

Telecommunication Regulatory Dilemmas

Essam Eldin Mitwally, Dr. Techn., SM IEEE, Regulatory Affairs, STC, Riyadh, KSA

Keywords: Telecom Regulations, Future Telecom Networks, National Developments, Market Liberalization.

Abstract. Telecommunication Regulation has been described in a Gartner Research report as the most influential factor shaping the telecommunication market, while in some cases, the influence is felt more through its absence (Hahn, 2003). Telecom regulatory challenges stem from the requirements of achieving multiplicity of important objectives, taking place in a highly dynamic environment of telecom technologies and services that are evolving to satisfy ever increasing customer needs at a pace faster than laws and regulations in place.

In this paper we describe the telecom regulatory environments in terms of objectives, principles, tools and attitudes. We then examine the critical regulatory dilemmas facing telecom regulators around the world and potentially influencing the telecom market. We conclude that those dilemmas may be dissolved with a balanced regulatory attitude based on sound lawful principles, and with regulations aiming to attain justice to all players while encouraging cooperation among them. We specifically address the necessity for regulations to evolve and align with new technologies, combined with means for “fair” observability and controllability of transported packets that can be technically achieved with right technology such as Deep Packet Inspection (DPI).

Introduction

Regulations have been integral constituent of telecommunications since its inception with varying themes. Along with the growth of telecommunications and the worldwide spread of the telephone service, regulations took the form of technical standards for service interworking and interconnection, with international commercial agreements for financial settlements. Government agencies, mainly Ministries of Communications, assumed the role of Regulators within national levels, while International organizations such as CCITT (Consultative Committee International Telephone and Telegraph), currently named ITU (International Telecommunication Union), formed the umbrella of regulations at the international level.

The first most drastic regulatory move was the breakup of AT&T that took place in January first, 1984 in the USA as a result of more than 30 years of legal battle by the USA government against AT&T, based on antitrust legislation. This represented a paradigm shift from Phase-1 Regulation (Regulating the Incumbent monopoly) to Phase-2 (Regulation for breaking the monopoly of the Incumbent). Such a breakup of AT&T and related regulatory requirements are commonly thought of being a symbolic milestone for the highly competitive telecom marketplace. In fact, the real enabler of competition, is technology evolution (Dorros, 2009), since during the 90's, grounds for digital, mobile, optical and packet communications were founded, which attracted intensive investments in networks, services and telecom products. UK followed USA and started deregulation for liberalization of the telecom market in the same year. The wave of telecom liberalization moved over most European countries during the 90's, fueled by globalization and liberalization principles under the guidance of the World Trade Organization (WTO). Most Arab states climbed the wave during the current decade.

Phase-2 regulations initially emerged to tackle the monopolistic situation of a single organization operating the Public Switched Telephone Network (PSTN). Accordingly, legislations have been developed along the business model, architecture and infrastructure of the PSTN. Difficulties of regulations are due to the attempt of achieving legal, technical and commercial controversy objectives for the different players of the telephone network. There has been an idealistic view that such regulation will continue to reduce as the market becomes more liberalized and competitive, with balanced forces of demand and supply. This turned to be untrue due to the dramatic technological and architectural evolution of the telecom network with associated services, infrastructure and business models. This led to what we may denote as Phase-3 regulation.

In the first part of this paper we shall describe the most common regulatory objectives, principles and tools that regulators around the world apply with different flavors. We add the dimension of regulatory attitude that resembles the degree of maturity of the market. We then examine some of the most challenging Phase-3 regulations, namely: Voice over Internet Protocol (VoIP), Next Generation Networks (NGN), Next Generation Access (NGA), and Convergence. We conclude with prescription of regulatory attitudes that avoid the manifestation of deficiencies and violations resulting from regulatory gaps and technical shortcomings.

Regulatory Objectives

Regulatory objectives are established to implement policies in line with the government national strategic economic reforms. The most common regulatory objectives are listed below in the order of their importance:

- Support operators to satisfy customers needs and demands for affordable and high quality of telecom services that enhance their living and improve their efficiencies and productivity, with applications covering social developments, home environment, health care, education, government agencies, security,etc.
- Ensure right infrastructure is made available to customers in such a way that will continue to expand the scope and increase the value of telecommunication services offered to them.

- Encourage and attract operators to invest in cost efficient information infrastructure and technologies.
- Encourage operators to provide suitable and affordable telecom services to communities in non-profitable localities (Universal Services/Universal Access),
- Ensure availability of the essential requirements and mechanisms to facilitate market entries of new operators in an adequate competitive environment (e.g. interconnection), thus improving services and reducing charges.
- Ensure justice and efficiency of utilizing National Scarce Resources (e.g. Frequency Spectrum , Numbering)
- Increase national competitiveness through use of ICTs.

Principles governing regulations

Regulators obtain their authority through implementing government policies to achieve regulatory objectives. Certain principles of Administrative Law constitute the legislation that shapes how such authority and legal powers are exercised in a fair and balanced manner (Buckley, 1993). The main such principles are:

- **Transparency:** is characterized by the degree of Clarity, Openness, Consistency and Predictability. The logic by which regulation addresses the problems must be stated. It must not introduce additional elements that do not relate to the problem. Published regulatory plans and properly presented public consultations are examples of transparency measures.
 - **Efficiency:** can be expressed in terms of the speed of performing their roles and enforcing regulations, as well as the effectiveness of observing compliances and violations.
 - **Independence.** The regulator should perform without specific bias to external influences coming from the government, or any of the operators. The regulator should take all views into considerations and make balanced assessment of the issues.
 - **Objectivity.** Each regulatory action must have a stated objective, and be consistent with the overall declared objectives of the regulatory process.
 - **Proportionality:** Regulation must be proportional to the problem being solved.
 - **Reasonableness:** It must be possible to explain and justify the steps being taken.
 - **Non-Discrimination:** No discrimination between players except when there is justified and revealed reasons.
- In addition to the above principles of Administrative Law, regulation should generally be forward looking to set up the stage for smooth transition to the regulatory requirements of future technologies, services and networks.

Regulatory Tools

Regulators use the following tools

- **Licensing:** Collection of conditions for the service providers in the market, specifying the rights entitlement and obligations. There are different types of licenses which can be granted for different durations.
- **Issuing of Guidelines** on certain regulatory requirements for clarity, standards, self regulation and incentives.
- **Making Decisions:** to elaborate rules, enact regulations, approve issues, resolve disputes, ... etc.
- **Carry out Public Consultations:** regulators must consult widely in arriving at decisions, guidelines, ,, etc.

Regulatory Attitude

Regulators around the world may apply all of the attitudes in fig. 1 at varying degrees, depending on the market competitive maturity. Such attitudes may also characterize the quality of regulation.

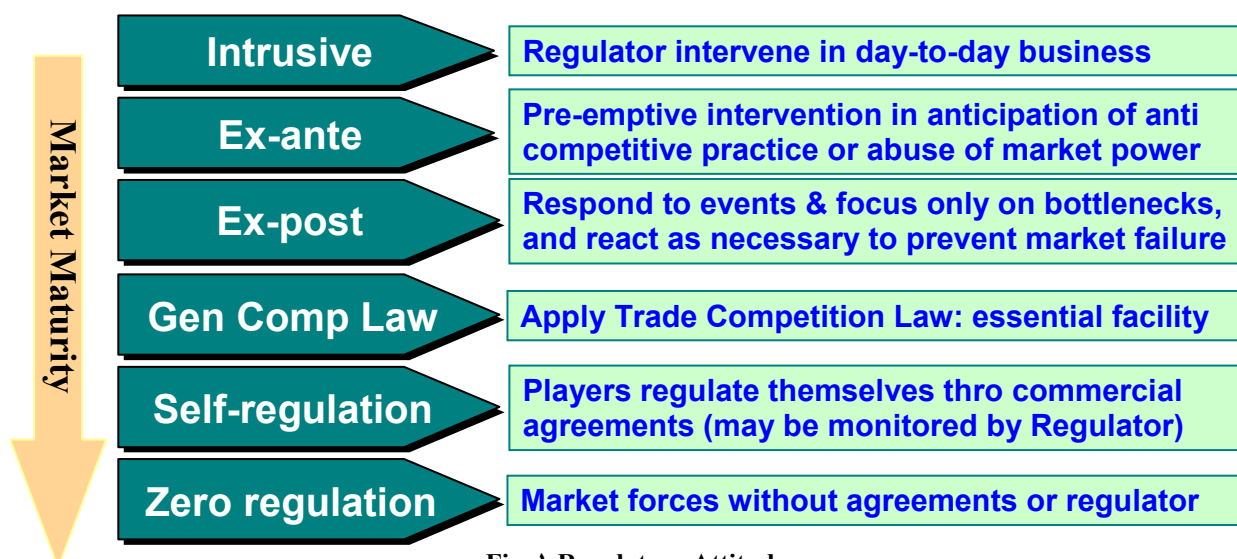


Fig. 1 Regulatory Attitude

Regulatory Dilemma of Voice over Internet Protocol (VoIP)

Voice communication has been the "killer" and yet most valuable telecom application, and is considered to be the main source of revenue for the large telecom operating companies worldwide. Voice over packets was a research dream of the 1980's, which was materialized in the mid 1990's in the form of Asynchronous Transfer Mode (ATM) technology. Along with the commercialization and evolution of the Internet, VoIP evolved in different communication forms, provisioning modes, architectures and business models.

Depending on the used terminal devices, the main communication forms of VoIP are:

Computer-to-Computer, Computer-to-Phone/Phone-to-Computer and Phone-to-Phone.

There are three main modes of provisioning of VoIP services over Broadband (BB) connections (OFTA, 2000):

- **Mode-1** : The IP Telephony services are provided by the supplier of the BB connection to the customer.
- **Mode-2** : The IP Telephony services are provided by a service provider who has direct access to, and interconnect with, the BB connection under a commercial agreement with the supplier of the BB connection.
- **Mode-3** : The IP Telephony services are provided by an operator as an application on the Internet which is accessed through the broadband connection. In this case, the IP Telephony service provider has no commercial relationship with the supplier of the broadband connection specifically for the IP Telephony services, although there may well be other commercial relationship between the two operators (such as peer-to-peer arrangement) for the exchange of generic Internet traffic.

While the first two modes of provisioning also entail several regulatory concerns that we shall depict in the next section in connection with NGN, it is Mode-3 of provisioning that represents most of the dilemma and reflects the conflicting nature of VoIP regulation globally.

It is globally agreed that VoIP will become a technology standard of choice as xDSL (x Digital Subscriber Lines), WiMax (Worldwide Interoperability for Microwave Access), mobile broadband and Fibre Optic systems proliferate (Banerjee, 2007). Productivity gains and socio-economic progress from adopting technologies like VoIP can be large. Most regulators are, therefore, encouraged to embrace the technology. Also, many regulators exempt VoIP from certain common carrier regulations (e.g. in USA VoIP is treated as information service). On the other hand, VoIP is subject to restrictions in countries where it poses revenue threats to PSTNs in an unfair manner. More specifically, Mode-3 of provisioning may offer complete bypass of the PSTN. Regulators of some countries, therefore, tend to either prohibit the technology or permit it under restrictive conditions. Further, those proponents of "Net Neutrality" supported by VoIP providers such as Skype are urging regulators in Europe to intervene to ensure that users aren't blocked from using their mobile phones to access calls via the Internet (Meller, 2009). On the other hand, it is worthwhile noting that The Swedish Post and Telecom Agency ruled that Skype must pay the government fees for the revenue-generating services it is offering in Sweden (Total Telecom, 2009). Skype service is blocked in some countries such as Oman and the UAE to protect the profits of telcos, while it is available in Bahrain. Table 1 below depicts the current diversity of policy choices regarding VoIP in selected countries. More information about the diversity of VoIP regulations can be found in many publications such as (Kadi, 2007) and (Haque, 2007).

Table 1 Current diversity of policy regarding VoIP in selected countries

Country	VoIP Regulation
Australia	No, there are several ISPs offering IP telephony services through calling card and pc-to-phone services
Brazil	Yes, certain VoIP services have to be licensed.
Canada	Yes, VoIP is regulated the same as local exchange services.
China	Yes, VoIP is regulated as a value-added service.
Egypt,	Yes, 3 VoIP scenarios are defined specifying permitted and unpermitted communications.
European Union	Yes, New Regulatory Framework treats VoIP the same as all electronic communication services.
Hong Kong	Yes, VoIP operators must have a 3 Class license and connect to emergency services.
India	Yes, VoIP is licensed as an Internet service.
Japan	Yes, VoIP is subject to the same regulations as all voice telephony services.
Saudi Arabia	Yes, Mode-1 provisioning is permitted, and Framework of interconnection issued.
South Korea	Yes, VoIP operators must be certified as telecom resellers or service providers
UAE	Yes, only Facility Based Providers (FBPs) are allowed to offer VoIP.
UK	No, but VoIP-specific regulations of emergency calls, number portability are being considered.
USA	No, VoIP is regulated lightly as an information service, with obligation to provide emergency service.

With such flowers and thorns of VoIP, the optimal decision to solve the VoIP regulatory dilemma is yet unclear in most countries. However we believe that proper regulatory attitudes should address the roots of the dilemma and make clear assessment of the lawful principles that govern VoIP deployment. It is to be pointed out that the root of the dilemma is mainly due to the deployment of a technology with insufficient observeability and controllability of existing network infrastructures and architectures. Further, innovative companies such as Skype and MagicJack are taking advantage of such design deficiency (of being non-observable and non-controllable), combined with the regulatory gaps of the unregulated Internet and content services, and escaping the regulatory regimes of voice interconnection services. Due to such design deficiency, VoIP international services are illegally provided by non-licensed non-FBP smugglers in many parts of the world.

A legal approach based on justice to every one should be developed and enforced both legally and technically. Rights and freedom of consumers to access applications of the Internet should be built on fair and legal ground, supported by appropriate and solid technical means. More specifically, the following legal and technical propositions may be carefully addressed to dissolve the current dilemma (see table 1 below):

- The current debate on "Internet Neutrality" should take into considerations that one's "Freedom" stops where it clashes with the freedom of others and affects their interest. A form of "Partial Net Neutrality" is required.
- Mode-1 VoIP Services should be deployed and expanded only when legally assessed through agreements
- The Machiavelli approach of making "the End justifies the Means" should be resisted and revisited.
- The principle of "avoiding harms takes precedence over gaining benefits" has always been applied in telecommunication regulations and should continue to be respected.
- The public should be informed not only about the benefits and forms of VoIP, but also about the justified cost that must be paid for the service.
- The form of free voice service (indirectly subsidized by other services or advertisements) makes unfair business model at present, and could lead to market failure. The current form of free international voice service should be denied based on competition laws as well as other licensing legislations.
- VoIP deployments (legal or illegal) should be technically observable in the sense of being able to detect, discover, measure, diagnose,etc. and controllable in the sense of being able to classify, charge, modify, prioritize, block, ..etc., as has always been the case for the PSTN services. This is realizable through the adoption of DPI technology (Mochalski, 2009). DPI facilitates the inspection of the entire packets travelling the network, and looking not only at the packet headers like legacy systems, but also at the packet's payload.

Regulatory Dilemma of Next Generation Networks

Next Generation Networks (NGN) are being deployed by many Facility Based Service Providers around the world. The concept of NGN started in the early 1990's in connection with Broadband ISDN, being a single Packet-based network using ATM technology to provide all types of telecom services. In the light of evolution and maturity of IP networks using Multi Protocol Label Switching (MPLS) techniques to enhance routing and quality of service, NGN are now based on Routers that are expected to offer Carrier Class grade of service in terms of availability, flexibility, scalability and performance. The Signaling System #7 (SS7) and Central Processing Units of the Telephone Exchanges as control layer of PSTN are being replaced by Session Initiation Protocol (SIP) and Soft-Switches and Servers in NGN. Voice will continue to be the "killer" service in NGN taking the technology form of VoIP.

For such new technology and network architecture, new types of service providers and business models are expected to emerge. It can be fairly assumed that VoIP in NGN will be based on Mode-1, Mode-2 and Mode-3 of provisioning described above. NGN related regulations in most countries tend to be yet light. The main concern of regulators is to avoid intervention that may deter innovations and investments. Regulators generally tend to take positive attitude towards encouraging operators building NGN. The most significant part of NGN is fibre optic in the access network as will be described in next section.

The dilemma of NGN regulation is due to the multiplicity of regulatory concerns that need resolution with varying regulatory attitudes. The main such concerns are (Ha, 2009):

- Licensing associated with new Business Models, Terms, and Charging schemes.
- Regulation of convergence aspects of Mobile and Fixed services served from same NGN.
- Regulatory concerns of convergence of Telecom, Media and Internet services offered over the NGN
- Addressing, Naming and Numbering issues, including the development of Electronic Number Mapping System (ENUM)
- Regulation of Local Number Portability associated with NGN
- Regulation of End-to-End Quality of Service for different types of services, especially for VoIP.
- Monitoring NGN standardization activities within ITU
- Regulation of NGN Interconnection at national and international levels, as well as service interoperability with associated commercial and technical agreements.
- Regulation for availability of Malicious Call Tracing and Lawful Interception Services ,

- Regulation for availability of Emergency calls and other Location Based management capabilities
- Regulation associated with implementation of the Internet Protocol IPv7
- Regulation of Services Provided from outside the country through the Internet (e.g. VoIP provisioning)

Some of the above regulatory concerns will require the adoption of DPI technology in order to allow proper NGN network and service management including provisioning, charging and interconnection agreements. It is worth noting that the use of DPI is currently under debate in USA and other parts of the world, addressed in connection with “Net Neutrality”. Net Neutrality attempts to enforce rules limiting network management capabilities (Greene, 2009) & (Frieden, 2009). A recent decision taken by the Canadian Telecom Commission establishes a principled approach that intends to balance the freedom of Canadians to use the Internet for various purposes with the legitimate interests of ISPs to manage their traffic (CRTC, 2009). This is in line with what we denoted as “Partial Net Neutrality” in table 2 below.

Regulatory Dilemma of Next Generation Access

Next Generation Access (NGA) is the access part of NGN. The main technologies of NGA in the wide sense are: xDSL, WiMax and Optical Fibre. Those technologies are evolving fast in terms of increased speed, reduced cost and improved deployment and operational flexibility and simplicity. All such systems are denoted the last mile access infrastructure, and will carry VoIP and other converged services such as (Internet Protocol TV) IPTV. In the strict sense, NGA commonly means the deployment of fibre access network that can offer speeds exceeding 100 Mb/s.

The main regulatory concerns associated with NGA are summarized as follows:

xDSL: The regulation associated with xDSL is mainly Local Loop Unbundling (LLU) by mandating the operator owning the PSTN copper access network to share it with other operators. The most viable approach is Bitstream service. In this approach, the copper network owner takes advantage of the economy of scale and builds a form of wholesale xDSL NGA network that can serve other operators.

There is currently an intense debate in Europe about the direction of the New Regulatory Framework “NRF” for Electronic Communications. Several years after the implementation of regulations mandating local loop unbundling throughout the European Union, there is still a great deal of disagreement about the impact that such regulation has had on the market for broadband services. In a research carried out by a consulting company (Waverman, 2007), it was found out that while access regulation may promote short-term competition based on the existing PSTN network, it does so at the cost of potential reduction in alternative infrastructure investment by both incumbents and the new entrants. Regulations on access seem to depress the investment incentives of the incumbents and the incentives to invest in fibre platforms. In another study (Gruber, 2007), it was shown that mandatory unbundling have become rather a substitute for investment by new entrants than a complement.

WiMax: The following main problems are associated with WiMax related regulations:

- Freeing Frequencies and allocations to competing companies as well as the competing technologies (i.e. Long Term Evolution of GSM networks “LTE”)
- Regulations associated with differentiation between mobility of WiMax and the Fixed license implications. Many WiMax implementations are based on fixed license which allows nomadic but not mobile services, while actual implementation adopts IEEE 802.16e which supports mobility.
- Quality of Service regulation specially in connection with VoIP service

Fibre Optic: Implementation of Fibre Optic in the access network has been a dream of the late 1980's and has only become practically viable in the last few years. The regulatory dilemma of fibre NGA is on how to promote both competition and investment in NGA. One regulatory challenge is to develop means to encourage competing operators to cooperate as much as practical in sharing NGA fibre infrastructure. Competition requires granting access so as to prevent the incumbent from again gaining dominant position. On the other hand, the incumbent required new investments not to be regulated. In a study associated with NRF (Czernich, 2009), it was concluded that mandating access to NGAs will discourage investment. However, it was indicated that when absolutely necessary to mandate competitor access to NGA, the regulated price should include an adequate risk premium for the first-mover investor who bears the risk of uncertain future demand, and should compensate for the fact that new facilities can be rolled out at lower cost in the future.

Regulatory Dilemma of Telco/Media Convergence

Convergence is the trend within the information and communications industries towards merging of networks, services, firms, and devices. The most common attribution for the recent drive towards convergence is the migration of networks to NGN and the use of VoIP. Convergence is bringing up specific and complex regulatory challenges (World Bank, 2007). With multiple players involved, it may be unclear as to who will bear responsibility to comply with national laws and regulations and what governmental entity has to enforce regulation. The following is a summary of the main convergence regulatory challenges:

licensing: One of the key notions of convergence is that licensees can offer different services using different access networks. Hence, the principles of technology and service neutrality in licensing need to be established.

Competition policy: There are very different rules and regulations for telecommunications and broadcasting markets related to mergers/acquisitions, foreign investment, and entry conditions. Service convergence poses problems because new entrants in these markets can upset service-specific competition policy.

Interconnection to the PSTN for non-traditional telephony providers such as cable television providers, and interconnection to content generators for non-traditional broadcasters will need consideration.

Numbering issues covers all areas of the industry such as E.164 numbers, IP addresses for ISPs, to channel numbers in television or cable networks. The introduction of IPTV, provision of data services over broadcasting networks, and VoIP telephony will require attention to these issues. Also Number Portability needs attention.

Spectrum licensing: VoIP, IPTV, and other systems like digital audio or video broadcasting (DAB/DVB) change the efficiencies and usage of spectrum, and hence might lead to a need for review of spectrum licensing systems. Similar to licensing, a technology or service-neutral approach to spectrum use might also have to be considered to be in line with convergence.

Service regulation. Broadcasting networks are not the focus of quality of service regulation as often as telecoms networks. However, if cable operators begin to offer IP-based services, QoS regulation will need attention. On the other hand, telecom service providers are typically not regulated for content. However, if a service like IPTV is offered over a telephone company's network, it might need to follow content regulation principles as well. Universal service obligations for IPTV, VoIP or other converged service providers will need resolution to ensure fairness among operators.

Structure of regulatory institutions. As converging services travel over the same access infrastructures, it might be necessary to converge regulators and the legal framework as well, in order to promote efficient regulatory decision-making, and minimize possibilities for arbitrage and complex procedures.

Regulatory Dilemmas Dissolving Prescription

In table 7 below, we provide some guidelines to help dissolve the regulatory dilemmas presented in this paper.

Table 7: Guidelines to dissolve regulatory dilemmas

	VoIP	NGN	NGA	Convergence
Intrusive	<ul style="list-style-type: none"> • Numbering allocation • Help public awareness of fair communications 	<ul style="list-style-type: none"> • Numbering allocation 	<ul style="list-style-type: none"> • Frequency freeing and allocations 	<ul style="list-style-type: none"> • Content monitoring with possible blocking
Ex Ante	<ul style="list-style-type: none"> • Licensing VoIP services to FBPs only and not to ISPs and not to non-FBP establishments. • Partial Net Neutrality* • Encourage DPI for regulated network management capabilities with Observeability and controllability. • Denounce International "Virtual Operators" without agreements as illegal. • QoS. • Lawful Interception. • Calling Line Ident. (CLI) 	<ul style="list-style-type: none"> • Partial Net Neutrality* • Encourage DPI for regulated network management capabilities with Observeability and controllability • Number Portability • QoS • Lawful Interception. • Denounce International "Virtual Operators" without agreements as illegal • Emergency Calling and CLIP 	<ul style="list-style-type: none"> • Encourage fair "Bitstream Service" on commercial basis • Ensure no access mandate on NGA investments (with exceptions in certain critical situations). • Encourage wavelength and dark fiber services. • Encourage site, duct and other infrastructure sharing services. • Encourage third party building NGA infrastructure. 	<ul style="list-style-type: none"> • Partial Net Neutrality* • Encourage DPI for regulated network management capabilities with Observeability and controllability • Denounce International "Virtual Operators" without agreements as illegal • Set up DPI rules for Privacy • Set up DPI rules for intellectual; property rights
Ex Post	<ul style="list-style-type: none"> • Disallow unlawful discriminations or blockings • Stop illegal offers • Apply penalties on violations. - Resolve disputes. 	<ul style="list-style-type: none"> • Disallow unjustified discriminations or blockings • Apply penalties on violations. • Resolve disputes. 	<ul style="list-style-type: none"> • Verify wholesale NGA access prices. • Monitor and intervene to avoid any monopolistic misconducts. 	<ul style="list-style-type: none"> • Disallow unjustified discriminations or blockings • Apply penalties on violations. • Resolve disputes.

Compt. Law	<ul style="list-style-type: none"> • Yes 	<ul style="list-style-type: none"> • Yes 	<ul style="list-style-type: none"> • Yes 	<ul style="list-style-type: none"> • Yes
Self Regulat.	<ul style="list-style-type: none"> • Interconnection and services agreements • Regulator, Operators, and citizens agree on technical and commercial DPI rules 	<ul style="list-style-type: none"> • Interconnection and services agreements • Operators agree on technical and commercial DPI rules • Communities involvement in social and legal DPI rules 	<ul style="list-style-type: none"> • Agreements of NGA access and infrastructure sharing on commercial basis 	<ul style="list-style-type: none"> • Agreements on commercial basis. • Operators agree on technical and commercial DPI rules • Communities involvement in social and legal DPI rules

* We define “Partial Net Neutrality” as special formulation of Net Neutrality adopting tools such as DPI to allow “fair” network management, which specifies what constitutes reasonable service classifications and price discrimination by Network operators and what amounts to an unfair trade practice.

Conclusions

The dramatic technological and architectural evolution of the telecom network with associated services, infrastructure and business models have drastically changed the Regulatory landscape of Telecommunication Regulations, which we denote as Phase- ν Regulation. While some existing legislations can be applied to the new systems, regulations are becoming more complex, and can have enormous impact on the economy. Therefore, regulations should follow proper principles and attitudes to achieve their objectives and cater for dilemmas such as those depicted in this paper, for which we have provided guidelines to dissolve. In particular, we have shown that while light regulations may apply on VoIP and NGN, Ex-ante and Ex-post regulations will be necessary to protect both customer interests and the rights of operators against violation of certain modes of voice service provisioning that can lead to market failure. We identified the necessity for Phase- ν regulations to be supported with technical means for “fair” observeability and controllability of the transported packets that can be achieved through DPI technology. We have also shown that certain classical regulatory practices such as LLU which are presumed to fuel competition may lead to more adverse effect in terms of reduction of infrastructure investments by the operators. Further, the need was emphasized for special preparedness of regulations to cater for the emerging telecom/media convergence.

References:

- Banerjee, A.B., (2007), "Regulatory Trends: New Enabling Environment", *ITU, New Initiative Program Document: FoV/07*
- Buckley, J.B., (2003), "Telecommunications Regulation", *The Institution of Electrical Engineers, UK*
- CRTC, (2009), "Review of the Internet traffic management practices of Internet service providers", *Canadian Radio-television and Telecommunications Commission, CRTC 2009-707, Oct 2009, Canada*
- Czernich, N. (2009), "Regulatory Framework for Next Generation Access Networks Across Europe" *Ifo Institute for Economic Research at the University of Munich*
- Dorros, I.D. (2009), "History of Communications", *IEEE Communications Magazine*, Vol. 47, No. 6., June 2009
- Frieden, R. (2009), "Net Neutrality and its Potential Impact on Next Generation Networks", *White paper, Penn State University, USA*
- Greene, T. (2009), "What's the FCC vote on net neutrality all about?", *Network World.com*
- Ha Y.K. (2009), "OFTA's Views on NGN", *OVUM's Executive Workshop on Convergent Telecoms, Commercial and Regulatory Challenges*
- Hahn, W.H. (2003), "Regulation Key Factor in Telecom Investment", *Gartner Research Report*, Feb., 2003
- Haque, M.H. (2007), "VoIP: Regulating the Future", *Washington Univ. Global Law Studies Review*, Vol. 6:109.
- Kadi, I.K. (2007), "VoIP Policy and Regulation, Regional Perspective", *ITU. Regional Seminar on Internet Protocol: VoIP, Algiers – Algeria, 19 - 20 March 2007*
- Meller, P.M. (2009), "Skype to Regulators: Push Mobile Operators to Allow VoIP", *PC World*, July 2009.
- Mochalski, K. (2009), "Deep Packet Inspection: Technology, Applications & Net Neutrality", *White Paper from IPOQUE provider of DPI solutions for Internet Traffic Management, Germany.*
- OFTA (2009), "Regulation of Internet Protocol (IP) Telephony", *Office of Telecoms Authority. Hong Kong*
- Total telecom, (2009) "Skype ordered to pay fees in Sweden", *Total Telecom*, July 2009
- Waverman, L.W. (2007), "Access Regulation and Infrastructure Investment in the Telecommunications Sector: An Empirical Investigation", *LECG Consulting with support of ETNO.*

World Bank, (2007), "Regulatory trends in service convergence", *Policy Division, Global Information and Communication Technologies department*, The World Bank, Washington, D.C.: June 29, 2007