

Analysis on Telecommunication Tower Sharing Among Mobile Network Operators Due to Telecom Tower Providers in Pakistan

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Abstract— This is an elaborative study based on a quantitative research model done with Mobile Network Operators (MNOs) and tower companies (TowerCOs also known as TTPs-Telecom Tower Providers) operational in Pakistan. It focuses on the impact analysis of infrastructure sharing (tower sharing) in Pakistan and its relative connection to the advent of 4G and 5G technologies. MNOs in Pakistan, such as Jazz, Telenor, Ufone, and Zong are now expounding more and more on the adoption of the infrastructure sharing model. Since, the focus of the telecommunication sector is now on the tower sharing model, which is a new concept for Pakistan's telecommunication sector, there is very limited literature available that provides thorough research on the impact of infrastructure sharing on the economy, mobile network operators, and the tower companies. The increase in the use of 4G and 5G across the globe has made the MNOs in Pakistan realize the importance of having a rather strong and reliable infrastructure model. It is very important to note that maintaining active and passive infrastructures on a personal basis is difficult considering the increase in OPEX and CAPEX it incurs. Furthermore, it is practically impossible for every MNO across the country to have the access to all geographical locations with potential users. All these factors combined, there was an increased requirement of having a third party where the services for maintaining the infrastructures could be leased out or purchased from another company. Hence the advent of tower companies in Pakistan. The research found that MNOs have been excessively active in getting the infrastructure from the tower companies on the basis of rent and shared revenue slabs. The reason for this approach is very simple, the MNOs are more focused on reducing their costs without compromising on the quality of services.

Index Terms— Tower sharing, Infrastructure sharing, Passive infrastructure sharing, Mobile Network Operator (MNO), Tower Company (TowerCOs), Telecom Tower Providers (TTP), Multi-operator tenancy, CAPEX and OPEX reduction.

1 INTRODUCTION

THIS research study is mainly focused on analyzing the latest advancements in the telecommunication sector of Pakistan due to infrastructure sharing among the MNOs specially after the incorporation of TowerCOs (a.k.a. Telecom Tower Providers – TTPs). This advancement in telecom sector is a prime factor behind current and even forthcoming technological revolutions.

The basic services rendered by the MNOs in Pakistan are voice (calls), text (SMS), and internet (mobile data, 4G/5G). In order for MNOs to provide these services to their consumers, underlying infrastructure is required including but not limited to tower, antennas, power, base stations, etc. With the increase in demand, MNOs have an opportunity to expand and grow, but the caveat in this for MNOs is rapid go-to-market (G2M) by ensuring the quality of service (QoS).

The current era of cut-throat competition has promulgated the need for subject matter specialization and triggered a baseline for Business-to-Business (B2B) engagements in every sector. The function of operating towers was always viewed by Mobile Network Operators (MNOs) as a supplementary service to enable them to focus on their primary objective of provision

of wireless communication services to the end-user.

Traditionally in Telecom sector, the wireless or mobile communications business model is based on the complete possession of network infrastructure; however, the upfront cost of positioning (CAPEX), then handling and continuing network infrastructure (OPEX) is driving the need for innovative models of infrastructure deployment and management within the wireless environment and has eventually enabled a business opportunity for the third-party network infrastructure owners commonly known as Tower Companies (TowerCOs) which are governed by the Pakistan Telecommunication Authority (PTA) under Telecom Tower Provider licence [1].

TowerCOs work within two paradigms: (1) Acquiring the existing network infrastructure/towers from the MNOs. (2) Building the towers at new locations, mostly on demand of the MNOs, which are commonly known as Build-to-Suite (B2S) sites and this demand arises as a result of enhanced Coverage (meaning geographical expansion which becomes a Unique Selling Proposition), and Capacity (newer technologies e.g., wireless data and value-added services, require the operation of active equipment on a higher frequency, which generally does not communicate over a wider geography, and a load of data on the active equipment is increasing with the rise in consumer data requirements). Hence, this prompted MNOs to require the supplemental sites nearby to share a load of traffic being generated.

Being the network infrastructure/tower owners, TowerCOs then lease space on their towers and start sharing them with multiple Mobile Network Operators (MNOs) to install and/or

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operate (if already installed) their Active communications equipment (i.e., radio, microwave, and other transmission equipment) on the towers; this phenomenon is generally known as Tower Sharing or Passive Infrastructure Sharing (this does not include sharing of active or electronic infrastructure).

1.1 Research Problem

MNOs have been investing in building their telecommunication infrastructure even when there exists excessive capacity from other operators in the same geographical area. This resulted in infrastructure repetition, underutilization of the available resources, wastage of energy, and as well as extensive human resources consumption that could have been utilized to serve the underserved geographical regions.

Thus, in today's telecommunication sector, which is undergoing rapid changes with the advancements in technology and sheer competitiveness in terms of low-profit margins, it has become imperative for MNOs to divest their owned infrastructure and opt for the services of TowerCOs in reducing the CAPEX and OPEX to justify their balance sheets in an extremely competitive telecom market of Pakistan. The objective or purpose of TowerCOs is to provide the transmission towers and site management to the mobile network operators decreasing their cost and effort [2].

1.2 Purpose of Study

Considering the rapidly evolving trends in technology within the wireless telecommunication sector specifically, the primary focus of this study is to analyze the existing dynamics of Telecommunication Tower Sharing among MNOs after the incorporation of TowerCOs within Pakistan in terms of:

- a. Possible telecommunication infrastructure sharing business models
- b. Mitigating the cause and effects of towers sharing
- c. Identification of direct and indirect benefits
- d. Identify key decision-making drivers of this business model, and
- e. Major considerations for MNOs to opt for infrastructure sharing

This research will aid MNOs to better understand and evaluate if opting for infrastructure sharing is a worthwhile decision for them, in improving their financial condition within a developing economy specifically Pakistan.

1.3 Objectives of Study

This research aims to achieve below objectives in this thesis:

- a. To identify the different sharing models of telecommunication specific to tower sharing in Pakistan.
- b. To determine the relationship between TowerCOs and MNOs during the Infrastructure sharing engagement.
- c. To determine the impact of telecommunication tower sharing on MNOs in Pakistan.
- d. To determine the impact of TowerCOs on the Value Maximization of MNOs.
- e. To determine the impact of TowerCOs and the OPEX Minimization of MNOs.

2 LITERATURE REVIEW

Telecom cellular infrastructure sharing methods or steps are different across the globe. In Europe, the USA, and India the use and adaptation of infrastructure sharing is more evident and widely used. The researcher has discussed the forms of infrastructure sharing and has focused the study on the tower sharing model given that it's the most adopted form of sharing model in Pakistan. This study is conducted over and across the tower companies and mobile network operators of Pakistan.

The practicality of sharing the infrastructure is accompanied by various modalities, however, it is categorized mainly into two types: towers along with other infrastructure sharing and sharing of an entire network i.e., RAN and core network sharing. Telecommunication involves the electronic transmission of information over distances. This information can and does contain voice, data, and image signals being transmitted from one network user to another.

The telecommunication industry is a huge industry with various components strung together to deliver harmoniously. Without all these equipment and components, communication through networks would be a nightmare. The main component of the telecommunication infrastructure is the transmission equipment. The transmission equipment refers to the hardware such as transmission lines, multiplexers, transmission towers, and base transceiver stations.

The mobile network operators must ensure that they have the best hardware available to provide network coverage and enhanced user experience. It is very crucial to note here that the cost management for the transmission towers was substantially very high and probed a thought process where the need for another vendor was felt. The concept of infrastructure sharing became popular as it was the inevitable solution available to mobile network operators to reduce their OPEX and CAPEX which are technically extremely high to afford. Infrastructure sharing is categorized into two classes: Active infrastructure sharing and Passive infrastructure sharing [1]. A tower section might include a gin pole, load line, jump plate, hook block, tagline, basket choker, etc. [3].

- a. Active infrastructure sharing: refers to the elements and components that make up the active layer of a telecommunication network. This includes antennas, switches, servers, databases, access nodes, and transmission nodes. Mobile network operators can opt for infrastructure sharing by partnering up with other operators, but this creates extreme interdependence between both parties. This is a complex sharing model, as the core telecom network operations are shared on runtime. Although the network providers shall continue to have their own separate managed subscriber base the active infrastructure sharing exposes them to common networks and BSCs. The most common and far-reaching benefit and feature of active sharing is mobile roaming. This feature allows one mobile network operator to use another operator's network to access coverage in a remote geo-location [4].
- b. passive infrastructure sharing: is where the non-electronic infra is shared. This includes power supply, management system, and physical support for the site [5]. It is interesting to note that with the increase in adoption

of the infrastructure-sharing concept, tower companies or mobile network operators have started to design their revenue models around it. So now when sharing infrastructure, it can be offered based on much power will be consumed by a site. Passive infrastructure involves the evaluation of several technical practical and logistical aspects before it is adopted. Although it's not as complex as active infrastructure sharing it involves financial aspects such as lease, buying, and maintenance of the sites which make it a well-thought infrastructure sharing model [5]. As this research study is based on the telecommunication industry of Pakistan the most common sharing category is passive infrastructure sharing [6].

There are two types of business model sharing: namely, (1) Inter-Operator Sharing, and (2) Third-Party Sharing.

Underlying are several telecom sharing categories, which include:

- a. **Site Sharing:** is a very simple and frequently adopted model of sharing towers among MNOs. This form of sharing allows an operator to install their communication assets on the infrastructure of the tower company or fellow MNOs, expanding the coverage and outreach of their network (Power) [12].

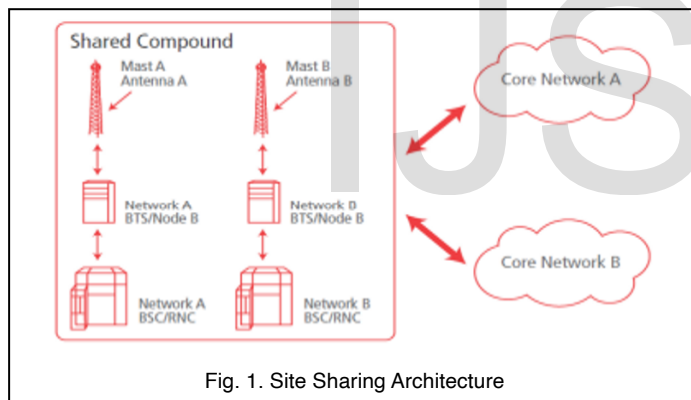


Fig. 1. Site Sharing Architecture

- b. **Mast (Tower) Sharing:** is the sharing of same mast, antenna frame, and rooftop. It's the most common form of tower sharing and is one of the prime reasons which have increased the ratio of tower businesses across the globe [12].

It illustrates a fenced-off area, inside which the MNOs deploy their separate infrastructures, connecting their antennas with their respective BTS cabinets. Though the MNOs co-locate on the same tower, each operator uses its telecom equipment.

The mast or the tower can be reinforced or built to accommodate more than one or two antennas (as usual) should the need arise; for example, in a case when the number of MNOs increases on co-location. The site-sharing category operators have the possibility of sharing support equipment whereby operator coverage remains distinct [2].

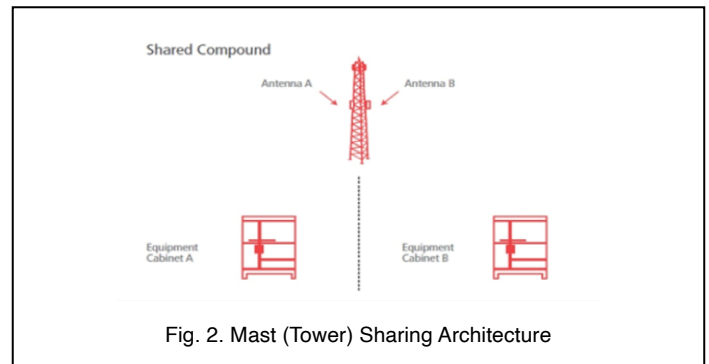


Fig. 2. Mast (Tower) Sharing Architecture

- c. **Radio Access Network (RAN) Sharing:** allows MNOs to connect their users' devices using the RAN equipment of another MNO while keeping the core networks separate. RAN or Radio access network sharing is where an MNO chooses to share the existing active infrastructure of another operator to enhance its network coverage. RAN sharing has taken an increase, especially in countries like the USA where the deployment of 5G has made it as-tutely important for MNOs to have effective and efficient coverage [7]. With the advent of 4G and 5G technology in the telecommunication industry, there has been the initiation of flexible multi-operator RAN sharing. Multi-operator RAN sharing is categorized into two types, MOCN where the spectrum of the core network is shared among operators, and MORAN where the spectrum is isolated among the operators that share the same RAN [8]. The MNOs need to consider upgrading their existing sharing models to upscale their infrastructure enabling support for 4G, 5G, and even 6G network technologies [9].

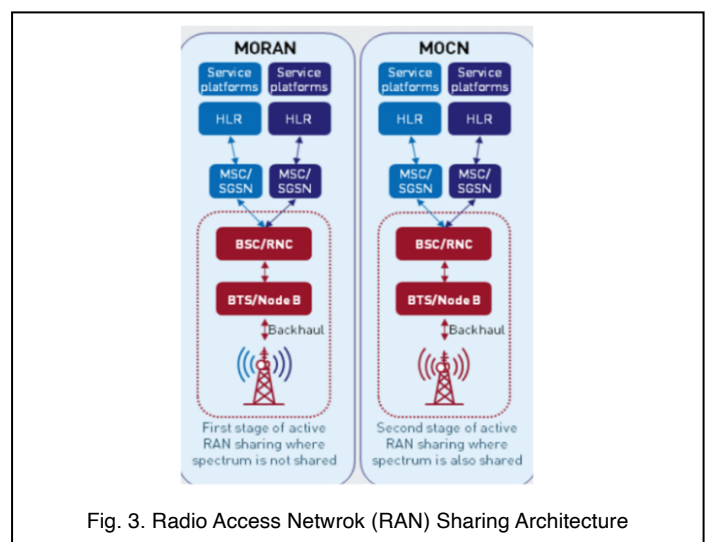
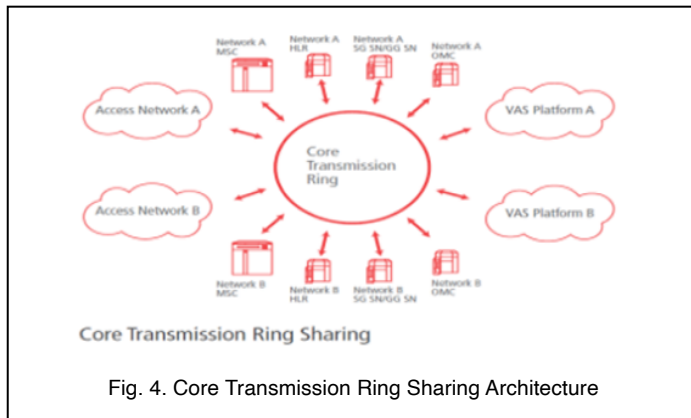


Fig. 3. Radio Access Network (RAN) Sharing Architecture

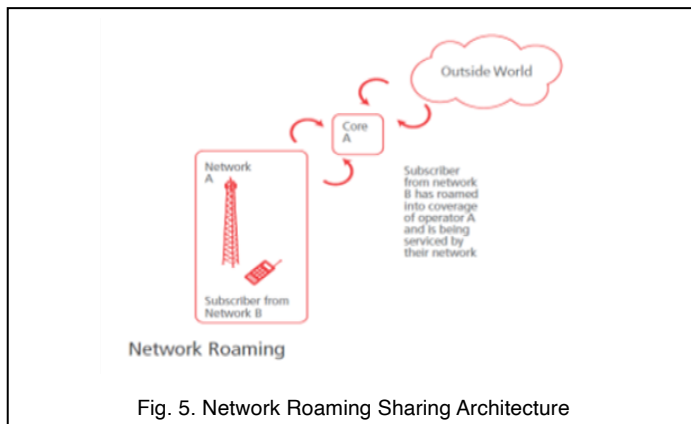
- d. **Core Network Sharing:** is a model adopted at two levels, which comprise: core network logical entities and transmission ring. At a granular stage, the core network comprises of core transmission ring, MSC or switching center, HLR, CBS, and VAS representing the logical entities, and could also shape part of the core network [4].

- e. **Core Transmission Ring Sharing:** is when an operator has additional capacity on its core network it can be easily offered for sharing. This sharing technique is usually very attractive for new entrants as it allows them to learn from the experience of an already-established MNO. Established MNOs use this as an additional source of generating revenue as they provide their lease lines. In support of the new entrants, they also offer a quick rollout mechanism as the new operator would face absolute difficulties in managing its first rollout with all the operational expenses [12].



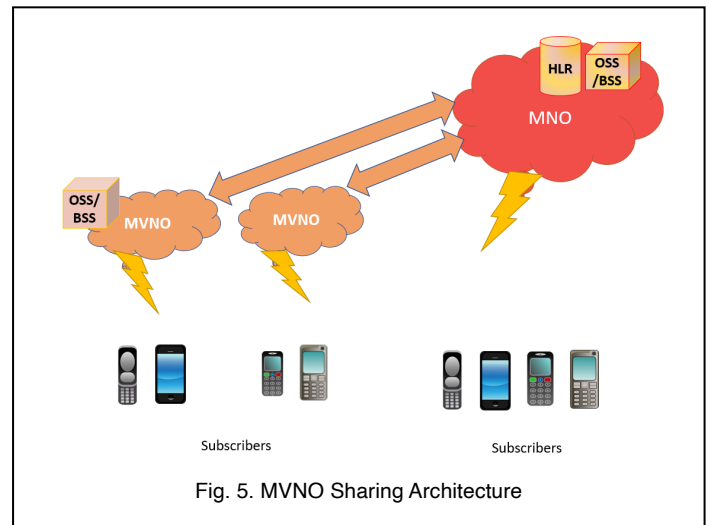
- f. **Network Roaming:** is where the infrastructure of one network operator is used by another operator. The traffic of one operator is carried from the infrastructure of another operator. This type of sharing does not require the MNOs involved to have a similar type of network.

This allows smaller operators, or operators with limited coverage in a specific area to increase their outreach without investing heavily in the entire infra setup. All they do is acquire the existing infra setup of an operator based on sharing an agreed revenue slab. Whilst using the infrastructure the operators can keep their traffic and subscribers separate [10].

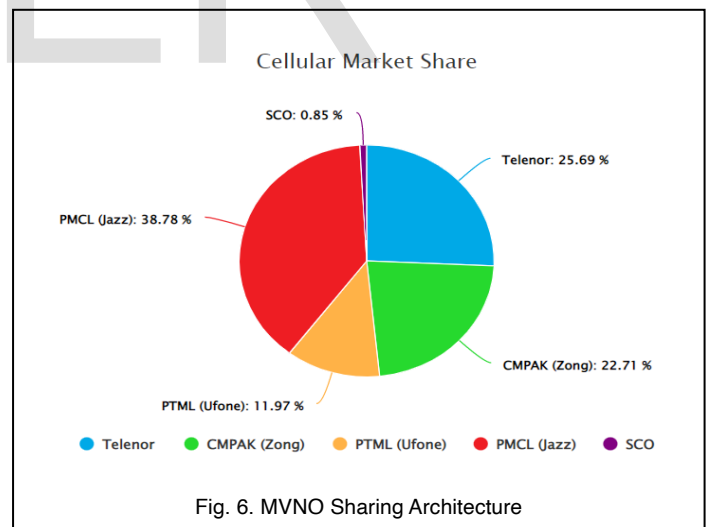


- g. **Mobile Virtual Network Operator (MVNO) Sharing:** is a reseller for wireless communication services. In this sharing, an MVNO involves the infrastructure of two MNOs where the MVNO uses the infrastructure to provide services to the final user and splits the revenue

between both the MNOs based on the count of traffic served by each MNOs infra and radio frequency. The concept of MVNO is on a rise, as it generates a revenue stream where the MVNO earns by providing wireless services to the end user and the MNO earns by providing their infra and radio frequency to the MVNO for providing the services.



Overall, as per the statistics shared by PTA in June the largest footprint amongst the common MNOs in Pakistan, Jazz has taken the mantle by occupying 38% of the market as elaborated in Fig. 6.



The teledensity in Pakistan has increased immensely reaching a whopping increase of 85% from 2014, where it was 60%. The increase to 85% in a developing country such as Pakistan is a great achievement of the telecom industry, as this proves the increased digital literacy of the country and its awareness of understanding the importance of wireless communication. There was a time when the survival of MNOs was threatened a great deal in Pakistan. Paktel and tango completely vanished from the telecom landscape whereas Warid was merged. Ufone was taken over by the government and only three MNOs survived

to remain private, i.e., Zong, Telenor, and Jazz.

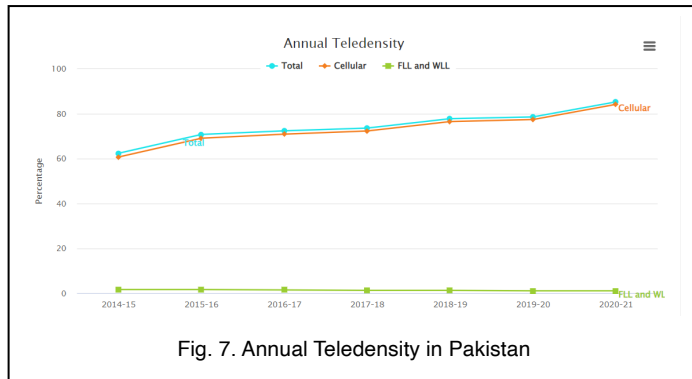


Fig. 7. Annual Teledensity in Pakistan

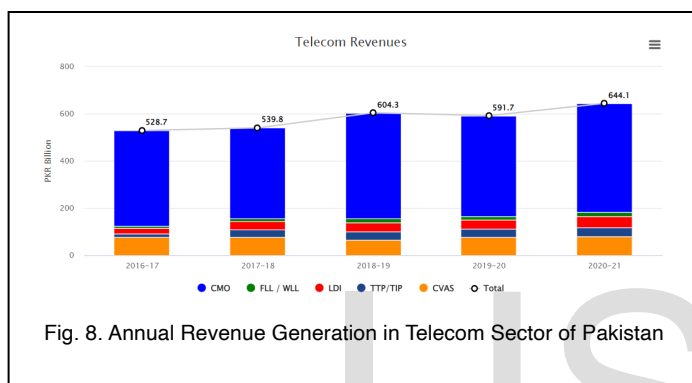


Fig. 8. Annual Revenue Generation in Telecom Sector of Pakistan

3 RESEARCH METHODOLOGY

The research approach used here is a mix of quantitative, qualitative, and exploratory research. The sampling size was acquired by implementing the non-probability sampling method and sub approached purposive sampling and snowball sampling. The reason for using this research and sampling size is that the focus group is related to a very selective niche and to achieve the desired outcomes and to respond to the research questions it is important to keep the focus group centered on the basic objective.

3.1 Data Collection Process

The acquired sample size is governed by [16]; where the target was to get achieve a level of 90% confidence.

The questionnaire was divided into multiple-choice questions and statements. To cater to the extent of agreement or disagreement from respondents, the Likert scale was used, along with weights oscillating from one (1) to five (5) for the questions or statements, where the numerical weights correspond to 'strongly disagree' 5, 'disagree' 4, 'neutral' 3, 'agree' 2, and 'strongly agree' 1.

Multiple choice questions (MCQs) were also used to gather the input of the respondent on the data-oriented questions. In MCQs, for the assessment of agreement (which is an accumulation of respondents saying strongly agree and agree), disagreement (which is an accumulation of respondents saying strongly disagree and disagree), and neutrals.

To meet the desired statistical results, the sample size was garnered based on the recommendations provided by the Geo

poll [15]. Considering the following were used to calculate the sample size:

- Confidence level: 80%
- Margin of error: 5%
- Population proportion: 50%
- Population size: 80

Hence, 54+ surveys were sent forth to different representatives of the MNOs selected for this study to comply with the 80% of confidence level and with a margin of error of 5%.

TABLE 1
NETWORK-WISE BREAKDOWN OF SAMPLE SIZE

Relevnt MNO	Sample Size
Zong	20
Telenor	20
Ufone	20
Jazz/ Al-Warid	20
Total	80

4 DATA ANALYSIS

There were two categories of the focused groups; (1) experts working in MNOs in network operations and (2) experts from TowerCOs/Service Providers working with MNOs. The split of them with response rate is given in Fig. 9 and Fig. 10. Out of the four MNOs, the respondents mainly comprised Jazz, Telenor, and Zong. The most response was provided by Zong.

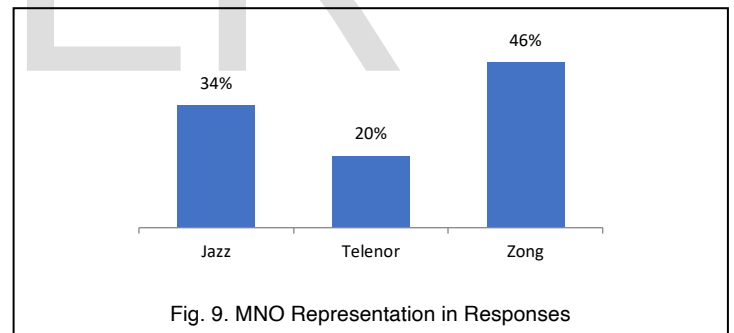


Fig. 9. MNO Representation in Responses

The second questionnaire was designed for the tower companies. The questionnaire was extended to the representatives of leading tower companies in Pakistan. Out of the 50 respondents reached the responses were divided between Awal Telecom and Associated Technologies Limited mainly.

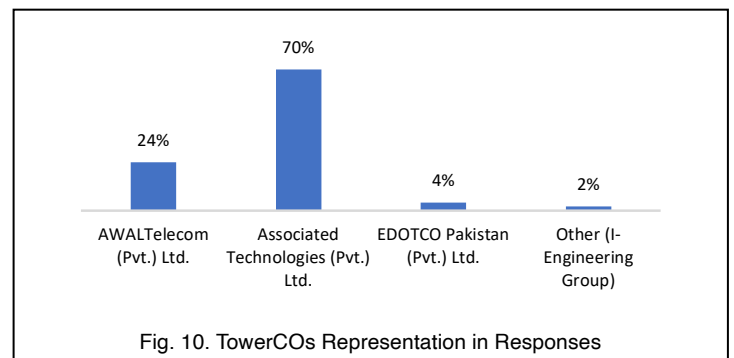
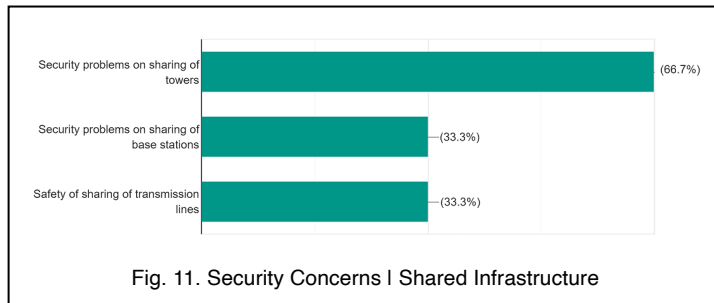
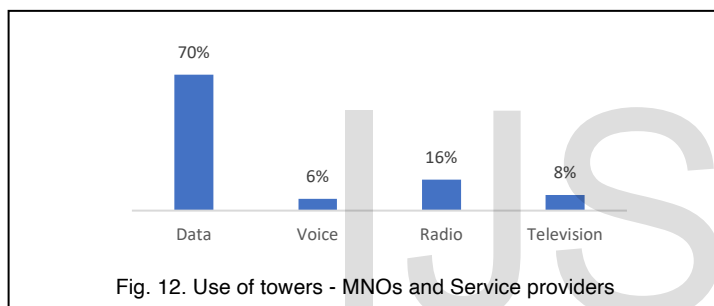


Fig. 10. TowerCOs Representation in Responses

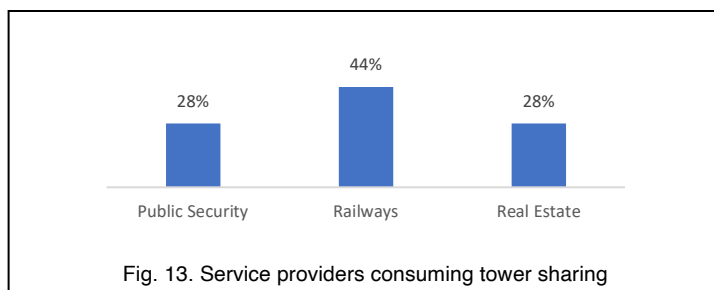
The companies however enthralled by the opportunity of tower sharing do carry certain security concerns. When inquired, the respondents agreed that there are security concerns when it comes to tower sharing.



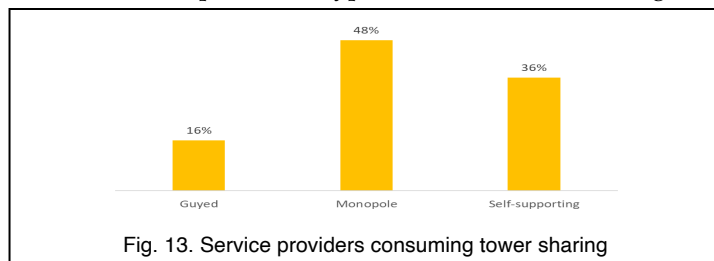
The reason for expanding the research sampling was to highlight the rising importance of tower companies as a leading domain in the industry. Upon inquiring through the questionnaire, it turned out that 70% of the towers are used by MNOs for data services but the remaining 30% was divided amongst the service providers, which is depicted in Fig. 12.



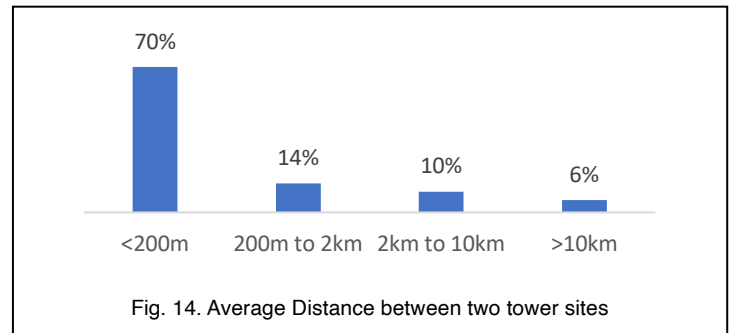
Survey result show that the service providers other than MNOs who engage tower companies for tower-sharing infrastructure include public security, real estate, and railways.



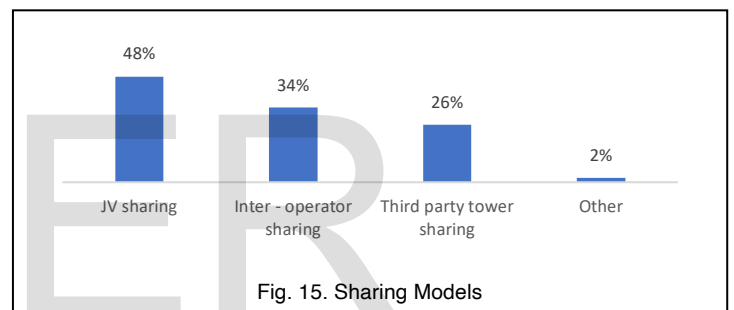
Accrued to the survey questionnaire it turned out that the MNOs often adopt the tower-sharing infrastructure model and choose the Monopole tower type; results can be seen in Fig. 14.



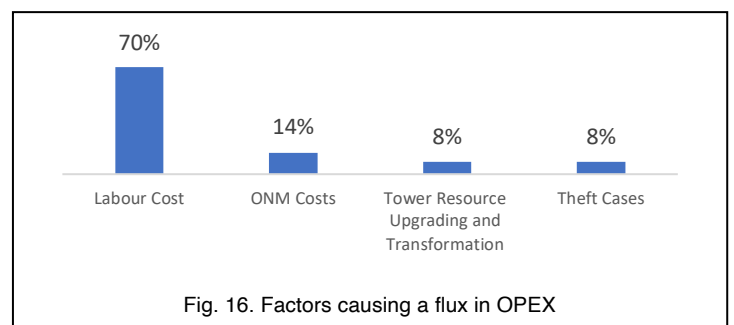
With a distance of fewer than 200 meters between two tower sites its evident that the coverage of services for MNOs will automatically increase.



Considering that infrastructure sharing is most common among MNOs, the results obtained from the respondents have highlighted that among the sharing models used most joint venture sharing between MNOs is more common than Third-Party companies.

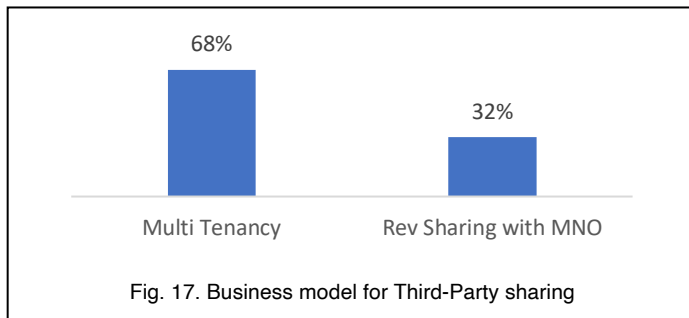


The MNO representatives to shed light on factors that play a role in increasing the operational expenses which in turn made it inevitable to choose the infra-sharing model, details of which are given in Fig. 16.



The reduced CAPEX and OPEX benefits for the MNOs are translated to tower companies when the MNOs choose Third-Party sharing by partnering up on revenue-sharing models or multi-tenancy models. The multi-tenancy model is where one tower site is rented out to multiple MNOs on a height allocation basis over the towers. The revenue sharing model is where the MNO partners up with the TowerCO to acquire the structure of the revenue sharing model. Out of the total samples reached 68% of the respondents shared that the preference of MNO is to

acquire shares in the multi-tenancy model with Third-Party tower companies.

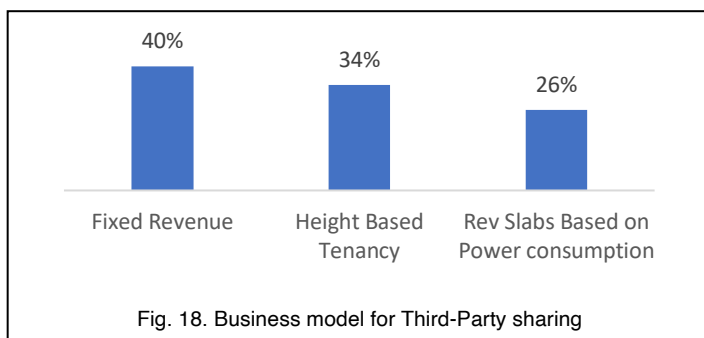


To understand the root cause, the researcher of this study imposed this question in the survey conducted and the results acquired shed light on the reasons for the lack of new entrants in the telecom industry, especially in the domain of mobile network operators.

TABLE 2
LACK OF NEW ENTRANTS IN THE TELECOM INDUSTRY

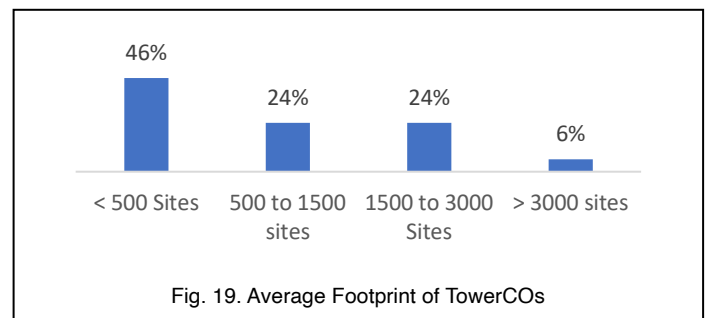
Statements	Frequency	Percent	Agree
Cost of setting up a new business	18	36%	42%
Lack of spectrum	5	10%	4.8%
Lack of investors	4	8%	9.5%
Mobile company license is not easy to obtain	5	10%	14.3%
Regulations/limitations by PTA	5	26%	23.8%
Saturation in the Telecom industry	50	10%	4.8%

There are three ways of generating revenue for tower companies. The revenue can be based on a fixed rate, can be based on height, and power consumption. The best-suited business working model for the tower companies based on the responses acquired is fixed rate revenue.

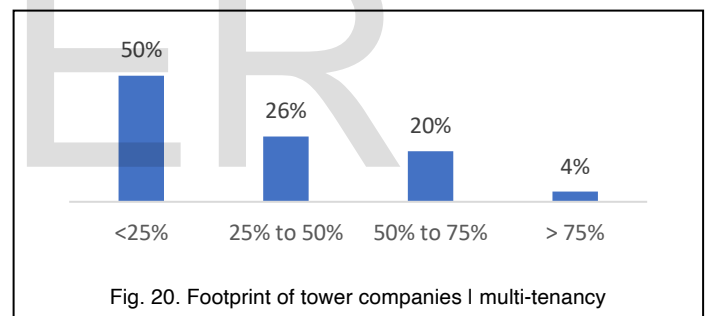


Out of the total respondents, 46% of the tower companies have an existing footprint of more than 500 sites which are providing shared infrastructures to MNOs and service providers alike. 34% of the tower companies have sites that fall under the range of 1500 to 3000 which in itself is a mark of increasing dependence on tower companies to enhance their service qualities.

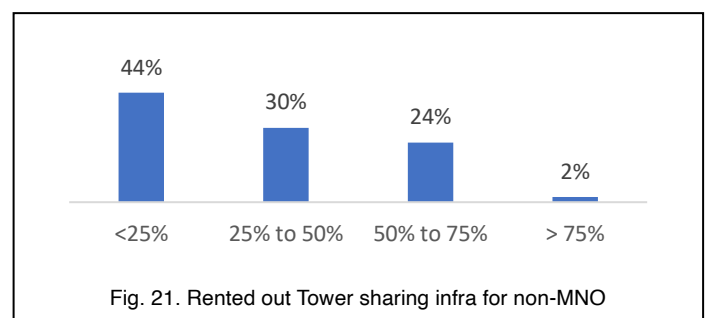
It is important to note here that the advent of 4G and 5G technologies has implored MNOs to invest in durable tower structures to support enhanced network services.



Less than 25% of the footprint is focused on multi-tenancy sharing. Tower companies based on the increase in the use of the tower sharing infrastructure approach are now focussing on increasing their footprint in the foreseeable almost 10%.



Of the total footprint of shared infrastructure provided by the tower companies 44% is rented out to non-MNO service providers and 48% is rented out to MNO. The ratio of MNO sharing is surely higher than any other service provider.



In the empirical studies, it is established that the ability of tower companies to engage MNOs based on multi-tenancy has not only shown a great impact on the economy but has also played a very significant part in the ecology. The share tower

sites allow reduced emission of green gasses ultimately inducing a positive impact on the global temperature.

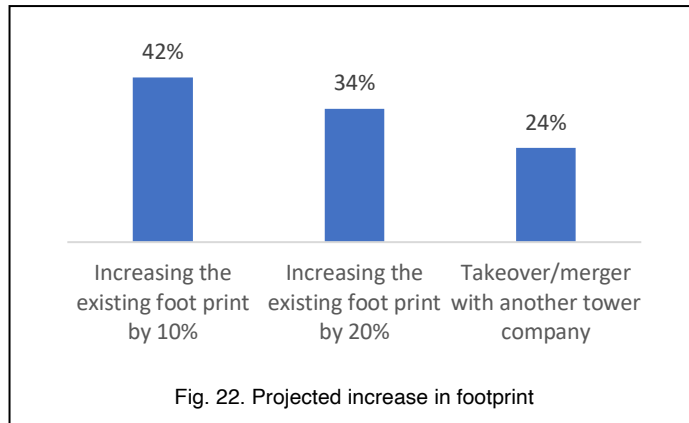


Fig. 22. Projected increase in footprint

5 CONCLUSION

Tower companies have no doubt an increasing footprint in the telecommunication industry of Pakistan. The impact of increased OPEX and CAPEX for MNOs has been daunting for the MNOs to maintain hence there has been the adoption of different business models. The advent of tower companies is most warmly welcomed, as it takes over the headache of maintenance from the MNOs and has provided multiple options where the rollout and expansion have become easier. It is also worth noting that due to tower companies, the concept of multi-tenancy on a high basis has contributed to reducing over-green gas emissions and has generated a better impact on the ecological system.

The reason is simple when one tower site is used by multiple MNOs without the fear of any competitive disadvantage at the horizon lesser tower sites are used decreasing the ecological impact that is created by the radiation of radio frequency. Furthermore, it has opened a new revenue stream for the emerging market of tower companies. When a mobile network operator reaches out to a tower company for infrastructure sharing, it not only reduces its CAPEX and OPEX but also allows the tower company to acquire revenue from the MNO based on the revenue-sharing model. The tower companies are the need of today's ever-increasing dependence on mobile networks.

The MNOs have to ensure that they have coverage in every possible local geographical location to increase their outreach and engage on a carpeted level with their existing and potential user base. Last but not the least, with technologies like 6G already over the horizon, it is highly important for MNOs to have an efficient and adaptive infrastructure where they can easily support these technologies and ensure that network of 4G and 5G is also readily available to the users. Considering this the need for having strong and maintained infrastructure is obvious, and hence the tower companies are not only reaching an increase in popularity, but we have also found in this study that they are looking forward to expanding their existing portfolio in the foreseeable future.

Under this study, it can be safely stated that the importance of tower companies in Pakistan is growing at a rapid state and within the next five years, the dependence and investment in the tower companies would be monumental.

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