astronomy, emergency, public need |
| Market-based or property right approach | Market | Whoever values spectrum the most |
| Commons | Technology | Promote innovation |

Source: Derived from (Marcus, Nett, Scanlan, Stumpf, Cave & Pogorel, 2005)

3.2.1. Command and Control Approach (Administrative)

Radio frequency spectrum management was traditionally done through centralised planning or a command and control decision making system, where the state dictates what technology and applications are allocated for a range of radio frequency spectrum (Peha, 1998). Melody (1980) concluded that spectrum will be allocated and assigned especially in developing nations, by administrative processes. The reason for this is that developing countries have additional imperatives such as universal service and access targets to be achieved, which could be done more cost effectively through wireless technologies which are dependent on access to spectrum resources.

The fundamental building blocks of spectrum management for access to radio frequencies have not changed much over the past hundred-year history of radio (Cave, 2002). Melody & Moller (1997, p. 117) analysed the access to essential public scarce resources such as spectrum, rights of way and numbers. Arnbak (1997) further assessed rights to spectrum and concluded that although technological developments enhance the capacity of spectrum, it produces a number of composite issues for the management of spectrum which surely affect the efficiency and usage of spectrum.

The comprehensive assessment of USA spectrum management through broad stakeholder participation (US General Accounting Office, 2002a, p. 58) suggested the following structural options that could be explored:

Determining whether the current regulatory structured should be continued; Creating mechanisms for better coordination of the NTIA, FCC and IRAC functions by any of the following means: Requiring agencies to develop a single spectrum plan that would be reviewed regularly; Making coordination among spectrum management agencies a critical objective in the strategic plan of each agency; Establish other policies and procedures

that requires on-going coordination; Creating a single agency to manage spectrum; and Letting federal agencies manage their own spectrum (USGAO, 2002a, p. 58).

In South Africa, similar to many countries around the world, the command and control or administrative spectrum management approach, which dated as far back as the early twentieth century, is still widely deployed (Wildman *et al*, 2006; Arnbak, 1997). This is the case in developing countries where the regulatory authorities are under resourced and spectrum policy and regulations are a copy and paste best effort from its developed nation counter parts. The command and control model is where the regulatory authority or in some cases the Government of the country decides who will use radio frequency channels and what technologies will be deployed in the respective bands. The spectrum management controlling body in many instances decides the duration of the spectrum usage which normally is accompanied with demanding roll-out obligations.

In ICASA's latest spectrum migration proposal and licensing of the 800 MHz and 2.6 GHz bands, the authority endeavours to attach ambitious roll-out obligations for access to these radio frequency bands. The roll-out obligations includes 70% of population coverage in five (5) years whereby 50% must exclude the metropolitan areas (ICASA, 2012).

The initial award for spectrum licences in a command and control system is generally done through a beauty contest. A beauty contest is a licensing process whereby a regulatory authority decides which firm's financial, technical, and general services offerings are sound. Bauer (2006) argues that the administrative or command and control spectrum management regime are commonly associated with long delays and governments inability to select the foremost promising submission. Long drawn out court cases is the order of the day. This was most evident in the licencing of the third mobile operator in South Africa, CellC and Second National Operator (SNO), now Neotel (ICASA, 2001). The assignment of spectrum and the usage thereof have been delayed for years due to losing parties challenging the outcomes of the licences.

Wellenius and Neto (2008) in their study of "radio spectrum opportunities and challenges for the developing countries" have admitted that there will always

be a need to apply the command and control approach to spectrum management for socio-economic development. Replacement of spectrum management regimes and policy processes cannot be changed overnight as governments must consider spectrum requirements for its country's safety and security and for scientific purposes (Wellenius & Neto, 2005).

3.2.2. Market-based property rights spectrum management approach

There are four market-based spectrum management mechanisms which should be considered as in Table 6:

Table 6: Market-based spectrum management mechanisms

| Type | Cost |
|----------------------------------|--------------------------------------|
| Auctions | Confronts opportunity cost acquiring |
| Secondary trading | Confronts opportunity cost retaining |
| Administrative Incentive Pricing | Confronts opportunity cost retaining |
| Liberalised usage of frequencies | No cost |

Source: Derived from Marcus, *et al*, 2005

Traditionally, the radio frequency spectrum has been managed by a government bureaucracy. The government agency sets aside blocks of frequencies for specific services (allocation). Within those spectrum blocks, a specified number of channels are engineered of which licenses to use these channels are issued to private users. Harmful radiocommunication interference is controlled indirectly, by rigidly fixing the technical radiocommunication standards and positioning of the transmitters and receivers within each radio frequency spectrum blocks. This practice was primarily employed to resolve technical problems related to RF interference and compatibility. It has had the adverse consequence by giving the spectrum management bureaucracy near-total control over market entry in all radiocommunication services (Mueller, 1993).

A number of countries around the world have undertaken reviews of their existing spectrum management processes with respect to government versus non-government services. These reviews were undertaken in order to free-up more spectrum for existing and new operators to achieve universal access and increase choice to consumers. The well-known review is the UK's detailed spectrum investigation (DSI) for government holdings (Cave, 2005).

In most of the developed world there is a tendency to move away from the central planning command and control method to a more market-based property

rights approach (Wellenius & Neto, 2005). Coase's (1959) article on the Federal Communications Commission gave impetus to the on-going debate on market mechanisms for spectrum management. This idea only effectively took off in the 1990s when market-based spectrum management approaches were adopted in New Zealand followed by Australia and the United States.

A market-based approach to spectrum management is effectively based on the introduction of property rights. This approach is characterised by three elements, (adapted from Baumol and Robyn 2006): i) Well-defined exclusive rights to the use of spectrum; ii) A market-type primary assignment mechanism such as an auction for the initial allocation of spectrum rights. iii) A secondary market in which these rights can be sold.

The New Zealand approach, the first market-based approach, was a radical departure from the traditional administrative centralised spectrum management methods. It was however undertaken in the context of a country that relies primarily on *ex post* competition regulation, rather than the establishment of a regulator for ICT until fairly recently. The prime motive for this market-based method was to deregulate entry into radio-based electronic communication services and advanced efficient allocation of spectrum resources (Mueller, 1993).

According to Cave (2001), Melody substantially contributed to the radio frequency spectrum controversial deliberations over approximately two (2) decades. Melody advanced universality principles to establish a spectrum management regime which fostered social and economic objectives. Melody (2001) appropriately anticipated that radio-frequencies will be allocated and assigned by means of administrative processes for a while. Cave (2001) further purported that Melody reconsidered the spectrum debate at the turn of the twentieth century and conveyed an adverse outcome on the third generation (3G) spectrum auction (Melody, 2001). Melody's solution for this unfavourable outcome was to eradicate monopoly rents associated with scarce public resources, such as spectrum, by permitting innovative new entrants into the telecommunications market.

In South Africa, the recent spectrum debate tends to focus on the same ideas. Increasingly, market-based models of planning and regulation are advanced.

In the licensing of the 2.6 GHz and 3.5 GHz bands and now the 800 MHz radio frequency bands, ICASA envisages the design of an auction process that will allow 450 holders of electronic communications network licensees to compete fairly for spectrum since demand exceeds the supply (ICASA, 2011b).

There are various advantages and disadvantages to the market-based approach. These advantages are often compared to various regulatory strategies such as command and control, self-regulation and enforced self-regulation, incentive-based regimes, market-harnessing controls. Market-harnessing controls for instance can lead to hoarding and create barriers for entry. Command and control mechanisms on the other hand are inflexible and may lead to regulatory capture (Baldwin & Cave, 1999).

Wilkin (2001), like most political economists, take Marx's critique of capitalism as their starting point which argues that "placing communications in the control of private entities is as dangerous as having it in the power of the state." Private entities surely preoccupied with revenues which wear down the independence element of human security of the masses in order to make balanced choices of social, political and economic life. Wilkin (2001) further argues that the neo-liberal institutional and policy regimes which are now a global inclination, raises major challenges for the realisation of human life security. The significance of this view is that the public arena becomes controlled and strengthened by the interests of private influence.

Centralised control generally associated with monopoly power on the other hand has more ramifications than just the introduction of apparent artificial scarcity of resources, affordability and sub-standard quality of basic services and goods. In reality, it influences markets and gain ICT profits while firms use their wealth and power to influence public opinion and policy hence controlling the culture and information society (Mosco, 1996). These arguments can also be applied to spectrum management approaches as telecommunication and broadcasting firms push approaches that limit new market entry.

3.2.3. Commons Approach to Spectrum Management

Under the commons model, radio frequency spectrum is allocated on a non-exclusive rights basis. It is the cases where a particular radio-frequency band

of spectrum is shared amongst multiple users and electronic communications devices. Regulators and policy makers allocate radio frequency bands which licensees and individuals can use unrestrained. The spectrum is also referred to as licence exempt radio frequency bands. The key driver for the commons spectrum management regulatory model is technology (Wellenius & Neto, 2005; Pogorel et al, 2005; ITU, 2004).

There are several technical rules by which users of the commons frequency bands have to adhere to. These rules are largely parameters such as technical standards and restricted power levels which are established to avoid harmful interference to other services. Typical bands being opened as commons or generally defined as licence exempt are the Industrial Scientific and Medical (ISM) radio frequency bands. The 2.4 GHz and 5.8 GHz bands are the most commonly used RF bands. These bands will typical be used for short-range devices such as remote control car locking mechanisms, microwave ovens, scanners, television remotes and blue tooth connections.

These commons radio frequency bands have been explored by various innovative technologies and are currently accommodating many low power electronic communications local areas networks (LAN). Laptops and wireless routers are typical devices which operate in these commons spectrum bands. It is argued that forthcoming radio technologies such as cognitive radio and software defined radios coming into the market and others being tested might declare spectrum scarcity obsolete. These latest state of the art devices allow for easier sharing of spectrum resources (Wellenius & Neto, 2005).

The spectrum commons approach has its draw backs as it cannot guarantee services free of harmful interferences. Electronic communications services operating in allocations for commons spectrum are done on a “non-protection, non-interference basis.” This means that services deployed in the spectrum commons bands will not receive protection from either other services in the band or should not be allowed to cause harmful interference to out-of-band services (ITU, 2008).

Where electronic communications network deployments requires substantial investments and long pay-back periods it will be essential to have

access to spectrum with exclusive usage rights. The risk is that services could be interrupted by various unwanted transmissions and interference sources. Although the spectrum commons model rapidly liberalising the electronic communications market place, there are significant technical and mostly economic limits on how far the implementation could be stretched (Wellenius & Neto, 2005)

There are various commons approach models which are tried and proposed, such as the licence-exempt models where users are allowed to operate in certain bands without authorisation. In the South African model, users are allowed to operate short-range devices in certain bands under technical power levels and equipment type approval limitations. Type approval is generally the certification of electronic communications equipment against an official standard. A more general open access model is currently proposed by ICASA and the DOC to implement bands for qualifying users and therefore managing the spectrum. This should be done on national public spectrum resources employing intelligent technologies (Benkler, 1998).

Pogerel et al (2005) argued that regulatory bodies should take care when opening bands for open access as the process is extremely challenging to reverse. Hazlett (2004) reiterate, when spectrum strategies are not well established, could lead to overuse of a resource, for example the “over-grazing” problem which renders commons spectrum unusable to all parties.

3.2.4. Primary spectrum assignment models

The International Telecommunications Union uses the following definition for the assignment of a single radio frequency channel or a contiguous block of channels.

Assignment (of a radio frequency or radio frequency channel):
Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions (ITU, 2008).

The initial assignment of radio frequency channels will always be a function of government irrespective if it is flexible market-based or an administrative command and control approach to spectrum management (Marcus et al, 2005; ITU, 2006b). The reason for this is that spectrum is a public resource

which is a sovereign right of the state whom will under all circumstance permit access to the use thereof.

The authorisation of the use of spectrum to a station or stations at a specified location is a function typically determined by a national regulatory authority or a government institution. These assignments are normally accompanied by a fee to either cover the administrative cost or the economic determined value of the spectrum channels. Radio frequency spectrum could also be assigned to a band manager who manages spectrum on behalf of an administration.

Mechanisms of primary assignment of spectrum fall under one of four categories i.e. first-come, first-served, comparative review or beauty contest, lotteries and auctions as illustrated in Table 7 below.

Table 7: Initial radio frequency assignment models

| Model | Characterised by |
|-------------------------------------|---|
| First-come, first-served | If demand < supply, economically efficient if no scarcity, Incumbents dominate the airwaves |
| Comparative Review (Beauty contest) | Subjective judgements, not economically efficient |
| Lottery | Non-discriminatory, not economically efficient |
| Auction | Non-discriminatory, economically efficient |
| Hybrid Model | Public interest |

Source: Derived from Marcus, *et al*, 2005

3.2.4.1. The first-come, first-served assignment method

The first-come, first-served assignment method of radio frequency channels has been deployed the world over and was applicable in a period where there was no scarcity of spectrum. This method is generally characterised by incumbent operators that dominating the airwaves (Oliver & Ohlbaum & DotEcon, 2008). This administrative method attracts little transaction cost and it is regarded as a very simple process. Marcus *et al* contended that “The central principle of this mechanism is that the right to use the spectrum is assigned to whichever candidate applies first (Marcus *et al*., 2005, p. 9).

Marcus *et al* (2005) as well argues that the first-come, first-served spectrum award system relies substantially on fairness of who exact in time have submitted its application. Otherwise the process is largely subjective and the more efficient operators, with adequate information sources and resources, will always

have an advantage over a smaller operator. The exact time of submission must be logged to create a fair, transparent and non-discriminatory assignment process.

The disadvantage of this process is that spectrum does not necessarily land in the hands of those who would use the spectrum more efficiently. Where the selection of the successful applicant is not determined by the economic value of spectrum, this can lead to over assignment of spectrum hence hoarding (Bauer, 2006). The fear for over assignment and hoarding is that radiocommunication network operators could in a new flexible spectrum management framework, where spectrum trading is prevalent, and gain windfall profits on high demand spectrum resources.

3.2.4.2. Lotteries

Lotteries are commonly used where there are conflicting interests such as cross ownership therefore spectrum is awarded randomly to qualified applicants. Poole and Lee pointed out in their presentation on the market-based approach to spectrum management that, although lotteries are a quick and transparent process, they have various disadvantages. Lotteries are often characterised by many applicants for spectrum and the administrator of the process determines the entry criteria (Poole & Lee 2007). Another disadvantage is that there is a strong possibility that it could lead to ineffective award hence inefficient assignment of valuable spectrum resources, meaning that players get too much or too little relative to their technology and usage needs. Spectrum could also land in the hands of speculators who flourish to achieve windfall gains from public goods (McClean *et al.*, 2007). This could further erode government revenues due to the potential to receive thousands of submissions as the transaction cost is fairly low. Governments have to allocate resources to assess these submissions which could delay the process.

Marcus *et al.* (2005) further argue that if the spectrum fees are fairly low and the market allows secondary trading, it creates incentives for speculators in lotteries to obtain an assignment in order to resell spectrum for windfall profits. The United States issued most of its spectrum licenses to qualified applicants through a lottery process. For reasons of speculators in lotteries, spectrum assignment through lotteries has not taken off in other jurisdictions and was

abandoned by the United States in favour of a more transparent auction process (Marcus *et al.*, 2005).

3.2.4.3. *Comparative Review or “Beauty Contest”*

According to Marcus *et al.* (2005) the comparative review or the “beauty contest” is most commonly used to do the initial assignment by government of radio frequency spectrum. Reason for the initial or first assignment by the state is because the state upholds the sovereign rights to radio frequency spectrum. Technically and financially sound proposals are generally considered as criteria to award spectrum to deserved users (Nunno, 2006). These criteria are normally set out in an invitation to apply or a request for proposals. Deserving applicants will mostly be scored or be weighted on issues such as rapid rollout, viability of the network and its ability manage competitive issues such affordability and choice of products (Wellenius and Neto, 2008; Ofcom, 2012). These criteria might hold for developed nations where processes are more transparent and well structured.

According to Melody (2001) developing countries have to contend with universal service access issues in the consideration of spectrum assignment. Wireless electronic communications is often the only means to communicate for most developing nations with little to no fixed line infrastructure. Spectrum assignments are normally accompanied by burdensome rollout obligations (Wellenius & Neto, 2008). The regulatory authority designs the licensing procedure and judges the quality of the submissions from applicants against criteria which should be in line with national objectives, including universality objectives.

3.2.4.4. *Auctions*

Marcus *et al* (2005) defines an auction as “a market transaction, conducted on the basis of explicit rules that allocates resources and determines a price by comparing the bids submitted by market participants” (ITU, 2006b, p. 9). An auction is regarded as a market-based approach to assign spectrum and to achieve maximum economic benefits from the resource (McClean *et al.*, 2007). An auction is also the method of assigning the spectrum channels the first time by a regulatory authority. Proponents of auctions as an assignment method have argued that it places spectrum in the hands to those who value it the most (Cave, 2005).

According to Nera Consulting, the auction process has been around since early 1700s and early 1800s but only took off in the early 1990's in the telecommunications environment when the New Zealand government decided to privatise radio frequency spectrum (Madden *et al*, 2011). More countries are adopting the auction process as it is effective. According to Ting *et al* (2004) auctions in the United States have shortened the awarding of spectrum assignments from forty eight months to four months. Nera Consulting reports that during the years 2000 to 2007, regulatory authorities in twenty one countries have awarded eighty one third generation (3G) licences through an auction process and the trend is growing.

According to Marcus *et al*. (2005) auctions can take various formats, such as the English auction, Sealed-bid auction, Vickrey auction, and the Dutch auction. Auctions can be employed when there is only a single lot or multiple-lots (ITU, 2006). For example in a single lot auction, the English auction runs repeatedly until no further bidding is forthcoming, then the highest bidder pays the price and is awarded the lot. Table 8 provides some features of auction formats for single lots. Each and every auction format has its own inherent risks but it is important that whoever designs the auction have to be mindful of these complexities.

Table 8: Auction Formats

| | English Auction | Sealed-Bid Auction | One Price Auction | Simultaneous Multiple Auction |
|--|--------------------------|--|------------------------------------|--------------------------------------|
| Meets the market place | yes | Only approximately | yes | Only approximately |
| Identifies the bidder with the highest esteem | yes | Not completely safe | yes | Not completely safe |
| Possibility for pooling | Afflicted with risk | Low risk | Low Risk | Affected with risk |
| Winners Curse | Provides some protection | Affected with risk | Affected with risk | Affected with risk |
| Procedure comprehensible to the open public | yes | Yes, appropriate to complex situations | No, afflicted with political risks | No |

Source: ITU, 2006b, p. 10

3.2.4.5. Spectrum Trading

Ofcom defines spectrum trading as “the transfer of rights and associated obligations to use spectrum by virtue of a licence” (Ofcom, 2004, p. 14). Global trends have shown that there is a transition towards alternative market-based

property rights spectrum management approaches. Administrations in numerous countries still practice centralised command and control over functions such as spectrum allocation. However some administrations have introduced market-based assignment methods such as auctions to award spectrum. There exist a wider base of policy options that allow for the market-based determination of spectrum allocation and assignment. At this secondary phase of spectrum management, market based players can be entrusted with a wide variety of rights that can be exercised through trading which ranges from leasing to re-farming spectrum. This normally involves a wide range of ownership rights that are involved.

Spectrum trading or sharing typically involves a partial transfer of a licensee's rights to spectrum either for a limited period of time and/or for a portion of the spectrum encompassed in the licence (ITU, 2004b). The allocation of spectrum is unlikely to yield socially optimal results given the existence of information asymmetry. In most cases the major operators has access to better information resources as well as experts which is a consequence of access to funding to procure information.

Spectrum trading is also prevalent in instances where spectrum was allocated through sometimes incorrectly designed auctions or where secondary trading acts as an insurance against potential undesired auction outcomes, although such trading may be short-lived after "initial misallocation has been corrected" (Crocioni, 2009, p. 451). In the event that a successful bidder is unable to fully utilise the spectrum, generally paid for upfront, provisions for spectrum trading allow for market transactions in such circumstances.

The OECD (2001, p. 34) encourages spectrum trading "unless there are clear and serious market failures associated with it" and also recommends that "regulatory oversight" should be in place "to ensure that trading does not lead to a consolidation in the market and creates oligopolies." The terms of access to the traded spectrum should ideally be specified by the regulator to avoid any competitive restrictive tactics like interferences, technological considerations, and geographical restrictions. In particular, the OECD (2005) recommends various

measures a regulator could implement for spectrum trading to yield socially optimal results.

Although spectrum trading has been introduced in countries such as Australia, New Zealand, USA, Guatemala, El Salvador and Canada, other countries are doubting the practicality of spectrum trading. For such countries, the OECD (2005, p. 5) recommends a “phased-stage-by-stage approach” like the one in the UK where “spectrum trading could be introduced first in areas such as Land Mobile PMR, Fixed Links, Fixed Wireless Access, and Land Mobile Public, followed eventually by other areas”.

Separate studies by Ofcom and the European Commission have shown that, the benefits of spectrum trading such as the introduction of competition in downstream markets and efficient utilisation of spectrum overshadows the costs (OECD, 2005). Costs of spectrum trading would, according to the OECD (2005), include low spectrum trading activity in practice, inefficient use of spectrum, high transactions costs, risk of increased interference, possible anti-competitive conduct, impact on investment and innovation, impact on international co-ordination/harmonisation, windfall gains, and disruptive effects on consumers and reduced ability to achieve public interest objectives. The European Commission study estimated an annual benefit from spectrum trading at £900 million in the European Union while Ofcom estimated benefits between £67 million and £144 million in the UK alone. Other scholarly literature supports this analogy provided there will be minimum interference of the transmission quality (Peha and Panichpapiboon, 2004; Crocioni, 2009). In addition, Peha and Panichpapiboon (2004) note that it would be possible for the primary and secondary user to coordinate using methods (like admission control and frequency assignment algorithm), to determine the appropriate time for the secondary user to access the traded spectrum without quality interference.

Spectrum trading activity in Australia and New Zealand peaked at the early stages in late 1980 and early 1990 but has seen a declining trend largely due to high transaction costs and low scarcity of spectrum in both countries. Low scarcity in this case refers an abundance of spectrum available (OECD, 2005). These country-specific challenges should not, according to the OECD (2005, p.

26), discourage spectrum trading activity as “low trade volumes do not necessarily mean that secondary markets are not working, and high trading volumes may suggest that spectrum was not efficiently assigned in the first instance”. Crocioni (2009, p. 453) suggests what appears to be a binding constraint for spectrum trading in the following form:

“ $V_s^e - V_s^i - c > 0$, where V_s^e is the value of a spectrum band to the entrant to provide service s and V_s^i is the value of a spectrum band to the incumbent to provide service. c is the transaction cost borne by the incumbent, the entrant or both. If transaction costs are high relative to the net value (i.e. the difference between V_s^e and V_s^i) of a spectrum band for the new entrant to provide a service, then trading will not take place, or vice versa” (Crocioni, 2009, p. 453)

For instance, any concerns relating to underutilisation or hoarding of spectrum if large bandwidths were assigned would be extinguished if secondary market provisions are in place.

3.3. Spectrum and Technology Neutrality

One cannot discuss spectrum allocation and assignment without having a consideration of technologies and standards. The two fit like hand in glove. As spectrum allocation and assignment are moving towards a more market-based property rights approach, it is commonly advocated that technologies are best left to the players. According to Laflin and Dajka (2007) “technology neutrality” may one day become a reality. Critics of the command and control spectrum management approach, advocates that a ‘technology neutral’ approach will be more efficient to ensure deployment flexibility.

Spectrum holders pay huge sums of money for radio frequency assignments. The risk of harmful inference from transmissions to licenced users is imminent hence spectrum licensees expect a high level of protection. The scope for total “technology neutrality” is diminishing by the risks of interfering sources. As the spectrum management environment moves towards greater liberalisation, national regulatory authorities, and policy makers will also play a part in decisions on the deployment of technological solutions. The transmitting and receiving devices have to be standardised to minimise the impact on the end-users.

Technological changes mean that subscribers of services have to change transmitters and receiving devices such as antennas. Technological change might mean that government want to meet certain socio-economic objectives such as education, health and safety and security. In this situation it will surely not be fair for consumers to pay for upgrades or migration of a service that government provides free of charge to the public. These free services may include amongst others public broadcasting and e-government services.

A technological change will certainly result in better spectrum efficiency and more services to the end-user. For example the migration to digital terrestrial television (DTT) will result in freeing-up spectrum for much more mobile broadband services. According to the Ministerial Digital Migration Working Group, in South Africa up to 102 MHz of spectrum could be freed-up for other electronic communications services including Public Protection and Disaster Relief (PPDR) and educational services (DOC, 2007). Foster (2010) in the ITU GSR discussion paper reports that the value of 72 MHz of spectrum for wireless broadband is valued between EUR 50 Billion and EUR 190 Billion over a 15 year period (Foster, 2010, p. 17). The reason for these high prices is that radio frequency spectrum has an essential role to play which leads to economic growth. The European Commission estimates these value based on 2.2 percent of the annual gross domestic profit (GDP) of electronic communications which depends on scarce spectrum resources (Foster, 2010).

Table 9: Wireless Technology Development

| Technology | Standards | Countries | Time | Spectrum Efficiency |
|------------|--|--------------------|------|---|
| FDMA | 1G-Analogue Systems AMPS NMT TACS | US Nordic UK | 1970 | Spectrum usage one-to-one per user |
| TDMA | 2G - Cellular Systems GSM | Europe | 1980 | Improve Spectrum Capacity by splitting spectrum into time slots |
| CDMA | 3G - IMT Systems IMT-2000 | Global | 2000 | Improve spectrum efficiency by allowing all users to access all channels at the same time |
| OFDM | 4G – LTE, HSPA | Global | 2005 | Improved Speeds and Increased data |

Source: Derived from ITU data (Foster, 2010)

Table 9 above illustrates how technological developments have contributed to spectrum allocation and certainly spectrum efficiency over time.

3.4. Spectrum Policy and Regulatory Institutional Arrangements

It is evident that there is no common policy and regulatory institutional arrangement to radio frequency spectrum the world over. Most jurisdictions have a particular approach to the way spectrum is controlled and planned to suit the administration of the particular country. These diverse approaches can be explained by differing political situation in each country and by the level of technological development of each country. This section discusses the spectrum management institutional arrangements in the United Kingdom, USA, Canada, Australia, New Zealand and France.

Table 10: Summary of spectrum policy and regulatory institutional arrangements

| Country | Policy Maker | Regulatory Authority | International Spectrum | Spectrum Planning | Spectrum Assignment |
|-------------|-------------------------------------|---------------------------------------|----------------------------------|----------------------------------|--|
| UK | UK SSC and Ofcom | Ofcom | Ofcom | Ofcom | Ofcom |
| USA | Office of Spectrum Management (OSM) | NTIA (Government) FCC (Private) | NTIA | OSM | NTIA (Government) FCC (Private) |
| Canada | Ministry of Industry | Industry Canada | Industry Canada | Industry Canada | Industry Canada |
| Australia | DBCDE | ACMA | DBCDE | ACMA | ACMA |
| New Zealand | Ministry of Economic Development | Ministry of Economic Development | Ministry of Economic Development | Ministry of Economic Development | Ministry of Economic Development |
| France | ANFR | CSA(broadcasting) ARCEP(telecomms) | ANFR | ANFR | CSA(broadcasting) ARCEP (telecomms) |

3.4.1. United Kingdom (UK)

Radio frequency spectrum management and planning in the UK is conducted in two statutory bodies namely the Office of Communications (Ofcom) and an official committee on UK spectrum strategy (UKSSC). These bodies are responsible for all civil spectrum usage. The responsibility of regulating the communications sector lies with Ofcom which must ensure the effective and efficient utilisation of the electromagnetic spectrum. The Department of Business Enterprise and Regulatory Reform (BERR), the former Department of Trade and Industry is responsible for international collaboration. However, Ofcom represents the UK at WRCs but not at the ITU Plenipotentiary conferences (Mazar, 2008 & Cave, 2005).

Ofcom was established in terms of the Communications Act 2003 as an independent regulator of telecommunications, broadcasting and radio frequency

spectrum, including accountability for all spectrum usage by so-called non-Crown entities. Non-Crown entities are those public institutions which are not controlled by the office of Her Majesty's, The Queen.. Ofcom's responsibilities include allocation, authorisation, and international representation on radio frequency spectrum matters. However the Government of the United Kingdom has retained delegation of authority of directions on international relations, national security, and public safety (Mazar, 2008). The spectrum interests for the UK Government are co-ordinated formally by the UK Spectrum Strategy Committee (UKSSC) which is an official committee of the Cabinet Office. Ofcom is just one of participating members to this committee. Although Ofcom represents the UK at international fora such as ITU conferences, it has to clear policy first in advance of such meetings through UKSSC. Preparations for these ITU meetings and conferences are done through the International Frequency Planning Group (IFPG) which is a sub working group which reports to UKSSC. The IFPG is generally chaired by Ofcom and members consist of government and industry (BERR, 2009).

It appears that there is an indication that more than one entity has spectrum responsibilities. This distributed responsibility of spectrum is also evident, judging by the observation that appears in the preamble to the UK table of frequency allocations (UKFAT). The following comment specifies that there are a number of departments or agencies with accountability for radio frequency spectrum matters: "The table identifies responsibilities for the management of frequency bands or services showing whether they are managed by Ofcom, the Ministry of Defense, or another Government department or Agency." (Ofcom, 2010)

3.4.2. United States of America

Radio frequency spectrum responsibilities, in the United State of America (USA) are predominantly handled in two organisations. These bodies are the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC). Broadly speaking the FCC is responsible for civil uses of spectrum while the NTIA is responsible for federal government use thereof. The FCC is established in terms of the Communications

Act of 1934 and has the responsibility to assign spectrum to all non-federal entities. The Federal entities falls under the President who delegated powers to the NTIA through the office of the Secretary of Commerce (FCC, 2012; Mazar, 2008)

The NTIA is the US President's principal adviser on telecommunications and information policy issues, and in this role frequently works with other Executive Branch agencies to develop and present the Administration's position on these issues. In addition to representing the Executive Branch in both domestic and international telecommunications and information policy activities, NTIA also manages the federal government use of spectrum; performs cutting-edge telecommunications research and engineering, including resolving technical telecommunications issues for the federal government and the private sector; and administers infrastructure and public telecommunications facilities grants. The NTIA is an agency within the Department of Commerce and one of its divisions is the Office of Spectrum Management (OSM). The OSM formulates and establishes plans and policies that ensure the effective, efficient, and equitable use of the spectrum both nationally and internationally. The OSM publishes the US table of frequency allocations.

The Federal Communications Commission (FCC) is an independent United States government agency, directly responsible to Congress. The FCC is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. Within the FCC there is an office of Engineering & Technology whose function is to allocate spectrum for non-government use and provides expert advice on technical issues before the Commission (Mazar, 2008).

3.4.3. Australia.

In Australia the Australian Communications and Media Authority (ACMA) is responsible for all aspects of radio frequency management. The ACMA was established as a result of a merger between the Australian Communications Authority (ACA) and the Australian Broadcasting Authority (ABA). This merger took place in July 2005 when most countries embarked on converging regulatory authorities. Over and above the spectrum management

function ACMA is also mandated to handle telecommunications, broadcasting and content (Hose & Kerans, 2007).

The Radiocommunications Act 1992 and Australian Communications Act of 1997 still form the basis of the ACMA spectrum management function. The Act broadly provides for a general outline of the Australian spectrum management goals such as allocation and usage, national security, technology usage and international engagements (Hose & Kerans, 2007). The combination of the presence of a resilient regulatory body and the establishment of a market-based spectrum management approach has recognised Australia as a benchmark for modern spectrum management administration. The buy-in of government and all stakeholders, including competing operators has propelled wireless development in Australia (ITU, 2004).

Policy advice for the communications sector in Australia is set by the Department of Broadband, Communications and the Digital Economy (DBCDE). This department also sets the framework for the development and maintenance of a comprehensive radiocommunications regime which takes account of international developments. There is close collaboration between this department and ACMA, which is responsible, among other things, the licensing of all radiocommunications systems. The Department of Broadband, Communications and the Digital Economy is further mandated to coordinate the Australian participation at international fora such as the International Telecommunications Union (ITU) and Asia-Pacific Telecommunity (APT). The Australian domestic framework encourages stakeholder involvement in the preparatory process for these international and regional fora through ACMA. The consultative work is primarily coordinated through ACMA's International Radiocommunications Advisory Committee (IRAC), its Preparatory Groups and Australian Radiocommunications Study Groups (ARSGs). The ARSG are essentially convened by the Australian industry and stakeholders which mirrors the work of the ITU study groups (Hose & Kerans, 2007).

The spectrum planning and assignment is a function that is fully mandated to ACMA. The Australian Radio frequency Spectrum Plan (ARSP) is regarded as a statutory instrument which is established under the Radiocommunications Act.

Authorising access to radio frequency spectrum is primarily done through class licensing (spectrum commons), apparatus licensing (command and control) and spectrum licensing (private spectrum). Spectrum commons are typical license exempt bands for WiFi type of services. Command and Control are typical services for maritime and public safety and disaster relief. Private spectrum is used by advance mobile services such as GSM and LTE.

The Australian spectrum planning framework caters specifically for what they call frequency band plans and administrative plans. The frequency band plans are viewed as legal instruments which specifies what the spectrum band should be used for and provides for certain reservations. The administrative band plans on the other hand does not have any statutory effects. ACMA also use spectrum embargos to initiate a spectrum planning process. These spectrum embargos place limitations on spectrum licensing subject to a planning process in a specific band.

As far as spectrum licensing is concerned, Australia has adopted an auction process in cases where spectrum demand is exceeding supply in specific bands. In Australia spectrum licenses are also considered as an asset and are allowed to be traded amongst licensees (ITU, 2004b).

3.4.4. Canada

Spectrum regulation and policy in Canada is done through a government institution, Industry Canada under the Minister of Industry. The spectrum policy and regulatory function is managed in a department of Spectrum, Information Technologies and Telecommunications (SITT). SITT under the Ministry of Industry are further responsible for international spectrum coordination and planning following the ITU processes. (Industry Canada, 2007). The spectrum management function is facilitated through the Department of Industry Act, the Radiocommunication Act and the related Radiocommunications Regulations. The Spectrum Policy Framework which was released in 2007 set the overall framework for management of the spectrum regarded as a scarce finite resource. As cited in the spectrum policy framework for Canada, policies for the telecommunications sector are also set by Industry Canada (Industry Canada, 2007).

The regulatory function for spectrum is additionally mandated to Industry Canada who is responsible for licensing of spectrum to all private and public wireless communication services. Spectrum is generally awarded on a first-come, first-served licensing process. However, where spectrum demand is high a spectrum is usually awarded through a competitive licensing process such as an auction (Industry Canada, 2011).

Broadcasting services licenses are awarded by the Canadian Radio-television and Telecommunications Commission (CRTC) as mandated by the Broadcasting Act. Spectrum for broadcasting services also falls within the mandate of Industry Canada hence extended to the Ministry of Industry. Policies for broadcasting services are set by the Department of Canadian Heritage. The Department of Canadian Heritage is responsible for Canadian arts, culture, communication network, media and sport activities (Industry Canada, 2011). In order to operate broadcasting services two authorisations are required from CRTC and Industry Canada for service and spectrum respectively (Industry Canada, 2007). In terms of the spectrum policy frame work of 2007 Industry Canada is responsible for all spectrum usage in Canada which includes spectrum for priority users. Priority users in Canada are those radiocommunication services that are critical for national defense, law enforcement public safety and disaster management.

In conclusion it is fair to deduct that all spectrum policy and regulatory functions is controlled by Industry Canada. The spectrum policy framework for Canada state “under the umbrella of the International Telecommunication Union ITU- obtain, plan and authorizes its use and use sophisticated equipment and automated system to ensure that harmful radio signals do not hamper its use by licensed essential communications services” (Industry Canada, 2007, p. 1)

3.4.5. New Zealand

The Ministry of Economic Development is responsible for radio frequency management and planning in New Zealand. The Ministry provides advice on the spectrum policy to the government under the Radiocommunications Act of 1989 and the associated supporting Radiocommunications Regulations of 2001. The Ministry is mandated to deal with all aspects of spectrum management which

include license compliance and enforcement, spectrum planning, radio frequency investigations (RFI) and spectrum licensing/assignments. International participation in organizations such as the ITU and APT is also bestowed on the Ministry of Economic Development. This is the reason why centralised planning will always play a role in any spectrum management and planning regime. Internationally spectrum planning enjoys treaty status and coordination and allotment negotiations are generally a function of the administration of the country (Nera, 1988).

New Zealand is the first country in the world that has adopted alternative market-based approaches to spectrum management by introducing auctions as an assignment method and tradable rights to spectrum as far back as 1989. Since then many countries have adopted a similar approach (Mueller, 1993; ITU, 2004). Mueller (1993) also make the point that auctions are an initial assignment right to spectrum which is referred to as surface reform. Mutually interchangeable or fungible, freely transferrable spectrum property rights on the other hand are referred to as deep reform. Deep reform has and will encounter various political and institutional debates. The successes and failures of the deep reform i.e. market forces of allocating spectrum are still been monitored. This could be ascribed due to vested interest of role players such as former monopolies and public entities. Mueller (1993) concluded that spectrum privatization is possible but the implementation will be stifled by political debates and intuitional arrangements.

New Zealand's market-based spectrum approach introduced a two-tiered property rights regime namely management and license rights. Management rights are generally regarded as a method to own a specific band of spectrum nationally for a specified period. The management rights are also tradable. License rights define specific terms for the uses and users of the band. The license rights are similar to license condition such as holder, power, frequency transmitter site and class of emission. The difference between the license rights and traditional license conditions is that it "may be freely bought and sold" (Mueller, 1993).

3.4.6. France

In France spectrum policy and regulation is also distributed across a more than one entity. France implements what Mazar (2008) calls a dual-level RF

framework. The spectrum functions are separated in a distinct allocation and assignment for civil and military spectrum. According to Roetter (2012) on “a Spectrum Management Agency for South Africa” allocation of all radio frequency spectrum is mandated to Agence Nationale des Fréquences (ANFR), an agency under the Prime Minister’s office (BMI-T, 2012 & Mazar, 2008). “ANFR’s responsibilities include, international negotiations on spectrum issues, spectrum planning and assessment of economic value of spectrum, allocation of frequency bands to radio services and to ministries and regulatory authorities, coordination and recording of frequency assignments, spectrum control and interference investigation” (Unpublished, 2011)

Mazar (2008) further confirms that while ANFR is the entity for allocating radio frequency spectrum in France, the assignment of frequencies is further subdivided between other agencies and ministries. The Ministry of Economy and Industry is responsible for policy setting for the e-Communications and Information Technology (Mazar, 2008). The Ministry of Industry is also mandated to represent France at international for such as the ITU. Mazar (2008) further observed that France is one of the most powerful administrations at the ITU. This is also indicative that current Director for the Radiocommunication Bureau of the ITU is Mr Francois Rancy of France who was elected at the 2010 Plenipotentiary Conference. ANFR is managed by a board which consists of representatives of broadcasting and telecommunications sector regulators, public entities such as defense, maritime and aviation and experts appointed by the Prime Minister.

The spectrum assignment is the responsibility of other agencies and ministries called “affectataires” (allocation bodies) or band managers. These “affectataires” are “Conseil Supérieur de l’Audiovisuel” (CSA) regulate and assigns spectrum for satellite and terrestrial broadcasting services (radio and television) and “Autorité de Régulation des Communications Electroniques et des Postes” (ARCEP) for civil electronic communications and the Ministry of Industry for military services (Marcus, et al., 2008). The Direction Générale des Entreprises (DGE), reporting to the Ministry of Industry, coordinate spectrum for public services of eight other entities. The DGE is also responsible for preparing

government policy positions on strategic issues such as spectrum trading and pricing on postal and telecommunications. According to Marcus et al (2008) the eight entities include the two Ministries of Defense and Interior and public administrative bodies responsible for Civil Aviation, Meteorology, Radio Astronomy, Ports and Maritime Navigation and French overseas territories (Marcus et al., 2008, p. 12).

The French spectrum policy and regulatory framework is further supported by a twenty one member advisory panel, Commission Consultative des Radiocommunications (CCR) appointed by the Ministry responsible for telecommunications in consultation with ARCEP. The twenty one member panel comprises of, seven representatives of radiocommunications network operators and services provider, seven professional and private users of these networks and services and seven qualified experts. A similar advisory panel, Commission Consultative des Réseaux et Services de Télécommunications (CCRST), is setup for wireline communications and services (Mazar, 2008).

3.5. Conclusion

In a regulatory state a sound separation of responsibilities leads to legitimatisation of the various actions of Independent Regulatory Authorities whether they are accountable upwards, horizontal or downwards (Scott, 2000). The success of sectoral reforms such as the market reforms undertaken in the electronic communications sector, rely exclusively on good governance within and by the Regulatory Authority that is at the centre of development of the sector. The success of the electronic communications sector furthermore depends on a well-resourced regulator and an unequivocally independent regulatory authority which can survive in a compact mixture accountability system.

4. Chapter Four: Research Methodology & Data Collection Process

4.1. Research Methodology

This research is based on the production of a single qualitative exploratory case study. The research examines the spectrum management process in South Africa and its policy and regulatory context. It explores the roles played by institutions such as the DOC, ICASA, Government, industry and entities which are the major users of radio frequency spectrum.

Before 1994, the incumbent operators Telkom and South African Broadcasting Corporation (SABC) performed the spectrum management function in the telecommunications and broadcasting sectors respectively. The spectrum management activities were governed until recently under the Radio Act no 3 of 1952. Around the same time the country saw the establishment of the first independent spectrum management function for broadcasting services with the promulgation of the Independent Broadcasting Authority (IBA) Act No 153 of 1993. It took as much as two years thereafter that the Telecommunications Act No 103 of 1996 established the South African Telecommunications Regulatory Authority (SATRA) which was mandated to manage radio frequency spectrum for the telecommunications sector (Horwitz, 2001).

Greater demand has been placed on spectrum resources by the bandwidth-hungry applications and disruptive radiocommunication standards such as digital terrestrial broadcasting, WiMAX and LTE. The spectrum management responsibility is primarily split between the DOC and ICASA, the policy maker and the regulator respectively. It is inevitable that there has been competing interests which may lead to duplication in these processes, especially in light of the high demand that wireless communications standards now places on spectrum resources, which in turn hinders effective policies and regulation in this sector.

In 2006, with the intensified demand due to commencement of the digital terrestrial broadcasting migration process, controversies surfaced. The DOC, through a comprehensive consultative process, agreed internationally on electronic communications standards and a spectrum plan for digital broadcasting,

as well as the regulatory authority soon thereafter embarked on a similar protracted public process to design the same course of action.

Conflicts over responsibilities and uncertainty of roles has led to court cases such as *Altech vs. the DOC* and *etv vs. ICASA*, where the management of radio frequency spectrum had been central to the outcomes of these cases. Similarly the conflict and concerns discussed above have impacted on the licensing of the spectrum bands for high demand (800 MHz, 1800 MHz and 2.6 GHz and 3.5 GHz, i.e. WiMAX/LTE) and have delayed the rollout of critical wireless broadband technologies (ICASA, 2010). The end result of these delays is the emergence of major obstacles to the rolling out of electronic communications networks and the provision of new services – this directly impacts on the achievement of the universal service and access to wireless broadband and the Internet.

Despite the increased interest in spectrum management over the last decade and the impact of wireless communications on universal access and services, it is astonishing that so little empirical research has been conducted on the impact that these institutional relationships have on allocation and assignment of spectrum resources. Moyo and Hlongwane (2009) have analysed the independence of ICASA with respect to public interest and the influence the Minister of Communications has on decisions taken by ICASA. They alluded to the fact that the Minister of Communications had major influence on the regulatory authority to fulfil its mandate.

It is therefore evident that the dual role of spectrum management shared between the DOC and ICASA and the centralised command and control system create inefficiencies from allocation to the eventual award of spectrum assignments to licensees. These inefficiencies create major delays in the rollout of new wireless technologies and hence the introduction of competition in infrastructure to foster socio-economic development.

The primary research questions the study which to address are, (1) how do varying policy and regulatory approaches create an enabling environment for radio frequency spectrum to be efficiently and effectively managed in South Africa in the context of increasing demand? In order to respond to this main

question, the sub-questions are answered developed on (a) how do policy, legal and institutional frameworks influence the South African approach to spectrum management? (b) how do the strategies that the DOC and ICASA currently employ expedite or fail to expedite the implementation of radio frequency allocations and assignments? (c) how should policy and regulation deal with alternative approaches to spectrum management (e.g. beauty contest, auction, etc.) as a means to alleviate inefficiencies which delay the licensing of radio frequency channels?

A qualitative case study was conducted with respect to the roles of the relevant institutions over the period from the commercialisation of the incumbent operator in 1992, onto the first South African Band Replanning Exercise (SABRE) done in terms of the Telecommunications Act 103 of 1996, to the most recent events in July 2012 to explore how the South African approach to spectrum management has influenced the allocation of radio frequencies up to and including the final award of assignments to operators, and as such the development of the sector. Through this case study method a thorough analysis of documents was done and in depth interviews were conducted.

4.2. The Case Study Approach

Case studies provide a structured way of looking at events or institutions and processes, collecting data, analysing information and reporting the results. The outcomes are a sharpened understanding of how a system works and why it has developed in the way it has. Additionally, the study can identify what might become important to look at more extensively in future research as what might be appropriate examples to be considered for application in other situations or environments (Jagun, 2009).

Qualitative case study approaches have been traditionally used in such disciplines as business studies, jurisprudence and social work. In all these disciplines there has been a tendency to see case study method as both a research tool and a teaching method (Babbie and Mouton, 2004).

Case studies are regarded as an approach in the methodological literature which is less scientific than other approaches to theory development. Campbell and Stanley (1966) rejected the “one shot case study” as having “almost no

scientific value.” This stance was later softened by Cook and Campbell (1979, p 96) who stated that this negative judgement was not meant to include “case studies as normally practised” in social and behavioural sciences (cited in Babbie and Mouton, 2004). According to Tellis (1997) the case study methods were used to determine whether particular programmes in government were efficient or the goals of a particular programme have been met.

The case study methodology is appropriate for this research because it enabled the researcher to explore the in-depth institutional, process, policy and regulatory aspects of the radio frequency spectrum management approach.

4.3. Units of Analysis

This is an exploratory case study research rather than having propositions. The primary unit of analysis will define what the case will be (Tellis, 1997). In this research the object or unit of study is the alternative policy and regulatory approaches to spectrum management. In this qualitative case study the units of analysis includes, the decision making process, legislative mandate, institutional arrangement, spectrum allocation and assignment methods.

According to Campbell (1975) as cited in Tellis (1997, p. 6) the technique of ‘pattern matching’ is useful to link data to a particular proposition. “Campbell (1975) asserted that pattern-matching is a situation where several pieces of information of the same case may be related to some theoretical proposition” (Tellis, 1997). It was through pattern matching that this research report indicates that there is a deliberate attempt from government to rightly or wrongly have control on spectrum. There are also patterns of moving away from the more transparent market based approaches to be entrenched in the traditional command and control spectrum approaches. Delays from allocation to eventual award or assignment of spectrum are a direct result of the underlying patterns.

4.4. Data Collection

According to Yin (1994) a case study investigator must act as the principal throughout the cause of data collection (Tellis, 1997). Spectrum management is such a specialised field worldwide which is often neglected in developing countries. Research in the spectrum field and collection of information and data from developing countries is almost none existent. Developing countries,

including South Africa, only participate in ITU WRCs at a very high-level. It is seldom that these countries participate in the real research which lead to copy and paste adoption of spectrum management strategies of the developed world.

Although there is a myriad of data that exist in the ITU domain, research in the field of spectrum management approaches in South Africa is unfortunately limited to a few discussion papers and opinions. The spectrum management roles of the policy maker and the regulator also appear to be a combination of institutional arrangements that exist elsewhere. The outcomes of the structure that exist in the country appear implemented without any detailed study and investigation for the most appropriate arrangement.

Since very limited research was conducted on the spectrum management approaches, in South Africa the empirical data which was collected was done through document analysis of primary and secondary documents. Primary material are those which could be obtained through one-on-one interviews with decision makers of the regulator, policy maker and the entities listed in Appendix A which have been purposely selected for this research which might not be in the public domain. The interviewees were in advanced presented with the questionnaire in Appendix B. The reviews of published and internal records and reports from regulator and policy maker as well were conducted. Other primary data was obtained from archival research of relevant notices published in Government Gazettes which these institutions have to, by law, place in the public domain.

Secondary data was largely collected from legislation, policy documents, published regulations legal opinions, and unpublished reports. The selection of multiple sources had allowed triangulation in order to verify the validity of the information as some participants historically might have been involved in some of these processes. The contents of the documents were examined and engage with to establish the specific meaning it has to the case.

An examination was conducted on both the policy maker and the regulator in terms of its institutional abilities and regulatory governance. Institutional endowment of a country is defined as the legislative and executive “institutions, judicial institutions, customs and informal broad norms, social interest and

administrative capabilities” (Levy & Spiller, 1996). This study focussed on the administrative capabilities of the policy makers and the respective regulatory authorities with respect to spectrum management. A broader high level examination on institutional arrangements was conducted in six countries namely, Australia, Canada, France, New Zealand, UK and USA. This was done to characterise underlying patterns which govern spectrum management in the know-how countries. These countries were selected based on successes in the spectrum management and the level of development which was achieved in expertise in these fields.

This study uses a qualitative single-case study approach. Data was collected through a variety of sources. Amongst others were observations which were recorded on the behaviour and comments of individuals in a semi-structured way. These field notes were done at the various spectrum management fora such as public hearings and workshops. Through the researcher’s responsibilities as a technical regulatory specialist, which includes spectrum management, a view on how key role players perceive the spectrum management approach in the country could be generalised. These were done through impromptu one-on-one discussions with various spectrum specialist and experts which were then noted.

There was a review of economic, legal and public policy material relevant to spectrum management in South Africa and internationally. There were also in-depth face-to-face interviews with selected representatives of the government, the policy maker, key regulatory agencies, operators, and academia as per Appendix A below. Particular attention was given to interviewing spectrum experts in public as well as private sector organisations which hold spectrum licences and have dedicated frequency planning units in order to understand how they value spectrum. On-going participation in expert radio frequency spectrum fora and online interactive discussion groups to obtain broader views and opinions on the status of spectrum management in the country and internationally was conducted. In this regard professional sites such as LinkedIn were utilised to obtain opinions from internationally renowned expert groups.

The interviewees were selected, firstly due to their expertise in the field of spectrum management and secondly the organisation they represent as a major

spectrum holder. Although as per Appendix C it is recorded that twenty one physical interviews were conducted, one organisation could have employed more than one expert or specialist. Many prominent individuals directly involved in spectrum management within in the Regulator, the Policy maker and licensees have turned down interviews and the questionnaire. The interviews took place around the same time in 2011/2012 when the draft ITA and policy direction were published. Interview candidates cited the sensitivities around both spectrum decisions and potential license applications, which may have compromised them personally and the organisations they represent.

A summary of the questionnaires and interviews reveals there is generally consensus on the facts that both the policy maker and the regulator are ineffective and that the spectrum management institutional arrangement should be reviewed. Furthermore, with respect to the spectrum award approach, respondents favour a market-based approach but also acknowledged the fact that this could only hold for certain frequency bands. A command and control approach is still required in bands that contain mission critical services. The lack of monetary and human resources has been identified as challenges within both the DOC and ICASA to perform their respective functions effectively. Roll clarification between the policy maker and the regulator has to be addressed through legislation to prevent any further delay in spectrum award. There was also general agreement that the current spectrum framework is adequate for awarding valuable radio frequency channels.

4.5. Data Analysis

Leedy and Ormond (2001, p. 150) indicated that there is no “right” way to analyse data in a qualitative case study. Tellis (1997) also asserted that data analysis is the least developed area and the most complex in case study approaches. In a qualitative case study approach the researcher collects extensive data on the program or event that is to be studied (Leedy & Ormond, 2001). In this research, material was extensively analysed to develop themes which were flagged in the literature review process.

Yin (1994) as cited in Babbie and Mouton, identified modes of organising data for case study analysis, including pattern matching. Leedy & Ormond (2001)

cited in Creswell (2003) and Stake (1995), identify a typical five (5) step process in the analysis of case study data. This includes the organisation and preparation of details of the case for analysis of which the process will involve the collection of documents and data interviews. A read through and categorisation of data which entails a thorough read through the data to get a general sense of what participants are saying. Furthermore an interpretation of single instances of the textual data of which a coding approach will be used to establish themes and categories for analysis of the data collected identification of patterns. A fourth element is the identification of patterns. In this context a broader high level review of spectrum management approaches was conducted in countries such as the UK, USA, Canada, Australia, New Zealand and France to characterise these underlying patterns. These patterns will be used to compare the institutional arrangements with that governing spectrum management in South Africa. The underlying patterns such as the institutional arrangements within the various countries are somewhat similar but also unique in many respects. Assignment and allocation functions exist in a variety of combinations between the policy makers and independent regulatory authorities. There are also indications of a total control by government on the spectrum management function through an agency. Lastly a synthesis and generalisation of the data which will be interpreted and a comprehensive picture will be presented about the case and the lessons learnt in this regard.

Since this is a single case study, any suggestion made is dependent on the interpretation of other related studies. Case study researchers are bound to interpret data during the data accumulation process and this might have an influence on the type data required later in the research (Leedy & Omrod, 2001). Cited in Babbey and Mouton (1995) and Yin (1994) as case study in an intensive investigation of a single unit. The unit of study could be an in-depth analysis of an approach to spectrum management. The influences of the various roles and relationships have on the event of spectrum management. Stake (1995) has similar views on case studies by stating that the approach explores an in event, an activity or a process (Creswell, 2003, p. 15).

In South Africa there are no other cases of spectrum management approaches hence the selection of a single-case design. The reason for selection of a single-case design is that there also exist very little empirical data in respect to spectrum management in South Africa. The few pieces of published information are restricted to articles and regulations and acts published in government gazettes. The single case design allows for an in-depth understanding of the phenomenon and to explore how spectrum is management in the policy and regulatory space.

With respect to the accuracy of the findings, it was verified through triangulation to profile a logical support of patterns and member-checking by confirming the themes with the respective participants.

The researcher's bias towards the analysis is also made transparent to give the participants an open scrutiny in terms of the data. Working in both the spectrum management units of policy maker and the authority, the challenges inside these organisations are not necessarily public information. The concerns range from lack of competencies and skills to a total disregard by the decision makers for the critical role radio frequencies play in society. Spectrum competencies are hardly taught at academic institutions therefore the only training is through practical exploration and experiences acquired in bureaucratic organisations such as the ITU, policy makers and regulators. The ITU is driven by member states and their administrations. Outcomes of highly technical documents are mostly political of nature and therefore most spectrum approaches is to satisfy the member states hence tend to be conservative.

5. Chapter Five: Findings: A Chronology of Spectrum Management Events

The findings in this section are synthesised from analysis of legislation and other relevant documents, as well as interviews with key informants. The chronological sequence of event captures the period from late 1992 to the first semester of 2012. Table 11 is an overview of block assignments to the major access spectrum holders in South Africa.

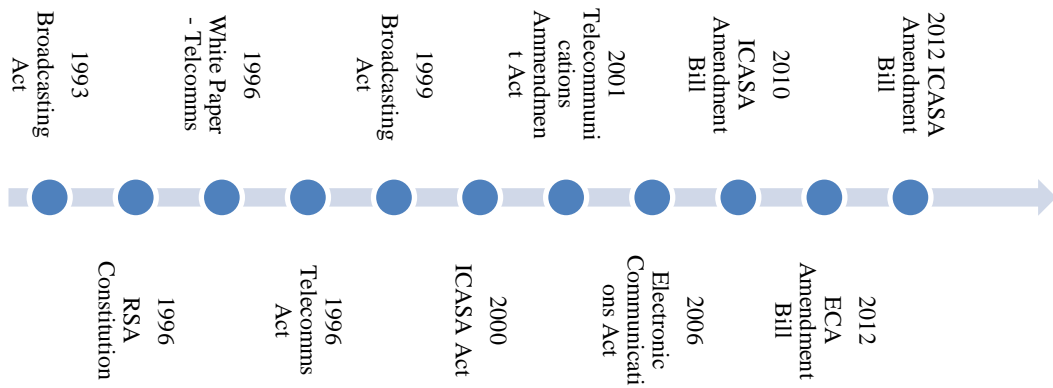
Table 11: Major Access Spectrum Holdings

| Spectrum Bands | | | | | | | | |
|-------------------------|---|----------|----------|----------|----------|----------|----------|---------|
| | | 800 MHz | 900 MHz | 1800 MHz | 2100 MHz | 2.6 GHz | 3.5 GHz | Total |
| Major Spectrum Holdings | Neotel (fixed network operator) | ~2x5 MHz | | 2x12 MHz | | | 2x28 MHz | 90 MHz |
| | Telkom (fixed network operator) | | | 2x12 MHz | 2x10 MHz | | 2x28 MHz | 100 MHz |
| | Vodacom (mobile operator) | | 2x11 MHz | 2x12 MHz | 2x15 MHz | | | 81 MHz |
| | | | | | 1x5 MHz | | | |
| | MTN (mobile operator) | | 2x11 MHz | 2x12 MHz | 2x15 MHz | | | 81 MHz |
| | | | | | 1x5 MHz | | | |
| | Cell C (mobile operator) | | 2x11 MHz | 2x12 MHz | 2x15 MHz | | | 76 MHz |
| | Sentech (broadcast signal distribution and satellite infrastructure provider) | | | | | 1x50 MHz | 2x15 MHz | 80 MHz |
| | WBS (wireless network service provider) | | | 2x12 MHz | | 1x15 MHz | | 49 MHz |
| | | | | 1x10 MHz | | | | |
| | USALs (universal service licensees) | | | | | | 2x14 MHz | 28 MHz |

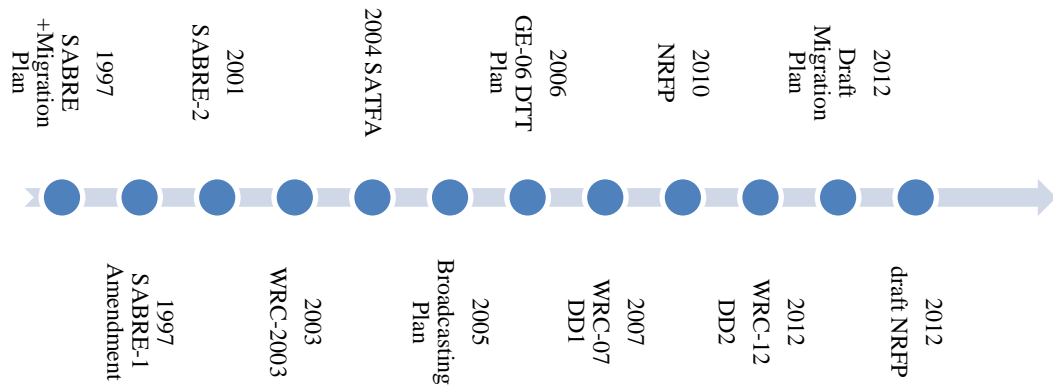
Source: Based on ICASA data (ICASA, 2011)

Figure 3: Chronology of Legislation, Planning and Licensing

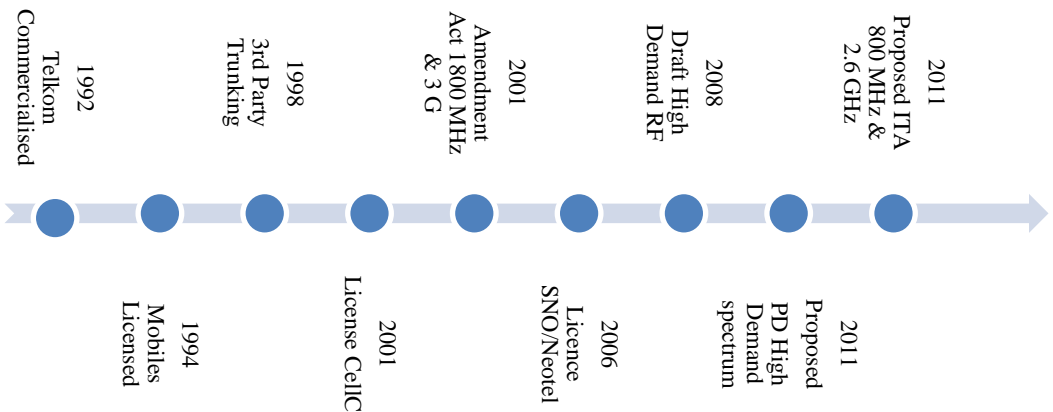
Timeline for Legislation



Timeline for Spectrum Planning



Spectrum Licensing Timeline



5.1. Radio frequency Spectrum Management in South Africa

The radio regulations of 1979 promulgated under the Radio Act of 1952 has until as recently as 31 March 2011, governed the way radiocommunications systems were operated in South Africa. The radio regulations contained in government gazette 34172, published on 31 March 2011, regulate spectrum management activities today. The validity of the 1979 regulations is under the spotlight in a court Case, 2012/12142 in the South Gauteng High Court between ICASA and Vodacom on the spectrum fees which were contained in the same radio regulations. This is further elaborated under the section “the spectrum fees debacle.”

Before 1994, the commencement of the telecommunications liberalisation period in South Africa, spectrum management was performed by the Ministry of Posts, Telecommunications and Broadcasting. With the establishment of the Independent Broadcasting Authority (IBA), broadcasting spectrum was managed by the IBA and this practise continued until the merging of the broadcasting and telecommunications regulators. Currently the spectrum management function is shared between the Department of Communications, the policy maker and ICASA, the regulator. Whereas the Department is responsible for international coordination functions of spectrum management, ICASA is conferred the responsibility to manage, plan and administer radio frequency spectrum resources. The DOC is additionally responsible for the coordination of spectrum requirements for government and security services (RSA, 2005).

5.2. Broadcasting Spectrum under the IBA

As early as 1993 spectrum for broadcasting services was controlled, planned and managed by the Independent Broadcasting Authority (RSA, 1993). The IBA was established (a) to prevent any political interference from any party (b) to prevent carrying of propaganda messages from such entities and (c) to prevent influence of regulatory processes. Respondent 2 (interviewed, 02 February 2012) raised the point that the independence of the IBA is enshrined in section 192 of the Constitution of the Republic of South Africa (RSA, 1996).

The IBA Act made provision for the creation of a broadcasting technical committee and the development of a radio frequency plan for broadcasting

services. The IBA Amendment Act promulgated in 1996 placed the control of the broadcasting radio frequency bands in the former Republics of the Transkei, Bophuthatswana, Venda and Ciskei under the umbrella of the IBA (RSA, 1996a). The IBA Act required the frequency plan to be reviewed and published annually to create transparency and to promote broadcasting access for new entrants.

5.3. Spectrum Management under the Telecommunications White Paper

The White Paper on Telecommunications Policy sets out the first managed regulated framework for spectrum management. The White Paper further recognised radio-frequencies as a strategic national asset and a scarce resource which should be regulated in the public interest. Additionally the White Paper supported the requirements to advance awarding spectrum to operators “with acceptable levels of equity stake held by members of the disadvantaged communities” (RSA, 1996b).

Since the military and security services are perceived generally to be large users of frequency bands, the White Paper called for the first review of the spectrum allocations to military and civilian sectors (RSA, 1996b).

The enactment of the Telecommunications Act, placed control of radio frequency spectrum under the auspices of an independent regulator, the South African Telecommunications Regulatory Authority (SATRA). SATRA was established through that same act. One of the core objectives of the Telecommunications Act of 1996 was to ensure spectrum efficiency which had been and is today still a real challenge because there have been various delays in spectrum allocation and assignment.

The Telecommunications Act 103 of 1996 conferred all radio frequency management functions, included international representation at spectrum management fora to the regulator. This Telecommunications Act anticipated the merger between two regulatory bodies of radio frequency spectrum, the IBA and SATRA through establishing a joint liaison committee also known as the JLC. Respondents 4, 5, 15 (interviewed, 2012) believe that this is a necessary structure to support effective spectrum management. The JLC was disregarded in the formation of ECA. The functions of the JLC amongst others were to coordinate

radio frequency spectrum for telecommunication as well as the broadcasting spectrum. The JLC was also required to identify which parts of the radio frequency spectrum has to carry broadcasting services. The Minister became the watchdog whereby all disputes that arose between the telecommunications and broadcasting regulators on the radio frequency bands had to be referred to the Minister for resolution. These decisions were made known through a publication of a notice in the Government Gazette (RSA, 1996b).

One of the key functions, conferred by the Telecommunications Act on SATRA, was to develop a radio frequency band plan that has to be revised from time-to-time to reflect international technological trends. The frequency band plan had to follow the ITU table of frequency allocations to ensure harmonisation to enjoy the benefits of economies of scale which resulted from this.

5.4. Telecommunications Spectrum Administered by SATRA

Whilst broadcasting radio frequency was placed under the control of an independent institution such as the IBA since 1993, the management and planning of other radio frequency spectrum bands remained under the control of the government through the Department of Post and Telecommunications.

5.4.1. The South African Band Replanning Exercise (SABRE)

The South African Band Replanning Exercise titled “project SABRE” was initiated in 1995 by then Department Post and Telecommunications to review the radio frequency spectrum allocations between 20 MHz and 3000 MHz. This review was implemented to align the South African frequency allocations with future technological trends and to ensure consistency with internationally developed band plans (DOC, 1997).

The development of project SABRE, the country’s first structured national radio frequency band plan, contained clear spectrum migration plans for designated radiocommunication services. These spectrum migration plans sought to achieve the essential harmonisation of the national table of frequency allocation or band plan with the ITU table of frequency allocations. SABRE should additionally be aligned with the prevailing and forthcoming frequency channel arrangements. After an extensive consultative process the DOC ultimately published the final version of the frequency allocation table, SABRE, in

government gazette 11701 in December 1996 (RSA, 1996). This band plan was guiding SATRA, the former telecommunications regulatory authority, to implement and to assign radio frequency spectrum licences according to the allocation and adopted channel arrangements in SABRE.

In 1997 the DOC subsequently published an amendment to the band plan to include the sub-allocation 3.4 GHz to 3.6 GHz. This frequency band was earmarked to impose universal service obligations in under serviced and underdeveloped rural and urban areas on the incumbent monopoly. Unpublished reports indicated that this sub-allocation was included at the last minute as part of the Telkom Strategic Equity Partnership (SEP) deal which took place in 1996 to 1997. Respondent 8 mentioned (interview, 2012) that the SEP deal came with onerous spectrum demands before the transaction could be endorsed by the consortium of international investors. . The potential investors wanted certainty on very specific spectrum assignments (Unpublished resource, 1997). The spectrum requirements as part of the SEP deal is a commercially sensitive Document which is not publicly available.

The 200 MHz of spectrum in the 3.4 to 3.6 GHz band was intended to deploy wireless local loop (WLL) technologies. This however has never materialised due to the extremely high spectrum fees for this assignment. The price for the spectrum was R 650, 000.00 per MHz paired which amounts to sixty five million rand (R 65, 000, 000.00) for a 200 MHz assignment (RSA, 1997a). This high spectrum fee has resulted in Telkom not taking up the opportunity to deploy the much needed wireless local loop services in the underserved areas. The spectrum in this band was assigned, in 2006, predominantly to the two fixed line operators, Telkom and Neotel, to deploy broadband wireless technologies such as WiMAX. The final SABRE band plan including the migration strategies was published in May 1997 (RSA, 1997b).

5.4.2. The Third Party Emergency Radio Trunking Feasibility Fiasco

One of the outcomes of project SABRE was the dedicated allocation of the 407.625 to 413 MHz paired with 417.625 to 423 MHz frequency band for use by Government and Public Safety Trunking Networks. This band was designated for use in mobile radiocommunications by organisations involved in ensuring public

safety, including police, fire, ambulance and traffic law enforcement services. This included personnel employed by government-funded local and regional authorities such as municipalities and provincial authorities.

In 1998 under the leadership of Mr Nape Maepa, the first Chairperson of SATRA, an investigation into the feasibility of issuing a national licence(s) for a trunked radio network(s), was conducted. Such networks were aimed at serving the needs of public safety, disaster and other critical second- and third-tier government and security services. It was also SATRA's desire that the network be implemented and operated by a third party operator using venture capital due to the high costs of rolling out radiocommunications infrastructure (SATRA, 1999).

Broadly, the benefits of a national third party trunking radio frequency network which combines the different public safety and local and provincial municipal organisations into a common single network are unparalleled. This third party network would have enabled the reliable and robust communication within and between the respective public safety and municipal entities, especially in circumstances of disasters. This would make management of joint operations more effective, and would be beneficial to those who these organisations serve, the citizens of South Africa. Additionally, combining these emergency and safety and security organisations on a common network would obviously result in economies of scale and cost savings in both network investment and operational expenses. This also meant that there would have been substantial savings on government funding for this network and related service. Also, a combined network would result in much needed radio frequency efficiency and would have therefore allowed for the effective utilisation of this scarce natural strategic resource, spectrum (Unpublished resource, 1998).

During that period of investigation, the level of radiocommunication equipment deployment in South Africa was fairly low, especially in the previously historically disadvantaged areas. As established during the consultation process, although in general, equipment and systems were old and the coverage provided had major limitations. In some areas there were excellent overlapping radio networks owned and operated by different emergency and government institutions and organisations. The main objective of the 'Third Party Emergency and

Municipal Services Radio Trunking Feasibility Study' was to investigate the business opportunities in Public Safety Trunking in South Africa. In addition it would do an estimate of the number of public trunking operators that could be licensed with the prospect of them being able to maintain sustainable businesses. The other main objective necessary to achieve was to evaluate the size of the market. This required an assessment of the likely amount of subscribers, in this case safety and security officials, and an estimate of both traffic demand and the capital required for providing such services. It included an assessment of the various equipment standards available for public safety trunking. It further required a recommendation on how this equipment standard should be incorporated in the proposed licensing procedure.

However according to Respondent 6 (interviewed, 2012), there were early indications that this project will receive major opposition from various institutions that are mandated to run public safety and emergency electronic communications. The initial responses during the consultation were raised as anticipated concerning security on such suggested third party network. This was nothing different than what the public protection and disaster relief management services are doing by using predominantly mobile electronic communications on privately owned third party networks. The uses of these privately owned mobile networks are so entrenched in the running of our day-to-day businesses hence the uncalled reasons advanced at that time were unwarranted. There was also a sense of fear by public officials involved in the maintenance and operation of government networks insofar as that they may potentially lose their jobs. This type of paranoia exists in many other jurisdictions. When the Finland Ministry of Interior implemented the Virve public safety system, the Finnish experienced typical resistance from public officials and entities (Omnitele Unpublished, 2000).

In May 2001, immediately following the establishment of the ICASA, the DOC held a workshop on public safety radiocommunications services. According to Mr Nape Maepa, former SATRA Chairperson, who spearheaded the Public Safety project, this intervention came as a surprise to the regulatory authority. It was further revealed at the time, that the DOC and Sentech had established a memorandum of understanding (MoU), to investigate and evaluate the national

requirements for a modern mobile interoperable radiocommunication system for emergency services in South Africa. The purpose of that workshop was to initiate the process and to allow various emergency service operators to participate in discussions around a proposed national public safety radiocommunication network. Considering the complexity of such a project, a number of local and international participants were invited to present papers at the workshop to share experiences with respect to their own public safety radiocommunication networks and service operations.

There was however a need for some sort of policy directions on Emergency Communications which would be finalised and presented to Parliament to obtain the buy in of all spheres of government. The intention of the DOC was to establish a forum to formularise a steering committee thereafter further consultation would be held with the portfolio organisations. This was apparently necessary to gain their confidence in the realisation of such a project. At the same time Sentech, the state owned signal distributor, would explore the prospect of installing a functioning pilot system in the greater Gauteng area, which should be licensed by ICASA. ICASA in turn would have to ensure that the regulations are in place to facilitate the licensing process.

This unfounded intervention by the DOC was clearly an indication of some disjuncture in understanding the roles of the policy maker and the regulatory authority. The effort made by the ICASA at the time was completely undermined which led to the DOC insisting on another protracted public process.

The much needed public safety trunking network never came to fruition and has led the various metropolitan councils and the public safety entities initiating rolling out of their own networks. It therefore still creates interoperability challenges and this duplication is costing the state and the tax payer in order to maintain these fragmented public safety radiocommunications networks, without the efficiency gains of a single network

5.5. Spectrum Framework under the ICASA Act of 2000

The Independent Communications Authority Act of 2000 (ICASA Act) in line with convergence trends elsewhere in the world, brought about the merger between the broadcasting regulator, the IBA, and the telecommunications

regulator, SATRA. In keeping pace with technological development in this fast paced field of telecommunications and broadcasting, policy makers the world over recognised the need of converging of the two sectors. Convergence is brought about by technological development. Electronic communications for both telecommunications and broadcasting can be supplied on multiple network platforms hence the push towards convergence (ITU, 2004).

The ICASA Act mandates the Authority to manage and plan radio frequency spectrum in the country. This radio frequency management function has to be conducted in accordance with bilateral and multilateral international treaties entered into by the Republic of South Africa. International agreements such as the ITU radio regulations resolution and recommendations, generally is reached by consensus amongst the various nations.

Although the management of radio frequencies for both the broadcasting and telecommunications sectors had been integrated under the Telecommunications Act through the joint liaison committee (JLC), the ICASA Act further corroborated this position. The ICASA Act, section 4(3)(i) imparts the mandate on ICASA to attend any international conferences convened by the specialised agencies of the United Nations such as the ITU (RSA, 2000). Section 4(3)(i) create some roll distortion as the DoC is taking the lead on this to represent the country at these ITU fora.

In the ICASA Amendment Bill of 2010, section 4(3) (c) there is an attempt to change the ICASA spectrum function to one of assignment only, which indicates that there is an attempt to place the spectrum planning function elsewhere. This assignment function would have made it clear that ICASA would only be responsible for licensing of the radio frequency spectrum. The overall development and revision of the allocation plan and international engagements would have been transferred to a separate structure (DOC, 2010).

The ICASA Amendment Bill came under fire and had been described by many commentators, including academia as the “undermining the independence of ICASA” (Benjamin, 2010, July 29). As reported on TechCentral “The SOS Campaign has raised serious concerns that proposed changes to the ICASA Act would undermine the independence of the regulator, and effectively make it an

operational body within the Department of Communications.” The SOS campaign is an informal advocacy body used as a vehicle to raise opinions and concerns in the ICT sector.

5.6. The Telecommunications Amendment Act 64 of 2001

An amendment to the 1996 Telecommunications Act sees the influence of the lobbyists to achieve, through an Act of Parliament, direct assignment of 1800 MHz and third generation (3G) radio frequency spectrum to the three mobile and two fixed line operators (RSA, 2001). Respondent 2 (interviewed, 2012) that it was rather profound at the time that the Authority’s independence and control of radio frequency spectrum were undermined. In expectation to further enhance the managed liberalisation process this aforementioned spectrum had been equally shared amongst the operators. Each of the mobile operators was assigned access to 2 x 10 MHz for Frequency Division Duplexing (FDD) services and 1 x 5 MHz Time Division Duplexing (TDD) in the 3G band. Each operator was also awarded access to 2 x 12 MHz FDD spectrum in the 1800 MHz band. This was later questionably increased to an assignment of 2 x 15 MHz in the 3G band for the three mobile operators (RSA, 2011). Reviewing the documents available, it appears that no public consultation took place for the further redistribution of these assignments. Respondent 19 remarked (interview, 2012) that spectrum was “given” to the three mobile operators and the incumbent fixed line operator considering that ICASA has placed a moratorium on licensing high demand bands.

However, these 3G and 1800 MHz bands were subjected to an extensive migration programme in line with the radio frequency band plan and international trends. The mobile operators effectively had access to 900 MHz spectrum but wished to augment their spectrum holdings to increase capacity and network rollout for broadband and voice services. The 3G band at the time was occupied by fixed links owned by the incumbent monopoly Telkom which was requested to relocate the existing fixed link services above 1 GHz in accordance with the migration strategy. The migration plan was finalised after the detailed spectrum investigation which was commissioned by the DOC (SATRA, 1997).

The 1800 MHz band which was then known as the DCS 1800 band was occupied predominantly by government services whihc had to be migrated to

suitable bands. The cost of migration was borne by the government entities themselves with very little compensation. Spectrum fees were determined at the time at an annual fixed spectrum fee of R 5 million for national operators plus R 100,000.00 per Mega Hertz for paired spectrum and R 50,000.00 for unpaired spectrum. Thus the mobile operators paid spectrum fees of R 7,2 million for 1800 MHz and 3G spectrum fees (RSA, 2004)

5.7. The Establishment of a Frequency Spectrum Directorate in Broadcasting Amendment Act

Against much resistance from industry and opposition parties, the 1999 Broadcasting Amendment Act saw the establishment of a frequency spectrum directorate (FSD). The intention of the creation the FSD was to meet the DOC's and government responsibilities to formulate policies and policy directions relating to the radio frequency spectrum. The primary responsibilities of this newly formed directorate were policy development with respect to the radio frequency spectrum and to undertake technological and economic research to ensure efficient use of spectrum. Over and above the afore-mentioned, the FSD in the performance of its functions, was supposed to co-operate with the relevant bodies where applicable (RSA, 1999). A former DOC official, Respondent 9 (interview, 21 September 2011), who served under the first Director-General of Communications, Dr Andile Ngcaba, this was an early attempt to move the spectrum planning function to the DOC away from the independent regulator.

During the same era there were major concerns that the spectrum management function was only performed by a few white staff members which marginalised black people from participating in this highly specialised area. The area of radio frequency then was specified as classified information which had the potential risk to sabotage electronic communications and destabilise the country. Under the Ngcaba administration there was an aggressive attempt to up-skill black people generally in ICTs and in particular spectrum management which the world over has been defined as scarce skills. It therefore appeared for some that it is imperative that control over the spectrum, the strategic national asset, should reside in the hands of the state.

5.8. The Second SA Band Re-planning Exercise (SABRE-2)

In 2004 during the Mandla Langa era, former chairperson of the IBA and ICASA, two important spectrum management milestones were achieved, the publication of the 2004 broadcasting frequency plan and the finalisation of the SABRE-2. SABRE-2 resulted in the South African Table of Frequency Allocations (SATFA). Respondents 6 and 8 (interviewed, 2011) remarked that this was achieved amidst the hysteria around the South African Communications Market Study by the Yankee Group. The study has identified various inefficiencies in the communications regulatory framework model. In particular the report identified the slow process towards digitalization of broadcasting which has been a policy goal in most developed nations. The report further highlighted delays in licensing of spectrum but failed to identify the inefficiencies in the spectrum management policy and regulatory framework (Finnie, Lewis, Lonergan, Mendler & Northfield, 2003).

This revised band plan, SABRE-2, covered radio frequency spectrum ranges from 20 MHz to 70 GHz. The first band plan titled SABRE only covered ranges 20 MHz to 3.6 GHz. After an extensive consultative process consolidated the two respective tables of frequency allocations of SABRE and SABRE-2 were consolidated into one band plan known as South African Table of Frequency Allocations (SATFA). This consolidation was due to numerous requests during the public consultation process. Although there were reportedly various successes and failures on migration implementation, some of the migration plans have been retained in SATFA. The migration plans then had to be taken through their transitional cycles to ensure that South Africa aligns the plan with international best practices and projected technological development broadcast and telecommunications fields.

One of key objectives of SABRE-2 was to update the bandplan with the ITU 1997 and 2003 WRC resolutions and recommendations. This update would also effectively align the allocation table with that of Region 1: Europe, Middle-East and Africa. Another objective was to allocate spectrum for public protection and disaster relief (PPDR) which has not been implemented due to the untimely intervention by the DOC on the ICASA third party public safety trunking process.

The PPDR radio frequency bands included 380-385 MHz and 390-395 MHz which had been awarded to rollout a TETRA radiocommunications system in most European countries. The name TETRA stands for TERrestrial TRunked RADio. This TETRA radiocommunication system is designed according to the robust needs of public safety. TETRA is also known as the wireless system that could do what GSM does and more (TCCA, 2012).

A big step towards harmonisation with regional and international band plans was achieved in SABRE-2 by allocating the 2.6 GHz band for Fixed Wireless Access Broadband networks. This spectrum allocation was accomplished at the WRC-2003 and has subsequently been allocated accordingly in SATFA. This also marked the initial identification of IMT 2000 in the South African radio frequency plan. In revising the SABRE-2 band plan the Authority had to take into account South Africa's potential bid to host the Square Kilometre Array (SKA) telescope for worldwide radio astronomy activities.

5.9. Production of the 2004 Broadcasting Plan

The IBA Act of 1993 required the Authority to revise and publish a terrestrial broadcasting plan annually. The plan was expected to be published as soon as practicably possible after the commencement of that Act. According to Respondent 18 (interviewed, 22 January 2012) this plan would represent the maximum amount of broadcasting frequency channels in use and available at any time. The terrestrial broadcasting frequency plan was published for the first time October 1999. The plan was revised and published in July 2002 and again November 2003. In 2004 the broadcasting frequency plan was again reassessed and updated to reflect the updated broadcasting assignments and undertakings in the previous calendar year. This annual revision of the broadcasting plan has been cited by many as a challenge which places undue pressure on the Authority's human and monetary resources. These remarks are simply just due to the resource intensive nature of public processes and what is seen to be the litigious nature of the broadcasting sector as remarked by Respondent 18 (interview, 21 May 2011).

At the time of the finalisation of the 2004 broadcasting plan, the digital broadcasting "dilemmas" began in earnest for South Africa (Armstrong & Collins, 2004). The ICASA spectrum management team responded to the international

digital migration process which was commenced in earnest by the ITU with the 2004 Regional Radiocommunications Conference (RRC-04) in May 2004. For these reasons the finalisation of the plan had been postponed until after the RRC-04 and subsequently only finalised and published in December 2005 (RSA, 2005).

Until 2005, as per the Telecommunications Act and the ICASA Act, ICASA led spectrum matters in South Africa. This included the digital broadcasting deliberations at the 2004 Regional Radiocommunications Conference and the planned intercessional planning sessions towards development of the digital terrestrial broadcasting plan. During the finalisation of the broadcasting band plan, the Authority recognised the planning work of the ITU in order to ensure a smooth transition from terrestrial analogue to digital broadcasting in the VHF/UHF bands. It was acknowledged, at a very early stage, that transition to digital terrestrial television cannot be achieved without reserving sufficient radio frequency channels and setting a holistic approach through policy direction. Hence, in the said 2004 broadcasting plan, the authority reserved the available spare frequencies for the transition to digital terrestrial broadcasting. Whilst ensuring spectrum reservation for digital broadcasting services, the challenge in the 2004 plan was to ensure that the existing analogue broadcasting services were accommodated and also make provisions for planned and imminent expansions on the broadcasting network.

5.10. Spectrum Management under the ECA

The Electronic Communication Act (ECA) 36 of 2005 introduced a new era in the ICT sector in South Africa. The ECA was introduced to promote the convergence of the broadcasting and telecommunications sectors. Digitisation, which results in convergence of technologies, was beginning to distort the boundaries of the original definitions of broadcasting and telecommunications spectrum allocations by the regulatory authorities (ITU, 2004b).

In South Africa, it appears that convergence has only brought about the convergence of the functions of the broadcasting and telecommunication sectors under one regulatory authority. However, the spectrum management units within ICASA are still run as distinct sections, as broadcasting and telecommunications units. While assignment of spectrum for broadcasting services is based on the

same technical principles as for telecommunications, assignment has a specific impact on the broadcaster, namely coverage areas and one-to-many one-way transmission.

The ECA introduces a different approach to the policy and regulatory framework in South Africa. The spectrum management policy and regulatory function has now been legally segregated between the DOC and ICASA. The Department had been conferred powers to make national policy and issue policy directions on radio frequency spectrum matters. These powers include the coordination requirements for security services and consideration for government planned and existing services. It further requires the Authority to consult with the Minister on migration of existing users. The in section 34 of the ECA the Minister further has the final sign-off on the national table of frequency allocations (RSA, 2005).

Similarly in terms of section 30(2) of the ECA, ICASA has been conferred with powers “in controlling, planning, administering, managing, and licensing the use of the radio frequency spectrum”(RSA, 2005) Although there is a separation of spectrum functions between the Authority and the Department, the complex integrated nature of spectrum management requires a combination of policy and regulation. Some of the questions which started to emerge were whether or not this is the optimum arrangement for spectrum policy and regulation. Respondent 3 (interviewed, 2012) pointed out that this arrangement appears to create some inefficiency in terms of allocation and bringing the band plan to eventual assignment to finalisation.

5.11. The South African Digital Terrestrial TV Migration Process

The migration or transition from analogue to digital terrestrial television (DTT) broadcasting is currently undoubtedly the focus for the electronic communications sector, especially the broadcasters. The transition to DTT broadcasting is underway in many parts of the world and is under consideration in a few others based on the timeframes set by the ITU (ITU, 2006).

DTT is not just simply a conversion of prevailing analogue transmissions to a digital modulation scheme. Effectively digital TV broadcasting offers a more superior sound and picture quality as well uses radio frequency spectrum more

effectively and efficiently. DTT broadcasting augments versatility to an array of applications including interactive services for example e-government, enhanced information and mobile and portable television reception.

The policy and regulatory issues relating to the transition from analogue to DTT are diverse and manifold. Therefore, it is essential to ensure that sufficient proficient human resources and capital are available for this multidimensional evolution. This section highlights the spectrum policy and regulatory issues that arisen with respect to the migration to DTT transmission. The implementation of the digital migration process appears to be a major challenge between ICASA and the DOC. In this respect the DOC, including industry members agreed internationally on digital broadcasting spectrum assignments and standards where after ICASA introduced equally protracted public process to develop a broadcasting frequency plan. There is a clear duplication of efforts on DTT and it appears that South Africa might not meet the internationally agreed timeline of 16 June 2015 for the cut-off of analogue transmission. This section provides an overview of the Digital Migration Process and its challenges.

5.11.1. Background on the ITU Digital Broadcasting Migration Process

The foundation for the analogue terrestrial television planning in the African Broadcasting Area (ABA) is captured in the ITU's regional agreement relating to the planning of VHF/UHF Television Broadcasting. That treaty is known as the Geneva 1989 (GE89) agreement which was developed in a conference held in 1989 in Geneva for ABA. A similar treaty existed for the European Union which is called the Stockholm 1964 (ST-64) agreement. These treaty status documents contain the analogue broadcasting service allotments for the two sub-regional groupings respectively (Cave, 2006).

Eminent DTT technologies that are on offer complement the many advantages and benefits. It is certain that DTT technologies and standards provide improved spectrum efficiency and the prospects to introduce greater access to a diversity of terrestrial broadcasting services. It therefore necessitated a review of the existing ST64 and GE89 ITU agreements and their associated frequency plans which was based on an analogues lattice arrangement. The assessment allows for the maximisation of the use of the available spectrum resources and to implement

the full potential of forthcoming digital broadcasting technologies (Cave, 2006 & OECD, 2006).

With respect to the need for digital broadcasting, the ITU Plenipotentiary Conference in Marrakech 2002, decided to arrange a Regional Radiocommunication Conference for the planning of DTT services in ITU region 1 and parts of the Middle East. The conferences which took place in 2004 and 2006 were task with planning of radio frequency bands: Band III (174-230 MHz) and Band IV/V (470-862 MHz). These two conferences RRC-04 and RRC-06 established a new regional agreement for the DTT broadcasting which included digital sound and television broadcasting in the respective radio frequency bands (OECD, 2005 & DOC, 2008).

RRC-04, the first session of the Conferences was held in 2004 in Geneva, Switzerland (termed “the technical session”) established the technical foundation of the new broadcasting frequency plans. The technical plan includes criteria and various coordination parameters to guarantee that all Member States have equitable access to broadcasting spectrum channels. The second session convened in Geneva in 2006 concluded a Regional Agreement and the associated frequency plans which would harmonise DTT in Bands III/IV and V. That Regional Conference furthermore set an digital switchover cut-off date thereafter no protection will be afforded to the analogue services in the DTT bands.

Under the leadership of the DOC, the country made a submission, on its input on the requirements for digital broadcasting channels for the ITU GE-06 Plan. The South African proposals were made based on the spare frequency channels which were reserved in the final 2004 broadcasting frequency plan. Prior to these Conferences, the DOC invited electronic communications stakeholders to offer expertise to participate in a National Preparatory Task Team, with the view to develop requirements for the DTT plan. The team comprised of the DOC and ICASA and was open to participation of all stakeholders in the broadcasting industry (DOC, 2007 & RSA, 2008). At that point none of the telecommunications operators participated in the development of the DTT requirements for the country.

The digital requirements consisted of an initial eighty three (83) DTT assignments in VHF Band III and one thousand and eighty four (1084) UHF assignments in bands IV/V. These DTT requirements have been coordinated successfully regionally and internationally and were entered in the GE06 plan for use of digital broadcasting in the country. According to the plan, these DTT assignments consist of two (2) national and two (2) metropolitan multichannel distribution networks or multiplexes also known as a mux/s. The DTT plan submission additionally included nine (9) regional Digital Audio Broadcasting (DAB) allotments each comprising of 2 x 1.5 MHz of spectrum in VHF Band III which was entered into the GE-06 Plan. This GE-06 plan, an international treaty has been coordinated successfully with all South Africa's bordering countries. South Africa, as a signatory to the ITU Constitution and Conventions, is bound by the provisions of the GE-06 plan (ITU, 2006 & RSA, 2008). In terms of section 231 of the Constitution of the Republic of South Africa, all international agreements has to be tabled timeously in the Assembly and the Council for ratification (RSA, 1996)

5.11.2. The National Digital Migration Policy Process

The late Minister of Communications, Matsepe-Casaburri, established, in 2005, an expert working group on digital migration (DMWG) to propose recommendations on transition to digital broadcasting. The ensuing year, 2006, a binding resolution was adopted at the RRC-06 that the region, Europe, Middle East and Africa, would switch from analogue to digital broadcasting services by latest June 2015 (ITU, 2006 & ITU, 2010)

This looming deadline compelled the DOC to devise a plan of action to ensure that the country fulfil its obligations and in order to bring the anticipated digital broadcasting services to all citizens. Responded 18 (interviewed, 2012) confirmed that the South African government tentatively "switched-on" DTT in October 2008, marking a landmark for the announcing a three year dual-illumination or transitional period. This period would allow government to implement a phased approach to achieve complete digital broadcasting, while minimising the costs of transition during the dual illumination period. According to the Digital Broadcasting Migration Policy of 2008 the first phase of the

migration process seeks to meet the aggressive domestic objectives. These targets are, for digital broadcasting signal, to cover approximately fifty (50%) percentile of the population by 2008, sixty five (65%) percentile of the population by 2010 and close to ninety five (95%) percentile by 2011 to enable analogue switch-off (RSA, 2008).

The South African government has acknowledged that digital migration should be a national priority. The adoption of the Broadcasting Digital Migration Policy (BDMP) offers a policy framework for the implementation of digital broadcasting. The Minister of Communication subsequently appointed a twelve member advisory council represented by stakeholders to oversee that digital migration process. This council which will supports national objectives is appropriately called the “Digital Dzonga” which means “Digital South.”

In the context policy framework, in his 2009 budget vote speech, the late Honourable Minister of Communications, Mr Roy Padayachie remarked that the DOC was in the process of finalising a scheme to support set-top boxes (STB) designed to assist the country’s poor television-owning households. According to the BDMP as amended in 2012, out of the approximately 11.5 million TV households it is estimated that 5 million poor house hold will not be able to afford a STB. The policy framework recognises the need for investment, job creation and re-skilling citizens therefore a local STB manufacturing strategy was developed.

5.11.3. Regulatory Process for DTT

In February 2006 ICASA published a discussion paper for the utilisation of channel 65 (822-830 MHz) and 66 (830-838 MHz) for services other than broadcasting in the sub-allocation 790-862 MHz band (ICASA, 2006). This publication pre-empted the usage of the upper end of the UHF radio frequency band which was allocated for broadcasting services and later to be allocated for future mobile and fixed broadband wireless access systems. These findings were finalised while RRC-06 was still in progress. This pre-empted that the Authority will licence this band for services other than broadcasting.

5.11.4. The Key Challenges Facing Transition to DTT

There are essentially two approaches to DTT migration, the first being a market-driven technological one where a progressive replacement of analogue technology with the better digital technology takes place and the second is a policy driven migration primarily focused on free-to-air terrestrial broadcasting services. This calls for Authorities to investigate appropriate spectrum management models to ensure an effortless digital migration process (OECD, 2006).

Respondent 18 (interviewed, 2012) noted that, need for a quicker switchover to allow for better use of radio frequency spectrum, is what leads to a policy driven migration with a firm switch-off date. It was projected that there are approximately 5 million households that cannot afford STBs, hence the consideration that a market-driven approach will not achieve the desired results considering the tight migration timeframes envisaged (Duncan, 2012). The Working Group on Digital Migration proposed a policy driven approach to achieve the desired policy objectives. According to Duncan (2012), although the USA and Canada's digital transition processes were market-driven of nature which effectively marginalised public interest objectives such as e-government, local content product. Bearing in mind that the country is lacking a selection of infrastructure options it was considered the best approach to introduce Digital Terrestrial Television, rather than more advanced technologies (DOC, 2008). Controversially in the draft DTT regulations, ICASA has revised the transition period and propose to extend it to 2012. The transition period of 1 November 2008 to 1 November 2011 was adopted through a parliamentary process. The question now remained whether ICASA could amend the parliamentary decisions by regulation without the Minister of Communications issuing a Policy Direction to ICASA for such major amendment. All these controversies are bound to delay the digital transition process.

5.11.5. The “Digital Dividend”

International studies indicate that one of the key benefits of digital migration is the value of the so-called “digital dividend” (OECD, 2006 & Cave, 2006). According to Cave (2006) the digital dividend is generally understood to

be savings or freeing-up of spectrum associated with the transition from analogue to digital television broadcasting. This shift to DTT not only provides television viewers with choice but the benefit is that it releases high demand spectrum resources for much needed broadband wireless electronic communication services. This digital dividend band, according to Cave (2006) in the “sweet spot” and Doyle (2011) in the “prime region” is highly valued. The combined characteristics of coverage (propagation and capacity bandwidth) in the VHF/UHF band makes the digital dividend suitable for a very wide range of technology applications for instance military, broadcasting, private and public mobile electronic communications, aeronautical and maritime communications and navigation (Burns *et al.*, 2004 & ITU, 2010).

Initial analyses projected that a digital dividend of 105 MHz is achievable after analogue switch-off. The 2007 World Radiocommunication Conference (WRC-07) allocated the band 790-862 MHz for mobile services on a primary basis and has additionally identified the band for IMT (ITU, 2007). South Africa and the SADC region were proponents of this position which was adopted in ITU Region 1 (Europe, Africa and Part parts of the Middles East). This 72 MHz sub-allocation is acknowledged to be de facto “digital dividend” (OECD, 2006). Many countries in Africa have already deployed services other than broadcasting in the band. South Africa as well pre-empted this move before the conclusion of the ITU RRC-06 process to assign spectrum on a secondary basis to CDMA on channel 65 and 66 on a non-protection, non-interference basis.

South Africa along with most of Africa’s digital migration requirements which were used in GE06 planning process are based on the lattice formulated GE89 plan. This lattice planning process is the format which was used to plan spectrum allotments for analogue broadcasting. It was agreed that due to the delays which were anticipated in coordination with neighbouring countries during the planning process that SADC region will plan their digital spectrum requirements based on the already coordinated analogue assignments (Respondent 18 refers to a DOC unpublished, 2005). From the outset it was recognised that there will always be a need to optimise the digital plan. In order to expedite the digital migration process it was a deliberate decision to use the frequency

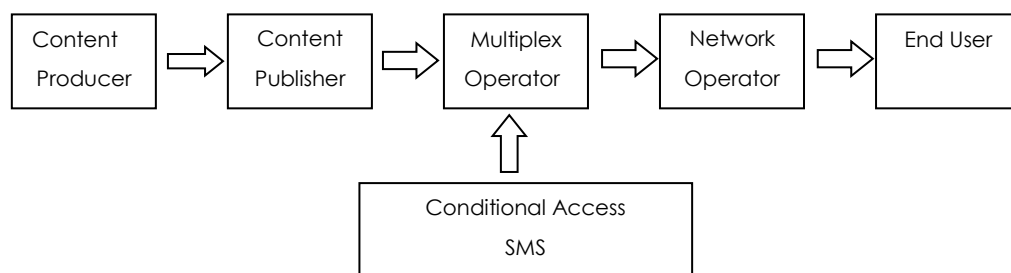
allocations achieved in the GE-06 plan. The Digital Migration working group recommended that the assignments in the ITU RRC-06 plans be used for the implementation of DTT during the digital switchover process and after analogue switch-off (RSA, 2008).

However, ICASA through its own consultation and apparent lobbying from broadcasting operators has gone through an entire re-planning exercise to ease the implementation of the digital broadcasting channels. Re-planning the already coordinated GE06 plan, an international treaty will have a knock-on effect on the allotments to all neighbouring countries. Coordination of these allotments at six (6) borders of Namibia, Zimbabwe, Botswana, Mozambique, Swaziland and Lesotho might further delay the implementation of digital migration especially in the remote rural areas where access to services is most needed. ICASA still has to finalise the national frequency plan which will further delay the implementation of digital migration. A regional re-planning exercise for the digital plan is required to meet the 17 June 2015 ITU deadline.

5.11.6. Licensing Arrangements

In a digital broadcasting environment a new regulatory approach is certainly required. The traditional broadcaster/signal distributor concepts now require new thinking. Instead it is necessary to distinguish between content providers, content publishers or bouquet operators, and network service providers or signal distributors. A typical digital broadcasting value chain is depicted in the Figure 3 below:

Figure 4: Typical Digital Broadcasting Value Chain



Source: DMWG Technical Committee, 2007

The traditional one-on-one relationship between a broadcaster and a single radio frequency channel no longer applies in a digital broadcasting environment. Currently analogue broadcasting frequency channels of 8 MHz are assigned to a particular broadcaster. The broadcaster in turn will request signal distributors to construct a transmission network based on their coverage requirements. In a DTT environment a public, commercial and subscription broadcaster could potentially exist on the same multiplex. This simply means that multiple broadcasters can share the same 8 MHz channel previously assign to one broadcaster.

Access to these multiplexes or 8 MHz frequency channels could be a challenge as the current broadcasters already claim usage rights to these muxes. The challenge is that broadcasters are licenced for the frequency channels, which will in a DTT environment, be licenced to third party hence they will relinquish the spectrum. The licensing of multiplex operators is under consideration whereby an operator could be any capable ECNS Licensee or the current traditional signal distributor, Sentech. It is imperative that ICASA put in place a licensing framework that gives access to broadcasters on an open, fair and non-discriminatory basis.

5.11.7. Technical Issues for DTT

The primary drivers for the take-up of DTT by consumers include the setting of an initial switch-off date for dual illumination, the provision of additional services and greater choice, enhanced picture and audio quality, mobility and portability. However, the affordability of Set-top-Boxes (STBs) is the single most important driver of take-up of digital broadcasting as possibly 20% to 40% of households would not afford one. Subsidies of STBs must therefore be considered to expedite the take-up of DTT and clearing the band for future more advance technologies. These processes are still under review.

5.11.8. The establishment of a Digital Migration Office (Digital Dzonga)

The digital migration framework proposed the establishment of a Digital Migration Office (DMO) which will be named initially the Digital Dzonga (means Digital South). This Office would host an independent Digital Migration Council which will be located and function within the DOC. The DOC will amongst other things act as the secretariat for the DMO. Respondents generally remarked that

this office must be manned with the right technical skills. The Council intends to involve key stakeholders from the broadcasting sector, signal distributors and technology vendors. This arrangement will require active participation from other government portfolios with a key interest in this process. These government departments may include National Treasury, Department of Trade and Industry; Department of Arts and Culture to mention a few. The intention of the DMO is to have a limited lifespan until the end of the dual illumination period and beyond if required.

Telecommunications operators especially the existing ECS and ECNS operators have been excluded in the development of digital migration requirements and the development of the digital migration strategy. These operators boast proven success records in customer service and rollout of digital transmission networks and have specialised expertise in optimum reuse of radio-frequencies and related planning thereof.

5.11.9. Summary of Key Spectrum Issues for Broadcasting Digital Migration

The current analogue broadcasting systems is using spectrum inefficiently and are wasting valuable resources. Digital technologies, which are more robust and more spectrum efficient, can through multiplexing accommodate more services on the same spectrum channel. Broadcasting digital migration will free-up spectrum, the so-called digital dividend, which could be used for much needed broadband wireless access services. It is imperative that policy and regulatory framework cater for how the digital dividend should be used and which operators should have access to the bands. This matter is currently still pending with the Department and ICASA.

The ITU has set a deadline of 17 June 2015 whereby analogue broadcasting services in the digital dividend portion of the band will not be protected by transmission from neighbouring countries. In order to meet this deadline a dual illumination period has to be set to ensure a smooth transition to digital. South Africa has undertaken a policy driven process by setting an earlier deadline of 2011 and a subsidy scheme for those who cannot afford the STBs. The earlier deadline is simply to minimise the cost for broadcasters to maintain two parallel networks over a longer period. However, the deadline for analogue

switch-off has now, officially been postponed twice due to the inability of the DOC and ICASA to implement the digital migration process. This could certainly be attributed to uncoordinated approach to this digital migration process.

5.12. ITU World Radiocommunication Conference Process

5.12.1. The 2007 World Radiocommunication Conference

The World Radiocommunication Conference (WRC) is an international treaty making meeting, where ITU Member States assemble to review and if necessary revise the International Radio Regulations (RR). The ITU RR is the treaty governing the use of the radio frequency spectrum as well as the geostationary and non-geostationary-satellite orbits. The decisions of the WRCs are recorded in the Final Acts of the ITU which require endorsement by member states (ITU, 2008)

The rapid growth of wireless and radiocommunication-based systems and the increased globalisation makes it difficult to share spectrum. The 2007 WRC was able to resolve key and complex radio frequency spectrum matters particularly relating to (a) identification of additional radio frequency spectrum for the International Mobile Telecommunications Systems (IMT) and systems beyond IMT-2000 (IMT Advanced); (b) identification of additional radio frequency spectrum for aeronautical mobile telemetry (AMT) applications; (c) amendments to the ITU Radio Regulations to align the non-Global Maritime Distress and Safety System (“GMDSS”) with the GMDSS system; (d) review of coordination, notification and recording procedures for satellite networks; (e) protection of radio astronomy bands from interference coming from satellite systems (ITU, 2007)

According to Respondent 12 (questionnaire, August 2011), the Republic of South Africa through the DOC was instrumental in national and SADC regional preparations for WRC-07. The agenda of the African Group preparations was also influenced through the submission of the SADC proposals to the WRC African Group Preparatory Meeting. Various national and regional consultative meetings were convened whereby South Africa’s and SADC positions and proposals with respect to WRC-07 agenda items have been developed and adopted. The SA and SADC proposals to WRC-07 were finalised within the time frame

required and submitted to the ITU as input contributions to the Conference (DOC unpublished report, 2008).

5.12.2. The International Mandate of the DOC

The DOC has a mandate to coordinate participation in international ICT organisations in line with the vision and mission of the country and the strategy to build a better world (ECA, 2005). Chapter 5 section 34 (1) of the Act mandates the DOC as follows:

The Minister, in the exercise of his or her functions, represents the Republic in international fora, including the ITU, in respect of - (a) the international allotment of radio frequency spectrum; and (b) the international coordination of radio frequency spectrum usage, in accordance with international treaties, multinational a bilateral agreement entered into by the Republic. (RSA, 2005 & DOC, 2010)

These international bodies such as the ITU have an impact on the development of electronic communications and broadcasting legislation as well as the development of standards and radio frequency plans. The country's endeavour to build an all-inclusive information society makes it imperative that the country participate in decision –making in international organizations such as the International Telecommunications Union (ITU), African Telecommunications Union (ATU), African Union (AU), Universal Postal Union (UPU), Pan-African Postal Union (PAPU).

World Radiocommunication Conferences are convened every three to four years. WRC's generally study the Radio Regulations, by addressing any radiocommunication issues globally. WRCs also instruct the Radio Regulations Board and the Radiocommunication Bureau to review their functional activities and define questions or identify focus areas for study by the Radiocommunication Assembly and its related Study Groups.

Emanating from the WRC-07 agenda, there were critical issues considered for South Africa. Several frequency bands have been identified as additional radio frequency spectrum for IMT-2000 and IMT Advanced standards. IMT is the global standard for third and fourth generation (3G & 4G) wireless communications, as defined by a set of interdependent ITU recommendations.

Radio frequency bands such as 450-470 MHz frequency band were identified for the IMT for countries wishing to implement such systems. This particular band is currently used extensively in South Africa for safety of life land mobile services, working mainly in a non-cellular approach. For this reason South Africa was not initially in support of the identification of this band for IMT. As a consequence a decision to use this 450 MHz band for IMT in South Africa will be further assessed as it is well suited for rural communication development due to the propagation nature of lower frequencies, which means that the lower the frequency the wider the coverage areas. In this regard less base stations are required hence less capital expenditure to roll out such a network. (ICASA, 2010). The 790-862 MHz (digital dividend 1) frequency band was additionally identified for the deployment of IMT systems. This DD1 band is currently used extensively in South Africa for the delivery of analogue television broadcasting services. This identification will come into effect fully from 17 June 2015 after final migration of the analogue terrestrial television services. The sharing possibilities among broadcasting and other services in this band were revisited at 2012 World Radiocommunications Conference. The final report of WRC-12 has not been released at the time of writing this report.

Similarly the frequency band 3400-3600 MHz was identified, as an ideal band for the deployment of IMT Advanced Systems. Systems with a higher data rate than IMT 2000, supporting new capabilities and advanced services. The band 3400-3600 MHz is currently not available for satellite services within the Southern African Development Communities (SADC) region, hence South Africa supported the band in question for IMT-Advanced.

The protection of South African fixed terrestrial services operating in the frequency band 2500-2690 MHz has been assured through the measures taken at the conference. In a similar way the protection of the South African terrestrial television broadcasting from the satellite television broadcasting in the 620-790 MHz frequency band is also protected.

Further identification of additional frequency spectrum has been considered for aeronautical mobile telemetry (AMT) applications. Although South Africa and eight (8) SADC countries supported the identification of bands 4400-

4940 MHz and 5925-6700 MHz for AMT in order to promote the local aeronautical flight testing industry, this was considered premature by Respondent 12. Nevertheless the issue was deferred to WRC-12 since it is considered to support the safe operation of unmanned aircraft vehicle systems (UAV), of which the country is the only known manufacturer of UAV on the African continent.

South Africa played a crucial role in influencing the inclusion of items on the agenda of WRC-12: (a) enhancing the radio frequency spectrum regulatory framework, (b) studies on international harmonization of radio frequency spectrum for electronic news gathering (ENG) services, (c) examination of the effects of emissions from short-range devices (SRDs) on radiocommunication services.

ICASA as the custodian of the radio frequency band plan should have taken cognisance of these amendments which must be adopted following a formal ratification process by the government.

5.12.3. Actions on outcomes of WRCs

The changes in the articles of the RR (International Table of Frequency Allocations) must be implemented in the South African Table of Frequency Allocations. Furthermore, relevant Resolutions for South Africa in certain frequency bands must be incorporated in the National Table of Frequency Allocations to ensure that this information is available to all users of the radio frequency spectrum. It is of paramount importance to update the National Frequency Allocation Plan to reflect and refer to up-to-date recommendations and resolutions as revised by WRCs.

Southern Africa including other African countries was instrumental in the debates in the Working Groups, Sub Working Groups and Drafting Groups and influenced to a large extent the outcomes of WRC-07. After four weeks of successful deliberations at WRC-07, almost all the SA and SADC proposals to the Conference on radio frequency matters were adopted. SADC and in particular SA were commended for the valuable inputs and indeed it was recognised for the first time that Africa had made a real impact on the outcomes of the Conference. It was recommended that the region should closely follow and contribute to the work of ITU-R Study Groups dealing in particular with those agenda items proposed by

South Africa and SADC as well as other relevant agenda items, to ensure that the national and regional interests are taken into account on deliberations regarding the same.

The decisions taken and adopted at the WRCs are contained in provisional Final Acts of the Conference of which the approved Final Acts are usually only available six months after the Conference due to translation and proof reading. This international treaty document must be ratified by Parliament. After ratification by Parliament, the Instrument of ratification will be included in the communication strategy related to the amendment of the National Table of Frequency allocations in terms of the Electronic Communications Act No. 36 of 2005. Only thereafter can the Minister direct ICASA on areas where South Africa needs to implement the Final Acts of the decisions of the Conference. ICASA only published the final table of frequency allocations based on WRC-07 in July 2010 (ICASA, 2010).

5.13. Spectrum developments in the period January 2007 to May 2012

5.13.1. Spectrum and Broadband Policy

The White Paper on Telecommunications policy recognises that policy making is a dynamic process and therefore should respond to the needs of the people of the country. It states that, “The state's vision for telecommunications is one that balances the provision of basic universal service to disadvantaged rural and urban communities with the delivery of high-level services capable of meeting the needs of a growing South African economy” (RSA, 1996). The White Paper further recognises the role of policy setting on radio frequency spectrum by the Ministry of Communications.

Fourteen years later, in 2010 the DOC published the broadband policy which announced very little on radio frequency spectrum. The Broadband policy only mentioned that allocation will be guided by the developmental goals or broadband.

5.13.2. Radio Frequency Spectrum Policy

The radio frequency spectrum policy 2010 for South Africa provides further guidance with the aim to provide clear directives to ICASA to promote

spectrum efficiency and to stay abreast of the latest technological developments. Respondents remarked that the said policy appears to infer that the Minister of Communications is responsible for spectrum planning and ICASA is mandated to manage and licence this scarce natural resource (DOC, 2010b). However, the ECA clearly states that, “the Authority controls, plan, administers, and manages the use and licensing of the radio frequency spectrum except as provided for in section 34.” Section 34 imparts international engagements and the responsibility of spectrum for security services, research, and migration plans to the Minister of Communications (DOC, 2010b, p. 12-13).

The ECA further recognises that the Minister may make policies on matters of national applicability to the ICT sector, including the efficient use of the radio frequency spectrum. However the Minister may not issue policy with the respect to granting of licenses.

5.13.3. Broadband Policy and Spectrum

In 2010 the DOC published the broadband policy which pronounced very little on radio frequency resources, except to mention that allocations will be guided by developmental goals (DOC, 2010c).

5.14. Policy Directions on High Demand Spectrum and Exploring the Digital Dividend.

An uproar on spectrum happened when ICASA announced that they would publish a draft invitation to apply with proposed band and migration plans in the 800 MHz and 2.6 GHz bands. However, intervention from the Ministry of Communications directed to hold back on the publication. ICASA postponed the publication of the draft ITA and in a media briefing announced that the DOC would issue policy directions relating to high demand spectrum. After much speculation on 14 December 2011, the DOC published in policy directions on high demand spectrum (ICASA, 2011b).

Fortunately the DOCs consultative and responsive engagement on this critical issue on radio frequency spectrum was well received. Various commentators believe that the finalisation of this process is long overdue. It was also stated that the policy intervention came at an opportune time and would go a long way to provide access to the much needed wireless broadband services in the

interest of competition and consumer welfare. The successful implementation to these policy directions may also facilitate the entry new players into the electronic communications market.

However the policy direction raises a few contradictory issues which should be resolved before the final publication. ICASA's draft ITA requires an I-ECNS license as one of the prequalification criterion to be awarded high demand spectrum. Section 5(6) of the ECA states that "the Authority may only accept and consider applications for individual electronic communications network services (I-ECNS) licences in terms of a policy direction issued by the Minister in terms of section 3". This infers that the high demand spectrum award shall only be applicable to I-ECNS licensees. It is therefore implied that the ECS only licensees, mostly the former value added network service (VANS) providers, will be excluded from being licensed this spectrum. Respondent 1 (interviewed telephonically, 2011) stated that this will limit the field for new players hence limited competition. This further suggests that in order to introduce new I-ECNS licensees, ICASA will first have to introduce an ITA for new I-ECNS licensees before it could award spectrum to new operators over and above the existing ECNS licensees. The licensing of additional I-ECNS licensees will further delay the spectrum award process as ICASA can only licence additional I-ECNS licensees following a policy direction issued by the Minister. Therefore the major spectrum holders have a better opportunity to be awarded additional spectrum if the an ITA for new I-ECNS licensees are not pursued.

The policy direction further proposes that the 790-862 MHz (800 MHz) band be licenced for broadband wireless applications. This band is known as the 800 MHz or digital dividend one (DD1) which would become fully available due to the transition from analogue broadcasting services to digital broadcasting services. In fact the ITU RR Article 5, Table of Frequency Allocations footnotes endorse the fact that the band could be licenced without delay. The ITU footnote 5.316A allocates the 800 MHz band until 16 June 2015 to the mobile services on a primary basis where after footnote 5.316B allocates the entire band to IMT in ITU Region 1 after the digital transition cut-off date of 17 June 2015. It is therefore unmistakable from the ITU Radio regulations and applicable footnotes that the

800 MHz band could be licenced without delay and does not have to wait until 2015 (ITU, 2008). At the WRC-12, in February 2012, a second digital dividend (DD2) was agreed upon and will be studied during the period leading up to WRC-15. The DD2 includes the band from 694/8 MHz to 790 MHz (ITU Provisional Acts, 2012). This was endorsed by an African regional meeting in Kampala, Uganda convened by ATU in April 2012.

On the one hand the Policy Direction states “2.1.4 Ensure that auction would be considered as a last resort, where necessary, in circumstances where there are competing applications who meet the policy stated objectives.” On the other hand in 2.1.5 it categorically states “Ensure that where the demand for radio spectrum exceeds available bandwidth auctions are applied as for assignments to users” (DOC, 2011). The aforementioned directly contradicts each other where it suggests an auction process but discard such a process only as a last resort. This in reality means that auction process might not be imposed as suggested in the second instance.

It must therefore be derived that the reason why this policy direction is issued is that this is a high demand spectrum band, hence the need for issuing this policy direction for I-ECNS licensees. Otherwise this will support the view that ICASA does not have to wait for a policy direction from the Ministry of Communications to licence high demand spectrum.

The Authority’s radio frequency spectrum regulations section 7 states that “the Authority must at all times prepare an ITA when the radio frequency spectrum licences will be awarded or granted on a competitive basis and there is deemed to be insufficient spectrum to accommodate demand (section 31(3) of the Act)”.(ICASA, 2011a). This intentional move to award spectrum through a market-based auction process, as it is considered to be the most transparent way. However, the effectiveness of an auction depends on the stage of development of a market in question, i.e., it is path-dependant. In markets dominated by incumbent firms, like South Africa, an auction should be designed in such a manner that does not preclude any new entrants from participating.

On an alternative competitive basis, spectrum could be assigned based on comparative selection methods or beauty contests. These methods entail a

subjective assessment through which the regulator or a select-committee assesses various applications on the basis of a number of key variables deemed important by the regulator including the entry price. Each variable is allocated weights and an application which receives a higher rating is chosen.

Comparative selection methods are prone to unethical practices as they are less transparent, whereas open auctions may create a platform for collusion as operators could be able to monitor each other's prices in the event of there being a previously agreed price. This conduct, however, is prohibited in many countries and carries enormous financial penalties if found guilty (Wellenius & Neto, 2008). In terms of the Competition Act, in the case of South Africa, a firm could be fined a maximum of 10% of its annual turnover in a given year for participating in such collusive practices. As regards to the unethical practices, there has been no reason to doubt the credibility of the Authority to judiciously execute a comparative selection method to promote competition in the affected markets (RSA, 1998).

The DOC postponed the deadline for inputs for submission to the 28 February 2012 which will certainly have a knock-on effect on the ICASA licensing process. This will result in further delays in implementing usage of the much needed spectrum resources for the rollout of broadband services. The policy direction proposed a combinatorial (800 MHz & 2.6 GHz) spectrum license package, awarded through the competitive licensing process or auctioned which may not be used for the supply of services to end-users but on a "wholesale open access" basis. This "wholesale open access" basis should be in line with the definition of "non-discrimination" and should be based on the definition in Section 9 of the Competition Act, no. 89 of 1998, which is that

A wholesale provider may not discriminate between purchasers in the supply of services if: (1) it relates to the sale, in equivalent transactions, of services of like grade and quality to different purchasers; and (2) it involves discriminating between those purchasers in terms of – (i) the price charged for the services; (ii) any discount, allowance, rebate or credit given or allowed in relation to the supply of goods or services; (iii) the provision of services in respect of the services; or (iv) payment for services provided in respect of the services (RSA, 1998)

The DOC's draft policy direction allows ICASA to proceed with the licensing process for high demand spectrum, where demand is exceeding the supply. This process is exploring licensing the 800 MHz and 2.6 GHz band. However it is clear from the draft Policy direction that ICASA should not embark on an auction process if it is not necessary. It is also clear that the policy direction seeks to address objectives of, universal access and broadband services for all with a specific focus on rural deployment, broad-based black economic empowerment, and the introduction of new entrants to enhance competition in order to drive down the cost to communicate.

In conclusion the DOC needs to ensure that a balance is struck between ensuring that new entrants enter the market, and ensuring that spectrum is efficiently utilised. The Authority can achieve the former objective, in ensuring new entry, with the introduction of the wholesale open access network. Any licensee assigned spectrum for a wholesale open access network would not be allowed to sell services to end users, which automatically excludes all of the existing mobile network operators, who would want to use this spectrum to supply services to end users. Additional spectrum outside of the wholesale open access network ought to be opened to all other licensees, to ensure that spectrum is effectively utilised.

5.14.1. The ITA and Draft Spectrum Plan for 800 MHz and 2.6 GHz Bands

5.14.1.1. Invitation to Apply(ITA)

It has been seven years since major access spectrum was issued to operators in 2005. There is currently a high demand for access to the spectrum resources which prompted the regulator to advance steps to award spectrum.

On 15 December 2011, ICASA published a proposed spectrum assignment plan and an Invitation to Apply (ITA) in the 800 MHz and 2.6 GHz bands (ICASA, 2011b). This process is aimed at introducing limited sharing mechanisms and increasing access to the 2.6 GHz and 800 MHz bands, now regarded as high demand spectrum bands. The process is also intended to achieve the national policy objectives of introducing new national and rural broadband providers and ensuring that licensees contribute to broad-based black economic empowerment. The Department of Communications draft spectrum policy

direction published on 14 December 2011 attempts to set the policy framework for ICASA to commence the licensing process. The draft policy directions issued by the Minister further addresses access to the so-called digital dividend spectrum.

The intention is to run the two processes in parallel to address the excessive delays to the licensing arrangements over the past five years. As such, ICASA cannot finalise its licensing process before the Minister has finalised the policy directions. Therefore, while ambitious dates and time frames were stipulated, these are likely to change given the interdependency of the two processes.

5.14.1.2. The ICASA spectrum licensing process and potential implications for operators.

ICASA's intention is to auction spectrum in the 800 MHz ("Digital Dividend") and 2.6 GHz bands. Applications to participate in the process, including an initial bid for the spectrum, were due on 23 March 2012 and ICASA aimed to finalise the licensing process by 30 April 2012. These dates have already shifted as extensions were granted to the original submission dates. Further delays are inevitable which will further delay the usage of spectrum. The policy directions was not finalised by the end of December 2012 and at the end of this study.

5.14.1.3. ICASA's Proposed Spectrum Licensing Process & ITA

ICASA proposed a "wholesale open access package." This is in line with ICASA's policy objective to introduce innovative spectrum resource sharing and to increase access to spectrum for licensees. This package consists of 2 x 10 MHz in the 800 MHz band and 2 x 20 MHz in the 2.6 GHz band. The successful bidder may not use this spectrum to provide services to end-users in other words retail services.

Considering these proposals there are suggestions by Responded 3 (interview, 11 June 2012) that "Ensure that in finalising the channel arrangements for the respective band that the spectrum blocks are awarded in such a way that it optimises the usage and to accommodate block expansions which are inherent in the development of future advanced technologies."

Respondent 19 and 6 (personal communications, 23 December 2012) expressed views that large contiguous blocks will allow the operators to use the full potential of the new technologies. Bandwidth hungry mobile technologies such as LTE Advanced and IMT Advanced will benefit from the large contiguous spectrum blocks and current specifications confirms that LTE requires 20 MHz blocks to maximise the speeds required for large mobile data networks. Contiguous blocks are essential for endeavours for spectrum efficiency. With large contiguous blocks the need for guard-bands between radio technologies and operators can be minimised. It is more likely that an operator with large spectrum blocks can use all the frequencies in the frequency block without employing guard channels by applying critical frequency reuse distances in critical cases (Respondent 16 & 6, interviews, January 2012).

This would allow respective new and incumbents wireless broadband operators to offer 2 x 20 MHz of spectrum in the 800 MHz band, along with 2 x 20 MHz of spectrum in the 2.6 GHz band, on a wholesale basis to other operators including the major ECNS licensees. The latter entities such as MTN and Vodacom are unlikely to bid for the wholesale package, as they will not be allowed to provide services using this spectrum to end-users, in this case retail customers. Respondent 3 pointed out at a public engagement that the incumbent operators will be limited for access to these bands. The remaining spectrum on auction will be two packages in the 2.6 GHz band of 2 x 15 MHz and 2 x 20 MHz respectively. ICASA already alluded to the fact that existing holders of spectrum in the 900 MHz, 1800 MHz and 2100 MHz bands may not be allowed to apply for these packages. An applicant cannot be licensed for more than one package, though it can apply for more than one package. The idea is to promote the introduction of new entrants hence more competition.

The introduction of a managed spectrum parks model is also proposed. This will allow ICASA to reserve 1 x 20 MHz open access 'Spectrum Park' in the TDD portion of the 2.6 GHz band, details of which ICASA will provide at a later stage. The managed spectrum park is a fairly new concept which was introduced in New Zealand.

This concept caters for a situation in which a nationwide spectrum right is not required, but likewise a general user licence would be too open as services require some coordination or sharing. It is intended for local and regional services, and seeks to encourage a flexible, cooperative, low cost and self-managed approach to allocation and use. (NZ Ministry of Economic Development, 2008).

In a personal interview and press briefing Respondent 4 (interview, 14 December 2014) mentioned that the introduction of this “Spectrum Parks” concept is to cater for ECS and ECNS licensees that currently do not have access to spectrum. Introducing this concept will also lower the barrier to entry to address the broader access market and rapid deployment of wireless local loop services.

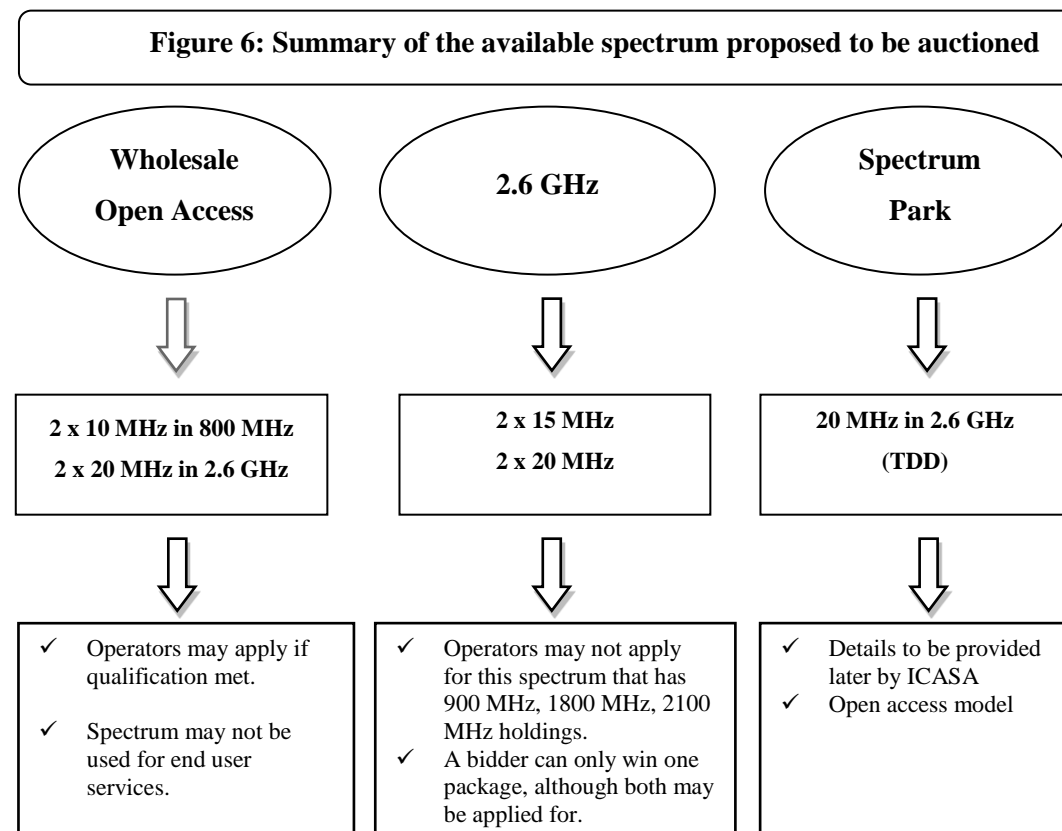
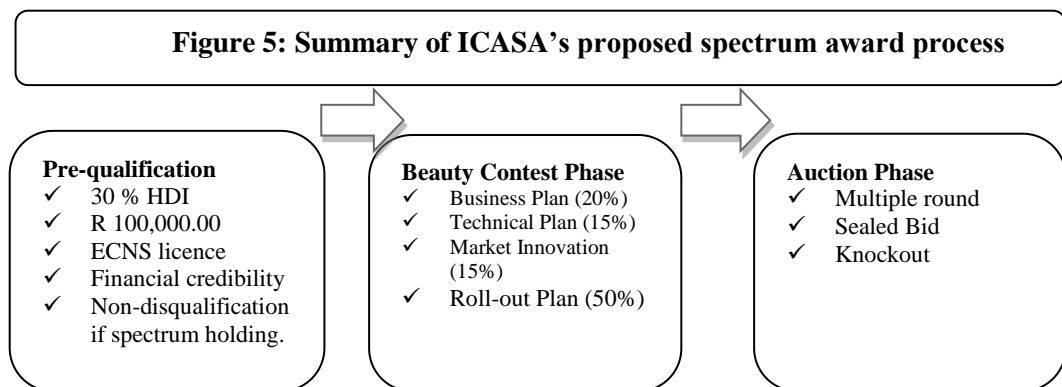
5.14.1.4. ICASA’s proposed assignment process

The intended spectrum assignment process is proposed to be a combination of ‘beauty contest’ and an auction. The initial pre-qualification criteria are proposed to be set out in an ITA, which could include a non-refundable fee of a hundred thousand Rand (R 100,000.00), thirty percent (30%) beneficial ownership by Historically Disadvantage Individuals (HDI), financial credibility, holder of an ECNS licence. Following pre-qualification, a beauty contest stage will be held comprising an evaluation as follows: proposed business plan of twenty percent (20%), technical plan fifteen percent (15%), market innovation and stimulation fifteen (15%) and a network rollout plan fifty percent (50%). For qualifying bidders, a multiple round sealed bid English auction is proposed. This entails that bids are entered for each package round after round until only one bidder remains for each package. The winning bidder will pay its winning bid price.

There were no rollout or coverage obligations set out in the initial draft ITA. However, ICASA published an erratum which specifies that the combinational licenses (800 MHz and 2.6 GHz) will be obligated to cover 70% geographic coverage in five years of which 50% must exclude major metropolitan area and for 2.6 GHz only licenses 50% population coverage in four years (ICASA, 2012) Applicants are expected to set out coverage targets at the beauty

contest stage of the licensing process. The migration plan entails that Sentech will be licensed a significant amount of spectrum of 2 x 10 MHz in the 800 MHz band, and 2 x 15 MHz in the 2.6 GHz band. Wireless Business Solutions will retain 30 MHz TDD in the 2.6 GHz band (including 2 x 5 MHz guard bands). Neotel will also be licenced 2 x 10 MHz to migrate their existing legacy CDMA network to the LTE platform to align the band with European and SADC channel arrangements. A summary of ICASA's proposals are contained in Figures 5 and 6.

Figure 5 & 6: Summary of ICASA's proposed spectrum award



Source: Adapted from Cohen (unpublished, 2012)

5.15. The Spectrum Fees Debacle

ICASA published spectrum fees regulations, based on an Administrative Incentive Pricing (AIP) regime for ECS and ECNS licensees which were due to be implemented on 1 April 2012 (ICASA, 2010; ICASA, 2011). Respondents 16 (response to questionnaire) expressed a view that the said regulations in its current format are not implementable as it places undue burden on licensees and it could create a barrier to new entrants. This goes against the principles that have been established in the radio frequency spectrum policy (RSA, 2010, p. 20). The Authority had been cautioned on numerous occasions that the spectrum fees regulation contains inconsistencies which can lead to various incorrect interpretations. These diverse interpretations create doubt for potential entrants with respect to the envisaged competitive licensing process for high demand spectrum bands.

To illustrate the point on the spectrum fee regulations, a new entrant or I-ECNS licensee that wishes to gain access to 800 MHz and 2.6 GHz spectrum would pay radio frequency spectrum fees in terms of the formulae below. These formulae contain factors such as frequency band, amount of assigned spectrum bandwidth, congestion factors, geographic area of operation, sharing criteria and area sterilised for use by others. The aim is to incentivise spectrum license holders to plan and use spectrum more effectively and efficiently. A point-to-area formula is used if a licensee is exclusively assigned to use spectrum in a square kilometre geographic area.

Point to area formula

$$\text{Fee} = (\text{Unit} * \text{FREQ} * \text{BW} * \text{CG} * \text{GEO} * \text{SHR} * \text{ASTER} * \text{UNIBI})$$

For 2 x 10 MHz in 800 MHz

$$\text{Fee} = 2000 * 0.75 * 10 * 1.5 * 1 * 1 * 600 * 1 = \text{R}13,500,000.00$$

For 2 x 20 MHz in 2.6 GHz

$$\text{Fee} = 2000 * 0.4 * 20 * 1.5 * 1 * 1 * 600 * 1 = \text{R}14,400,000.00$$

A point-to-point formula is used if a licensee is exclusively assigned to use spectrum between two fixed points in a geographic area over a distance.

Point to Point formula

$$\text{Fee} = (\text{Unit} * \text{FREQ} * \text{BW} * \text{CG} * \text{GEO} * \text{SHR} * \text{HOPMINI} * \text{UNIBI})$$

For 2 x 28 MHz in 15 GHz for country wide assignment

$$\text{Fee} = 2000 * 0.2 * 28 * 1 * 1 * 1 * 600 * 1 = \text{R } 6,720,000.00$$

A new entrant for the combinational licence will therefore pay approximately twenty eight million Rand (R 27, 9 million) annually for spectrum licence fees. Over a licenced period of twenty years including an escalation of 10% year-on-year, a total amount for spectrum fees will be approximately R1.6 billion. Spectrum fees are paid in advance annually before end of March of the ensuing year. Fees will be prorated depending in which month the spectrum licence is awarded. Furthermore, ICASA subsequently published draft spectrum fee regulations for broadcasting services and held public hearings, which to date have not been finalised (ICASA, 2010).

With respect to the radio frequency spectrum fee parameters, the controversy is that the spectrum fees for comparable services are not charged consistently. Respondent 19 (personal interview, 17 May 2012) stated that it is not clear how the boundaries between the different frequency blocks have been determined; though it appears that it conforms to the spectrum block breaks contained in the national table of frequency allocations. This results in potentially prejudicing some users, particular close to the boundaries between blocks, and especially if the band plan changes, resulting in these “natural” boundaries blurring or changing, such as through the digital migration / digital dividend process. By way of a particular example, the boundary in the spectrum fee calculations at 880 MHz is arbitrary, and specifically prejudices users of spectrum in the range just below 880 MHz whose services are near-identical to those just above 880 MHz (e.g. CDMA 2000 at 824 MHz / 869 MHz vs GSM at 890 MHz / 915 MHz). Near-identical services in similar spectrum ranges should be treated similarly. This can be achieved by changing the boundaries or the number of frequency blocks. Additionally, the same bands are allocated to the broadcasting and mobile services on co-primary basis. Respondent 19 mentioned (in a personal conversation) that suggestions were made to ICASA by operators such as Telkom and Neotel that the spectrum boundaries be revised to make spectrum charges fair to all licensees and beneficial to end-users (DOC, 2010, p. 20).

In submissions to ICASA on the spectrum fees it was suggested that the Authority considers consistent breaks in the boundaries for spectrum ranges to make the frequency factors more uniform. This will prevent a situation that the same service in a specific frequency range is charged using a different set frequency factors. For example a licensee could have been assigned spectrum in 1710-1785//1805-1880 MHz allocation. It is not clear from the regulation whether one part of the assignment will be subject to a frequency factor from 880 MHz - 1800 MHz and another part of the assignment be charged with a different factor from 1800 MHz to 5 GHz. The capital intensive nature of the deployment of wireless networks requires that the spectrum fees payment structure must be clearly defined upfront as it has a critical impact on the technical rollout and financial business case.

5.15.1. The Vodacom vs. ICASA case

In March 2011 ICASA deferred the implementation date of the spectrum fees regulations until 1 April 2012. The commencement date of the radio regulation was 1 April 2011, twenty four (24) hours after publication thereof which appears to be controversial (ICASA, 2011a). The aforementioned radio regulations repealed the 1979 radio regulations which included charges for the spectrum which contained the charges for spectrum fees. This deferment notice was published at a very late stage in March 2011. ICASA's motivation for deferring the implementation date was based on the Authority's inability to procure software tools to calculate the spectrum fees and their readiness to execute the spectrum fees regulation. The publication of the deferment notice created a vacuum for the payment of spectrum licence fees due to the April 2011 radio regulations repealing the 1979 radio regulations therefore there was no basis for payment of fees until 1 April 2012. The 1979 regulations contained the fees for spectrum.

Following the deferment notice, Vodacom SA is disputing that the ICASA's deferment notice is unlawful and that they, Vodacom, had concluded their spectrum fee calculations for the financial year 2011 to 2012 based on the new fee regulations which Vodacom accepted as final as published in August 2010. The implementation of the new spectrum fees regulation apparently will be

saving Vodacom a significant amount in spectrum licence fees. On the other hand the so-called historical bulk spectrum licensees such as the incumbent fixed line operators, Telkom, Neotel and other government entities such the Department of Defence will see an increase of approximately 800 % in licence fee (ICASA, 2012b).

A Senior Counsel Marcus opinion to ICASA has revealed that ICASA's deferral notice was potentially unlawful (Marcus & Budlender, 2012). This opinion also indicated that Vodacom has paid a portion of spectrum licence fees for the financial year 2011 to 2012 based on the new spectrum fees regulations. However due to uncertainty, the majority other licensees have paid spectrum fees according to the old spectrum regulation as it was deemed to be in place (Marcus and Budlender, 2012). ICASA has now approach the Gauteng South High Court to seek relief on the implementation of the spectrum fees regulations. The matter is now before the Court and respondents which include Vodacom, Minister of Communications, and all spectrum licence holders have an opportunity to oppose and to file founding affidavits.

ICASA's chairperson of the spectrum fee specialised committee, confirmed in workshop with stakeholders on 5 March 2012 that the Spectrum fees regulations and the associated radio regulations must be amended due to the inconsistencies. These amendments to the regulations seek to eliminate the various interpretations which exist with the current regulations.

ICASA still does not have software tools in place and the said radio spectrum fees regulations contain various inconsistencies. There is a general belief that further deferment is warranted until ICASA resolve the radio frequency regulations and the associated spectrum fees regulations. The outcome of the court case will be of interest to all ECNS licensees as ICASA planned to collect approximately R 1.2 billion in spectrum licence fees (ICASA, 2012).

5.16. Radiocommunication Standards

South Africa like many other developing nations is an adopter of technologies. Very few wireless devices are developed and produced locally. Most of the radiocommunications systems deployed are developed and manufactured abroad very often in the most developed countries. In most cases

these systems are customised for the use of the most developed nations which could hold numerous challenges for local conditions.

As we move towards more liberalisation and technology neutrality the international trend is towards consolidation of standards for spectrum for radiocommunications. A typical example is harmonisation of spectrum bands at ITU level to suit the standards for International Mobile Telecommunication (IMT) and third generation (3G). Whilst South Africa is supporting harmonisation of spectrum at international and regional level, it is important to note that the country will benefit from economies of scope and scale from larger markets. South Africa can become a hub for distribution of radiocommunication devices for the continent and in particular the SADC region as the input cost can be reduced substantially and a bigger market can be addressed from a central point. The country has for many years played exactly that role.

Radiocommunications standards development is the responsibility of ICASA with cooperation of the South African Bureau with Standards (SABS). ICASA has, in terms of section 36 of the ECA the mandate to prescribe standards for radio apparatus and electronic communications facilities (RSA, 2005). The radiocommunication standards are developed subject to the Standards Act of 1993. SABS is geared to provide a platform for standards development and is mandated to be the depository for all national standards. The SABS radiocommunications standards developments are done through various technical committees (TCs) and subcommittees groups. Radiocommunications standards are tasked to TC74 which is chaired by a member of the ICT industry. SABS also have the mandate to represent South Africa in international standards bodies such as ETSI, WTO. The World Trade Organization's Technical Barrier to Trade (WTO/TBT) – Annex 3 was signed by SABS in 2000. Standards' development procedures are based on ISO/IEC Guidelines with specific national deviations. In most cases South African National Standards (SANS) are developed by adopting these international standards (SANS, 2009).

Coordination between ICASA and SABS are done through an MOU which established a standards technical committee TC80. TC80 is a specialised committee consisting of industry experts, under the auspices of the SABS to

review telecommunications and broadcasting standards. In addition, a standards liaison committee (SLC), established by ICASA and chaired by a councillor, oversees the work of the SABS technical committees dealing with electronic communications standards. The SLC is task to adopt mandatory standards which are then listed in a regulation.

Emerging technologies not only put pressure on spectrum resources and the policy and regulatory frameworks but additionally exerts pressure on the standards development process. The development of one standard could take up to eighteen (18) months to finalise. Standards should be early identified and tracked for timely adoption to meet the mandatory ICT regulatory and policy requirements.

5.17. Other Institutions Involved in Spectrum Management

The South African spectrum management function is distributed across numerous policy and regulatory government departments. This separation of the spectrum management function is based on the requirements and needs of tightly controlled safety of life and disaster management functions. These are functions where a typical command and control type of spectrum management approach is most effective due to the critical nature of services allocated in designated frequency bands. This section is introduced to highlight the fragmented nature of spectrum management.

5.17.1. Department of Science and Technology (DST)

5.17.1.1. *South African National Space Agency (SANSA)*

The South African National Space Agency (SANSA) established under the SANSA Act 36 of 2008 is a government institution which promotes the use of astronomical space and natural resources. SANSA fosters cooperation in space-related activities and research in space science. The Agency further seeks to advance scientific engineering and supports the promotion of the development of space technologies (RSA, 2008b).

One of the key functions of the ITU is the coordination of orbital slots and spectrum for space to earth and earth to space for radiocommunication services. The ITU ensures that all sovereign member states have equitable access to orbital slots for satellite launches. The SANSA in collaboration with ICASA and the

Department of Communications must ensure that the orbital slots allocated to South Africa by the ITU are protected (ITU, 2008).

Over and above the space science and earth observation activities SANSA is also involved in space operations such as satellite launches and tracking. SANSA further advances capacity in state of the art space technology assembly and integration. Under the SANSA predecessor, the former South African Space Council, the country launched an experimental satellite, Sumbandilasat, which was developed and assembled locally. This project was assigned to Sunspace locally based satellite Technology Company in conjunction with the University of Stellenbosch. SumbandilaSat was successfully launched into orbit on 17 September 2009.

The experimental satellite carried the following four payloads. Two science experiments (one on lightning and climate change, the second on forces in space); a communications radio that is being used by amateur radio enthusiasts; and a camera that takes photos of the Earth at a resolution of about 6,2 m. The camera is of particular importance because it provides the Earth imagery needed to develop programmes that, for instance, monitor air quality and water distribution, which can ultimately be used for planning to increase food security (Sunspace, 2010).

At the time of the research Sunspace was in negotiations with the Department of Science and Technology to acquire a stake into the company. Very little monetary resources are set aside by government for space exploration.

5.17.1.2. Square Kilometre Array (SKA) Africa project

The SKA radio telescope projects will be the largest scientific deep space research ever conducted globally. The reason why it is called the "Square Kilometre Array" is that the telescope will consist of many large parabolic antennas and radio frequency receivers. These receivers cover roughly one square kilometre and will be connected via high speed optic fibre cables. This project of about twenty billion Rand was jointly awarded to South Africa and Australia who were the last two bidders in a tightly considered contest.

One of the qualifying criteria to host this telescope was the assurance of tightly regulated radio quiet zones in the core areas of the SKA sites. Radio quiet

zones are geographic areas where very limit of no radio signals are transmitted. For this reason the Department of Science and Technology promulgated the Astronomy Geographic Advantage Act, 2007 which came into effect on 17 June 2008 (RSA, 2007). The promulgation of the AGA will restrict electronic communications network and broadcasting licensees to rollout wireless services in these areas without the SKA's permission. Most wireless system will unavoidably interfere with the highly sensitive radio telescope which will be deployed in carefully selected areas. Alternative networks will have to be investigated for inhabitants of these remote rural areas.

Broadcasting and electronic communications network operators are subjected to onerous licence terms and conditions regulated by ICASA. The mandatory quiet zones for AGA requirement extends an additional administrative element for licensees to consider and effectively be controlled by multiple regulatory bodies. More regulatory liabilities escalates the cost of operators, which will ultimately, translate in to higher cost to the end-users. There is also now a manifold of spectrum coordination requirements which will certainly impede licensees' abilities to rapidly rollout wireless networks, much needed in the underserviced rural areas. It is therefore imperative that proper coordination between the different spectrum management bodies be implemented at a central point to achieve the most efficient rollout in the AGA areas.

5.17.2. Department of Transport (DOT)

5.17.2.1. *South African Maritime Safety Authority (SAMSA)*

SAMSA, an authority under the auspices of the Minister of Transport, is mandated to monitor, enforce and ensure marine safety requirements. SAMSA was established on 1 April 1998 in terms of the South African Maritime Safety Authority Act (RSA, 1998b). Amongst upholding marine standards, SAMSA is also responsible for responding to marine pollution and emergency incidents. Through the South African Search and Rescue unit in the Department of Transport, SAMSA is responsible for ensuring that the country has a capability to detect, locate and rescue people in maritime distress situations. These are binding requirements which are enforced internationally by the COSPAS SARSAT and SOLAS Conventions.

In December 2011 ICASA and SAMSA entered into a memorandum of understanding to transfer some of the maritime spectrum management functions to SAMSA (ITWEB, Dec, 2011). In terms of the agreement SAMSA will be responsible for training and the issuing of radio maritime operators certificates which was previously facilitated by ICASA. These certificates are a requirement which permit operators on vessels out at sea to use and monitor radio frequencies allocated for distress and safety purposes. There are specific radio frequency bands that are allocated by the ITU for maritime services which should be used for that intended purpose only. Any other use will be in violation of international conventions and treaties and the South African radiocommunication legislation.

5.17.2.2. *South African Civil Aviation Authority (SACAA)*

SACAA an authority under the auspices of the Minister of Transport is mandated to monitor, enforce and ensure aeronautical safety requirements. SACAA was established on 1 October 1998 under the South African Civil Aviation Authority Act No. 40 of 1998 (RSA, 1998c).

The Authority is mandated with promoting, regulating, supporting, enforcing and continuously improving levels of safety and security throughout the civil aviation industry. The above is to be achieved by complying with the International Civil Aviation Authority (ICAO) Standards and Recommended Practices (SARPs) whilst considering the local context. This mandate relates to aviation safety and security oversight of airspace, airports, aircraft, operations and personnel (SACAA, 2012).

Amongst the mission critical air safety operations, SACAA is also responsible for the assignment of radio frequencies to services in the aeronautical radio frequency bands which have been allocated internationally by the ITU. These radio frequency bands which are generally harmonised throughout the world, contains various constraints on the usage of such bands.

5.17.3. Department of Health (DOH)

ICASA uses international standards such as ETSI and ITU to type approve electronic communications equipment for electromagnetic compatibility (EMC) and electromagnetic interference (EMI) as well as for the safe use of device.

Under the Hazardous Substances Act 15 of 1973, the Department of Health is responsible for enforcing some standards relating to the protection of the public from radiated health hazards.

International guidelines and national safety standards adopted and developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) are intended to ensure that the electromagnetic fields humans encounter are not harmful to their health. To compensate for uncertainties in knowledge, large safety factors are incorporated into the exposure limits. The guidelines are regularly reviewed and updated if necessary. An effective system of health information and communication among scientists, governments, industry and the public can help raise general awareness of programmes dealing with exposure to electromagnetic fields and reduce any mistrust and fears.

The relevance of these regulations and standards to radio frequency usage is that if the prescribed interference limits are not adhered to, it may cause harmful interference to essential radiocommunication services. Moreover if the radiation limits are also not contained it might cause damage to humans. Radiation of electronic communication devices is an area which is highly contested and various studies are underway to ensure the safe use of these devices.

ICASA and DOH have a dual responsibility to enforce safety standards to ensure that end-user devices are safe for use and are not harmful to the citizens. The current lack of coordination on the mandate with respect to radiation safety has to be reviewed, considering the latest developments in communications technologies.

5.18. Summary of Key Findings

- (a) Over period of two decades, the delay in awarding spectrum, from the allocation of radio frequency spectrum bands at ITU level to the assignment of channels at a national level, is characterised in this findings.
- (b) The DOC has in many occurrences intervened with consequential delays in the implementation of spectrum policy and regulation.

- (c) The broadcasting digital migration dilemmas with the policy approach, has been anticipated and may cause that the country will be missing the ITU imposed deadline.
- (d) Standards development is a critical component of the spectrum management framework.
- (e) Numerous government entities manage spectrum in dedicated bands for purposes of public protection and disaster relief.

6. Chapter Six: Data Analysis: Spectrum Policy and Regulation is a “bottleneck” to sector development

Chapter six deals with interpreting the data and an analysis of the findings presented in this study. The research questions will be addressed in terms of research goals, the literature studied and the theoretical framework. The various themes that are presented here are primarily a result of the findings.

The theme which foremost comes through is the constant institutional challenges that arise. This is perhaps attributed to the lack of role clarification in the principle legislation and a far-reaching absence of the appreciation of the field of radio frequency spectrum management by industry and government. Regarding who should be responsible for what part of the spectrum management role, whether the policy maker or the regulator, is clearly evident. The independence and performance of the Authority is often compromised due to this lack of role clarification.

Secondly the definitions of spectrum management activities with respect to allocation (planning) versus assignment (licensing) are often misinterpreted. These distinct activities of the spectrum management function are sometimes misunderstood and are central to the problem and demarcation of the role of the regulatory authority and that of the policymaker, the DOC and ICASA respectively. Similarly there appears to be general consensus that it is difficult to absolutely isolate the allocation and assignment functions as the two processes must occur in sequence.

The *third* theme that is prevalent is that the regulatory and policy approaches to spectrum management are not necessarily mutually exclusive. Government involvement in spectrum management is inevitable as it involves public goods and socio-economic development. Spectrum is regarded as a national scarce strategic asset which deserves to be treated with the necessary high-level attention. However, there are clear indications that the current administrative approach is restraining spectrum award and that the market will determine further distribution of spectrum assignments, as evidenced in most developed countries.

The *last* theme is the structural approaches to spectrum management in the purported more advanced spectrum know-how jurisdictions. There are various diverse approaches and it is apparent that there are not one single policy and

regulatory approach. The level of spectrum management approach is often attributed to the developmental status of a country. However there appears not to be one single approach to the policy and regulation of radio frequency spectrum.

6.1. The Legislative Mandate: The Roles of the Policy Maker and the Regulator w.r.t. Spectrum

Throughout the two decades of development of the allocation (planning) and assignment (licensing) of the spectrum management function in South Africa, the roles of the DOC and ICASA have been cluttered with issues of direct administrative intervention. There appear to be a disregard for who is responsible for what of the various spectrum management functions. This uncertainty of the roles was further exacerbated by the DOC's attempt to clarify the spectrum management roles through an amendment of the ICASA Act through an Amendment Bill in 2010 which was subsequently withdrawn. Almost all respondents to the interviews formally and informally have raised these concerns with respect to the lack of role clarification in spectrum management.

From the findings of this study it clearly shows that there were various interventions by government influencing the spectrum management function and processes. It is certainly in the case of the award of 1800 MHz and 3G spectrum to the major operators in South Africa which was assigned through an amendment of the Telecommunications Act 3 of 1996 through an act of parliament. The third party emergency radio trunking feasibility initiated by the regulator which was duplicated by government and were never finalised. The establishment of a spectrum management directorate in the Broadcasting Act responsible for planning and research purposes. The DTT migration process which is creating various dilemmas and delays in decision making since 2004 when focus was turned to the planning of DTT. Armstrong and Collins (2004) cautioned about these digital dilemmas in research on digital TV in South Africa.

A further complexity, over and above is the spectrum management function under SACAA for aeronautical and SAMSA for maritime, was introduced by the SKA project. The SKA project falls under the control of the Department of Science and Technology (DST). The SKA project requires radio quiet zones around the core site thus preventing operators to further deploy

wireless telecommunications and broadcasting networks in these areas. The SKA project is impacting on the rights of the licensees, which are regulated by ICASA, to roll out networks in the areas of the SKA. Operators have to obtain authorization from an additional statutory body to deploy services in the areas of the SKA which further delay realisation of services to the rural under serviced areas and the increase regulatory cost.

The study further shows that independence and accountability of the regulatory authority, ICASA, with respect to spectrum management is often compromised. This lack of independence is enshrined in legislation from the White Paper on Telecommunications to the ICASA Amendment Bill 2010. However too much power remains in the hands of the policy maker which evidently creates a “bottleneck” for sector development (Horwitz, 2001 & Gillwald, 2003). Evidently ICASA is not operating at arms-length from central government as advocated but appears more as an extension of the DOC with respect to the spectrum management function (Moyo & Hlongwane, 2009).

In the case of licensing high demand spectrum in the 800 MHz and 2.6 GHz band, ICASA clearly has the right in section 31 (3) of the EC Act to prescribe criteria for awarding radio frequencies where demand exceeds supply (RSA, 2005). However the Minister of Communications intervened and believed that the policy maker has the right to issue policy directions on this matter. Section 3(3) of the ECA Act does not allow the Minister to pronounce policy directions on licensing matters. In Respondents 3 and 4 (interviews, 14 December 2011) view, ICASA believed that they have the legal mandate to proceed with the licensing of the high demand spectrum without the policy direction. Respondents 3 and 4 certainly subscribed to the fact the “to be an independent regulator is dangerous work” (Jamison, 2004).

The 800 MHz (2 x 30 MHz paired) and 2.6 GHz (2 x 70 paired and 50 unpaired) bands were allocated and identified for IMT services on a primary basis by WRC-07. Five years down line, by the end of 2012, there is no finalization on a policy direction or criteria to award spectrum for these high demand bands that is key to rural network rollout and capacity requirements on the increasingly congested wireless broadband networks. Parts of this valuable spectrum are

currently not licenced and unused. With 350 ECNS licensees, this spectrum is almost the only available bands to introduce more players into market.

When one considers ICASA's contentious spectrum fees regulations, the country has lost close to a billion Rand in collection of annual spectrum fees over a five year period. Let alone the billions of dollars that are generated in other jurisdictions in auctioning of these bands. The formula below contained in the spectrum fees regulations are used calculated for wireless point to area services which applies to wireless access networks. Table x illustrates the calculation of spectrum license fees over a 5 year period.

Fee (area)=UNIT*FREQ*BW*CG*GEO*SHR*ASTER*UNIBI (ICASA, 2010)

Table 12: Spectrum Fee Calculations

| 800 MHz Band (2 x 30 paired) | | | | | | | | |
|--|------|----|-----|-----|-----|-------|-------|------------------------|
| UNIT | FREQ | BW | CG | GEO | SHR | ASTER | UNIBI | Annual Fees (Rand) |
| 2000 | 0.75 | 30 | 1.5 | 1 | 1 | 600 | 1 | 40, 500, 000 |
| 2.6 GHz Band (2 x 70 paired) | | | | | | | | |
| UNIT | FREQ | BW | CG | GEO | SHR | ASTER | UNIBI | Annual Fees (Rand) |
| 2000 | 0.4 | 70 | 1.5 | 1 | 1 | 600 | 1 | 50, 400, 000 |
| 2.6 GHz Band (50 unpaired) | | | | | | | | |
| UNIT | FREQ | BW | CG | GEO | SHR | ASTER | UNIBI | Annual Fees (Rand) |
| 2000 | 0.4 | 50 | 1.5 | 1 | 1 | 600 | 0.5 | 18, 000, 000 |
| Total Annual Fees | | | | | | | | 108, 900, 000 |
| Fees over 5 years in including a 10% escalation | | | | | | | | R 664, 845, 390 |

Table 12 is a clear illustration on how the delay in spectrum decisions can cost the country in underutilizing scarce spectrum resources.

The current spectrum management framework is characterized by unwarranted delays in the updating of the allocations of the radio frequency bands nationally. These delays in updating the band plans have consequential delays in licensing and the ultimate usage of spectrum. The 2012 World Radiocommunications Conference finished in February 2012 which may have a further impact on the licensing of the 800 MHz and 2.6 GHz spectrum. WRC-12 has resolved to study a second digital dividend in the 800 MHz band from 694/698 to 790 MHz. All indications are there that this allocation will be concluded at WRC-2015. The adoption of the resolutions of the Final Acts of this Conference must officially be adopted by the South African government and subsequently inform the updating of the national table of frequency allocations.

This adoption of international treaties has to be done through a ratification process of executive legal instruments by the Cabinet.

This study shows in a summary in Table 3 that there is not one single institutional arrangement that is employed in six countries which appear to be in the forefront of spectrum management development (Mazar, 2008). Each one of these six countries has a varying combination from the entire spectrum management role performed by government and the regulator respectively. In other cases the spectrum management function is split between the Ministry and the Regulatory Authority and a specialized agency responsible for spectrum management. McCubbins *et al* (1989) argues that it is generally accepted that regulatory authorities are better equipped than the policy maker and that there is an information asymmetry between the two. The combination of the spectrum management institutional arrangement indicates the contrary and that the institutional arrangement could be a direct result as to the capabilities in government that could be the same or more efficient.

South African spectrum management institutional framework has a similar combination but is unique and not necessarily the same. Currently the ICASA Act confers the spectrum management planning and assignment function to the regulatory authority, ICASA. This includes the development of the national radio frequency spectrum allocation plan. Similarly the ECA vested control of the radio frequency spectrum with ICASA (RSA, 2000). Section 34 of the same Act confers powers on the Minister of Communications to represent the country in international fora such as the ITU. The law specifically states the international allotment and coordination of spectrum for the country. It further states that the Minister must approve the radio frequency plan developed by ICASA. This frequency plan approved by the Minister must further take into account radio frequency spectrum for security services. In terms of international engagements, the Ministry in principle coordinates a spectrum allocation plan to be negotiated at WRCs through the National Planning Working Group (NPWG). ICASA, the developer of the spectrum plan, with industry participate in developing position papers and proposals towards the ensuing WRC. Respondents 8 and 11 (interviews, 11 March 2012) in their responses indicated that “ICASA’s

participation appears to be the role of an observer”. As the custodian of the NRFAP, industry expects ICASA to take the lead and the spectrum plan should be a high priority for the regulator. Furthermore there are views that industry experts mostly lead the debates on spectrum and influences position papers to pursue their own interests. Apart from a few individuals that are competent in spectrum planning the capacity in the Ministry and ICASA are appears to be limited. A personal observation is that the power in leadership in spectrum management has over the years shifted between ICASA and the DOC with strong personalities who has relevant spectrum management competencies. This is an area that could be studied.

Furthermore the, the ECA in section 3 on “Ministerial Policies and Policy directions” mandates the Minister of Communications to make policy and policy directions on any radio frequency spectrum matter when required to do so. The DOC’s radio frequency spectrum policy attempts to further clarify the roles of ICASA and the DOC. However, the radio frequency policy contradicts the ICASA Act and the ECA (DOC, 2010, p. 9-10). This policy bestows the frequency allocation function to the DOC and spectrum assignment function to ICASA. The DOC in terms of the policy will now be solely responsible for the planning hence the allocation of the radio frequency spectrum for public and private use.

ICASA introduced a further contradiction in terms of the ECA when it issued final radio frequency spectrum regulations in March 2011 which surprisingly was effective from the 1 April 2011. This occurrence is unfounded in the regulating making process when within twenty four hours a regulation is effective from the date of publication. In rushing the publication of these regulations effectively now requires to be reviewed due to clear disregard for expert advice from officials and industry. This regulation of which ICASA’s senior officials publicly admitted in a stakeholder workshop on the 5 March 2011 contains various inconsistencies therefore has to be reviewed.

From the analyses, the amendment in the ICASA Amendment Bill 2010 was an attempt to clarify the roles and responsibilities of the spectrum management function. Whilst the intention is good, misinterpretations place an

impediment on the process. These amendments unfortunately are accompanied by more controversial amendments such as conferring more decision making power to the Minister which were not well received by various interest groups and industry. The Bill separates the spectrum planning and the spectrum assignment functions between the DOC and ICASA respectively. The controversy is that according section 4(3)(c) to the ICASA Amendment Bill 2012, ICASA will only be responsible for assignments of spectrum for non-government use. This provision will certainly introduce conflicts of interest if government has to plan and license spectrum for state entities. In a highly competitive environment such as the electronic communications sector, where government has shareholding in operators such as Telkom and Sentech, will introduce further delay in spectrum award. This will also see operators turning to the courts for reprieve on spectrum matters.

Respondent 7 (interview, 28 October 2012) and international precedence support a distinct separation spectrum assignment and allocation role provided that two are independent from each other. The spectrum allocation function does not necessarily have to be located a department of the Ministry but can also be conferred to an agency responsible for planning. This makes the proposition of an Agency responsible for spectrum planning as in France and Canada and option to resolve the South Africa spectrum challenge.

Groups such as the SOS campaign stated that the new Bill undermines the independence of ICASA. Respondents 3 and 4 (interviews, 14 December 2011) raised the independent constitutional mandate of ICASA though the broadcasting function. These respondents believe that ICASA could never be stripped of any the spectrum management functions. The SOS campaign is a civil society alliance which represents trade unions, Non-Governmental Organizations (NGOs), CBOs, industry bodies, academics and others calls on citizens to protect the independence of broadcasting and telecommunications in South Africa (TechCentral, 2010; SOS, 2010). Kate Skinner, convener of the SOS Campaign, in an article in the Mail and Guardian on July 2010, stated “that the Amendment Bill at first appears to be enhancing the effectiveness of a defunct ICASA but instead it relegates ICASA to a tool of government” (Benjamin, 2010). Other

observations are that ICASA is merely relegated to an operational unit of the DOC. The ICASA Amendment Bill 2010 must introduce consequential amendments to the ECA to ensure that there is no misunderstanding of the roles of ICASA and the DOC. The timing of these amendments is important as the country is embarking to venture into alternative approaches to spectrum management.

6.2. The Spectrum Allocation versus the Assignment Function

The terms spectrum allocation and assignment are frequently misinterpreted and very often used interchangeably in radio frequency planning and licensing processes. These roles are so closely linked and can be handled by one entity or could be separated. Spectrum allocation and the initial assignment of radio frequency spectrum will always be a function of national government including a government agency responsible therefor. According to Mazar in an email exchange, it is very difficult to separate spectrum planning from the assignment process. Mazar's PhD thesis, investigated "the frameworks for wireless communication societal concerns and risk: The case radio frequency allocation and licensing" (Mazar, 2008). Mazar further remarked that "though these functions are interrelated, assignment could be looked at as short-term and planning as long-term, where both could be regulatory and policy functions".

Pogorel (2007), Bauer (2006) and Marcus *et al* (2005) draw a clear distinction between the spectrum allocation and assignment process. They concluded that from an international perspective spectrum allocation has to be a function of national government or an agency delegated such a function. In most countries, the policy maker represents Member States at the ITU. The ITU is responsible for the broader spectrum planning hence the allocation of radio frequency bands to designated radiocommunications services at a high level. The ITU is the custodian of the ITU Radio Regulations and the associated articles which include the Table of Frequency Allocations (ITU, 2008). In planning the spectrum bands consideration must be given to electromagnetic interference that is an inherent characteristic of radio frequency spectrum. From an electromagnetic interference point of view, it makes more sense for national government to protect the sovereign rights of usage of radio frequency channels at the borders. National governments are generally better structured/mandated to rapidly respond to cross-

border issues on an intergovernmental level and in line with the spirit of the United Nations and its relevant agencies. Laflin and Dajka (2007) highlighted that total technology neutrality is diminishing as there must be synergies in deploying devices with similar modulation schemes in the same bands. Therefore harmonisation of radio frequency bands often happens at an ITU or Regional level. This allows for international roaming and economies of scale of devices deployed in harmonised radio frequency bands. A specific country's international coordination role could be delegated to a more competent agency of government, which is often prevalent in some jurisdictions around the world.

International spectrum allocation and harmonisation is a function of the ITU and on a regional level a function of entities such as Communications Regulatory Authorities of Southern Africa (CRASA) and the European Union (EU). The African Telecommunications Union (ATU) which is the only African Regional recognised body at the ITU, who largely attempt to compile harmonised or common proposals on radio frequency bands.

On the African continent it is found that harmonisation of common proposals to spectrum matters are very difficult to achieve. Harmonisation has been successfully demonstrated on an economic sub-regional level because of the close trading relationships these groupings have on a particular region. The one roaming rate in East African Community (EAC), harmonised SADC Frequency Allocation Plan (SADC FAP) for spectrum bands between 9 kHz and 100 GHz and the common equipment type approval framework by WATRA in the Economic Community of West Africa (ECOWAS) (Kerret-Makua, 2009).

It is often that at the ITU World Radiocommunications Conferences that regional groups agree on common proposals to the radio regulations but country positions are sometimes compromised. This conduct is largely attributed to unwarranted political influences and intense lobbying by the more developed nations. Many developing countries are often influenced by its former colonial rulers which subsequently in many cases causing administrations to change its original country positions. It is also very often that funding to developing countries influence positions in favour of donor countries. African Member States then often take an opposing view than what was agreed at regional or sub-regional

level. Respondents 8 and 22 (interviews, 2012), while participating in three WRCs in 2000, 2003 and 2007, had often observed this, which was debated at length by delegates. This in many respects questions the credibility of country positions and the type of commitment governments place behind decisions of this scarce national strategic asset. National stakeholders often raise numerous concerns that their participation in these spectrum planning processes are futile and result in a waste of their valuable time and resources.

However, the SADC region at the WRC-2007 in all probability had the most improved preparation for harmonisation. It was at WRC-2007 that for first time the SADC group of countries submitted harmonised common proposals to the work of the ITU WRC. This was achieved through dedication and willingness from all Member States to have a meaningful participation at that Conference and not just be seen as having a presence. African ITU Members States are often criticised for its non-contributions at debates on critical spectrum matters. The allocation of a harmonised band for the digital dividend spectrum, 790 MHz – 862 MHz, was one of the harmonised positions which nine SADC countries endorsed before WRC-07. The adoption of this position was a major contribution to the successful compromise reached at that Conference (ITU, 2008). This spirit of the harmonisation on spectrum matters has also opened the door to harmonisation of various other ICT initiatives in the region. In most cases national government departments responsible for ICTs are often the representative and coordinator at an international level. The successes at that conference could also be attributed to the leadership on spectrum management issues in the respective countries.

A radio frequency band allocation is generally defined as the designation of a range of frequencies to a specific radiocommunications service, namely broadcasting or mobile services. This allocation is made as an entry in the Table of Frequency Allocations at an ITU level and subsequently reflects at Regional and National levels. From a spectrum holder's or licensee's perspective, the assignment awarded to them by the relevant Authority, could technically also be regarded as their specific "allocation" if it is a block or range of frequencies. The spectrum holder in turn assigns its licenced allocation as individual channels to specific individual sites or usage. Therefore the larger holders of spectrum have

well equipped spectrum planning teams as well as software tools to assist the complex assignment processes.

These specialised planning units are generally essential to prevent harmful interferences and to ensure optimum usage of the radio frequency spectrum. These planning units in the respective spectrum holders in all circumstances will be involved in the participation in developing the broader national radio frequency allocation plan. In most countries it is often that the spectrum planning expertise based in the licensees dictates the planning principles and processes. It is evident that government entities and its agencies do not necessarily have the expertise to accommodate such critical human resources. Respondent 2 and 4 (interviews, 2012) indicated that spectrum planning expertise and research is not prevalent in ICASA or the DOC. They further indicated that it is essential that such a spectrum planning capacity must be established. It must be clearly understood that the planning function done by the spectrum licensee differs from the allocation process performed by the regulator or the policy maker.

The *assignment* process on the other hand is the award of a radio frequency channel or range of radio frequencies to an electronic communications operator in a specific geographic area. Radio frequency channel arrangements are developed to ensure that licensees are assigned interference free spectrum. These channel arrangements or channel plan are commonly developed by standards bodies in coordination by manufacturer. Marcus *et al* (2005) stated that initial assignment process always be a function of government or an agency responsible for spectrum, whether or not it is a flexible market-based approach or not. This is due to the fact the all governments have sovereign rights of spectrum resources of the country territory therefore their involvement in spectrum assignment from the outset is inevitable. Spectrum assignments always have competitive features accompanying such a process. Whether or not it is on a first-come, first-served basis or an auction, depending who produce the best strategies and technical plans, either way there will be a loser. The various assignment models have their advantages and disadvantages.

Spectrum allocation and assignment are intrinsically dependent on each other with an assignment of channels which will always follow and allocation of a

band. The two functions can be performed in one organisation or alternatively in separate entities.

6.3. The Spectrum Management Approach is characterised by delays

As many countries are moving towards more flexible spectrum management regimes, South Africa is still contemplating whether or not an auction is the right approach. With four hundred and fifty network licensees with equal rights for access to spectrum, there is a real demand exceeding the supply of spectrum (ICASA, 2011c). Through the Altech versus the Minister of Communications court case, ICASA was compelled to license 450 network licensees with the same rights to spectrum which is now placing added pressure on the limited available radio frequency resources. The South African administration historically has employed the traditional command and control approach of spectrum and the first-come, first-served and beauty contest spectrum assignment method. The government only decided to explore an imminent auction process for awarding spectrum where demand exceeds supply in 2012. This process will potentially introduce for the first time be a flexible market-based assignment method on an enquiry to licence spectrum in the 800 MHz and 2.6 GHz bands. According to Bauer (2006) whatever approach policy and regulation of spectrum management is adopted has to have efficiency at the centre.

Melody (1980), predicted that in developing countries, such South Africa, the administrative methods of spectrum management will still be in use for a while. According to Cave (2002) & Moller *et al* (2004) the building block of spectrum management is still the same for more than century. The reality is that developing countries are facing socio-economic factors such as universal access and services. Wellenius and Neto (2008) likewise pointed out that spectrum management regimes cannot change overnight and that the safety and security is a high priority for governments to protect its citizens.

The command and control spectrum management approach is generally applied in areas such as maritime and aeronautical. SAMSA and SACAA play a secondary spectrum management role or act as a spectrum band manager where command and control is essential as human lives are at stake and should be protected. Similarly the protection of an area of 200 km radius from the SKA core

site will be managed and regulated by DST. In these scenarios the government decides what technology is deployed in which band following allocation of radio frequency bands for such services.

The Administrative approach is also characterised by onerous universal services obligations. Rollout obligation is contemplated in the licensing of the 800 MHz and 2.6 GHz bands. A seventy percentile (70%) rollout geographical rollout in rural areas are proposed in licensing of the 800 MHz and 2.6 GHz bands. This will certainly create a barrier to entry for new players that have to rollout services in rural underserved areas where incomes are low. It is also not economically feasible to rollout and maintain infrastructure in areas where population densities are very low. The licensing of the Universal Service Area licensees (USALS) has proven to be a failure. According to Respondent 7 (interview, 28 October 2012) industry has called over many years that the ever increase universal service fund (USF) be used for rolling out wireless network services in these underserved and underservice areas. USF is collected from licensees at a rate of 0.2% of annual turnover (ICASA, 2011). Access to the USF to rollout services to the underservice rural areas is currently under review.

A comparative or beauty licence process that is one of the assignment process for spectrum in a command and control environment has many advantages it also has its drawbacks. The major disadvantage of a beauty contest is that it is subjective and in most cases it will be challenged by the losing applicant. This is assured to lead to long drawn out litigation and judicial review which will delay the award and the effective utilisation of the spectrum. These legal challenges could result from the licensing authority's ability to maintain transparency and the fierce lobbying that accompany such a process. This was certainly in the case of licensing the third mobile cellular network operator (MCNO), Cell C in 2000 which has led to a protracted legal battle in which Nextcom one of the losing bidders has interdicted ICASA. Nextcom claimed that ICASA was unfair in its decision and was influenced by the National Executive of the day. Nextcom however settled out of court which allows CellC to continue operating 18 months later. Not soon after CellC was awarded 1800 MHz spectrum, the incumbent mobile and fixed line operators threatened to go to court on the 1800 MHz

frequency band by issuing the GSM 1800 license only to Cell C. This was resolved by the policy maker and the regulator succumbing to the petitions from the incumbent operators for access to the 1800 MHz band. The Telecommunications Act of 1996 was amended accordingly (Telecommunications Act as amended, 2002). Jamison (2005) alluded to that the fact that operators are powerful and influence the policy and regulatory process.

Many respondents agree that due to information asymmetry, beauty contest only favours the well-established incumbents and multinationals partnering in such an assignment process. Marcus *et al* argues that because it is a subjective process and it does not necessary mean that spectrum will be awarded to the applicant who will best be able to use it to maximum economic advantage.

The market-based property rights model on the other hand, as pointed out by Mueller (1993) decrease the administrative burden to regulatory authorities and advance more efficient spectrum use. Actions are associated with spectrum assignments in a market-based mechanism. Spectrum licences has never been awarded through an auction process in South Africa. It is only recently in 2012 that the policy maker and the regulator embarked on an intention to pursue a hybrid auction and beauty contest process for the licensing of the 800 MHz digital dividend and the 2.6 GHz spectrum. The policy direction which was issued by the MoC 2012 has only contemplated an auction as a last resort for licencing the bands in question. This is a clear indication that government wants to have a say in who get access to spectrum (DOC, 2012, p. 7).

There appear to be a few paradoxes in the awarding of spectrum through an auction process in South Africa. ICASA on the one hand appears to believe that they have the mandate to licence spectrum through an auction process in situations where demand exceeds supply in particular radio frequency bands. The DOC on the other hand believes that they should first issue a policy direction on spectrum matters as prescribed by the Electronic Communications Act. This was certainly obvious that when ICASA announced that they intended publishing an invitation to apply (ITA) the process was delayed until the DOC published its policy direction. ICASA's ITA and proposed migration plan was published on the 15 December 2011 a day after the DOC published its policy direction on spectrum

where the demand exceeded the supply (ICASA, 2012). Spectrum assignment through an auction process is eminent but it is evident that the process of engagement between the policy maker and the regulatory authority will delay the release of valuable broadband wireless spectrum. Government wants to control access and intends setting the terms on who should get access to spectrum. It is now five years after spectrum in the 450 MHz, 800 MHz and 2.6 GHz bands have been allocated for mobile services on a primary basis but no spectrum have been awarded at the end of 2012. The independence of ICASA comes under the spotlight and it creates an impediment to license suitable spectrum for broadband services. Sector development is also slow because of the delay in the licensing of these bands.

Spectrum trading is a natural progression from a market that is employing auctions and for large blocks of spectrum resources which is held by incumbent monopoly operators. ICASA has included secondary spectrum trading and leasing in the initial draft radio frequency spectrum regulations of 2010 but for some unknown reason it was removed from the final regulations which was published in March 2011. The Authority erroneously left the definition of the term spectrum trading in the final document which implies that there is an intention to allow spectrum trading. There should be clear policy directions to indicate to the Authority to include the provisions for spectrum trading and leasing which will provide a rapid way to introduce more competition to drive cost down (OECD, 2005). According to Crocioni (2009) spectrum trading will as well lead to spectrum efficiency and the usage of dormant radio frequency channels Crocioni (2009). Spectrum trading could also transfer spectrum rapidly without long licensing process and could additionally rectify auctions where spectrum have been assigned incorrectly. However the OECD (2005) report warns against windfall profits which incumbent operators who were awarded blocks of spectrum and paying licence fees for it. Though controversial the incentive administrative pricing mechanism for spectrum fees which was introduced by ICASA is having the desired effect on spectrum efficiency. Bulk spectrum holders are contemplating returning some unused spectrum to the regulator.

Many administrations realise that the current historical administrative or command and control approaches are restrictive and creates inefficiencies in the award of spectrum. However, command and control spectrum management approach cannot be ignored completely and could be deployed in spectrum bands that is allocation for public safety and disaster relieve and enhancing socio-economic development (Wellenius & Neto, 2008). According to Marcus *et al* 2005, the introduction of a more market-based assignment approaches should allow spectrum holders an opportunity to trade spectrum in a secondary market. It suggests by default that auctions as a spectrum assignment method introduces property rights ownership of spectrum.

Coase (1959) has argued for decades to allow the markets to assign spectrum against the arduous administrative slow allocation and assignment of radio frequency spectrum. A market environment must be created where “owners can buy, sell, subdivide and aggregate spectrum parcels which would lead to efficient allocation of this scare spectrum resource” (Faulharber & Farber, 2002). With the introduction of new technologies such as agile radio (software defined radio and cognitive radio the spectrum management regime will have to adapt more rapidly. Property rights of spectrum are an area that should be explore and requires further research.

6.4. The Spectrum Management Institutional Arrangements

As illustrated in table 10, from the various leading countries in spectrum management, it is apparent that there is not one common institutional model. Various countries established particular spectrum management policy and regulatory institutional arrangements due to the political landscape of the country (Mazar, 2008). For example in South Africa, the broadcasting authority was established under the constitution in order not to become a mouthpiece of new regime who take over the control of government. It is also evident that a distributed spectrum policy and regulatory arrangement will result in delays in the allocation and assignment of invaluable spectrum resources. Cooperation between the spectrum management entities is a challenge to achieve. However spectrum management under the respective band managers such as the aeronautical and maritime services appears to be effectively performed by organisations such as the

CAA and SAMSA. These pockets of excellence can only be attributed to a focus on the specific services and that there are no competing elements for the same spectrum.

The current spectrum management arrangement between ICASA and the DOC is almost a mirror image of the USA model i.e. the relationship between NTIA and FCC. However, the cooperation between the two entities in the USA with parallel jurisdiction over spectrum matters is not encouraging. Similarly in South Africa the cooperation between the regulator and the policy maker has been criticised since the inception of the Electronic Communications Act in 2005. On the other hand, in France the entire spectrum management function is entrusted to an Agency of government ANFR similar to the Canadian model where the function has been mandated to the SMA under the auspices of Industry Canada.

The UK approach where spectrum management is entrusted to an independent regulatory authority, Ofcom also experience numerous challenges. The UK model which appears to be an effective spectrum management arrangement has also its own inherent challenges which unintentionally resulted in many delays in awarding radio frequencies. These delays are often due several unresolved disputes between Ofcom, the independent regulator and UK mobile operators. Irrespective of the UK's proactive steps to introduce technologies early and to make spectrum available, the disputes has resulted in the implementation of identified spectrum bands, amongst last of the European countries.

The various institutional spectrum management arrangements from, the UK's apparent effective regulatory control model, to the USA's distributed approach between government and non-government, as well as the centralised approach in France and Canada have numerous challenges. Awarding spectrum in these various know-how jurisdictions is and will in future always be a contentious matter, due to the competitive nature of the electronic communications sector. The spectrum management institutional arrangement in South Africa will not yield any different results than these developed nations. Therefore whatever model is adopted should have clear boundaries to be effective.

7. Chapter Seven: Conclusions and Recommendations

Radio frequency spectrum is an essential component of a mobile and fixed wireless system, whether it is broadband or narrow band electronic communications networks. Radio frequency spectrum allows for rapid deployment of networks where it does not make economic sense to rollout fixed line electronic communications infrastructure. Broadband services for entertainment and video conferencing and innovations such as the smartphone, have been brought about by mobile networks which contribute substantially to the digital economy. It is therefore imperative to have an effective policy and regulatory approach that is conducive for efficient spectrum management.

Naturally radio frequency waves do not stop at national boundaries; as a result they are transmitted across country borders. Uncoordinated use of radio-frequencies may cause harmful interference to radiocommunication systems in other countries and vice versa. Internally the ITU, made up of Members States, sets the high level rules for managing spectrum resources. The ITU is the custodian of the radio regulations, an international treaty, which contains the international table of frequency allocations. The ITU radio regulations resolutions and recommendation sets a framework to govern how spectrum is manage amongst Members States in order to prevent harmful interference. The ITU table of frequency allocations forms the basis for all Member States on how services are designated in respective frequency bands. The table of frequency allocation provides a platform for coordination and harmonisation of the use of radiocommunication services between neighbouring countries. The radio regulations are developed at WRCs and provide a framework to harmonise and protect as well as to ensure the rational, efficient and economical use of the radio frequency spectrum including that of national safety and security.

The ITU Radio Regulations has international treaty status therefore Member States have to formally adopt the ITU Radio Regulation. The ITU Constitution and Conventions mandate Members States to ratify the Final Acts of WRCs. On a national level, the DOC is mandated to represent the country at international ICT fora as the ITU, therefore has to formally ratify the ITU Radio Regulations, developed by a competent conference. The ratification has to be done

through a formal adoption process by the Cabinet, in terms of section 231, international agreements, of the Constitution of South Africa. The formal ratification of the ITU Radio Regulations makes it indeed as part of government policy and forms the basis for developing the national radio frequency plan in South Africa.

The regulator, ICASA, is mandated to develop and plan the national radio frequency plan. The national radio frequency plan allocation in turn forms the basis for developing assignment plans whereby licences are awarded to individual entities. ICASA as well sets the rules and conditions for operating a radiocommunications system in a certain geographic area.

Generally while the institutional frameworks vary from country to country it can be concluded that within most countries, government administrations retains a significant role regarding spectrum policy and allocation. The management of the spectrum is delegated to the communications regulatory authorities and in a number of cases to other agencies or government departments responsible for radio frequency services or applications.

Radio frequency spectrum management happens in most instances at two centres, the policy maker and the regulatory authority. The occurrence exists irrespective whether or not it is in a highly liberalised market or in monopolistic government control environment. In order to avoid duplication of efforts and to expedite implementation of much needed communications infrastructure, it is important that spectrum planning and research be centralised in either the Regulator or the policy maker or some cases a specialised agency of government.

7.1. Spectrum Allocation is Policy Function?

The international agreements such as the radio regulatory framework is ratified by the Cabinet which makes it part of government policy. It makes sense for national government to represent the country internationally in this complex radio frequency field. However it must have the appropriate competencies to deal with and debate the issues at that level in concurrence with the country's stakeholders. As advocated the world-over, that spectrum is a scarce national strategic asset and needs to be preserved for future. This can only be achieved if there is a high level of government control with respect to the protection of this

scarce natural resource. Like many other natural resources such as clean air, land, and minerals, spectrum should enjoy the same level of protection and high level of visibility by the government.

Some critics will argue that it will be a duplication of functions spectrum allocation is extended as a policy function. However spectrum as a scarce natural resource needs to be protected with the appropriate skills available in the country. It is important to have an abundance of human capital available in the country in order to have a healthy debate on this essential and complex subject.

As spectrum debates are highly politicised at ITU level, national government departments are well structured to protect the sovereignty of nation states. Cross-border harmonisation of radio frequency channels is more easily achieved through the intervention on government-to-government level. Harmful interferences could also easily be resolved if there is a high-level of government involvement, notwithstanding the fact that an agency of government can achieve the same results. Moreover, national governments already have multiple bi-lateral relationships and interaction on host of activities such as safety and security and economic developments. These bi-lateral relationships, where vigorous talks are the order of the day, will certainly assist in influencing a quicker turn around on resolving spectrum matters.

Spectrum allocation as a policy function will ensure that spectrum for e-government services is secured. This is very important in a developmental state such as South Africa. Spectrum for the safety and security and the more non-competitive scientific areas such as radio astronomy and research will be accommodated and will receive the immediate high-level intervention by the state. As a result, the DOC which is well placed as the policy maker for the sector should be the custodian of the national radio frequency plan and the development thereof. This will require consequential changes to the respective legislation.

7.2. Spectrum Assignment Should Always be a Regulatory Function

The radio frequency spectrum assignment process involves the award of wireless communication licences to deserving applicants. This often consists of spectrum award on a command and control, first-come-first-serve basis or a beauty contest or a market-based auction process. In many countries governments

still have major shareholding in incumbent operators hence should not be involved in any licensing activity. The shareholding of national governments in operators will in many respects raise conflict of interest challenges in a liberalised electronic communications environment.

The assignment process often contains complex economic and technical analysis which has a huge impact on the investment required to operate an electronic communications network. This function should be left to a competent organisation such as an independent regulatory authority or competition authority that has the specialised skills to deal with such decision making. The South African government's direct control in operators such as Telkom, Sentech and the recently established Broadband Infraco can never justify that any spectrum assignment function should reside with the policy maker. The establishment of independent regulatory authorities was especially introduced to prevent government from being a referee and a player. Independent regulatory authorities are well placed to enforce rules and to avoid anticompetitive behaviour. Independent regulatory authorities are mandated to police abuse of dominance by incumbent monopolies and major operators (Wellnius & Neto, 2005). Therefore an assignment process or spectrum licensing process should not be entrusted with a national government who cannot be impartial due to its shareholding in incumbent operators.

In a broadcasting context the assignment of spectrum has always been controversial. There is always competing interest between public and commercial broadcasting. With government responsible for policy on public broadcasting, which is regarded as a basic right to citizens, it could be argued that government should have a bigger say in spectrum assignments. However the independence of the public broadcaster is always under scrutiny such that it does not become a mouthpiece for whoever is the ruling party or the administration of the day. The independence of public broadcasting is enshrined in the constitution, therefore any intervention by government on assignment processes will be challenged and seen as interference.

It is therefore evident that the spectrum assignment process should be entrusted to an independent agency of government, who can deliver this service without fear and favour.

7.3. Role Clarification through Legislative Amendments

The roles of spectrum allocation and assignment functions are often misconstrued. The attempts that government had to rationalise these roles, through legislation, was not well received due to this lack of understanding what the various functions entails. Unfortunately this role clarification accompanied other controversial legislative amendment which has a greater impact on the independence of the regulator.

The roles of spectrum management of the different entities are enshrined in the radio frequency usage policy, the ICASA Act and the ECA. Amendment to any one of these pieces of legislation will require consequential amendments to the others. Amendments to address role clarification would therefore have to follow a specific or logic. Firstly the radio frequency usage policy should be amended to reflect that the spectrum planning of the table of frequency allocation will be the sole responsibility of the policy maker. Secondly the ICASA Act has to be amended to ensure that ICASA has been delegated the spectrum assignment role. Thirdly the international representation must be address as this is not clear in the ECA. Lastly the ECA has to be amended to ensure that the roles and responsibilities of between ICASA and DOC, or an agency responsible for the development the national table of frequency allocations are not in conflict. Any inconsistencies amongst these aforementioned pieces of legislation could be challenged and would delay the award of spectrum substantially.

All these consequential amendments can be done in parallel but the ratification has to be in the sequence of the spectrum policy, the ICASA Act and then the ECA. This logic has to be followed because the spectrum policy sets out the respective roles of the policy maker and the regulator, the ICASA Act mandates the regulator and the ECA clearly defines the spectrum management framework. The amendment to any piece of legislation is not easy as it has to follow the government and parliamentary law making processes. These amendments can take anything from six to eighteen months. If there is buy-in

from thorough consultation with all stakeholders, the process could be shortened if these amendments can uphold any constitutionality challenge.

7.4. Introduce a Flexible Spectrum Management Approach

The rapid advances in technologies have forced many countries to assess their spectrum management policy and regulatory approaches. These approaches often receive conflicting attention because for a developing nation public interest considerations are the order of the day. As the country is shifting towards a “digital economy,” access to spectrum for high-speed broadband for smart devices and internet access, persuades a regime change to be more spectrum usage efficient

With respect to socio-economic development, governments, have to ensure that spectrum is available for the less financially feasible radiocommunication services such as scientific research, health, education and most importantly public protection and disaster relief. Regulations are necessary to facilitate migration of spectrum users to make space for more efficient technologies. Therefore there appears to be a need for a command and control approach on certain frequency bands allocated for such services. At ITU, regional and national level it is imperative to allocate harmonious spectrum bands for these less financially viable services. However, the command and control spectrum management approach appears to be stifling innovation and the rapid deployment of disruptive technologies.

Considering that advance wireless access technologies, such as LTE, change so rapidly, it is imperative for governments to consider spectrum management approaches that could promote the early adoption of new technologies, new infrastructure and devices. . Migration processes of spectrum users additionally cannot be done overnight. In a highly competitive environment, the advantage is about the first mover who will have the edge on its rivals. Spectrum planning conversely is a long term process, therefore it is imperative that government stays abreast of the latest developments in technology and its utilisation. This will allow countries to timeously develop transitional periods for the migration of existing users of identified bands to other band, enabling new technologies to operate in the most appropriate band of the spectrum.

The timing of spectrum licencing is rather important as it will allow operators to do advance planning for future network development and to commit the prerequisite funds as electronic communications network deployment is highly capital intensive. Network operators can only finalise their rollout plans and resources once they have a firm approval on the awarding of spectrum assignments. No matter what spectrum assignment approach is permitted, licensees as well require a long term license to rollout the wireless network and to recover their investment. A period of between fifteen (15) and twenty years (20) is required if an operator wishes to invest in any geographic area country or region.

Spectrum auctions have been successfully structured in countries that are leaders in radio frequency management. An auction appears to be the most transparent way of assigning spectrum to a successful bidder. An auction process will also award spectrum to the operators who value the scarce resource the most. Nevertheless the advantages of auctions, the South African approach is to steer away from the auction processes and government position is to see it only as a last resort. It is understandable that the government has developmental imperatives to ensure broadband electronic communications to all citizens by the year 2020. However the existing mobile operators have proven that rollout to approximately 95% of the population has been done successfully with very little direct government intervention. Government should therefore only be concerned about the rest of the population that has no or limited coverage of electronic communications services in the rural geographic areas.

Beauty contests in the award of spectrum are characterised by protracted public hearings and the losers are bound to challenge a decision in awarding spectrum to the winners. Individuals making decisions in a beauty contest are susceptible to external influences and judgement is often swayed away from the best bid and solution. These protracted processes can take as much as two to three years which delay the use of spectrum and the rollout of critical infrastructure to the much needed underserviced areas.

Government established the Universal Service Fund under the control of USAASA which, except for the USALs, has not been accessed for its purpose. This fund was established to ensure network deployment in areas which are

perceived to be financially unviable. All network operators make contributions to this fund and it is continually growing with very little benefits to the underserved areas of the country. This fund is paid directly to National Treasury. Consideration should be given to investigate a reverse auction processes which allow operators who have the technical and monetary know-how to deploy networks to do so. A reverse auction allows the economically viable bid to be awarded the contract as oppose to the highest bidder which escalate cost. This is recommended in the light that licensing universal service area licensees (USALs) did not enable network deployment in un-served and underserved areas with less than 5% teledensity. ICASA has introduced an administrative incentive pricing (AIP) spectrum fee regime which is being challenged in court by Vodacom on procedural grounds.

The approach of AIP is generally well received because it ensures that spectrum holders utilise spectrum more efficiently and effectively. Historically incumbents had access to numerous bands and large blocks of spectrum assignments. AIP encourages spectrum licence holders to reconsider their spectrum plans and usage. The process to re-plan and return some of these radio frequency assignments could be a long term process. This will result in further delays in spectrum access to numerous other network licensees who wish to have access to these bands. The authority had indicated that spectrum trading will be implemented. These provisions were at the very last minute deferred and withdrawn from the radio frequency spectrum radio regulation. Spectrum trading is a mechanism that will allow easy and quicker access to other operators without a protracted licensing process. This will further ease the administrative spectrum licensing burden to the regulatory authority. AIP and spectrum trading complement each other and could be applied to certain bands for efficiency and use of dormant spectrum resources.

In conclusion, moving to a more effective market-based spectrum assignment process such as an auction and spectrum trading is essential to satisfy the rapid developments in disruptive technologies. Capital raised in an auction process could be utilised for assistance to incumbents and earlier migration of services from the desired frequency bands. Likewise the proceeds can be used to

address the underserved areas by ring-fencing funds for development in these areas. Spectrum trading is a logical transition from an auction assignment process. Once spectrum is awarded through market-based approaches, a market of trading platform must be created to ensure returns on investment. The market will determine the price of the real estate and will prevent artificial scarcities which translate into higher prices.

7.5. A South African Spectrum Management Institutional Arrangement.

From the literature and findings it can be concluded that the current arrangement of which the DOC inhibits the regulatory process is impractical. Noting the digital broadcasting dilemma, the third party emergency trunking public safety network and the assignment of 1800 MHz and third generation (3G) spectrum to the major operators through an Act of Parliament. Likewise the outstanding policy directions on high demand spectrum deferred the award of valuable spectrum hence delaying the rollout of broadband wireless services.

In South Africa the level of spectrum expertise is thinly spread with most of the competencies employed in the network planning functions of operators. The regulator and the policy maker as well have limited spectrum expertise. The government and private sector in the most developed nations has built spectrum expertise over decades to rationally debate spectrum matters with operators. Splitting the spectrum planning and the spectrum assignment function, in the country, is seen by industry as a duplication of manpower. On the contrary this however will have the desired effect to develop sufficient scarce spectrum expertise to take the country to the next level in handling the adoption of the so-called disruptive technologies.

The centralized spectrum management policy approach in Canada and France appears to be working for these jurisdictions. The risk of these entities to be not only captured by political agendas and powerful operators appear to be avoided. It is also safe to say that these jurisdictions have built expertise over the decades to rationally debate spectrum issues with the well informed stakeholders. These agencies of government responsible for spectrum allocations and

assignments are also well resourced to enable them to negotiate with the most powerful operators in a highly competitive environment.

The current spectrum policy and regulatory arrangement is clearly not attainable therefore there is absolute merit in the separation of spectrum policy setting and implementation. As in France and Canada, an agency responsible for spectrum policy could be setup independent from the sector regulator, ICASA. Considering the current spectrum management framework, it is evident that the South African government wants the function under its purview. It is fair to infer that the electromagnetic spectrum must enjoy the protection it deserves to preserve this scarce national resource for the future and for generations to come. Spectrum should be treated no different than other natural resources such as land, minerals, air and marine life.

The developmental objectives of government have to be met in order to shrink the digital divide between the first and second economy, the haves and have-nots. It is for this reason that wholesale adoption of spectrum management institutional model should be discouraged as the country's needs are different. The South African spectrum institutional arrangement is a combination of the different approaches of the countries in this study. The current policy and regulatory arrangement is not sustainable therefore there is merit in the separation of the policy setting, spectrum planning and implementation, assignment. This arrangement will be consistent with the principle that the regulatory authorities such as ICASA are responsible for spectrum policy implementation and policy enforcement. The policy function could be housed in an agency or an arm of the policy maker responsible for the setting of spectrum policy.

Notwithstanding the fears that more government centralised control will delay spectrum access. On contrary as illustrated in the examples in other jurisdictions that centralised spectrum planning functions can be effective. The separation of the planning function will certainly improve and streamline the current spectrum management institutional arrangement. The clear demarcation on functions of spectrum management policy and spectrum policy implementation will expedite the allocation to the eventual assignment and award of licences. This is achievable as long as the functions are clear. The spectrum planning

responsibilities amongst others should include spectrum allocation, all international liaison, as well as pre-emptive research into spectrum developments. This function could also include monitoring and tracking of technological standards development.

The assignment of spectrum, the sole responsibility of the Independent Communications Authority of South Africa should include amongst others, licensing of spectrum channels, adoption of channel arrangements and enforcement. The assignment function should never be a function of government as it will be conflicted due to its shareholding in State Owned Companies and parastatals. The detailed processes in the two organisations have to be development base on further research.

7.6. Know-how and skills

There may appear to be an overlap or duplication of resources in spectrum management between the DOC and ICASA. However due to the highly specialised nature of spectrum management, competencies in this area are regarded in many countries as a scarce skill. It is fair to say that the full complement of spectrum management competencies i.e. allocation, assignment, enforcement and engineering (standards development) can only be developed in a regulatory authority or policy maker. The regulator and policy maker often serves as training ground to develop spectrum management skills therefore having this dual function in ICASA and DOC or agency, should strengthen research in this complex area.

Having an abundance of spectrum skills further enhances the country's competitive edge and its ability to confidently contribute to the international agenda. The development of spectrum management skills does not have specific formal training programmes, hence most competencies acquired in practising the functions, which largely are located in the DOC and ICASA. The skills pool could be enhanced through educational institutions that could make spectrum management as a fundamental module of ICT programmes.

The movement and appointment, from Ministers to Directors Generals to officials in the DOC and ICASA has unintentional shifted the balance of strength in spectrum management between ICASA the DOC. Appendix D has the names

of former influential persons in spectrum management. The focus on spectrum management in these entities shifted with the movement of some individuals. This skills area was not elaborate in detail but could be an interesting topic for future research.

7.7. High-level Summary of Recommendations

- A. A separation of the spectrum allocation (planning) and assignment (licensing) function to the policy maker and the regulatory authority respectively. This spectrum planning function could also be placed in an agency of government. This will require subsequent amendments to the various pieces of legislation, amongst others the spectrum policy, ICASA Act and the ECA.
 - i. The planning function should amongst others include, representation internationally, development of the national radio frequency allocation plan as well as spectrum and technology research.
 - ii. The licensing function should amongst others include assignment of spectrum to all users, adoption of channel arrangements, standards development, as well as enforcement.
 - iii. Appoint a committee of experts consisting of government entities involved in spectrum and industry to advice on spectrum management matters to the policy maker and the regulator.
- B. Introduction of a more market-based spectrum management approach, as opposed to the command and control regime only for the high demand bands.
 - i. Allow spectrum trading and spectrum sharing to introduce unfettered access to spectrum holdings to the current assignments to new entrants.
 - ii. Venture into auctions as an assignment method in the high demand bands. An auction is a much more transparent process and hardly challengeable. It could also raise much needed capital for the state to fund priority programmes and to assist in spectrum management and technology research

C. Although not explicitly explored in this study a separate Spectrum Management Bill could be introduced to avoid that the spectrum matters be debated alongside other more controversial legislative amendments.

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Appendices

Appendix A: List of Potential Interviewees

| List of Interviewees | |
|--------------------------------|--|
| INSTITUTION | ORGANISATION |
| Government | Portfolio Committee on Communications |
| | Department of Communications |
| | Department of Science and Technology |
| | Department of Defence |
| | Department of Transport |
| | South African Police Services |
| Portfolio Organisations | Independent Communications Authority of South Africa |
| | Sentech |
| | South African Broadcasting Corporation |
| | South African Maritime Authority |
| | Civil Aviation Authority |
| | South African Space Agency |
| Major Spectrum Licence Holders | CSIR |
| | Telkom SA |
| | Neotel |
| | Vodacom SA |
| | CellC |
| | MTN |
| Academia | iBurst |
| | University of Witwatersrand |
| | University of Cape Town |
| | University of Stellenbosch |
| | Cape Peninsula University of Technology |
| | Tshwane University of Technology |

Appendix B: Questionnaire

University of the Witwatersrand

Research Questionnaire

Research Topic:

To examine possible alternative approaches to policy, regulation and management of the national radio frequency spectrum and their implications for the optimal usage of radio-frequencies in order to achieve specified national ICT sector objectives.

Dear Sir/Madam

I am currently processing a research report as part of my completion of my Master Degree in ICT Policy and Regulation.

I would be obliged if you could avail yourself for approximately 30 minutes to respond to the questions below. The detail of these responses will purely be used for the completion Masters Research report. I hereby commit that

in terms of the research ethics of the University that the information collected will be treated confidentially unless agreed by you.

Thanking you in advance

Peter Zimri

Masters Student

Student Number: 0517527J

University of WITS, South Africa

Interview Questions

| |
|---|
| 1. Please provide your name, background and area of responsibility |
| 2. Name of the Institution you representing or indicate if you making statements in your personal capacity. |
| 3. What elements of Spectrum Management policy and regulation are various bodies responsible for? |
| 4. Can you please provide an overview of reform in the Spectrum Management arena in South Africa since 1992 to date? |
| 5. Which institutions do you believe should manage radio frequency spectrum in South Africa? Who should make the allocations and who should license spectrum? Why? |
| 6. Which institution/s should be responsible for international spectrum coordination? Who should represent the country at the international and regional spectrum management fora? Why? |
| 7. Should South Africa adopt a market-based spectrum management approach as opposed to the current command and control method? Why? |
| 8. Do you believe that the ICASA and the DOC is performing its current spectrum management function effectively and efficiently as mandated by law? |
| 9. Do you believe that Spectrum Planning should be part of the policy or the regulatory function? Can you provide reasons why? |
| 10. Should the spectrum bands on high demand be auctioned or should a beauty contest or an alternative method be followed. Why? |
| 11. Any other issues that you want to raise in terms of current state of spectrum management in South Africa and an international context. |
| |

Appendix C: List of Respondents

| Respondent | Interviewee | Organisation | Position |
|------------|-------------|-----------------------------------|----------|
| 1. | Removed | Ministry of Communications | Removed |
| 2. | Removed | ICASA | Removed |
| 3. | Removed | ICASA | Removed |
| 4. | Removed | ICASA | Removed |
| 5. | Removed | Vodacom | Removed |
| 6. | Removed | Cell C | Removed |
| 7. | Removed | Pygma Consulting | Removed |
| 8. | Removed | Independent Consultant | Removed |
| 9. | Removed | Department of Communications | Removed |
| 10. | Removed | ICASA | Removed |
| 11. | Removed | Director | Removed |
| 12. | Removed | Manager | Removed |
| 13. | Removed | Israel Ministry of Communications | Removed |
| 14. | Removed | Independent Consultant | Removed |
| 15. | Removed | Shuttleworth Foundation | Removed |
| 16. | Removed | Telkom | Removed |
| 17. | Removed | Neotel | Removed |
| 18. | Removed | Multichoice | Removed |
| 19. | Removed | Neotel | Removed |
| 20. | Removed | Neotel | Removed |
| 21. | Removed | ISPA | Removed |

Appendix D: Spectrum Management and Human Capital

Ministers of Communications

Dr Zweledinga Pallo Jordan

Mr Jay Naidoo

Dr Ivy Matsepe-Casaburri

General Sphiwe Nyanda

Mr Radhakrishna Lutchmana "Roy" Padayachi

Ms Dina Pule

Director-Generals of the Department of Communications

Dr Andile Ncgaba

Ms Lyndall Shope-Mafole

Ms Mamodupi Mholala

Ms Rosey Sekese

Chairpersons of ICASA

Mr Nape Maepa era

Mr Mandla Langa era

Mr Paris Mashile era

Dr Steven Ncube era