

# Annual Report on the Development of the Information and Communication Industry in Mauritius: 2009

January 2010

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## Foreword



2009 could arguably be considered a watershed year in many respects. Globally, the past year was marked by profound geopolitical changes against a backdrop of unabated financial turmoil. The credit crunch irrevocably altered consumer behaviours, which in turn challenged many business processes and models. Yet, as the dust slowly begins to settle, not only does it emerge that the ICT sector has been the most resilient sector of most world economies but also that ICT tools, coupled with innovative approaches, have enabled businesses to adapt with speed and agility to these transformations.

The foresight of the government of Mauritius to develop the ICT sector has been handsomely rewarded by the double-digit growth figures that the latter sector has experienced despite – and all through – the global economic tumult. Since our government is committed to providing stakeholders in this sector with the opportunity to develop it into the fifth pillar of our economy, we should be able, at any given time, to offer investors the necessary information with which to assess our market dynamics.

This Annual Report on the development of the ICT industry is a contribution to this effect. By the time that it shall be published, there will however have emerged even newer facts and figures concerning ICT in Mauritius - and our regulatory framework in particular - of which the public should be made aware. Our website which shall be revamped in February 2010 shall be one way to address this constant need of upgrading our knowledge of a sector where progress is relentless.

2009 might have been a tumultuous year globally. By law, ICTA must also furnish a document to outline its yearly achievements, but such a document will also indicate that in this most memorable year, the Authority has been able to rededicate itself to different challenges with renewed vigor.

In 2010, we aim at focusing our efforts towards addressing particular areas of critical importance to the sustained socio-economic development of the country. In order to further bridge the digital divide and democratize access to information, we shall bring forward the issue of the Universal Service Fund. We will, furthermore, endeavour to tackle fraud in telecommunications, to take such steps as will allow us to usher in number portability, to establish more secure communications and to ensure optimal performance of the regulator by continuously monitoring the ICT sector in the interest of both operators and consumers. Cybersecurity will be on top of our agenda.

We are alive, at the ICTA, to the fact that our sector is not only an industry in its own right but also a vital support for almost all industries that contribute to the national wealth. Conscious of this critical responsibility, the Authority will invest more in capacity building in the future to make for a more robust, professional, confident and vigilant regulator.

On behalf of the ICTA Board, I would like to express my appreciation to the Executive Director and his staff for producing this Annual Report on the development of the ICT industry as we look forward, together, to an even more fulfilling year.

#### Trilock Dwarka

Chairman

## Introduction

Over the past few years, there has been a paradigm shift in the development model adopted by Mauritius. The novel model that has been implemented is centred on the notions of international openness and a transparent and better managed fiscal regime, with the principal objective of boosting investment. Indeed, as a Small Island Developing State (SIDS), Mauritius is heavily dependent on investment inflows to navigate within the global economy. Furthermore, in order to remain resilient and successful, a campaign of economic diversification has been chartered by the Government of Mauritius (GoM). The link between investment and its positive and direct association with employment creation and economic growth is a well known tenet in economics, through the so-called multiplier economy-wide effects. Consequently, as Mauritius determinedly strives to move up the development ladder, a re-invention and reinforcement of traditional sectors of sugar, textiles, financial services and tourism sectors has occurred, while the emergence of promising sectors like ICTs, the sea food hub, education and health to name a few, have been called upon to supplement economic growth.

In particular ICT stands out as the emerging sector which has the potential to revolutionize the workings of the adopted development model, through productivity gains that permeate across all the layers of the country, through digital information communicated quickly and securely across all levels of society and through technologies that facilitate interactions and transactions across the digital economy. The above traits encapsulate what we know today as ICTs, and given the far-reaching implications of developing such a sector, a National ICT Strategic Plan 2007 – 2011 has already been charted out to ensure that Mauritius benefits wholly from the prospects that it promises to create. This is most clearly reflected in the GoM's declared policy to groom the ICT sector as the fifth pillar of the economy together with the more traditional sectors. In order to face the new challenges that lie ahead, it is imperative that the right foundations for developing the ICT sector are put in place, as Mauritius embarks on redefining its image as a cyber-island and to become a regional information hub in the Indian Ocean.

The impetus for the ICT sector to grow into the real fifth pillar of the Mauritian economy has gathered even more momentum, especially due to its spill-over effects that it brings in services and industries that go beyond the boundaries of the ICT sector itself. In particular, the events of September 2008, characterised with the onset of the worldwide financial crisis coupled with the feared credit crunch, immediately cast doubts on whether the performance of the global, traditionally vibrant, ICT industry would be seriously hampered. In fact, having survived the earlier scare of the so called dot.com crash<sup>1</sup> at the turn of the century, the threat of a more serious venture capital crisis would be expected to seriously undermine the confidence of investors into the digital economy. For instance, worst case estimates by analysts pointed to a 30%<sup>2</sup> decrease in investment within the sector through to 2009. As the worst was feared across developed and developing countries alike, a statement of intent was made on behalf of the ICT sector in Mauritius, aided by the reforms of the GoM, through its ASP (additional stimulus package). Despite the world recession peaking by mid-2009, the ICT sector witnessed double digit growth, falling connectivity costs and rising employment levels. Further policy direction is being given towards re-dynamizing the regulatory framework for the sector, with the objective of making it more resilient and boosting the complementary growth points it can generate as a support pillar for other sectors of the economy as Mauritius embarks on its path to a fully digital broadband based economy.

<sup>&</sup>lt;sup>1</sup> http://en.wikipedia.org/wiki/Dot-com\_bubble; accessed 26 Nov 2009

<sup>&</sup>lt;sup>2</sup> Trends in telecoms reform 2008 p1 - ITU

The ICT Authority (ICTA) has been established as a body corporate under the ICT Act 2001 (as amended) with as one of its main objects to license and regulate the information and communication services. In the exercise of its functions, the Authority is required to regularly analyse the evolution of the ICT industry with a view towards orienting its regulatory actions in the right direction. In effect, Section 18(3)(b) of the ICT Act 2001 (as amended) requires the Authority to furnish to the Minister "an annual report on the development of the information and communication industry in the country, as may be prescribed".

The present report is the third which is being released by the ICTA on the ICT sector and it focuses on the development of the information and communication industry which highlights the evolution of the sector from a regulatory angle. Development should not be confined to mere economic growth. In its wider sense development is about re-distribution of wealth and growth, ensuring sustainable livelihoods, integrating people who have been left at the margins of society and bridging the digital divide. This is why ICTs are often associated with the term 'enabler' because if properly harnessed, ICTs offer prospects that traditional policy instruments have failed to deliver and can also dramatically improve the chances of any given country towards meeting its commitments under the Millennium Development Goals. Therefore, in recognising the scope for development of the ICT sector, it is fundamental that the regulatory framework that has been designed to develop the ICT industry of Mauritius is constantly adapted to maximise the gains and opportunities afforded by ICTs.

The aim of this report is therefore to identify the different facets of regulation (technical, engineering, licensing, financial, security, and consumer oriented), as implemented by the sector regulator, and establish firstly, how these have converged to shape today's ICT developmental landscape in the country, and secondly, how these regulations will be expected to evolve to face future challenges.

The report is divided into four main sections. The first section gives an overview of the definition and economic health of the ICT sector based on which a digression is made in terms of the various spheres of regulation and the link with industry performance where possible, for the upcoming sections. Section 2 looks at the work done by the ICTA in relation to its licensing, technical and engineering role, while Section 3 will cover the realm of market regulation and its impact on sector development. The fourth section will consider the major policy implementations and projects being spearheaded by the Authority with the spotlight on key IT & security related issues, together with social regulations in the pipeline, geared towards the advancement of the ICT sector. This will serve as the backdrop to the conclusion of the report.

"ICT offers unprecedented opportunities for people in developing countries, but realizing the promise of this fast-changing sector takes timely regulatory and policy responses, leadership, and partnerships that harness the ability of the private sector to meet public sector objectives"

> – Mohsen Khalil, Director for Global Information and Communication Technologies Department, The World Bank Group

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# 1. The ICT sector in Mauritius: Scope and Development

## 1.1 Scope of the ICT Sector

The foundation for providing a concise analysis of a given industry or sector is to first define what constitutes this particular industry or sector. This has proven problematic on the global stage with respect to ICTs, essentially because such activities usually span across various other industries, notably manufacturing and services industries. In an attempt to bringing some uniformity, various national and international bodies have tried to develop a common definition of the ICT sector. The definition of the ICT sector of Mauritius, as adopted by the Central Statistics Office (CSO), is now in conformity with the recommendations of the 'Global Partnership on Measuring ICT for Development' of the United Nations<sup>3</sup>. In essence, this definition ascertains all the nomenclatures (by activity) that make up the ICT industry, in order to allow a scientific measurement of the output of the latter industry. One of these nomenclatures cover 'telecommunications', the sector regulator is most directly involved as per its legal mandate, while it is also true that the regulatory instruments endorsed by the Authority also have indirect repercussions within the remaining nomenclatures that make up the ICT sector in Mauritius.

## **1.2** Development of the ICT Sector

Having delimited the scope for the measurement of the ICT sector in Mauritius, principally defined in terms of certain specific manufacturing and service industries, it is pertinent to draw some macroeconomic observations especially by taking the liberalisation of the ICT sector as a reference point.



#### Size of the ICT sector

Source: CSO estimates 2004 - 2008

<sup>&</sup>lt;sup>3</sup> The ICT sector of Mauritius accordingly includes manufacturing and services industries whose products capture, transmit or display data and information electronically It includes related activities of Manufacturing, Wholesale and retail trade, Communications, Business services (such as call centres, software development, website development and hosting, multimedia, IT consulting and disaster recovery). Since 2008 Training in IT is excluded from the ICT sector definition.

With the spotlight firmly directed towards the ICT sector as the emerging fifth pillar of the economy, a burning issue that remains to be explored is to establish the importance of the ICT sector for Gross Domestic Product and by extension, to economic growth, over the past few years. Based on the latest estimates by the CSO, Figure 1 reveals a steady rise in the performance of the ICT sector, in terms of value-added. By the end of 2008, the contribution of the ICT sector towards value-added stood at some Rs 12,700 million, which represents a rise of some Rs 5,135 million from its 2004 level, i.e. one year after the sector was first liberalised.

In other words, the remittance of the ICT sector has more than doubled, over a four year period, on this particular count, as represented above. However, as a proportion of GDP, the contribution of the ICT sector over the period 2004 to 2008 has shown marginal improvement, as revealed by Table 1 below:

Table 1: Value added by ICT sector relative to the Mauritian economy's GDP						
	hdicator / Year	2004	2005	2006	2007	2008
IL	Value added in ICT sector as a % of total GDP	5.0	5.3	5.5	5.6	5.4

Source: CSO estimates 2004 - 2008

In 2004, the contribution of the ICT sector to total GDP stood at 5.0%, failing to breach the next percentage point over the next four years. The latest figures portray a contribution of 5.4%, suggesting that the ICT sector has not yet delivered the goods as opposed to the other sectors of the economy. This is in contrast with the agricultural and manufacturing sectors, which contributed 4.1% and 19.6% respectively to GDP in 2009. This highlights the fact that the ICT sector is still in the process of establishing itself more as a 'support' pillar of the Mauritian economy, rather than a leading sector to date.

Furthermore, one of the plausible explanations as to why the Mauritian ICT sector has managed to cushion and even avert the pressure from the global crisis is that the ICT sector for Mauritius is typically service-centric, as opposed to being manufacturing-oriented. In the latter case, where the emphasis is based on the production of ICT related equipment such as micro-chips, network equipment etc... huge financing requirements, R&D expenditure, capital outlays and sunk costs are generally involved. In comparison, the Mauritian ICT sector is more service-driven, as illustrated by the success of the BPO-ITES industry and the significant economic performance of the telecommunications industry at large. All factors combined, only a 0.2% decrease in the contribution of the ICT sector towards GDP was noted from 2007 to 2008, while a 0.4% increase to 5.8% of GDP is expected for the year 2009.

# Growth of the ICT Sector

In terms of growth, the ICT sector fared particularly well over the period 2004 to 2008, averaging a 16.3% growth rate per annum, while overall annual GDP grew by 4.5% on average, over the given timescale.

Table 2: ICT sector growth relative to Overall GDP Grow	<i>t</i> h				
Indicator / Year	2004	2005	2006	2007	2008
Growth rate in ICT Sector(%)	22.7	18.2	12.9	14.9	12.6
Growth rate across economy(%)	4.7	2.3	5.1	5.5	5.0

#### Source: CSO estimates 2004 - 2008

<sup>&</sup>lt;sup>4</sup> National Accounts of Mauritius, 2006 - 2009, CSO publication.

<sup>&</sup>lt;sup>5</sup> Budget speech 2010 By Dr. The Hon. Ramakrishna Sithanen, G.C.S.K, p11

Table 2 reports that annual growth in value added goods and services, generated by the ICT sector, was consistently higher than overall annual GDP growth during the whole period. A further observation to be derived from Table 2 is that the ICT sector sustained double digit growth rates throughout the period being examined. Moreover, the period 2003 - 2004 signalling liberalisation of the ICT sector, which may be regarded as a positive one-off shock to the sector, was linked to the highest growth rate over the period, above the 20% mark, which has slowed down to around the 12 – 14 % mark in subsequent years.

The performance of the ICT sector in Mauritius should also be commended especially in 2008, when the world economy was hit by the global financial crisis and recession. Despite the numerous major shocks, which led to downturns in international trade and tourism, which are key drivers of the Mauritian economy, the ICT sector maintained its high growth trajectory at 12.6%. As we reach the end of 2009, even more promising figures have been released, with growth expected to be around 16.2%<sup>6</sup>, especially in the context of the additional stimulus packages, endorsed by the GoM to navigate the country out of the world recession. In fact, while most sectors took heavy knocks in terms of economic performance during the crisis, the ICT sector remained one of the few success stories, and the spill-over effects it may generate for the other sectors of the economy should not be under-estimated.

# Employment in the ICT Sector

Another key area on which to judge the performance of the ICT sector relates to its impact in terms of employment. Based on available estimates the CSO has identified that as at 2000, some 4,360 persons were employed in the field of ICT. Subsequent estimates from the CSO are available for the years 2004 to 2008, with regard to the extent of employment generated by the relevant manufacturing and services sub-industries, which make up the ICT sector, reveal the following evolution on the employment front.

Table 3: Employment in the ICT Sector					
Indicator / Year	2004	2005	2006	2007	2008
Employment in ICT s ector	6,150	7,410	7.970	10,170	11,250
Employment in ICT sector as a % of total employment	2.1	2.6	2.8	3.5	3.7

#### Source: CSO estimates 2004 - 2008

Table 3 highlights that employment within the ICT sector has been on the rise, from an estimated 6,150 in 2004 to 11,250 by 2008, implying that the employment level in the ICT sector has nearly doubled over this four year period. It is to be noted that the above figures relate only to large establishments, i.e. establishments that employ more than 10 workers, and therefore represent lower-estimates of the true employment figures for the ICT sector. As a proportion of total employment, a notable increase is also experienced, where nearly 4% of the working population is now involved with the ICT sector at the end of 2008, compared to only 2% in 2004.

# 1.3 Development of the Information Society

It is generally agreed that widespread use of ICTs in an economy is conducive to economic growth, which can be traced back by examining the various economic indicators, as discussed earlier. Now, this presupposes that there is also widespread access to ICTs, which is why an examination of statistics on ICT diffusion and usage is warranted, in deducing whether they have indeed correlated with overall economic performance.

<sup>&</sup>lt;sup>6</sup> Budget speech 2010 By Dr. The Hon. Ramakrishna Sithanen, G.C.S.K, p11

This section will therefore provide an overview of the extent to which ICTs have permeated Mauritian society by considering how the evolution of telecommunications services, in particular, have impacted on the socio-economic wellbeing of the country. Consequently, particular emphasis will be directed towards certain key Information Society Indicators (ISIs), notably: fixed teledensity, mobile cellular penetration and Internet penetration respectively.

## Fixed Line Penetration

Penetration rates for standard telephone access lines represent a reasonable parameter to evaluate the extent to which basic connections are available to users. This is especially relevant in ascertaining whether the objective of the GoM to ensure Universal Telephony Service and Access<sup>7</sup> is being met while also being one of the most basic ISIs of a 'connected' country.

Line Telephor	ny			
2001	2002	2003	2004	2005
307,000	327,000	348,000	354,000	358,000
25.5%	26.9%	28.4%	28.6%	28.6%
2006	2007	2008	Sep-09	
357,000	361,000	364,500	379,088	
28.4%	28.6%	28.6%	29.7%	
	Line Telephor 2001 307,000 25.5% 2006 357,000 28.4%	2001      2002        307,000      327,000        25.5%      26.9%        2006      2007        357,000      361,000        28.4%      28.6%	2001      2002      2003        307,000      327,000      348,000        25.5%      26.9%      28.4%        2006      2007      2008        357,000      361,000      364,500        28.4%      28.6%      28.6%	2001      2002      2003      2004        307,000      327,000      348,000      354,000        25.5%      26.9%      28.4%      28.6%        2006      2007      2008      Sep-09        357,000      361,000      364,500      379,088        28.4%      28.6%      29.7%

#### Source: ICTA & CSO estimates

With growing incomes and the ever- rising demand for access to telecommunications services, fixed line teledensity, defined as the number of fixed telephone lines per 100 inhabitants in Mauritius has, by implication, witnessed a significant increase. In 1995, fixed line teledensity stood at 13.2% and latest available data suggest that it has reached 29.7% by the end of September 2009, as highlighted in Table 4 above.

It is also the case that fixed line teledensity experienced high growth rates during the mid-1990s, but this has subsequently tailed off during the past few years. The latest figures from 2003 onwards document stagnation in the rate of fixed line penetration which should be placed in the context of 74%<sup>8</sup> of households and the near totality of businesses across Mauritius having access to a fixed line. Past data even suggests that the growth of fixed line teledensity has been restricted to single digit rates after 1997. This is partly attributable to the surge in popularity of mobile phones as a means of communications, as will be discussed next, coupled with the fact that the fixed line market may be nearing its saturation point.

<sup>7</sup> This can be understood as having a relatively high level of household telephone connectivity. <sup>8</sup> CSO ICT Indicators 2008

## Mobile Penetration

The use of mobile phones has flourished over the last decade not only because of its functionality and affordability, but due to also its cultural and trendy appeal to the public at large. In addition, the intensive network rollout by Emtel Ltd and Cellplus Mobile Communications Ltd has ensured almost complete coverage of the island while the coming into operation of the third mobile operator, MTML in late 2005 further widened the use of contemporary mobile based technologies.

Table 5: Evolution of Mobil	e Telephony				
Information Society Indicators	2001	2002	2003	2004	2005
Mobile Subscribers	279,000	348,000	466,000	548,000	657,000
Mobile Penetration	23.10%	28.60%	38.00%	44.30%	52.60%
	•				
Information Society Indicators	2006	2007	2008	Sep-09	
Mobile Subscribers	772,000	929,000	1,033,300	1,049,261	
Mobile Penetration	61.50%	73.40%	81.20%	82.2%	

#### Source: ICTA & CSO estimates

Mobile penetration rates have exploded from a mere 1.05% in 1995 to a staggering 82.2% by the end of September 2009. Moreover, the growth in mobile cellular subscriptions per hundred inhabitants is still being sustained in double digits, suggesting that the mobile market is still some way off from reaching its carrying capacity. It is worth noting that as early as 2002, the rate of mobile penetration already surpassed that of fixed line and this gap has consistently increased over time, a development common to many developed and newly industrialised countries across the globe. In fact, the laudable performance of the mobile telephony industry in Mauritius, in spite of the crisis, may be translated in that many Mauritian mobile subscribers own 2 or more SIM cards registered in their names, a trend which has been gathering pace in recent times.

#### **Internet Penetration**

The rate of internet penetration per 100 inhabitants remains a key ISI that governs the progress made by a country in its transition towards becoming a fully digital broadband based economy. In fact, increasing recognition has been given to the role of broadband in shaping the economic outlook of a country, with a study by the World Bank<sup>9</sup> reporting that economic growth rises by 1.3% for a given 10% increase in high speed connections. Tables 6 and 7 therefore provide the overall picture in terms of both the level of Internet penetration, as well as the nuance for broadband Internet penetration for the Mauritian ICT sector.

Table 6: Evolution of Intern	et Penetratio	n			
Information Society Indicators	2001	2002	2003	2004	2005
Internet Subscribers	43,000	50,000	61,000	78,000	129,000
Internet Penetration	3.60%	4.10%	5.00%	6.30%	10.30%
Information Society Indicators	2006	2007	2008	Sep-09	
Internet Subscribers	143,500	166,000	199,500	203,375	-
Internet Penetration	11.40%	13.10%	15.70%	15.95%	

#### Source: ICTA & CSO estimates

<sup>&</sup>lt;sup>7</sup> World Bank Report on Extending Reach and Increasing Impact 2009

Table 7: Evolution of Broadband Internet Penetration							
Information Society Indicators	2004	2005	2006	2007	2008	Sep-09	
Broadband Internet Subscribers	2,800	51,400	87,100	119,000	157,300	166,500	
Broadband Internet Penetration	0.20%	4.10%	6.90%	9.40%	12.40%	13.05%	

Source: ICTA & CSO estimates

It can be gauged that while much progress has been made since liberalisation in 2003, in terms of overall internet penetration across the country – figures from Table 6 show that the level of penetration has more than doubled from 2004 to September 2009 – much remains to be done to steer the economy onto the broadband arena, which would be expected to positively influence economic growth. Indeed, the latest estimates for broadband penetration is only at 13.05%, as at September 2009. However, there are encouraging signs, as may be gathered from Figure 2, in the sense that broadband is increasingly becoming the preferred subscription approach of end-users seeking to connect to the Internet, as observed over the period under examination.



The vision of the GoM is therefore crucial in promoting Broadband Mauritius, with reaffirmed commitments from the policy makers to bring broadband prices further down in the quest to boost take up levels and consolidate the foundations for digital commerce in the country.

# 1.4 The Mauritian ICT Sector on the World Stage

The progress made by Mauritius in terms of the various spheres that make up the fabric of the Information society can best be gauged through a benchmarking exercise with established frontrunners in the field of ICT development. To enable such a global comparison, an especially useful index is the one developed by the ITU, commonly known as the 'Digital Opportunity Index (DOI)'. The basic premise of this index is to consider a number of parameters regrouped under 3 main categories, notably 'Opportunity', 'Infrastructure' and 'Utilization' respectively. Accordingly, the DOI varies from 0 to 1, which is equivalent to lowest digital opportunity and highest digital opportunity correspondingly.

Available figures<sup>10</sup> for 2004 to 2008 suggest that Mauritius fared quite well in terms of the sub-index for 'Opportunity', which hovered around 0.98. With regards to 'Infrastructure', the said index stood at 0.34 in 2004 and reached 0.45 by 2008. The most progress made, however, was in the area of 'Utilization' which rose from a mere 0.06 in 2004 to reach 0.30 by 2008. The combined progress achieved under the 3 sub-indices ensured that the DOI score for Mauritius improved from 0.45 in 2003 to 0.58 by 2008. Mauritius was ranked 50th in 2003 out of 188 countries, same being updated to 58th out of 181 countries for 2006, and maintained its position as the highest ranked African country. Comparable figures for 2007<sup>11</sup> suggest the DOI for the top 25 economies varied between 0.80 (Rep of Korea, 1st) and 0.65 (New Zealand, 25th) while the DOI for Mauritius was then computed at 0.56. Overall, the evolution in the 3 sub-indices that is taking place in the country is ensuring that Mauritius is consistently closing the gap to move closer to the top 25 DOI ranked countries.

With this overview of the economic and information society vital components of the ICT sector in Mauritius, it is now opportune to establish the effectiveness of the role of regulation in facilitating and promoting the interests of the sector, in line with the mandate set out under the ICT Act 2001 at a more micro-level. The next few chapters of this report examine and explore the regulatory framework defined by the Authority for the advancement of the sector, together with the various regulatory actions taken in conjunction with measurable impact indicators where available.

<sup>&</sup>lt;sup>10</sup> CSO ICT Indicators 2008

<sup>&</sup>lt;sup>11</sup> Extract available at <u>http://www.itu.int/ITU-D/ict/doi/index.html;</u> accessed on 07 December 2009

# 2. Regulatory Functions – Licensing & Technical

The identification of the boundaries that govern the courses of action and behaviour of the sector regulator, as well as operators and end-users alike is a pre-requisite for an effective management of the ICT industry. This entrusts the Authority with the object of delineating a regulatory framework within which all stakeholders can flexibly operate, whereby risks are minimized and opportunities are promoted. Consequently, the sector regulator is tasked with the execution of key functions such as licensing, numbering, spectrum management, standardisation and type approval respectively.

# 2.1 Licensing

A telecommunication licence authorises an entity to provide telecommunications services or operate telecommunications facilities. Licences are documents which set out the terms and conditions under which an operator is authorised to operate and define its rights and obligations. Licensing has not had the same importance throughout the history of the telecommunication sector. During the period when the sector was under a monopoly regime, the unique operator was either not given a licence or the objectives for which a licence was issued were different from those prevailing in a liberalised environment.

Since the liberalization of the ICT sector in Mauritius, the ICT Authority has been actively involved in creating a competitive environment by authorizing companies to compete for ICT activities and services in a large number of market segments. This chapter will first of all review licensing objectives by contrasting monopoly and competitive regimes, to demonstrate how the current licensing regime has contributed to the development of the ICT sector in Mauritius. The limitations of the said regime in the light of convergence will then be discussed. Finally the proposed new licensing regime will be presented.

# 2.1.1 Telecommunication licensing objectives

Under a monopoly regime, a state-owned company was the only entity authorised to offer telecommunication services to the public. The types of telecommunication services offered were mainly local and international telephony. Telecommunication was usually considered as being a branch of the public administration along with postal services, road transportation and other government services. Under these circumstances, licences were not usually considered as key necessary instruments.

In view of preparing the market for liberalisation, governments in many countries around the world started to privatise their incumbent operator. The incumbent, though still in a state of monopoly, had changing business objectives. In the course of this privatisation, the incumbent operators were in many cases issued with a licence to attain specific objectives.

It is generally established that the main licensing objectives are as follows:-

- 1. Regulating provision of an essential public service
- 2. Privatisation and Commercialization
- 3. Consumer protection
- 4. Allocation of Scarce Resources
- 5. Regulating Market Structure
- 6. Expansion of Networks and services and other Universal Service objectives
- 7. Establishing a Competitive framework
- 8. Generating government revenues
- 9. Regulatory certainty

While most of the above objectives are to be fulfilled by licensing operators in a competitive environment, some were more important during the monopoly regime.

# Licensing Objectives – Monopoly Regime

Objectives 1 to 4 above constitute the main licensing objectives under a monopoly regime. These are summarized below.

	Main Licensing cojectives under Moncpory Regme
Regulating Provision of an Essential Public Service	As explained previously, the state owned operator has in the past been offering, essentially, a social service. In this context, tariffs (usually for local telephony) were charged under cost. When the state owned operator was privatised, government decided that this social dimension of the service offered should not be compromised. Licensing obligations were consequently imposed on the incumbent with a view to maintaining some control and ensuring that basic telecommunication services are provided in the public interest.
Privatisation and	During the privatisation process of the state-owned operator, the licence
Commercialisation	constituted the instrument specifying what the investor was buying and what
	the government expected from the operator and the investor. The licence in
	this context may have also specified the period of exclusivity given to the
	incumbent operator prior to the liberalisation of the sector. This enabled the
	incumbent to modify its business strategy in view of the then forthcoming
	liberalisation.
Consumer Protection	Consumer protection has been of prime importance even during the monopoly regime especially once the incumbent operator had been privatised. This has been done with a view to avoiding compromising consumer protection against profitability considerations. The licence may be considered as a means to ensuring that consumer rights are protected, by including therein conditions relating to price regulation, billing practices, and mandatory services to consumers (e.g. directory services).
Allocation of Scarce	Whereas licensing for allocation of scarce resources has not usually been
Resources	applied for the state-owned operator, same had to change with privatisation.
	As regards spectrum licensing for instance the Radio Regulation (RR) \$18.1
	polegatos spectral international etabliched or operated by private
	persons or enterprises belicensed by the Administration.

Table	8:	Licensing	ob	iectives	under	Mono	polv	Regime
TUNIC	۰.	Liochonig	UN,	Jeou	under	mono	poly	regime

# Licensing objectives – Competitive environment

The above licensing objectives have their importance in a competitive environment as well. However, objectives 5 to 9 above are believed to have been given priority with a view to fostering competition. The priority licensing objectives and the role of licensing in opening up a market to competition are analysed next.

Main Licensing objectives under Open Competition Regime						
Regulating Market	A monopoly regime has been found to generally reduce efficiency in					
Structure	telecommunication markets and to dampen economic growth in services that					
	are dependent on telecommunications. Licensing, in this context serves as a					
	tool to authorise new telecommunication operators to enter the market with a					
	view to fostering competition. In the same breath, licensing is also a					
	mechanism to limiting the number of players in a market segment so as to					
	ensuring the viability of the new businesses.					
Expansion of	Licensing serves as a tool for ensuring infrastructure expansion by specifying					
Networks and services	the network roll-out and service coverage obligations. Once a market has					
and other Universal	been liberalised, operators may have the tendency to concentrate on niche					
Service objectives	markets with a view to increasing their profitability. The licence attempts to					
	ensure that this does not happen by specifying the abovementioned					
	obligations and also by imposing universal service obligations on all operators.					
Establishing a	Licensing may establish a level playing field for the operators in a competitive					
competition	market by laying down the appropriate anti-competitive safeguards to prevent					
framework	incumbent operators from abusing of their dominant position.					
Generating	Generating revenues for the government and for the subsistence of the					
government revenues	regulator is an important objective of licensing in a competitive environment.					
	The collected fees enable the regulator to carry out its regulatory functions					
	and to ensure its financial independence from the government.					
Regulatory certainty	Setting out the terms and conditions for the operation of telecommunication					
	services in a licence ensures transparency and regulatory certainty. This may					
	be viewed as a means to attracting foreign investors.					

#### Table 9: Licensing objectives under Competitive Regime

# 2.1.2 The ICT (Amendment of Schedule) Regulations 2003

The opening of the ICT sector in 2003 required that a new licensing regime be adopted. The ICT (Amendment of Schedule) Regulations 2003 structures the licensing framework in three categories, namely: (1) Commercial, (2) Private Network, and (3) Engineering. The Commercial licence category defines three types of licences, namely (1) Infrastructure provider, (2) Networking Services Provider and (3) Network Application Provider. The general idea behind this framework is to unbundle the different activities involved in providing ICT services. The infrastructure provider is only authorized to set up the physical infrastructure for operators and service providers, the networking services provider on its part is allowed to offer networking services which includes the provision of network capacity (e.g. leased circuits) to service providers. The network application provider is allowed to offer services to the general public.

This licensing regime attempted to take care of convergence by proposing a "pseudo-horizontal" licensing model. This licensing regime is not a fully horizontally integrated licensing model since the network application provider licence category still defines a list of licences in a vertically integrated fashion. This was considered necessary at that point in time given that the newly liberalized market had not yet defined its segments and hence same were proposed through regulatory intervention.

The licensing regime adopted in 2003 has been a major driver for development from liberalization to date. The number of licences issued under this regime includes one Public Switched Telephone Network (PSTN), one Public Land Mobile Network (PLMN), nine International Long Distance (ILD), fourteen Internet Service Provider (ISP) and over one hundred Dealers' licences respectively.

In more recent years, as convergence was gaining ground, the limits of the current licensing regime could increasingly be observed. The main drawback of this regime is the vertically integrated model to a large extent on which it is based, which features a rigid classification of services. This fact made it difficult to licence innovative services such as Triple Play and Mobile Virtual Network Operators (MVNO). As a consequence and in order not to hamper the development of the sector, the ICT Authority has devised a new licensing regime.

# 2.1.3 Proposed New Licensing Regime

The ICT Authority has recommended a simplified and more flexible licensing regime that is based on the horizontal integration paradigm. The Authority believes that this paradigm shift will favour new business opportunities in the converged world. The proposed licensing regime defines two main licence types for commercial licences, namely Facilities Based Operator (FBO) and Service Based Operator (SBO). The FBO will be authorized to deploy and operate telecommunication networks, systems and facilities for the conveyance of traffic locally or internationally. Service Based Operators on their part will be allowed to lease telecommunication network elements from FBOs for the provision of telecommunication services or for the resell of such services to third parties.

# 2.2 Numbering

The ICT Authority has as statutory function under section 18 (1) (q) of the Information and Communication Technologies Act 2001 (as amended) to "determine the numbering system to be used for every ICT service including telecommunication services, and manage, review, and, where appropriate, re-organise the numbering system".

In pursuance of its above function under the law, the ICT Authority took over the administration of the National Numbering Plan from the incumbent operator following the liberalisation of the telecommunications sector. The numbering plan has since been managed by the Authority: - allocation of different categories of numbers (E.164 numbers as well as non-E.164 numbers) have been made to eligible applicants; new number ranges have been opened up in the numbering plan to accommodate new services; migration of services has been requested by the Authority where appropriate; and the numbering plan is in the process of migrating from its current 7-digit to an 8-digit service-based plan.

As the administrator of the national numbering resources, the ICT Authority also conducts a numbering audit on an annual basis in order to ensure the efficient usage of the numbering resources.

#### 2.2.1 Allocation of Numbers

Different numbers are managed by the ICT Authority and are allocated in different unit sizes to applicants. The following table provides a summary of the allocations made by the ICT Authority for each category of numbers during the period 2004 to 2009.

		Allocations made by the Authority						
Category of Number	Unit Size	2003/ 2004	2005	2006	2007	2008	2009	
Geographic (Fixed)	10,000	0	6	2	5	2	7	
Mobile	100,000 or 10,000	5	3	3	3	0	1	
Short codes	individual	11	4	7	18	28	26	
Toll Free ' 800 xxxx'	individual	25	23	12	9	12	44	
Access numbers for Internet Services (312 xxxx)	individual	4	0	0	0	0	o	
Access numbers for remote dial-up (318 xxxx)	individual	2	1	0	0	0	0	
Access numbers for SMS- based Value-Added Services (319 xxxx)	individual	0	0	0	0	3	0	
Access numbers for Virtual Telephony, Virtual Fax & Fax- to-Email services (39x xxxx)	10,000	0	1	0	0	1	0	
Carrier Selection Codes	individual	8	0	1	0	1	1	
National Signalling Point Codes (NSPC)	individual	0	0	0	10	5	12	
International Signalling Point Codes ( ISPC)	individual	3	2	0	0	1	0	

#### Table 10: Numbering Allocations

Source: ICTA 2009

#### Geographic (Fixed Numbers)

Within the current numbering plan, the number ranges 2xx xxx, 4xx xxxx, 5xx xxxx and 6xx xxxx are earmarked for geographic (fixed) numbers prior to liberalisation. This represents a total capacity of 4 million geographic (fixed) numbers. Wireless Local Loop subscribers were until very recently allocated numbers in the 5xx xxxx range. Additionally, numbers in the ranges of 83x xxx and 814 xxxx have also been earmarked for use in outer islands such as Rodrigues and Agalega.

As per the records of the ICT Authority, a total of 178 office codes (approx. 1,780,000 numbers) are currently opened on fixed PSTN networks, representing about 45% of the available capacity. The Authority has been allocating some 22 office codes for the period 2004-2009, which represents about 220,000 geographic (fixed) numbers allocated during that period. This includes a block of 10,000 fixed numbers allocated in 2005 to a new PSTN operator for use in Rodrigues.

However, it is to be noted that several WLL number blocks (5xx xxxx) have been deactivated during the abovementioned period, because the incumbent operator has been in the process of phasing out its WLL service. At the request of the Authority, the number range 5xx xxxx has recently been surrendered by the incumbent operator in view of facilitating the smooth transition to the new 8-digit numbering plan in 2010.

#### Mobile Numbers

Prior to liberalisation, the number ranges 7xx xxxx, 25x xxxx, 49x xxxx, 421 xxxx, 422 xxxx and 423 xxxx had been earmarked in the numbering plan for mobile services. Numbers in the range 87x xxx have also been earmarked for use in Rodrigues. This represents a total capacity of about 1, 330,000 mobile numbers.

For the period 2004-2009, the ICT Authority allocated 15 blocks of mobile numbers, amounting to 1,050,000 mobile numbers. This includes three blocks of 10,000 numbers allocated for use in Rodrigues. A new number range 9xx xxxx was also opened during that period to cater for the increasing demand of mobile numbers.

The average demand for mobile numbers per year stands at about 100,000 per operator. It is to be noted that the current capacity of mobile numbers is close to depletion, with only two blocks of numbers remaining for future assignment. In order to cope with the current scarcity problem, mobile operators have been requested to review their number reuse policy until such time that additional capacity becomes available through the implementation of the 8-digit numbering plan.

#### Short Codes

Short codes were allocated mainly in the 1xx range pre-liberalisation of the sector. The successful take-off of the SMS gave rise to an increasing demand of SMS-based services requiring short codes. Considering on the one hand the increasing demand for short codes for value-added services and on the other hand the need to reserve enough capacity of short codes for emergency/public interest services, the ICT Authority earmarked a new 4-digit number range 8xxx for short codes.

Short codes in the 1xx range are now allocated only for emergency and public-interest services while the 8xxx range caters for other services such as SMS-based services or value-added services. During the period 2004-2009, some 94 short codes have been allocated by the ICT Authority, out of which 11 short codes allocated for emergency and public-interest services. The remaining short codes have been allocated in the 8xxx range.

#### **Other Numbers**

During the administration of the numbering plan, the Authority opened new numbers within the numbering plan to promote fair competition among operators and to ensure the entry of new services on the market. For instance, the carrier selection code '0xx' was opened for call-by-call selection of ILD carriers for the purpose of International Direct Dialling (IDD). As at date, 11 such codes have been allocated to different ILD operators offering IDD. Moreover the number range 320 xxxx has been opened for accessing Internet telephony services offered by international telephony service providers.

Considering the inefficient usage of the access numbers for virtual fax/ virtual telephony services, the ICT Authority requested the incumbent operator to surrender some 50,000 numbers within the 39 x xxxx range. Numbers from this capacity were thereafter been allocated by the Authority for new fax-to-email services. Other special service numbers opened by the ICT Authority include the 318 xxxx for accessing remote dial-up services and the 319 xxxx for accessing value added SMS-based services. In May 2007, the Authority also took over the administration of National Signalling Point Codes from the incumbent operator.

# 2.2.2 Numbering Plan Migration from 7 to 8 digits

The decision by the Authority to migrate the numbering plan from 7 to 8 digits (whereby a leading digit is added to the existing 7-digit numbers to differentiate between different services) is mandated for the following main reasons:

- *i.* There is no coherent structure in the existing 7-digit Numbering Plan; numbers allocated for mobile services are interspersed with those allocated for fixed services;
- *ii.* A service-based numbering plan, where a service can be identified by the number range used, is more user-friendly and gives the subscriber an indication about the tariff of the call;
- *iii.* Number blocks have been opened in the whole range from 0-9 in the current plan. New services requiring a different number range will have to be interspersed with number ranges already allocated to existing services. The plan therefore does not provide an appropriate framework for creation of new services;
- *iv.* The numbering plan should sensibly allow for at least three usable geographic numbers per person and at least five nongeographic numbers per person. This is presently not the case with the current plan. Moreover the mobile numbering capacity is being consumed very rapidly.

The numbering change which was previously scheduled for November 2009 has now been postponed for August 2010.

## 2.3 Radio Spectrum Management

The ICT Authority has as one of its mandate under the ICT Act 2001 (as amended), to manage the radio spectrum resource for the territory of Mauritius. Since its creation in July 2002 the Authority has achieved several significant milestones pertaining to spectrum management. These have greatly helped the development of the ICT sector by enabling new technologies to be deployed in Mauritius and novel services to be offered. These achievements include the following:-

- i. Establishment of the National Spectrum Allocation Plan;
- ii. Spectrum refarming of the 1800 MHz band for the purpose of deploying DCS1800 mobile networks;
- iii. Spectrum refarming of the 2.1 GHz band and allocation of the said band to IMT-2000 services;
- *iv.* Review of the licensing procedure for Private Mobile Radio (PMR) and proposal to review the licensing regime with a view to including individual licensing, class licensing and licence exempt;
- v. Spectrum planning and allocation for Broadband Wireless Access (BWA) Services to enable the deployment of BWA technologies such as WiMAX;
- vi. Spectrum planning and international coordination for Digital Terrestrial Television Broadcasting;
- vii. Spectrum reorganization of the 900 MHz band and opening of the EGSM band in order to cater for Mahanagar Telephone (Mauritius) Ltd;
- viii. Adoption of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) reference limits for the safety of the general public with respect of Electromagnetic Fields (EMF);
- ix. Adoption of an In-situ measurement protocol for evaluating the level of EMF.

# 2.3.1 Main Spectrum Allocation between 100 MHz and 10 GHz

A national table of frequency allocations provides a foundation for an effective spectrum management process. It provides a general plan for spectrum use and the basic structure to ensure efficient use of the spectrum and the prevention of Radio Frequency (RF) interference between services nationally and internationally. The table at Annex 1 presents part of the frequency allocation table for Mauritius together with the main services and applications in each band.

The objective of the ICT Authority in respect of spectrum management is to ensure that the resource is efficiently managed in order to foster development and to encourage the adoption of new and more efficient technologies. In that respect, the Authority is moving towards more flexible methods of spectrum management in view of catering for convergence which is also now a reality in radio-communications.

# 2.4 Standardisation and Type Approval

A standard is defined as 'an object or quality or measure serving as a basis or example or principle to which others conform or by which the accuracy or quality of others is judged'. Under section 18 (1)(n) of the Information and Communication Technologies Act 2001, the ICT Authority has the statutory duty to 'ensure the safety of every information and communication service including telecommunication service, and for that purpose, determine technical standards for telecommunication network, the connection of customer equipment to telecommunication networks.'

The ICT Authority fulfills this function by type approving radio-communication and telecommunication equipment to be used in Mauritius. The main goal of the type approval procedure is to ensure that all radio communication equipment that are used in Mauritius comply with international standards approved by the Authority. Type approval of equipment also ensures that no sub-standard equipment, which can represent health and safety hazards, are operated in Mauritius.

Type approval further ensures that the operating frequency of all radio-communication equipment is as per the frequency spectrum allocation in Mauritius and that no interference is caused to essential services. Radio-communication and telecommunications equipment that need to be type approved by the ICT Authority before being used in Mauritius are defined in the Telecommunication Directive 1 of 2009. Type approval may be requested by:

- *i.* A company/individual holding a valid Dealer's Licence issued by the ICT Authority, in order to market the equipment in Mauritius;
- *ii.* A holder of a valid licence other than a Dealer's licence to import an equipment for its own use;
- *iii.* An individual willing to import a radio-communication or telecommunication equipment for his own use, after having sought the approval of the ICT Authority.

Applications for type approval are made on the application form available on the ICT Authority's website. The equipment to be type approved is currently not examined by the ICT Authority. A procedure of 'Type Approval by Reference' is followed. The applicants are requested to submit the following documents with their applications:-

- *i.* The original brochure of the equipment listing all the technical specifications, including operating frequency and maximum effective isotropic radiated power (eirp) especially for radio communication equipment,
- ii. The type approval certificates obtained in the country of origin, if available,
- *iii.* Test reports or Certificates of compliance with international standards issued by accredited independent test houses and laboratories having tested or type approved the equipment,
- iv. Declaration of Conformity with international standards issued by the manufacturer.

Type approval is granted based on these documents. As at date international (ITU, ISO/IEC) and European standards (ETSI, CENELEC) are accepted for type approval purposes.

# 2.4.1 Collaboration with Customs Department

A key development in June 2006 saw the ICT Authority initiating collaboration with the Customs Department in order to:-

- Ensure that radio communication and telecommunication equipment imported for use in Mauritius are duly type approved;
- Ensure that companies importing these equipment are duly licensed to either commercialise these equipment or operate them in Mauritius;
- Effectively Control the importation of any equipment capable of being used to intercept a message, which is one of its functions under the Information and Communication Technologies Act 2001.

The Customs Department now requires companies importing radio-communication or telecommunication equipment to produce the type approval certificate and licence issued by the ICT Authority before clearing such equipment from Customs.

As a result of this collaboration, the number of applications for type approval received by the ICT Authority has more than doubled as shown in Fig 3, and the ICT Authority has succeeded in preventing the importation of several types of equipment which are non-compliant with the radio frequency allocation plan in Mauritius or which do not comply with technical standards as determined by the ICT Authority.



Fig 4 below gives the trend in the number of type approval certificates issued by the Authority as from 2004 to date. Fig 4 - Number of Type approval certificates issued 300 250 200 150 100 50 0 2008 2004 2005 20.06 2007 2009 2003 Number of Type approval certificates issued Source: ICTA 2009

The coordination with the Customs Department has also resulted in several companies taking out the Dealer's licences or engineering licenses for commercialisation or operation of radio-communication or telecommunication equipment. This collaboration remains ongoing and there contact with officers of the Customs Department is maintained on a regular basis.

# 3. Regulatory Functions – Financial & Market oriented

The spin-off effects of development within the ICT industry are invariably translated into market realities. For instance, do consumers have a choice of ICT services? Are ICT services increasingly more affordable, and is competition across operators healthy and progressive? These are a few of the key themes, which are traditionally tackled by sector regulators and associated authorities in their mission to promote the interests of the ICT industry. More specifically, there is an imperative on the sector regulator to ensure that a dynamic and effective framework is defined to lead the sector onto a high growth path while balancing the interests of all stakeholders involved – policy makers, operators and consumers – at the broadest level. As mentioned earlier, the way a regulator generally intervenes in the industry is through regulatory instruments and when considering such instruments in the sphere of market regulations, these have typically taken the form of the setting of interconnection usage charges (at the wholesale level) and of tariff determinations (at the retail level). In the case of Mauritius, the above regulations have been implemented through telecommunication orders and directives as well as relevant decisions by the ICTA.

#### 3.1 Network Interconnection

At the heart of the provision of ICT services is a reliance on the development of telecommunications networks, whether these are fixed, mobile, wired or wireless respectively. In particular, the more connected the networks are to one another, the higher the social benefit they create for all stakeholders. This is well known as the network externality feature of telecommunications networks, and network interconnection is thus fundamentally recognised as a pre-cursor to fostering effective competition in telecommunications markets in general. In the Mauritian context, network infrastructure providers are mandated to offer interconnection services to interested parties at fair and non-discriminatory rates.

In practice, this has translated into the major milestones of direct peering between the two main mobile operators in Mauritius in 2003 while the process of linking fixed and mobile networks, as well as connecting ISPs offering dial-up services to fixed network operators at subsidised rates, was also streamlined over the period 2003 to 2008. A broad overview of the major decisions taken at the wholesale level, which directly impact the market scenarios at the retail level, covers inter-alia: carrier pre-selection for international calls (2004), the Calling Part Pays (CPP) regime & cost based interconnection charges to mobile operators (2004), minimum termination charges for international calls terminated in Mauritius (2006), and cost-based interconnection charges to fixed line operators & no provision for Access Deficit Charges (2008). All the above key initiatives at the regulatory level have helped re-dynamize the business cases of interconnected operators while ensuring competitive voice call tariffs to end users within various markets. This is elaborated further in the coming sections.

The rule of thumb about Interconnection Usage Charges (IUCs) across telecommunications networks is that decreases in selected call tariffs to end users are possible as and when IUCs are reviewed downwards. Through this said mechanism, cost savings become feasible to both relevant network and service providers, with part of these savings being re-distributed to end users at the retail end. The latest determination by the ICTA regarding IUCs was implemented via Telecommunication Directives (TD) 1&3 of 2008, as tabled next, which led to renewed competitive dynamism across the main telecommunications markets, notably fixed network services, mobile network services and ILD market services in particular.

Table 11: Revision of IUC with the proclamation of TD1 & TD 3 of 2008										
	IU	IUC in Rspermin								
Call Category	Rates prior to TD1 & TD3	New Rates	Difference							
Fixed to Fixed	0.16	0.38	0.22							
Mobile to Fixed	1.25	0.38	-0.87							
Fixed to ILD	2.50	0.38	-2.12							
Mobile to ILD	2.50	0.90	-1.60							
ILD to Fixed	2.75	0.38	-2.37							
ILD to Mobile	2.75	0.90	-1.85							

Source: ICTA 2009

The newly proclaimed IUCs in 2008 were determined based on the principles of fully distributed historic costs of the incumbent fixed line operator and unlike the previous IUC determination exercises, there were no conditional requirements to factor in issues of revenue neutrality and access deficit (i.e. below cost access / line rental charges). The latter elements are typically quite significant especially at the onset of liberalisation when incumbent operators try to minimize revenue flight to other competitors while also seeking to obtain funds to finance the cost of rolling out their networks, to even serve uneconomic areas, under the premise of universal service obligations. While revenue neutrality was an early requirement at the time of impending liberalisation, with same being accomplished during so called tariff rebalancing exercises on behalf of Mauritius Telecom Ltd, the condition of access deficit continued to be present in subsequent iterations of the IUC computation framework. In fact, the IUC determination methodology included an inbuilt mechanism to factor in this cost element, until the proclamation of the above-mentioned Telecommunication Directives in 2008. The latter took on board the policy direction by the GoM that no access deficit charge (ADC) is prescribed for the below cost access charges (also known as line rentals) of the incumbent fixed line operator. The ultimate impact of the revision in IUCs, as documented in Table 11, led to significant tariff decreases across several call categories as will be expanded upon in forthcoming sections.

# 3.2 International Bandwidth Connectivity

Access to the international information highway is a lynchpin for any aspiring or successful economy in terms of its ICT sector. The rationale behind this is based on the notion that digitisation has revolutionized the way of doing business or facilitating international trade. In this day and age, a given business is no longer required to be physically present in the geographical market it seeks to serve. Instead, the fast paced development of telecommunications networks across the globe has created a beehive of commercial opportunities, whether it is business to business, or business to consumer. In addition, so called multinationals have also jumped on this bandwagon, by outsourcing part of their activities in countries where operating costs are lower, leading to the creation of a market in itself known as the global BPO-ITES market. While countries such as India, China and the Philippines remain the front runners in this global market, Mauritius is consistently improving its credibility in this area, to serve both Anglophone and Francophone markets given our human capital and locational advantages. What's more Mauritius is also trying to establish itself as the preferred business platform between Asia and Africa. For instance, the 2009 A.T. Kearney Global Services Location Index<sup>12</sup>, which looks at the financial attractiveness, business environment and people skills and availability of a given economy, ranks Mauritius as the 25th country, in a sample of 50, ahead of many developed countries such as Canada (28th), UK (31st) and Singapore (35th) to name a few.

<sup>12</sup> 'The shifting geography of Offshoring ' – The 2009 A.T. Kearney Global Services Location, p2



Source: ICTA 2009

The rise in stature of the Mauritian economy as one of the preferred destinations for BPO-ITES activities is explained by a combination of factors spanning an attractive fiscal regime, economic and political stability, affordable operational & human resource costs, and modern infrastructure among others. In terms of operational costs in particular, the affordability of international connectivity is of particular relevance, especially since Mauritius is quite far away from major European and American markets. It is therefore of capital importance for the ICT sector to take off now that international connections are possible at competitive rates. Much has been accomplished at that level, especially over the past 5 years, as gathered from Fig 5, facilitated through various determinations made by the Authority:



Source: ICTA 2009

The bulk of the international capacity available to Mauritius is typically via undersea cable systems, most notably through the investment stake of Mauritius Telecom Ltd in the SAFE cable. For instance, over the past 5 years, the price of a full circuit E1s (a 2Mbps capacity), from Mauritius to Paris, on SAFE has fallen by as much as 61%.

A similar story applies to the tariffs for half circuit E1s on selected routes where on average a 65% decrease has been experienced over the period 2005 to 2009, as highlighted in Fig 6 above. Taken together, the said decrease in the tariffs for international bandwidth connectivity has had direct repercussions in terms of the available capacity to service providers and other ICT sector operators. For example, it is documented that the level of International Internet bandwidth available to Mauritius has increased by more than 6 times, from 71 Mbps in 2004 to 462 Mbps by the end of 2008. Further development in terms of bandwidth capacity is expected to materialize with the coming into operation of the LION undersea cable in 2009, and the impending link up of Mauritius to the EASSy cable project. The combination of falling connectivity costs, coupled with rising capacity levels has led to significant changes within the relevant retail markets which will be taken up in the forthcoming sections.

# 3.3 Wholesale ADSL

The copper based fixed line network of the incumbent operator, Mauritius Telecom Ltd, is presently deployed across the entire island with the objective of offering not only voice but also data services to the people of Mauritius, notably through digital subscriber line services. This is accomplished through the reselling of its wholesale ADSL connections principally through its subsidiary, Telecom Plus Ltd, or any other licensed ISPs that may be commercially inclined to do so at the retail level. The tariffs of wholesale ADSL therefore remain a key component in the democratization of high speed Internet access, especially through feeder effects onto the retail ISP market. In recognition of the above link, the tariffs for wholesale ADSL connections have been reviewed downwards in February 2009, following a determination by ICTA, with an applicable magnitude of decrease ranging from 30% to 50% from the existing price levels, depending on the selected speed and committed number of lines.

These then are the major developments that have been engineered at the wholesale level, which sets the scene towards assessing their aggregate impact at the retail end, and same is now examined through an analysis of the development of the main retail telecommunications markets.

# 3.4 Evolution of Telecommunications Markets

The telecommunications industry has been recognised as one of the key foundations of the ICT sector and an analysis of the telecommunications services offered would provide some useful trends in this context. The degree of availability of these telecommunication services will of course depend on the state of development of their underlying infrastructural foundations as well as the prevalent relative pricing structures for access to, and usage, of these respective networks. An assessment of the different telecommunications services markets is therefore fundamental, the more so because the ICTA is legally empowered to oversee the regulation of these particular markets.

Broadly speaking, a fly-through of the telecommunications market generates the consensus view that substantial progress has been achieved overall, although some market segments have performed better than others when assessed on various criteria such as level of take-up, level of usage, tariff evolution and revenue generation. The main trends that have emerged over the period 2004 to 2008 are captured in Table 12:

Table 12: Tr	ends within the main retail Te	lecommunications Markets of Ma	uriti us					
	Trends in Telecommunications Markets							
	SUBSCRIPTION: Noticeable increase in take up of the various telecommunications s envices	CHOICE: Improving range of choices available to cons umers						
	TRAFFIC: Significant increase in the us age level of the various telecommunications services	PRICES: Clear decline in tariffs for the various telecommunications services in general						

Furthermore, the liberalisation of the ICT sector as of the 1st of January 2003 meant that falling prices for telecommunications services, coupled with the injection of sectoral competition, have heavily boosted the overall prospects of the various telecommunications market segments. For the purpose of this report, the ICTA has identified the following distinct telecommunications services markets, on which data have been collected with a view towards performing regular market appraisals. The main markets are listed below:

Table 13: Categorization of Main Retail Telecommunications Markets									
Division of Main Telecommunications Markets									
	Fixed Telephony	Mobile Telephony							
	hternational Long Distance	Internet Service Provision							
	the name and a state								

It is further noted at this stage that the evolution of the above mentioned markets will be examined, especially at the retail level, in light of the type of data that have been collected. Wherever possible, the main dimensions to be appraised will focus on the level of service take-up, related usage and the tariff evolution with regards to the respectively identified telecommunications services markets.

# 3.4.1 The Market for Fixed Telephony

The market for fixed line telephony has been dominated by Mauritius Telecom Ltd (MT) since its launch in 1992, following the merger between Overseas Telecommunications Services (OTS) and Mauritius Telecommunications Services (MTS). It is not until the liberalisation of the ICT sector that MT has seen the appearance of genuine competition in the form of Mahanagar Telephone Mauritius Ltd (MTML). The latter was granted a PSTN licence in January 2004, and entered into operation in January 2006, in line with its commercial and network deployment strategy. MTML's entry into the fixed line telephony business is expected to gradually assist the competitive development of this market in the medium to long term. Nevertheless, MT still remains the incumbent operator in this market to date, given its established role in the history and development of telecommunications in Mauritius.

#### Subscriber Base

In terms of the fixed line subscriber base, growth has remained minimal at best since liberalisation, hovering at around 1.4% per annum on average, except for the year 2006 where a dip in the level of subscriptions was actually noted, as captured in Table 14:

Table 14: Growth of fixed line subscribers									
Fixed Line Subscriber Base	2004	2005	2006	2007	2008	Sep-09			
Total Number of Fixed line Subscribers	354,000	358,000	357,000	361,000	364,500	379,088			
Evolution (%)	n.a.	1.1%	-0.3%	1.1%	1.0%	4.0%			

Source: ICTA 2009

As highlighted by the above table, there was only a marginal increase of around 10,000 in the number of fixed line subscribers from 2004 to 2008. Estimates for 2009 reveal however that nearly 15,000 subscribers were signed up over the past year. Furthermore, 2006 marked a change in the underlying technology for offering fixed voice telephony, with MTML providing such services on a country-wide wireless basis. In fact, underneath such sluggish results, it should be highlighted that this particular market is nearing its carrying capacity, with nearly three quarters of house-holds having a telephone line, coupled with the notion that mobile phone service uptake has been growing exponentially in parallel. In addition, the business model within the fixed telephony market is being subjected to the challenge of convergence, whereby a digital subscriber line is now expected to carry a multiple of services, in particular data, as opposed to the traditional restriction of voice based traffic only.

#### Volume of Traffic

National PSTN traffic comprises all voice calls made from the fixed networks, and terminating to fixed or mobile recipients in the Republic of Mauritius. Inter-island calls are therefore also included whenever these are originated from the PSTN.



#### Source: ICTA 2009

Over the period 2004 to 2008, the volume of national voice calls generated from the PSTN has experienced a reduction of around 18%, with the primary driver being a consistent decline in the volume of fixed to fixed calls. In contrast, fixed to mobile calls stood at 79 million minutes in 2004, compared to 325 million minutes in 2008 i.e. nearly a 312% rise over the said time frame. Inter-island calls originating from the PSTN have amounted to 8 million minutes on average for the period.

There are 2 key factors that may account for the developments depicted above. Firstly, this signals a change in the calling habits of users with many having shifted to mobile phone communications, while other fixed line subscribers have increasingly been making calls to mobile over the said period. In fact, the probable substitution towards the use of mobile phones as an increasingly preferred means of communication, especially with the high rates of mobile penetration, is sure to have eaten away at the share of overall volume of domestic fixed minutes of communications. Secondly, the introduction of the 'Calling Party Pays' (CPP) principle in October 2004, coupled with an in-built bias in the pricing of calls, may have encouraged more fixed to mobile calls than vice-versa. This is because as at date, it remains cheaper to call a mobile from a fixed line, as opposed to calling a fixed line from a mobile phone, the latter still being relatively costly.

# Tariffs

Market development with regards to fixed telephony services would not be complete without an overview of the types of services that have permeated this segment, together with the associated tariff evolution. As highlighted earlier, retail developments in the voice market is a result of the influx of competition, with the arrival of a new competitor, while also being distinctly linked with the interconnection framework overseen by the regulator. In addition, the application of new technologies has given life to new business dynamics, with notably the rise in the number of value added services associated with fixed telephony today. For instance, 3-way conferencing, caller line identification, voice mail and SMS over fixed networks, and audiotext services are but a few of the new breed of services that have emerged on the fixed telephony platform.

The coming into operation of MTML has further widened the range of options available to end users. To date, the latter has introduced its own brand of prepaid fixed wireless telephony service, while consumers have a choice of 7 fixed wireless plans in terms of postpaid options. In fact, before the opening up of the sector to competition, since September 2003, residential subscribers had to earmark Rs 90 per month for a landline connection, compared to Rs 225 per month for business subscribers respectively, in terms of package rental. Today, a range of offers, with some plans featuring zero rental charges, or with included free talk time, is available to business and home users alike. In terms of communication charges, Table 15 provides an indication of applicable tariffs adapted from the services of Mauritius Telecom Ltd and MTML respectively.

1	Table 15: Evolution of tariffs for fixed telephony calls	5					
	Calling rates for Fixed Telephony Services (Rs)	2004	2005	2006	2007	2008	2009
	Fixed to Fixed On-net of 3 minutes duration	2.05	2.05	1.44	1.44	1.44	1.44
	Fixed to Fixed Off-net of 3 minutes duration	2.05	2.05	1.83	1.83	1.83	1.83
	Fixed to Mobile of 3 minutes duration	4.75	4.75	4.14	4.14	4.14	4.14

Source: ICTA 2009

In 2009 it is evident that for a 3 minute on-net call, a savings of Rs 0.61 (i.e. nearly 30%) is earned by the end-user compared with 2004. On the other hand, with the new rates available for fixed to mobile calls as from 2006 onwards, consumers are entitled to a 13% savings on a 3 minute call. It should be also be highlighted that while the underlying cost of a fixed to fixed call was raised by Rs 0.22 per minute in 2008 (See Table 11), as part of the new IUC regime, the ICTA has ensured that the associated tariff to end-users was not reviewed upwards, thereby putting the onus directly on operators themselves.

Furthermore, the year 2008 also saw a major development in terms of inter-island calls whereby a 72% decrease in the tariffs for fixed to fixed calls from Mauritius to Rodrigues, and vice versa, was implemented. Similarly, the tariffs fixed to mobile inter-island calls were also re-adjusted downwards by around 55%. The policy perspective of the Authority in facilitating the above development was the promotion of a common pricing regime across the entire Republic of Mauritius.

# 3.4.2 The Market for Mobile Telephony

The market for mobile telephony services experienced its first major development in 1989, when Emtel Ltd became the first mobile phone operator in the Mauritian telecommunications market. As the pioneer operator in this market segment, Emtel Ltd was granted an exclusive right of operations for a period of 7 years, and it was not until 1996 that its main competitor emerged, in the form of Cellplus Ltd, a wholly owned subsidiary of Mauritius Telecom Ltd. Since then, Cellplus Ltd has managed to eat away at the market share of Emtel Ltd, acquired through its first-mover advantage, and is now the market leader in terms of subscriber base and turnover figures. 2004 saw a further significant development in that post-liberalisation of the sector, MTML was granted a PLMN licence by the ICT Authority. The operator launched its activities by mid 2006, through aggressive pricing strategies and diversified service delivery. The particularity with MTML is that it is offering its mobile telephony services on the same platform as its fixed telephony and data services thereby reaping the benefits from the associated economies of scale.

#### Subscriber Base

The development and deployment of mobile phone technology has been one of the most important events in the telecommunications sector across the globe. Mauritius is no exception to that rule, and based on available statistics, it is observed that double-digit yearly growth rates have been achieved during the period 2004 to 2008, as shown in Table 16 next:

T	Table 16: Growth of mobile cellular subscribers									
	Mobile Cellular Subscriber Base	2004	2005	2006	2007	2008	Sep-09			
	Mobile Subscribers	548,000	657,000	772,000	929,000	1,033,300	1,049,300			
	Evolution (%)	na.	19.9%	17.5%	20.3%	11.2%	1.5%			

Source: ICTA 2009

Overall mobile subscriber growth rates have been particularly impressive over the period, which has also coincided with falling prices for mobile handsets, coupled with an increasing choice of brands becoming available. Although growth in terms of subscriptions slowed down by September 2009, hitting a low of 1.5%, this must be put in the context of the mobile penetration rate having reached 82.3%. Unlike fixed line penetration, whereby households and businesses have one or more phone line for many users, mobile cellular phones, and the associated SIM cards, are directly related to a per user basis. Moreover, it may be expected that Mauritius might breach the 100% mobile penetration level with users increasingly having more than two SIM cards to their name.

A further examination of the figures for mobile subscriptions also reveals that the preferred mode of access remains through prepaid mobile telephony. The latter accounts on average for 93% of the total mobile cellular subscriber base over the period 2004 to September 2009, with postpaid subscribers accounting for 7% in comparison. This trend has remained consistent over the period in question. Moreover, the arrival of MTML three years ago has not yet unsettled the stronghold of the two established operators, Emtel and Cellplus Ltd, over this particular market. Over the period in question, the market configurations favour the latter, with an average of around two thirds of the share of total subscriptions, with the remainder accounting for Emtel's share in the most part.

# Volume of Traffic

The evolution of the volume of national mobile voice traffic originating from the PLMN is almost the complete opposite to that presented for the national fixed voice trend depicted in Fig 7 earlier. As would be consistent with the growth in the number of mobile subscriptions for the period 2004 to 2008, voice communications over mobile phones have known a sharp ascension, from 624 million minutes exchanged in 2004, to 1.3 billion minutes by the end of 2008, i.e. a 116% increase.





At a finer level, it is inferred that the major fillip to the above growth in mobile traffic volumes originates from the significant increase in intra-network calls i.e. calls exchanged within the same operator's network, from 458 million minutes in 2004 to nearly 1.1 billion minutes in 2008. This was further supported by the overall increase in both inter-network calls i.e. calls exchanged between different mobile operators, as well as mobile to fixed calls, as observed in Fig 8 above.

While the introduction of the CPP principle in October 2004 was most definitely a catalyst for the growth of mobile communications, it is observed that the sheer convenience of being available to communicate anywhere, anytime or while on the move, combined with an increasing range of affordable handsets, are the principle drivers behind the rise in mobile voice minutes. It is consequently more of a subscription-based effect, as opposed to a communications based price effect – the price for prepaid mobile calls has remained largely unaltered – that may be understood as the main factor behind this growth.

Table 17: Evolution of SMS Traffic originated on Mobile Networks									
SMS Traffic originating from PLMN (million)	2004	2005	2006	2007	2008				
Total Number of SMS exchanged	261	500	752	891	855				
Evolution (%)	n.a.	91.3%	50.4%	18.5%	-4.0%				

Source: ICTA 2009

In addition, the access to prepaid credit has also entailed better micro-management for individual users, who especially do not have to bear the monthly rental associated with a traditional fixed line, irrespective of use. A parallel development to mobile voice telephony, which gathered steady momentum over the period, pertains to the sending of text messages. In 2004, some 269 million text messages were exchanged, and this has reached a staggering 855 million by the end of 2008. This is despite the fact that the tariffs for SMS remain largely unchanged over the said period.

# **Tariffs**

Prior to the entry of MTML into the mobile telephony market, the tariffs for mobile communications had remained for the most part static. As observed from Table 18, over the 2004 to 2006 period, the tariff for the 3 main mobile call categories, on a prepaid basis, remained constant.

Table 18: Evolution of tariffs for Prepaid Mobile telephony calls									
Calling rates for Mobile Telephony Services (Rs)	2004	2005	2006	2007	2008	2009			
Mobile to Mobile On-net of 3 minutes duration		3.60	3.60	2.40	2.40	2.40			
Mobile to Mobile Off-net of 3 minutes duration	11.70	11.70	11.70	10.80	5.40	5.40			
Mobile to Fixed of 3 minutes duration		13.05	13.05	10.80	8.10	8.10			

Source: ICTA 2009

With new packages becoming available, associated principally with the launch of MTML's mobile network operations, more attractive tariffs were made available to end-users, as documented above for the period 2007 to date. Furthermore, the review of the mobile to fixed interconnection rate was also passed on to end-users, which accounts for the reduction in tariffs for the said call category by 25% over the period 2007 to 2008. Overall, it is observed that a decrease of 33% on the price of on-net calls, compared to 54% for off-net calls, is applicable from the year 2004 to 2009. Similarly, the tariffs for mobile to fixed calls experienced a reduction of 38% over the period in question. The year 2007 also saw the introduction of per second pricing by the 3 licensed mobile network operators, which brought even more flexibility to subscribers, in relation to their consumption patterns.

Furthermore, the period 2008 - 2009 featured a broadening of the range of postpaid plans or packages available to subscribers, with operators seeking to target user segments with specific communications patterns and requirements. In fact, not less than 24 postpaid plans are commercialised today, compared with merely 6 plans in 2004. Assisted by the committed investment in network upgrading earmarked by mobile operators, the panoply of mobile postpaid services has also evolved much beyond traditional voice telephony, with an emphasis on premium and other valued added services, as well as data services, becoming particularly pronounced. It is common to see postpaid plans, offering free call minutes or SMS, and a given allowance for data consumption, being commercialised, often with the latest available mobile handsets for a flat monthly rental. However, this still remains a burgeoning niche, with most users preferring the prepaid mode of subscription to date, as argued earlier.

# 3.4.3 The Market for International Voice Communications

Pre-liberalisation of the ICT sector, substantially high tariffs for international calls were practised by the incumbent operator, Mauritius Telecom Ltd, the profits from which were in effect used to cross-subsidise the deployment of the copper-based fixed line network across the whole of the island. This allowed for the charging of relatively low tariffs for business and residential telephone lines respectively. However, having earmarked the need for the liberalisation of the ICT sector, a tariff re-balancing policy - implemented by the ICTA in 2002 and 2003 and which led to a dramatic decrease in the tariffs for international calls, coupled with a marginal increase in monthly access charges for fixed lines – was a pre-requisite for the effective opening up of the sector.

Similar to many other countries, which have opened up their respective ICT sectors, Mauritius experienced a significant influx of competition in the International Long Distance (ILD) market, principally because the returns were high in comparison with relatively small barriers to entry. To date, there are 9 licensed ILD operators offering international voice services, compared with only 1 prior to liberalisation. In general, the market for ILD communications may be broken down as being made up of on one hand, a market for ILD call origination (calls originating from Mauritius to foreign destinations), and on the other hand, another market for ILD call termination (calls from abroad terminating to Mauritius respectively).

# Subscriber Base

At this stage, it is appropriate to distinguish between essentially two kinds of end-services offered as part of the ILD market: Internet Telephony Service (ITS) and International Direct Dialling (IDD) services. These two end-services are appreciably different in terms of price and quality although they share a common intended use (ILD communications). The overriding distinction between these 2 services lies principally in the fact that IDD calls are provided at a guaranteed premium quality of service, as opposed to Internet Telephony, which features reasonable though variable quality of service.

However, improvements in technology, notably digitisation and the use of IP, coupled with the increase in international bandwidth connectivity of Mauritius has given rise to a narrowing of the gap between the definition of these two services, in favour of what is more commonly known as international VoIP service. Consequently, several of the licensed ILD operators today typically operate only an IDD service, or are phasing out their ITS, with this being heavily underlined by the transport of Voice over IP based networks, at increasingly higher quality levels.

With the entry of new players in this market, the mode of payment for international calls also underwent some degree of evolution, with consumers now having the choice between prepaid cards or the more traditional postpaid billing. This development has also to be associated with the decision of the Authority in 2004<sup>13</sup>, to implement carrier pre-selection codes for ILD operators, which further complemented the convenience and choice of consumers in terms of available ILD services for their outgoing IDD communications needs. Nevertheless, the use of prepaid cards or prepaid cards or prepaid cards the most popular form of access to ILD services.

<sup>13</sup> Telecommunication Order 1 of 2004

## Volume of Traffic

A preliminary analysis may be made for both the incoming and outgoing ILD market segments respectively, based on the volumes of traffic being exchanged, with the proviso that outward ILD traffic is aggregated to include both Internet telephony and IDD minutes. From Fig 9, it is observed that over the period 2005 to 2008, the incoming ILD market segment expanded by around approximately 48% in terms of volume of traffic, peaking in 2008, while experiencing a slight decrease in 2007. In comparison, a consistent increase in the volume of ILD traffic originated from Mauritius, highlighted by a significant surge of 109% over the same period.



Source: ICTA 2009

Taken together, this implies a gradual shift in the drivers behind the business models of ILD operators, with outgoing international traffic acquiring increased importance in terms of revenue generation.

Being one of the most dynamic markets within the telecommunications sector, especially in terms of price competition, it is interesting to analyse the said market in terms of the evolution of the effective extent of competition. To that end, the C3 index i.e. the concentration ratio for the 3 largest firms in terms of share of traffic is adopted. In relation to the outgoing ILD market, 6 operators were in competition in 2005 with the C3 index standing at 87%. This implies that the 3 largest operators accounted for 87% of total outgoing international minutes in 2005. In contrast, the C3 index for 2008 reveals that this had dropped to 76%, entailing that the share of the remaining operators had increased overall. While this suggests that the degree of competition within the outgoing ILD market has improved, the 2008 ratio does nevertheless imply a high level of concentration and accordingly, the potential and scope for more competition is present.

As regards the incoming ILD market, the C3 index stood at 80% for the year 2005, with 6 operators in competition, and this ratio worsened to 84% for the year 2008, implying that the share of the largest 3 operators was actually bigger than it was 3 years earlier, and this was despite 8 ILD licensees contesting this particular market segment in 2008. This signals an increase in the degree of concentration level, suggesting competition is not as effective as it would be surmised. It must be noted however that the incoming ILD market segment is not subjected to the operation of free market forces, with a minimum termination rate having been prescribed by the regulator on each minute of incoming calls entering Mauritius.

#### Tariffs

The impact of price competition has been most keenly pronounced in the market for ILD voice communications. With regards to the ILD call origination market from Mauritius, particular attention must be devoted to Internet Telephony Services and IDD services respectively. As far as the former is concerned, such services were launched as from 2004, and given their variability in terms of quality of service, they were often priced significantly cheaper than classical IDD services, which featured a guaranteed level of quality. Given the boom in the global international bandwidth capacity market, the nuance between classical IDD and Internet telephony is increasingly being relegated in favour of what is more commonly know as Voice over IP (VoIP) traffic. The latter is basically eliminating much of the quality differential that existed in the distinction between Internet Telephony and traditional IDD calls.

As a result, the spotlight is given to the evolution of tariffs for IDD calls pre- and post liberalisation to establish the dramatic development that has taken place at the retail level.

Γ	Table 15: Comparison of cheapest Off-peak IDDTariffs in Reimin for the ; ears 2001 & Nov 2005										
	IDD tariffs (Rs) - 3 min call to:	2001	2009	Reduction							
	Retailos island	4500	15.00	តាង							
	UK	7500	12.00	84%							
	South Africa	7500	15.60	79%							
	USA	90.00	12.00	ST %							
	Ciha	105.00	900	91%							
Ŀ	Source: ICTA 2005										

Source: ICTA 2009

Table 19 above compares the cheapest off-peak postpaid tariffs for a sample of popular destinations for the years 2001 and 2009. It is clear that Mauritius has benefited abundantly from the policy of liberalisation, especially in the outgoing ILD market, and the role of cheaper international communications should not be under-estimated in its contribution to the facilitation and development in the diplomatic trade relations between Mauritius and the rest of the world.

With regards to the ILD call termination market, pre-liberalisation, the applicable termination rate into Mauritius was bilaterally negotiated by the incumbent operator with its foreign carriers, and stood at Rs 7.60 per minute in 2002. With the advent of competition, there was pressure on the termination rate to decrease as many licensed ILD operators were now selling Mauritius as a calling destination, with the termination falling by more than 70% to some Rs 2.00 per minute by 2005.

Based on this trend, the GoM decided that the minimum charges for termination rates in Mauritius shall be prescribed with a view to, inter alia, stabilising the incoming international call market segment, in order to meet the demand of ILD operators for a sustained business case. This culminated in the coming into force of Telecommunications Order 2 of 2006, implemented by the ICTA as from 01st February 2006, where the minimum charges for terminating calls onto a fixed line and/or mobile phone into Mauritius were prescribed at 13.3 US cents (approx. Rs 4.00) per minute. The latter rate was subsequently revised through Telecommunications Directive 2 of 2008, effective as from 01st September 2008, to 8.55 US cents (approx Rs 2.60) per minute.

# 3.4.4 The Market for Internet Service Provision

At the early stages of the development of the ISP market in Mauritius, the principal mode of access to the Internet by the general public was through traditionally low-speed dial up technology through Telecom Plus Ltd in 1996, while large business establishments would be using more advanced options such as leased lines or satellite connectivity. The connection of Mauritius to the SAFE cable in 2002 ushered in a revolution in terms of Internet access possibilities culminating with the launch of ADSL services shortly afterwards, compared with the advent of Internet over mobile in the recent past.

However, the retail market for Internet service provision has transited through the process of liberalisation with mixed results. While progress has undoubtedly taken place in terms of take-up, choice of plans, pricing and usage, there are indications that this particular market is not developing as well as it could, for a handful of reasons. For instance, even though the fees for acquiring an ISP licence have been kept at only Rs 50,000 annually, and despite the number of licensees rising from 7 (pre-liberalisation) to 14 by 2009, very few are presently commercialising Internet services to the public at large, while those that do are typically offshoots from established companies such as Telecom Plus Ltd & Cellplus Ltd (Mauritius Telecom Group), Emtel Ltd. Newcomers such as MTML and Africa Digital Bridges Network (ADBN) Ltd have yet to strongly challenge the stranglehold that the more established operators have on this particular market. Encouraging signs in the form of Internet access provided over mobile or wireless networks (GPRS, 3G, HSDPA, and Wimax among others) to reach subscribers, are the highlights in terms of development, while the more

traditional fixed line based services clearly feature a lack of effective competition, with Telecom Plus Ltd for instance not facing any serious competition in the ADSL market segment as an example. A complete flythrough of the state of the national Internet infrastructures may be obtained by considering the following aspects.

#### Subscriber Base

The ISP market has experienced an average growth of around 23% in terms of take-up over the period 2004 to September 2009, as depicted by Table 20. In particular, year on year growth has been maintained in the double digits bracket, being especially significant for the year 2004/05, while it has again picked up the pace over the period 2007/08.

Table 20: Growth of Internet subscribers										
Internet Subscriber Base	2004	2005	2006	2007	2008	Sep-09				
Internetsubscribers	78,023	128,555	143,479	166,059	199,511	203,375				
Evolution (%)	n.a.	64.8%	11.6%	15.7%	20.1%	1.9%				

Source: ICTA, 2009

Estimates for 2009 do however suggest a deceleration in terms of the growth in Internet subscriptions.

At a more refined level, a subtle development has been occurring, given the plethora of access technologies over which Internet service provision may be ensured today. The following charts depicted in Figure 10, signal the evolution that has taken place with regards to the breakdown of the Internet subscriber base. For instance, in 2005, fixed Internet subscriptions accounted for nearly 66% of the total subscribers to the Internet, with dial-up Internet being the predominant mode of access. By 2008, a drastic reversal had taken place with nearly 53% of the total subscriber base accessing the Internet through mobile subscriptions, through WAP, GPRS, and 3G. To a lesser extent, 3% of all Internet subscribers were connected through fixed / semi-fixed wireless technologies notably Wimax and W-CDMA 2000, typically offered by ADBN and MTML respectively.



Source: ICTA 2009

Figure 10 also reveals that the proportion of subscribers to xDSL technology had shot up by around 21% to reach 27% by September 2009. In fact, the use of fast Internet connections has grown relentlessly over the last few years in Mauritius by both individual and business users. As more people buy home computers and create home networks, the demand for Broadband (high-speed) connections is increasingly being felt. While technologies like Asymmetric Digital Subscriber Line (ADSL), 3G and WAP are becoming a mainstay in the Mauritian telecommunications landscape, they are still someway off from fully supporting the integration of converged services such as digital television and video-on-demand (VoD), although triple-play services, currently provided through the MyT platform of Mauritius Telecom Ltd, is a sign of things to come.

# Volume of Traffic

The gradual shift in terms of access technologies to the Internet is further reflected in the available traffic figures, with particular reference to dial-up minutes and data consumption. As expected for the period 2005-2008, the volume of dial-up minutes for Internet traffic has decreased by nearly 39% from its 2005 level, in line with declining dial-up subscriptions as noted earlier. This is an encouraging sign for the ICT industry in a post-liberalised period where subscribers tend to switch to other Internet connectivity media mainly in terms of Broadband connectivity. In comparison, the volume of data downloaded and uploaded through faster access technologies reveal an opposite trend.



Source: ICTA 2009

For instance, Fig 11 documents almost a sevenfold increase in the amount of information downloaded, with only 251 terabytes downloaded in 2005, compared to 1,857 by the end of 2008. In contrast, the volume of data uploaded increased fivefold over the said period. By definition, Mauritius tends to be a net downloader on the global information highway, as most of the contents as accessed by Mauritian users tend to be hosted on foreign servers.

# Tariffs

Much of the gradual shift from narrowband to broadband access technologies has been underscored by an overall decline in the respective prices of the various Internet services. On the one hand, in an attempt towards ensuring universal Internet connectivity to all households, the ICTA in 2003 issued maximum tariffs for dial-up Internet services at Rs 0.57 per minute (peak time) and Rs 0.27 per minute (off-peak). Today, even though the popularity of dial-up Internet access has fallen, it is not uncommon to find postpaid dial-up packages with equivalent per minute charges as low as Rs 0.10 per minute.
The above decision by the ICTA was further reinforced by the determination of below-cost interconnection charges for dial-up internet. However, there is now a substitution effect towards the use of broadband packages, this being notably associated with the consistent decrease in prices coupled with the rising GDP per capita of the population over the past decade. The fundamental linkage between pricing by ISPs at the retail level must be traced back to the facilitative work by the ICTA, in its various determinations to bring down the tariffs of international bandwidth connectivity at the wholesale level.

With regard to broadband Internet access, though major improvements have taken place in terms of affordability, same has tended to happen sporadically. Table 21 illustrates the evolution of the tariffs for a typical ADSL 512 kbps connection over the past five years. While a significant price decrease has indeed occurred – 66% reduction on the home offer compared to 55% on the business offer – it is highlighted that the applicable tariffs were maintained at the same level from 2006 to 2008.

	Table 21: Evolution of ADSL Tariffs –512 kbps						
	Fixed Broadband Services - (Rs/month)	2004	2005	2006	2007	2008	2009
	ADSL 512 Kbps - Home	2,178	1,590	1,300	1,300	1,300	750
I	ADSL 512 Kbps - Business	5,500	3,600	3,190	3, 190	3,190	2,500

Source: ICTA 2009

Furthermore, the fact that many licensed ISPs have not ventured into the resale of ADSL connections from Mauritius Telecom Ltd has entailed an absence of direct competition with Telecom Plus Ltd in this particular market segment.

Instead competition has shifted from being service based towards becoming facilities-based, characterised by the deployment of wireless networks such as Wimax, in conjunction with the continued network investment by mobile operators to enrich the ISP topography in Mauritius. As highlighted earlier, the emergence of the mobile platform as the preferred mode of access to the Internet by 2008 is no coincidence. Over the said period, various mobile and wireless data packages have been launched, in tandem with the expanded capabilities of new mobile handsets and the new generations of laptops and other PDAs. This was initially highlighted by a shift in the pricing principle for such services, notably from a time-based per minute charge to data consumption (per Megabyte) based charge.

In terms of tariffs for Internet access over mobile platforms, in 2005, a 1GB postpaid plan over 3G networks was being sold for Rs 750 per month, entitling the subscribers to speeds up to 384 kbps. The same package is now priced at Rs 399 per month, implying a reduction of nearly 47%. However, the continued development within the ISP market may be somewhat hindered by the fact that present networks, whether fixed or mobile, were designed to be as efficient as possible for the carriage of voice traffic, and are by definition not optimized for the delivery of data services, implying a limited potential for growth. It is important, therefore, to encourage additional facilities-based competition, such as investment in land based fibre networks, and hopefully the planned investment by some established operators towards a migration to Next Generation Networks will open further avenues for the development of the ISP market in Mauritius.

### 3.5 Improving the competitiveness of the IT-BPO Industry

The international dimension to the impact of financial & market oriented regulations by the ICTA is best encapsulated in terms of feeder effects to the flourishing IT-BPO industry in Mauritius. In effect, the progress achieved in terms of the various spheres identified in the previous sub-sections at the national level has direct repercussions for the exportoriented profile of the ICT industry. Indeed, one of the drivers behind Mauritius being ranked as one of the least expensive countries<sup>14</sup> in the global IT-BPO market pertains to cost competitiveness. The latter typically spans critical success factors such as labour costs, telecom & infrastructure affordability among others. In particular, when directing the spotlight towards the costs of telecommunication services, international bandwidth pricing becomes one of the key considerations for potential IT-BPOs investor, when selecting a host country. According to recent estimates from the Board of Investment, the number of IT-BPO companies has grown from 90 in 2005 to 258 by 2008. In contrast, the tariffs for a full circuit E1 (2mbps capacity) has fallen from USD 12,600 to USD 4,900 over the same period, as highlighted earlier. The correlation that may be broadly drawn from the above is that for every USD 100 average decrease in the cost of international bandwidth connectivity, nearly 2 new start ups are created within the IT-BPO industry. Spillover effects are noted in terms of employment, with the above industry registering a growth of nearly three times its initial level in 2004 i.e. 10,440 knowledge professionals employed in 2008 compared with 2,392 in 2004. The BOI further estimates that direct employment figures for 2009 are expected to hover around 14,000 - 15,000 professionals, again highlighting the resilience of the ICT industry, despite the hurdles and challenges brought about by the global recession.

## 3.6 Regulation of the competitive environment – ICTA & the CCM

The coming into force of the Competition Act 2007 has seen the establishment of Competition Commission of Mauritius which has now reached operational status given the full proclamation of all the relevant parts under the said Act towards the end of 2009. The guiding principle of the CCM is be to promote competition, as opposed to regulating businesses and this will be primarily accomplished by deterring anti-competitive or restrictive business practices. The ICTA is also tasked with the promotion of the interests of the ICT sector including the fostering of competition and the maintenance of a level playing field. Therefore, the symbiotic relationship that is expected to develop between the two organisations will be clearly expected to re-dynamize competitive behaviour and market development within and beyond the ICT sector which will also lead to the ultimate protection of consumers' interests at large. It remains likely that some regulatory decisions by the ICTA may lead to situations whereby competition is restrained or distorted, but the presence of the CCM will now help streamline such interventions, through increased coordination and cooperation.

<sup>14</sup> IT-BPO Strategic Review 2009 – Board of Investment Publication, p 7

## 4. Re-engineering the ICT Sector in Mauritius

Within the realm of ICTs, change does not just occur but occurs fast, especially through innovations which involve cycles of creative destructions bringing in their own wave of transformational technologies. What is meant by that is new technological development often tends to render obsolete previously established technologies at a very high pace, thereby confining the latter to being recycled. The pace of change in this sector therefore leads to many complications and challenges from a regulatory perspective, since a balancing act is required to ensure a given country benefits from the latest and most effective technology, while ensuring a competitive playing field, guided by the rule of law, including rights of private individuals within the digital economy.

More often than not, progress in the field of ICTs has given rise to new business models, whereby economic agents operating in unrelated sectors, suddenly venture into the ICT sector, simply due to new technological applications and solutions being available. For instance, today it is common to find traditional telcos offering TV channels and VoD, while traditional cable TV operators now offer Internet access services. While this is undoubtedly to the benefit of consumers, the regulatory regime is often not flexible or fast enough to cope with such change. In more developed countries, there has been a transition from technology neutrality towards service neutrality within the licensing regime, with the regulator focusing more on issues like quality of service, fair rules of competition and so forth.

What has been described above is one of the many dimensions of the notion of 'convergence', and it is against this fundamental evolution which the Mauritian ICT sector now faces and from which most of the opportunities should be fully exploited. To that end, the previous sections of this report have highlighted various observations, which may be enlisted towards a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the ICT sector in Mauritius. The views of various ICT stakeholders, whether gathered from the media, official policy assessment reports and other reports by international organisations, generally have some common themes to them and have also been considered in identifying the critical areas on which the foundations for the success of the Mauritian ICT sector may be built and strengthened. In addition, to address the various lacunas which currently exist or may potentially arise in the development model of the Mauritian ICT sector, the ICTA has currently embarked on various projects, falling under its purview, towards the fulfilment of its vision of playing "a leading role in the future of ICT, in Mauritius, contributing to an efficient, competitive and optimally regulated ICT sector".

## 4.1 SWOT Analysis of the Mauritian ICT Sector

The evolution of the ICT sector in Mauritius over the past few years has led to the identification of certain fundamental attributes and shortcomings of the sector, as well as the various challenges and threats that ought to be tackled and overcome. These are summarised in the SWOT matrix, as illustrated in Table 22.

1 40	Table 22: SWOT Matrix for ICT sector in Mauritius				
	Strengths	Weaknesses			
-	Rising level of ICT investment	<ul> <li>Shortage of specialised/highly-skilled ICT local</li> </ul>			
-	Services-driven growth of ICT sector and	workforce			
	market size	- Foundations for E-commerce are under-			
-	Increasing contribution in terms of GDP &	developed			
	employment	- Broadband Internet penetration still low among			
-	Productivity gains across all sectors with	households and businesses			
	adoption of ICTs	- Mainstream ICT activities currently restricted			
-	Modern ICT infrastructures& high global	to low value-generating activities: call centres,			
	visibility	database maintenance, disaster recovery,			
		etc			
		- Low share of high-tech products from ICT			
		manufacturing industries			
	Opportunities	Threats			
-	Incentives/mechanisms in place for start-ups in	<ul> <li>Insufficient e-commerce activities to further</li> </ul>			
	ICT sector	foster ICT development			
.	ICT sector Public Key Infrastructure will act as a catalyst	foster ICT development - Intense competition in IT enabled services			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security	foster ICT development - Intense competition in IT enabled services (ITES) from other destinations with more			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the	foster ICT development - Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs	foster ICT development - Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force - Huge unemployment losses expected in case			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range and more competitive ICT services	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> <li>Limited scope for transition to higher value-</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range and more competitive ICT services Foreign direct investment into the ICT sector	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> <li>Limited scope for transition to higher value-adding ICT activities (e.g. software</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range and more competitive ICT services Foreign direct investment into the ICT sector likely to boost and innovate ICT solutions, and	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> <li>Limited scope for transition to higher value-adding ICT activities (e.g. software development) compounded by small pool of</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range and more competitive ICT services Foreign direct investment into the ICT sector likely to boost and innovate ICT solutions, and generate other positive externalities	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> <li>Limited scope for transition to higher value-adding ICT activities (e.g. software development) compounded by small pool of expert ICT resource persons</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range and more competitive ICT services Foreign direct investment into the ICT sector likely to boost and innovate ICT solutions, and generate other positive externalities Convergence of networks and services	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> <li>Limited scope for transition to higher value-adding ICT activities (e.g. software development) compounded by small pool of expert ICT resource persons</li> <li>Prices of ICT related goods and services not</li> </ul>			
-	ICT sector Public Key Infrastructure will act as a catalyst for E-commerce & E-security Improved productivity in all sectors of the economy, based on increased use of ICTs More telecommunication providers expected to start their operations, offering a wider range and more competitive ICT services Foreign direct investment into the ICT sector likely to boost and innovate ICT solutions, and generate other positive externalities Convergence of networks and services towards providing complete ICT solutions on	<ul> <li>foster ICT development</li> <li>Intense competition in IT enabled services (ITES) from other destinations with more competitive/skilled labour force</li> <li>Huge unemployment losses expected in case of relocation of call centres and BPO activities abroad</li> <li>Limited scope for transition to higher value-adding ICT activities (e.g. software development) compounded by small pool of expert ICT resource persons</li> <li>Prices of ICT related goods and services not falling fast enough to minimize the Digital</li> </ul>			

There is general consensus regarding the various themes described in the SWOT matrix, and the ultimate objective of the ICTA is to act as a facilitator in terms of ensuring that the strengths of the ICT sector are consolidated upon, notably by promoting the use and access to ICTs in order to take advantage of foreseeable opportunities in the sector. On the other hand, the Authority must also take note of the existing weaknesses of the sector, and come up with projects that will minimize these inefficiencies, where possible, in order to negate existing and future threats to the Mauritian ICT sector. In that respect, several projects have been undertaken and earmarked by the Authority, as will be discussed next.

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## 4.2 Existing and Forthcoming ICT undertakings by the Authority

The responsibility of the ICTA is manifold in that not only should it ensure the economic viability of the sector, but also create and sustain an ICT environment, within defined legal and security-related parameters while also efficiently managing the scarce resources that pertain to the ICT sector. This implies that the Authority must devise and oversee various major project initiatives, with particular applicability to the telecommunications industry as part of the wider ICT sector. These initiatives can be regrouped into 4 broad categories notably: IT related Projects, Engineering & Licensing Projects, Financial & Market related Projects and Social Regulation Projects respectively.

## 4.2.1 IT Related Projects

As an adaptive ICT regulatory body, the ICT Authority has embarked on the process of consolidating regulation across sectors that are converging, such as telecommunications, broadcasting and IT. In fact, there is a very real need to bring regulation up-to-date in light of the convergence of information and communications technologies. Amendments to the ICT Act 2001 have recently been proposed to further create a forward looking and more flexible regulatory framework to enable the ICT Authority to transform itself into a resilient organisation responsive to the numerous pressures for change that confront it in the light of convergence. It is against this backdrop that the ICT Authority is harnessing its resources to enforce regulation for converging ICT services.

There will be several units within the IT department of the Authority which will be called to act as areas of focus for the converging ICT services regulatory framework. The day to day regulatory activities of the different units of IT department of the Authority will be driven by the sections 18 (1) (m), (n), (o) and (z) of the ICT Act 2001, as amended and which read as follows:

- (*m*) take steps to regulate or curtail the harmful and illegal content on the Internet and other information and communication services;
- (n) ensure the safety and quality of every information and communication services including telecommunication service and, for that purpose, determine technical standards for telecommunication network, the connection of customer equipment to telecommunication networks;
- (o) entertain complaints from consumers in relation to any information and communication service in Mauritius and, where necessary, refer them to the appropriate authorities;
- (z) be the Controller of Certification Authorities.

In order to come up with operational measures required to enforce the first three legal provisions, there is a need to understand the regulatory implications underpinning the:

- use of Internet Protocol (IP)-based transmission technologies which is driving the design and use of telecommunications network and platform convergence.
- emerging content and network management technologies characterising ICT services. Key issues in this theme are the increasing use of content monitoring technologies and the need to improve e-security and identity management.

The main IT related projects being handled by the Authority generally emphasize IP-based evolution, content monitoring, E-security, identity and digital content management and coordination among the various stakeholders among others, as described next:

Table 23: Identification of IT Related Projects			
Programmes under IT Department	Status		
IP-Based services	Forthcoming		
Content Monitoring Technologies	Forthcoming		
E-security	On-going		
Ide ntity M a nagement	Forthcoming		
Access & Management of Digital Content Technologies	Forthcoming		
Licensing of PKI certification services	On-going		

#### **IP-Based services**

The use of internet protocol (IP)-based transmission technologies is driving the design and use of telecommunications networks and platform convergence. Voice over IP (VoIP) and IPTV are examples of IP-based services and applications. An additional consequence may be that data carriage requirements will become more symmetrical. Currently upstream and downstream data requirements for residential Internet access are generally asymmetrical with the upstream path requiring much less data capacity than the downstream path. Increasingly, user interaction applications, such as Facebook, will require similar uplink and downlink capacities. This will impact on radiofrequency spectrum demand in wireless networks, as uplink and downlink RF bandwidths will need to be more balanced, and require a revision of xDSL deployment standards.

The regulatory framework was designed in a circuit-switched network environment and the transition to IP-based networks will lead the Authority to consider how existing regulations translate to an IP environment. The regulatory implications of same will therefore revolve around issues including device interoperability, network interconnection, operational systems inter-working and access to IP-based networks.

### **Content Monitoring Technologies**

Content monitoring technologies include 'Deep Packet Inspection' (DPI) and content filtering software. DPI examines the inside structure of data packets to determine their contents. If the technology was to be deployed in Internet Service Providers' (ISPs) networks it could potentially help them to know more about their users and traffic. ISPs would be able to block, shape, monitor and prioritise that traffic (in any direction), and diffuse the threat of traffic congestion. In comparison, content filtering software can be used to block access to specific content or categories of web-delivered content. The technology can be deployed by the end-user on home computers or on service providers' networks (known as ISP filtering). When filters are deployed on ISP networks they can have a costly impact on network performance if they use a large index or undertake dynamic analysis of content.

Examples of potential regulatory uses of DPI filtering systems are:

- Blocking of illegal (i.e., in accordance with local laws) contents such as child pornography;
- Blocking of encryption and tunneling systems that render lawful interception systems (as required by many legislations) ineffective;
- Blocking of unregulated Internet telephony.

However, DPI has the potential to be significantly abused—service providers could discriminate between differentiated payloads, possibly for anti-competitive practices. Some regard DPI as a serious threat to the concept of Internet neutrality. On this score, the role of the regulator would be to ensure a fair distribution of available bandwidth among all network users. Such a fair bandwidth distribution can be achieved through bandwidth management mechanisms which uses DPI-based classification of application traffic.

The regulator will need to explore and come up with application-specific traffic management regulations which would ensure a QoS reservation and guarantee mechanism for Internet based applications. The simplest form of such an application-specific traffic management regulation would be the assignment of priorities to different application classes. A ruleset could for instance be:

- i. Internet telephony (e.g. SIP, H.323, Skype) gets the highest priority
- ii. Interactive applications (Web, instant messaging) get high priority
- iii. Non-interactive applications (FTP, e-mail) get normal priority
- iv. High-bandwidth downloads (P2P file sharing, file hosting) get low priority

#### E-Security

Information security plays an important role in protecting the assets of an organisation. As no single formula can guarantee 100% security, there is a need for a set of benchmarks or standards to help ensure an adequate level of security is attained, resources are used efficiently and the best security practices are adopted. While information security plays an important role in protecting the data and assets of an organisation, we often hear news about security incidents, such as defacement of websites, server hacking and data leakage. Organisations need to be fully aware of the need to devote more resources to the protection of information assets and information security must become a top concern for both government and business.

To address the situation, a number of governments and organisations have set up benchmarks, standards and in some cases, legal regulations on information security to help ensure an adequate level of security is maintained, that resources are used in the right way and the best security practices are adopted. A multifaceted approach to e-security is necessary to maintain the integrity of Internet transactions, and consumer and business confidence in undertaking these transactions. User education, effective legislation and enforcement, international cooperation and the ongoing development and implementation of technical solutions and standards will be required to address e-security problems. The ICT Authority has a significant role to play in all these activities.

#### **Identity Management**

A digital identity is a set of attributes for an entity such as a person, service, device or an application. In order to assert a particular identity in each case, it is necessary to enable the mutual exchange of information that is relevant to the provision of a particular service or application but which may also be personal or sensitive. The structure, security, storage, interoperability and availability of digital identities are requirements that form part of an Identity Management (IdM) framework. IdM has been developed by the International Telecommunications Union to progress standardisation processes for digital identity attributes.

Whatever form identity may take, there is a need to manage the parameters that together form the identity of users or objects globally. As IdM is likely to pervade all walks of life, and may manifest itself in a diverse range of technologies, the need for unified policies, legislation and codes is obvious.

The use of IdM in the delivery of communications and media services may be relevant to the ICT Authority for standardisation of network and application layer addressing in Next Generation Networks. For example, the large addressing range available with IPv6 may enable these addresses to be used as unique identifiers for individual devices or objects connected to a network.

## Access and Management of Digital Content Technologies

Digital Rights Management (DRM) is the control and protection of intellectual property in content that is stored in digital form, including documents, images, video and audio. DRM attempts to limit what a user can do with that content even when in possession of it. The arrangements for managing digital rights might be a combination of encryption and validation processes, conditional access; for example, smart cards, or any other means used to secure and control access to digital content. These technologies may be contained within the operating system or program software, or be found in the actual hardware of a device.

Internationally, governments and holders of intellectual property are examining what action ISPs and end-users might take over illegal file-sharing. Some advocate legislative measures to force ISPs to take action. Others suggest self-regulatory measures. An example of responsibility being placed on the user, with increasing regulatory access channelled through the ISP, is to terminate the Internet connections of those who are caught sharing pirated content. Whatever controls are put in place, compliance is likely to be problematic. Various encryption techniques and proxy identities are also available to file-sharers to make monitoring such activity challenging.

The ICT Authority does not have primary responsibility for protecting intellectual property but may have a role in promoting consumer awareness of rights and responsibilities. Other issues relevant to the ICT Authority include industry standardisation for DRM, technology interoperability and access to information. As these technologies run in the background, there are potential implications for privacy and security—privacy may be an issue because access control is tied to individual user identities.

## Licensing of PKI certification services

Coupled with the above mandates, the ICT Authority is also tasked with the function of acting as Controller of Certification Authorities. In order to discharge this function, the ICT Authority will be required to service the supervision and licensing of Certification Authorities for the Mauritian Public Key Infrastructure.

Following the signature of the MoU between the ICT Authority and the Controller of Certification Authority (CCA) of India, the final phase of the PKI project for Mauritius has been initiated. The final phase consists of translating the terms of the MoU into practical terms such that the office of CCA of Mauritius is set up and the operation of Root Certification Authority for Mauritius enabled. The implications of the above are the setting up of:

- an appropriate licensing framework for the ICT Authority to issue licenses to potential Certification Authorities willing to operate in Mauritius. Required amendment to this effect has recently been proposed in the ICT Act 2001.
- a minimal technical infrastructure to interface the technical Root Certification infrastructure in India for the start of operation of the Mauritian PKI. The Mauritian technical infrastructure will at the same time give autonomy to the operation of the Mauritian PKI in case of disruption of communication services between India and Mauritius.

## 4.2.2 Engineering & Licensing Projects

The main engineering and licensing projects that are being pursued by the Authority place particular emphasis on the efficient management of radio-communication and telecommunications respectively, covering issues such as radiofrequency planning, spectrum allocation and monitoring, numbering plans and increased inter-operability across networks among others.



## Infrastructure and Service Regulation

In the past few years, the ICT industry around the world and also in Mauritius has witnessed the fall of so called "vertically integrated" single service networks. These traditional networks were conceived such that the operators could offer everything from subscriber access to service creation and service delivery across a wholly owned network infrastructure, optimized for a particular service category <sup>15</sup>.

Convergence is already a reality in Mauritius, especially with the introduction of such innovative services as triple play and mobile television. Converged services pose new challenges to regulation and as such new ways for regulating infrastructure and services have to be adopted. The ICT Authority has recommended a simplified and more flexible licensing regime that is based on the horizontal integration paradigm. The Authority believes that this paradigm shift will favour new business opportunities in the converged world.

<sup>&</sup>lt;sup>15</sup> Anders Olsson, Understanding changing telecommunications, Wiley, 2003

So far the Authority has been regulating the ICT sector based on the clear cut demarcation which the current licensing regime had established. This was possible whilst networks were vertically integrated. Given that these demarcations are now blurring, the ICT sector will have to be regulated in the coming years mainly by way of the competitive conduct of its players in defined market segments. As a consequence, a strong competition regulatory framework is expected to be adopted.

Under Infrastructure and Services Regulation, the following programs have been earmarked for the coming three years:-

- VoIP Services Regulation;
- Telecommunication Fraud Prevention Management;
- Next Generation Networks (NGN) Regulatory Framework;

#### **Resource Management – Radio Spectrum**

Convergence and new radio technologies which include software defined radio, Ultra Wide Band (UWB) and cognitive radio, are the new challenges to which national radio spectrum management bodies around the world are being confronted with. These challenges require an urgent need to adopt modern and more flexible radio spectrum management procedures and principles. Moreover, the pervasiveness of radio technologies in society requires regulatory authorities to give more attention to the rising public concern about possible adverse effects to human health from electromagnetic radiation.

The ICT Authority is committed to modernizing its spectrum management functions and to play a leading role in electromagnetic radiation compliance assessment. To that effect, the Authority has recommended amendments to be brought to existing legislation. It is believed that these amendments would enable the Authority to face the challenges ahead. The Authority is also preparing itself to adopt modern concepts of spectrum management including spectrum trading and auctioning. In addition the Authority will advocate light regulation of the radio spectrum wherever justified.

The Authority has recently embarked upon a radio spectrum audit so as to record every single radio transmitter installed on the island. This is a Herculean task given that this has never been conducted before, but the regulator is determined to pursue its objectives and provide Mauritius with a complete database. This database will improve the spectrum management process as a whole and will result in a better protection of systems and services against harmful interference.

The ICT Authority has been further improving its spectrum monitoring capabilities over the last few years and it intends to pursue this objective in the coming years as well, given its prime objective to continually invest in state-of-theart equipment that will ensure that the national radio spectrum resource is efficiently managed.

The staff of the Authority has been regularly undergoing training on different aspects of spectrum management including spectrum monitoring. These training courses have been of great help to consolidate and update their knowledge of what is a very technically complex field. This is testimony of the Authority's commitment to capacity building.

Whereas the past years have enabled the Authority to lay a strong foundation in the field of radio spectrum management, the coming three years will be the opportunity for it to grow and to innovate for the benefit of the industry and the country as a whole.

The programmes defined under this topic are as follows:-

- the elaboration of a flexible spectrum management framework;
- the acquisition of radio monitoring equipment
- the elaboration of a radio infrastructure management framework which may include provisions for infrastructure sharing;
- the elaboration of a consumer safety framework;
- the elaboration of a radio frequency equipment standardization framework.

### **Resource Management – Numbering**

The management of the numbering resource enters in a new era with convergence and the coming of Next Generation Networks (NGN). Convergence from the point of view of numbering means the convergence of two numbering systems. The E.164 numbering system used for PSTN/ISDN/PLMN networks on the one hand and the IP numbering (IPv4 or IPv6) used for IP networks on the other hand. This convergence has led to the creation of the ENUM which is the mapping of E.164 numbers to URLs that can be used for SIP, HTTP and SMTP. The Authority will, as one of its priority, see to it that its management of the numbering plan takes into consideration this convergence of numbering systems.

The Authority does not foresee the elimination of the E.164 numbering in the IP world. For this reason, the Authority will pursue its objective of migrating the current numbering plan to eight digits. This migration has several advantages including recovering coherence in the national numbering plan, increasing the capacity for non-geographic numbers and ensuring that numbering is not a limiting factor to competition.

The Authority's main objective, once the eight digit numbering plan is in place, will be to study whether the introduction of number portability for mobile numbers in Mauritius will be beneficial to the market. Number portability is viewed as a means of boosting competition in the mobile market by enabling consumers to change their service providers without changing their telephone number. The migration to eight digits initially scheduled for 2009 has been postponed to 1st August 2010. One main program of 2010 will therefore be the migration to 8-digits.

### Quality of Service Monitoring

Quality of Service monitoring is considered a priority for the Authority and a framework in that context is being worked out and is expected to be ready for consultation for the beginning of 2010. The Authority has established, through a survey conducted with operators and service providers, the current state in terms of QoS monitoring. On the basis of the said survey, QoS parameters have been worked out and the QoS monitoring framework is being finalized. It is expected that the draft framework will be released for public consultation during the course of 2010. The Authority also reiterates its commitment to participate in international fora on QoS and especially in ITU-T Study Group 12 where the Authority has been contributing so far.

## 4.2.3 Financial & Market oriented Projects

As far as financial & market related projects are concerned, the priority remains the continuous promotion of competition, especially within the telecommunications industry, within the currently defined legal boundaries. There are consequently 4 main projects that warrant particular interest, as explained next:

Table 25: Identification of Financial & Market oriented Projects			
Financial & market based Projects	Statu s	Objectives	
Calculation of Revised Cost-based IUC based on LRIC	Ongoing	An interconnection usage charge (IUC) is paid by one operator to another for the use of latter's network for call origination or termination. It is important that the IUC is based on the underlying cost of the terminating or originating operator. In case the IUC is below cost, it will be difficult for the operator to survive in the long run. Conversely, if the IUC is above cost, it may lead to higher profits and also give rise to major tariff anomalies. The Authority is currently working on a revised IUC regime which will reflect the most recent cost figures, based on the long run incremental cost methodology	
Guidelines on Accounting Separation	Ongoing	Accounting separation provides an analysis of information derived from accounting records to reflect as dosely as possible the performance of various parts of the business of a licensee as if they are operated as separate businesses. Such statements then create capabilities of analyzing costs, revenues and capital employed in major areas of a licensee's business. Defining the guidelines to work out the cost of providing a particular service is, therefore, the first and most important step in creating a fair, transparent and just regulatory environment	
Management of Universal Service Fund	Ongoing	The operational and administrative framework for the management of the USF has already been set up, and contributions to the USF are effective as per the regulations of October 2008. The funds will be used towards recipients that have been entrusted with the concretisation of such universal service(s), as decided upon by the ICT Authority Board, under the guidance of the USF Advisory Group.	

#### 4.2.4 Social Regulation Projects

As regulation becomes more complex, there is a need to raise awareness and democratize information to all to promote and protect the public interest. The increasing complexity of ICT use in people's lives requires a high level of digital literacy and even digital media literacy in an age of converged networks. The ICTA will seek to brand itself as the regulator par excellence in the area of promoting digital media literacy for the people. Digital media and technology has come to play an increasing role in the social, public and private lives of people.

Issues of the safety of children and young people online, the explosion of social networks and the security of personal data will become increasingly prominent in months and years to come. The risks and the benefits associated with the way people use technology and the manner in which services and products are sold by the carriers/operators will become even more complex especially with the emergence of converged networks and content. Consumers of ICT products and services will best to engage with their providers and the regulator when they are aware of their rights but also their responsibilities.

These are the hot issues where the ICTA can take the lead in generating an informed debate through digital media literacy projects. Generating awareness within the organisation through a learning and growth perspective and more crucially promoting digital media to ensure that Mauritians make informed choices about communication services and enabling them to participate in the digital economy.

This will be addressed through a Public Relations strategy and outline action plan by the Authority within a Corporate Communications paradigm taking in the classic public relations tools and tactics which are the most appropriate to the operating context of a regulator. The key areas of activities that the action plan focuses on have been fleshed out in an outline communication strategic plan which seeks to outline PR practice with the corporate objectives. The broad aim is that by stepping up the PR-related activities the level of engagement and debate will become more refined, targeted and more importantly generate a culture of continuous improvement through measurable feedback.

Table 26: Identification of Social Regulation Projects				
Projects under Social Regulation	Status	Objectives		
Campaign on Mobile Phone Theft	Ongoing	<ul> <li>A wide-ranging campaign in both print and broadcast media is being run to achieve the following:</li> <li>? To educate the public on the precautions they should take to safeguard their mobile phones</li> <li>? To inform the public about the official licensed dealers of mobile phones</li> <li>? To inform the public on the way forward in case of lost/stolen mobile phones.</li> <li>? To create awareness on the measures that the public should take when purchasing a mobile phone (eg. IMEI/Receipt)</li> </ul>		
Campaign on Radio Frequency Safety	Ongoing	The purpose of this campaign to come up with a set of guidelines for operators/local authorities and the public on awareness of RF Safety, and the avenues and reporting procedures in case of queries/complaints		
The Beehive Project	Forthcoming	The Authonty is funding this social project which consists of setting up a website that will provide self-help oriented content (Health/Education/Career/Business) and interactive tools written specifically for low- income people that are designed to provide them with the information and connections they need to take action to improve their lives.		
Community Projects Forthcoming		In line with its CSR activities, the Authority will donate PCs to all Primary and Secondary Schools, as phase 1 of its earmarked community based projects		
ICT Awareness promotion campaign	Forthcoming	To create more visibility around ICTs, the Authority will embark on various awareness campaigns for the promotion of ICTs, eg. through painting or essay competitions, to depict the different attributes of ICTs on selected themed days throughout the year		

## 4.3 The Way Forward

It must be distinctly highlighted that the fundamental way in which the Authority is able to ultimately influence the development of the ICT sector is through its proximate regulatory determinations and initiatives within the telecommunications industry in particular. Consequently, the roadmap that will provide the basis upon which the ICT sector may be re-engineered to operate to its strengths heavily, though not entirely, heavily hinges upon a competitive, innovative and highly secure telecommunications industry. It has been argued before that a competitive telecommunications market will definitely have positive repercussions with regards to the cost of access to ICTs, the eventual usage of such ICTs, which will in turn have feeder effects onto employment, investment and economic output. It is anticipated that

by embarking on the various projects described above, the Authority will be in a strong position contribute to the Mauritian ICT sector on these particular counts.

On a more general note, there are certain attributes that differentiate a country in its march towards recognition and prosperity among the comity of nations. Undoubtedly, the ICT industry, more specifically ITES and BPO, presents the future unique selling point of Mauritius. The focus on services is going to continue and we are determined to build and consolidate on that strength.

At the same time, there is no denying that we have made, and are still making, considerable breakthroughs in other industries like manufacturing, agro-processing and the like. Yet there is a symbiotic relationship between the ICT sector and the rest. The way in which we are trying to make a difference in other segments is to add value to them, mostly through increased application of ICTs in all aspects of public life, be it manufacturing, agriculture, governance or the like. There is much merit in advocating that our future growth and our efforts to become a developed economic powerhouse depend greatly on how well we can marshal our actions on the ICT front.

How well entrenched is our ICT sector? Perceptions differ. While the region acknowledges Mauritius phenomenal pioneering effort to develop computer literacy and use in the last ten years or so, we are aware that introspection is required to fathom our strengths and weaknesses with a view to emerge stronger and more efficient.

As we gaze on the way forward, at the national level, we believe that we need to focus our efforts on a number of areas:-

#### Next Generation Networks (NGN)

For the operators in Mauritius, next-generation-network (NGN) technologies are not a long-term aim, but a starting point, since NGN systems actually provide solutions to many of the problems they now face. From a technological standpoint, it is not sufficient for operators to merely create networks that rival those in Western Europe, but that actually surpass them. Over the next decade operators should seriously consider deploying broadband optic fibre networks that completely bypass the copper lines given that copper wiring is becoming increasingly expensive. It is also subject to theft. Since optic fibre cables have no intrinsic value, it makes more sense to lay them than copper.

We also recommend that operators give serious thoughts to deploying WiMAX and IMS systems to provide 'instant' Broadband services. Wireless broadband is an excellent means of reaching rural or transient populations and spots where coverage is blocked out. Unlike copper cable, one can secure wireless broadband equipment against theft and it costs much less than laying and maintaining hundreds of kilometres of cable infrastructure. In this regard, operators are encouraged to invest in the longer term use of flexible, multi-technology and multi-vendor platforms, providing holistic network management, future-proofing for evolution and customer centric perspectives.

As our telecommunications infrastructure becomes more advanced, we will be able to source a wider range of new services and products rather than just outsource the operations of others. It will not be long before a 21st century communications network is available in Mauritius. With ARPUs falling worldwide, operators now desperately seek to add value to their services. As medium and high ARPU countries increasingly feel the bite of revenue reduction on their operations, they must question whether their networks can provide them with the means to exploit economies of scale. The approach that Mauritius will have to adopt to these problems can teach us valuable lessons about the challenges that developed markets have not yet had to contend with, but may soon find themselves facing.

#### Market opportunities

In the interconnected world economy where markets everywhere rise and fall in sync, the innovative and dynamic models from key emerging markets are playing a prominent role on the world business stage. The Mauritian Telecom

industry has been on a consistent wave of growth with significant monthly additions of customers and annual revenues and CAGR (compound annual growth rate) between 2003 and 2009. Growth of revenue through innovation is the name of the game. Value-added services (VAS) offer new and unexplored ARPU growth opportunities. In this area, we have already seen successful synergistic partnership between telecom operators, content providers, and technology enablers. VAS are expected to contribute a significant share to the total revenue of mobile service providers over the next five to seven years; we believe that collaborative partnerships between various stakeholders in the value chain to develop more innovative applications will help make it happen. In this way, the impact of telecom services on various socio-economic segments, which has so far been profound and has resulted in shifting consumption patterns with regard to IT and Telecom, will have to be extended to other industries as well.

## Partnering for growth

As carriers - mainly ILD operators in Mauritius - and emerging markets develop strategies to serve their customers, finding the right partnerships remains a crucial success factor. Carriers are looking for cost-competitive and innovative solutions to create differentiation, as well as the right partner to provide managed infrastructure services that allow operators to focus on their core competence areas. There is a great need to find knowledgeable partners to help optimise costs, to support strategies to transform the existing business and promote emerging business streams through the managed cloud environment. The market is evolving towards a more mature managed outsourcing model where a variety of partners take part in the realisation of common growth goals.

For retail carriers, the prime objectives continue to be acquiring and retaining customers, expanding service reach, introducing new value-added products and building usage and revenue. For these carriers, a 'one stop shop' integrated partner providing services, ranging from in-country and international voice transit, interconnect and bandwidth products or mobility, signalling and roaming solutions, is an important step towards increasing business efficiency and focus.

Mauritian carriers in particular have long realized the importance of partnering and sharing various facilities and infrastructure as mandated under the law in terms of high-quality access and interconnection agreements. The industry has clearly recognized 'co-opetition' or co-operative competition as a key strategy for sourcing and expanding infrastructure at optimal cost. Sharing of in-country network elements like cell sites, bandwidth, co-located PoPs (points of presence) and data centres will have to be prevalent in order to result in improved economies of scale.

As consumers increasingly demand global connectivity and mobility solutions, retail carriers need to partner with global leaders who can offer a wide array of capabilities. Carriers will look to share and capitalize on these capabilities while focusing on their core growth objectives. Some of the attributes carriers should look for include:-

### • Global network assets

One of the key advantages a global voice leader can bring to the table is a presence that is truly global, and one that is actively expanding through investments in new infrastructure. A best approach is to look for a partner who owns and operates globe-spanning network infrastructure - for voice and data - with PoPs in the range of emerging and established business centres.

### • High traffic volumes

In a highly competitive market, the leading providers are best positioned to negotiate rates and invest in routing intelligence to deliver the optimal mix of price and quality. Delivering high call quality within a competitive cost structure has a direct influence on customer relationships and retention.

#### • Significant customer base

A provider with the widest base of customer relationships has an advantage in sourcing high-quality and cost-competitive terminations with A through Z route sourcing. A market leader in the international arena will offer the best selection from a single supplier to simplify vendor management and overhead without compromising quality or cost basis.

#### • Global solution coverage

As international business connections and international travel increase, customers around the world increasingly seek a global orientation from their carriers, whether for calling cards, pre-paid or post-paid roaming. To reach beyond home regions, providers need partners that can ensure a high-quality experience, no matter where their customers travel.

#### • In-region expertise

Emerging market players will want to work with partners that can bring local market presence and assets to the table. The right solution provider can bridge time zone and language barriers, reducing the complexity and overhead of global integration projects.

## • Tailored product offerings

Along with a global perspective, a truly comprehensive partnership will also allow our carriers to leverage solutions tailored to meet unique market challenges and opportunities. Whether it is rolling out services that leverage convergence, or enabling low-value, cross-border remittances seeking out partners that can deliver unique solutions that positively differentiate the customer experience.

## • Positioning for the future

Next-generation, all-IP networks offer new opportunities to carriers to drive revenue growth. While timeframes for IP rollouts differ drastically across markets based on service needs, market conditions and regulatory concerns, forward-looking services providers in all markets will have to seriously think about developing IP strategies and roadmaps. The right partner can make all the difference in managing a successful IP transition. A service provider with a strong track record in VoIP services and hybrid networks can help carriers anticipate and overcome any potential roadblocks in the transition and interconnection process. It is recommended that carriers reach out to partners with experience in solving interoperability challenges stemming from disparate equipment used across networks.

### Re-engineering the outsourcing industry

The current BPO and ITES environment offers important opportunities for Mauritian players. The Mauritian market continues to offer huge potential for substantial growth within the home market footprints, so BPO operators need to continue to focus on their core business objectives to achieve growth. They need to foster partnerships with global companies and leverage the strengths they bring including their mix of capabilities spanning both local and global domain knowledge. This partnership when backed with global customer relationships and expertise, network reach, scale of operations and innovative products like voice transit solutions, mobile roaming solutions and IP solutions, can only strengthen the Mauritian carriers to meet their growth objectives. This has the potential to transform the outsourcing into a truly win-win synergistic partnership.

The outsourcing industry is on the verge of revolutionary changes that ought to take it to the next level. The recent meltdown in the global financial market and the recessionary trends are only adding further momentum to this shift. Historically, outsourcing has been considered a reactive, operational-level intervention. It has been connected to specific goals such as reduction in cost and headcount or improvements in return on invested capital. Conventional outsourcing focuses on service improvement, better performance and access to superior skills and expertise as un-stated benefits.

This relatively tactical approach has been effective in achieving specific outcomes, but has not necessarily resulted in creating competitive advantage throughout an organization. The 'new order of outsourcing' covers a new sort of thinking and approaches that need to become part of every organization's strategic planning process-both outsourcer and service provider. Our local BPO and ITES companies may consider adopting some or all of the following new order of outsourcing principles; these would help both the outsourcer and the service provider gain significantly higher benefits from their traditional outsourcing strategy.

#### Outsourcer -

- *Strategy based upon differentiators:* The organizations need to ensure that outsourcing is not taken up for short-term gains, but rather aligned to seek competitive advantage from internal sources, external sources and the combination of the two. Instead of relying only on small cost differences, organizations gain when their serv-ice offerings and quality are differentiated even if it means paying a premium. Speed to market, customer experience, and unique product or service offerings are some of the differentiators to assess before outsourcing. Outsourcers tend to do well when they adopt a more pragmatic strategy than just focusing on meeting short-term needs and targets.
- Modify the value model: The traditional outsourcing model looks at the business case based upon the project's impact on cost, revenue and assets. The alternative is to make leverage whatever advantages the service provider can bring to the outsourcer- including its technology and people. With more and more outsourcers looking for new ideas and innovations that they can bring to their business, the greater the number of new ideas the service provider can bring to the outsourcer, the greater the reliance upon, and the need for, the service provider.
- Just-in-time sourcing: Outsourcers need to analyse their outsourcing needs as continuously as they do their cash flow. Just-in-time sourcing helps them to evaluate their service partners on a project-by-project basis. This mitigates some of the disadvantages of end-to-end outsourcing wherein the commitment to the service provider is for the duration of the contract whether or not it is justified by business volumes and other needs. This frees the outsourcer from justifying changes in the services they contract in a given period. Nevertheless, it is important that outsourcers analyse their overall strategy regarding their short-term project based needs versus their long-term outsourcing needs.
- Outsourcing as a management discipline: It is common knowledge that outsourcing cannot resolve all problems; outsourcers need to closely manage and discipline their use of outsourcing to be sure it is the best way to meet their needs. There are usually a broad series of activities involved in the services that the outsourcer needs. The transfer of responsibilities to the selected service provider is a critically important process that can determine the overall success of the operation. The transition involves preparing, managing and monitoring the work of the service provider. Monitoring of the service should continue for the entire duration of the outsourcing relationship. Relationship management is a key discipline; the outsourcer's managers need to ensure the health of their business partnership arrangements with each of their service providers.
- Extended partnerships as a vertically integrated business: Outsourcers must recognize and accept that they cannot succeed if their business partners do not know enough about the outsourcer's business to carry out turnkey projects. Using service provider staff just to fill positions and holes in the outsourcer's organisation is generally recognized as an inefficient way to work. Tightly coupling the service partner's business vertical

as an integral part of the outsourcer's organization will provide additional value and benefits to the outsourcing relationship.

#### Service provider -

- Outsourcing the outsourced Salaries are the service provider's greatest cost. With wages increasing substantially each year at major offshore destinations like India, some of the non-critical outsourcing work is further outsourced to Mexico, the Czech Republic and the Philippines among others. This tendency will accelerate in the years to come as service providers try to optimise their cost structure and boost their bottom line. Thus, outsourcing the already outsourced work to a service provider's alternate sites in other countries will become increasingly common. This is precisely where our local service providers will need to be on the lookout to take advantage of such opportunities.
- Partnerships with other service providers: Today, outsourcers must have proven expertise in many areas and with many technologies. The ability to offer a wide variety of skills and services is more of an opportunity than a challenge or the service provider. Consequently, service providers should consider partnering with other service providers whose specific experience in non-core areas can be leveraged to mutual advantage. This reduces the need to invest in and maintain people without a clear and immediate business need. This lets service providers concentrate firmly upon building their core strengths instead of spreading themselves thin.
- Explore innovative business models: With fierce competition in today's market for the limited outsourcing work, service providers need to offer clients a compelling value proposition. One classic option is to reduce the outsourcer's investment and total cost of ownership (TCO) by making an upfront payment to take over all of the client's systems. Subsequently, the outsourcer can raise its usage charges somewhat to recover the cost over time. Thus, both parties agree that the outsourcer not only execute the work, but will also have a say in the day-to-day execution of the systems. This sort of agreement requires the service provider to assume a greater degree of risk.
- Special needs outsourcing: Outsourcing is no longer a run-of-the-mill but more a just handle routine services business. Whenever the outsourcer has a specific need, the service provider is expected to come up with viable, competitive and innovative proposals to handle it. It might be necessary to create a joint venture where both the outsourcer and service provider have 50/50 stake in a new entity. The outsourcer may need an inhouse operation, but not want to be directly involved in building a new operation from the ground up. In this case, the service provider might propose creating the new operation via a build-operate-transfer (BOT) agreement with the outsourcer. Another option might be to create a special purpose operation that caters to all the outsourcer's daily needs; the new entity would operate as an extension of the outsourcer. Obviously, these options are not simple; they generally require extensive groundwork, regulatory clearances and the like, to operate effectively.
- Green Sourcing: High energy prices and cascading recessionary trends are impacting the outsourcing service market. Outsourcer CIOs and CEOs are increasingly evaluating environmental factors when selecting their technology suppliers and partners. Prudent service providers are embracing green technology and practices to stay ahead of the competition by building and demonstrating the sort of green credentials that might play a decisive role in the future outsourcing decisions.
- Data centre and infrastructure outsourcing: A great many companies are reluctant to outsource their IT infrastructure and processing because of the sensitivity of the data and related privacy issues. Advances in technology, data handling and processing, transmission between the outsourcer and the remote service much more widely available than in the past and to be competitive, service providers are increasingly investing in and building advanced facilities to deal with the nuances of managing these critical activities worldwide. As

the price of international bandwidth and the capacity become more abundant, service providers should already integrate these features in their strategic business plans for the future.

• Diversifying product and service portfolio: Mauritius is known to be the preferred destination for many IT-BPO activities as it offers a unique amalgamation of attributes. As the BPO sector continues to grow strongly and steadily, it is important that our local service providers start planning seriously for an accelerated knowledge process outsourcing (KPO). We believe that Mauritius should consider catering to global KPO needs and its high end processes like valuation research, investment research, patent filing, legal and insurance claims processing, online teaching, media content supply, among others. Mauritius very highly skilled manpower - including chartered accountants, doctors, MBAs, lawyers, etc. gives the country important advantages in the KPO market. This combined with the multilingual capabilities and low costs as well as global partnerships, will definitely help us emerge as a global winner in the KPO sector.

#### Addressing Identity Management issue through effective Cyber Security

As we continue to advance the frontiers of innovation in computing and communications, we also have the duty of making the experience of consumers safer and more secure on the Internet. The issue of information security is one of the themes that has received high level consideration at the World Summit on the Information Society (WSIS) held in Tunis in November 2005, and should be well anchored in the mission of the relevant organisations.

At the international level ITU member states has recognised that security is of paramount importance to build confidence in the use of communication networks and to improve personal privacy and Cybersecurity. Moreover, members of states agreed that there is a need to effectively confront challenges and threats resulting from use of ICTs with the objectives of maintaining international stability and security. Consequently, Members have taken the commitment to prevent the abuse of information resources and technologies for criminal and terrorist purposes, while respecting human rights. The ITU therefore recommends, amongst other things, that member countries:-

- Collaborate at international level to develop synergy in tackling this constantly evolving topic
- Develop and implement dynamic Cybersecurity action plans on emerging key areas of concern e.g. Spam, Child Online Protection, Critical Information Infrastructure Protection
- Set up of a national CERT

The setting up of a national CERT under the ICTA under the present legislative provisions will allow ICT professionals and consumers in general to get updated information on latest ICT security threats and possible countermeasures through awareness promotion and capacity building initiatives and will assist them in handling security incidents reported and monitor ICT security problems.

In order to be able to provide these services, a proper national CERT needs to be set up imminently within the legislative framework with the following attributes:-

- a national Cyber Threat Monitoring Center (CTMC) where local ICT incidents are reported (reactive) and where internet traffic and critical information infrastructures are proactively monitored for threats;
- a research team to analyse incidents and threats from the CTMC and propose remedial as well as preventive measure;
- adequate marketing campaigns, sensitization programmes and training mounted for all stakeholders to ensure significant visibility.

# Conclusion

The layers of development of the ICT industry are many and varied, with inter-linkages that influence the expansion of other sectors notably through direct and indirect spill-over effects. This "enabling" dimension of ICTs allows a country to implement and accelerate reforms, whether the latter have to do with economy, education, health or even good governance. To engender and sustain such changes, the need for investing in ICTs remains a prime consideration, which can be aided through the collaboration of both the private sector and the policy-maker. While there is undoubtedly strong support for the workings of the free market in any given sector, ICTs are associated with considerable positive externalities, which on its own the free market would fail to consider, or would under-estimate. As a result, investment into the industry might end up being sub-optimal. Furthermore, other instances of market failures are also present within the ICT sector, notably the ability of incumbents within the telecommunications market to disrupt or exert their own market power vis-à-vis the new competitors in a post liberalised era. Taken together, the continued existence of the above establishes and defines the need for ICT sector regulation.

To that end, regulation and sector development are far from being mutually exclusive. In effect, the role of the regulator towards promoting the interests of the ICT industry is enshrined in its commitment towards the creation and nurturing of a competitive, viable and innovative state of affairs or environment, conducive towards overall socio-economic development and integration. The methodology adopted by the ICTA to achieve this particular mission is through the use of specific regulatory instruments which, broadly speaking, originate from the precincts of licensing & engineering, financial & market oriented, IT related and social regulations respectively.

This report has established how the regulatory framework has evolved within these various fields to continue the fostering of the digital economy and information society of Mauritius. While progress cannot be denied, as most of the measurable impact indicators would globally suggest, the roadmap to further success must be even more shrewdly followed, as ICTs are key in accelerating the pace of development and improving the livelihoods of people through its attribute of integration. This is of special significance to Mauritius, given our relatively limited pool of natural resources, as with ICTs the quality of our human capital may be improved towards enabling Mauritius to play an increasing role within the New World Economy. It is therefore imperative that our people both have access and the knowledge to harness ICTs effectively, to ensure that the ICT sector of Mauritius indeed lives up to its billing as the fifth pillar of the economy.

The financial crisis and recession of 2008/09 has hardly left any member country of the world economy unscathed. Nevertheless, it is heartening to find that the ICT sectors of many countries have demonstrated varying degrees of resilience<sup>16</sup>, with generally those economies where the ICT industry is heavily manufacturing-oriented, as opposed to service driven, being hit relatively harder. Mauritius has benefited from the fact that the national ICT industry is closely service-centric, such that the main economic performance indicators for the sector for 2008 were mostly in the green. While 2009 shows encouraging signs of global recovery, ripple effects from the crisis will still be felt by Mauritius given the dependency of the country on international trade. Therefore, the resilience displayed by the ICT sector must be played to our advantage, and a window of opportunity for continued ICT development may in fact emerge from the crisis. The socio-economic stability of the country, coupled with the overall economic performance of the ICT sector, must be marketed to keep attracting ICT related investment, and maintain the multiplier effects on the rest of the economy in terms of productivity, output and employment.

<sup>&</sup>lt;sup>16</sup> "The impact of the crisis on ICTs and their role in the recovery" – OECD, Aug 2009

At a more refined level, the ICTA together with the policymakers and the private sector must consolidate their endeavours towards the micro-management and promotion of the ICT industry, with one of the key themes being the implementation of a national broadband policy. Unlike more developed countries, where 'Stimulus Packages' have allocated much significance to investment in broadband networks as one of the solutions to generate growth in the face of the ongoing crisis, the ASP adopted by the GoM has not targeted this particular front, potentially bearing in mind the relatively solid performance of the ICT sector. Nevertheless, the experience of other countries would suggest that investment in high speed broadband networks would offer both medium term and long term growth prospects. Such gains would arise directly from the said investment itself, but would also be amplified through secondary returns in the form of economy-wide productivity gains and competitiveness. This calls for a need to ensure that expenditure is directed towards enhancing the education system, deploying broadband networks or even reducing taxes on ICTs to ensure strategic spending for both today and tomorrow. The very nature of information and knowledge, as a public good, coupled with the expansion of broadband networks would entail that companies would change the way they do business, public service delivery would be streamlined and more accessible, innovation would be shared, while markets would operate more efficiently based on updated and rapidly disseminated information. Altogether, the identification and implementation of such a national broadband policy should be given due recognition as part of the overall economic strategy of Mauritius, and not remain solely a sectoral regulatory concern, towards the overarching objective of democratization and development of the country within the digital era.

The consolidation of the vision and efforts by all the relevant ICT stakeholders at the national level will also clearly contribute towards asserting the visibility of the Republic of Mauritius on the international scene, especially in relation to the global IT-BPO market. In essence, the wave of reforms, regulations and projects being streamlined must not only facilitate the workings of the country's internal socio-economic backbone, but also enhance our external regional and global presence. Therefore, continued and concerted efforts to bring down the costs of international connectivity, to improve the quality of our manpower, and to promote a business friendly environment will further ensure that Mauritius becomes a turnkey platform and solutions provider within the global IT-BPO realm. In turn, this will require a change in the aspirations of the country within this latter field, which would demand a transition from basic value added services such as call centre activities, towards the hosting of more complex and content-rich oriented services such as software development, CGI and virtual animation, to be delocalised to our shores. Nevertheless, the solid foundations upon which our ICT sector is being elevated, together with the progress accomplished in various converging spheres, have endowed the country with the right attributes to meet such aspirations and challenges confidently, as Mauritius carries on its ascension up the development ladder of the New Global Economy.

*""The policy choices made now will determine how much countries and nations benefit from next-generation technologies."* 

- Dr Hamadoun I. Touré, ITU Secretary-General

Frequency	Mauritius	Main Service	Applications
Band	Table of Allocations		
100 - 108 MHz	Broadcasting	Broadcasting	FMoroadcasting
108 - 117.975 MHZ	AERONAUTICAL RADIONAVIGATION	AERONAUTICAL RADIONAVIGATION	ILS/VOR
117.975 - 137 MHz	AERONAUTICAL MOBILE (R)	AERONAUTICAL MOBILE (R)	Communication between aircraft and Aeromautical base stations
137 - 137,025 MHz	SPACE OPERATION (space-to- eafth) METEOROLOGICAL-SATELLITE (space-to-eafth)	ME TEOROLOGICAL-SATELLITE (59302-to-e3dh)	NR Jeo
	MOBILE-SATELLITE (space-to- earth) SS 208A SS 209		
	SPACE RESEARCH (space-to- eath) Fixed		
	No bile except a eron autical mobile (R)		
137 025 - 137.175 MHz	SPACE OP ERATION (sp ace-to- ea dh) ME TEOROLOGICAL-SATELLITE (sp ace-to-ea dh)	ME TEOROLOGICAL-SATELLITE (space-to-eastn)	
	SPACE RESEARCH (space-to- earth) Fixed		
	No blie-satelite (space-to-earth)		
	No bile except a eron autical mobile (R)		
137.175 - 137.825 MHz	SPACE OPERATION (\$p308-15- earth) METEOROLOGICAL-SATELLITE (\$p309-40-93fth)	ME TEOROLOGICAL-SATELLITE (space-to-eadti)	
	MOBILE-SATELLITE (space-to- earth)		
	SPACE RESEARCH (50 ace to- earth) Fixed		
	No blie except a eron autical mobile (R)		
137.825 - 138 MHz	SPACE OPERATION (space-to- earth) METEOROLOGICAL-SATELLITE (lipace-to-earth)	NE TEOROLOGICAL-SATELLITE (Space-to-earth)	
	SPACE RESEARCH (space-to- eadh)		

# ANNEX 1: National Table of Frequency Allocations

137.825–138 MHz	SPACE OPERATION (space-to- earth) METEOROLOGICAL-SATELLITE (space-to-earth) SPACE RESEARCH (space-to- earth)	METEOROLOGICAL-SATELLITE (space-to-earth)	
	Fixed		
	Mobile-satellite (space-to-earth)		
	Mobile except aeronautical mobile (R)		
138 – 143.6 MHz	AERONAUTICAL MOBILE (OR)		
143.6 - 143.65	AERONAUTICAL MOBILE (OR)		
MHz	SPACE RESEARCH		
	(space-to-earth)		
143.65 – 144 MHz	AERONAUTICAL MOBILE (OR)		
4.44 4.49 1411-			Pada amataur
144 – 140 MHZ			Radio amateur
	AWATEUR-SATELLITE		
148 – 148 MHz	FIXED	MOBILE	Private Mobile Radio
	MOBILE except a eronautical mobile (R)		
148 – 149.9 MHz	FIXED	FIXED	Private Mobile Radio
	MOBILE except a eron autical mobile (R)	MOBILE	
	MOBILE-SATELLITE		
	(Earth-to-space) S 5.209		
149.9 - 150.05	MOBILE-SATELLITE		
MHZ	(Earth-to-space)		
	RADIO NAVIGA TION-SATELLITE		
150.05 – 153 MHz	FIXED	MOBILE	Private Mobile Radio, Radio
	MOBILE except a eronautical mobile		Astronomy
	RADIO ASTRONOMY		
153 – 154 MHz	FIXED	MOBILE	Private Mobile Radio
	MOBILE except a eronautical mobile (R)		
	Meteorological Aids		
154 - 158.7825	FIXED	FIXED	
WH2	MOBILE except a eronautical mobile (R)		

156.7625 -	MARITIME MCBILE		
156.8375 MHz	(distress & calling)		
	(concert a coming)		
156.8375 - 174	FIXED	FIXE D	
WI E	MOBILE except a eronautical mobile	MOBILE	
174 - 223 MHz	BROADCASTING	BROADCASTING	
223 - 230 MHz	BROADCASTING	BROADCASTING	
	Elved		
	Mobile		
230 - 235 MHZ	FIXED		
	MOBILE		
235 - 267 MHz	FIXED		
	MOBILE		
267 - 272 MHz	FIXED		
	MOBILE		
	Space operation (space to-Earth)		
272 - 273 MHZ	SPACE OPERATION		
	(space-to-Earth)		
	FIXED		
	MOBILE		
273 - 312 MHz	FIXED	FIXE D	
	MOBILE		
312 - 315 MHz	FIXED		
	MOBILE		
	Mobile-sztellite (Earth-to-space)		
246 - 200 1/12	EVED	EIVE D	
315-322 MHZ	FIXED	FINED	
	MOBILE		
322 - 328.6 MHz	FIXED		
	MOBILE		
	RADIO ASTRONOMY		

156.7625 -	MARITIME MCBILE		
156.8375 MHz	(distress & calling)		
	(distress a carrig)		
156.8375 - 174	FIXED	FIXE D	
MHZ	MOBILE except a eron autical mobile	MOBILE	
	-		
174 - 223 MHz	BROADCASTING	BROADCASTING	
114-220 1112	enched on the	Sites Bereine	
223 – 230 MHz	BROADCASTING	BROADCASTING	
	Fixed		
	Mobile		
230 - 235 MHz	FIXED		
100-100 mm L	MOBILE		
	MODILE		
235 - 267 MHz	FIXED		
	MOBILE		
267 - 272 MIN	EVED		
207 - 272 MH2	FIXED		
	MOBILE		
	Space operation (space-to-Earth)		
272 - 273 MHz	SPACE OPERATION		
	(soace-to-Earth)		
	EVED		
	PIXED		
	MOBILE		
273 - 312 MHz	FIXED	FIXE D	
	1000115		
	MOBILE		
312 - 315 MHz	FIXED		
	MOBILE		
	Mobile-szellite (Earth-to-so ace)		
315 - 322 MHz	FIXED	FIXE D	
	MOBILE		
	WOOLE		
322 - 328.6 MHz	FIXED		
	MOBILE		
	RADIO ASTRONOMY		

328.6 – 335.4 MHz	AERONAUTICAL	AERONAUTICAL	ILS
	RADIONAVIGATION	RADIONAVIGATION	
335.4 – 387 MHz	FIXED	FIXED	
	MOBILE		
387 – 390 MHz	FIXED		
	MOBILE		
390 – 399.9 MHz	FIXED		
	MOBILE		
399.9 – 400.05 MHz	MOBILE-SATELLITE (Earth-to- space)		
	RADIONAVIGATION-SATELLITE		
400.05 - 400.15	STANDARD FREQUENCY & TIME		
MHz	SIGNAL-SATELLITE		
	(400.1 MHz)		
100.45 104.1411			
400.15 - 401 MHZ			
	(space-to-Earth)		
	MOBILE-SATELLITE (s pace-to-		
	SPACE RESEARCH (see co. to.		
	Earth) S5.263		
	Space operation (space-to-Earth)		
401 – 402 MHz	METEOROLGICAL AIDS		
	SPACE OPERATION (s pace-to- E arth)		
	EAR TH EXPLORATION- SATELLITE (Earth-to-space)		
	METEOROLOGICAL-SATELLITE (Earth-to-space)		
	Fixed		
	Mobile except aeronautical mobile		
402 – 403 MHz	METEOROLGICAL AIDS		
	EAR TH EXPLORATION- SATELLITE (Earth-to-space)		
	METEOROLOGICAL-SATELLITE (Earth-to-space)		
	Fixed		
	Mobile except aeronautical mobile		

328.6 – 335.4 MHz	A ER ONAUTICAL RADIO NAVIGATION	AERONAUTICAL RADIONAVIGATION	ILS
335 4 - 387 MHz	EIXED	EIXED	
000.4-007 10172	MOBILE	T KED	
	MOBILE		
007 000 MUL			
387 - 390 MHZ	FIXED		
	MOBILE		
390 – 399.9 MHz	FIXED		
	MOBILE		
399.9 - 400.05	MOBILE-SATELLITE (Earth-to-		
WIN2	RADIONAVIGATION-SATELLITE		
400.05 - 400.15	STAND ARD FREQUENCY & TIME		
MHz	SIGNAL-SATELLITE		
	(400.1 MHz)		
400.15 – 401 MHz	METEOROLOGICAL AIDS		
	METEOROLOGICAL-SATELLITE		
	(space-to-Earth)		
	MOBILE-SATELLITE (s pace-to- Earth) S5.208A S5.209		
	SPACE RESEARCH (space-to- Earth) S5.263		
	Space operation (space-to-Earth)		
401 – 402 MHz	METEOROLGICAL AIDS		
101 102 10112	SPACE OPERATION (space to		
	Earth)		
	EARTHEXPLORATION- SATELUTE (Earth-to-space)		
	METEOROLOGICAL-SATELLITE		
	(Earth-to-space)		
	Fixed		
	Mobile except aeronautical mobile		
402 – 403 MHz	METEOROLGI CAL AIDS		
	EAR TH EXPLORATION- SATELLITE (Earth-to-space)		
	METEOROLOGICAL-SATELLITE (Earth-to-space)		
	Fixed		
	Mobile except aeronautical mobile		
403 – 408 MHz	METEOROLIGALAIDS		
	Fixed		
	Mobile except aeronautical mobile		

405 - 405.1 MHz	MOBILE-SATELLITE	MOBILE-SATELLITE	Search & rescues zellite-zided
	(Eaith-to-space)		tracking system
405.1 - 410 MHz	FIXED	FIXE D	
	MOBILE except a eron autical mobile		
	RADIO ASTRONOMY		
410 – 420 MHz	FIXED	FIXE D	
	MOBILE except a eron autical mobile		
	SPACE RESEARCH (space-to- space)		
420 - 430 MHz	FIXED	FIXE D	
	MOBILE except a eron autical mobile		
	Radiolocation		
430 - 440 MHz	AMATEUR	RADIOLOCATION	Radio Amateur
	RADIOLOCATION		
440 – 450 MHz	FIXED	FIXE D	
	MOBILE except a eron autical mobile		
	Radiolocation		
150 155 MIN	EVED	MOBILE	Drivata Mahila
+30 - +35 MIP2	MOBILE	WODILE	Private Woone
	mobile		
455 - 456 MHz	FIXED	MOBILE	
	MOBILE		
456 - 459 MHz	FIXED	FIXE D	
	MOBILE		
459 - 460 MHz	FIXED	FIXE D	
	MOBILE		
460 – 470 MHz	FIXED	MOBILE	Private mobile
	MOBILE		
	Meteorological-Satellite (space-to- Earth)		
470 - 790 MHz	BROADCASTING	BROADCASTING	Broadcasting

790 - 862 MHz	FIXED	FIXED	824 - 849 MHz CDMA
and the management of the	BROADCASTING	BROADCASTING	Constructions of the research of the Proposition States and States Proposition and
	5.05.0		
862 - 890 MHz	FIXED	FIXED	869 – 885 MHZ CDMA
	MOBILE except a eronautical mobile		
890 - 942 MHz	FIXED	MOBILE	GSM Mobile
030 342 11112	MOBILE except a gropautical mobile	MODILL	
	Radiolocation		
942 - 960 MHz	FIXED	MOBILE	GSM Mobile
	MOBILE except a eronautical mobile		
960 – 1215 MHz	AERONAUTICAL	AERONAUTICAL	DME
	RADIONAVIGATION	RADIONAVIGATION	
1215 - 1240 MHz	EARTH EXPLORATION-		
	SATELLITE (active)		
	RADIOLOCATION		
	RADIO NAVIGATION-SATELLITE		
	(space-to-Earth) S 5.329		
1240 1260 MH -			
1240 - 1200 WITZ	SATELLITE (active)		
	RADIOLOCATION		
	DADIONAVICATION SATELLITE		
	(space-to-Earth) \$5.329		
	SPACE RESEARCH (active)		
	Amotour		
	Amateur		
1260 - 1300 MHz	EARTH EXPLORATION-		
	SALELLI E (active)		
	RADIOLOCATION		
	SPACE RESEARCH (active)		
	Amateur		
	1 Part - Carl 2012 837		
1300 - 1350 MHz	AFRONALITICAL		
1500 - 1550 WHZ	RADIONAVIGATION		
	Radiolocation		
1350 - 1400 MHz	FIXED		
	MOBILE		
	DADIOLOCATION		
	RADIOLOCATION		

1400 - 1427 MHz	EARTH EXPLORATION-		
	SATELLITE (passive)		
	RADIO ASTRONOMY		
	SPACE RESEARCH (passive)		
1427 – 1429 MHz	SPACE OPERATION (Earth-to-	FIXED	Fixed links
	space)		
	MOBILE execute execution mehics		
	MOBILE except a eronautical mobile		
1429 - 1452 MHz	FIXED	FIXED	Fixed links
	MOBILE except a eronautical mobile		
1452 - 1492 MHz	FIXED	FIXED	
	MOBILE except a eron autical mobile		Fixed links
	BROADCASTING S5.345 S5.347		
	BRO AD CASTING-SATE LLITE		
			Fixed links
1492 – 1525 MHz	FIXED	FIXED	
	MOBILE except a eronautical mobile		
1525 – 1530 MHz	SPACE OPERATION		
	(space-to-Earth)		
	FIXED		
	MOBILE-SATELLITE		
	(space-to-Earth)		
	Earth exploration-satellite		
	Mobile except aeronautical mobile		
1530 – 1535 MHz	S PA CE OPERATION		
	(space-to-Earth)		
	MOBILE-SATELLITE		
	(space-to-Earth) S5.353A		
	Earth exploration-satellite		
	Fixed		
	Mobile except aeronautical mobile		
1535 - 1559 MHz	MOBILE-SATELLITE	MOBILE-SATELLITE	Inmarsat
	(space-to-Earth)		
	/-t-as is realized		
1559 – 1610 MHz	AERONAUTICAL		
	RADIO NAVIGATION		
	(space-to-Farth)		
	(space-to-Lain)		

1610 - 1610.6	MOBILE-SATELLITE		
MHz	(Earth-to-space)		
	AERONAUTICAL		
	RADIONAVIGATION		
1610.6 - 1613.8	MOBILE-SATELLITE		
IVIHZ	(Earth-to-space)		
	RADIO ASTRONOMY		
1613.8 - 1626.5	MOBILE-SATELLITE		
MHz	(Earth-to-space)		
	RADIONAVIGATION		
	Mobile-satellite (space-to-Earth)		
1628.5 - 1680	MOBILE-SATELLITE	MOBILE-SATELLITE	Inmars at
MHz	(Earth-to-space)		
1660 - 1660.5	MOBILE-SATELLITE		
MHz	(Earth-to-space)		
	RADIO ASTRONOMY		
1660.5 - 1668.4	RADIO ASTRONOMY		
WIN2	SPACE RESEARCH (passive)		
	Fixed		
	Mobile except aeronautical mobile		
1668.4 - 1670 MHz	METEOROLOGICAL AIDS		
···· -	FIXED		
	MOBILE except a gronautical mobile		
	RADIO ASTRONOMY		
1870 - 1875 MH-			
1070 - 1073 WHZ	FIXED		
	METEOROLOGICAL-SATELLITE		
	(space-to-Earth)		
	MOBILE S5.380		
1675 – 1690 MHz	METEOROLOGICAL AIDS		
	FIXED		
	METEOROLOGICAL-SATELLITE		
	(space-to-Earth)		
	MOBILE except a eronautical mobile		
L			

1690 - 17 00 MHz 1700 - 17 10 MHz	METEO RO LOGICAL AIDS METEOROLOGICAL-SATELLITE (space-to-E arth) Fixed Mobile except aeronautical mobile FIXE D	METEO RO LOGICAL AIDS	
	METEOROLOGICAL-SATELLITE (space-to-E arth) MOBILE except a eronautical mobile		
1710 – 1930 MHz	FIXE D MOBILE	Mobile	GSM 1800
1930 - 1970 MHz	FIXE D MOBILE	FIXED	
1970 – 1980 MHz	FIXE D MOBILE	FIXED	UMTS
1980 – 2010 MHz	FIXE D MOBILE MOBILE-SATELLITE (Earth-to-space)	FIXED	UMTS
2010 – 2025 MHz	FIXE D MOBILE	FIXED	
2025 – 21 10 MHz	SPACE OPERATION (Earth-to-space) (space-to-space) EARTH EXPLORATION- SATELLITE (Earth-to-space) (space-to-space) FIXE D MOBILE S5.391 SPACE RE SEARCH (Earth-to- space) (space-to-space)	FIXED	
2110 - 2120 MHz	FIXED MOBILE SPACE RSEAR CH (deep space) (Earth-to-space)	FIXED	UMTS
2120 – 2160 MHz	FIXE D MOBILE	FIXED	UMTS

2160 - 2170 MHz	FIXED	FIXED	
	MOBILE		
			UMTS
2170 - 2200 MHz	FIXED	FIXED	
	MOBILE		
	MOBILE-SATELLITE (space-to- Earth)		
0000 0000 144			
2200 – 2290 MHz	SPACE OPERATION	FIXED	
	(space-to-Earth) (space-to-space)		
	EARTH EXPLORATION- SATELLITE (space to Earth) (space-to-space) FIXED		
	MOBILE S5.391		
	S PA CE RESEAR CH		
	(space-to-Earth) (space-to-space)		
2290 - 2300 MHz	FIXED		
	MOBILE except a eron autical mobile		
	S PA CE RES EARCH (deep space)		
	(spa ce-to-E arth)		
2300 - 2450 MHz	FIXED	FIXED	Radio based Local Area
	MODULE		Networks
	MOBILE		
	Amateur		
	Radiolocation		
2450 - 2483 5	FIXED	FIXED	Radio based Local Area
MHz	1000	1020	Networks
	MOBILE		
	Radiolocation		
2483.5 - 2500	FIXED		
MHz	MOBILE		
	MOBILE-SATELLITE		
	(spa ce-to-E arth)		
	Radiolocation		
2500 – 2520 MHz	FIXED S5.409 S5.410 S5.411	FIXED	
	MOBILE except a eronautical mobile		
	MOBILE-SATELLITE		
	(Space-to-Earth) S5.403		
	S 5.405 S 5.407 S 5.408 S 5.412 S 5.414		
2520 - 2655 MHz	FIXED \$5.409 \$5.410 \$5.411	FIXED	Wimax
	MOBILE except a eronautical mobile		
	B RO AD CA STING-SATE LL ITE		

2655 – 2670 MHz	FIXED \$5.409 \$5.410 \$5.411	FIXED	Wimax
	MOBILE except a eronautical mobile		
	BROADCASTING-SATELLITE		
	Earth exploration-satellite		
	(passive)		
	Radio astronomy		
	Space research (passive)		
2670 – 2890 MHz	FIXED \$5.409 \$5.410 \$5.411	FIXED	
	MOBILE except a eronautical mobile		
	MOBILE-SATELLITE		
	(Earth-to-space)		
	Earth exploration-satellite		
	(passive)		
	Radio astronomy		
	Space research (passive)		
2690 - 2700 MHz	EAR TH EXPLORATION		
	SATELUTE (passive)		
	RADIO ASTRONOMY		
	SPACE RESEARCH (passive)		
2700 29.00 MH-			
2700 - 2500 MH2	RADIONAVIGATION \$5.337	RADIONAVIGATION	
	Radiolocation		
2 900-3 100 MHz	RADIONAVIGATION \$5.428	RADIONAVIGATION	
	Radiolocation		
3 100 – 3 300 MHz	RADIOLOCATION		
	Earth exploration-satellite (active)		
	Space research (active)		
3 300 – 3 400 MHz	RADIOLOCATION		
3 400 – 3 600 MHz	FIXED		Wimax
	FIXED SATELLITE (s pace-to-Earth)		
	Mobile		
	Radiolocation		
3600 - 4200 MHz	FIXED	FIXED	VSAT
	FIXED SATELLITE (s pace-to-Earth)	FIXED SATELLITE (space-to-	
	Mobile	Caru1)	
		1	

5 725 - 5 830 MHz	FIXED - SATELLITE (Earth-to-	RADIOLOCATION	
	Amotour		
	Andteur		
5 830 - 5 850 MHz	FIXED - SATELLITE (Earth-to-		
	Ameteur		
	Amateur cotollito (co coo to Earth)		
5850-5925MHz	FIXED		
	FIXED - SATELLITE (Earth-to-		
	space) MOBILE		
	MODILE .		
5925-6700MHz	FIXED	FIXED	Fixed links
	FIXED - SATELLITE (Earth-to-	FIXED - SATELLITE	VSAT
	MOBILE		
6 700 - 7 075 MHz	FIXED	FIXED	
	FIXED - SATELLITE (Earth to-		Fixed links
	space) (space-to-Earth) S5.441		
	MOBILE		
7 075 - 7 250 MHz	FIXED	FIXED	
	MOBILE		Fixed links
7 250 - 7 300 MHz	FIXED	FIXED	Fixed links
	FIXED - SATELLITE (space-to-		
	Earth)		
7 300 – 7 450 MHz	FIXED	FIXED	Fixed links
	FIXED - SATELLITE (space-to)		
	Earth)		
	MOBILE except a eronautical mobile		
7 450 7 550 111-	EIVED	EIVED	Fixed links
1 40 U - 1 550 MHZ		L L L L L L L L L L L L L L L L L L L	Fixed links
	Earth)		
	METEO RO LOGICAL- SATELLITE		
	MOBILE excent a croneutical mobile		
7 550 – 7 750 MHz	FIXED	FIXED	Fixed links
	FIXED - SATELLITE (space-to-		
	Earth)		
	NUDBILE except a eronautical mobile		
7750 - 7850 MHz	FIXED	FIXED	Fixed links
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	METEOROLOGICAL-SATELLITE		
	(space-to-Earth) S5.461B		
	MOBILE except a eronautical mobile		
7 850 - 7 900 MHz	FIXED	FIXED	Fixed links
	MOBILE except a eronautical mobile		
7 900 – 8 025 MHz	FIXED	FIXED	Fixed lin ks
	FIXED-SATELLITE (Earth-to-s pace)		
	MOBILE		
8 025- 8 175 MHz	EAR TH EXPLORATION - SATELLITE (space-to-Earth)	FIXED	Fixed links
	FIXED		
	FIXED-SATELLITE (Earth-to-s pace)		
	MOBILE S5.463		
8 175 – 8 215 MHz	EAR TH EXPLORATION - SATELLITE (space-to-Earth)	FIXED	
	FIXED		
	FIXED-SATELLITE (Earth-to-s pace)		Fixed links
	MOBILE S5.463		
8 215 – 8 400 MHz	EAR THEXPLORATION -	FIXED	
	SATELLITE (space-to-Earth)		
	FIXED		Fixed links
	FIXED-SATELLITE (Earth-to-space)		
	MOBILE S5.463		
0.000 0.000 MIL		- NEO	
8 400 – 8 500 MHz	FIXED	FIXED	Fixed inks
	S BACE RESEARCH (and so to		
	Earth) \$5.465 \$5.466		
8 500 – 8 550 MHz	RADIOLOCATION		
8550 - 8650 MHz	EARTH EXPLORATION - SATELLITE (a clive)		
	RADIOLOCATION		
	SPACE RESEARCH (active)		
8 650 - 8 750 MHz	RADIOLOCATION		
8 750 – 8 850 MHz	RADIOLOCATION		
	AERONAUTICAL		
	RADIONAVIGATION S5.470		

8 850 – 9 000 MHz	RADIOLOCATION		
	MARITIME RADIONAVIGATION \$5.472		
	S 5.473		
9 000 – 9 200 MHz	AERONAUTICAL - RADIONAVIGATION \$5.337		
	Radiolocation		
9 200 – 9 300 MHz	RADIOLOCATION		
	MARITIME RADIONAVIGATION \$5.472		
9 300 – 9 500 MHz	RADIONAVIGATION \$5.476	RADIONAVIGATION	WeatherRadar
	Radiolocation		
	Radiolocation		
9 500 – 9 800 MHz	Radiolocation EARTHEXPLORATION- SATELLITE (active)		
9 500 – 9 800 MHz	Radiolocation EARTH EXPLORATION- SATELLITE (active) RADIOLOCATION		
9 500 – 9 800 MHz	Radiolocation EARTH EXPLORATION- SATELLITE (active) RADIOLOCATION RADIONAVIGATION		
9 500 – 9 800 MHz	R adiolocation EAR TH EXPLORATION- SATELLITE (a ctive) RADIOLOCATION RADIONAVIGATION SPACE RESEARCH (active)		
9 500 – 9 800 MHz	Radiolocation EAR TH EXPLORATION- SATELLITE (a ctive) RADIOLOCATION RADIONAVIGATION SPACE RESEARCH (active)		
9 500 – 9 800 MHz	R adiolocation EAR TH EXPLORATION- SATELLITE (a ctive) RADIOLOCATION RADIONAVIGATION SPACE RESEARCH (active)		
9 500 – 9 800 MHz 9 800 – 10 000 MHz	R adiolocation EAR TH EXPLORATION SATELLITE (a ctive) RADIOLOCATION RADIONAVIGATION SPACE RESEARCH (active) RADIOLOCATION		
9 500 – 9 800 MHz 9 800 – 10 000 MHz	Radiolocation EARTH EXPLORATION- SATELLITE (a ctive) RADIOLOCATION RADIONAVIGATION SPACE RESEARCH (active) RADIOLOCATION Fixed		