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WORKING PAPER

WHEN SHARING ISN'T ALWAYS CARING: UNDERSTANDING TELECOM INFRASTRUCTURE SHARING IN THE MULTILATERAL CONTEXT

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I. INTRODUCTION

A phone in every hand. If this was the vision of the pioneers of the telecom industry, they ought to be popping champagne bottles. Telecommunications today has become ubiquitous and omnipresent. It plays a very important role in all of our lives. From merely being instruments in facilitating verbal communication with each other over distances; telecommunications today has evolved to a much larger platform for offering a wide variety of services.

The global telecommunications market today is a huge one, representing millions and millions of consumers catered to by hundreds of telecom service providers. This has also meant a fiercely competitive industry with various players vying with one another for a sizable chunk of the growing telecommunications market. Besides being a very competitive industry, the telecommunications sector is also a highly investment-intensive industry. Indeed, the nature of telecommunications equipment and infrastructure required for providing high-end telecommunications services capable of wide outreach means that the industry is going to have to deploy huge amounts of capital. The gestational nature of these investments means that the particular telecom company is going to have to sustain significant financial losses till it can break even. This can be a potential entry barrier for companies interested in making an entry into the telecom market.

Thus, problem precedes opportunity. As a result, one of the issues that policy makers and regulators may have to grapple with is how to reduce entry barriers and increase competition in the market. Thus comes the concept of "infrastructure sharing". According to a background paper to the World Development Report, infrastructure sharing in the telecommunications sector can be understood as the joint utilization of assets and/or services necessary to provide telecommunication service.[1] According to

[1] Jose Marino Garcia and Tim Kelly, *The Economics and Policy Implications of Infrastructure Sharing and Mutualisation in Africa*, Background Paper (World Development Report: Digital Dividends), 2016, World Bank Group, available at <https://openknowledge.worldbank.org/handle/10986/23643> ("WDR Background Paper, 2016")

the Nepal Telecommunications Authority, "infrastructure sharing (is) generally translated as having two or more operators coming together to share various parts of their network infrastructure for the purposes of their service provisioning. According to the TRAI's 2006 Consultation Paper, infrastructure sharing refers to "the sharing of mobile towers for provision of wireless service between service providers, sharing existing base station sites, air conditioning, power, backbone, radio links, and other resources to reduce infrastructure duplication and costs."

In a typical telecom market where infrastructure is expected to be shared, most of built infrastructure is owned and built by incumbent service providers over the years. As per the concept of infrastructure sharing, these incumbent services providers are expected to share their telecom services infrastructure with new telecom service providers who desire to enter the particular telecom services market but are unable, at entry, to cough up huge capital investments for building the telecom infrastructure. The basic motive of infrastructure sharing is to reduce the costs of building, operating, and maintaining network infrastructure.[2] In theory, this is expected to encourage the entry of competition into the market.

Inspite of the apparent benefits of infrastructure sharing, the status of infrastructure sharing is not uniform across countries. Instead, a combination of market and regulatory approaches dictate the status of infrastructure sharing between incumbent operators and new entrants. In some countries, infrastructure sharing is not restricted, i.e., is permitted, whereas in other countries, it is absolutely prohibited. Yet again, in certain countries, the telecom regulator may permit sharing of certain type of infrastructure (such as, in passive) while prohibiting sharing of the other type of infrastructure (that is, active). Apart from these, certain countries have gone a step further and required mandatory sharing of infrastructure (either passive or active or both) by incumbent operators with new operators, whereas certain other countries have deferred to market choice in sharing of infrastructure.

[2] *ibid*

The need and importance of infrastructure sharing has been studied and discussed by the telecom regulators of various countries. In fact, in India, the national telecom regulator, the Telecom Regulatory Authority of India (**TRAI**) has floated two Consultation Papers, one in 2006, and the other in 2011, to consider the question of making infrastructure sharing mandatory. Other regulators too, such as Bhutan's and Nepal's, have floated consultation papers on this issue.

At present, in the multilateral context, countries have the regulatory space to shape their policies pertaining to infrastructure sharing in the telecom sector. Apart from the provisions of certain Free Trade Agreements (FTAs), there are no international legal provisions which dictate the regulatory approach that countries should adopt with respect to sharing of telecom infrastructure. However, the topic of infrastructure sharing has assumed greater relevance and importance in the current international trade negotiations climate. There are two important and inter-linked developments which have contributed to this aspect: (1) the increasing demand for negotiating disciplines on e-commerce at the WTO; (2) the conclusion of the Trans Pacific Partnership (TPP), a mega-FTA in October 2015, which contains significant disciplines on the telecom sector. Given the possibility that the provisions on infrastructure sharing contained in the Telecom Chapter of the TPP may be used as a springboard for initiating discussions on e-commerce at the WTO, it becomes important to have a better understanding of the subject.

This paper is divided into seven sections. After introducing the topic in Section 1, Section 2 discusses the type of telecom infrastructure. The two main types, passive and active, are discussed in this section. Given that infrastructure sharing is usually determined by the regulatory framework of a country, Section 3 then discusses the regulatory approach towards infrastructure sharing. Sections 4 and 5, discusses in brief, the advantages and disadvantages of mandatory infrastructure sharing. The main aspect of infrastructure sharing, which is the impact on competition in the sector, is discussed in Section 5. Section 6 discusses the FTA provisions on infrastructure sharing including TPP. Section 7 highlights the global approaches towards infrastructure sharing, with the

Indian approach being at the heart of this section. Section 8 contains the conclusions with some recommendation for countries in this regard.

II. TYPES OF TELECOM INFRASTRUCTURE

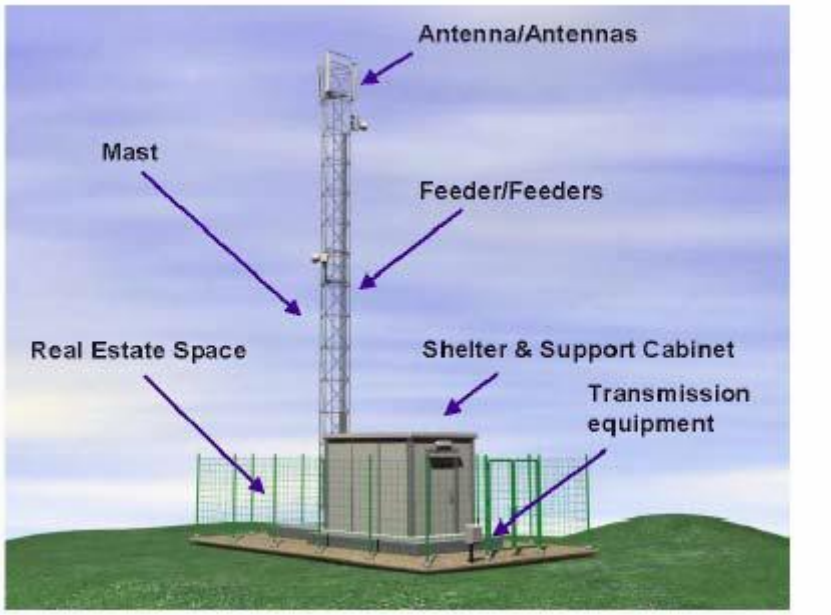
Before discussing the types of infrastructure that can be shared, it is imperative to understand the different infrastructure involved. For the purposes of this paper, the TRAI's detailing of telecom infrastructure is relied upon extensively. This is not discussed here but is captured in the Annex to this paper.

For the purposes of infrastructure sharing, the telecom infrastructure that is used by a telecom service provider can be classified into two types: passive and active. They are differentiated by the electronic/non-electronic nature of the components.

Passive Infrastructure refers to the non-electronic infrastructure such as tower, sites, air-conditioning equipments, diesel electric generator, battery, electrical supply, technical shelters, equipment rooms, premises, security systems, billing systems, poles, ducts, trays, power system, etc

According to the TRAI's 2006 Consultation Paper: "In passive site sharing, a common site is shared between operators to host the Base Transceiver Station (BTS), share space in shelter or transmission room etc. What is not shared is the antennae and separate feeder cables which each operator has of its own. Given the nature of passive site sharing, exit from such an arrangement is easy and chances of dispute between operators are minimal. For these reasons, this is the simplest version of the site sharing." Passive infrastructure sharing is also highly preferred by telecom companies world over as it accounts for the larger chunk of rollout costs.

ILLUSTRATION OF BASIC PASSIVE INFRASTRUCTURE ELEMENTS



Source: TRAI Consultation Paper, 2006

Active Infrastructure refers to the active electronic infrastructure/ elements such as base tower station, microwave radio equipment, switches, antennas, spectrum, signal transceivers, antennae. Active infrastructure is basically the infrastructure necessary for the reception, processing and/or transmission of telecommunication signals.[3]

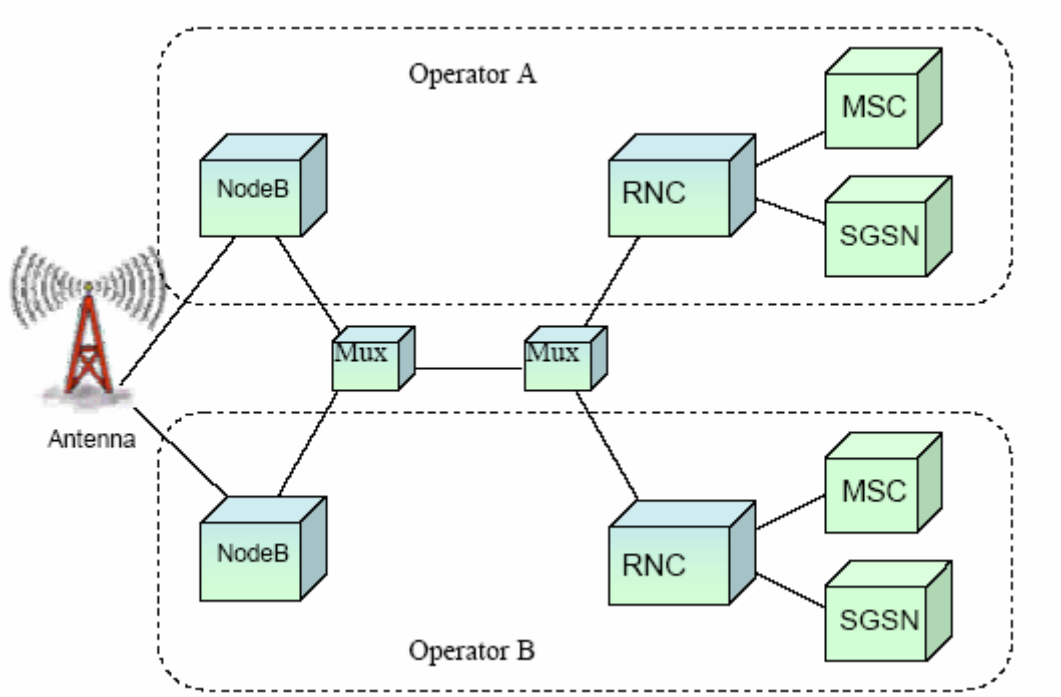
Within the category of active infrastructure sharing, there are different sub-categories of active infrastructure sharing such as Radio Access Network (RAN) sharing; spectrum sharing; and virtual network operations. These are discussed below:

RAN Sharing

This is the simplest type of active infrastructure sharing. Here antenna, feeder cable and transmission equipment are shared.

[3] *ibid*

ILLUSTRATION OF RAN SHARING



Source: TRAI Consultation Paper, 2006

Spectrum Sharing:

This is the most complex model. In this model, the parties who are already sharing infrastructure may agree to share the allocated spectrum to increase the economy of operation. Very close association/coordination between the operators is required for such a model to be successful. (TRAI Consultation Paper, 2006)

Mobile Virtual Network Operator:

A mobile virtual network operator (MVNO) is an operator who usually does not have its own infrastructure. It merely owns a subscriber database, buys minutes in bulk from a mobile network operator (MNO) who has the necessary infrastructure (including spectrum), and uses its own brand to sell to subscribers. (TRAI Consultation Paper, 2006)

The link between active and passive infrastructure is that passive infrastructure is necessary for the functioning of the active infrastructure.[4] Unlike passive infrastructure, sharing of active infrastructure is quite complex, and a thorough understanding between the various operators is required in order to implement such arrangements. The TRAI 2006 Consultation Paper notes that exiting from such arrangements becomes difficult "as separation of networks between the operators may not be easy".

In comparison to sharing of passive infrastructure, sharing of active infrastructure has not been that popular world over. There are various reasons for this, the most important being the increased inter-dependence between the service providers, which may reduce their competitive edge.[5] This could also lead to situation where competitors end up colluding on prices or service offering and lead to elimination of consumer choice.[6] When it comes to active infrastructure sharing, conditions of competition in the market are the main consideration. Regulators may disallow sharing of active infrastructure for the reason that if operators are permitted to pool or share the infrastructure then the group can get added advantage in deployment of services. In such a scenario, the level playing field is disturbed and conditions of competition in the sector are affected.[7]

III. REGULATORY APPROACHES TO INFRASTRUCTURE SHARING

Regulatory decisions have to be informed by policy objectives. In considering making infrastructure sharing mandatory, regulators must identify the policy objective that is intended to be achieved by such decision. Policy objectives can include extending coverage, promoting competition, environmental concerns, etc. Depending on what the regulatory objective is, the regulator determines the degree or mode of sharing. If, for example, the objective is to reduce aesthetic impact on account of numerous towers, then sharing could be limited to certain types of mobile towers. If the regulatory

[4] *ibid*

[5] Consultation Paper on ICT Infrastructure Sharing, 2009, Bhutan InfoComm and Media Authority

[6] *ibid*

[7] *Broadband Regulation and Policy in Asia-Pacific Region: Facilitating Faster Broadband Deployment*, White Paper, 2016, International Telecommunications Union ("ITU White Paper,2016")

objective is to increase coverage, then the regulatory approach would be to share a wider spectrum of infrastructure.[8]

Before delving into the regulatory approaches towards infrastructure sharing, it would be pertinent to be informed by the jurisprudential basis of infrastructure sharing – the doctrine of essential facilities which is the legal basis of infrastructure sharing and serves as the justification for mandating infrastructure sharing.

A. Doctrine of Essential Facilities

The notion of sharing infrastructure is not unique to the telecommunication sector but usually cuts across sectors which are critical for a given economy, such as railways, roadways, etc. The concept of sharing of infrastructure has its origins in the "doctrine of essential facilities" which evolved in the United States in the 20th century. This doctrine was shaped by the judiciary in the 1912 decision in *United States vs. Terminal Railroad Association of St. Louis*, which was a dispute involving certain railroad companies which owned both the railroad terminal as well as the only bridge link to the terminal.

For a new firm to enter the market, it would necessarily require access to both this terminal and the bridge linked to this terminal. However, the incumbent operators denied access to this infrastructure on the ground that it would give way to competition; they argued that the new entrant ought to build its own infrastructure. The court noted that this was a case of monopolization of infrastructure and the infrastructure under question constituted "essential facilities". The incumbents were directed to open up access to the new entrants.[9]

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[8] Infrastructure Sharing, Notice of Proposed Rule-Making, 2017, Office of Utilities Regulation (Jamaica)

[9] Mahendra Reddy, *"Commons" in the Telecoms Sector: Competition Policy Challenges in a Small Economy*, Working Paper No. 03/13, 2013, Fiji National University, available at < www.fnu.ac.fj/new/images/CBHTS/Working_Paper/2013/wps_03_13_commons.pdf>

For the application of the doctrine of essential facilities, the following aspects must be considered:

i. the facility should be "essential";
ii. it would be practically infeasible for the competitor to duplicate the essential facility;
iii. the denial of access and use of the facility to a competitor by the monopolist is primarily to maintain status quo and thus would contribute to deadweight loss;
iv. providing access to the competitor will result in no direct loss to incumbent except possible loss of market share; and,
v. access to the essential facility is in public interest.[10]

While the doctrine seems to justify mandatory infrastructure sharing, it is important to note that the above doctrine was developed in the context of the state of the United States economy at the time of the decision. Unlike most other world economies in the early 20th century, the United States economy had a huge market size for roadways and thus room for multiple players to make individual investments into infrastructure in the sector.[11] The same conditions wouldn't be applicable in case of developing economies whose markets are yet to attain maturity.[12]

Besides the above aspects, it is also important to note that essential facilities doctrine does not imply that any infrastructure constructed by an enterprise would be subject to mandatory sharing with other operators. It is only after meeting certain conditions (as listed above) that a particular facility would be accessible by other operators. Otherwise, it may discourage prospective investments into infrastructure.[13]

[10] *ibid*

[11] *ibid*

[12] *ibid*

[13] *ibid*

B. Types of Regulatory Approach

There are two main regulatory approaches to infrastructure sharing: optional and mandatory. The International Telecommunications Union (**ITU**) has described these approaches. According to the ITU:[14]

> **Optional sharing**: In many cases operators will voluntarily opt to share infrastructure in order to reduce costs. Self-regulatory bodies such as operator associations may encourage sharing through the establishment of uniform conditions for site sharing, as well as communicating with government authorities. The government may provide guidance on the types of sharing allowed, and may encourage sharing by allowing access to state-owned facilities, as well as providing financial incentives for sharing such as tax concessions.
>
> **Mandatory sharing**: Operators are required to share sites or facilities on request. This should be implemented with clear policy objectives in mind, for example to achieve certain geographic or population coverage targets or addressing competition issues. The authority needs to develop criteria for determining those facilities subject to sharing, the setting of tariffs and other conditions, access to technical site information and conditions for the negotiation of sharing agreements between operators (e.g. time limits for sharing agreements).

C. Market Maturity and Regulatory Approach

The spread of infrastructure sharing is usually determined both by the commercial and regulatory environment of the concerned market.[15] The regulatory approach adopted by most countries is to first allow sharing of passive infrastructure. The next step is then to allow sharing of active infrastructure. After permitting the sharing of both types of infrastructure, the regulator may then chose to make sharing of this infrastructure mandatory, first, in the passive category. Only after the market has reached a certain

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[14] ITU White Paper, 2016, *supra* note 7

[15] *Consultation Paper on Infrastructure Sharing*, Consultation Paper No.17, 2006, Telecom Regulatory Authority of India ("TRAI Consultation Paper, 2006")

level of maturity does the regulator consider making the sharing of active infrastructure also mandatory.

As far as regulatory considerations are concerned, the level of maturity of the market is a key determinant of the stage of infrastructure sharing. It would be pertinent to note that sharing of passive infrastructure in many countries was not permitted by the regulator at the initial stage of liberalization in some countries with the putative objective of boosting infrastructure development in the country.[16] For instance, in Europe, early attempts to share networks were restricted by regulators on competition grounds.[17] As the market matures, the regulatory approach has been to permit sharing of passive infrastructure subject to conditions imposed by the regulator with little or no intervention from the regulator.

According to a research report by the GSM Association (an industry association of mobile service providers), the strategic rationale for engaging in infrastructure sharing differs between new entrant and incumbent operators, and in mature and developing markets. Their analysis reveals the following:[18]

- MNOs in mature markets: Infrastructure sharing may reduce operating costs and provide additional capacity in congested areas where space for sites and towers is limited. It may also provide an additional source of revenue but may be limited by differing strategic objectives.
- MNOs in developing markets: Infrastructure sharing may expand coverage into previously un-served geographic areas. This is facilitated via national roaming or by reducing subscriber acquisition costs (SACs) by sharing sites and masts or the radio access network (RAN). Infrastructure sharing is also increasingly being used in congested urban centres where new site acquisition is difficult. However,

[16] *ibid*

[17] *Wireless Market Structures and Network Sharing*, Working Party on Communication Infrastructures and Services Policy, Organization for Economic Cooperation and Development, DSTI/ICCP/CISP(2014)2/FINAL, 2015 ("OECD, 2015")

[18] *Mobile Infrastructure Sharing*, Report, 2012, GSM Association ("GSM Association, 2012")

it may be less likely to occur in markets where coverage is used as a service differentiator and, if mandated, could potentially reduce investment incentives for continued network roll-out.

IV. BENEFITS OF INFRASTRUCTURE SHARING

1. Reduced Expenditure

As mentioned in the introduction, one of the entry barriers into the telecom sector is the high cost of capital that will have to be spent on building the requisite infrastructure (capex). Given the rise in property and construction costs in recent times, capex costs are a major determinant of infrastructure construction.[19] Infrastructure sharing thus eliminates the need for high capex by an entrant, facilitating competition in the market. Apart from the capex, the particular entity will also be able to significantly save on expenditure towards operations such as on energy, management, and maintenance of the particular infrastructure (opex). These benefits will enable service providers to focus on their own core areas of service production, and sales.[20] It will also enable service providers to expend resources on network expansion and distribution[21], and avoid infrastructure duplication.

2. Benefits to Consumers

An accompaniment benefit of saved costs resulting from infrastructure sharing is that telecom service providers can then pass on the benefits of reduced costs to their customers vide lower tariffs.

3. Aesthetic, Health and Environmental Concerns

One of the biggest grievances that have been raised against telecom infrastructure expansion (specifically towers) is that they end up distorting the aesthetics of an area's the skyline. A related concern against the increasing number of towers is that these towers pose a health hazard to residents of the particular area due to the radiation

[19] *Consultation Paper on Infrastructure Sharing*, 2010, Nepal Telecommunications Authority

[20] *ibid*

[21] *ibid*

emanating from these towers, though the jury is still out on this issue. One of the arguments in favour of infrastructure sharing (specifically towers) is reducing the number of towers that need to be installed, when instead one tower can be used by multiple operators. Another benefit accruing on account of infrastructure sharing is that a reduced number of towers means reduced energy requirements and thereby savings on carbon emissions.

4. Financial Benefits to Incumbent Operator

An obvious benefit for incumbent operators is that the sharing of infrastructure is an additional source of revenue that can accrue on account of license fees. Telecom companies, which had invested heavily in setting up infrastructure such as towers to cope with the increasing subscriber base, have realised that it there are benefits to sharing the infrastructure with other players.[22] As a result, some of these companies have hived off their infrastructure segments into a separate business. For example, in 2007, Bharti Airtel hived off its tower business into Bharti Infratel, which currently provides infrastructure leasing and services to interested telecom service providers.

5. Faster Rollout of New Technology

A benefit associated with the benefit arising on account of savings of investment is the faster rollout of new technology. Infrastructure sharing is expected to lead to faster rollout of new technology as the saving of investments on account of infrastructure sharing can instead be used towards acquiring new sites and increasing resources for rollout instead.[23] However, while acknowledging this particular benefit of infrastructure sharing, the OECD cautions that "these benefits are not certain and depend on local market conditions, including sufficient facilities based competition among MNOs".[24]

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[22] Vrishti Beniwal, *The Active Role of Passive Telecom Infrastructure*, 14 August 2007, Financial Express, <http://www.financialexpress.com/archive/the-active-role-of-passive-telecom-infrastructure/210195/>

[23] TRAI Consultation Paper, 2006, *supra* note 15

[24] *ibid*

V. ARGUMENTS AGAINST INFRASTRUCTURE SHARING

1. Technical Limitations

Increased load sharing

For tower sharing, the TRAI had identified the load bearing capacity of an antenna as one of the issues which need specific consideration, apart from other issues such as azimuth angle of different operator, tilt and height of the antenna.[25] According to the TRAI, "while new infrastructure can be built taking into consideration the ultimate load bearing capacity required, the existing towers may not be designed to cater to more load resulting in unsuitability of such towers for sharing of infrastructure. In case of roof top mounted antennas, load bearing capacity of the building/foundation also becomes very important and may limit the possibility of sharing. Microwave antennae required for backhaul are also mounted on the same towers increasing the load."[26]

Azimuth Orientation

A crucial technical concern identified by Pakistan's telecom regulator pertains to the azimuth orientation of the antennae as decided by the service provider. According to the Pakistan Telecommunication Authority, "If service providers (especially GSM) sharing the infrastructure, have same azimuth orientation requirement, then it will pose technical limitation. Height of the antenna mounting and tilt of the antenna are also very important parameters. Though individually they may not be very critical, but where service providers' azimuth angle requirements are same, they become very critical and may result in serious interference if not resolved properly".

2. Whither Consumer Benefit?

One of the misgivings associated with infrastructure sharing pertains to the concern as to whether the recipient service provider passes the benefit of savings to the consumers. While there are price benefits to consumers, at the same time it is important to acertain "whether competition does result in these savings being passed on to consumers will

[25] *Consultation Paper on Issues Related To Telecommunications Infrastructure Policy*, Consultation Paper No.1, 2011, Telecom Regulatory Authority of India

[26] *ibid*

depend upon the state of competition between network providers and the extent to which the sharing arrangements change these competitive conditions".[27] This is a concern expressed even by regulators. According to Nepal's Telecom Authority: "Likelihood of reduction in tariffs as a result of infrastructure sharing may be too little. Such advantages are generally retained by service providers unless there is tough competition. The monitoring and regulating such costs becomes almost impossible since the sharing pattern will not be uniform and between service providers."

3. Potential to Discourage Investment in New Service Areas

Though sharing of infrastructure could save costs for new entrants, mandatory sharing presents one disadvantage in this context. Where an operator has recently established the requisite infrastructure in a new service area, forcing this incumbent to share the infrastructure even before it becomes profitable in this new service area would be harmful for this particular entity.[28] This may discourage infrastructure construction in new areas. Indeed, one of the main arguments against infrastructure sharing is that the incumbent operator will no longer have full control over network strategy and investment. The incumbent will no longer be able to dictate the direction that its network will take, its rollout strategies and vendor choices. Network sharing involves ceding some of this control.[29] This may discourage infrastructure construction in new areas. Against this background, optional sharing seems to be a more natural model.[30]

4. Impact on Competition

When formulating policies on infrastructure sharing, one of the major challenges for the telecom regulator is: how to handle the relations between the infrastructure sharing and

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[27] TRAI Consultation Paper, 2006, *supra* note 15

[28] Submissions by Econet, List of Consultation Questions and Responses on Infrastructure Sharing Framework, Postal and Telecommunications Regulatory Authority of Zimbabwe

[29] Malcolm Webb, *Accelerating Broadband Deployment Through Network Sharing and Coinvestment*, GSR Discussion Paper, 2015, International Telecommunications Union

[30] Isabel Ornelas, *Legal Framework for Infrastructure Sharing in Ghana* (PowerPoint Presentation], 2016, Vieira de Almeida & Associados

market competition.[31] The conventional theory behind the policy advocating for sharing of infrastructure is that it can increase competition in the market by facilitating the entry of new operators. By helping save investments (capex and opex) that would otherwise have to be made into the necessary infrastructure for providing service, new operators can instead utilize the existing infrastructure built by incumbent operators. The same school of thought argues that the cost savings on account of infrastructure sharing can be passed on to consumers who may benefit in terms of cheaper tariffs. However, much of the literature argues that while sharing of infrastructure may increase competition in the short-run, it may harm competition in the long-run. While mandating sharing of an incumbent's facilities may increase competition in the short term, it may decrease incentives for network rollout and the likelihood of two or more viable competing networks in the long term.[32]

In 2016, the World Bank Group published a background paper, to its World Development Report, on the economics and policy implications of infrastructure sharing. According to the literature review on mandatory sharing of infrastructure that formed part of the background paper:

> "Existing literature suggests that forcing an incumbent to share fixed access network infrastructure may delay facility based competition and may also decrease investments in service quality (Woroch, 2004; Kotakorpi, 2006; Bourreau and Doan, 200; Hori and Mizuno, 2009). There is also evidence that mandatory sharing can reduce innovation because the incumbent is incentivized to keep leasing prices low to prevent the entrant from adopting innovative technologies (Bourreau and Doan, 2005)."
>
> "Other studies, however, suggest that mandatory sharing does not stifle all investment. Vareda (2007) shows that although mandatory sharing does reduce

[31] *Survey Report on Infrastructure Sharing and Broadband Development in APEC Region*, Workshop on Infrastructure Sharing to Foster Broadband Access, APEC Telecommunications and Information Working Group, Asia Pacific Economic Cooperation

[32] GSM Association, 2012; *supra* note 18

quality upgrades, it actually increases the incentive to invest in cost reduction strategies in service provision."

"Most of the existing empirical analysis, which focuses on Europe and the US, supports the theoretical results. Wallsten (2006) and Zackaras et al (2005) show that a regulatory measure that mandates infrastructure sharing may promote competition in the short-run while reducing investment incentives in the long-run. Hausman (1998) argues that incorporating the sunk cost character of network deployments in the regulated price may be a solution to increase an entrant's investment incentive. Friederiszick et al (2008) find that fixed network infrastructure sharing discourages entrants' investments in infrastructure but has no effect on the investment behavior of incumbents. They do not find any significant impact, however, of mandatory sharing in the mobile network. They also concluded that higher incumbent investment increases the regulator´s incentive to mandate regulated access."

Even the OECD has expressed caution in mandating infrastructure sharing. While the OECD sees merit in mandating infrastructure sharing in brownfield investments, it expressed skepticism on whether mandated network sharing would be productive in encouraging greenfields investment.[33] The OECD further states that:

"*In the case of network sharing where there is significant competition among MNOs and new facilities entry is unlikely, the benefits of these savings are more likely to be passed on to consumers. However, regulators will need to remain vigilant when overseeing network sharing agreements. Under some conditions network sharing agreements may lead to a decrease in competition similar to a potential diminution of competition experienced with a merger*."[34]

To illustrate the issue of mandatory infrastructure sharing on competition, it would be relevant to discuss Pakistan's case, where in 2005, three new operators entered the

[33] OECD, 2015, *supra* note 17

[34] *ibid*

telecom market – Telenor, Ufone and later Zong. These new entrants pitched support for mandatory infrastructure sharing from the incumbent operators. However, the dominant operators were opposed to this, arguing that their towers served as a competition differentiator.[35] It was not until 2011 that the incumbent operators agreed to the idea of sharing infrastructure[36]. This also was done on a commercial and optional basis rather than on a mandatory regulatory approach.

On a general note, the implications of mandatory infrastructure sharing for the competitive health of the telecom sector are extremely important. Under the right conditions, the telecom sector of any country can be highly competitive. While this may have benefits in the short run such as consumer choice and lower tariffs, if the growth of incumbent operators is muzzled by extreme competition, this can force certain operators to shut shop. This can be disastrous for the sector in the medium to long run. It is therefore important to have an optimum number of operators that are able to attain viability while delivering quality and affordable services to the customers.

In a typical telecom market, having around five operators for providing service would be optimal.[37] According to HSBC Global Research, "a three-player market should generate the optimum balance of competition and investment. In-market consolidation would likely help sector-level Average Revenue Per User and Return on Equity and encourage infrastructure-based competition".[38] Having optimum competition would lead to

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[35] *Spotlights on the Asia Tower Industry*, TowerXchange Asia Dossier, 2016, Tower XChange

[36] *ibid*

[37] *Indian Telcos Market to Yield Five Major Players Creating 'Enough Competition': Telecom Secretary*, 26 Feb 2017, The Economic Times, available at <http://economictimes.indiatimes.com/news/company/corporate-trends/indian-telcos-market-to-yield-five-major-players-creating-enough-competition-telecom-secretary/articleshow/57354485.cms>

[38] *Consolidation: Good for Telecom Industry, Better Service for Customers*, 30 Jan 2017, The Hindu Business Line, available at <http://www.thehindubusinessline.com/info-tech/idea-vodafone-merger-and-consolidation-plan/article9510046.ece>

benefits such as "stable long-term realisations and significant improvement in capital efficiency".[39]

VI. FTA PROVISIONS ON INFRASTRUCTURE SHARING

A. TPP Provisions On Infrastructure Sharing

In October 2015, twelve countries across the Pacific came together to conclude one of the biggest free trade agreements, the Trans Pacific Partnership. Covering over 40% of the world's GDP, its Members were expected to draw competitive advantages on account of enhanced market access. However, the United States' withdrawal from the TPP means that it is unlikely to enter into force. Nonetheless, given that the norms contained in the TPP have a huge potential to define the agenda of future negotiations in the world trading system, they become relevance and important for understanding some of the emerging issues of liberalization in the services sector.

In many ways, the TPP's Telecommunications Chapter substantially goes beyond the GATS Annex on Telecommunications. Negotiations on the Telecom Annex were concluded after the WTO came into being. The purpose of the Annex, as evidenced from the nature of many of its provisions is to *facilitate* market access for suppliers of services dependent on telecom services for supplying their services in the particular market. Many of the Annex's provisions, especially pertaining to access and use of telecommunication services have been repeated in FTA chapters, including the TPP. However, in many aspects, the telecom chapters of many of these FTAs, including the TPP, are more comprehensive than the provisions contained in the Telecom Annex as they contain provisions related to, inter-alia, resale, international roaming, co-location, and unbundling of network elements.

For the purposes of this paper, it would be relevant to understand the TPP's provisions pertaining to infrastructure sharing which are contained in the Telecommunications

[39] *ibid*

Chapter of the TPP. The scope of the Telecommunications Chapter is defined in sub-paragraph 1, paragraph 2, of Article 13 to apply to:

a) any measure relating to access to and use of public telecommunications services;
b) any measure relating to obligations regarding suppliers of public telecommunications services; and
c) any other measure relating to telecommunications services.

The Telecommunications Chapter contains normative obligations on sharing of both passive and active infrastructure. The obligations regarding sharing of passive infrastructure are contained in Article 13.14. According to paragraph 1 of this Article, each TPP Member is required to ensure that a major telecom service provider (**TSP**) in its territory provides access to passive infrastructure such as poles, ducts, etc which are owned or controlled by such TSP to the TSP of another TPP Member. A similar provision is contained in Article 13.15 pertaining to sharing of submarine cable landing stations, which, as mentioned earlier, constitutes part of the infrastructure necessary for long distance telecommunications.

According to Article 13.15, each TPP Party is required to ensure that any major supplier who controls international submarine cable landing stations in that Party's territory provides access to those SCLS landing stations to the public telecommunications suppliers of another Party. Further, this access has to be in accordance with the Telecom Chapter's provisions on interconnection, provisioning and pricing of leased circuit services, and co-location.

The main objective of the TPP's provisions on telecom is market access. This is evident from the USTR Summary of the Telecom Chapter of the TPP which states:

> **Reasonable access to networks of other suppliers**
>
> In a competitive environment, telecommunications depends on the ability of suppliers to access each other's facilities and services. ***Operators need to interconnect with each other, which often requires access to a***

competitors' physical infrastructure where the two networks can meet. But an incumbent operator often has an incentive not to cooperate, and instead to hinder a competitor. TPP's Telecommunications chapter accordingly includes provisions intended to ensure that companies offer such access on a reasonable and timely basis.

Entry to Markets

Even when a market is nominally open to investment in the telecommunications sector, new entrants often face enormous challenges in getting a foothold. ***In addition to obtaining a license, a new entrant typically has to rely, in part, on existing operators to reach customers. In such circumstances the opportunities to thwart a competitor are legion. Some of these obstacles are physical—access to buildings, rights of ways, and particular equipment necessary to lay down lines and physically interconnect one network with another.*** Other obstacles are financial or operational, including lack of access to leased lines and interconnection arrangements.

Similar statements have been made in Australia's Summary of the Telecommunications Chapter of the TPP Agreement:

> Telecommunications is a significant means for services delivery and a critical enabler of international trade, including for SMEs. The obligations in this Chapter apply to government measures affecting trade in telecommunications services. It seeks to ensure that Australian telecommunications companies are treated equally in TPP markets. **It contains a comprehensive suite of rules to ensure incumbent telecommunication companies with a dominant market position provide foreign telecommunications suppliers with access to services and key infrastructure on reasonable terms and conditions.** TPP Parties have agreed to enhanced transparency in telecommunications regulation. These rules will provide existing suppliers with

greater certainty about their operating conditions and space for new players to enter the market.

Treatment of foreign telecommunication suppliers

The TPP establishes a set of rules for suppliers of public telecommunications services who have the ability to influence the market as a result of their control over essential facilities, such as poles or wires, or have a dominant position in the market. These are known as 'major suppliers'. This includes a prohibition on engaging in anti-competitive practices.

A major supplier is required to offer telecommunications services to foreign suppliers on reasonable and non-discriminatory conditions and at cost-oriented rates. **These requirements apply to: services which a TPP Party offers for resale; network elements which a TPP Party offers on an unbundled basis; leased circuit services; co-location of equipment; access to essential facilities and infrastructure, including but not limited to poles, ducts, conduits and rights-of-way; and international submarine cable landing stations.**

From the above paragraphs, it is clear that the purpose of the TPP's Telecommunications Chapter is to facilitate or enable market access for its telecom players in new markets. Given this is the objective, it would be relevant to identify who might be intended beneficiaries if this norm was multilateralized. A list of corporate entities who would benefit from such norms can be ascertained from the global rankings of telecom majors and the countries they are based out of. For the purposes of this paper, the rankings of published by Forbes for the year 2016 are considered. The list of these rankings is given in Annex 2 of this paper. According to this list, 8 of the leading telecom majors are located in the United States followed by 4 in China, 4 in the European Union, 3 in Japan and Korea, and 2 in India. Except India, all these countries are pushing for negotiating disciplines on ecommerce at the WTO.

B. Other FTAs

The previous section highlighted the TPP's provisions on infrastructure sharing as contained in its telecommunications chapter. However, it is important to note that the TPP's provisions are not novel and legal texts with similar provisions can be traced to certain FTAs. Some of the examples of FTAs which contain binding provisions on mandatory sharing of passive infrastructure include the KORUS FTA; Singapore – Australia FTA; US-Singapore FTA, etc.

Even in the case of developing countries such as India, some of its FTAs have provisions pertaining to sharing of passive infrastructure such as its FTAs with Singapore and the Republic of Korea. However, provisions in most of these FTAs are in the nature of best endeavour clauses and do not bind the parties. Even in the one particular FTA, with Malaysia, where there are binding commitments on mandatory sharing of passive infrastructure, India has not implemented them at the domestic level.

Therefore, at the multilateral level, the provisions on infrastructure sharing, including on a mandatory basis, even for developing countries, is not novel. However, what elevates the importance of the TPP's provisions is the hype and clamour that preceded the agreement before the United States' withdrawal from it early this year, and the high possibility of it being contemplated as a gold standard to be emulated at the WTO by certain demandeurs.

VII. COUNTRY APPROACH TO MANDATORY INFRASTRUCTURE SHARING

A. India

1. Liberalization of infrastructure sharing norms

Hitherto a state monopoly, the Indian telecom sector was opened up for competition in the year 1994 with the government's announcement of the National Telecom Policy in 1994.[40] The regime for infrastructure sharing was given a boost when the Department of

[40] TRAI Consultation Paper, 2006; *supra* note 15

Telecom (DoT) permitted infrastructure sharing through special vehicles called Infrastructure Provider companies in the year 2000.[41] Government support for encouraging infrastructure sharing was followed by initiatives such as Project MOST and creation of a Universal Services Obligation Fund.

With the objective of ensuring optimum utilization of the available resources and to bring down the cost of providing services, the DoT issued 'Guidelines on Infrastructure sharing among the Service Providers and Infrastructure Providers'. As per these guidelines, service providers were permitted to share the active infrastructures limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only. However, it was only in 2016, that the licensing conditions of service providers were amended to permit sharing of the aforesaid active infrastructure components.

2. 2006 Consultation Paper

In 2006, in recognition of the need to roll out telecom services at faster pace and to ensure higher penetration of telecom services in rural areas, the Telecom Regulatory Authority of India (**TRAI**) had floated a Consultation Paper on "**Infrastructure Sharing**". One of the key considerations for the TRAI was whether or not to make sharing of passive infrastructure mandatory. This question was again considered by the TRAI in its 2011 Consultation Paper on "**Issues related to Telecommunications Infrastructure Policy**". In both these papers, the TRAI had discussed the various aspects of telecom infrastructure, including infrastructure sharing, at length and breadth. Both these papers are heavily referred upon and reproduced for a technical understanding of the type of telecom infrastructure that is used in the industry.

In its 2006 Consultation Paper, the TRAI had solicited views from stakeholders on the following question pertaining to sharing of passive infrastructure: i**s there a need to mandate or promote passive infrastructure sharing through policy**

[41] This was however limited to passive infrastructure only till 2009. From 2009, these companies were permitted to share active infrastructure components.

intervention? Views to this question, among others, were provided by various industry stakeholders including associations and individual companies.

The majority of the associations and the operators were of the opinion that sharing of passive infrastructure should not be mandated, except for the following: where critical locations are involved; in case of rural/underdeveloped areas; where it is technically, logistically, economically, or environmentally difficult to do so. Most of the respondents were of the opinion that the regulator/government should develop regulatory policy to incentivize or promote sharing of passive infrastructure rather than take a mandatory approach in respect of the same. One player – Reliance Communications expressed the need for a limited approach to mandatory sharing: sharing should be mandatory for atleast three or more players.

The emphasis of the 2006 Consultation Paper was on[42]:

- Developing mutual cooperation among service providers
- Pursuing Mobile Operators to adopt infrastructure sharing and avoid mandating
- Facilitate active infrastructure sharing also
- Provide incentive to develop towers and infrastructure to roll out mobile services in rural and far flung areas

On the basis of this Consultation Paper and the views received from the various stakeholders, the TRAI forwarded its recommendations to the Department of Telecommunications. Some of the main recommendations are:

- Encourage passive infrastructure sharing among service providers on mutual agreement basis.
- Emphasis was laid to bring in transparency, reasonability and well defined time frame to facilitate infrastructure sharing.
- Well defined mechanism to facilitate infrastructure sharing in critical areas (where possibility to erect towers is limited).

[42] S.K.Gupta [TRAI], *Infrastructure Sharing: An Indian Experience* [PowerPoint Presentation], 2008, available at <https://www.itu.int/net/wsis/c2/docs/2008-May-19/mdocs/C6-session3-Gupta.pdf >

- Facilitate active infrastructure sharing by modifying restrictive clauses in the existing license.
- Financial support for creation of infrastructure in rural and far flung areas.
- Encourage use of non conventional energy sources in areas where electric power supply is erratic

Telecom policy has been to note mandate sharing of infrastructure rather to encourage it among operators. The result has been quite positive. Many incumbent operators have hived off their tower segments into separate telecom infrastructure companies. In one case, a consortium of telecom companies came together to form a joint venture in infrastructure sharing. The TRAI itself notes that "sharing of telecom towers is now being favored by telecom operators in a big way".[43]

3. 2011 Consultation Paper

In its 2011 Consultation Paper, the TRAI had again solicited views on the same question. The Tower and Infrastructure Providers Association (TAIPA) was of the opinion that sharing of mobile towers should be decided by market forces, rather than mandated by the regulator. It added that infrastructure sharing instead of being mandated, should be encouraged by the government through key policy interventions. The Cellular Operators Association of India (COAI) similarly was against a mandatory approach and stated that it should be left to operators' discretion as each operator would have its own requirement/strategy.

Incumbent operators such as Idea Cellular and Reliance Communications Pvt. Ltd, also while arguing against mandatory sharing, were of the view that the already existing competitive environment meant there was adequate incentive for operators to share towers, and the market forces were already taking this into account. Reliance Communications further stated: "Considering environmental and visual benefits of tower sharing, the Government should also encourage tower sharing by providing

[43] *ibid*

certain incentives like availability of utility power connections on priority and concessional basis. **Infrastructure sharing may only be mandated in critical locations** such as cantonment areas, government office buildings, where installation of cell sites by individual operators is either difficult or is not permissible due to lack of policy/ security / aesthetic concerns." (emphasis original)

There were some parties who expressed a contrarian view. According to a private consultancy firm, Dua Consulting was of the view that the regulator must ensure conditions conducive to ensure infrastructure sharing as it would help in lowering stress on service provider's resources to ramp-up infrastructure as well as lower usage cost for end-consumers. Dua Consulting even argued that sharing should be made compulsory by the regulator.

The new entrant Uninor (subsequently Telenor), a joint venture between an Indian company and a Norwegian telecom major wanted infrastructure sharing to be made mandatory, arguing that it would lead to more efficient use of resources and lower overall costs to the industry, society and environment while at the same time enabling a faster rollout of coverage and a competitive market for the customer. The Internet Service Providers Association of India (ISPAI) and the Telecom Equipment Manufacturers Association of India (TEMA) were of the opinion that the sharing of mobile towers should be mandated as it would help the new service providers quickly roll out services and ensure optimal utilization of existing infrastructure. This would also remove impediments in the adoption of new technologies.

4. Current Regulatory Position

Under the Indian telecom regulatory framework, the sharing of passive infrastructure has been permitted; it is not mandatory except in the case of SCLS discussed below. As

far as active infrastructure is concerned, in the year 2016, the Department of Telecommunications (DoT) announced a slew of infrastructure sharing measures:[44]

i. In February 2016, the DoT amended the licensing conditions to permit active infrastructure sharing as discussed earlier.
ii. In April 2016, the DoT permitted the sharing and trading of spectrum.
iii. From May 2016, the operation of mobile virtual network operations has been permitted.

5. Sharing of Submarine Cable Landing Station

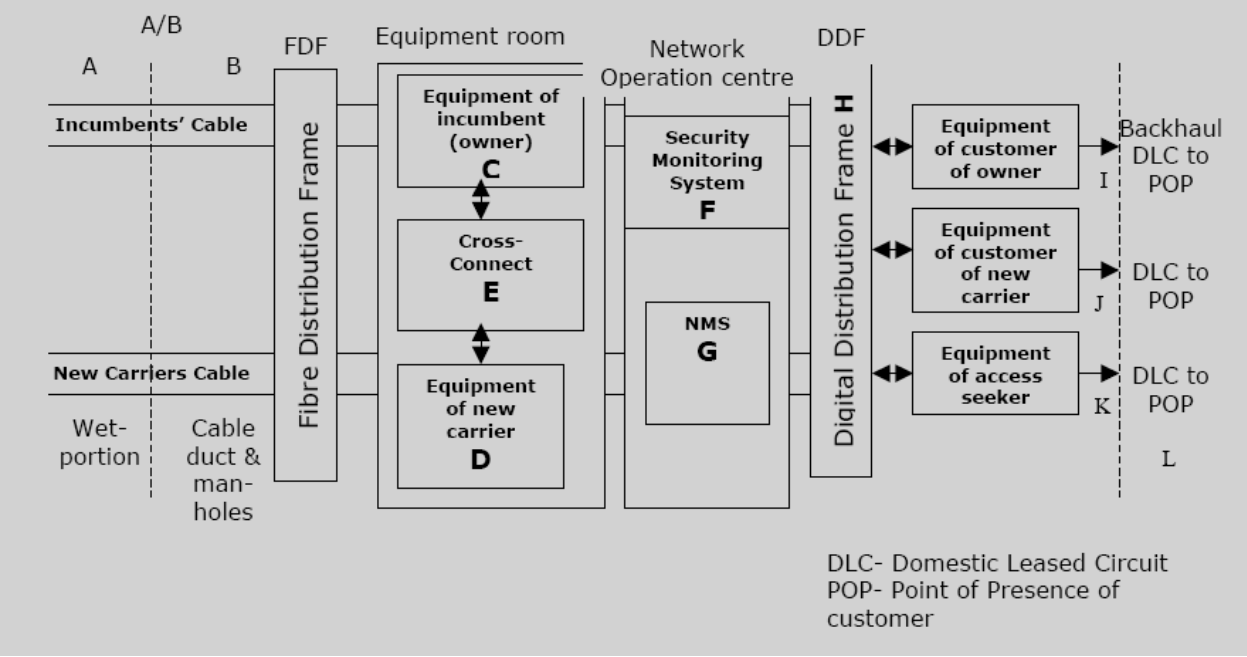
In contrast to optional sharing of active and passive infrastructure, the regulatory approach in India towards sharing of submarine cable landing station (**SCLS**) is totally different. Before discussing the regulatory approach to cable landing stations it would be pertinent to discuss about CLS in brief.

In case of transnational telecommunication services, the existence of vast oceans and seas between the lands of countries and continents necessitates the use of submarine cables between operators. These submarine cables are located at landing sites, in different territories, called submarine cable landing stations (**SCLS**). The TRAI describes CLS as: "the point at which international submarine cables come onshore and terminate. Generally, these are buildings, which contain the onshore end of the submarine fiber optic cable, house the necessary equipment to interconnect and pass traffic to and from the submarine cable, and are the point where the submarine cable capacity is connected to the domestic backhaul circuit."[45]

[44] Annual Report (2016-2017), Department of Telecommunications, Ministry of Telecommunications and IT, Government of India

[45] *Measures To Promote Competition In International Private Leased Circuits (IPLC) In India,* Consultation Paper No.5, 2005, Telecom Regulatory Authority of India ("TRAI Consultation Paper, 2005")

ILLUSTRATIVE LAYOUT OF SUBMARINE CABLE LANDING STATION



Source: TRAI Consultation Paper, 2007

These SCLSs constitute an extremely important element, along with international private leased circuits, for enabling international connectivity for trans-boundary telecom services such as International Long Distance (ILD).[46] SCLS is also the preferred alternative to communication vide satellites. In the absence of a sufficient number of SCLS, access to SCLS can constitute a bottleneck facility for ILD.[47]

As far as ownership is concerned, SCLS have gradually become individually owned as against ownership being vested in a consortium of telecom operators. These individual operators usually operate the SCLS for their own purposes and sell excess capacity to others. However, the monopoly over such an essential facility means that the incumbent can abuse its dominance and engage in anti-competitive practices such as charging high tariffs with the purpose of preventing the entry of new operators. The simple solution would be for a new entrant to construct its own SCLS. However, for this, new entrants

[46] *ibid*

[47] *ibid*

would have to incur huge investments costs besides the time it would take for obtaining regulatory permissions.[48] Recovering such investments could take a long time, especially in the face of competition from an established operator.[49] Thus, a regulatory approach with the objective of encouraging competition in the particular segment would be to either permit or mandate the sharing of this particular facility.

In 2002, the ILD segment, which was hitherto under the monopoly of government-owned VSNL, was opened for competition from private players. Subsequently, four private operators also started to provide ILD. Realizing that SCLS would be a bottleneck facility, the government permitted the incumbent to share its SCLS with new operators for a limited time period of three years. However, practical difficulties such as non-standard contracts, delay in granting access, etc hindered the sharing of SCLS. Thus, competition was quite limited. This was taken due note of by the TRAI in its 2005 Consultation Paper on **Measures To Promote Competition In International Private Leased Circuits (IPLC) In India**. In this Consultation Paper, the TRAI stated: "*The ability of the new entrant to access capacity on these cable system is still very limited and they are likely to face problems in accessing international capacity and also other issues relating to Co-location and Access charges." The TRAI also noted: "From the above it appears that the effective competition is yet to emerge in the IPLC market. Also, the ownership of cable landing station to provide restorable international capacity is still restricted and not really competitive at present*."

In light of the limited competition in the ILD segment, the TRAI was of the conviction that: "*Competition can be infused only through facilitating an environment in which all ILDOs can access any international cable capacity through any of the cable landing stations in the country. Further, new ILDOs, who do not have such facility, should be enabled to have access to cable capacity through cable landing stations that already exist and those that are likely to be established. Such ILDOs would then be provided an environment where there is a choice between `Buy (Lease)' and `Build'*."

[48] *ibid*

[49] *ibid*

The publication of the TRAI Consultation Paper on increasing competition in IPLC was followed by comments from the new entrants. Most of the new entrants expressed the view that SCLS constituted bottleneck facility for international telecommunications and the incumbent operator (VSLNL) was denying access to the SCLS on some pretext or the other.[50]

In its analysis, the TRAI recognized SCLS as an essential network facility, and did not consider it to be economically feasible to duplicate such infrastructure given the huge costs involved. The TRAI was of the opinion that it would be desirable to land new submarine cables on the existing CLS.[51] The TRAI noted that the international practice was for regulators to intervene by mandating non-discriminatory, fair and open access to SCLS.[52] The TRAI also noted that SCLS would constitute a bottleneck facility for its entire life and not just for a short duration. Therefore, on the basis of all these factors, the TRAI, in December 2005, recommended that the sharing of SCLS be made mandatory on a non-discriminatory basis without any temporal limitation.[53]

B. Global Approach

According to data supplied by the ICT's Regulatory Tracker, as of 2013, 102 countries have mandated sharing of passive infrastructure in some form or the other. For the same year, 98 countries permitted sharing of active infrastructure in some form or the other. An illustrative list of countries and the status of infrastructure sharing approaches in their countries is given below:

[50] *Measures To Promote Competition In International Private Leased Circuits (IPLC) In India*, Recommendation, 16 December 2005, TRAI

[51] *ibid*

[52] *ibid*

[53] *ibid*

Table: Illustrative List –Regulatory Approach of Various Countries

S. No	Country	Passive	Active	Comments
1.	Australia	Permitted	Permitted	
2.	Brazil	Permitted	Permitted	Only passive overcapacity is permitted to be shared
3.	China	Mandatory	Permitted	
4.	France	Permitted	Permitted	Control over shared active elements should remain with the owner
5.	Germany	Permitted	Not permitted	
6.	Hong Kong	Mandatory		
7.	Ireland	Mandatory		
8.	Jordan			
9.	Malaysia			
10.	Netherlands	Permitted		
11.	New Zealand	Permitted		
12.	Norway	Permitted	Permitted	Control over shared active elements should remain with the owner
13.	Pakistan	Permitted	Permitted	
14.	Singapore	Permitted		
15.	Sweden	Permitted	Permitted	
16.	Switzerland	Mandatory		
17.	Tanzania	Permitted		Passive sharing can be mandated by the regulator in case of facilities owned by dominant operators
18.	United States	Mandatory		

VIII. CONCLUSION

Telecommunications is important today not only for personal and commercial purposes but also for critical services such as health where any breakdown of communication could be deleterious. To ensure that there is a continuous and quality supply of telecommunication services, a robust and reliable telecommunications infrastructure is essential.[54] Given the high costs involved in constructing the requisite infrastructure, many favourable opinions have been expressed regarding infrastructure sharing. However, the regulatory approach towards infrastructure sharing needs serious consideration.

One of the key regulatory considerations is whether to make infrastructure sharing mandatory or let it be at the option of the incumbent operators. Proponents may flash the prospects of lower prices contributed by increased competition on account of mandatory infrastructure sharing. However, these short-term benefits must not be at the cost of the benefits that would arise on account of investment in advanced telecommunications services which would accumulate continuously over time.[55] Literature suggests that in many countries the regulatory approach followed towards infrastructure sharing is to make it optional rather than mandatory. Furthermore, maturity of the particular telecom market is a key consideration in determining the regulatory approach to infrastructure sharing. Indeed, for reasons listed in this paper, this would seem the preferable approach except for making it mandatory in critical locations.

At present, countries have the regulatory space to determine the regulatory approach towards infrastructure sharing. However, the growing chorus for initiating discussions on e-commerce disciplines at the WTO, and the TPP's conclusion in October 2015, has brought to focus the possibility of it becoming a global norm through the WTO. Even

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[54] TRAI Consultation Paper, 2006; *supra* note 15

[55] William P. Zarakas, Glenn A. Woroch, Lisa V. Wood, Daniel L. McFadden, Nauman Ilias, and Paul C. Liu, *Structural Simulation of Facility Sharing: Unbundling Policies and Investment Strategy in Local Exchange Markets*, 2005, The Brattle Group

though a number of countries world over have mandated sharing of passive infrastructure, and some have even agreed to binding commitments at FTAs on infrastructure sharing, those countries who have not, should be cautious for the reasons discussed in this paper and in this conclusion.

Domestic telecom regulations which are behind-the-border in the nature, as against customs regulations (which are at the border), have been identified as the main barriers to market access by foreign telecom companies.[56] New disciplines on services, at whichever international fora, while extending liberalization to services, essentially addresses national regulatory measures applicable to foreign services and services providers. Besides technical disciplines, the main objective of such disciplines is to enable market access for foreign service providers. In this context, there arises the need to balance national regulatory space with commercial benefits that could arise from granting market access to foreign players.[57]

Though demandeurs may be able to convince countries of the benefits of mandatory infrastructure sharing, these countries should also be aware that such commitments are in essence commitments on ensuring market access for foreign service providers. While infrastructure sharing may enable newer entrants to obtain market share faster, it exposes incumbent operators to the risk of losing market share.[58] This needs to be kept in mind in the context of allowing foreign competitors into the market at the cost of incumbent domestic players.

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[56] Lee Tuthill, *User's Rights? The Multilateral Rules on Access to Telecommunications*, Telecommunications Policy, 20 (1996) 89-99, cited in Henry Gao, *Annex on Telecommunications*, in Rudiger Wolfrum, et al (eds.), *Max Planck Commentaries on World Trade Law: WTO – Trade in Services*, 2008, (Leiden: Max Planck Institute for Comparative Public Law and International Law)

[57] *Services, Development And Trade: The Regulatory and Institutional Dimension*, TD/B/C.I/MEM.4/11, Note by the UNCTAD Secretariat, 2016, United Nations Conference on Trade and Development

[58] Allan Asher, *RI Connected* [PowerPoint Presentation], ISD Coffee Talk on Telecommunications Network Sharing, 2016, Indonesia Services Dialogue Council

While this paper notes that infrastructure sharing may present certain advantages, it is important to note that the benefits that may actually accrue to a particular economy differ based on extant maturity and structure of the market, and also current technological deployments.[59] Further research is necessary to convincingly establish the implications of mandatory infrastructure sharing on competition, investment and innovation.[60] Thus, countries should retain their policy space on deciding the regulatory approach towards sharing of infrastructure.

Furthermore, countries that have not agreed to, or implemented provisions on mandatory infrastructure sharing should do so at their pace and their development considerations. Before being asked to barter with precious policy space for facilitating market access for foreign telecom service providers, they should be cautious against doing so without obtaining anything commensurate in return from the demandeur countries.

[59] Submissions by Dantemunde, List of Consultation Questions and Responses on Infrastructure Sharing Framework, Postal and Telecommunications Regulatory Authority of Zimbabwe

[60] WDR Background Paper, 2016, *supra* note 1

ANNEX I – CLASSIFICATION OF TELECOM INFRASTRUCTURE

According to the TRAI, there are many ways to classify telecom infrastructure. (TRAI Consultation Paper, 2011) TRAI has classified it as:

A. Fixed Network
B. Mobile Network
C. Broadband Network
D. Long Distance Network
E. IP Network

A. Fixed Network

The fixed telecommunications network primarily consists of the following:

1. Switches
2. Transmission links
3. Access Network
4. Intelligent Network systems

1. Switches

A switch or a switching exchange or simply an exchange can be defined as: "an aggregate of traffic carrying devices, switching stages, controlling and signalling means at a network node that enables subscriber lines and/or other telecommunication circuits to be interconnected as required by individual users."[61] Switches are installed in buildings that are referred to as central offices or exchange buildings. The capacity of a switch could be from a few hundred to tens of thousands of lines. Modern local switches are all digital electronic switches that allow subscribers not only to call each other but also supplementary services like dynamic call barring, call forwarding and conferencing. A digital switch works on time division switching of digitized signals.

[61] *Vocabulary of Switching and Signalling Terms*, General Recommendations on Telephone Switching and Signalling: ITU-T Recommendation Q.9, 1993, International Telecommunication Union,

2. Access Network

The access network consists of cables and equipment between the subscribers and the local exchange. Today the access network is predominantly made of copper cables and the flexibility points viz Main Distribution Frame(MDF), Cabinets, Pillars and Distribution Points.

3. Transmission Links

In a multi exchange local area, there are links between the local exchanges called junctions.

4. Intelligent Network (IN) Systems

IN systems are platforms used in the fixed network for providing services and features that are ordinarily not available in the switches. Intelligence is placed in the computer nodes that may be placed anywhere in the network. Services like freephone, universal personal number, televoting and virtual calling cards are offered through these systems.

B. Mobile Network

The cellular mobile networks primarily consist of the following:

1. Network and Switching Subsystem(NSS)
2. Base Station Sub-system(BSS)
3. Tower and associated infrastructure
4. Transmission Network
5. Spectrum

1. Network and Switching Subsystem

The Mobile Switching Centre (MSC) performs the switching functions required in the associated geographical area. The MSC is involved in the interworking functions to communicate with other networks such as PSTN and ISDN. The call routing, call control and echo control functions are also performed by the MSC.

2. Base Station Sub-system (BSS)

The BSS provides all the components and the transmission facilities for the radio part of the network. It consists of the Base Transceiver Stations (BTSs), Base Station Controllers (BSCs) and Transcoder Rate Adaptation Units (TRAU). The main function of the BSS is to connect the subscriber mobile stations to the network through connections to the MSC.

3. Transmission Network

The links between the BTS and the BSC may use either land lines/OFC or microwave links.

4. Spectrum

Besides the voice communication requirements, the new technologies have made possible communication of data and video. Besides the 2G, 2.5G, EDGE and GPRS, service providers have started deploying 3G, WiFi, WiMax and LTE networks. Increasing requirement of high data rates may see operators deploying networks such as 5G. Wireless devices are also making possible man to machine and machine to machine communication such as Internet of Things. However, none of these networks can be deployed if suitable spectrum is not available.

C. Broadband Infrastructure

The broadband infrastructure can be divided into two parts:

1. The broadband core network
2. Broadband Access Network

1. Broadband core network

The broadband backbone consists of carrier grade routers connected with high speed links. The routers in the core network, also called provider routers, typically range from hundreds of gbs per second to a few terabits switching capacity. The backbone network also has edge routers which provide connection points to the second part of the network or directly to the customers' networks.

2. Access Aggregation and Access Network

The access aggregation network aggregates traffic from a number of sources and funnels them to the backbone network. This part of the network may contain Ethernet and/or RPR switches connected through high speed Ethernet over fibre links. The broadband access networks that may consist of equipment that work on copper or fibre e.g. DLSAM, GPON, GEPON, MSAN etc. These are the equipment to which subscribers are connected.

D. Long Distance Communication Infrastructure

The long distance communication infrastructure has elements that enable subscribers to make national and international calls. This primarily consists of the following:

1. National and International trunk switches
2. Transmission Network
3. Submarine Cable Landing Stations

1. Trunk Switches

The trunk switches do not terminate subscriber loops but the local switches are connected to these switches. A number of trunk switches are interconnected to make a long distance network. When a subscriber calls a national or an international number, the call can be routed through one or more trunk switch to the destination within or outside the country.

The international trunk switches are also known as international gateways. The international network consists of International Gateways, Cable landing stations with associated equipment and the international submarine cable terminating on the cable landing stations.

2. Transmission Network

The transmission network connecting the trunk exchanges to each other and local to trunk exchanges is predominantly of SDH technology. Both the fixed and mobile networks use the same infrastructure for voice and low rate data traffic.

3. Cable Landing Stations

A submarine cable landing station has the following infrastructure to which other eligible service providers will need access:

- Fibre Distribution Frame
- Equipment Room
- Network Operation Centre
- Digital Distribution Frame
- Backhaul Termination
- Landing Facilities

A service provider seeking to use submarine cable landing facilities needs to collocate its equipment in the owner's premises and for this they need facilities including building space, power, environment services, security and site maintenance.

E. Internet Protocol Networks

1. IP Backbone
2. IP Access Network
3. IP Address Space
4. Internet Exchange

1. IP Backbone

The backbone network is a bearer network usually architectured as a multi-level distributed network providing traffic channels for the rest of the network. It may consist of routers, route-reflectors, packet shapers, load balancers and fibre-optic links between them. The network has a network management system that is used for configuration, diagnostics and accounting. The contemporary IP backbones are multi-protocol multi-service networks that can cater to voice, data and video traffic. The same backbone could be used for high speed Internet access, Virtual Private Networks (VPNs), hosting services and Video based services like IPTV.

2. IP Access Network

Earlier, dialup used to be the main method for accessing the Internet. Now there are various ways to implement end-to-end IP networks. DSL equipment at the central office end has native IP interface to connect to the IP aggregation network or the IP backbone. The fibre-to-the-home (FTTH) and Ethernet switches are also being increasingly deployed.

3. IP Address Space

An IP address is a unique address allocated to computers and other devices on a network so that they can identify and communicate with one another. The IP addresses of users browsing the World Wide Web are used to enable communications with the server of the web site. Each device in the network must have its own unique address. Users of the Internet are allocated IP addresses by their ISPs either permanently (static IP) or at the time of creating a session (dynamic IP).

The predominant standard protocol for the Internet is IPv4 in which each IP addresses is of 32 bits, giving over 4 billion addresses. While a number of measures have been taken to conserve the limited existing IPv4 address space, the number of 32-bit IP addresses is not sufficient to accommodate the long-term growth of the devices that can connect to the Internet. In comparison, the 128-bit IPv6 protocol will be able to provide about more addresses that should suffice for the foreseeable future. This protocol also offers advanced features like security, quality of service, better multimedia support that could play a catalytic role in the growth of IP network infrastructure in the country.

4. Internet Exchange

The Internet offers access to content and users anywhere in the world. The ISPs have to secure network connections to all potential senders and recipients of content. Reciprocal interconnection makes it possible for an ISP to access the entire global Internet “cloud” for its subscribers. An important way to reduce cost of Internet traffic for the ISPs is through development of Internet Exchange Points (IXPs). IXPs offer traffic switching and routing flexibility. By using an IXP, ISPs can individually and collectively reduce

their bandwidth and line transmission costs, provide more reliable service with lower latency, and operate more efficiently. It provides a neutral, universally supported "clearing house" for the exchange of traffic, making it possible to keep local traffic local. In India, the National Internet Exchange of India (NIXI) was set up by the Department of Information Technology in 2003.

ANNEX II – LIST OF LEADING TELECOM MAJORS

Company	Country	Sales	Profits	Assets	Market Value
AT&T	United States	$146.8 B	$13.2 B	$402.7 B	$234.2 B
Verizon Communications	United States	$131.8 B	$18 B	$244.6 B	$206.2 B
China Mobile	China	$107.8 B	$17.1 B	$219.9 B	$241 B
Nippon Telegraph & Tel	Japan	$94.2 B	$5.6 B	$172.5 B	$94.5 B
Softbank	Japan	$74.7 B	$4.3 B	$178.7 B	$67.1 B
Deutsche Telekom	Germany	$76.8 B	$3.6 B	$156.3 B	$81.8 B
Telefónica	Spain	$52.4 B	$3 B	$133.6 B	$55.2 B
China Telecom	China	$52.7 B	$3.2 B	$97 B	$41 B
Orange	France	$44.6 B	$2.7 B	$100.9 B	$44.5 B
América Móvil	Mexico	$56.3 B	$2.2 B	$75.1 B	$51.9 B
KDDI	Japan	$37.3 B	$4 B	$46.5 B	$81.6 B
BT Group	United Kingdom	$27.3 B	$3.9 B	$38.1 B	$62.4 B
China Unicom	China	$43 B	$1.3 B	$92.7 B	$29.1 B
Telstra	Australia	$20.2 B	$3.2 B	$30.9 B	$50.8 B
BCE	Canada	$16.8 B	$2.1 B	$34.6 B	$39.9 B
Etisalat	United Arab Emirates	$14.1 B	$2.2 B	$34.9 B	$45.2 B
SingTel	Singapore	$12.5 B	$2.8 B	$30.9 B	$46.7 B
Saudi Telecom	Saudi Arabia	$13.6 B	$2.5 B	$25.8 B	$32.6 B
Vodafone	United Kingdom	$64.5 B	$-2.1 B	$182.4 B	$87.3 B

CenturyLink	United States	$17.9 B	$878 M	$47.6 B	$17.1 B
Vivendi	France	$11.9 B	$891 M	$38 B	$28.2 B
Bharti Airtel	India	$14.7 B	$849 M	$33 B	$21.2 B
Swisscom	Switzerland	$12.1 B	$1.4 B	$21.1 B	$26.1 B
Teliasonera	Sweden	$11.5 B	$1 B	$31 B	$21 B
Level 3 Communications	United States	$8.2 B	$3.4 B	$24.1 B	$19.2 B
SK Telecom	South Korea	$15.1 B	$1.3 B	$24.4 B	$14.2 B
MTN Group	South Africa	$11.5 B	$1.6 B	$20.3 B	$18.9 B
Rogers Communications	Canada	$10.3 B	$1 B	$22.3 B	$19.8 B
Telenor	Norway	$15.6 B	$470 M	$23.2 B	$24.6 B
TELUS	Canada	$9.7 B	$1.1 B	$19 B	$18.5 B
Telecom Italia	Italy	$21.9 B	$-80 M	$77.4 B	$18.4 B
Chunghwa Telecom	Taiwan	$7.3 B	$1.3 B	$13.8 B	$26.5 B
Telekom Indonesia	Indonesia	$7.8 B	$1.2 B	$13.3 B	$27.4 B
KPN	Netherlands	$7.9 B	$574 M	$19.3 B	$16.5 B
KT Corp	South Korea	$19.7 B	$489 M	$25 B	$6.5 B
Ooredoo Telecom	Qatar	$8.8 B	$582 M	$25.9 B	$8 B
Crown Castle International	United States	$3.7 B	$467 M	$21.7 B	$29.6 B
Advanced Info Service	Thailand	$4.5 B	$1.1 B	$5.1 B	$13.1 B
VimpelCom	Netherlands	$9.8 B	$-627 M	$33.8 B	$6.7 B
Belgacom	Belgium	$6.6 B	$535 M	$9 B	$11.5 B
Turkcell	Turkey	$4.7 B	$753 M	$9.1 B	$9.3 B

Idea Cellular	India	$5.4 B	$537 M	$12.1 B	$6.4 B
Frontier Communications	United States	$5.6 B	$-199 M	$27.1 B	$6.6 B
Sistema	Russia	$11.6 B	$-9 M	$17.8 B	$2.7 B
Turk Telekom	Turkey	$5.2 B	$453 M	$9.9 B	$8.2 B
Oi	Brazil	$8.2 B	$-1.5 B	$24.5 B	$179 M
Taiwan Mobile	Taiwan	$3.7 B	$494 M	$4.8 B	$11.2 B
MegaFon	Russia	$5.1 B	$637 M	$6.4 B	$6.7 B
China Communications Services	China	$12.9 B	$372 M	$8.9 B	$3.3 B
Maxis	Malaysia	$2.1 B	$456 M	$4.6 B	$11.4 B
PLDT	Philippines	$3.8 B	$485 M	$9.7 B	$8.4 B
United Internet	Germany	$4.1 B	$406 M	$4.3 B	$9.9 B
Emirates Integrated Telecom	United Arab Emirates	$3.4 B	$529 M	$4.9 B	$8.2 B
LG Uplus	South Korea	$9.5 B	$311 M	$10.2 B	$4.1 B
NII Holdings	United States	$1.7 B	$1.1 B	$2.7 B	$557 M
Zain	Kuwait	$3.8 B	$513 M	$11.5 B	$4.5 B
Millicom International	Luxembourg	$6.7 B	$-559 M	$10.4 B	$6 B
SBA Communications	United States	$1.6 B	$-176 M	$7.4 B	$13 B

Source: Forbes 2016 Rankings