Adapting the Regulation of Spectrum and Telecom Networks to 5G Technology-A Cross Country Analysis

Anuradha Mitra(✉)

TERI-School of Advanced Studies, New Delhi, India
anu.mitra1960@gmail.com

Abstract. The fifth generation of wireless mobile technology (5G) is under deployment, with new capabilities and systems of value generation in the market. New services, market paradigms and stakeholders in 5G will likely necessitate a review of regulation of spectrum, telecom networks and infrastructure. Through an in-depth cross-country case study, this paper examines the regulation of telecom resources in 4 administrations that have successfully deployed 5G technology. Archival and current documentary data and information from subject-matter experts is analysed through thematic content analysis with three-tier coding, classification and thematization.

The paper finds that successful roll-out of 5G is concomitant with strong signalling by telecom administrations of intent to support 5G through a clear policy and road map for spectrum availability, holding spectrum auctions, keeping spectrum prices reasonable, and moderating the terms of spectrum licence, methodology of assignment and types of property rights created. Further, there is a policy thrust for local infrastructure access for small cells, infrastructure sharing and simpler Rights of Way administration.

There are few in-depth studies of different countries' regulatory adaptation to 5G. The findings of this research are not exhaustive since 4 countries were studied. Nonetheless, they create a broad framework of themes and provide useful pointers to the common directions of 5G policy evolution, which could be a valuable guide to other countries embarking on 5G implementation.

Keywords: 5G spectrum policies · 5G spectrum auctions · Pricing 5G spectrum · 5G infrastructure regulation · Right of Way regulation in telecom · 5G infrastructure siting · Net Neutrality and 5G

1 Introduction

Mobile technologies have already evolved through several generations. We are witnessing today the advent of the next generation of wireless mobile technology i.e., the 5G[1] technologies. 5G will bring exponential growth in system capacity, high speeds of

A. Mitra-PhD Research Scholar.

[1] Fifth Generation.

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data transmission, low latencies and migration to machine-to-machine communications (Alexiadis and Shortall 2016) (Morgado et al. 2018). The telecom market is expected to witness a range of innovations, new levels of technological complexity, new systems of value generation, and changes in the horizontal and vertical structures of the mobile telecom industry (Cave 2018) (Bauer and Bohlin 2018).

Lin et al. describe the spiral co-evolutionary nature of the relationship between technological innovation, market structure and regulation, using a three-vector model (Lin et al. 2017). As per this model, new technologies influence existing market and infrastructure, creating a need to adapt regulation to influence market structure and performance, which in turn motivates further innovation. The broad principles of this framework can be applied to 5G technologies in telecom.

Network slicing in 5G will allow end-to-end connectivity at a lower cost and small cell deployment so that small localized networks in specific locations on higher frequency bands can be provided by smaller service providers (Matinmikko et al. 2018). 5G will also entail higher investment in new equipment, higher technical quality of service, greater backhaul capacity, cell densification, deployment of active antenna systems and building a network capable of supporting multiple types of devices (Merz 2019) (Forge and Vu 2020). These investment costs can be reduced through resource sharing. 5G is likely to bring in sharing based operational models in networks (Forge and Vu 2020). Sharing must be geared to the market mechanism so that innovation and investment are not adversely affected.

Regulation will have a key role to play in ensuring equitable balance in allocation of spectrum and a level playing field in the sharing of telecom resources. The regulation of access of different kinds of service providers to scarce resources, expensive infrastructure and hard-won user bases, assumes importance in determining telecom market structures, conduct and performance.

Spectrum accords rights to entry into mobile markets and shapes markets. Its availability dictates number of players, the range, quality of service and network costs by setting the inter-site distances (Forge and Vu 2020). For 5G services, spectrum in all 3 frequency bands – low, mid band and high frequency - must be made available - if necessary, existing users have to be relocated (GSMA 2019) (Forge and Vu 2020). A more flexible approach towards sharing, trading and leasing of spectrum is required. Regulators will have to think of ways of distributing spectrum other than by exclusive property rights through auctions (Merz 2019). Dynamic sharing, and a judicious mix of auctioned, administratively assigned and unlicensed spectrum may be required. The size of assigned blocks, spectrum caps, set-asides for vertical use cases and new entrants and auction reserve prices will have to be balanced to achieve both competition and investment (Merz 2019) (Forge and Vu 2020). Regulators have traditionally specified stringent roll-out obligations on spectrum licensees to prevent spectrum hoarding. 5G market potential is not so clear as of now. To avoid unjust penalization of licensees, and to prevent the market from getting set into predetermined (and not necessarily optimal) development paths, roll-out obligations have to be carefully set (Bauer and Bohlin 2018). Licensing durations, geographical extents and approach to technology neutrality may need review (Forge and Vu 2020) (GSMA 2019) (Bauer and Bohlin 2018).

Dominant service providers may develop in 5G, bottleneck control over network facilities such as civil engineering infrastructure for small cell antennas and cell densification, access to buildings especially multi-tenanted residential and commercial buildings, and backhaul transport (Bauer and Bohlin 2018). This may call for a review of existing rules for access in competitive mobile markets. Some authors have suggested opening of 5G networks to Mobile Virtual network Operators (MVNOs), reliance on open Application Programming Interfaces (APIs) and Network Function Virtualization (NFVs) (Lemstra et al. 2017). Others have called for open access to buildings, symmetrical sharing obligations and standardization of access (Godlovitch and Pluckebaum 2017). Oughton et al. use scenario analysis to compare the global cost-effectiveness of different infrastructure strategies for the developing world to achieve universal 4G or 5G mobile broadband (Oughton et al. 2021).

Several authors have written about the regulation of access by content providers (CPs) to the customers of network service providers (ISPs) with non-discriminatory carriage of data traffic over the ISPs network-what is known as "net neutrality" (NN). In 5G, network slicing will allow network resources to be configured on-the-fly in response to end-users' immediate needs (Andrews & et al. 2014) (Kantola 2019). Innovative services will be provided in the network layer rather than in the application layer. Network resources will be smarter, more flexible and more scalable (Frias and Martinez 2018). The network will be differently tailored and traffic differently treated for each use case, which is antithetical to NN, adding a new dimension to the NN debate.

The response of regulation determines the extent to which 5G innovations will get diffused and adopted in everyday life. Outcomes derived from regulation will play an important role in the suppression or encouragement of further technology and innovation (Trubnikov 2017).

To provide useful pointers to common directions of 5G policy evolution, it is pertinent to examine the impact of 5G technology on telecom resource regulation and the approaches followed by telecom administrations across the world in adapting to 5G requirements.

2 Literature Review, Research Gap and Research Question

While there has been ample exploration by scholars into the likely effects of 5G technology and services on regulation of spectrum resources, network, and infrastructure, there have been relatively fewer empirical studies on approaches and measures taken for adapting regulation in different countries. A few studies have been undertaken from specific perspectives. An analysis of recent 5G spectrum awarding decisions by telecom administrations and their impact on emerging local 5G networks is the subject of a paper by a group of authors from Finland (Mattinmikko Blue et al. 2021). Spectrum management policy of the national spectrum authorities in Europe, China, South Korea and the United States of America, aimed at enabling or promoting local dedicated private 5G networks is discussed in a WIK Consult publication (WIK Consult 2019). Bauer examines the roles and consequences of approaches and policy arrangements in 5 countries to 5G market design on innovation (Bauer and Bohlin 2022). Radu and Amon study the policy and regulatory announcements in several developed countries to thematize major security concerns about 5G infrastructure expansion (Radu and Amon 2021).

The lack of broader studies of the process of different countries' regulatory adaptation to the new technology is perhaps on account of the relative novelty of the 5G phenomenon. Using qualitative thematic analysis, this paper examines how various countries have approached the regulation of spectrum, network and infrastructure access and NN in the 5G era. Specifically, it seeks to address the following research question:

In what ways did telecom administrations in different countries adapt their regulatory policies for management of spectrum, network & infrastructure access and NN for dealing with the impacts by 5G technologies and how were impediments and issues in the formulation and implementation of these regulatory policies resolved?

3 Research Methodology

The paradigm adopted for this research is both interpretive and constructivist. Its goal is to develop theory or patterns of meaning through an inductive analysis of qualitative data (Creswell 2014). The research looks at empirical evidence-non numerical data, facts, views and opinions collected from the real world of telecom- and extracts themes from analysis of repetitions, resemblances and patterns in the evidence. The objective is to arrive at new knowledge through an exploration of an emerging phenomenon using insights and interpretation, rather than stopping at mere description (Laverty 2003).

The research also incorporates threads of a critical and transformative paradigm, incorporating some form of an action agenda for reform (Creswell 2014). There is intention to point the way to new structures and resolve conflicts in transition to the new structures. It incorporates elements of the transformative approach- understanding, critical analysis, diagnosis and creation of knowledge- to inform practice and policy making in regulation. However, it stops short of action research and does not involve any action planning or intervention.

Quantitative research focuses on objectivity. It works well when it is possible to collect quantifiable measures of variables and inferences from population samples and analyse them through statistical tools. Qualitative research is not concerned with numerical representativity, but with the deeper of understanding a given problem. It deals with aspects of reality that cannot be quantified (Queirós et al. 2017). A qualitative approach was considered more appropriate for this study because of its exploratory nature. Also, because of the lack of previous research, there was very little guidance on use of numerical measures for assessing regulatory performance.

The case study is a qualitative research method that seeks to get in-depth knowledge and understanding of a set of phenomena (the 'case') set in a real-world context (Yin R. K., 2009). A collective case study provides a general understanding using a few instrumental case studies that either occur at the same site or at multiple sites (Shoaib and Mujtaba 2016). This research uses a collective case study to tap into the telecom resource regulation experiences of countries in transitioning to 5G.

4 countries – South Korea, United States of America, UK and Australia were selected for study from amongst those that were ahead of the global average in implementing 5G technologies. Based on dates of commercial launch of 5G services as early as 2018

and 2019 and achievement of substantial coverage by 2021, the early movers and implementors of 5G in their networks were Republic of Korea, the United States, UK, Spain, Germany, the Gulf countries, China, Japan and Australia. The cases of Australia, Republic of Korea, UK and USA were selected in order to include a wide representation of countries across the continents[2].

The main data sources for this research are the archival and current documents on spectrum management, infrastructure and access regulation and NN- reports, regulations, orders, and laws available on the websites of ministries and regulators- and information obtained through email correspondence with identified experts and subject matter specialists in these countries.

Qualitative thematic content analysis has been adopted to study the case study data. The 3-phase approach to the analytic process described by Lochmiller – set up of the data, analysis, and interpretation (Lochmiller 2021) – was broadly followed. The analysis was carried out using the Atlas ti software package. In the first phase, the documentary evidences in spectrum management, infrastructure and access regulation and NN policy pertaining to each country and the transcripts of the questionnaire responses of the country experts were uploaded to the software. In the second phase, the dataset was initially studied to understand the main ideas and concepts contained therein. Next, the three-step process of thematization- initial coding, categorization and researcher produced themes (Lochmiller 2021)- was taken up. First, initial codes were applied to sections of the textual data which captured the essential idea or meaning of that section. These were the "meaning units"- parts of the data with sufficient information to provide a piece of meaning to the reader (Elliot and Timulak 2005). The coding was open as there were no pre-set codes; rather the codes were developed and modified as the coding proceeded (Maguire and Delahunt 2017). 402 initial codes were created. Next, the initial codes were re-assembled (Lochmiller 2021) into categories based on emergent patterns and interrelationships between the codes that suggested commonalities. 49 category codes were created. Finally, the categories were organised into broad, overarching statements (Lochmiller 2021), capturing the underlying themes. 12 themes were identified and abstracted from the 49 categories. This was an interpretative stage. The themes collate and unify particular aspects of regulatory policy and action across the multiple jurisdictions that are being studied. The themes invite a deeper look into these facets of the data (Lochmiller 2021). Under the umbrella of each theme, there are commonalities as well as differences, as discussed in the next section.

[2] A notable exception in this selection of countries is China. China is not being included in the study as, prima facie, it appeared that the Chinese model of telecom administration and regulation would not yield answers to the type of issues outlined in the hypotheses. This conclusion was arrived at based on responses of the Chinese telecom administrator to a CMS survey on 5G law and policies across the world. (https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law accessed on 2nd Oct 2021). CMS is an international law firm that offers legal and tax advisory services. CMS sought information on 5G deployments, conditions, and prices for award of spectrum licences, rules for spectrum sharing, long term spectrum plans, regulations for access to networks etc., in different countries. The replies furnished indicate that China's system of award of licences and management of spectrum would render most of the issues of concern in this paper, not applicable in their jurisdiction. Hence, China is not included in the case study.

Research validity is a reference to how accurately a technique has been in measuring the object of study. Daytner (Daytner 2006) describes several safeguards that can increase the validity of qualitative research. The following safeguards are applicable in the context of this research:

-Triangulation through the use of multiple data sources, documentary as well as expert opinion. (Since there was only one researcher, triangulation of investigators was not possible).

- Rigorous documentation for creating an audit trail with complete research log, data analysis and coding steps and decision processes.

-Disclosure of the researcher's bias and perspective upfront, by outlining the conceptual framework within which the research was undertaken.

- Consideration of disconfirming or contradictory evidence and giving it due weightage in the findings and interpretations.

4 Findings

The 12 themes which emerged at the end of the coding process are listed in Table 1 below. One theme relates to general policy: the articulation of an overall 5G vision for the country. The rest are listed under spectrum management, network and infrastructure access, and NN. Since the research is concerned with cross-country assessment of regulatory approach and practices, a frequency analysis of the themes across jurisdictions was also done. The number of cases (out of 4) in which the theme occurred is tabulated in column 3; coefficient of occurrence of each theme across the 4 cases is tabulated in column 4.

Table 1. Regulatory and policy themes emerging from thematic analysis. *Source: Own research and analysis*

	Theme	Number of cases in which theme occurred	Coefficient of occurrence of theme (As a proportion of total occurrences of all themes)	Rank in terms of coefficient of occurrence
General Policy	Articulating a National 5G Vision	4/4	0.10	5th
Spectrum Management	Signaling Availability of Spectrum	4/4	0.13	1st

(*continued*)

Table 1. (*continued*)

	Theme	Number of cases in which theme occurred	Coefficient of occurrence of theme (As a proportion of total occurrences of all themes)	Rank in terms of coefficient of occurrence
	Making Spectrum Available	4/4	0.07	9th
	Enabling Spectrum Sharing	3/4	0.09	7th
	Deciding Method of Assignment and Grant of Spectrum Rights	4/4	0.07	8th
	Stipulating Conditions of Spectrum Use	4/4	0.13	1st
	Promoting Competition in Spectrum Assignment	4/4	0.11	3rd
	Ensuring Balance of Affordability and Revenue Earning in Pricing	4/4	0.09	6th
Network Access and Infrastructure	Involving State/ Local Governments in 5G infra creation	3/4	0.11	4th
	Regulating Interconnection and Network Sharing by Mobile Network Operators (MNOs)	4/4	0.06	10th

(*continued*)

Table 1. (*continued*)

	Theme	Number of cases in which theme occurred	Coefficient of occurrence of theme (As a proportion of total occurrences of all themes)	Rank in terms of coefficient of occurrence
	Granting Financial and Non-financial 5G Investment Incentives	4/4	0.02	12th
Net Neutrality	Reviewing NN policies for 5G	4/4	0.03	11th

5 Discussion: Implications for Policy and Practice

The implications of the findings for regulatory policy and practice in a 5G technological environment are discussed below:

5.1 Articulating a National 5G Vision

In all the cases, the overall national vision for 5G was articulated through a policy announced by the government. A common feature was the intention to achieve leadership position for the country in the new technological era. A highly proactive role was played by the Korean government, with the stated objective of making Korea a global leader in 5G. In the US, government strategy was less directly propulsive and more directed to creating enabling conditions and removing impediments to innovation and investment to achieve overall economic leadership in 5G. In UK, to make the country a global leader in 5G mobile technology, the policy focused on creating optimal market conditions for investment with fit-for-purpose regulation. The vision of the Australian government included spectrum availability and sharing, simplification of processes and rapid deployment of infrastructure. Another common feature was the declared intention to promote public and private sector co-ordination and strategic dialogue.

The findings highlight the importance of a national 5G policy signalling the government's intent, at an apex level, to support the development and deployment of 5G.

5.2 Signalling the Availability of Spectrum

This was one of the two most frequently occurring themes across the 4 cases. There were 3 major areas in which such signalling was directed: announcing roadmaps for spectrum availability, charting the path forward for spectrum re-allocation from the public sector to commercial use, and refarming and defragmentation plans for spectrum

already in use. The repurposing of spectrum already in use had to take account of resistance from existing users, which was managed partly through diktat and partly through accommodation. In the Korean case, evidence was not found of any announced plan for making available public sector spectrum for commercial purposes. It is possible that announcing such a plan was not considered necessary and this co-ordination was intended to be achieved through the 5G Strategy Committee, a cross-ministerial, multi-stakeholder, public-private partnership entity with members from relevant ministries, industry, academia, and civil society.

Under the umbrella of overall 5G intentions signaled by national governments, the implications of these findings are that spectrum managers will also have to signal that spectrum will be available, with concrete time-bound plans to back their claims. Such plans must take account of requirements of existing users, who may include powerful public sector institutions such as the Defence forces. A combination of executive fiat and market-based approaches (e.g., incentive auctions in the US) can be used for redistributing spectrum.

5.3 Taking Action to Make Spectrum Available

In all 4 cases, auctions for 5G spectrum were held across a range of bands- low frequency, mid frequency and mmWave. Local and private networks are essential to 5G. In 3 out 4 cases (US excepted), policies announcing specific spectrum arrangements for local and private networks were made. In the US, rather than a general policy for local/private spectrum access, the Federal Communications Commission (FCC) follows a band-by-band approach to geographic area determination for spectrum licences to take care of smaller players. In all 4 cases, there were arrangements for making spectrum available for 5G tests and trials.

These findings underline the essentiality of holding timely auctions for 5G spectrum, providing clarity on terms and conditions of spectrum access for smaller players and new stakeholders in the 5G eco-system and making spectrum available for tests and trials.

5.4 Enabling Spectrum Sharing

The theme of spectrum sharing occurred in 3 out of 4 cases (Korea excepted). There are variations in approach. The US has implemented schemes for spectrum sharing through market means as well as under government aegis, but has not announced general policies on spectrum sharing. The US has adopted hybrid licensing regimes for facilitating shared access- e.g., by creating a new service- the Upper Microwave Flexible Use Service (UMFUS)- in the higher frequency bands. In UK, there made policy statements on the significance of spectrum sharing. However, spectrum sharing has been enabled by flexibility in licensing through national licenses, local licenses with interference control, and unlicensed regimes, rather than by implementation of specific sharing schemes. In Australia, class licensing is already used, implying that spectrum arrangements are less closely managed; technology-based sharing such as dynamic spectrum access is also under consideration.

While there is some recognition of the importance of spectrum sharing in 5G, consensus is yet to evolve as to how a sharing regime is to be managed, and how far technology-based solutions can be practically utilised.

5.5 Deciding Method of Assignment and Grant of Spectrum Rights

In all the 4 cases studied, assignment and rights policies adopted for 5G found mention. The most significant concerns centred around use of spectrum auctions for making assignments, accommodation of rights of existing users and administrative assignments or delicensing for some frequency bands. Each country used some mix of assignment methods and rights regimes. Korea used a mix of auction with rights of exclusive use, administrative assignment for local and private use and unlicensed spectrum using a commons approach (in 5GHz; planned delicensing in 57–64 GHz). In the US, there was a combination of auction, administrative assignments for General Authorised Access (GAA) users of 3.5 GHz and higher mmWave and delicensing in some bands such as the 5.9-7.1 GHz, 57–71 GHz, and >95 GHz bands. The rights regimes adopted were varied, ranging from the exclusive rights, exclusive rights subject to protection of existing users, overlay rights to licence by rule or registration-based authorisation and delicensing using a commons approach. UK used auctions, usually exclusive but sometimes subject to co-existence arrangements with existing users such as TV or satellite, administrative assignments on first-come-first -served basis and local assignments on shared basis with power limits. Arrangements in Australia were similar with auctioned spectrum given for exclusive use subject to protection of earth stations from interference, and class licences with shared access and limits on power and interference.

The findings point authoritatively to the use of mixed assignment methods and rights regimes to meet the special requirements of 5G. Protection of the rights of existing users and availability of spectrum for local service provision are special factors that must engage the regulator's attention.

5.6 Stipulating Conditions of Spectrum Use

Stipulating conditions for use of spectrum was the other most frequently occurring theme. Long licence periods were prescribed in all cases (except for mmWave in Korea) and renewal terms were included in the licence to enhance certainty. Except in Korea, where licences were granted on national basis, the geographic area of the licence varied according to frequency band and service provided. Service and technology neutrality were prescribed in all cases except Korea. In Korea, the licence generally specifies the permitted use and no policy was found on technology neutrality.

The approach to roll-out and coverage obligations in spectrum licences to ensure rapid investment varied between the countries. Whereas Korea and the US imposed roll out and coverage requirements for the 5G mid band spectrum, UK and Australia did not impose such obligations and instead relied more on competition to drive coverage.

Regulatory approaches in setting the conditions of use of 5G spectrum have focused on encouraging greater certainty for investments along with flexibility in technology and service provision. The approach to roll-out and coverage has been mixed, with regulatory diktat as well as market reliant models in evidence.

5.7 Promoting Competition in Spectrum Assignment

Block sizes of auctioned spectrum are a function of availability of spectrum, but they are also an indicator of the regulatory intention with regard to the number of market players. Block size varied with frequency across all the cases. For mid band spectrum, block size was a low as 5 MHz in UK to as high as 100 MHz in Korea. Where auction in higher frequency mmWave bands had taken place, block sizes were larger- 1000 MHz in the 28 GHz band in Korea and 200–425 MHz in the 28, 37 and 39 GHz bands in the US. In Korea, competition is limited, in practice, to 3 operators. In the other cases, there were limits placed on spectrum aggregation through auction or secondary trading for most of the bands. In general, eligibility conditions and spectrum caps continued to be enforced as per established practice. Bidding credits were not awarded (except in US). Australia, did however adopt a 10 MHz set aside for their incumbent operators in their 900 MHz auction.

Management of competition by the regulator through adjustment of block size, use of spectrum caps and prescription of eligibility conditions for service provision and auction participation, continues in 5G mobile markets.

5.8 Ensuring Balance of Affordability and Revenue Earning in Pricing

There was an effort to keep spectrum prices reasonable and balance affordability and revenue earning for the government. In all cases, administrative pricing of spectrum was based on economic principles, especially opportunity cost in alternative uses. The reserve price for C- band (mid -band) spectrum on an equated USD/MHz/pop[3] basis was 0.20 in Korea, and even lower at 0.03 in the USA, 0.01 in UK and 0.02–0.05 in Australia. The reserve prices for mmWave auctions were lower than reserve prices for mid-band spectrum in all three cases where the issue found mention (UK data does not mention reserve price for mmWave as no auction had been announced).

International experience points to importance of keeping spectrum affordable in the 5G market. It provides indicative benchmarks for reserve prices for various 5G bands, as well as best practices for the pricing of administrative spectrum.

5.9 Involving State/Local Governments in 5G Infra Creation

In all 4 cases, public facilities were opened for siting and development of 5G infrastructure. In the US, UK, and Australia there was greater local government participation in planning, government facilitation of fibre laying and simplification of RoW administration. In Korea, this matter was addressed through co-ordination under national level cross-institutional committees. Policy in the US, UK and Australia focused on simplification of processes for setting up 5G small cells. In the US, State and local government rules on review of infrastructure siting applications were amended for small cells and Distributed Antenna Systems. The FCC has paid attention to additional infrastructure deployments and collocations on existing utility poles, towers and structures. UK has concentrated on standardisation of practices. The Facilities Access Code in Australia

[3] US dollar per MHz per capita.

already defines low-impact facilities with special processes which support the setting up of small cells.

The findings highlight the crucial role of State and local government in 5G infrastructure creation. Telecom has been largely a national enterprise in most jurisdictions. However, for proliferation of 5G infrastructure, greater co-ordination between central and local authorities for simpler procedures, early clearances, ease of siting fibre and small cells and more integrated planning will be required.

5.10 Regulating Interconnection and Network Sharing by MNOs

In 3 out of 4 cases (US excepted), policy statements on promotion of active and passive infrastructure sharing find emphasis. Except in the US, there is legal obligation on incumbent operators, with full or partial price regulation, to share wholesale access on their networks. While in all 4 cases a liberal MVNO policy was adopted, only Korea mandated access to MVNOs by telecom operators.

Lack of network access, especially backhaul access, to new stakeholders in the 5G eco-system is a potential bottleneck to proliferation of services. To ward against this possibility, several regulators may consider it prudent to continue with a regulatory regime for interconnection and backhaul. In addition, liberal arrangements should be made for active and passive sharing of network and infrastructure.

5.11 Granting Financial and Non-financial 5G Investment Incentives

Though this theme does not occur very frequently, it is detected in all 4 cases, affording examples for regulators in other countries. Korea provides up to 3 percent tax credit for 5G investments by the private sector. The government also financially supports development banks and public funds primarily involved in 5G investment. It has replaced the permit system for facilities-based telecoms business entities by a registration system to aid new entrants. In US, a 5G Fund for Rural America was set up in Oct 2020 to make up to USD 9 billion in USF support available to carriers to deploy advanced 5G mobile wireless services in rural America. FCC's revised rules to make it easier for companies to invest in next-generation networks and services instead of past networks. In UK, private investment and innovation is supported through the 5G Testbeds and Trials (5GTT) programme. A $20 million Australian 5G Innovation Initiative, supports private sector investment in 5G trials. Carrier separation rules have been amended; the wholesale-only obligation exempted for networks servicing small businesses and residential groups.

5.12 Reviewing NN Policies for 5G

In all 4 cases, review of NN regulations was undertaken and has either been completed or is under process. Korea has consistently tailored its regime to bring in checks and balances between ISPs and CPs. In 2016, it implemented the Sending Party Network Pays (SPNP) Rule which provides that payments are based on volume of traffic delivered to the ISP, for which ISPs can charge fees from CPs. In 2020, Content Providers' Traffic Stabilization Law was enacted so that large CPs had to stabilise customer systems and

ensure reliable access to their content. In 2020, the Telecommunications Business Act was amended to prohibit unreasonable or discriminatory conditions and restrictions in agreements for use and provision of telecom networks which strengthens the SPNP regime and permits network slicing and zero rating. In 2018, US repealed the NN rules of 2015 classifying ISPs as Title II services. ISPs were restored to Title I non-common-carrier status and hence outside purview of FCC regulation. However, State and local level NN enforcement continues. In 2021, UK commenced consultation, post Brexit, on review of NN policy to deal with latest technology developments, value chains and market structures with focus on specialised services, traffic management, zero-rating and differences between fixed and mobile access. Australia does not have any NN policy in place. As the market is very competitive, no one ISP can restrict, prioritise or filter content without adverse commercial consequences. In addition, there is a strong competition law in operation.

These findings provide pointers for accommodation of NN policy regimes to the 5G environment.

6 Conclusion

There has been substantial commonality of experience in regulatory adaption to the challenges of 5G technology. All the countries studied have focused on making available appropriate 5G spectrum at reasonable prices through auction, accommodation of rights of existing users and delicensing of specific frequency bands. They have recognised the importance of signalling, through policy announcements and plans, their intent to support the deployment of 5G technology. To enable a successful roll-out, these countries have moderated the terms and conditions on which spectrum is granted for use, the methodology of assignment and the types of property rights created. Some have experimented with novel methods of spectrum sharing. The need to open public facilities for siting and development of 5G infrastructure and to ease RoW has also been in focus, although the paths followed have been in some cases decentralised and in others centralised. Interconnection and backhaul access have, in some instances, been mandated and in others left to market forces. Some countries have resorted to pro-active incentivisation of 5G infrastructure. In NN, the need for a flexible regime has been implicitly recognised and implemented in various ways. These broad indications of the likely directions of evolution of policy in spectrum, network and infrastructure access, and NN could be of value to other countries that are adopting 5G technology in their networks.

7 Limitations of the Research and Directions for Further Study

Since the present study is confined to 4 countries, the universality of the findings cannot be categorically asserted. In future research, the scope of the study can be expanded to test the applicability of the results to other jurisdictions. There is also potential for further in-depth research into each of the regulatory themes that have emerged from this analysis.

8 Certificate of Originality

This paper is an original piece of work and has neither been published elsewhere nor submitted elsewhere for publishing.

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