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FREE MARKET FOUNDATION

on

South African Government Radio Spectrum Policy

for

Serving Consumers

produced as a public service by the FMF

Socio-Economic Impact Assessment (SEIA)

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I. INTRODUCTION TO THE CONCEPT OF SOCIO-ECONOMIC IMPACT ASSESSMENTS - SEIA

This Socio-Economic Impact Assessment (SEIA) on government spectrum and related ICT policy is a substantial body of carefully researched work and analysis and draws conclusions that are crucial to shaping the direction of policy, which is vital for a booming young industry.

Having introduced the concept of SEIAs to South Africa when it was still an embryonic idea in pioneering countries, the FMF is uniquely qualified to produce quality SEIAs and provide guidance to others. The FMF is the country's leader in the field having monitored developments and studied the concept intensively (see Background Appendix for a brief history of introduction of SEIAs to South Africa.)

What renders SEIAs a critical policy-making tool is (a) that the Cabinet ruled that all new laws and policies *must* be preceded by a *bona fide* SEIA, and (b) that SEIAs are by far the best way to ensure quality policies and laws that achieve intended consequences.

SEIAs promote evidence-based policy making. Correctly undertaken, they remove conjecture and assumptions from making excellent policy decisions. Plans must be adjusted according to SEIA findings, and SEIAs must be done properly—not misused and abused as a means of legitimising pre-determined ideas; otherwise they are not just pointless, but counter-productive.

The FMF's President, Leon Louw, undertook research in pioneering countries, including advanced and developing countries, to research their early experiences, lessons and proposals.

Through the Good Law Project (GLP), the FMF published SA's leading analysis of how SEIAs should be undertaken and used as a powerful policy tool, and the standards to be targeted. *The Principles of Good Law* publication[1], with a Foreword by the country's leading corporate governance expert, the eminent Professor Mervin King, is freely available electronically and in hard copy from the FMF.

SEIAs should ideally:

1. Start by defining the problem to be addressed (the 'mischief principle').
2. Define the extent to which the policy is predicted to solve the problem.
3. Consider which existing measures might be causing or intensifying the problem – which measures should be relaxed or repealed.
4. Identify trade-offs – what intended and unintended negative consequences will there be (there are always some).

5. Ask and answer 'at what cost' will the benefits be achieved – observing the fact that "there ain't no such thing as a free lunch" (the TANSTAAFL principle).
6. Ask and answer a range of other questions, such as why it is assumed that measures will be effectively implemented and enforced; when and by which criteria will effects be monitored; which measures are in place to change direction if unsuccessful, and so on.
7. Ask and answer a range of other questions, such as why it is assumed that measures will be effectively enforced, when and by which criteria will effects be monitored, which measures are in place to change direction if unsuccessful, and so on.

It is not always appropriate, as in this case, to apply all these criteria inflexibly. What is essential is that SEIAs must convince policymakers, role-players, the media and the public that proposals have been subjected to comprehensive, careful, objective and informed analysis, and that they are therefore likely to maximise benefits and minimise costs (which term means all negative aspects).

Different countries refer to such impact assessments by different names and apply different criteria. Despite these differences, there are core common themes.

These are so strictly observed in this SEIA that it might well be the premier SEIA yet produced in SA. It lends itself to being an example for others to emulate.

The introduction and potentially resolute application of SEIAs in SA is arguably our most important and promising recent policy development. All policymakers should adopt, apply and respect this discipline.

II. EXECUTIVE SUMMARY

This study examines the South African government's regulatory policy in the mobile telecommunication sector. Since the first mobile networks went live in the early 1990s, the sector has undergone radical transformation. The evolution of the initial voice product on the basis of post-paid contracts in urban areas to today's mass market service happened in an astonishingly short timeframe. The radical game changer was the introduction of prepaid voice whereby a market offering that was thought to be a service for a few hundred million of affluent consumers in wealthy urban areas became affordable to everybody virtually overnight.

The enormous technological and commercial innovation we have been witnessing in all parts of the mobile value chain is a response of consumer demand. It makes a difference for the market dynamics when a product at the price of R50,00 is affordable to everybody or a product for R500,00 or more is only offered to a few in the absence of competition. This was the case with fixed telecommunication services provided by overstaffed and sclerotic public monopolies. In many low-income countries, fixed voice services were available to only a few thousand subscribers. Even in relatively well-off countries, such as South Africa or Brazil, fixed-line penetration never surpassed a household penetration rate of a few percent.

Spectrum regulation was not a serious issue when the first mobile operators entered the market. Voice services require relatively little bandwidth with which MNOs were able to increase geographical coverage and densify their network footprint in urban areas. Matters changed when it became clear that internet services, or more generally, content, would have to be accessed by most people through mobile networks.

At the outset of the new millennium, demand for data in low- and lower-middle-income countries was still miniscule compared to voice services, but it was understood that this would change quickly. In 2004 and 2005, South Africa's leading mobile operators, MTN and Vodacom, received spectrum in the 1.8 and 2.1 GHz bands from the regulator to roll out 3G network infrastructure. It was also the last time the two carriers who serve roughly 80 percent of South Africans received spectrum. The third MNO, Cell C, established in 2001, received its last spectrum in the 2.1 GHz frequency band in 2011 which brought it on par with the two market leaders. In the following ten years, Telkom, Liquid Telecom (formerly Neotel) and Rain (formerly iBurst/WBS) have entered the mobile market, either in direct competition for consumers or as wholesale providers offering their network capacity to other operators.

Since 2005, mobile technologies, end-user devices, and complementary technologies in the fibre space have evolved rapidly. At the same time, mobile broadband has evolved as the key access medium to the Internet for billions of people demanding ever-higher bandwidth and traffic speeds. From a socio-economic perspective, the provision of

mobile broadband in rural areas has proven to be particularly important because most countries did not have copper network coverage and the rollout of terrestrial fibre networks is too costly. Mobile 3G technologies have filled the coverage gaps in many countries. However, it has become apparent that the 1.8, 2.1 and 2.3 GHz frequency ranges are uneconomical for the provision of 3G and 4G in sparsely populated areas. Radio networks utilizing such relatively high frequencies require a high density of mobile infrastructure. Even in the most affluent countries, the investments for network rollouts using frequencies around 2 GHz and higher cannot be funded or amortized by revenues from rural customers.

The 4G mobile communications standard LTE in the low frequency range between 700 and 800 MHz largely solves this problem. Compared to 4G in the frequency range between 1.8 and 2.3 GHz, for covering the same geographical area LTE-800 reduces the cost of network rollout by half (up to two-thirds). In addition, LTE-800 can also be used in urban areas in the course of carrier aggregation. The higher spectral efficiency associated with the connection of radio elements in, for example, the frequency range of 800 MHz and 2.6 GHz accommodates significantly higher data rates in urban areas with the same infrastructure. However, the problem had to be solved which was that spectrum in the low frequency bands below 862 MHz were occupied by analogue TV. Progress in the digitization of all types of content, including TV signals, has made it possible to achieve significantly better TV signal transmission rates with higher quality in the frequency ranges below 600 MHz.

The process of migrating TV stations to lower frequency ranges does not happen overnight and requires careful coordination. On an international level, all member states of the International Telecommunication Union (ITU), a UN organization, have established a transition period intended to facilitate the migration from analogue to digital television. The deadline for the switch-off of analogue TV signals agreed by the ITU member countries was 2015. By reassigning the spectrum in the 700/800 MHz range to mobile telecommunication services, networks could be rolled out cheaper and help bridging the digital divide between the urban and rural population. The release of this spectrum is termed "digital dividend" spectrum because the rural population benefits from its utilization in the form of better broadband coverage and cheaper data services.

South Africa also committed to end analogue TV in 2015. The Department of Communications and Digital Technologies (DCDT), then Department of Communications (DOC), announced that it would switch off the signal by 1 November 2011, which would have made South Africa a world leader. Almost a decade later, it is still unclear when digital migration will be completed. Experts estimate that the spectrum in the 700/800 MHz frequency range cannot be utilized nationwide before 2023. The cost of this regulatory failure is borne by consumers through poor broadband coverage, higher prices, reduced economic productivity and impaired educational opportunities.

This study provides an overview of the regulation of the South African mobile sector with particular focus on the public assignment of spectrum. It argues that due to a misguided economic understanding of the scarce resource "spectrum" and an ideologically coloured view of "competition", a number of interventions have been made that have no economic theoretical basis and fundamentally misconceive the nature of market processes in the telecommunications sector. In an increasingly complex market with constant technological progress, the regulator has largely lost its coordinating function and—not only in South Africa—has become an obstacle to development.

This study concludes that South African regulation of the mobile market has failed over the past decade, resulting in needless costs to the consumer. While most other countries have been able to use LTE-800 and carrier aggregation for five years or more, South Africa remains years away because digital migration has been badly managed. Instead of making resources worth hundreds of billions of Rand available to the market, spectrum has been left to gather dust in bureaucratic drawers for over a decade. More seriously, spectrum in the sub-1GHz frequency range continues to be occupied by analogue TV offerings. Had it been possible to trade spectrum between current users and mobile operators, the digitization of TV would have long been completed. This is simply because the value of spectrum in the digital-dividend band is a manifold of the comparatively insubstantial cost of migrating to lower frequency bands.

The key message of this study is that regulatory failure and political ideology have deprived South African consumers of better coverage and lower prices.

III. KEY FINDINGS OF THE SPECTRUM SEIA IN ABRIDGED FORMAT

This section is for readers who want an understanding of the main technical arguments as outlined in chapters 2 to 6 without going into the very detail. For each of the chapters, the abridged SEIA first formulates a key question to motivate the discussion. This is followed by a brief discussion of the key facts that must be considered to address the question. The complexity of telecommunication markets and the degree of public intervention entail a discussion about the socio-economic impact of government's policy interventions that touches on four dimensions:

- An understanding of the technological nature of the issues.
- An understanding of the nature of competitive markets, and an assessment of resource employment and market results informed by sound economic theory.
- An assessment of how the government views markets and market results.
- An assessment of the regulatory framework.

Key question guiding Chapter 2: Do technological facts, historical experience and economic theory back the view of spectrum as a particular (scarce) resource that requires public spectrum ownership and assignment to avoid market failure and justify the current regulatory framework?

In order to understand spectrum and the use of spectrum, we have to understand the nature of what spectrum is and how it is utilized for purposes of producing telecommunication services. Since in dynamic market economies entrepreneurs benefit from inventing new technologies and devise new commercial models to furnish consumers with better and cheaper services, markets and its structures are in continuous flux. Any historical account of the socioeconomic development during the last five hundred years is at the same time a history of technological progress and the evolution of institutional rules that govern political participation, ownership rights, legal frameworks, and matters of distributive justice, to name a few. Regulatory frameworks constitute an important part of such institutional rules, which in turn reflect the socio-economic theories that guide governments in the formulation of intervention mechanisms.

The emergence of the current regulatory framework of public spectrum assignment—that is, the prohibition of private spectrum ownership and trading—is an artefact that has neither a technological basis nor is supported by economic theory. Spectrum is a distinctive resource, but not more distinctive than milk, cars or haircuts. All sectors have self-regulating mechanisms that ensure their functioning. Why should telecommunication operators not strike agreements for the use of spectrum based on the type of private-property framework that guides all other industries?

Miraculously, the operators of the key internet peering points (IPP) that intermediate the broadband traffic flows between the five continents have not preyed on each other. In fact, they do not have a license. They simply emerged in the 1990s when the need arose to ensure a more reliable flow of cross-border and intercontinental traffic. The same happened when radio broadcasting emerged in the 1920s. They used the spectrum that was unoccupied and the very few cases of interference were settled by private arbitration.

There is no valid technological, economic or historical reason for not entrusting the telecommunication industry to own, trade and share the resource "spectrum" as players in other industries own, trade and share other resources, including "natural" resources. Logically, all resources are natural. The current regulatory framework derived its justification from contrived historical narratives and flawed economic theory. It will not survive the next decade, not only in South Africa but worldwide.

Key question guiding chapter 3: Have the spectrum policies, for which the DCDT and ICASA are responsible, created the conditions for the mobile industry to achieve the government's socio-economic goals of rural broadband coverage (to bridge the digital divide) and lower (effective) broadband data prices?

In short, the period from 2005, when the last significant spectrum resources were assigned to MTN and Vodacom, to 2017, when DCDT Minister Cwele's Department prevented the last of ICASA's three failed attempts to make frequencies available, was disastrous. When compared with other markets in South Africa's peer group, collectively MNOs may not have an unusually low total spectrum endowment. It has to be understood, however, that the current 167 MHz of spectrum assigned to MTN and Vodacom means that the two carriers are serving close to 80 percent of total South African consumers with only 30 percent of the total spectrum assigned. That is unparalleled in the world and coincides with the government's inclination to punish market leaders for competing successfully. Firms are encouraged to compete, but not succeed.

Whilst Telkom, Liquid Telecom and Rain have received generous spectrum allocations in the 2.3, 2.6 and 3.5 GHz frequency bands, which are crucial to deliver high-speed broadband in dense urban areas, MTN and Vodacom were left out in the cold, so to speak. That by itself has put MTN and Vodacom at a severe disadvantage relative to MNOs in most of South Africa's peer countries. The already difficult conditions to offer network services at low cost were exacerbated by the failure of analogue to digital migration, which refers to relocating analogue TV to lower and spectrally more efficient frequency bands. This spectrum is called "digital dividend" because, as stated above, it enables MNOs to roll out rural broadband networks at much lower investment cost when compared to the rollout in the 1.8 and 2.1 GHz bands, in which MTN and Vodacom

currently operate their 3G and 4G/LTE networks. This forces consumers to pay higher data prices than would otherwise be required.

The utilization of spectrum in the digital-dividend band is not only important for rural coverage, but even more important for affordable broadband data services in urban areas through "carrier aggregation." Carrier aggregation refers to a radio network technique that uses spectrum in different frequency bands by combining two or more carriers to increase the performance of the radio network. One of the most common types of aggregation is the pairing of the spectrum in the LTE-800 MHz band with the spectrum in the LTE-2.6 GHz band, both of which are unavailable to MTN and Vodacom. Carrier aggregation results in technically more efficient spectrum utilization leading to higher data throughput rates, reduced traffic latency, expanded network coverage, power savings and better consumer services at lower prices. Signals using the lower frequency of LTE-800 have an even better in-building penetration, thereby rectifying one of the key problems that concerns carriers in the provision of broadband services in dense urban areas.

According recent government statements, migration will not be completed before 2023. Carrier aggregation has been employed since 2015 in all countries where regulators did their job. By subverting digital migration, the government thwarted its own mobile socio-economic telecommunication goals: (a) broadband coverage in rural areas, and (b) making broadband data services more affordable.

The impact has been that only a handful of base stations have been rolled out for testing purposes to the two leading carriers. The results corroborated the fear that spectrum in the 700 and 800 MHz band is unusable on a national basis because of interference from current users. In other words: consumers will not reap the benefits of better rural coverage and more efficient use of spectrum in dense urban areas for at least another three years.

Key question guiding chapter 4: Does the government's use of the regulatory toolset in relation to competition economics strike a balance between supporting the key players in the mobile industry and keeping the market open for entry guided by evidence-based policymaking for the sake of consumer prosperity?

Economic theory of competition is a relatively primitive branch of economics. When one or two or a handful of firms serve a significant share of the market or generate a significant share of revenues, companies are accused of having excessive or "significant" market power (SMP). Contrary to popular rhetoric, this not bad for consumers. Most markets appear "concentrated" initially as it is upon a few, often one company, to shape a market until the market sector is sufficiently mature for others to enter. Consumers benefitted from Nokia's early high mobile handset market share, or Blackberry's early dominance in the smartphone market which they pioneered respectively.

Serious problems arise when competition authorities suspect "insufficient" or "ineffective" competition and supposed "market failure". It should be obvious that a high market share is more probably evidence pro-consumer competition than anti-consumer competition. Defensive regulatory agencies that place consumer prosperity above political agendas rarely find evidence of ineffective competition when markets are freely contestable. Usually, the specific production structure and the number of players in an industry emerge for sound reasons. It, for instance, makes absolutely no economic sense for three other operators to roll out rural networks in South Africa in order to compete with MTN and Vodacom in the Karoo. Does this mean that MTN and Vodacom have "excessive" market power in the Karoo? Clearly not.

If the answer is "yes" because a supposed competition expert's Excel spreadsheet spits out 45 or more percent, it tells us nothing about whether there is "ineffective" competition in these regions. To answer the question, it must first be known what "effective" or "ineffective" competition means. As there is nothing in economic theory that answers this question, the regulator has to contrive a meaning of "ineffective" competition. It might be tantamount to "ineffective" competition when, for example, some MNOs complain about not having indiscriminate access to a rival MNO's network, which is another way of saying that they are unwilling to pay market prices. Or it might be a sign of "ineffective" competition that MTN and Vodacom have not allowed dozens of MVNOs to occupy bandwidth of their spectrum-crunched network. The irony is that such misconceptions result in firms being penalised for competing effectively.

In the case of the Karoo, the regulator could force MTN or Vodacom to grant a third operator access to towers at a cost-plus "price" decided by the regulator. If, two years later, MTN's and Vodacom's market shares have dropped to 34% and the third operator serves 33%, competition would be deemed effective mistakenly. The fact that such interventions lead to higher consumer prices and lower profits—with lower taxes and investments—plays a subordinate role in the regulatory drive for cosmetically "effective" competition. Regulators evade thorny questions such as whether this would benefit consumers. In their response to the Market Inquiry into mobile broadband services (and data prices), MTN pointed out that "… it is insufficient, as a matter of economics, to determine a market failure on the basis of market shares alone."

Imagine two established hairdresser salons in a small town that have been around for twenty-five years. Customers are happy. Various attempts to establish a third salon failed. The latest entrant, Tel-Hair now seeks government intervention arguing that the established salons have a lower cost base as they have amortized their buildings, appliances and interiors many years ago. They can use these sunk costs to undercut the prices of the new competitor and thus present a "structural" barrier to entry in accordance with Section 67(4A)(a) of the ECA. The regulator sends a team and finds out that indeed the established players have an "unfair" advantage and impose two interventions: (a) the

two established hair salons must increase their prices by 10.42% based on the hypothetical cost base they would incur were they to build a new salon, and (b) they must grant Tel-Hair access to the expensive hair-drying machines and other resources at cost-plus 5%. For this purpose, the two established salons must provide a room where customers opting to dry their hair are granted indiscriminate access. The costs are to be borne by the two incumbents, which the regulator considers "fair" given the two existing players' entrenched market position and better financial endowment.

It is torturous for believers in Marxian economics to find that MTN and Vodacom still serve 75 percent of the market after 25 years. As spectrum withholding and generous assignments to other operators have not changed their leading position, a mistaken proposal is to impose competition through a government-created Wholesale Open Access Network (WOAN). When the first concrete ideas were presented in 2017 in a policy White Paper, the DCDT contemplated withdrawal of all exclusively assigned spectrum on the basis of which MNOs have invested hundreds of billions of Rands. All spectrum would be pooled into a kind of spectrum park to be managed by a public wholesaler. The fact that the government proposes policies that are tantamount to the expropriation of a key resource of one of the most successful industries in South African history is indicative of potentially disastrous misconceptions. It also exhibits fundamental disrespect for the vital institution of private property. Luckily, reason prevailed when Minister Cwele put it mildly: "*For you to lay down your network on the basis you have spectrum, and then if your spectrum is removed, it may affect your continuing investment and cause uncertainty*."[2]

The idea of a WOAN reveals the general problem of what Business Day columnist Stuart Theobald described as not having "a culture of evidence-based policy-making." To the extent that there are a few examples of WOANs in other countries, most prominently the Mexican *Red Compartida* created by the government as a PPP, there is no evidence that such constructs will succeed. Those who have been led to believe that in the special case of *Red Compartida*, the operator is building infrastructure where there is no broadband (in order to bridge the digital divide), will be disappointed to hear that services are being expanded where existing networks already exist. We commend the Technology Policy Institute's podcast on *Red Compartida* to all wishing to understand the adverse rent-seeking character of WOAN artefacts.[3]

In exchange for keeping their existing spectrum on an exclusive basis, South Africa's MNOs promised to off-take 30% of the capacity of the WOAN that would be established by the time new spectrum will be made available by auction. The auction, finally, appears to be happening by March 2021 when 326 MHz high-demand spectrum is planned to be put on auction. A further 80 MHz is reserved for the WOAN. At the time of writing, the "incentives" (a euphemism for coercing off-take payments) upon which the livelihood of the WOAN artefact would rest, the ownership structure, and the concrete role of

government, remain unclear. Had the government created the WOAN in 2018 and endowed it generously with spectrum while continuing to withhold spectrum from MTN and Vodacom, it might have had a chance of establishing itself in "the market." But sometimes the slow-grinding regulatory mills allows market players to come up with solutions in ways that seem mundane at the time but, over time, turn out to change the industry structure far beyond what might have rendered an idea previously plausible. (This is elaborated below.)

When ICASA's 2017 attempt to auction spectrum was thwarted by the DCDT, carriers set about doing their best to work around the government-created spectrum crunch. Two acquisitions paved the way. In 2015 investors bought WBS (iBurst), which in 2017 was rebranded as Rain. In 2017 Liquid Telecom took over ailing fixed-line operator Neotel. With these takeovers, the new owners acquired high-demand spectrum that MTN and Vodacom had been denied. It was therefore no surprise to industry experts when in 2018 and 2019, "roaming" agreements between MTN and Vodacom (on off-taker side), and Rain and Liquid Telecom (on network wholesale side) were announced. This eased the leading carriers' government-created constraints in urban areas.

ICASA approved these agreements, which effectively amount to the sharing of infrastructure (BTS, antennas, tower space, sites) and spectrum, because the regulatory framework did not provide a legal basis for rejecting the deals. Considering that, since 2019, Cell C has been roaming on MTN's network (slowly but surely morphing into an MVNO) and Telkom has been roaming on Vodacom's network, the market has been moving towards a "shared" network for the benefit of consumers. In other words, through past assignments of high-demand spectrum that was underutilized as well as allowing more potent investors to put them to use, the government inadvertently paved the way for the industry to create a free-market WOAN. The difference between the WOAN as planned by the government and the free-market WOAN is that, in the latter case, access to other carriers' networks is open subject to paying market prices and respecting property rights while the former artefact rests on coercion and the violation of property rights.

The fact is that there is already a WOAN and a government WOAN will serve no useful purpose. The market based WOAN will be expansive, dynamic and innovative to the extent allowed by government.

This SEIA shows that after the successful completion of the spectrum auction in March 2021, carriers will have sufficient spectrum resources across all high-demand frequency bands to provide cost-effective rural LTE-800 coverage and spectrally efficient high-speed broadband by utilizing carrier aggregation. The government's regulatory apparatus should focus on one task only: to fast-track analogue to digital migration, the lack of

which prevents consumers reaping socio-economic benefits associated with spectrum that is fully usable, securely held and freely tradable.

Key question guiding chapter 5: Is the assignment of emergency spectrum in combination with the upcoming auction due to take place by March 2021 likely to signal the end to counter-productive spectrum and competition policies?

Of a total of 446 MHz of emergency spectrum assigned, carriers could, for legitimate and foreseeable reasons, utilize just 15 percent (66 MHz) immediately. Only Telkom, Rain and Liquid Telecom have been assigned emergency spectrum in bands where they were already operating radio infrastructure. All of the 300 MHz of the emergency spectrum assigned to MTN and Vodacom is outside of the frequency bands that carry roughly 80 percent of South Africa's data traffic. To use this, MTN and Vodacom would need costly new radio equipment that operates in these frequencies. Understandably, carriers are hesitant to undertake substantial investments based on *temporarily* assigned spectrum that they might be required to return to the regulator, thus nullifying the viability of their investment.

Another important aspect is that Vodacom and MTN have been utilizing spectrum in the 2.6/3.5 GHz bands through their "roaming" agreements with Rain and Liquid Telecom. According to industry sources, MTN and Vodacom have limited their emergency spectrum-related rollout to the 2.6 GHz band where they had installed an estimated (combined) four hundred base stations by November 2020. Considering that Vodacom and MTN own 17,000 towers between them and collocate on an additional few thousand towers from third parties, the share of new base stations operating on the emergency spectrum is a meagre 2 percent of all radio modules in operation. The fact that MTN's and Vodacom's networks were able to cope with the traffic surge induced by the lockdown is unrelated to the few additional base stations in the 2.6 GHz band.

The assignment of emergency spectrum, however, is important for two reasons. Firstly, it demonstrated that dormant spectrum was, as critics had observed, readily available despite being withheld for years. A pandemic was needed to force the government to act quickly and unbureaucratically without imposing undue costs and delays.

Secondly, once spectrum is in the market and carriers invest in radio equipment making use of spectrum, it is inappropriate to claw it back.

The emergency spectrum is largely identical to the spectrum that will be put on auction in March 2021. As discussed in Chapter 2, according to economic theory the crucial condition for resources to be employed for the sake of consumer prosperity is that they are *in* the market and out of the hands of government. If this condition is met and regulators do not restrict trading, sharing and pooling of spectrum, the South African

mobile telecommunication market will have sufficient spectrum to roll-out rural broadband at much lower cost and provide better and cheaper data in dense-urban areas.

The answer to the question at the commencement of this section is in the affirmative, provided that the government completes the digital migration without further delays, and an ideologically motivated WOAN artefact does not drain the sector of resources.

To accommodate the further increasing bandwidth needs and use cases with specific quality requirements, abundant spectrum resources below 700 MHz and in the L, S and C Bands between 1.0 and 8.0 GHz are available that could be released relatively quickly were current holders able to trade it on market terms. Likewise, the dynamic, demand-driven sharing and pooling of spectrum and network infrastructure among carriers to support mission-critical (high-bandwidth and/or low-latency) use cases in dense-urban areas will soon become a reality that will render the static regulatory model unfit for the future needs of consumers.

To allow consumers to derive the full benefits of spectrum and network infrastructure sharing and pooling, it must not succumb to the myth that co-operation is "collusion".

Key question guiding chapter 6: Is the current regulatory framework of assigning spectrum to MNOs (and other economic entities) on an inflexible exclusive basis fit for the future of further massive increases in data demand and cutting-edge innovations in the 5G/IoT world?

It is not. The current practice is to assign spectrum for exclusive use to individual carriers in fixed (often arbitrary) frequency blocks through national licenses in conflict with geographical and demographic factors. If the current technological developments in the 5G/IoT lead to densification levels anywhere near what levels experts are expecting, this will show the limits of administrative spectrum distribution even more mercilessly. The reason is that the further increases in bandwidth demand and specific quality requirements of mission-critical use cases, for example the monitoring of critical infrastructure or health-related applications, will require to utilize the spectrum where it is most needed in a dynamic fashion. The technology of dynamically assigning spectrum according to bandwidth needs is ready to be applied. The current planning of mobile telecommunication networks and utilization of spectrum, in contrast, is still a static, largely manual process. This is an inevitable result of all public licensing and concessioning regimes, which effectively cartelize the use of spectrum among a closed group of users. This is an inevitable result of all public licensing and concessioning regimes, which effectively promote regulatory cartels, in this case amongst a deliberately closed group of users. It is well-known that public licenses along with their onerous regulations slow down markets and reduce the pressure to introduce innovations. Yet, this is about to be transformed by rapidly advancing technological progress.

The rapidly increasing capabilities and computing power of machine-learning technologies pave the way for networks that are self-optimizing and self-healing. According to a White Paper published by the World Economic Forum,[4] networks are already approaching a point where it will be impossible for human beings to control and manage networks and rectify network incidents by using manual interventions. As the functions of networks become virtualized on standardized hardware shells, automated networks will be a reality soon. The one implication of this development is that the utilization of spectrum resources will happen dynamically in an automated fashion—across carrier boundaries. For this to work, spectrum must become a commodity traded on the spot. Whether it is worthwhile for MNOs to own spectrum for commercial or technical reasons must be seen. Irrespectively, it will make sense for carriers to optimize spectrum utilization by pooling it if use-cases in dense-urban areas provide the economic rationale to do so. The second implication is that the current regulatory practice of assigning spectrum on an exclusive-use basis will soon be a thing of a past. Once spectrum resources become allocated dynamically, driven by consumer demand in accordance with the market principles of marginal cost and marginal benefit. Regulators who bear no risk or cost for harm inflicted on consumers are incentivized to promote negative, tardy and haphazard spectrum policies. If regulatory wisdom prevails, this will be a relic of the past.

IV. SOCIO-ECONOMIC IMPACT ASSESSMENT OF SPECTRUM POLICY IN SOUTH AFRICA

1. Structure of the SEIA Study

To render the formal part of SEIA which follows more comprehensively, there is some repetition.

It provides an overview of the regulation of the South African mobile sector with particular focus on the public assignment of spectrum. It argues that due to flawed assumptions regarding (a) the economics scarce spectrum resources and (b) ideologically distorted conceptions of competition, a number of interventions have undermined the telecommunications sector. The cost of sub-optimal policies is ultimately always borne by consumers. In an increasingly complex market with constant technological progress, the regulator has largely lost its coordinating function and - not only in South Africa - has become an obstacle to further innovation, investment and development.

Chapter 2 starts with a brief overview of the technological basis of the use of spectrum in telecommunications followed by a historical account of the use and allocation of spectrum by government agencies and the development of mobile technology. It then discusses the arguments that serve as justification for state ownership and public licensing of spectrum. It is made clear that there are no logical grounds for the regulatory a priori presumption that private ownership and free trading of spectrum leads to market failure.

Chapter 3 addresses the problem of government failure during the past 15 years. This failure must be seen in the context of South African competition policy which focusses mistakenly on the number of firms and their market shares, and which assumes that consumers are better served by more firms with smaller market shares. This profoundly flawed conception of effective competition has resulted in misguided concepts of "non-discrimination," "exclusivity" and "open access". These are addressed in Chapter 4. Understanding what the government considers fair competition and how this thinking translates into regulatory approaches is fundamental to understanding the idea of both WOAN and spectrum policy.

In Chapter 5, this SEIA progresses to 2020 and analyses the award of the Emergency Spectrum, the planned auction of high-demand spectrum in March 2021, and the specific ideas that underpin the creation of the WOAN. It is specifically argued that South Africa already has a WOAN and would, in any event, not derive net benefits from a government-created WOAN artefact. Through "roaming" agreements between the spectrum-starved market leaders MTN and Vodacom, and wholesale providers Liquid and Rain, as well as further arrangements between Cell C, MTN, Telkom and Vodacom, there has long been a

functioning and efficient market-based WOAN which includes all 6 MNOs. This WOAN emerged because the leading MNOs were forced to satisfy increasing data demand whilst confronted with government hoarding of superfluous spectrum.

This SEIA concludes with an outlook on the future development of the mobile market and the consequences that will result in flexible and efficient spectrum allocation and use. The conclusion is that spectrum regulation as we know it should soon be history because consumer needs will expose flaws in rigid and bureaucratic assignment and constricted use of spectrum.

A key finding is that South African regulation of the mobile market has mistakenly been imposing excessive costs on consumers.

Whereas most countries have been using LTE-800 and carrier aggregation for five years or more, South Africa is still far behind, especially because of its failure to implement digital migration. Instead of making resources worth hundreds of billions of Rand available, large amounts of spectrum have remained unutilised or underutilised. As explained above, had spectrum trading been allowed, the digitization of TV would have long been completed simply because the value of spectrum in the digital-dividend band is a manifold of the relatively insubstantial cost of migrating broadcasters to lower frequency bands.

Regulatory failure and political ideology have deprived South African consumers of better coverage and lower prices.

2. Understanding Spectrum: Technology, History, Regulation, Economics

2.1. Technological Basics: Spectrum Utilization and Carrier Aggregation

In this section, a brief treatment of the technological nature of spectrum in the context of mobile telecommunication is given. The study assumes that readers have a basic understanding of the technical principles of cellular networks and the provision of services. One of the key aspects in the technical design of cellular networks and the commercial viability of service offerings concerns the relationship between the availability of electromagnetic spectrum in a particular frequency band that radio modules use to propagate signals and the cost of network rollout. As a general rule, spectrum in lower frequencies such as in the 700-900 MHz bands are suitable to cover relatively larger geographical regions with less infrastructure compared to utilizing spectrum in higher frequency bands such as 2.6 GHz or 3.5 GHz. Signals from radio modules that use low frequencies for signal transmission can also penetrate buildings better. Higher frequencies, in contrast, allow for superior data throughput rates but the signals fade out quicker and penetrate buildings less effectively with increasing frequency. Mobile networks that use high frequencies require a far denser footprint, which becomes more pronounced the higher the traffic load per network cell.

Informed readers know that there is no such thing as the ideal spectrum for all use cases. It is also not the case that some frequencies are utilizable *per se* while others are not. The development of the first GSM-radio standards was mainly premised upon what frequencies were available, which were the bands of 900 MHz and 1800 MHz. It could have been equally well the pair of bands in the 600 MHz and 1500 MHz frequency range or the pair of 1000 MHz and 1300 MHz. The same applies to the bands utilized for the first data standards. Since the lower frequencies, however, were occupied by broadcasters and other users, 900 MHz was the logical choice for voice services because of its propagation characteristics and the relatively low bandwidth requirements. Since the early 1990s, the development of radio technology has made quantum leaps, in lockstep with equally impressive developments in all other areas of mobile telecommunication value chain such as data compression and transmission technology via fibre, antenna technology, user devices, wireless chipsets, to name but a few. As different countries in different regions have a different history of utilizing spectrum for purposes of radio and TV broadcasting, over the course of the last thirty years a diverse array of different cellular standards across the entire utilizable frequency range emerged.

All spectrum between 600 MHz and 2000 MHz could have been utilized for GSM. Spectrum in the 900 MHz band was the best available at the time across global jurisdictions.

Yet, it turned out that the spectrum most suitable for purposes of providing data broadband services in rural areas, which are typically characterized by low population densities and below-average incomes, could not be utilized to the greatest advantage of consumers. The reason, which is still valid today, is that the employment of spectrum resources has been subjected to regulatory constraints that run counter to the economic principles, the validity of which we take for granted in other markets (which we will discuss in next section 2.2). From the 1920s until the late 2000s, it was regulatory practice to assign spectrum to link the use of frequencies to the production of a specific service and also to prescribe the use of a certain technology, say, the use of radio broadcasting technology using 10 MHz of spectrum in the 550 MHz frequency band to transmit TV signals, or the use of GSM radio technology employing 2x11 MHz in the 900 MHz frequency range to transmit GSM voice.

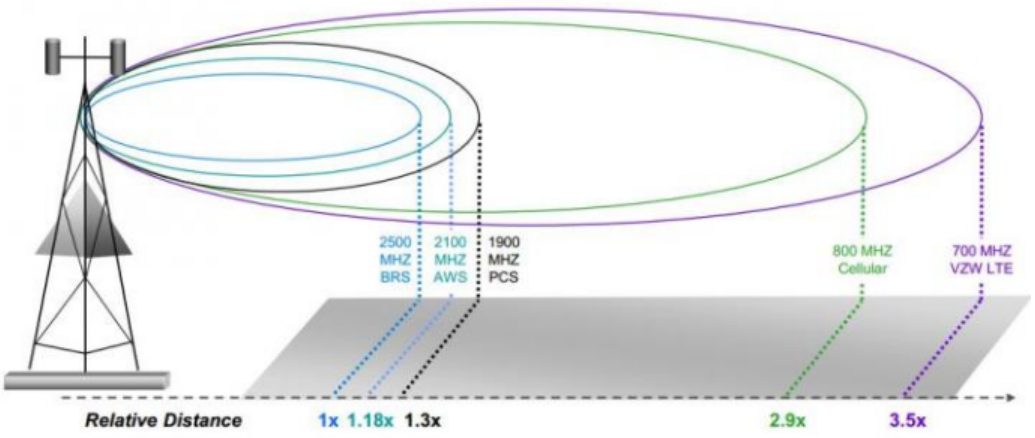
Only a few years after the first mobile networks were launched, mobile operators and regulators realized that such fixed assignment of frequencies was tantamount to a hugely ineffective utilization of spectrum resources. In other words, there was no market mechanism that would have allowed existing spectrum users to economize on spectrum based on market principles—that is, consumer preferences. At the time, regulators could have decided to liberalize the use of spectrum. Yet, political entrepreneurship and the ability to extract rents from the mobile sector resulted in regulators clinging to their mandate of trickle-feeding markets with spectrum in time-consuming and protracted regulatory processes. The received wisdom was and still is that liberalization of the spectrum market would result in "market failure", which is to say that mobile operators would be unable to agree on mechanisms to avoid interference and spectrum hoarding, to mention two of the most common regulation dogma concerns. From the early 2010s, the distrust of market-based allocation of spectrum has resulted in a cumbersome regulatory process of migrating broadcasters to lower frequencies in order to free up spectrum for cellular use. The migration process is guided by non-binding recommendations of the ITU. However, every country is free to progress at its own pace. South Africa is among the world's laggards. The set-top box saga that kept the public waiting from 2013 to 2017 was an embarrassing example of government failure. It is also a key reason why South African consumers pay higher prices than they would otherwise have. Rolling out networks based on the spectrum assigned since 2005 is more costly than it would have been had the migration process been properly managed and spectrum in the 700/800 MHz band been freed up.[5] In a piece on brainstormmag.co.za, Admire Moyo (2019) states:

> Progress of South Africa's digital migration project is like watching the Titanic movie. You know the collision will happen, the ship will sink, and you know it's too late to change the script.[6]

In this SEIA, the term "digital dividend" is interpreted to refer to the spectrum freed up as a result of migration of TV broadcasting from analogue to digital.[7] It is a "dividend"

because the frequency range where the spectrum used to be assigned for analogue TV is particularly suitable to roll-out lower-cost rural broadband networks. Figure 1 below illustrates the relationship between frequency bands and network cost under *ceteris paribus* conditions.

FIGURE 1: RELATIONSHIP BETWEEN FREQUENCY RANGE AND NETWORK COST



Source: Verizon[8]

Two aspects are important for the discussion of the market situation in South Africa. First, around 2010 the first network trials of LTE-800 were carried out. A couple of years and a few technology leaps later, the combination of a high-capacity radio broadband standard and greatly improved antenna technology began to be rolled out across the globe providing broadband connectivity to regions where 3G proved to be too costly and fibre or copper-based DSL networks were equally unviable. Self-evidently, the introduction of the LTE-800 network presupposes that the frequency band is cleared through the migration of broadcasters to lower frequency bands. According to the timelines set by the ITU, the migration process often termed "digital switchover" was to be completed latest in 2015. Many countries in the same income group are still to fully complete the digital migration from the UHF analogue broadcasting band (470-790/862 MHz) to the VHF digital broadcasting band (49-216 MHz).

In the context of South Africa, the early release of spectrum to employ LTE-800 would have enabled MNOs to achieve vastly improved network economics in suburban and, particularly, in rural areas. To achieve the same network coverage of LTE services in the 1.8 GHz and 2.1 GHz frequency band used by South Africa's MNOs,[9] rolling out networks utilizing spectrum in the LTE-700/800 band currently occupied by broadcasters, as a rough rule of thumb, only requires 40 percent (1.18/2.9) of the infrastructure (i.e., eNodeBs, antennas, microwave links, diesel generators). The difference becomes more pronounced when comparing 700 MHz with the soon-to-be-auctioned 2.6 GHz or 3.5

GHz bands. As to the timeline set by 2015, few middle-income countries, if any, are further behind than South Africa. While it is true that the migration has not been fully completed in peer-group countries,[10] LTE in sub-1 GHz bands have been successfully deployed, for example LTE-800 in Kenya[11] since 2014, LTE-700 and LTE-800 in Brazil[12] and Argentina[13] since 2016 and 2017, respectively, and also in 2016, LTE-800 in Ghana[14] and LTE-450 in Russia.[15] The availability of spectrum in the sub-1 GHz bands becomes even more important when it is understood that it opens the door to reaping the significant benefits of carrier aggregation.

The regulatory practice of assigning spectrum on the basis of technology and the prohibition of spectrum trading means that MNOs cannot acquire sub-1 GHz spectrum occupied by analogue TV broadcasters—an economic mistake for which the consumer pays the price in the form of lower rural coverage and higher data prices.

"Carrier aggregation" is the technique that uses spectrum in different frequency bands by combining two or more carriers to increase the performance of radio networks. Among other factors, carrier aggregation results in a technically more efficient use of spectrum resulting in increased data rates, reduced traffic latency, expanded network coverage, power savings,[16] and leveraging of underutilized spectrum. One of the most common types of aggregation is the pairing of spectrum of LTE-800 MHz with spectrum in LTE-2.6 GHz. The use of LTE-800 MHz is not only the most successful radio standard for purposes of rural coverage. It is also highly useful to provide general coverage of urban and suburban areas due to its capacity-enhancing characteristics when combined with bands of 2.6 GHz or 3.5 GHz. Moreover, signals using the lower frequency of LTE-800 have a much better in-building penetration, thereby rectifying one of the key problems carriers are concerned with in the provision of broadband services in dense urban areas. Carrier aggregation is an ingenious technology to optimize the spectral efficiency of existing radio modules operating in different frequency bands. Carrier aggregation does not only result in better services at given retail prices (that is, lower effective prices), it enables MNO to save Capex for other investments. It also leads to a better utilization of existing spectrum assigned to carriers, even more so when MNOs are allowed to employ carrier aggregation across carrier boundaries.

The other dimension that needs to be considered is the channel bandwidth. Spectral efficiency can be improved with wider channel bandwidths. The ITA (Invitation to Apply) for the upcoming auction is based on 2x5 MHz lots for 700/800 MHz bands (4 lots for each).[17] It might aim to accommodate more players having access to digital dividend spectrum, yet it fails to consider the efficiencies that can be achieved with wider bandwidths. Similar to the digital-dividend sub-1 GHz bands, a small dicing approach has been pursued for 2.6 GHz and 3.5GHz bands, which are diced into 10MHz lots. The

proposed spectrum caps further add to the complexity as they may limit the ability of MNOs to acquire multiple lots in desired bands to improve the economics of their networks.

The proposed structure of spectrum lots chooses to ignore market realities. MTN and Vodacom are the only two operators with a national footprint. They will continue to be the dominant players. Cell C, in turn, decided to dismantle its RAN and roam over MTN's networks. Telkom has no significant rural footprint and roams on Vodacom in non-metro areas. Rain and Liquid Telecom's business model is premised on providing infrastructure and spectrum-sharing services to the two large operators allowing MTN and Vodacom ease the constraints imposed by the failed spectrum policy. The government is to be complimented for allowing the current roaming agreements between Rain/Vodacom, Cell C/MTN, Liquid/Vodacom, Liquid/MTN and Telkom/Vodacom whereby smaller operators leverage their spectrum to meet larger operators' requirements rather than using it to deploy their own physical networks.

The sizing of spectrum lots is arbitrary. It is informed neither by technological reasons nor by goals to maximize consumer advantage. Lots should, at least, be large enough to be commercially viable and directly usable.

Under prevailing competition policy, roaming and aggregation could have been condemned as "collusion". This misconception inflicts needless harm.

As to the lot-sizing in the upcoming auction, it is not implausible to think that the proposed smaller spectrum lots may enable smaller operators to acquire spectrum and then make it available to larger operators through "roaming" deals. In the end, subscribers pay the cost for the added complexity of denying MTN and Vodacom the spectrum they would naturally acquire by forcing them to partner up with smaller operators. It is rather ironic that former state-entity Telkom is threatening legal action to revoke one of the (not their own) roaming agreements by which Vodacom and MTN seek to ease the spectrum constraints created by the state (as will be discussed in greater detail in chapter 5.3). Finally, the small lot-size will make it more difficult to meet the required performance obligations such as a throughput of 5Mbps at the edge of the cell. The resulting need for denser sites and associated Opex of using spectrum in small chunks leads to increased network cost that must be recovered through higher prices.

2.2. History of Spectrum Regulation until the 1990s

In 1959, Nobel Laureate, Ronald Coase, wrote a seminal paper on wireless spectrum in which he argued that spectrum should be allocated via public auctions to firms that would own the spectrum, which was regarded as an outlandish proposal at the time (Hazlett 2017). In 1978, two FCC commissioners remarked that the chances of the FCC holding

an auction to assign spectrum licenses were "about the same as those of the Easter Bunny in the Preakness" (Nuechterlein and Weiser 2013, 98).[18] Two decades later, however, this is what regulators began to do (not least to reap juicy tax revenues). There are, however, two principal problems with Coase's approach. First, in line with what most people held (and continue to hold to this day), Coase (1959) regards spectrum as a scarce, finite resource. Second, he accepts a priori public ownership of spectrum, which is to say that he grants governments the mandate to auction off spectrum and reap the proceeds. Yet, in the first paragraph of his paper, he asks how the FCC came to acquire its power to choose among the applicants of broadcasting and television stations and to withdraw the licenses. The common narrative is that in the early stages of broadcasting, a chaotic market was not able to solve interference problems deriving from free spectrum usage. The only way to handle the problem, thus, was to entrust a central state agency with the ownership and granting of spectrum rights. Coase (1959, 14) debunks this reasoning, which

Spectrum is a scarce and finite resource. But so are all other resources, which is why humans economize. There is nothing distinctive about spectrum. Economics is the study of human action concerned with finding the most beneficial use of scarce resources, i.e. *all* resources.

> seems to ascribe the confusion which existed before government regulation to a failure of private enterprise and the competitive system. But the real cause of the trouble was that no property rights were created in these scarce frequencies. We know from our ordinary experience that land can be allocated to land users without the need for government regulation by using the price mechanism. But if no property rights were created in land, so that everyone could use a tract of land, it is clear that there would be considerable confusion and that the price mechanism could not work because there would not be any property rights that could be acquired. . . . A private-enterprise system cannot function properly unless property rights are created in resources, and, when this is done, someone wishing to use a resource has to pay the owner to obtain it. Chaos disappears = and so does the government, except that a legal system to define property rights and to arbitrate disputes is, of course, necessary.

Coase's solution is to create property rights in spectrum by auctioning off the scarce resource to the highest bidders. To the extent that licensing spectrum allocates legal rights to spectrum licensees, the rights do not represent ownership but only rights of exclusive use for a period of typically fifteen to twenty years. The ultimate holder of spectrum rights remains the state, which is able to withdraw usage rights. Though, to my knowledge, no large carrier has been denied renewal of its license to one of the frequency blocks on which the core services of MNOs rest, licensing gives regulators undue power to enforce certain policies, such as increased rural coverage or lower data prices. The bigger problem, however, is that spectrum lessees cannot trade or share spectrum without

the consent of the public regulator. Some more progressive regulators, such as Ofcom in the UK, have been warming up to the idea of sharing licensed spectrum and shifting toward less cumbersome regimes for tapping into unused spectrum—for instance, boosting rural connectivity and allowing the rollout of bespoke mobile networks on the local or regional level.[19] As welcome as these policies are, they will end up producing enormous regulatory complexity and a decreasing ability to assign spectrum in an economically meaningful fashion. By economically meaningful, it is referred to the fact that private ownership of productive resources in combination with market prices of consumer goods, in which the values of factor inputs become imputed, tends to take into account the opportunity cost of alternative uses.

In his landmark paper "*The Rationality of U.S. Regulation of the Broadcast Spectrum*," Thomas Hazlett (1990) interprets the emergence of public spectrum assignment, beginning with the Federal Radio Act of 1927 in the United States, as a result of a deliberate political process that sought to realize an equilibrium solution for competing economic and political interests by bringing together "a rent-sharing arrangement created from the proceeds generated in the spectrum-assignment process" (1990, 134). Like Coase (1959), Hazlett exposes the myth of the alleged "breakdown of the market" due to interference. Until 1926, the broadcasting market had worked remarkably well, which included trading of broadcasting licenses and spectrum sharing between broadcasting companies without any regulatory intervention.

The alleged need for public ownership and assignment of spectrum to avoid market failure is not grounded in historical facts.

It is correct that the market broke down and that interference paved the way for the FCC to assume the mandate it holds until today. The question to address, however, is whether the interference that led to the breakdown of the market was itself a result of the market. And here Hazlett's (1990) careful historic study of the true events that unfolded in 1926–27 debunks the received wisdom of the origin of spectrum regulation. The reason for the breakdown of the market in fact is the deliberate destruction of the market itself that ensued when the Hoover administration effectively declared vested (property) rights of existing broadcasters, who were the users and de facto owners of the spectrum, open for grabs. Following the *Oak Leaves* judicial decision in 1926, which established existing broadcasters' spectrum property rights (factually homesteaded by employing a previously unused resource for the benefit of consumers), the Hoover administration made the decision to issue broadcasting licenses to each applicant at no cost, granting them the "right" to choose any wavelength irrespective of its current use; that is, the government ceased to serve its single most important function of protecting private property rights. The historical events cannot but be regarded as a deliberate attempt to discredit and destroy a market that in its early stage had worked remarkably well.

The conclusion of Hazlett's historical account is that a market solution—in his words, a "common-law solution"—in response to the alleged tragedy of the commons was seen by the creators of the regulatory system as a politically unsatisfactory alternative. It does not surprise the historian when she finds the explanatory factors behind economic occurrences and outcomes to be a result of political solutions carried out by bearers of sovereign force, which more often than not explains the tide of economic events. In the specific case of spectrum regulation, no one expects regulators to reveal as a fairytale the story of the self-destroying nature of private spectrum markets that results from people's inherent tendency to prey on other people's property and create the inevitable tragedy of the (spectrum) commons. The economic discipline, however, should scrutinize the economic theories, or narratives rather, on which regulatory systems continue to be built almost a hundred years after the *Oak Leaves* decision.

Given that neither economic reason nor historical evidence lends any support to the conjecture of failing spectrum markets, we do not see any economically or commercially valid reason why spectrum should continue to be assigned based on nation-states' borders. If it were possible to organize ownership and service provision of spectrum and infrastructure by technical category and the commercial merits of use cases, national regulators and national operators would cease to exist much faster than they would otherwise.[20] We will probably see the same thing happen to spectrum as happened to the voice minute: it will become a commodity, only in this case it will be traded between firms and not between firms and users.

A Brief Excursus on the Notion of "Market Failure"

The term "market failure" is used and abused to legitimise policies that are not independently rational. Since "markets" as such do not have objectives, the concept of "market failure" is inherently flawed. Only people have objectives. "Markets" are simply people transacting. What is called "market failure" is when the spontaneous outcome of what freely transacting people do is not the outcome someone whimsically prefers. But who is to say that the cumulative effect of what freely transacting people do is a "failure"? It could more plausibly be called "market success".

Externalities, such as pollution, are a different matter. These are concerns about non-economic phenomena, for which sound economic analysis is also essential, but in a different context for different purposes.

Merely declaring spectrum usage to be "market failure" is not evidence of anything failing. For the term to be used plausibly, there is a heavy onus on the person using it to:

(a) explain why the revealed market preference of participants is sub-optimal,

(b) define and quantify what is considered superior, and why, and

(c) why the intervention proposed is likely to achieve the desired departure from a market order.

In the absence of this burden of proof being convincingly discharged, there is no reason to suspect or allege "market failure".

2.3. History of Mobile Telecommunication since the 1990s

One reason for the success of mobile telecommunication network in lower-income and emerging markets is that access to cellular services does not rely on physical connections to residential premises. Also, while fixed telephony requires subscribers to have a dedicated access (local loop), a radio signal is picked up wherever one goes, assuming coverage. This made it easier to cover densely populated areas in a relatively short time. These factors, however, only explain the success to a limited extent. The true reasons are entrepreneurial freedom and little regulatory interference.

Governments in lower-income countries emulated the Western model of providing fixed-telephony services through a public monopoly that owns and operates all parts of the value chain. The first issue with fixed-line telephony is that it will not work where no electricity is available. As grid access in 1995 in lower-income countries was only 37.7 percent in lower-middle-income countries, two-thirds of the market was not addressable.

Considering the substantial imprecision of access-rate data, as discussed in section 2.2, and the very low median incomes in these countries, a maximum of 10 percent of the entire population, in many countries much less, constituted the market that fixed-telephony operators could serve. If the goal of universal service provision is one of the important reasons for the decision in Western countries to run telephony services as a public utility, then the potential market in lower-income countries after World War II should not have supported decisions to pursue the same goal.

Yet fixed telephony was of course a basic service important to industry, commercial business, and public entities. Moreover, we probably have to understand universal-service levels as goals that policymakers believed to be realistically achievable within, say, one to two decades. As long as public fixed-line monopolies could get closer to the goal with reasonably quick leaps, public provision could still have been defended against its critics by arguing that the goal of universal service was not a goal for the medium run but for the long run. This means that the argument could be supported on empirical terms if fixed-line telephone subscriptions had been substantially extended over the course of, say, ten or twenty years. What follows is a statistical overview of subscriber-penetration levels in lower-income countries, which do not support such reasoning.

The data on fixed-telephone subscriptions in table 1 are taken from the World Bank Development Indicators database.[21] It is immediately visible that penetration levels in both low-income and lower-middle-income countries were extremely low at all times. In comparison to the roughly 10 million subscriptions in the two lower-income groups in 1985, in upper-middle-income and higher-income countries 52 and 335 million subscriptions respectively were reported. This means that only higher-income countries achieved the penetration level of 35 percent that is in line with the idea of universal service, bearing in mind that fixed-line connections were paid for by households and that an average household size in the 1980s was 2.5 to 3.0. In upper-middle-income countries, however, the subscriber-penetration rate in 1985 was also at a very low 3 percent. Without China's low number of 3.1 million lines, the subscriber-penetration rate in the upper-middle-income segment looks a bit better at 6.3 percent, but it is still far from being in line with the notion of universal service.

TABLE 1: FIXED-TELEPHONE SUBSCRIPTIONS IN LOW-INCOME AND LOWER MIDDLE INCOME COUNTRIES

Fixed-telephone subscribers (million)	1960	1965	1970	1975	1980	1985	1990	1995
1 Low-income	0.09	0.15	0.25	0.41	0.68	1.66	2.02	2.76
in % of population	0.1%	0.1%	0.1%	0.2%	0.3%	0.6%	0.6%	0.7%
2 Lower-middle-income	2.18	2.89	4.39	6.57	9.09	14.17	21.11	37.66
in % of population	0.2%	0.3%	0.4%	0.5%	0.6%	0.8%	1.1%	1.8%
3 Lower-middle-income less India & Ukraine	0.65	0.67	1.31	2.30	3.14	5.81	9.01	17.37
in % of population	0.1%	0.1%	0.2%	0.3%	0.3%	0.5%	0.7%	1.2%
4 Low-income Sub-Saharan Africa	0.18	0.27	0.40	0.50	0.68	1.15	1.56	1.56
in % of population	0.02%	0.02%	0.03%	0.03%	0.04%	0.06%	0.07%	0.09%

Source: World Development Indicators Database, World Bank

Based on the subscriber numbers of lower-income countries, by the end of the 1970s it was becoming clear that the natural-monopoly model could not be politically defended by reference to equitable and universal access, which should have been the result of the utility model at least to a certain degree. Hence, the economic theory of natural monopolies as such had to suffice to justify the monopolization of the sector. The theory's narrative was that competition is not possible in fixed-line telephony because of economies of scale and sunk costs. Under such conditions, a private monopoly would emerge that would maximize profits and leave some consumers unprovided (which would lead to social welfare losses as the monopoly would not capture consumer rents). Even if we assume the validity of the theory and assume that public carriers in low-income countries did their best to fulfil their mandate, it is unlikely that competitive markets could have done worse. Just note that public carriers on the whole subcontinent of sub-Saharan Africa (excluding South Africa) managed to roll out merely 1 million new connections between 1960 (0.18 million connections) and 1985 (1.15 million). Put differently, even under the counterfactual assumption of a free market inhabited by the most predatory breed of private firms conceivable, the result could not have been worse for society. Private firms would have very likely found ways to roll out more connections, diversify products, and differentiate their pricing because they would have had to make a profit (in contrast to public operators). And, of course, the operators would have charged very high prices, possibly higher prices than the subsidized prices that served a few tens of thousands of (mostly public) customers in sub-Saharan Africa's capitals.

The natural-monopoly doctrine held that infrastructure markets naturally result in monopolies, which is why governments have to step in to avoid market failure. Is it hard to imagine, however, that private players could have failed more convincingly than public fixed telecommunication carriers in low- and lower-middle-income countries.

In the 1970s and 1980s, the idea that telephony services could be provided more successfully by private operators was never entertained. When, in standard economic textbooks, economists present the theory of natural monopoly in the context of infrastructure provision, such a theory—to be a good and universally valid theory—would naturally apply to all of the world's electricity markets and fixed-telephony markets irrespective of varying economic conditions in different countries (and regions within the same country). This, in turn, suggests that the technology and network design of the fixed-telecommunication infrastructure that is run as a monopoly in Germany should be basically the same as in Burkina Faso and also run as a natural monopoly there.

Firstly, "natural monopoly" theory is premised on static notions of technology. Generally, the assumption that the technological status quo of a given network design is believed to have achieved a degree of maturity that no better technologies could replace it is distinctively nihilistic considering the concurrent progress achieved in other sectors. Such end-state thinking underpinned the regulatory frameworks of public monopolies, and the posited maturity became a self-fulfilling prophecy in the form of significantly constrained innovation.

Secondly, "natural monopoly" theory leads to a one-size-fits-all approach that, again, is closely tied to the notion of universal service. Large income increases and buoyant tax revenues provided the economic conditions in high-income countries for financing the universal rollout of high-quality networks after World War II. For lower-income countries, this approach was infeasible in any case because of much lower average (or median) purchasing power and because of fiscal constraints. However, just as technology is not static, neither is affordability. In free markets, the task of entrepreneurs is to take existing technologies—for instance, those implemented in high-income countries—and adjust them to fit local needs and incomes. Affordability is relative and always a moving target. The irony of fixed-telephony utilities in lower-income countries was that the natural-monopoly model itself ensured that telephony would never become affordable to the average citizen in these countries. There was no entrepreneur who could have devised solutions that might have provided cheaper technological solutions and commercial models in line with low average incomes (such as prepaid service).

In a nutshell, the one reason for the extremely low subscription rates in lower-income, and many upper-middle-income countries was simply that private rollouts of fixed-telecommunication infrastructure were prohibited. The fixed-line telephony market became effectively insulated from the entrepreneurial pressures of innovation. A lot of technological progress happened between the end of World War II and the end of the Cold War; it just did not create the market dynamics that would have resulted in the increased consumer-product diversification and technological complementarity between industries that we witness today. The incumbents just had no urge to make their own lives more unpleasant than necessary.

When in the 1990s most of the telecommunication markets were liberalized in high-income countries, many carriers in lower-income countries followed the same course. A factor that made such decisions easier in lower-income countries was that within a few years mobile telephony had reached penetration levels a hundred times greater than the levels achieved by fixed-telephony carriers. Both the liberalization in high-income countries and the success of mobile telephony made it politically safe for governments to get rid of their fiscal-resource-draining telephony utilities. The most interesting part of these privatizations, in both higher- and lower-income countries, from the perspective of economic theory is that they revealed the financial rottenness and nonviability of the businesses.

The key reason for the success of mobile telephony in lower-income countries is that it happened fast. In fact, it happened faster than governments were able to develop the capacity to interfere via regulation. In the following, I explain how this process unfolded and how the success in serving even the poorest income groups actually provided protection against encroachments by public representatives and their cronies. In the mid-1990s in some lower-income countries, when the first mobile-network licenses were awarded to international telecommunication groups such as Vodafone, Orange (France Telecom), and Telefónica, the mobile business model was firmly based on post-paid voice. For potential subscribers to sign a post-paid contract for what was at the time a very costly service, they had to furnish the seller with proof of income (three salary slips), proof of residence, and a debit-order authorization from the bank. These requirements meant that at least 90 percent of the inhabitants of lower-income countries were excluded. Given that penetration rates were expected to not come anywhere close to 10 percent of the populace soon and network rollouts were costly, licenses and spectrum were sold for rather moderate sums even in countries such as South Africa[22] and Brazil where an affluent middle class numbering in the millions made for a significant market. Compared to the fortunes collected by public treasuries through auctioning off UMTS spectrum in the early 2000s, the amounts were negligible.

Governments cannot afford to create another loss-making public enterprise. As nobody expected the initially expensive postpaid offerings to turn into mass-market services, unsuspecting governments gave away licenses to private bidders without giving sufficient thought to it—inadvertibly creating an innovative and profitable industry driven by consumer choice.

When governments awarded the first licenses in lower-income countries, the regulatory authorities as we know them today did not exist. If there was regulation in telecommunication markets at all, the regulators were appendages of ministries that did not interfere much with the carriers' fast network rollouts in the initial years. Given the short reach of telecom services at the time and the monopoly status of fixed-line telecoms, there was simply no case for universal-service mandates. Again,

when the first cellular networks were rolled out, postpaid service ranging from fifty dollars a month to much more was a luxury product. Accordingly, the universal-service-related license conditions imposed on carriers until the end of the 1990s were very moderate. In South Africa, for example, one condition imposed was to reach population coverage of 70 percent within four years of launching. Apart from the fact that population coverage is difficult to measure because the coverage radius of radio cells is not static but shrinks with traffic load, the condition is detrimental to ideas of equitable service because it can be easily fulfilled by rolling out more base stations in bigger cities (where operators would have gone even without the condition). In any case, after four years, coverage approached 90 percent, which provides additional evidence that the success could not have been foreseen (see ITU 2004).

It was the introduction of prepaid voice services that truly revolutionized worldwide communication. The very simple commercial—not technological—idea of letting subscribers prepay for voice service in small amounts meant that the worldwide addressable market multiplied from five hundred million to five billion literally overnight. For the first time in history, people with low incomes could afford telecommunication services. At the same time, it was no longer necessary to have a bank account, as was required to receive electricity and water services. Suddenly, there was an infrastructure service that the entire world populace could afford, which created the supply chain dynamics I discuss in detail in sections 4.4 and 4.5. On the consumer side, the two key developments that explain the fast subscriber uptake were a sharp drop in prepaid-voice prices and a vibrant second-hand market for mobile handsets (imported from Europe). MNOs were suddenly confronted with huge sales opportunities in low-income segments of low-income urban and rural areas (neglected by fixed-line incumbents). The problem was that their staff did not dispose of the knowledge to create the appropriate sales-and-distribution channels for accessing rural and suburban low-income-consumer markets. Whereas post-paid services to affluent customers were mainly marketed through sales hubs in posh shopping complexes, reaching customers with a monthly budget of five dollars meant tapping into a world that white-collar (expatriate) managers from operator groups such as Vodafone, Orange, and MTN did not understand.

With the introduction of prepaid services and the multiplication of the addressable market came a massive spike in demand for network equipment. Due to economies of scale, the prices of all network elements fell rapidly, most importantly those of costly GSM radio modules that allowed carriers to densify their networks and increase coverage. Because of the absence of fixed-line connectivity in lower-income markets, prepaid data also provided a unique opportunity for equipment providers and MNOs to bring the internet to people. This explains the fast development and quick introduction and rollout of 2.5G and 3G nodes capable of transmitting data. A world market of five billion people set in motion the research and innovation that within ten years would churn out the key

technological standards that are needed to serve basically the whole population. A particularly big challenge arose from the fact that carriers had to work with a given amount of spectrum allocated by the regulator and the spectral efficiency of different frequency bands is not a fixed parameter but varies with geography, population density, and the type of service. In the 2000s, a fast succession of radio standards paved the way for today's mobile-broadband speeds. With increasing data demand, spectrum scarcity became an issue. Market-based spectrum allocation, sharing, and trading could have overcome this problem. But global regulatory practice has it that spectrum is a public good to be allocated by the state.

Only now we are learning how many different use cases mobile-telecommunication technology offers. One or two carriers alone cannot exploit all of these different use cases. The key argument perhaps is that MNOs themselves benefit from competition. Assume that no prepaid service existed. The market would be a fraction of its current size. In 2000, just after the commercial launch of prepaid services, African MNO Vodacom Group earned revenues of approximately 10 billion Rand. In 2019, revenue stood at 90 billion Rand while the MNO had roughly the same market share in terms of subscribers.[23] During the same period, South Africa's GDP increased roughly fivefold. During these two decades, the mobile carriers' revenue profile shifted from almost 100 percent voice-based to 37 percent data-based. Because of strong competition and incessant innovation, operating margins (EBITDA) of MNOs have been decreasing steadily over the last ten years from as high as 55 percent to below 40 percent. But this lower margin applies to market revenues of 90 and not 10 billion Rand. Thus, while consumer demand in a competitive market reduced profit margins, it not only grew market revenue but also led to better quality, lower prices (more minutes and data per Rand), increased coverage, and new services (data, content). This growth would have been impossible had one carrier—say, the fixed-line incumbent—hoarded the entire spectrum.

Mobile telecommunication is the biggest success story in the history of infrastructure provision in low- and lower-middle-income countries. This is especially true for SA – arguably our greatest post-apartheid accomplishment. The fact that private MNOs succeeded even in the poorest countries should make the defenders of public infrastructure ownership ponder.

Hence, international operator groups that rolled out their cellular networks found a regulatory vacuum that allowed them to define or at least shape many of today's best practices while regulatory bodies struggled to develop the competence required when negotiating with experienced (expatriate) managers. Consequently, a thriving regulatory-consulting practice drafted the policy frameworks on behalf of governments. The fulfilment of universal service obligations, as discussed, did not present a big challenge. Also, it would take a few years before the rollout of mobile towers would become more difficult because of residents' concerns about alleged health

hazards of high-frequency electromagnetic radiation and on aesthetic grounds (disfigurement of sites). No labour unions (often arms of the ruling regime) existed that would tie up business with red tape. And the international status of operator groups gave them a degree of protection too. All of this facilitated the relatively unconstrained rollout of mobile networks in the first years.

Yet what provided the best protection against governmental encroachment was the operators' success. This success has had two dimensions. First, almost instantaneously, prepaid voice became hugely popular. From the perspective of the economic scholar brought up in a high-income country with ubiquitous fixed-line coverage, it is important to understand that most of the population in poorer countries had no direct access to means of telecommunication. Public payphones and the phones of employers did not help if a family emergency arose in the rural area where one's relatives lived. Mobile voice was the first infrastructure service in low-income countries that was provided ubiquitously and at affordable prices. In fact, it was the first infrastructure service that made sense given the average income of people. The popularity grew also because mobile carriers played smartly. They immediately became the biggest sponsor of national soccer leagues and other popular sports. They were engaged in manifold charity activities. They immediately became the most popular employer because they provided genuine career opportunities across all levels of management, not least because it was rational to replace expensive overseas experts with local workers. Finally, the supply chain elements adjacent to mobile services—such as operating diesel generators for mobile towers in rural areas, repairing mobile handsets, or distributing SIM cards—created positive market externalities. Second, it helped a lot that mobile operators quickly turn profitable, which makes them among the biggest tax contributors in many countries. In summary, the popularity of MNOs and their financial success made them untouchable during their first decade.

2.4. Economic Theory of Spectrum: Myth versus Truth

As discussed above, Coase's solution is to create property rights in spectrum by auctioning off the scarce resource to the highest bidders. The auction prices for publicly assigned spectrum may indeed reflect the opportunity cost of spectrum use to an adequate degree. The problem is that the alleged market prices achieved through auctions reflect much more than the opportunity cost of resource use—namely, they include the opportunity cost of the uncertainty induced by the regulatory and licensing regime itself. When, as happened in many countries, spectrum is eventually released at artificially low levels for arbitrary periods with restricted ability to share and trade the resource, and when in addition it is unknown when the next auction round will happen, the conjecture that auction prices reflect the opportunity cost of resource use is more than unwarranted. To the contrary, the enormously high auction prices achieved in many countries are more

reflective of the opportunity cost of the uncertainty induced by contrived political processes than of anything else. From a fiscal perspective, the creation of such uncertainty in combination with rigid conditions of spectrum use maximizes tax income.

In a way, excessive auction prices can be largely regarded as a premium that carriers (are coerced to) pay for mitigating regulatory uncertainty given the dysfunctionality of spectrum markets.[24] First, carriers might have to wait years for regulators and the many involved government branches to agree about what conditions the next spectrum lots will be made available under. Second, attempts at acquiring additional spectrum in the market—for example, through spectrum sharing agreements or mergers and acquisitions—come with many pitfalls. Provided such attempts have a chance at all, the finalization of such agreements is subject to time-consuming regulatory processes. Worse, regulators tend to attach conditions to their approval for a transaction (often in response to lobbying by other MNOs) that neutralize the deal's commercial merit to a greater or lesser degree. If regulators, scholars, and telecom professionals were cognizant of and honest about the artificial nature of spectrum auction prices, spectrum assignment would not present a problem from the perspective of economic theory. The real damage is done when these people appropriate pseudo-economic terms from neoclassical textbooks such as efficiency, scarcity, finiteness, and social welfare.

From tautology to truism—an example of the state of economic reasoning on spectrum matters:
"Wireless spectrum is a valuable, finite resource, so it's vital we use it efficiently."
(P. Marnick, Spectrum group director at Ofcom)

The danger of neoclassical narratives is exemplified by Philip Marnick, spectrum group director at Ofcom, who is quoted by *TechRadar* (MaCaskill 2019): "Wireless spectrum is a valuable, finite resource, so it's vital we use it efficiently."[25] The implication is that regulators are able to allocate spectrum so as to ensure finite spectrum is used efficiently. The first problem with this typical yet economically meaningless statement is the notion of efficiency. How can something be efficient in the hands of governments when it attracts enormous auction prices when auctioned off to market players, possibly after years (in South Africa more than a decade) of regulatory limbo? And how does Marnick know what the efficient use of spectrum is when it is unused? This is an example of "pretence of knowledge" Hayek (1974) was referring to in his Nobel Prize speech. The only empirically valid, non-normative notion of efficiency is bilateral exchange based on market prices. Efficiency is when people agree. The key point, however, is that it is wrong to consider such auction prices as reflecting the opportunity cost of spectrum use in the same way that the opportunity costs of actors would be reflected in spectrum prices in a counterfactual free market.

This point does not seem to have received attention from economic theorists. The mere fact that spectrum is auctioned off in a competitive bid does not mean that the bid equates

market prices. Market-based spectrum pricing would reflect the opportunity cost of spectrum use. For markets to reveal the opportunity cost of a production factor, such factors must be tradable. By definition, spectrum auctioned by governments cannot have been traded freely (as no public auction would have been needed); and it continues to be non-tradable after the auction because of the regulatory practice of constraining spectrum use to dedicated carriers for limited periods and restricted uses. GSMA (2019b, 7), after all representing the interests of more than 750 MNOs, states in its publication *Auction Best Practice*:

> Spectrum is a scarce resource that underpins wireless services which deliver profound socioeconomic benefits. Governments should aim to base mobile spectrum prices at a level that ensures that no alternative user would be willing to acquire the rights at that price (i.e. opportunity cost pricing).

The above definition of the opportunity-cost principle blatantly advocates that governments should aim at extracting as much as possible from MNOs (who pay GSMA staff's salaries). This maximum price then is considered to be in line with opportunity-cost pricing. This misunderstanding could be exonerated given that the text is not an exposition of economic theory in an academic journal. In the *Journal of Economics, Business and Management*, though, Malisuwan et al. (2014, 88) also have difficulty understanding the concept of opportunity cost:

> Over a decade ago in preparation on Administrative Incentive Pricing (AIP) in the United Kingdom, the *key concept that emerged* was what economists call opportunity cost. In principle, the opportunity cost is the amount that a potential bidder would have to encounter before they would quit and *go elsewhere* to acquire what they required. In terms of mobile communications spectrum, the opportunity cost of a given frequency used is the cost saved as a result of using that frequency rather than its next best alternative. In regard to spectrum, opportunity cost *is relevant due to* the range of costs and benefits associated with spectrum's role as an input to commercial services. Assessment of opportunity cost reflects the estimated price markets [place] on spectrum at auction.[26] (italics added)

For a start, it is quite telling that the authors raise the concept of opportunity cost in the first place, by doing which they must be recognizing that market-based valuation of resources is important. Next, opportunity cost is not something that is relevant "due to" costs and benefits. The calculation of an action's particular costs and benefits (that is, valuation) is premised on understanding the opportunity cost of alternative actions; valuation and opportunity cost are two sides of the same coin that inform a course of action. Because opportunity cost is the highest-value option forgone, the opportunity-cost principle implies the possibility of choice. In the case of public spectrum auctions, the choice is to bid or not bid the amounts other bidders (are expected to) bid. Unfortunately, spectrum bidders cannot "go elsewhere." Thus, they encounter no market from which to source spectrum, as spectrum is either held by the state or restricted to dedicated uses of

dedicated licensees. The Australian Government Department of Communication and the Arts (ACMA), in a consultation paper on spectrum pricing, submits a more informed opinion by highlighting that characteristics of the spectrum market make it difficult for governments to set administrative prices that reflect market prices accurately:

- Spectrum is rarely traded, unlike other assets like land and shares.
- There are a limited number of technological alternatives to base a pricing model's cost profiles on.
- To take advantage of the cost of equipment and economies of scale, spectrum use is typically harmonised with other international jurisdictions, limiting the use of different spectrum bands.
- There is no easy way to determine whether there is excess supply or excess demand in particular spectrum bands.
- There is a lack of data on how prices respond to spectrum demand, therefore there is subjectivity about how much to reduce (increase) prices in the face of excess supply or demand.
- Pricing needs to be updated regularly to reflect changes with market developments such as technological, demographic, and band plan changes.

For these reasons, administrative prices should be seen as a "best attempt" to approximate opportunity cost, given limited information, rather than being an exact efficient price.[27] (2017, 18)

While the six bullet points are all correct and ACMA uses the correct term "administrative prices," the conclusion is wrong in two respects. First, it is wrong to suggest that opportunity cost and price are on the same categorical level; they are radically different economic entities. In the market, prices result from subjective valuations that reflect the evaluator's individual opportunity-cost profile. Hence, prices are results of people applying the opportunity-cost principle (opportunity cost being a counterfactual entity[28]). Second, if there is something to approximate at all, then the administrative prices set by regulators should approximate hypothetical efficient prices, which at least would be the theoretically correct comparison. That said, to view the outcomes of public auctions as more or less a satisfactory approximation of market prices—informed by the conjecture that bidders pay prices reflective of the opportunity cost of alternative actions in a counterfactual free market—is purely speculative.[29] Vietor (1994) has coined the apposite term to describe such regimes: "contrived competition."[30]

Public auctions of spectrum do not take place under competitive conditions. To the extent spectrum "price" bids are deemed competitive, the setup of public spectrum auctions is artificial and has no equivalent in the free market. There is no market on which spectrum can be traded, neither before the auction nor thereafter. Licensed spectrum is licensed for exclusive use only (thus not satisfying the Coase Theorem).

The supposed finiteness of resources is a mirage, economically speaking. In the spectrum discourse, people inadmissibly draw economic conclusions from their understanding of objective natural characteristics. To illustrate this, consider the following two statements: in the spectrum band of 700–800 MHz, there is only 100 MHz that can be used for providing LTE broadband services; the available spectrum is thus finite. As (trivially) true as these statements are, they do not allow any economic conclusions to be drawn. As technology is about "how to use means to arrive at ends" (Rothbard (2004 [1962]), 74), it is precisely the nonfinite nature of *employing* (finite) natural resources that allows us to economize. Note that economics is about doing something (dynamic), not about what is (static). Justifying regulatory intervention by referring to resource finiteness is an intellectual error. I illustrate the matter for spectrum in the frequency band of 700–800 MHz:

- The so-called "digital dividend band" (DD band) used to be fully employed for broadcasting analogue television signals.
- It turned out that digital encoding of TV signals allows transmission at far higher quality while using less frequency (spectrum efficiency allows for greater use of the same amount of spectrum).
- This made it possible to unfreeze frequency in the band of 700–800 MHz for purposes of mobile-broadband transmission.
- Given the strong growth of mobile data, the DD band attracted a higher economic value for transmission of mobile broadband.
- The rollout cost of mobile-broadband (LTE) infrastructure for covering rural and suburban areas is made drastically lower by using spectrum in the DD band compared to frequencies above 2.3 GHz.
- Carrier aggregation allows MNOs to combine spectrum resources in different bands—for example, 800 MHz and 2.6 GHz—so as to maximize throughput in urban areas, given the better building-penetration characteristics of radio signals using spectrum in the DD band.
- Mobile-broadband data services started in dense urban areas where 3G and 4G/LTE radio technology operated on frequencies above 1.8 GHz.
- Rolling out 3G or 4G/LTE at frequencies above 1.8 GHz in rural areas proved to be financially nonviable.
- LTE-800 MHz radio technology was developed when the migration from analogue to digital TV gained traction in the 2000s.
- The assumption that frequency bands in the 800 MHz band are better suited for mobile-broadband purposes than those in the 600 MHz band, in the 2.8 GHz band, or in the 2.6 MHz band is unwarranted.
- Clearly, LTE 800 MHz is economically more worthwhile for providing broadband services in rural areas while LTE 2600 MHz is better in dense urban areas.

- With respect to spectral efficiency and financial viability, mobile networks could equally well operate LTE in the 600 MHz band in rural areas and in the 2.8 GHz band in dense urban areas.
- However, 600 MHz continues to be assigned to TV broadcasting while 2.8 GHz is reserved for airport surveillance radars.
- Finally, spectrum in the GSM 2G frequency band of 900 MHz (voice services) has an average spectral efficiency of 0.16 bits per Hz for data transmission compared to 1.9 bits per Hz—twelve times higher—if the same spectrum could be used for LTE data services (see GSMA 2019d, 9).

In other words, within the nominal finiteness of the spectrum, it seems as if there are more or less infinite possibilities for increasing technical efficiency for the sake of consumers. Moreover, the respective technological solutions for decreasing the relative degree of finiteness in one frequency band stand in a delicate balance with the technological solutions and possibilities of spectrum use in other bands. Moreover, spectrum in different frequency bands can be used to produce the same service, and spectrum in the same frequency band can be employed to produce different services. As in all other markets, heterogeneous capital combinations are a result of asset specificity. It is worthwhile to quote the word of German economist Ludwig Lachmann (1906-1990) who taught economics at Wits University from 1948 until 1972 and died in Johannesburg:

> Beer barrels and blast furnaces, harbour installations and hotel-room furniture are capital not by virtue of their physical properties but by virtue of their economic functions. Something is capital because the market, the consensus of entrepreneurial minds, regards it as capable of yielding an income. (1956, xv)

In addition to possibilities of supply-side substitutability in the specific technological realm of mobile broadband, other technologies—such as coaxial cables, fibre cables, and fibre-based Wi-Fi—are more suitable for in-building data consumption in dense urban areas (while mobile broadband is economically more viable in rural areas). We will discuss the matter of supply-side substitutability in chapter 3.3 in the context of ICASA's market inquiry on the cost of data prices in South Africa.

Our daily economizing actions presuppose resource scarcity. Prices are not measurements of physical scarcities; prices are *results* of our actions and reflect the subjective valuations people attribute to the consumption or employment of resources.

On a more general note, the thinking of Coase and the other authors quoted above—that spectrum is a scarce and finite resource—is fundamentally flawed. First, the notion of a scarce resource is a tautology. A resource would not be a resource if it were not scarce. Without scarcity, there is no need for economizing. The way scarcity is perceived, the effect it has on our well-being, and the means we employ to reduce scarcity are different for each category of goods and resources; nothing in economics allows us to say

that a particular resource is scarcer than another. Second, the term "finite" has little to no meaning in economics. Most of us think that some goods are more finite than others; say, spectrum is more finite than sand. This is wrong. If a good, ceteris paribus, becomes scarcer, higher prices will work toward making it less finite because higher prices will make people more entrepreneurial. Entrepreneurs either find substitutes or adopt production techniques that use less of the good, whereby a good previously perceived as relatively finite may become surprisingly abundant (the crude oil market seems to fit this narrative).

In technological terms, spectrum finiteness is nonsense. Above I have illustrated different degrees of spectral efficiency at given states of technological knowledge. Meaningful economic theorizing must never be ignorant of time and the dynamic nature of human action. Considering that the first 3G standard, EDGE, achieved a maximum speed of 384 kbit/s and twenty years later the same amount of spectrum (with 5G) can deliver 10 Gbit/s, we are talking about an increase of 26,000 times. How finite is spectrum now?[31] Has it become scarcer or in fact more abundant?

If the notion of scarcity is to be used meaningfully in economics, it is only meaningful insofar as perceived scarcity sets entrepreneurial action. Should the expectations that underpin such actions turn out to be correct, they result in entrepreneurs reaping profits and consumers capturing use value (implying the affordability of scarcity reduction). There is, however, one type of scarcity that is real—namely, the artificial scarcity created when regulators withhold spectrum. This has become known in the ICT discourse as spectrum crunch or spectrum starvation. In South Africa, the regulator has not allocated high-demand spectrum needed by the two leading carriers, MTN and Vodacom, to provide broadband-data services since 2005. At the same time, the South African Competition Commission has launched a process with much fanfare with the aim of forcing carriers to lower their data prices but has ignored the impact of spectrum withholding on capital expenditures as a "significant inhibitor in efforts to lower data prices" (Odendaal 2019).[32] In many countries, governments use national spectrum ownership rights as a means to coerce carriers to pursue policy goals, to extort fines for not complying with procedural license conditions, and to raise revenue through auctions of new spectrum blocks or through bilateral negotiations when spectrum licenses are due for renewal.

In South Africa, the Telecommunications Ministry and regulator ICASA cannot be said to be coercive in the literal sense of the word. In retrospect, it is difficult to make sense of the fact that public representatives were unfazed by the MNOs' continuous pleas to release spectrum for a decade. The dysfunctionality of the Zuma administration has played a role but this does not explain the ignorance reflected in the Telecommunication Minister Dina Pule's (2013) riposte to calls for spectrum release that "spectrum is not top-five priority." Of the top-five communicated were broadband, broadcasting digital

migration, e-skills, the successful launch of Postbank, and an information and communications technology (ICT) policy review, the first two certainly relate to spectrum.[33] The dysfunctionality might explain, however, the set-top box saga and the failed digital migration from analogue broadcasting spectrum to lower-frequency and more spectrally efficient lower frequency bands. Finally, the Government's brainchild WOAN meets the conditions of coercion understanding that compulsory off-takes from existing carriers and free spectrum assignment to the WOAN operator can hardly be considered voluntary.

3. Current Assignment of Radio Spectrum in South Africa

3.1. Spectrum Assigned to MNOs as per November 2020

Below, table 2 gives depicts the spectrum assigned to South Africa's MNOs before the Covid-19 lockdown took effect on 27 March 2020.

TABLE 2: FIXED SPECTRUM ASSIGNMENT[34]

Fixed Spectrum Assignment (IMT Bands)*	700/ 800**	900	1800	2100	2300	2600	3500	3700***	Total
VODACOM		22	24	35					**81**
MTN		22	24	40					**86**
CELL C		22	24	30					**76**
TELKOM			24	30	60		28		**142**
RAIN			34			20		80	**134**
LIQUID	10		24				56		**90**
TOTAL	**10**	**66**	**154**	**135**	**60**	**20**	**84**	**80**	**609**

*Icasa_Discussion-document-on-the-market-inquiry-into-mobile-broadband-services.pdf; **10 MHz in 850 MHz; ***80 MHz in 3.7 GHz band no IMT band

The first point to highlight is that the two carriers MTN and Vodacom, serving more than three quarters of South Africa's subscriber base[35], can only use 167 MHz of the totally assigned 609 MHz of radio spectrum. In 2004, ICASA granted spectrum in the 2100 MHz band for purposes of 3G, followed by the eventual assignment of 1800 MHz spectrum in 2005 which at the same time were the last assignments to the two leading operators. Since 2006, a multitude of announcements have been made by ICASA and DCDT to change this status. In total, ICASA launched four official processes to assign or reassign spectrum, all of which vanished into thin air (but kept the regulatory sections of MNOs busy). Below, table 3 summarizes key events during the last 20 years.

TABLE 3: KEY EVENTS OF REGULATORY ACTION

2001	Cell C granted a license to operate in 900 MHz and 1800 MHz bands
2003	**Temporary** access to 1800 MHz spectrum to MTN and Vodacom in exchange for free SIM cards for the poor
2004	Cell C, MTN and Vodacom granted 3G spectrum licenses in the 2.1 GHz band (whereas MTN and Vodacom launched 3G services in 2005, Cell C didn't do so until 2010).
2005	MTN and Vodacom granted licenses to operate in the 1800 MHz band
2006	ICASA announcing plans to release spectrum at 800 MHz (TV channels 65 and 66) and 2.6 GHz (process stalled)
2007	Neotel granted a license to operate fixed wireless services in the 800 MHz band.
2008	DCDT publishes *Broadcasting Digital Migration Policy for South Africa* based

	on ITU suggestion to complete migration by 2015. DCDT announces: "analogue signal is **switched off on 1 November 2011**."[36]
2009	ICASA put out ITA for the 2.6 GHz and 3.5 GHz spectrum imposing heavy BEE-conditions whereupon the process stalled.
2009	Spectrum granted for WiMAX and/or HSPA/LTE on a "use it or lose it" basis to: iBurst and Sentech in 2.6 GHz, Telkom and Neotel in 3.5 GHz
2011/ 2012	ICASA unveiled spectrum plans in Dec 2011 intending to bundle 800 MHz and 2.6 GHz spectrum and to assign spectrum for wholesale networks (incl. a *Managed Spectrum Park*).[37] New network operators would not be allowed to re-sell services in the retail market. Auction process withdrawn in 2012 (six years after the process first started).
2011	Assignment of 5 MHz to Cell C to complement its existing 2x10 MHz of 3G spectrum
2016	ITA by ICASA on 15 July 2016 for spectrum to provide broadband services for urban and rural areas "using the complimentary (sic!) band, 700 MHz, 800 MHz AND 2.6 GHz" (with auctions planned to take place in January 2017).
2016	Minister of Telecommunication Cwele's bid to set aside the spectrum auction upheld by North Gauteng High Court (CASE NO 2016/59722) (30 Sep 2016)[38]
2018	In line with a policy provision formulated in a CSRI-White Paper, DCDT publishes WOAN policy suggesting "all currently unassigned high demand spectrum . . . be set aside for assignment to the WOAN."[39]
2020	Assignment of emergency spectrum gazetted on 20 April 2020; extended to no later than March 2021.
2020	Announcement of high-demand spectrum auction to be held by no later than March 2021
2020	Announcement that analogue-to-digital migration will not be completed before 2022.

Apart from the fact that no high-demand spectrum has been made available to the two leading operators for 15 years, the wholesale failure of the analogue-to-digital migration stands out. The recent announcement by DCDT director general Batyi that the migration process will not be completed before 2022 must be viewed in the light of DCDT's goal announced in 2008 to switch off the analogue TV signal by 2011.[40] The table does not contain any events of the tumultuous set-top box saga which was a primary contributing factor for the spectrum crunch and provides evidence of South Africa's blatantly dysfunctional ICT regulation.

The reasons for these failures lie neither in the nature of the mobile telecommunications industry nor in its competitive structure, but are owed to particular ideas of economic and ideological nature that are ignorant of—or deliberately ignore—the economic realities and complexities of dynamic markets under the division of labour. It is the contention made in this study that these ideas entail an irresolvable contradiction between political ideology and economic reality.

3.2. Comparison with other Markets

In their *Discussion document on the market inquiry into mobile broadband services in South Africa*, ICASA states that "South Africa is well behind the leading countries when it comes to assigning spectrum for mobile broadband, having assigned about half the spectrum compared to the UK for example, and with an *extremely low* assignment per operator" (ICASA 2019, 47, emphasis added).[41] Comparing the national spectrum endowment in South Africa with BRICS member states and countries with similar GDP per capita reveals that MNOs in South Africa (and Egypt) indeed have been assigned extremely little spectrum.

TABLE 4: COMPARISON OF SPECTRUM ASSIGNMENT IN PEER-COUNTRIES

Country	GDP / Capita (current US$)	LTE[1] 700/800	LTE[1] 2.6	LTE 1.7/1.8/1.9	LTE 2.1/2.3
South Africa	6.4	---	---[2]	B3	B1, B40[4]
Russia	11.6	B20	B7, B41	B3	B38
China	10.3	B20	B41	B3	B1, B40
Brazil	8.7	B28	B7	B3	---
India	2.1	B5, B8	B41	B3	B40
Mexico	9.9	---[3]	B7	B4	---
Peru	7.0	B28	---	B2, B4	B40
Colombia	6.4	B28	B7	B4	---
Philippines	3.5	B28	B41	B3	B40
Morocco	3.2	B20	B7	B3	---
Egypt	3.0	---	---	B3	B1
Nigeria	2.0	B20	B7	B3	---

[1]Only retail MNOs considered; [2]Rain has spectrum in B39; [3]ALTAN Redes in B28 (the Mexican equivalent of a WOAN), [4]Telkom only

First, with the exception of Egypt and South Africa, all countries have managed to complete the analogue to digital migration. This failure has a significant impact on South African consumers in three respects. First, the inability to use LTE in the frequency band 700/800 MHz means that MTN and Vodacom are still relying on LTE 1.8 GHz to provide data service in rural areas. As discussed in the previous section 3.2, this means that carriers have to spend 2.5-3 times the network Capex to achieve ceteris paribus the same network coverage and density. Second, the unavailability of 700/800 MHz means that MNOs cannot harness the increased spectral efficiencies of carrier aggregation in urban areas. The three most common combinations are B3/B7 (81), B3/B20 (54) and B3/B7/B20 (36).[42] MTN and Vodacom can implement neither of the combinations as ICASA has not issued spectrum in band B7 and B20. Third, carrier aggregation of B3 and

B7 is popular because carriers can optimize spectrum usage in dense urban areas and achieve significantly higher data throughput rates at a given site (tower) footprint. This is the third impact on the carrier's network performance that ceteris paribus increases network cost and thus makes broadband data services pricier.

South Africa's leading MNOs are deprived of using spectrum in the most valuable frequency bands that carriers around the world use efficiently for the benefit of consumers.

Price benchmarking, as undertaken in the Market Inquiry, is a largely fruitless undertaking. Inevitably, such comparisons brush over the complex realities of not only different geographical and demographic conditions but, more importantly, are ignorant of the quality of network services that determine the *effective* pricing of services. Effective pricing means that a gigabyte that is nominally priced at the same amount of, say, $10, is provided at high download speeds in all dense urban areas in South Africa whereas the lower-priced Gigabyte in countries such as Tanzania and Mozambique is only available in a few large metros at much lower download speeds. Figures 14 and 15 in the Market Inquiry report show South Africa's far above average 3G coverage compared to countries in the same income-group, but a relatively lower LTE coverage compared to China or Brazil. As to the reasons for the low LTE-coverage, the report explains: "China's much better performance in terms of speed and price is put in context when seen alongside the fact that it has assigned nearly twice the spectrum that South Africa has." The reader who would have interpreted this to provide a quite robust causal relationship, namely that lesser spectrum, or no spectrum in certain frequency bands, *ceteris paribus* means higher network costs, will rub their eyes in disbelief:

> *While these comparisons do not prove a causal link between spectrum assignments and prices, the graph below highlights a lack of additional spectrum in South Africa and that more spectrum needs to be assigned in order to enable licensees to deploy new technologies efficiently and increase network capacity*.

So, while the comparisons do not *prove* the purported causal link, the same comparisons do *highlight* that more spectrum is needed to increase network capacity and deploy new technologies, possibly LTE-800 to have better coverage and better network performance. Got nothing to do with prices.

4. DCDT / ICASA's Understanding of Competition and Open Access

This section elaborates on, first, the idea of the WOAN as a vehicle for the promotion of competition and, second, on the idea of what Government regards as "fair" competition to highlight the claim made in this study of the incompatibility of the logic of regulatory measures and economic logic implied in voluntary action.

4.1. The idea of the WOAN as a Vehicle for the "Promotion" of Competition

The idea of establishing a wholesale network operator on an open access basis seems to have firstly appeared in the section "Highlights of the Year" of ICASA's Annual Report for the financial year 2005/2006 which it presented to Parliament: "Possible Sharing of the 800 MHz Frequency Spectrum."[43] A few years later in 2011, ICASA gave notice and invited comments on the proposed draft Spectrum Assignment Plan for the 800 MHz and 2.6 GHz frequency bands.[44] Under "Licensing Philosophy," the idea of a wireless open access network in the form of a Managed Spectrum Park was officially announced for the first time:

> 5.1. It is the intention of the Authority to allow as many entities as possible to access the spectrum in the 800 MHz and 2.6 GHz bands. For this reason the Authority has considered mechanisms that will encourage sharing of spectrum.
>
> 5.2. In order to fulfil national policy objectives the Authority has considered introducing Wholesale Open Access model and Managed Spectrum Park model as forms of sharing mechanisms over and above Universal Service Access as part of obligations.
>
> 5.8. The Managed Spectrum Park model refers to a sharing model where a number of entities apply to participate in sharing a block of common spectrum on self-managed basis and according to some regulations and/ or agreed procedures. The model encourages efficient use of spectrum, innovation and flexibility and provide for low- cost compliance and administration over time.

In December 2011, Dumisa Ngwenya, general manager for technology at ICASA, reportedly said that license winners in both the 2.6 GHz and 800 MHz bands would have to provide a wholesale open access network. These licensees would also have to complete 70 percent geographic coverage in five years, of which 50 percent must exclude metropolitan cities in Gauteng, Cape Town and Durban. 2.6 GHz-only licensees must achieve 50 percent population coverage in four years. Qualifying requirements included that companies must be electronic communication network services (ECNS) license holders in South Africa with a minimum of 30 percent ownership by historically

disadvantaged individuals (HDI). Notably, the report pointed out that Vodacom South Africa did not meet the latter requirement.[45]

The process was abandoned in 2012 after harsh opposition from established carriers. The idea of establishing a wholesale open access provider resurfaced under today's common acronym WOAN (wireless open access network) in 2016 playing a critical role on two counts. First, following ICASA's ITA on 15 July 2016 for spectrum in the 800 MHz and 2.6 GHz bands (with auctions planned to take place in January 2017) and MoC Cwele's interdict against the planned spectrum auction, the judgment was delivered on 30 September 2016. Second, DCDT published the National Integrated ICT Policy White Paper dated 28 September 2016, two days before the judgment.

When ICASA rushed to announce the ITA for high-demand spectrum in July 2016, there was widespread relief in the industry after years of regulatory limbo. ICASA is a product of statute, the Independent Communication Authority of South Africa Amendment Act of 2000, amended in 2005 (gazetted 18 April 2005). Section 2 reads:

> "The primary object of this Act is to provide for the regulation of electronic communications in the Republic in the public interest."[46]
>
> (e) ensure efficient use of the radio frequency spectrum;
> (f) promote competition within the ICT sector;
> (m) ensure the provision of a variety of quality electronic communications services at reasonable prices;
> (n) promote the interests of consumers with regard to the price, quality and the variety of electronic communications services;

The function of ICASA according to the Act relating to spectrum are described as follows:

> 30. (1) In carrying out its functions under this Act and the related legislation, the Authority controls, plans, administers and manages the use and licensing of the radio frequency spectrum except as provided for in section 34.

The Act is also clear as to the need for the minister's consent:

> 34. (2) The Minister must approve the national radio frequency plan developed by the Authority, which must set out the specific frequency bands designated for use by particular types of services, taking into account the radio frequency spectrum bands allocated to the security services.

Subject to the Act, ICASA could not move forward without the Minister's consent. In democracies, ministers form part of the government administration elected by the citizens. In contrast, employees in public administrations are not elected. They serve the respective governments and are bound to their instructions (and parliamentary oversight). The remarkable part of ICASA's unauthorized move was the invocation of public interest, that is, the consumer interest and ICASA's mandated duty to promote competition. In this regard, Judge Sutherland's ruling on DCDT's interdict application on

30 September 2016 specifically dealt with ICASA' duty to promote competition quoting 2(f) of ECA and the promotion of consumer interests (as per 2(n) of ECA):

> The primary object of this Act is to provide for the regulation of electronic communications in the Republic in the public interest and for that purpose . . . promote competition in the ICT sector. Other provisions of section 2 enjoin the promotion of investment, and *consumer interests*. Section 67 of ECA addresses extensively the particular steps that ICASA must take to promote competition, in particular, by imposing conditions in the licences. The obligations on ICASA involve, among other steps, a continual monitoring of the market relations and effecting modifications to sustain a competitive environment. ICASA does not dispute the duty to consider the competition dynamics that its decisions can precipitate. (para 61, emphasis added)

Sutherland concluded that "ICASA has not been shown to have breached any positive duty imposed on it to promote competition" (para 72). He explicitly recognizes ICASA's role as guardian of the public—that is, consumer—interest but ultimately rules in favour of DCDT:

> The critical contention on that score is the justifiable impatience of consumers to get access to better services. Can the envisaged delay undermine this interest? In my view it cannot. First, a messy process is undesirable. Second, ICASA itself has twice since publishing the ITA, postponed the deadlines to apply, the most recent being to February 2017. This points in the direction of an absence of prejudice by the delay. The deadline for 2020 is, in any event, a specious target given the deferment of a need to achieve full roll out until access to 100% of the assigned spectrum is made available. The balance of convenience favours a grant of the relief sought.

The ruling is remarkable in that it lacks substance. Impatient consumers might benefit from better services but this does not justify a messy process. The judge does not explain why or for whom the process would have been messy. Certainly not for the consumer. The ruling is effectively saying that because consumers have become used to waiting more than a decade (in part due to ICASA's delays), they can continue waiting. Judge Sutherland missed a rare opportunity to indicate to political elites that the prime objective of politics is to increase consumer welfare. The unprincipled stance of the ruling is illustrated by the fact that he invokes procedural criteria and the "balance of convenience" to reach its conclusion.

The DCDT's interdict killed the last "messy" attempt to release spectrum to MNOs. The judgment made it clear that South African consumers have not been paramount.

In the end, the ruling served two convenient purposes from the government's perspective. Firstly, it confirmed the political pecking order by putting ICASA in a subordinate role. Secondly, the ruling uncritically endorsed the DCDT's belief in its primacy over strategically relevant aspects whereby the DCDT also could proceed with spectrum policy via a WOAN premised on the ministry's idiosyncratic understanding of "*effective*" competition. In respect of the ministerial primacy on ICT-related policy matters, in chapter 2, *Ministerial Policies and Policy Directions*, the ECA reads:

> 3. (1) The Minister may make policies on matters of national policy applicable to the ICT sector, consistent with the objects of this Act and of the related legislation in relation to—
> (a) the radio frequency spectrum;
> (b) universal service and access policy;
>
> (4) The Authority, in exercising its powers and performing its duties in terms of this
> Act and the related legislation must consider policies made by the Minister in terms of subsection (1) and policy directions issued by the Minister in terms of subsection (2).

The Ministerial Policies and Policy Directions came in the form of *National Integrated ICT Policy White Paper* dated 28 September 2016. The publication two days before the ruling was well timed and addresses the policy issues as viewed by the DCDT:

- Unclear roles and responsibilities between the Minister and the regulator resulting in institutional inefficiencies;
- Gaps in the spectrum management regime with regard to the *alignment* between national *universal service objectives* and the *licensing of frequency spectrum* resources, the setting of spectrum fees, spectrum trading, sharing, re-farming and migration;
- An *exclusive* spectrum regime which promotes economic growth for a few market players at the expense of broader socio-economic development, and therefore an *inequitable* assignment broadband spectrum which is in high demand. "High demand spectrum" in the context of the White Paper refers to spectrum where demand for access to the radio spectrum resource exceeds supply, or radio spectrum is fully assigned. (2016, 78; emphasizes added)

As to the first bullet, the White Paper leaves no doubt who is in charge:

> The ECA recognises the strategic importance of spectrum and thus enjoins the Minister to issue policies and policy directions in relation to the treatment of spectrum. The act of licensing (or assignment) itself, however, is the prerogative of the regulator. (2016, 80)

The White Paper killed three birds with one stone. Firstly, it relegated ICASA to the role of a recipient of the ministry's policy instructions. Secondly, it specified principles of

how to treat spectrum so as to match debatable conceptions of "fair competition." Thirdly, it institutionalized the previously loose idea of the WOAN as a means of achieving "fair competition."

The next subsection (ii) reviews the Government's understanding of what is "fair competition" and how they propose promoting "fair competition."

4.2. DCDT's Search for a Paradigm Shift of Competition: The 2016 White Paper

In the opinion of the key public players involved in the regulation of mobile telecommunication market—in the presented study the DCDT, ICASA, and CompCom (possibly also including incumbent operator Telkom)—fair competition is presumed when it meets three criteria:

(a) There must be many players in the market (more players are always good).
(b) No player must not have a market share of significant scale in any of what these players define as "relevant" markets.
(c) Players in such markets must not own or dispose of assets of exclusive use that may protect their competitive position by capitalizing on such assets.

The thinking underpinning the three notions of unfair competition is premised on three matching economic ideas:

(aa) The neoclassical idea of perfect competition.
(bb) The idea of regulatory intervention needed (and able) to rectify significant (i.e. harmful) market power.
(cc) The idea of creating fair or fairer competition through sharing of resources and open access network principles.

For the purposes of this SEIA, the flawed nature of the economic thought patterns contained in these three juxtaposed pairs can only be roughly sketched. As to pair (a)-(aa), the neoclassical model of perfect competition assumes a market with an infinite number of buyers and sellers. No player in the market has the market power to affect the outcome in terms of prices and quantities (both, consumers and firms are price takers). Information is perfect and mature technologies are readily available to all firms so that no single firm is able to achieve a competitive advantage through product differentiation. Consequently there are also no profit opportunities to reap implying that in the model of perfect competition the function of the entrepreneur ceases to exist. As in such a state all rents are exhausted, the economic system is in equilibrium meaning that consumers and producers are involved in an endless repetition

Bad economic theory leads to bad policy. The SA official benchmark of effective and fair competition is based on discredited conceptions of perfectly polypolistic markets and non-objectifiable ideas of "fairness" and "open access".

of their actions. In other words, the model of perfect competition is the economic-theory version of the *Groundhog Day* with the decisive difference, however, that unlike actor Bill Murray the people in the neoclassical world are perfectly happy.

If we take the fair assumption that the vast majority of people are concerned with improving their socioeconomic conditions, people will embrace technological progress and new commercial ideas. When entrepreneurs succeed in providing people with new, better or cheaper products, or new combinations of products such as Amazon, Uber and Airbnb, they inevitably gain what is mistakenly presumed to be "market power," for which "market success" in that consumers prefer their product, would be a more accurate description. If there is such a thing as "power" in a free market, it is the consumers who impart this power to entrepreneurs who fail if they do not satisfy consumers more substantially than rivals. It is more accurate to say that they must "out-cooperate" rivals than that they must "out-compete" them.

Far from being castigated, firms with large market shares (in unregulated markets) should be praised for how much more satisfactorily they serve consumers than rivals. Success, as eminent South African economist, Willian Hutt, observed, is a triumph of "consumer sovereignty". The focus on suppliers instead of consumers leads to perverse conclusions.

Typically, competition policy subverts consumer rights and freedoms more than the rights of so-called "monopolies" and "duopolies".

If in a nascent market the product of one firm attracts a significant proportion of the consumer base, there is only one way for entrepreneurs to serve the market: earning equally significant net incomes (profits) to create the tangible and intangible asset base to produce the quantity and quality demanded. The important takeaway is that market power, for which success or market reach might be better terms, is not something that falls from the sky. It has to be earned. High market shares and profits are thus to be understood as the economic materialization of fulfilling the mandate conferred upon firms (as agents) by consumers (as principals) to produce what they want (implying that this mandate can be withdrawn in the blink of an eye for which the quick demise of mobile phone producers Nokia and Blackberry provide a stellar example). One can lament about the market reach of some firms, for example Google, and for evident reasons such reach seduces firms to bend the rules of the game in their favour. Yet, we must not forget that in the eyes of consumers Google's search machine appears to be vastly superior to others. In South Africa, 95 percent of consumers freely chose Google for their searches in the twelve months to October 2020.[47]

So far, the discussion has led to the realization that market reach is a result of consumer choice (excluding other forms of "market power" such as the creation of public monopolies and market-entry barriers through public licensing and concessioning). If

now regulators consider a certain market structure to meet their criteria of significant market power (SMP), they are essentially confirming that consumers preferred to choose a good or service from a firm that satisfied their needs. As to pair (b)-(bb), the crux of the problem with notions of SMP arises with qualifiers such as "harmful" and insinuations that the market position is tantamount to "unfair" competition. Regarding the high market share of the Google search engine in South Africa, for example, there are no arguments to support the allegation of unfair competition let alone that consumers are harmed. If certain people consider it unfair or not tantamount to "effective" competition that all consumers chose the same thing, then this is as valid an opinion as any other. It would be an equally valid opinion to say that the markets served by Google and Facebook are a particularly fitting case of effective competition because how else could one explain that "garage" companies shaped an offering that the entire globe jumped at. To do away with one cliché once and for all: The number of companies in a market and their market shares (measured in whatever form) do not allow to infer any judgment about "effectiveness" or "ineffectiveness" of competition. What such numbers do allow, however, is to understand the structure of the industry and the preference profile of consumers.

The third idea (cc) of creating "fairer" competition through enforced sharing via open access regimes is particularly toxic. The key terms in point (c) are "assets" and "exclusive use." When economists and finance professionals talk of assets, they refer to tangible or intangible production factors that firms employ for the assets' expected period of use (or the lifetime of the asset). In the case of mobile markets, the assets recorded on an MNO's balance sheet are a result of past investments that were financed through two channels: operational free cash flows and commercial debt. Operational free cash flows are the surpluses that remain after having paid all variable costs such as wage and supplier bills, having made allowance for working capital requirements and taxes. When free cash flows are understood as a result of consumers paying in excess of the marginal cost of production, then consumers pay for investment in assets and compensate the entrepreneurial entity's owners (dividends).

If investments in assets are financed through a firm's operational free cash flows, the source of capital is internally generated. In contrast, external financing refers to commercial debt raised in the credit market. Banks' credit decisions to issue commercial loans rests on two pillars: the firm's assets and the free cash flow expected in the future. The value of the firm's assets (as recorded on the balance sheet and/or valued in the market) form part of the bank's security pool they are eligible to appropriate and dispose of in the event of insolvency. While the security pool is a result of past success, the payment of interest cost and the ability to repay loans are premised on the firm's going concern status, meaning that it is viable and able to meet its financial obligation going forward. A going concern is a firm that is expected to continue earning profits, which means nothing else than that consumers continue to pay in excess of marginal cost of

production that would only pay variable cost but no innovation, new investments and commercial debt.

This discussion serves to explain the singular most important institution in economies that operate under a system of division of labour: property ownership. Self-evidently, the notion of property ownership entails that for property to be owned, the use of it is subject to the exclusive discretion of the property owner. It is important to distinguish between the notion of the "exclusive use" of an asset and the notion of an "exclusive discretion of how to use" an asset. The notion of "exclusive use" and the related idea of an asset's "non-exclusive use" are intellectual aberrations. In a division-of-labour economy, nobody uses productive assets exclusively. The essence of capitalist systems lies precisely in the fact that property owners expose their assets to be used by other parties. Apple allows their applications platform to be used by app developers, any firm's buildings and production facilities are used by their employees and supply chain partners, mobile operators use the capacity of external data centres and submarine cables, and banks "use" the assets of companies to securitize their loans. In our search for commercial and technological solutions to the problems towards which our economic efforts are directed, solutions are always directed at finding ways how to find the most productive way of sharing one's own assets with other people and of how to use other people's assets.

The single most important institution for creating economic prosperity is property ownership and tradability, which is not synomomous with the *exclusive use* of property. It, however, confers upon owners the discretion of *how to use* their property for their own benefit and the benefit of others.

Historically, economic development and increased prosperity always coincide with an increased division of labour. In terms of economic theory, development means higher complementarity in the *use* of production factors.[48] The concrete patterns of how production factors are used are a result of consumer choice. A key axiom of economic theory relates to the theory of imputation according to which factor prices are determined by consumer-good prices (in which the values of the various production factors employed are imputed according to their marginal value product). Note that the labour-theory of value until its refutation by the economists Carl Menger, Stanley Jevons and León Walras in the second half of the nineteenth century (marginal revolution) assumed that the value of production factors is determined by the (objectively measurable) amount of labour and not by the people's valuations that reflect consumer demand.

Combining the two takeaways of this brief exposition in economic theory yields two results:

- the value of production factors is a function of consumer choice;

- the institution of property grants owners the exclusive right to use their assets, to not use them, and to allow other parties to use them.

The conclusion is that a firm's commercial success hinges on their owners' ability to use their and other people's production factors so as to best satisfy consumer demand. In other words, profit is the result of entrepreneurs having made discretionary use of their ownership rights that cannot but be understood as consumers' approval of the firm's profit implied in their choices.

In the following, the goals and objectives formulated in the White Paper (64-65) will be contrasted with the teachings of sound economic theory:

> In order to make the changes in the ICT sector that are needed to recognize South Africa's developmental objectives and transform society and the economy . . . this chapter confirms that spectrum needs to be defined and treated as a public good used to meet public interest objectives. Spectrum generally needs to be managed and used *effectively* and *efficiently*; and broadband spectrum needs to be governed in line with a paradigm shift towards the non-exclusive assignment of highly *contested spectrum* in bands where *demand exceeds* the amount of spectrum.
>
> To support this new approach, the open access regime must be extended, and more direction is given in this policy on how networks should be shared between all licensees for the benefit of society, including through a Wireless Open Access Network. The reconceptualised spectrum policy and enforcement of an open access regime will facilitate lower costs and more efficient networks that *use the latest technologies* and are able to deliver a multitude of services. This will also promote the extension and deployment of networks *in rural and underserviced areas* to support inclusive economic growth. The Government recognizes that *time is of the essence* if the country is to meet the targets set out in SA Connect and the economic growth targets put forward in the NDP. (emphases added)

Firstly, it is impossible to determine objectively what the *effective* or *efficient* use of a resource is. The use of production factors, including spectrum, *is* effective or efficient when it *is* employed by MNOs operating as a going concern. As a matter of principle, economic reasoning must not make use of the term "efficient" in a prescriptive manner because there is no objective criterion of "efficiency" or of what could qualify something as "efficient" in the real world of economic activity. Efficiency is when people agree to the terms of exchange. We have, however, a good understanding of what an inefficient use of resources entails. It is surely inefficient, for example, if governments hoard spectrum for a decade or if regulations tie the use of spectrum to particular technological uses. The South African government's (and those of many other countries') regulations would not have failed to release spectrum in the pursuit of their own developmental objectives if broadcasters and other commercial spectrum users could have traded off their resources and occupy spectrum in lower frequency bands that are not only spectrally

better suited to emit TV signals but are also relatively uncontested as they are of lesser productive value for purposes of providing cellular broadband services.

As to the notion of "contested spectrum" where "demand exceeds the amount of spectrum" in the first paragraph quoted above, it is the very function of markets that production factors become contested to the maximum degree possible. For this to happen, markets must *be* contestable in the first place. There is, however, no market for spectrum because the regulator assigns spectrum based on non-market criteria. If we had a contestable market, lossmaking TV stations would have long ceased to occupy spectrum worth in the billions of Rand. The White Paper's reference to "demand" that "exceeds the amount of spectrum" is curious in that there is no demand in the common sense of the term because due to the fact that government withholds spectrum there is no economic way to satisfy the demand in the first place. If Jeff Bezos and Bill Gates suddenly decided to buy hundred new luxury yachts for three hundred million dollars each, their demand could at least be satisfied hypothetically (though they had to wait for decades and prepay billions of dollars for yachts producers to begin producing). The South African experience shows that even the highest demand is unable to become economically effective precisely because the regulator stands in the way of markets for spectrum ownership titles to develop and do their job.

For resource uses to become contested, there must be a market on which economic actors can contest the prevailing uses by bidding higher prices. Public ownership of spectrum is precisely a case for non-contestable "uses" (that is, non-uses). As there is no market for spectrum yet, and by implication no market pricing, there is also no demand that could exceed supply.

In the second paragraph quoted above, it is insinuated that the solution of bringing services to "rural and underserved areas" by using "the latest technologies" lies in the purposed "new approach" of an open access regime. Such a reading would amount to a gross distortion of fact. The fact is that it is largely due to the Government's withholding of spectrum that rural broadband services are unsatisfactory and latest technologies could not be employed. The non-availability of spectrum in the 700/800 MHz band have prevented carriers from rolling out more radio infrastructure at the same investment amounts. In addition, as discussed in the technology chapter, this also prevented carriers from realizing the efficiency gains of carrier aggregation, higher data throughputs, better in-building signal penetration, and reduced energy costs. The claim that Government recognizes that "time is of the essence" is not reflected in concrete undertakings which could have been undertaken many years ago.

To conclude this sub-section, we address the assertion of the need for regulatory provisions for an open infrastructure-sharing regime (as stipulated in chapter 7 and 8 of the ECA) in two steps. First, we look at the principles the White Paper considers underpinning open-access regimes. In the second step, we look at how infrastructure

sharing works in the reality of South African mobile infrastructure markets. The five principles listed in the White Paper are:

- Openness;
- Transparency;
- Equal access and non-discrimination;
- Sharing and non-duplication;
- Efficiency, standardisation and reasonableness.

The curious aspect about the above list is that the paper does not define seven of the nine criteria. It defines "transparency" as follows: "Access must be provided in a way that is clear to all market players." The question is who decides what is clear. While the paper does not define "equal access," it does define "effective access" which "refers to access by competitors that is easily obtained in reasonable locations using standardised interfaces. The service should be of a high quality and unbundled to a sufficient degree so that the access seeker does not have to purchase services it does not need." This definition boils down to the regulator assuming the role of the network planner and telling operators what to do.[49]

The goal of firms—and purpose of entrepreneurship—is to best distinguish or *discriminate* offerings against competing offers. Likewise, if as consumers we pay R20 for a litre of organic milk, we're not only "discriminating" against non-organic milk producers. We also "discriminate" against consumers who would have bought the same organic milk for R17.

The third term defined is non-discrimination: "All access seekers must be granted access to networks in a non-discriminatory manner; a vertically integrated infrastructure provider cannot favour services affiliated with its own company." To illustrate the presumptuousness of this idea, let us apply the idea to the everyday reality of a firm. For the sake of the argument, assume that you are the owner and only employee of a workshop where you typically exercise the discretion of how to use your hammer and saw. According to the idea of non-discrimination, you now must grant other people access to the hammers and saws on the same terms you use them to earn your income.

The ideas of non-discrimination and non-exclusivity effectively mean to render the institution of property ownership invalid. It does not seem to occur to the authors (and those that have signed off on the version quoted here) that the entire fabric of economic life rests on how to best discriminate among the various use of production factors. This discrimination also entails that firms hire only those people that their managers expect to be best suited in *the* function to create economic value and not people third parties view as eligible to assume *a* function in disregard of economic value. This positive notion of productive discrimination, which confers upon property owners the right to exercise the

discretion of choosing how to employ their property given the host of alternative uses, applies as much to MNOs as it does to the workshop owner in our example.

The idea of non-exclusivity is in the same vain. We repeat the intention expressed in the White Paper that spectrum "needs to be governed in line with a paradigm shift towards the non-exclusive assignment of highly contested spectrum." First of all, taken literally this means that other agencies, possibly the market, can also "assign" spectrum in future, which would indeed be a paradigm shift. What the Government, however, wants is that the spectrum it exclusively assigns is used on a non-exclusive basis. Certainly, the WOAN concept as presented in the White Paper is of particularly exclusive (or discriminatory) nature as it compels carriers to buy 30 percent of the network's capacity (ITA 2020). The White Paper further stipulates that "all high demand spectrum will be assigned on an open access basis" (75).

There is no such thing as non-exclusive access to resources Whoever the owner is, including government, has "exclusive access". The only way to allocate resources in the interest of consumers is through a market process. Where access to resources is non-exclusive, the resources are either not *economic* resources (that is, they are free) or taxpayers pay for some parties chosen by government to have privileged (exclusive) access (that is, they do not pay "market prices").

This was correctly interpreted by industry to say that MNOs must hand back to the regulator the spectrum they had been assigned and had been using exclusively. Consulting and research firm Africa Analysis stated that Government's national integrated ICT policy white paper essentially amounts to the "nationalisation of spectrum in South Africa" and that implementing the ideas in the White Paper would "lead to loss of confidence in investing in the infrastructure market."[50] Such a loss of confidence increases investment uncertainty and by implication leads to higher unemployment and a generally depressed economic outlook, which is what South Africans have observed for years. By advancing such regulatory ideas, regulators effectively tell consumers that the choices they made for more than two decades were wrong. At the same time, had the idea of open-access moved ahead in line with what was suggested in the White Paper, it would have coerced companies into radically changing their business model and asset structure just to meet the ideas of fairness and equality of a few government bureaucrats. Apart from the fact that such policy proposals constitute a severe violation of effective property rights,[51] they ignore that the long-term investments needed for the creation of long-term economic value are premised on the reliability of institutional framework. Fortunately, the Government seems to have realized that it has overshot its mark. Interpreting the ITA released on 2 October 2020 for the auction planned to be held in March 2021, carriers may continue to use the spectrum ICASA has assigned so far and will assign upon completion of the auction exclusively.

The second step to contest the Government's notion of sharing and open access as formulated in the White Paper is to look at the reality of mobile telecommunication markets we find in South Africa and most other countries. There is widespread sharing in the industry of the space on towers to collocate radio equipment, in some countries RAN-sharing is allowed, in some countries carriers are allowed to pool their spectrum to achieve better outcomes. In any case, there is widespread sharing of fibre networks for backhauling traffic, sharing of data centre capacity and sharing of submarine cable capacity. As to the purported wasteful duplication of infrastructure such as mobile towers: the dream of ubiquitous IoT services and high-speed 5G data will remain a pipe dream without the joint utilization of tower assets across all carriers.

In the Market Inquiry on data prices, ICASA responds to Cell C's claim that the deal between Vodacom and Rain effectively fulfils the criteria of a spectrum-trade as follows.

> Cell C has raised a concern that Vodacom is enjoying ... an advantage due its site sharing and roaming agreement with Rain. The Authority's view is that Vodacom has not acquired Rain's spectrum, however, and is only able to make use of it through roaming on Rain's network, so it cannot be termed a spectrum assignment advantage as indicated by Cell C.

What ICASA effectively says is: "We agree that Vodacom is enjoying an advantage through a spectrum sharing agreement with Rain. But you must not term it a *spectrum assignment advantage* because Rain is still the owner of the spectrum—legally speaking." It is instructive that ICASA invokes the legal definition of property ownership to defend itself. For this chapter,[52] it suffices to understand that Vodacom could not have acquired Rain's spectrum without the approval of the regulator. More importantly, beneficial economic outcomes as to the best-possible employment of a given set of production factors ensue irrespective of initial distribution of property rights. This insight was formulated by Ronald Coase in his landmark paper *The Problem of Social Cost* (1960) and became known as the Coase-theorem (or, alternatively, the "invariance thesis") earning him the Nobel Prize in economics in 1991. In his words:

> It is always possible to modify by transactions on the market the initial legal delimitation of rights. And, of course, if such market transactions are costless, such a rearrangement of rights will always take place if it would lead to an increase in the value of production. (1960, 15)

It is important to note that the *legal* delimitation of rights as to who *owns* resources may remain unaltered while the *economic* delimitation of resources as to its *use* changes radically. Two conclusions can be drawn in the presented case of Vodacom making *use* of Rain's spectrum. Firstly, there is no market on which spectrum is traded because the regulatory framework does not allow market-based buying and selling of spectrum. Secondly, there is no need for swapping ownership titles if other arrangements are capable of achieving the same results. From the perspective of consumer value, the value

of Rain's network assets utilizing frequency in the 2.6 GHz band is largely a result of Vodacom roaming the traffic generated by their subscribers over their partner's network. The consumer could not care less who owns the assets as long as she reaps the benefits of better services. ICASA is thus absolutely correct that the arrangement between Rain and Vodacom cannot be *termed* a spectrum assignment. Cell C is also correct in that Rain has assigned its spectrum to Vodacom—economically speaking at least. So, who's right?

The first takeaway of this discussion is that the question cannot be answered. The second takeaway is that the need for answering such questions would not occur in free markets, that is, in the absence of regulatory intervention. The mandate of regulatory authorities is to deal with issues and create artefacts that would not occur without them. The creation of a WOAN, for that matter, belongs in the group of regulatory artefacts. The market, it seems, finds ways to circumvent negative regulation.

4.3. Government's View of Competition in the 2018 Market Inquiry on Data Prices

On 16 November 2019, ICASA published the *Discussion Document on the Market Inquiry into Mobile Broadband Services in South Africa*[53] ("Market Inquiry"), which was preceded by various rounds of public discussions about the level of data prices in South Africa.[54] In figure 6 in the Market Inquiry it is shown that data prices in South Africa are neither extraordinarily high nor particularly cheap. Based on ITU-data from 2017, the 500MB bundle was priced at $16.61 (in PPP), pretty much in the middle of the benchmark group. Switzerland and Brazil were a bit cheaper, Senegal and Malaysia were a bit more expensive.

There are a few important aspects to consider when performing benchmarks. Firstly, prices are a function of the production structure which in turn is a result of market demand, which inter alia, is determined by a country's specific economic, geographic and demographic conditions. Both the demand and supply side of mobile telecommunication markets are affected by the degree and scope of regulatory interference: spectrum cost and availability and other regulatory stipulations such as coverage obligations and caps on interconnection fees have an impact on prices. Let's also not forget that corporate taxes and VAT on consumer goods in South Africa also have an impact on consumer prices as does the cost imposed by onerous public bureaucracy and red tape.

Secondly, there is no such thing as *a* price. All prices are relative; they are relative to prices of other goods, they are relative to income levels, and they are relative to quality. Accordingly, all prices are effective prices. A haircut for 200 Rand (or $12) in Johannesburg might be as stylish as the one in Denmark for $50 reflecting the higher productivity and thus income and wealth levels of Danish citizens. Likewise, the comparison of the price for 500MB data in Johannesburg with the equally priced 500MB data in Senegal is not straightforward, even without looking at different levels of

spectrum endowment. There are service quality differences, and, in South Africa, mobile network coverage is almost 100 percent while it was 92 percent in Senegal in 2016. It is a well-known fact that closing the last 10 percent of the coverage gap is a multiple of the cost of achieving 70 percent or 80 percent. The ability to finance the last 10 percent is a sole function of the revenue earned in a few core metros. Rolling out broadband in rural areas is particularly costly because population density is low (2 people/km^2 in Northern Cape vs. 375 people/km^2 in Gauteng), even without taking into account much lower average incomes. The economic problem to provide connectivity in such areas is multiplied when carriers do not dispose of spectrum in sub-1 GHz bands (as discussed in chapter 2.1).

South Africa is a large country with all the beautiful geographical features that make the rollout of network infrastructure challenging, such as mountains, rivers, forests, national parks. In the absence of fibre networks, it is not sufficient to build a tower. Somehow the carrier must get the traffic that originates in Calvinia or Pofadder to an exchange connected to the carrier's core network that will satisfy demand. In the absence of fibre, this can be done by microwave links or satellite backhaul, both of which are not cheap. The economic backbone of South Africa sits in four metros. The performance and network quality in these metros is on par with first world standards because people can pay for it, though not all of them. It is the standard trajectory in free markets that new offerings are dedicated to a few who want the product and can afford to pay the initially high prices. This is what happened when MTN and Vodacom started operations in the mid-1990s by launching post-paid services at prices well north of R500. In 1996, Vodacom South Africa introduced the world's first prepaid offering paving the way for telecommunication services to become a universal service for citizens in basically all income brackets within a few years. As discussed in chapter 2.3, the Western utility model of providing fixed-telecommunication services by creating a natural monopoly failed on all accounts in low- and lower-middle-income countries. Citizens in these countries earning median incomes did not have a fixed-line—and also no bank account. Prepaid and mobile-money wallets introduced one and a half decades later solved both problems.[55]

GSM voice services based on post-paid contracts started off as a luxury product that no industry expert expected to ever surpass market penetration levels of 10% in low and lower-middle income countries. Famously, McKinsey conducted a study for AT&T in the early 1980s which estimated the number of cell phones in use worldwide in 2000 at 900,000.

To an extent, the price structure of data offerings is a reflection of the relatively high number of high-income earners (including corporates) and their willingness to pay for quality. The South African telecommunication network ecosystem does reflect this. It is not only towers and base stations that add to the cost of services. It is also fibre backhaul,

data centres, property prices, long-distance fibre and submarine cable capacity, and the above-average salaries paid by MNOs, that are to be funded. The ICT infrastructure in South Africa's four key metros is world class. Comparing data prices in Maseru with those in Sandton is an interesting but futile exercise from the perspective of economic theory: nominal prices for a 500MB data package might be the same; effective prices differ, often significantly. Regulatory efforts to enforce price decreases through undertakings such the Market Inquiry, even if rated as well-meaning, are premised on the assumption that MNOs' pricing structure is something that can be tweaked and twisted so as to fit policy objectives. If carriers were to shave off a few percentage points of their profit margin, lower prices could be realized. This is correct. Unfortunately, such a move comes with reverberations the same politicians would not quite endorse, such as less new hires, lower salaries, lower corporate tax incomes from carriers, and lower equity returns affecting share prices and, by implication, the financial performance of pension funds.

One of the most popular targets of political attack are the purported excessive operating margins (EBITDA) of MTN and Vodacom. This argument misses the point in various respects. Firstly, revenues are under pressure for traditional voice and messaging services due to OTT substitution. MNO needs to diversify in search of new revenue pockets such as financial services, entertainment offerings or Cloud services, which cost money. Secondly, mobile telecommunication is a capital intense sector. Consumers' rapidly increasing demand for bandwidth requires continuous capital investment in new radio technology and denser network footprints. Thirdly, to the extent that the EBITDA-margins may be slightly above those in other countries, insufficient spectrum requires MNOs to roll out relatively more network infrastructure. Note that the cost of depreciation and financing of network equipment is not included in EBITDA. And, of course, South Africa is not quite a tax haven. The key point that reveals the hypocritical and uninformed nature of arguments of excessive margins and anti-poor pricing, as made in CompCom's Final Report "Data Services Market Inquiry"[56] (dated 2 December 2019), is that if there is one thing that the generally depressed and hamstrung South African economy is in desperate need of then it is more investment in viable infrastructure such as mobile telecommunication services. The cash flows to finance such investments have to be earned. If regulatory conditions make it more costly to operate networks, consumers will pay the prices for MNOs to realize the margins needed to satisfy the interests of debt and equity providers. Authors of the CompCom report should ask whether the prices of data services or their policies are "anti-poor".

The third point analyses spectrum available to carriers in different countries. Firstly, having 20 MHz spectrum in the 2.1 GHz band in Maseru equates to a much higher assignment of MHz/pop compared to having 20 MHz in Johannesburg. The same amount of spectrum in the same frequency band does not infer anything about the relative profitability or performance of a network. Depending on population density and

consumption patterns, 20 MHz in Johannesburg could make it difficult to achieve the same returns on capital as in Maseru. Higher income levels in Johannesburg, however, could compensate for the higher investments needed to build the much denser network footprint (everything else being equal). Secondly, it is rarely the case that everything else is equal. In South Africa, it is the spectrum available to MTN and Vodacom that is unequal compared to other countries. On the face of it, South Africa's leading MNOs provide data services at average or slightly above average prices but do so with a comparatively dense network footprint and at comparatively high quality levels. Given, however, the extraordinarily low amounts of spectrum available to MTN and Vodacom which, to make matters worse, are in bands that not only make network rollouts comparatively costly but also deprive MNOs of reaping the spectral efficiency gains of carrier aggregation, requires the impartial analyst to assess the carriers' achievements much more favourably.

Looking at the Market Inquiry document, it is not the case that these three points escaped Government's attention. The authors make explicit reference to the fact that "data prices are neither extremely high nor very low" and that "South Africa has been assigned relatively little spectrum for *mobile use*" (p47). The emphasis is on "mobile use" here because in South Africa, the economic impact of spectrum withholding is aggravated by the fact that the average spectrum per carrier puts South Africa at the bottom of the ranking (which is illustrated by the little yellow rhombus in Figure 17, page 47). Yet even the average spectrum per MNO does not reflect the full economic truth. We must weigh the amount of spectrum per carrier with their respective market share. Doing so renders the disconcerting result that MTN and Vodacom serve roughly 80 percent of the retail market but only have 27 percent of total spectrum of 609 MHz (as per November 2020). This is an extraordinary accomplishment probably unrivalled in any other country. Despite this, the authors of the Market Inquiry condemn "significant market power (SMP)," another term for dominance, and "ineffective" competition as if none of the highlighted points influence prices. Their regulatory logic is in conflict with common sense and economic theory.

From an economic theory perspective, the Market Inquiry is intellectually unsound. The version of neoclassical economics that underpins it is outmoded. Yet, even within the confines of orthodox neoclassical economics the authors make no effort to go beyond applying simplistic theory to complex markets such as the ICT sector. This is all the more problematic because the trajectories of global ICT markets in general and that of the mobile telecommunication sector in particular have disproven cruder versions of neoclassical theories of "perfect competition", "natural monopoly" and "market failure" on all counts. For the purpose of this SEIA, a brief exposition of the notions of efficiency and effective competition included.

According to introductory textbooks, a market is considered efficient when it is in "perfect competition." Competition is perfect when no single buyer and no single seller has any market power, for example the power to charge a higher price or to introduce a new product. In this world, knowledge is universal and any hypothetical step away from the equilibrium price is a futile exercise. It is important to understand that in equilibrium there is no entrepreneurship, no innovation, and no real progress because no profits are made that would allow investing in new technologies and markets. It's Groundhog Day forever.

Real markets are not like that. Neoclassical scholars have noted that some companies indeed set prices and have significant market shares because consumers prefer their products. In some instances, only one company serves the bulk of consumers, which means that consumers like their products very much. In the latter case, according to neoclassical textbooks, a market structure of natural monopoly might result in some sectors if firms are able to fend off entry of potential competitors by decreasing prices below average cost implying that past investment is sunk and thus irrelevant for price determination. Further, assuming universal knowledge of technologies (there are only efficient technologies) and perfect information about consumers' preferences (and their indifference curves), a challenger will not be able to enter the market at prices less than average cost because it would imply that shareholders earn returns below equilibrium market returns. The interesting part is that neoclassical theory cannot explain how the market arrived at equilibrium. For example, at some time before equilibrium something must have induced entrepreneurs to assume equity risk, build something new and take risks for which they expected above-equilibrium rates of return. Also, before equilibrium, consumers must have been willing to pay entrepreneurs for launching new products and services. In other words, somehow all the capital assets of modern economies we see around us must have been financed based on the expectation of higher consumer prosperity and above-average profit returns. As all market activity is necessarily forward-looking and happens under uncertainty, investments will be amortized over time when entrepreneurial expectations about consumer value turn out to be correct.

The number of legal entities serving a particular consumer market is not a guide to the effectiveness of competition. The crucial point is whether competition is allowed. In line with William J. Baumol, a market is competitive when it is *contestable*. The only "markets" that are naturally incontestable are state monopolies.

An example of a single consumer-driven supplier is that half the world's zippers, and 100% in many countries, are supplied by YKK. If the CompCom forces YKK's nearly 100% market share in South Africa down, it will not be acting so much against YKK as against the revealed preferences of consumers. A free or nearly free market is a

permanent consumer democracy in which consumers vote with purchase for or against the world's "most powerful" suppliers. Were a sole supplier of something to emerge, it would be justly rewarded for being better than all others at pleasing consumers.

Another standard misconception is that "competition" exists between suppliers of similar products and services. In the real world, every supplier of anything competes with every other supplier. Since consumers have finite wealth, all competition is "Rand competition", namely competition against everything consumers buy.

For consumers to achieve increasing prosperity, they must compensate entrepreneurs for investment uncertainty and risking their wealth (savings and capital). The function of capital markets is to intermediate between savings and investments.[57] The key point is that debt financing greatly constrains firms to decrease prices below average cost. In companies that own and invest in long-term infrastructure, a significant portion of their operating cash flow goes to meeting debt obligations. Cutting down on employee cost, reducing investment or paying out lower dividends are not sustainable strategies to defend a firm's market position. The *Theory of Contestable Market*, mostly associated with British economist William J. Baumol, was first presented in 1982.[58] The novelty of this theory was that it did not look at competition as is but at potential competition of new entrants. As we are still in the perfectly competitive market with perfect knowledge, absence of uncertainty and no transaction cost, the threat of entry disciplines the market incumbent because any movement away from the equilibrium price would conjure up the threat of (a hit-and-run) entry. The theoretical setup is as remote from reality as the usual model of perfect competition with the exception that Baumol allowed for the possibility of a dynamic element.

Leaving the nirvana world of neoclassical economics, as Chicago-economist Harold Demsetz (1969) termed it, an exploration needs to be undertaken of what contestability means in the competitive context of real markets. Firstly, the new theory (re)introduced the distinction between *competition in the market* and *competition for the market*, which is to say that a disturbance of equilibrium can be endogenously motivated. Yet, this does not change the fact that the theory is still fundamentally incommensurable with anything that would resemble real markets. A particularly noteworthy aspect of the theory concerns the implicit assumption that competition in Baumol's model means competition for consumer markets. The supply-side is defined away through the assumption of perfect knowledge and perfect capital markets (i.e., no return spreads). These assumptions immediately beg the question on which basis an entrant could threaten

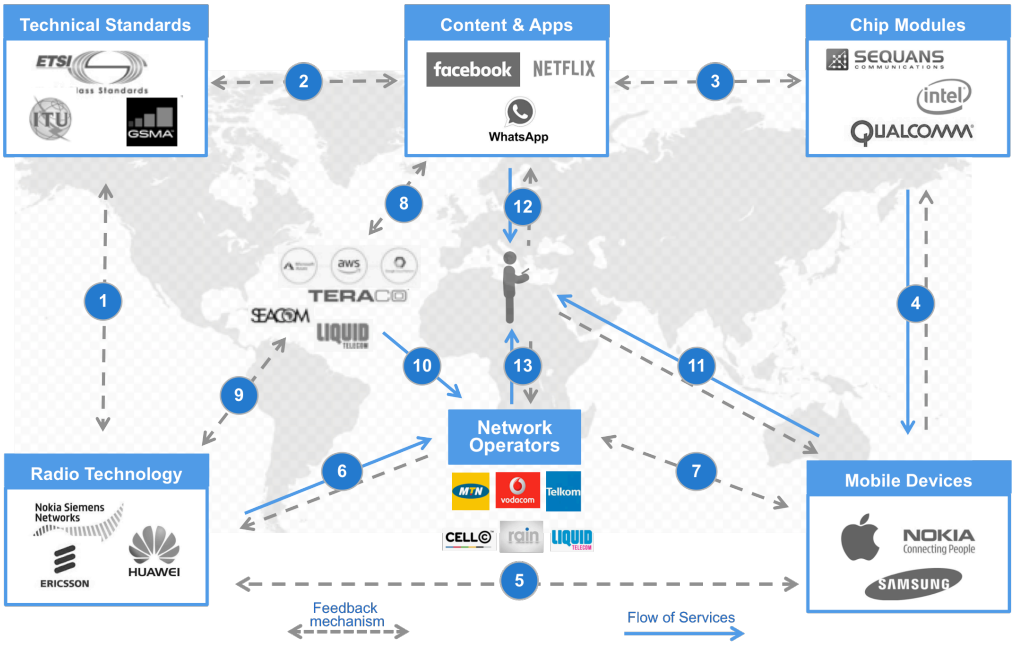
There are few global markets that are more competitive than those for the various elements of the mobile value chain. The entities that started off as vertically integrated MNOs with significant control over most value chain elements have turned into technology aggregators forced to employ the best technologies for the benefit of consumers.

the incumbent (apart from the fact that neoclassical consumers already live in a happiness end-state which makes ambitions for inventing new technology superfluous).

While the *theory of contestable markets* as presented above is inapplicable to real world scenarios, the *idea* of contestability can be fruitfully applied to real markets, for example to the supply-side of mobile telecommunication markets. Accepting that the (weighted average) return on capital for most sectors and firms ranges between 5 percent and 10 percent, implies that 90 percent and more of a firm's net revenues earned are needed to pay employees, suppliers and debt providers. Of this cost base, the bulk is needed to pay the cost of long-term infrastructure investments. While there are only a few MNOs serving end-customers, there are hundreds of firms scrambling to produce the various elements of the MNOs' supply side—or value chain. The value chain of mobile telecommunication networks might well be the most contestable—and contested—production structure in the history of capitalism. The decision of regulators to issue two or more licenses turned out to be a game-changer. The decision was partly informed by the lacklustre performance of fixed-telecommunication carriers across the world. The fall of the Iron Curtain and the market-friendly supply-side politics of the Reagan- and Thatcher-administration facilitated privatization. Selling SOEs also gave governments the opportunity to realize short-term revenues.

The bottom line, however, is that nobody had mobile prepaid technology on the bill and that a relatively simple commercial idea would first make voice telecommunications universally available and, a few years later, turn MNOs into the most important providers of Internet access (and now into retail banking providers). This was understood only a few years after mobile networks were introduced in most countries and entrepreneurs seized the opportunity. The telecommunication market, which used to be divided into national fixed-line monopolies serving roughly half a billion people in high-income countries and a slim strata of the urban (political) elite in other countries, suddenly was able to address the needs of everybody. It further helped that the market for mobile handsets and content were beyond national jurisdiction, as was the sales and distribution chain (remember that in most countries we had to source rotary phones from the post office). All of these conditions have contributed to stimulating an unprecedented wave of innovation in all areas of the mobile value chain. Below, figure 2 attempts to give an idea of the nature of the current mobile telecommunication value chain:

FIGURE 2: MNOS AS AGGREGATORS IN THE MOBILE TELECOMMUNICATION ECO-SYSTEM



To the extent that the above-described conditions helped investors to raise capital to profitably roll out networks even in countries with very low incomes (whose population technically speaking had no access to telecommunication before) and turned MNOs into valuable companies literally overnight, they could only achieve this in cooperation with national and international value-chain partners. On a closer look, it becomes clear that mobile operators are pure aggregators of equipment and content that is produced outside their firm boundaries. Their task is to plan networks in such a way that consumers are willing to buy services at prices that allow them to pay suppliers, service debt and generate cash flows to expand their network and improve services. Of course, it is possible to do a better or worse job in managing an MNO. But it does not seem as if management is the make-or-break element in the value chain. To my knowledge, there have been very few cases of illiquidity of MNOs with a significant market share (with the notable exception of India). As it is rather unlikely that the world of MNOs is inhabited by particularly outstanding management teams and as it is also not the case that MNOs are so profitable that bankruptcy is a remote possibility, something else must explain the extraordinarily stable nature of MNO operations across the world.[59]

The explanation appears to be that the supply-chain ecosystem exerts a disciplining effect on what MNOs can and cannot do. This disciplining effect can only play out to the advantage of consumers when the elements of the mobile value chain are contestable. By way of example, if we assume that MTN had taken the decision in the early 2010s to roll out LTE in South Africa's metros and we also assume that Vodacom's shareholders had decided to cash in dividends for five years and keep on going with 3G data, then the

market would have forced Vodacom shareholders to correct their decision very quickly. This logic essentially applies to the whole value-chain ecosystem. It is inconceivable that within two decades six or seven new technological standards would have been implemented in the SOE-world of fixed-line incumbents. The reason is not that there is anything intrinsic to managers of MNOs that would justify the conjecture that they are particularly keen to overhaul the production structure of their company every three years; they just have to.

It is the contestability of mobile value chains that explains the enormous leaps of innovation in RAN and chip technology and the emergence of business models such as tower outsourcing and carrier-neutral data centres. The *Market Inquiry Study* is silent on innovation and supply-side pressures of competition and the disciplining effects exerted upon MNOs through the constant introduction of new technologies.

Administrators of public monopolies, in turn, are not subjected to market discipline because there is no threat that a rival will leap ahead by implementing a new technology. This demonstrates that the competitive advantage firms can reach is first and foremost a consequence of innovation efforts on the supply-side of the value chain. Note that the ontological nature of one megabit of data is such that it is hard to differentiate. But the same megabit can be fast; you can get it fast or slow; you can get it reliably at peak times in Sandton; you can get it in rural areas; and you can get it for more or less money. Until the 1990s, you got a fixed-line minute, or you did not; you paid what you had to pay; you had to take the phone they gave you; and in most low-income and lower-middle income countries you had to wait for years until you got connected even where there was a network (unless you paid some incentive to speed up the process).

The high degree of contestability for the elements of the mobile value chain is not only exemplified by the quick succession of radio standards. Since the mobile market emerged in the 1990s, external suppliers have captured—or are in the process of capturing—most of the value-chain elements that were owned and controlled by MNOs until ten years ago. Fibre backhauls to offload traffic is in the firm hands of suppliers; most carriers source their data centre capacity from independent providers; more than 70 percent of the world's mobile towers were sold to towercos by 2020; radio modules have begun to be shared in many markets.[60] Most importantly, MNOs do not sell a bespoke product anymore. While GSM voice and SMS in the 1990s could only be produced and transmitted by MNOs, in the world of IP it is content that consumers look at. The role of MNOs is to facilitate the delivery of content produced by other firms. There are thus two forces of contestability. The first force disciplines MNOs to adopt the best technology, often by giving up control over parts of the value chain where external producers can deliver the service at lower cost.[61] The second force is consumer demand for evermore data-heavy content. In terms of dynamic economic theory, the introduction of new

technologies (first force) serves to satisfy consumer demand (second force). In other words, all economic activity is necessarily a result of consumers looking for better and cheaper services.

In contrast, the only "market" that per se is not contestable is a public monopoly, most typically in the form of utilities and the prohibition of market entry.[62] It is also the only legitimate theoretical definition of "monopoly" because no competitive market can exist in such constitutional settings: consumers do not have the choice of alternative offerings, entrepreneurs cannot enter the market even when the penetration levels of services hover around 0.1 percent for decades (as was the case for fixed-telecommunication in low-income countries), because competition would lead to market failure. This is no joke; it is what we read in the textbooks used to teach economics in undergraduate courses. For the sake of younger readers born in the 1980s or later and only have a faint childhood memory of rotary phones, it was a criminal offense in Germany to connect a French rotary phone to the German copper loop because of the potentially destabilizing effect it could have on the overall network (apart from the fact that you could not buy a French rotary phone without living in France and having a subscriber line with the French monopolist and that there was nothing to be gained by connecting a French rotary phone to the German network).

As to the quality of both economic reasoning and empirical evidence that could corroborate the claim of ineffective competition and SMP, the authors of the Market Inquiry document do not succeed in submitting any argument that goes beyond commonplace and assertions. I will provide four examples to illustrate the depth of reasoning. The first one concerns roaming ("Upstream Market 3"):

> The Authority considers a market for roaming services that has a geographic dimension at least as narrow as local and metropolitan municipal areas. This is based on, among other factors, the nature of roaming agreements in South Africa which have geographic limitations. These markets are ineffectively competitive as only MTN and Vodacom have substantial coverage in many municipalities. From a network capacity perspective, measured by number of network sites, MTN is dominant (has a market share of 45% or more) in 34 local and metropolitan municipalities, Vodacom is dominant in 86 and MTN and Vodacom both have a market share exceeding 45% in 15 municipalities.

The causality is that markets are ineffectively competitive because MTN and Vodacom have done their job, namely, to provide coverage to all municipalities. The first question to ask the authors is why Telkom and Cell C are not offering their services in these municipalities. There must be some inherent economic reason that two network operators are sufficient. The verdict "ineffective competition" is derived from section 7 of the Competition Act, which the authors quote: "In terms of section 7 of the Competition Act a dorminat [sic] firm has market share of 45% …" In other words, the fact that it is

somewhere defined that 45 percent is constitutive of dominance (irrespective of the specific nature of the market), firms in all markets that meet this criterion are dominant implying consumers are harmed and regulatory intervention is warranted. So, what about the towns with one bank branch only, one gas station or one butcher? It is not worthwhile to elaborate any further on this.

The second question to ask is whether MTN and Vodacom exploit their so-called "duopoly" by charging different prices for voice and data in Johannesburg or Cape Town. If MTN and Vodacom were to charge cost-based prices for the services they render to subscribers in small municipalities, they had to charge tenfold the price. They do not do this, not because they are Good Samaritans, but because of two very tangible market-related reasons. Firstly, a cost-based price differentiation along geographical and demographical boundaries is almost unsolvable from an accounting perspective.[63] How do you price a piece of the backbone that branches off to provide fibre to the little municipality? What does the MNO finance professional make of the fact that a radio module in Sandton possibly amortizes in three years or less while the one in Pofadder only in fifteen years or never? Secondly, consumers perceive price differentiation along geographical factors as unfair. We are all well aware that it is more expensive for Shoprite to put a litre of milk on the shelves in Kuruman than in Johannesburg. Even so, the prices are usually very similar. There seems to be a market consensus that prices for basic groceries and essential services such as mobile telecommunication should not put people in Kuruman at a disadvantage.

The *Market Inquiry* states that "access to spectrum" faces very "high barriers to entry" because of the "nature of spectrum assignments." It is important to note that this barrier is a political barrier, not a market or technological barrier.

The second example is about "Barriers to entry" under section 4.2, "Effectiveness of competition:"

> In respect of facilities-based entry, access to spectrum, sites and supplementary roaming are very high barriers to entry. This is because of the nature of spectrum assignments, the expense of rolling out new sites, the relatively limited extent of site sharing in South Africa, and the high costs of national roaming (discussed in sections 6 and 7 below). These barriers to entry contribute to the ineffective levels of competition in markets for mobile services in South Africa. (para 37; emphasis added)

As to facilities-based entry, Cell C and Telkom are free to erect towers in all South African municipalities. They, however, prefer to roam on MTN and Vodacom infrastructure for very good commercial reasons. Because only MTN and Vodacom own sites in many rural municipalities, according to Government, site access is ineffectively competitive. Since roaming is "supplementary" to sites, roaming is also ineffectively

competitive. Again, Telkom and Cell C are free to convince Rain or American Towers to erect a tower or put radio modules on existing towers in Pofadder or Aggeneys. For good economic reasons, they instead chose to have towers in Upington only and benefit from MTN's and Vodacom's countrywide network. This is infrastructure sharing on commercial terms. Vodacom CEO, Shameel Josub, stated that of the 11,000 sites it has in South Africa, over 7,000 are shared.[64]

It is instructive to have a look at the formal response MTN gave to the Market Inquiry to compare CompCom's definition of "markets" based on contrived market-share parameters and an exceedingly simplistic understanding of "sites" with the complex realities of real markets:

> MTN notes that in respect of the determination of market shares, ICASA has simplistically and incorrectly relied on the "number of sites" as the metric to calculate market shares. This suggests that ICASA has mistakenly equated all types of sites as intrinsically equal in value. This is incorrect as, for example, tower deployments vary significantly in value and operational functionality, dependent on the various deployment criteria, including, *inter alia*:
>
> > Tower type: towers differ considerably dependent on deployment architectures, e.g. macro tower, roof top tower, small cell, distributed antennae system (DAS) etc.;
> >
> > Tower height: which differs according to the terrain and environmental typology in order to ensure that the appropriate coverage footprint is achieved;
> >
> > Technology deployed at a tower or other facility (2G/3G/LTE/5G), which is spectrum dependent; and
> >
> > Tower functionality: cellular towers perform different functions, for example, microwave hub-towers are key towers that connect several other towers, unlike point-to-point (PTP) microwave links which uses a single hub-tower to create a sector of coverage that can backhaul multiple towers.
>
> Accordingly, the equal weighting of sites with a "number of sites" metric provides a skewed and inaccurate assessment of market share.

The above documents the danger of regulators contriving mental constructs of markets that ignore real value. The authors of the Market Inquiry, however, do have a point that barriers to entry are very high in respect of spectrum because there is no free market for trading spectrum. To the extent that publicly assigned spectrum can be considered a market at all, the "market" is suffering from an artificial shortage of spectrum that Government failed to make available for which there is only one logical justification: regulatory failure. It is the reduction of this artificial scarcity that deserves the full attention of Government, not any perceived ineffective competition in Pofadder.

Generally, the fact that ICASA uses municipalities as a geographic market to investigate significant market power (SMP) misconstrues the complexity of mobile networks and the fact that carriers are not free to set prices as they please. ICASA derives its conclusion that MNOs have SMP exclusively on their assessment of market shares. If a carrier's market share is found to be 45 percent (or more), then the carrier is presumed "dominant", which to the authors implies that the market is ineffectively competitive. Part of the problem is that the Market Inquiry does not define what "ineffective" competition is or could be. Might it be a doubling of data prices in Pofadder overnight, or the clandestine throttling of a roaming partners' traffic speed? Since economic science deals with human actions, the verdict "ineffective" must necessarily refer to some people's concrete actions. If an action is regarded as "unfair", an unfair or "anti-competitive" action must be proven (not to be confused with breach of contract or fraud). The Market Inquiry does not provide any example for such behaviour.[65]

The third example deals with the concrete findings in respect of high data prices. The following sections are from the Market Inquiry report in order of their appearance:

> The ITU data suggests that South Africa's prices are not disastrously high but neither are they as low as they could be, particularly in comparison to South Africa's peers in the BRICS group. (para 49)
>
> … while South Africa's prices are not the lowest, the download speeds experienced by South African customers are much faster than anywhere else in the continent, including large comparator countries like Egypt, Morocco, Ghana, Nigeria and Kenya. (p 56)
>
> Figure 13 illustrates that while mobile data speeds in South Africa are *extremely* high by African standards (see figure 12), they are no better than average in the more advanced grouping. Interestingly, while South African prices are higher than India and Russia's, the speeds provided in South Africa are much higher. Put in an appropriate context, therefore, South Africa's speed and quality performance looks neither excellent nor terrible. However, the examples of China and Turkey demonstrate that there is plenty of room for improvement. (para 58/59)
>
> … while South Africa's prices are not the lowest, the proportion of the population with access to LTE (approaching 80%) is much higher than most other countries. (para 60)
>
> A barrier to lower mobile data prices in South Africa which has frequently been cited is the lack of spectrum assigned to the mobile operators. This is since having access to spectrum lowers the cost to operators of rolling out both improved coverage and capacity, since it requires them to build fewer base stations. In addition, large amounts of spectrum are necessary to provide high speed mobile broadband, especially as the demand for data increases rapidly. *If operators with inadequate spectrum assignments are struggling to meet data capacity requirements from their existing customers, this lowers their incentive to reduce prices as lower prices will lead to higher volumes which could result in declining*

> *network quality*. There are therefore a number of reasons why spectrum assignment is critical to achieving cheap, high quality mobile broadband.
>
> … South Africa is well behind the leading countries when it comes to assigning spectrum for mobile broadband, having assigned about half the spectrum compared to the UK for example, and with an extremely low assignment per operator.

The causal relationship between the extremely low provision of spectrum to the two leading mobile network operators and the resulting relatively higher costs for the provision of network services largely invalidates the subject of the Market Inquiry from the outset. The quoted paragraphs suggest that the authors understood this. Even if one understands that the result of the investigation had to somehow provide evidence for the presumptions of "dominance" and "ineffective" competition (not least to politically justify the need for the WOAN), it is worth looking at the italicized section because of the confused line of reasoning. It is mistaken to assume that the operators' incentives to reduce prices are *lowered*. What is *lowered* is the MNOs' profitability as a consequence of the relatively higher network costs resulting from low spectrum assignment. Accordingly, it is network cost that makes it impossible to reduce prices. Incentives have nothing to do with this; operators would cut prices in half overnight if they found a way to achieve this at given profitability levels.

Competition in South Africa's mobile market is as effective as it can be, given the circumstances of public spectrum withholding and failed digital migration. MNOs could do their job more "effectively" if they could compete for spectrum in the first place.

Regarding what ineffective (that is, no) competition is, it is sobering to consider the financial statements of PRASA or Eskom. These entities survive only because of the absence of competition and the fact that public money is misappropriated to plug financial holes. The astonishing number of "turnarounds" have not produced tangible results.[66] In contrast to South Africa's aimlessly drifting SOEs, MNOs do not need turnarounds and bailouts. With the help of equipment manufacturers, consumers make sure through their purchase decisions that MNOs turn into the direction they want MNOs to go. There must be something to the disciplining effect of free consumer choice provided it means something that no large (privately owned) MNO has ever gone bankrupt since the emergence of the first cellular voice offerings thirty years ago.

5. Assignment of Emergency Spectrum 2020 and Planned Spectrum Auction

5.1. Assignment of Emergency Spectrum in April 2020

The emergency Information and Communications Regulations framed by ICASA that were gazetted on 20 April 2020 state that specific spectrum bands are made available on that date for assignment to incumbent licensees and others, temporarily, until three months after termination of the Covid national state of disaster or 30 Nov 2020 (whichever occurred first).[67]

TABLE 5: CURRENT SPECTRUM ASSIGNMENT VS. EMERGENCY SPECTRUM ASSIGNMENT[68]

Current Spectrum Assignment (IMT Bands) as per Nov 2020	700/800	1800	2100	2300	2600	3500	Total
VODACOM		24	35				59
MTN		24	40				64
CELL C		24	30				54
TELKOM		24	30	60		28	142
RAIN		34			20	80	134
LIQUID		24				56	80
TOTAL	**0**	**154**	**135**	**60**	**20**	**164**	**533**

*Icasa_Discussion-document-on-the-market-inquiry-into-mobile-broadband-services.pdf

Emergency Spectrum Assignment as per Nov 2020	700/800	1800	2100	2300	2600	3500	Total
VODACOM	40			20	50	50	160
MTN	40				50	50	140
CELL C							0
TELKOM	40			20	40	12	112
RAIN					30		30
LIQUID						4	4
TOTAL	**120**	**0**	**0**	**40**	**170**	**116**	**446**

Of the 446 MHz spectrum assigned temporarily on an emergency basis, only 66 MHz (highlighted in green) is in frequency bands in which MNOs currently operate radio infrastructure, i.e. 66 ./. 446 = 15 percent. Note that only Telkom, Rain and Liquid Telecom have been assigned emergency spectrum immediately employable. This means that MTN and Vodacom must first acquire new base stations and/or adjust the spectrum utilization plan. Responses from the two major carriers indicate that they hesitantly started to rollout equipment, predominantly in the 2.6 GHz band, after the spectrum auction date was confirmed. It has to be noted that carriers bear significant investment uncertainty. Firstly, emergency spectrum is only assigned on a temporary basis. Secondly,

given the SA Government's erratic track record of announcing and cancelling spectrum auctions, a delay beyond March 2021 is within the realm of possibility.

The emergency spectrum in the 700/800 MHz bands is also not readily available due to failed digital migration. Since analogue and digital television broadcasting services are still operating in these frequency bands, sharing and co-existence must be implemented systematically through a geographic separation of mobile and broadcasting services in affected areas, according to ICASA.[69] This is a painstaking process which requires MNOs to verify the degree of interference on region-per-region basis. As per October 2020, one of the two large carriers had rolled out five base stations in this band. The MNO indicated that it was for testing purposes. Given the fact that the digital migration will not be concluded before 2022, the potential of using the most valuable part of the emergency spectrum will not be captured, which will have a particularly detrimental impact on broadband provision in the rural areas. In addition, the benefits of carrier aggregation combining LTE800 and LTE in bands between 2.1 and 2.6 GHz will also not be realized.

A pandemic was needed to push the regulator to release the spectrum it has been hoarding and withholding from the country for more than a decade.

The strongly impaired utilization of the 120 MHz in the 700/800 band leads to the conclusion that the SA Government's two major socioeconomic goals related to the ICT sector will not be achieved (or to a limited extent only):

- Affordable, ubiquitous data provision in dense urban areas to accommodate increasing data demand leading to effective lower data prices.
- Harnessing "digital-dividend" spectrum to provide rural and sub-urban areas with better broadband data coverage at more affordable data prices.

When in April 2020 the assignment of emergency spectrum was announced, carriers and the general public praised the SA Government. However, this generally positive and welcome decision must not prevent us from carrying out an honest assessment in the greater scheme of things. The first point is that a pandemic was needed to encourage Government to act quickly and unbureaucratically. It must be assumed that those responsible for the decision were aware that spectrum that is once assigned can only be reclaimed with great difficulty. Possibly, the Corona pandemic provided those Government representatives (or factions) eager to overcome the spectrum crunch–and genuinely concerned with consumer welfare–with a window of opportunity to sideline political resistance within the tripartite alliance and those SOEs operating in the ICT sector.

In the end, the motivation of the decision-makers and the making of the decision do not matter. The assignment of emergency spectrum serves as a magnifying glass that exposes

the failed spectrum policy with particular clarity. The quick and unbureaucratic assignment of emergency spectrum is tantamount to the admission that political tug of war, incompetence and political entrepreneurship were the true reasons for the sustained spectrum crunch burdening the South African consumer with the socioeconomic cost in the form of suboptimal rural broadband coverage and higher data prices.

5.2. The Regulatory Thinking Underpinning the Spectrum Auction 2021

On 1 November 2019, ICASA published the much anticipated Information Memorandum for the high-demand spectrum licensing process inviting comments in respect of the "provisioning of mobile broadband wireless open access services for urban and rural areas using the complimentary band IMT700, IMT800, IMT2300, IM2600 and IMT3500" (gazetted under 42820).[70] Initially, it was planned to complete the process by end of 2020. Later in 2020, ICASA announced that "In light of the time lost as a result of the delay in the issuing of the ITAs, the auction of the high-demand spectrum, which was originally contemplated to take place during December 2020, will be completed by no later than March 31 2021."[71] On 2 October 2020, ICASA finally released the long-awaited ITA. The closing date for the IMT Spectrum ITA is 28 December 2020 and for the WOAN ITA is 30 March 2021. The key points are:

- IMT auction of spectrum to eligible licensees in the 700 MHz, 800 MHz, 2600 MHz and 3500 MHz IMT frequency bands;
- IMT spectrum divided into different lot categories and lot sizes;
- Reserve prices for each IMT lot rang from R9.8 million for the 3500 MHz lot to R1.1 billion for the 800 MHz lot;
- Individual IMT licensees will not be able to acquire more than 18 percent of the total spectrum assigned by ICASA to date (including historic allocations of high demand spectrum);
- Successful licensees to acquire a radio frequency spectrum license valid for 20 years (renewable annually upon payment of a prescribed license fee); and
- Licenses will be issued on a technology-neutral basis.

Before addressing the concrete details of the ITA (discussed in the next Sub-Section 5.3), it must be clear what informs the policymaking of the SA Government as represented by the DCDT, ICASA and CompCom. The last point of the above list dovetails with the Competition Commission's paper "Competition in the Digital Economy" published on 7 September 2020 which recommends that the regulation of telecommunication and broadcasting should not differentiate between digital platform operators and traditional operators, in order to reduce regulatory barriers to entry. Hence, the CompCom explicitly advocates a technology-neutral approach:

> We should avoid regulatory responses that distort markets. Regulation should adopt a technology-neutral approach, without differentiating whether firms traditionally

> operate their business or whether they make use of digital platforms. The Commission advocates for regulatory responses that are geared at levelling the playing field and reducing regulatory barriers to entry and expansion. (ibid., 8)[72]

Generally, the paper is laudable in that it explicitly assumes a consumer perspective but the CompCom's understanding of technology-neutrality and undistorted competition suffers from a material flaw. Because the paper refers to the digital economy at large, it covers a broad range of subject matters, particularly how the digital age affects various industries, its players and consumers. An important aspect is the competitive pressures due to the digital disruption in the broadcasting sector "where new technologies and the dynamic effects of convergence are changing the way consumers access audio-visual content." The authority remarks that streaming (OTT) services "could constitute 'broadcasting'" (ibid., 47) but comes to the conclusion that such regulations are not the right way to move into the digital future.

> We propose that regulation in these and other sectors should adopt a technology-neutral approach, without differentiating whether firms traditionally operate their business or whether they make use of digital platforms. The unequal application of regulation means that the firms making use of these platforms have a competitive advantage over the traditional operators. This is because they have little or no costs of compliance with regulations. (ibid., 47)

The crucial question now is what – economically speaking – technology-neutrality means. In a paper[73] on technology-neutrality, the authors Maxwell (Hogan Lovells) and Bourreau (Professor of Economics, Télécom Paristech) list three different context-related meanings:

> Meaning 1: technology neutrality means that technical standards designed to limit negative externalities (e.g. radio interference, pollution, safety) should describe the result to be achieved, but should leave companies free to adopt whatever technology is most appropriate to achieve the result.
>
> Meaning 2: technology neutrality means that the same regulatory principles should apply regardless of the technology used. Regulations should not be drafted in technological silos.
>
> Meaning 3: technology neutrality means that regulators should refrain from using regulations as a means to push the market toward a particular structure that the regulators consider optimal. In a highly dynamic market, regulators should not try to pick technological winners. (2015, 1)

The authors are advocating meaning 2 for the telecoms sector and Internet content providers and strongly discourage going down the route implied in meaning 3 "because such attempts are likely to create more harm than good in fast-moving markets (2015, 4)." The attempt to push the market towards a particular structure, however, is exactly what the SA Government is doing by creating a WOAN.

In the section where the authors explain the principles of meaning 2, they mention in passing the idea of "service neutrality" as proposed in the European Union's directive 2009/140/EC on a common regulatory framework for electronic communications networks and services,[74] better known under the *2009 Better Regulation Directive*. In both papers, the SA Government's paper and the one on technology-neutrality, the notion of technology-neutrality upholds the arbitrary split between spectrum used by mobile operators and by broadcasters (radio, TV, satellites). Technology-neutrality understood this way means that a mobile operator can use spectrum in the 1800 MHz band for GSM voice, for 3G or for LTE data services. TV stations can apply their spectrum to providing broadcasting services, e.g. news, sports or kid entertainment, but not telecommunication services.

Hence, technology-neutrality with respect to using the spectrum resource means that mobile carriers and TV broadcasters can do whatever they want with their spectrum provided they do what is written in their license that regulated the use of the spectrum resource, i.e., emitting signals carrying mobile telecommunication content and TV content. If we apply this regulatory principle to unregulated markets, say, the iron ore market, it would stipulate that you can use it to build a car but you must not use it to build a ship. The historical flaw of the regulatory split between broadcasting spectrum and mobile telecommunication spectrum was first exposed in the 2000s when data demand rocketed and it became clear that coverage of rural areas is uneconomic in frequencies above 1800 MHz. The artificiality of the split was led *ad absurdum* when in the 2010s streaming services such as Netflix began to rival traditional TV broadcasting content. Certainly, regulators may have contemplated banning such offerings in the absence of a TV license, but Netflix does not need to acquire a spectrum license to provide its services. It, however, needs the spectrum of mobile operators that carry their content. The MNO, however, does not have TV license because it does not need broadcasting spectrum and does not produce broadcasting content.

The above quoted CompCom paper carefully navigates around this topic. The authors propose easing the regulatory burden on existing broadcasting license holders. OTT players have a competitive advance, the authors argue, "because they have little or no costs of compliance with regulations" compared to licensed broadcasters. This is unsound reasoning. The existing model of licensed broadcasters disappear soon. The competitive advantage of OTT players lies in the fact that they not only provide better content but particularly that they are not being hamstrung by national regulation and thus can address principally the world's entire population. It appears that national regulators only reluctantly seem to face the fact that their neat old world of dividing markets into technology and service drawers are being overtaken by realities as we speak.

From an economic theory perspective, the notion of technology neutrality is nonsensical as illustrated by the iron-ore example. In free markets, people can do what they want with

their resources as long as they have been legitimately acquired and they do not inflict harm on other people by consuming or employing them. That said, on the way toward more meaningful economic (market) institutions we have to start from where we are and tackle the current regulatory provisions.

The EU pushed ahead, at least on paper, with the *2009 Better Regulation Directive* referred to above by invoking the idea of "service neutrality" for the use of spectrum:

> (36) Flexibility in spectrum management and access to spectrum should be increased through technology and service-neutral authorisations to allow spectrum users to choose the best technologies and services to apply in frequency bands declared available for electronic communications services in the relevant national frequency allocation plans in accordance with Community law (the 'principles of technology and service neutrality'). The administrative determination of technologies and services should apply when general interest objectives are at stake and should be clearly justified and subject to regular periodic review.
>
> (39) In the interests of flexibility and efficiency, national regulatory authorities *may allow* spectrum users freely to transfer or lease their usage rights to third parties. This would allow spectrum valuation by the market. In view of their power to ensure effective use of spectrum, national regulatory authorities should take action so as to ensure that trading does not lead to a distortion of competition where spectrum is left unused. (emphasis added)[75]

By allowing the holder of the spectrum resource to apply it for whatever service they want, the above amounts to a paradigm shift, at least from a regulatory perspective. In the ordinary course of market action, it is simply what people do. The italicized "may allow" indicates that the authors are aware of the delicate nature of the matter. It will take a long time still until regulatory frameworks will become reflective of the realities of the market in the ICT sector. EU's *2009 Better Regulation Directive* shows that political decision-makers are aware of the convergent nature of ICT markets in which it will become ever less meaningful to regulate along old notions of technology and service. The 2020 CompCom paper on digital competition illustrates that the SA Government is surely not yet there:

> Given the level and adequacy of their technical expertise, the government needs to adopt a 'whole-of-government approach' and engage a broad and diverse range of stakeholders for regulatory effectiveness in the era of digitalisation. The Independent Communications Authority of South Africa (ICASA) has an important role to play in the management of spectrum licensing and ICT infrastructure. Competition regulation is needed to regulate the potential for consumer lock-in and cases of abuse of dominance by big tech. The Department of Communications and Digital Technologies will be instrumental in the roll-out of the National e-Government Strategy and the provision of inclusive communication services to all South Africans. (ibid., 54).

The above citation shows that Government upholds the artificial split between ICASA as spectrum guardian, the CompCom as manipulator of market structure and market conduct, and the DCDT as ensurer that consumers get the communication services they desire. The tussle between ICASA and the DCDT discussed in section 4.1 illustrates the danger of such artificial delineations which usually play out to the detriment of consumers.

5.3. ITA for Spectrum Auction to be Held by March 2021

Below table 6 displays that the spectrum to be auctioned is divided into different lot categories in the relevant frequency bands, three lot categories in 700/800 MHz, one in 2.6 GHz and three in 3.5 GHz. The bidding is subject to reserve prices per lot which ensures the SA Government a minimum of ZAR 8.3 billion assuming prices in all lots attract the reserve price and will be bid off in line with the auction conditions.

TABLE 6: SPECTRUM PLANNED TO BE ASSIGNED BY MARCH 2021

Planned Spectrum to be on Auction by 30/03/2021	700	800	800	2600	3500	3500	3500	Total
Lots per Lot Category	4	4	1	14	1	8	1	**34**
Lot Size in MHz	2 x 5	2 x 5	2 x 10	1 x 10	1 x 2	1 x 10	1 x 4	
Total Spectrum	40	40	20	140	2	80	4	**326**
Reserve Price per Lot (in bn ZAR)	0.53	0.75	1.16	0.10	0.01	0.08	0.02	
Revenue per Lot Category (in bn ZAR)	2.11	3.01	1.16	1.40	0.01	0.60	0.02	**8.3**
Price per MHz (in m ZAR)	52.70	75.20	57.75	10.00	5.00	7.56	4.90	**25.5**

One of the conditions is that individual IMT licensees will not be able to acquire more than 184 MHz (or 18 percent) of the total spectrum assigned by ICASA to date—including historic allocations of high demand spectrum. This is a condition aimed at avoiding the financial strength of market-leading MNOs leading to a spectrum assignment structure perceived as entrenching market dominance and thus unfair. However, the condition has three important implications that appear to be surprising at first glance.

First, as shown in table 6 in section 5.1, Telkom has spectrum of 142 MHz currently assigned by ICASA, 23.3 percent of the total 609 MHz currently assigned to all carriers. Adding the 326 MHz (excl. WOAN) of new spectrum to be assigned in the upcoming auction makes a total of 935 MHz. This means that Telkom cannot acquire more than 42 MHz of spectrum to not exceed the 18%-threshold: (142 + 42) ./. 1015 = 18 percent. Given Telkom's abundant spectrum assignment, this does not appear to be a problem at first glance. However, Telkom's voice services are currently provided using the 1.8 GHz

frequency band. Should Telkom plan to acquire spectrum in the 700/800 MHz band to provide GSM voice services, little would be left to acquire in other bands.

The announcement by Telkom's CEO Sipho Maseko on 9 November 2020 to consider legal action because ICASA "disregarded or had given insufficient weight to the promotion of competition as a material consideration in the licensing of high-demand spectrum"[76] seems to support the conjecture that the implications of the 18 percent threshold were not fully considered. Maseko states that ICASA "designed the ITA in a manner that disadvantages Telkom as the only credible infrastructure competitor to the monopoly of the two larger players" and that the "caps proposed in the ITA disregard the fact that spectrum is *available* to the duopoly already through spectrum arrangements between themselves and smaller licensees." Maseko has to consider spectrum arrangements between the two leading carriers MTN and Vodacom with smaller carriers as available spectrum (though not legally assigned), which we will discuss in more detail in next section 5.4. Maseko, however, does not mention the fact that Telkom is only able to bid for 42 MHz.

Telkom faces the risk of losing its "competitive" advantage in the provision of data. It seems that Telkom might soon have to compete on market terms rather than relying on preferencial regulatory treatment.

Second, given MTN and Vodacom's eminently sparse current assignment of spectrum of 86 MHz and 81 MHz, respectively, means that in line with the 18 percent-threshold, MTN can bid for 98 MHz and Vodacom for 103 MHz (rounded). Assuming they do, this would amount to MTN and Vodacom being awarded 201 MHz or 62 percent of the 326 MHz spectrum at auction. Given the two leading carriers' financial strength, it is eminently likely that they will acquire the spectrum quantities in the frequency bands they choose to bid for. The 18 percent-threshold can thus be interpreted as an admission of the fact that MTN and Vodacom as the two most important carriers from a consumer perspective have been disadvantaged in the past.

To unpack the third implication, a short calculation is conducted in table 7. Assuming that MTN, Telkom and Vodacom acquire the maximum spectrum of 239 MHz allowed under the 18 percent-threshold means that 83 MHz of spectrum is left for the three other carriers, Cell C, Liquid Telecom and Rain. Taking note of Cell C's liquidity issues and the fact that Cell C voice and data offering are increasingly based on roaming via MTN's network, it is rather unlikely that the carrier will bid aggressively in the auction. If at all, they will bid for spectrum on the basis of their "roaming" agreement with MTN. As to Liquid Telecom and Rain, we have to bear in mind their business model of providing wholesale services to MTN and Vodacom in the 3.5 GHz band and 1.8/2.6 GHz bands where they are equipped with 56 MHz of 5G-spectrum and 49 MHz of 4G-spectrum, respectively. Rain might have an interest in acquiring spectrum in the 2.6 GHz band to

complement the 20 MHz of spectrum they already own for purposes of optimizing their network rollout and using carrier aggregation.

TABLE 7: DISCUSSION OF POSSIBLE AUCTION OUTCOMES

	Total Spectrum Assigned (end of 2020)	Maximum Spectrum Bids MTN, Vodacom, Telkom in Line with 18% Threshold	Remaining Spectrum Available for Other Bidders
VODACOM	**81**	**103**	
MTN	**86**	**98**	
CELL C	**76**		**?**
TELKOM	**142**	**42**	
RAIN	**134**		**?**
LIQUID	**90**		**?**
TOTAL	**609**	**243**	**83**

Three outcomes seem to be most likely. Firstly, some spectrum remains unassigned because Liquid and Rain have sufficient spectrum for their current wholesale model. Second, they decide to extend their current business model beyond providing wholesale services and venture into the crowded space of retail offerings, which is very unlikely. Third, they bid for the excess spectrum premised on expectations of extending the scope of their prevailing "roaming" agreements with MTN and Vodacom. Premised on MTN's and Vodacom's existing "roaming" agreements, there is straightforward economic case for Cell C, Liquid and Rain acquiring additional spectrum. This spectrum could enable MTN and Vodacom to overcome the artificially narrow lot sizing by utilizing wider bands. The resulting spectral efficiency gains (obviously subject to roaming cost and terms) would help MTN and Vodacom to deploy their networks in the new bands (700/800, 2600, 3500) at lower cost while at the same time making it easier to meet performance obligations. Given the long periods of spectrum assignment of twenty years, however, comes with considerable investment uncertainty for Cell C, Liquid and Rain because MTN and Vodacom will not sign commercial agreements reaching that far into the future. Even if the two leading carriers were willing to enter into shorter agreements with Liquid and Rain, this would entail the risk of ICASA perceiving such contracts as tantamount to collusion. Section 12.6.1 of the ITA reads: "The spectrum on this licensing process is to be assigned on national basis exclusive to the Licensees."

Section 7.2. in the ITA provides that MTN and Vodacom can acquire at most 2x10 MHz spectrum each in the sub-1 GHz bands, leaving 60 MHz on the table for other carriers who are allowed to acquire 2x20 MHz. This seems to be designed to enable Telkom to level the playing field with MTN and Vodacom. The remaining 20 MHz could be used by either of the remaining three MNOs for purposes of carrier aggregation. It is very unlikely

that any spectrum in the sub-1 GHz band will not be auctioned off. In case spectrum in the 2.6 and 3.5 GHz bands should remain unsold, section 17.18. provides for an "unsold lots round" according to the same auction rules. Further, the section stipulates that after the completion of the auction, ICASA will make sure that the spectrum lots are assigned so as to ensure contiguous spectrum bands. It is thus very likely that all spectrum at auction will eventually become assigned.

This raises the question whether the expected result of the public auction would be vastly different compared to a hypothetical scenario that the same 326 MHz of spectrum were available to South African carriers in the total absence of any regulation and spectrum caps. Assuming for the sake of the argument that the six MNOs own the 609 MHz of spectrum currently assigned by Government, would a market-based allocation of the available spectrum involve the risk of an outcome perceived as unfair or detrimental to what Government considers effective competition? The answer to the question is twofold. Firstly, is does not matter what the Government regards as fair or effective because with the current spectrum to be made available, South Africa's MNOs will finally have spectrum that dovetails with their idiosyncratic business models. MTN and Vodacom are the country's two tier-one carriers providing universal voice and data offerings in rural and urban areas. To assume this role, they need spectrum across the total range of frequencies.

Cell C's business model is geared toward becoming more of an MVNO (with own spectrum resources) than a carrier that is able to compete with MTN and Vodacom based on own infrastructure. The roaming agreement with MTN, which effectively is an infrastructure and spectrum sharing agreement (ignoring the semantic subtleties of regulatory provisions for now), points in this direction. Whatever Cell C might bid for in the auction, it will be factually shared with MTN (and possibly other MNOs in future). The business models of Rain and Liquid, as discussed, are premised on providing wholesale services to MTN and Vodacom (though Rain ventured into the retail space in 2020).[77] There is no indication that the upcoming auction will change their strategies. As to Liquid and Rain's bids in the upcoming auction, it is likely that they concentrate on the 140 MHz in the 2.6 GHz band for purposes of carrier aggregation which will enable them to provide broadband wholesale services at better spectral efficiency levels.

Coming back to our hypothetical scenario and the question whether a private spectrum allocation process would render different results, the answer is no with regard to the spectrum in the 2.6 and 3.5 GHz band and generally the business models of Cell C, Liquid and Rain. Where the outcome in the hypothetical market-based allocation would be most likely to differ from the public auction is in the 700/800 MHz band. Already having 60 MHz in 2.3 GHz band, the ex-incumbent does not need spectrum in the 2.6 GHz band. Furthermore, having 28 MHz of 3.5 GHz spectrum and given Telkom's spectrum cap of 42 MHz according to the 18-percent-threshold, it is likely that they will

bid for (at least) 30 MHz in the 700/800 MHz band and 12 MHz to complement the 28 MHz in the 3.5 GHz band). It is thus the design in the 700/800 MHz band that arouses the solid suspicion that the auction was tailored to Telkom's needs.

Understanding now that Telkom will be likely to succeed in bidding for the spectrum resources it needs, the threatening of legal action by CEO Maseko appears in a completely different light. His unhappiness with the auction design is premised on the fact that the outcome will entrench the market leadership of MTN and Vodacom as the two universal carriers that from the perspective of consumer welfare play the most important role by far. To make matters worse, MTN and Vodacom are effectively using the spectrum of Cell C, Liquid and Rain to provide better services, which has obliterated the previous advantage of Telkom having spectrum in the 2.3 and 3.5 GHz bands. Telkom's "success" in providing cheaper data offerings in dense urban areas is a result of being able to roll out LTE infrastructure in spectrally more efficient bands that the South African government deprived MTN and Vodacom of accessing for fifteen years. If Government had intervened and prohibited the agreements between MTN/Vodacom and Liquid/Rain and if Government had designed the auction to somehow make it more difficult for MTN/Vodacom to acquire spectrum, Telkom might actually have had the chance to become an equal competitor—with the subtle difference, however, that this opportunity would have been premised on non-competitive grounds.

Maseko's idea of "promoting competition" is to continue depriving MTN and Vodacom of spectrum in the 2.6 and 3.5 GHz bands. In other words, regulatory interventions forcing MTN and Vodacom subscribers to pay higher data prices with curtailed coverage satisfy Maseko's criterion of competition, because consumers are more likely to resort to Telkom. This is the antithesis of competition.

Given the auction design as per the ITA published on 2 October 2020, it appeared that Government appreciated that it cannot achieve its developmental goals by depriving the two leading carriers of the spectrum they need to provide better coverage at lower prices. Given the spectrum cap of 18 percent per carrier, MTN and Vodacom would have been in the position to catch up on spectrum from their current meagre endowments of 86 MHz and 81 MHz, respectively, to 184 MHz each. Understanding that this would have enabled MTN and Vodacom to snatch 201 MHz of the total 326 MHz on auction, ICASA devised an "opt-in" spectrum portfolio that grants tier-2 carriers (including potential new carriers) the right to capture this spectrum before the official auction process. As per the published ITA, ICASA reserved 50 MHz (of a total of 100 MHz) in the sub-1 GHz bands and 100 MHz in the 2.6 GHz band (of a total of 140 MHz) for tier-2 carriers Cell C, Liquid, Rain and Telkom.

According to this scheme, MTN and Vodacom would have been left to bid for 50 MHz in the sub-1 GHz bands, for 40 MHz in the 2.6 GHz band and 86 MHz in the 3.5 GHz band.

As a bid spectrum cap of 2x10 MHz is applicable to tier-1 carriers, they may bid only for 40 MHz. Given the financial power of the MTN and Vodacom, it is fairly safe to predict that they will succeed in obtaining the 40 MHz.

This is more critical in the 2.6 GHz band because 20 MHz is rather meagre from a network economics perspective. However, given the fact that Vodacom is utilizing Rain's current 20 MHz in this band and Liquid is very likely to acquire spectrum in this band, which it will make available to tier-1 carriers on a wholesale basis, MTN and Vodacom could have survived such an outcome. Most importantly, the ITA excluded the 86 MHz in the 3.5 GHz band crucial for 5G and IoT services from the opt-in scheme—at least that's what MTN and Vodacom thought in good faith based on what was in black and white in the ITA.

There should be caution regarding South African regulation. Although the 3.5 GHz band was initially excluded in clause 6 of the ITA, ICASA subsequently confirmed that the opt-in lots include all the spectrum bands to be licensed in this process. This leads to a situation in which MTN and Vodacom might be unable to bid for the 86 MHz in the 3.5 GHz frequency band because tier-2 carriers capture all of it in the opt-in scheme. The counter-productivity of this change of the ITA provisions becomes clear when it is understood that the two carriers serving three quarters of the South African population may be excluded from acquiring spectrum in the band most important for the future of mobile broadband. Here history repeats itself. Objectively, it should be asked whether those advocating this scheme considered who the beneficiaries would be. Certainly not consumers.

It appears as if the arbitrary definition of tier-1 and tier-2 carriers in the Market Inquiry has been incorporated into the ITA for the opt-in scheme. The following statement, quoted from a letter that the legal practice Webber Wenzel sent to ICASA on December 18, 2020 on behalf of MTN, is instructive: "The Opt-In Scheme deliberately sterilizes the two Tier-1 operators from bidding for the spectrum they need to advance 5G network roll out and advancement. In effect, this means that the least efficient users of spectrum and the licensees with fewer number of customers will be privileged over the most efficient (and needy) licensees in the acquisition of spectrum."[78]

In response to criticism of the auction design, which has the potential to damage MTN's viability in the 5g/IoT space, ICASA reprimands MTN for not being "patriotic" and pursuing "their commercial interests". If the term "patriotic" means anything in an economic context, it must mean acting in the best interests of South African consumers. Satisfying consumers is in MTN's best commercial interests.

Since ICASA did not, according to MTN, responded constructively, MTN instituted legal action intended to force ICASA to redesign what MTN regards as an irrational and

discriminatory aspect of the opt-in scheme (by way of an urgent court application MTN filed on 27 January 2021). In the past, ICASA did not respond substantively by undertaking steps to migigate the damage caused by the prolonged delays in spectrum assignment during the past ten years. In a recent public statement, ICASA made clear that they will also not address this problem substantively: "At this stage, industry players and all stakeholders need to reflect on the extent to which *their commercial interests* ought to *override patriotic considerations*. We believe that this licensing process has been balanced, with no room for a winner-takes-all attitude" (emphasis added).[79]

It is one thing to dismiss constructive criticism and avoid fact-based discussion, but another to expect enterprises to replace commercial interests with "patriotic considerations". It would, in fact, be unlawful for MTN or any other firm to place amorphous interests above clear and obligatory investor and consumer interests. It would, with respect, be more constructive for ICASA to concede past mistakes and avoid repetitions.

The good part of the ITA is that it comes with the very clear message to Telkom that the honeymoon is over. The spectrum-cap of 2x10 MHz applicable to MTN and Vodacom can be interpreted as Government's (that is, taxpayers') *lobola* (dowry) to Telkom to facilitate it entering real competitive life. Furthermore, Government has not undertaken any regulatory action against the "roaming" agreements between MTN/Vodacom and Liquid/Rain. Since the agreements appear to be compliant with the existing regulatory provisions in the ECA, the policy stance will be informed by how the regulator *chooses* to interpret the commercial and technical nature of the collaboration between the carriers in terms of the existing provisions of the Competition Act.

Notwithstanding all of the above, the private mobile telecommunication industry welcomed the publication of the ITA with a heavy sigh of relief. The WOAN, for that matter, could not spoil the party mood, which is the last topic addressed in this chapter. It can only be hoped that ICASA corrects its irrational opt-in scheme as it stands right now for the auction to happen by end of March 2021.

5.4. Factual Spectrum Sharing and the Fatal Conceit of the WOAN or: Why South Africa already has a WOAN

Below, table 8 shows a summary of the current spectrum assignment and the spectrum that will be at auction. Of a total of 406 MHz, 326 MHz are foreseen to be assigned to existing operators. The remaining 80 MHz is reserved for the WOAN that is still to be established. So far, the question has been avoided whether the WOAN as planned by Government is actually necessary given the current market structure and taking into account the release of 326 MHz of spectrum. The question becomes explosive if the nature of the current "roaming" agreements is analyzed as to its economic implications.

As discussed further above, and in line with section 12.4. of the ITA, all successful auction applicants are compelled to procure a minimum of 30 percent national capacity from the WOAN shared proportionally to the amount of the spectrum acquired. It will be interesting to see how the number of 30 percent will be calculated based on which definition of capacity and how geographical aspects will be taken into account.

TABLE 8: SUMMARY OF SPECTRUM ASSIGNMENT POST-AUCTION

Current Spectrum Assignment (IMT Bands) as per Nov 2020	700/ 800	900	1800	2100	2300	2600	3500	Total
VODACOM		22	24	35				**81**
MTN		22	24	40				**86**
CELL C		22	24	30				**76**
TELKOM			24	30	60		28	**142**
RAIN			34			20	80	**134**
LIQUID		10	24				56	**90**
TOTAL		**76**	**154**	**135**	**60**	**20**	**164**	**609**

Planned Spectrum Assignment by 30/03/2021 incl. WOAN	700/ 800	900	1800	2100	2300	2600	3500	Total
Existing MNOs	100					140	86	**326**
WOAN	20					30	30	**80**
TOTAL	**120**					**170**	**116**	**406**

Current and Planned Spectrum Assigned by 30/03/2021	700/ 800	900	1800	2100	2300	2600	3500	Total
TOTAL	**120**	**76**	**154**	**135**	**60**	**190**	**280**	**1015**

It is interesting to look at how MTN and Vodacom responded to the idea of creating a WOAN in their responses to the Market Inquiry on Data Prices. Vodacom considers "the WOAN has the potential to increase competition at both the network-level and the retail-level" quoting a telecommunications expert who said the same. This surprising statement might be best understood as a tactical manoeuvre. Understanding that, at the time the market inquiry was carried out, Government was in full swing planning the spectrum ITA, Vodacom's management possibly came to the conclusion that a friendly gesture would be best so as to not do anything that could pose a risk to the a further delay of the auction: "Let's secure the spectrum first. We'll deal with the WOAN later as and when it comes."[80] MTN, for that matter, might have thought the same in their response to the Market Inquiry. Yet, they decided to not mention the WOAN once in their document, an eminently principled response.

The fact that Government must have come to the conclusion that the WOAN stood little chance to survive without the "incentives" —a euphemism for the planned offtake coerced upon existing MNOs— at the same time reveals Government's peculiar take on competition. This notwithstanding, however, the WOAN is simply not needed because Cell C, Liquid Telecom, MTN, Rain and Vodacom have been in the process of creating a

WOAN Government has helped to shape. When DCDT Minister Cwele interdicted the 2017-ITA to the frustration of MNOs, MTN and Vodacom had to find other solutions to satisfy their spectrum requirements. The opportunity arose due to Liquid Telecom's acquisition of Neotel's spectrum in 2016 and the ailing WBS turned into a well-capitalized Rain launching 4G services in 2018. Much to the disgust of Telkom, Government took no steps when Vodacom signed the "roaming" agreements with Rain in 2018 and MTN with Liquid Telecom in 2019. In 2019, Vodacom also signed a "roaming" agreement with Liquid. Rain furthermore asserted as early as 2018 that it is open to roaming deals with any operator on a non-discriminatory basis.[81]

The South African government considers it an "incentive" to force existing operators—and by implication, their customers—to buy services from the WOAN. But when the WOAN is so desperately needed, why would it require coercion to turn it into a viable enterprise?

Without delving into the legal subtleties of the interpretation of the technical and commercial nature of these agreements vis-à-vis the prevailing regulatory provisions on matters of spectrum and/or infrastructure sharing, it is safe to say that they clearly go beyond what used to be commonly understood as roaming of voice across carrier network boundaries. In their *Q&A guide to communications regulation and outsourcing law in South Africa*, legal practice Thomson Reuters (2018) states: "The Spectrum Regulations only provide for spectrum sharing where two or more licensees have been granted radio frequency licenses for all or part of the same frequency assignment. They also stipulate that all radio frequency spectrum sharing agreements are subject to approval by the ICASA, and to a non-discriminatory approach."[82] As there is nothing in the ECA that would specify the notion of spectrum sharing, an agreement is a spectrum sharing agreement when it reads "spectrum sharing agreement."

Chapter 4.2 already contained a discussion about ICASA's justification of the "roaming" agreement between Vodacom and Rain. This discussion is of enormous importance for the future trajectory of regulatory action not least because of Telkom's recent announcement to take legal action to achieve a revocation of these agreements. Again, in the Market Inquiry document ICASA concedes that carriers in South Africa, in particular MTN and Vodacom, dispose of much less spectrum to provide mobile broadband in comparison with mobile operators in other countries. Since more spectrum is needed but Government has failed to make more spectrum available, carriers have found market-based solutions of gaining access to more spectrum, which are considered legit as long as such arrangements are deemed pro-competitive:

> In terms of one operator having a greater ability to introduce new products and services without harming existing services, due to its beneficial spectrum *assignment*, Cell C has raised a concern that Vodacom is *enjoying such an advantage* due its site sharing and roaming agreement with Rain. The Authority's

> view is that Vodacom has not *acquired* Rain's spectrum, however, and is only able to make use of it through roaming on Rain's network, so it cannot be *termed* a spectrum assignment advantage as indicated by Cell C. The arrangement has also facilitated the expansion of Rain as a wholesale and retail competitor in mobile broadband, which is deemed to be *pro-competitive*. (emphasis added)

The above quote is remarkable in various respects. ICASA first clarifies that Vodacom does not enjoy a spectrum-assignment advantage because spectrum can only be assigned by ICASA and ICASA did not assign it to Vodacom; they only sanctioned the site sharing and roaming agreement. Accordingly, to the extent that Vodacom clearly enjoys an advantage due to the agreement, it is not an advantage by virtue of regulatory assignment. Second, Vodacom has also not *acquired* Rain's spectrum. In the case of market-based spectrum acquisitions of spectrum, such as implied in the case of Liquid's takeover of Neotel, Government approval is needed. Certainly, such approval would have to be viewed as consistent with the meaning of "assignment." Because the cooperation between Vodacom and Rain does not constitute a merger privately agreed between two parties, it "cannot be *termed* a spectrum assignment advantage." The agreement must thus be regarded pro-competitive. Surely, Government would have intervened had the agreement be deemed anti-competitive.

On the one hand, it is understandable that the representatives of government authorities, as political entrepreneurs, defend themselves. On the other hand, the last paragraph provides a paramount example of the twisted and perverse nature of regulation and regulatory proceedings. Another problem with regulation is that it always provides laggards with possibilities to rectify via regulatory channels what they do not achieve in the competitive market process by serving consumers with superior offerings. This is known in the economic literature as the theory of regulatory capture, which is usually associated with Nobel Prize laureate George Stigler's article published in 1971.[83] In this article, Stigler sought to dispel the "idealistic view" of benevolent and impartial public representatives and stressed the subservience of regulators to industry. Given the extended period of spectrum withholding, it does not appear that ICASA and DCDT are subservient to (or serving) anybody, with the exception of former SOE Telkom. It is thus particularly delicate that after an incubation period of two years after Vodacom and Rain entered into their agreement Telkom is threatening legal action.

Being cognizant of ICASA's regulatory take of the "roaming" agreement between Vodacom and Rain, Telkom has understood that there is nothing in the regulatory framework that would lend support to their case. They must convince Government that the roaming agreement is to be regarded a de facto merger in retrospect whose detrimental effects on competition the Authorities failed to recognize at the time. It thus makes perfect sense when Telkom group executive for regulatory affairs and government relations Siyabonga Mahlangu states that the issue is not whether Vodacom and Rain

should be allowed to enter into the agreements they have but rather whether they should be required to go through merger control regulations.[84] In his view, "Rain is giving control of its spectrum and its radio-access network to a dominant operator. The only way in this country that kind of transaction would be regulated is through the Competition Act."

Mahlangu further argues that Rain has committed its productive capacity to serve Vodacom's needs with an impact on the market structure and the dynamics of competition. This is correct. Thanks to this and other agreements between MNOs, consumers enjoy better services at cheaper prices whereby the four MNOs have begun to make up for the socioeconomic costs suffered by the consumer as a result of the extended spectrum crunch.

Let us now summarize in bullet-point style the salient facts of the current market structure in the South African telecommunication market against the backdrop of the pending auction in March 2021:

- South Africa's ICT market is served by 6 MNOs: Cell C, Liquid Telecom, MTN, Rain, Vodacom and Telkom.
- Leading MNOs MTN and Vodacom are and will continue to be the carriers providing universal broadband offerings in rural and dense urban areas.
- Once the digital migration is concluded in a couple of years, the relatively lower cost of rolling out LTE network based on digital-dividend spectrum (700/800 MHz) will help to realize the vision of ubiquitous and affordable broadband.
- South Africa's telecommunication market is served by two wholesalers Liquid and Rain that effectively share their network with MTN and Vodacom for the sake of consumers.
- Cell C is in the process of becoming more of an MVNO than an MNO trying to compete by rolling out their own mobile network across South Africa (a large country, after all). There is nothing to be found in (serious) economic textbooks that would support the fact that a country has to have three fully-fledged mobile infrastructure networks.
- Telkom's fibre portfolio is the most significant (which, for the sake of consumers, appears to have the potential to serve the market better than it currently does). Liquid Telecom also has a significant long-distance and metro fibre network (having acquired Neotel).
- In 2007, Seacom launched the first commercial submarine cable breaking up the SAT3-monopoly of Telkom catapulting South Africa from ISDN-Internet into the 21st century of broadband. Other submarine cables followed suit.
- In 2008, Teraco launched the first carrier-independent data centre, by far the biggest on the continent by end of 2020.
- In 2010, American Towers took over Cell C's tower portfolio.

- In 2014, Vumatel launched a consumer FTTH offering, which was considered nonviable given the particular property density in South African metros. Many others followed suit.
- In addition, a hugely contested market offering fibre-to-the-building (business, residential estates) and fibre-to-the-base station (mobile data traffic backhauling) has emerged since the early 2010s: Open Serve (Telkom), Dark Fibre Africa, Seacom, Liquid Telecom, MetroFibre, and many smaller providers. MTN and Vodacom are also trying (hard) to move beyond their homeopathic market share.

There would be more ICT providers and network elements of the ICT value chain to add, for example indoor fibre networks (DAS) that will play an increasingly important role in ensuring a seamless experience between wireless and fixed infrastructure, not least to accommodate IoT use cases that will emerge in the near future and will require much denser urban radio (BTS) footprints and fibre backhaul that MNOs alone will be able to roll out. All of the abovementioned players are already in the process of creating one convergent network that is to cater for the broadband needs of South African consumers and businesses. In the free market, exclusivity in legal terms confers upon property owners the right to employ their resources as they deem fit. In the factual world of economic success and failure, however, legal titles are little more than the most basic production factor. In the end, legal titles will not help companies that fail to serve consumers—provided, of course, that markets are contestable and are not fenced off from competition, as is the case for the rest of South Africa's infrastructure sectors. Blackberry is a reminder of how quick a market-leading company can vanish. Blackberry also is a great example of the harmlessness of market-based bankruptcy proceedings. Few consumers shed any tears over Blackberry.

In the regulatory zeal to make the mobile market supposedly more "competitive" by creating a WOAN artefact, it went unnoticed that genuine *competition* in the form of voluntary "roaming" agreements has already led to the emergence of a market-based WOAN.

It is noteworthy that, with the exception of Telkom (and duly ignoring Broadband InfraCo[85]), the funding of the investments and operating costs borne by all of the above-mentioned players are an outcome of private funding. Mostly backed by the wealth of South African citizens, a vibrant ICT sector has emerged against all regulatory odds. The advantage of private investments is that their shareholders have skin in the game and do not burden citizens through a never-ending succession of bailouts. Provided government does not give in to commercial and political rent-seekers further obstructing the assignment of spectrum, with the 326 MHz becoming available by March 2021 and the digital migration to be eventually completed, the structure of South Africa's telecommunication infrastructure is gradually taking shape. There is abundant wealth to financially support the further flourishing of South Africa's ICT sector and there is

abundant spectrum to achieve these goals provided that the spectrum can be employed to best serve consumers (that is, economically). The question left to be answered is: What do we need another WOAN for when we already have one?

The proposal of the WOAN reveals the general problem of the ANC government of what Business Day columnist Stuart Theobald described as not having "a culture of evidence-based policy-making."[86] To the extent that a few examples exist in other countries, most prominently the Mexican *Red Compartida* created by the government as a PPP, there is no evidence that such constructs will succeed. And anyone who believes that in the special case of *Red Compartida*, the operator is building infrastructure where there is no broadband in order to bridge the digital divide, will be disappointed to hear that services are being expanded where existing networks already offer services. It is worthwhile to listen to a Technology Policy Institute's podcast on *Red Compartida* to understand the rent-seeking character and flawed economic nature of such WOAN artefacts.[87] The likelihood that the WOAN will emerge as a foreign body in a dynamic market that requires continued support from taxpayers or further "incentives" that are forced upon privately-owned network operators operating under competitive conditions is a clear and present danger. South Africa's ICT market and the consumers they serve do not need another foster child clamouring for taxpayer money. Or to put it in the words of John Galt: "When you clamor for public ownership of the means of production, you are clamoring for public ownership of the mind."[88]

6. An Outlook on Future Requirements of Spectrum Utilization

6.1. The Future of Convergent Telecommunication Networks

With respect to the prevailing regulatory viewpoint, according to which spectrum is a type of public commons, Hazlett and Leo (2010, 22) remark: "The tragedy is not the overuse of the commons, but its underuse." No better example than South Africa. A related tragedy is that the social damage caused by state-hoarded spectrum is unobservable in concrete quantitative terms. For prices to fulfil their function as indicators of the relative scarcity of resources, resources must be privately owned. If governments withhold spectrum, no market price exists. If governments auction off spectrum, then the amounts paid are contrived prices in that the bidders are not acquiring the spectrum from private owners. If governments withhold spectrum in frequency bands crucial for certain services, they create artificial scarcity, which may lead to obscenely high bids, as happened in Germany and some other countries in the wake of the UMTS auctions.

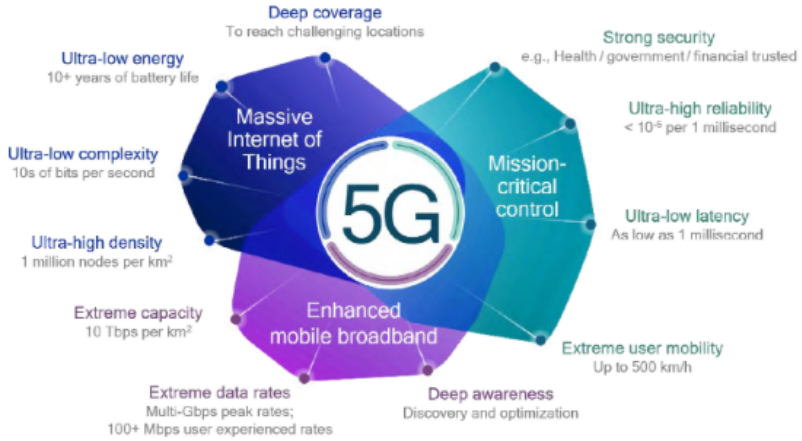
Within the next ten to twenty years, it is very likely that a spot market for spectrum rights and the dynamic use of spectrum will emerge as it will be the only way to accommodate the future use cases' diverse and dynamic spectrum requirements along performance margins such as quality of service, capacity needs, latency, number of users, location, security level, and peak versus off-peak use. As the various fibre networks, carrier-owned mobile networks, and user-owned wireless access infrastructures (for example, small cell equipment, DAS, Wi-Fi hotspots) converge to form *one* broadband network eco-system, the management of its capacity in terms of the just-mentioned margins will be enhanced by the particular 5G-related capability of "network slicing." Network slicing allows MNOs to create on the same physical infrastructure virtualized and independent logical networks that cater to particular clients and use cases. GSMA (2017) regards network slicing as a paradigm shift because 5G networks will be able to adapt to the external environment rather than the other way around. Compare this to a three-lane highway that was intended to cater to traffic twenty-four hours a day but experiences traffic jams during the busy hours of the morning and afternoon. The equivalent of network slicing in combination with dynamic spectrum allocation applied to highways is allowing operators to move a lane or two from uncongested highways to the congested highway when needed.

The specific use case will determine which slices of the network will be required given the use case's quality-of-service (QoS) requirements with respect to bandwidth, latency, or data-processing power. Depending on time of day and geographical and demographic factors, the same use case's QoS requirements might differ significantly. The traditional

network-planning paradigm would scale the RAN network to meet peak-traffic requirements, which implies overcapacity at times of low traffic and constrained capacity at peak times. Theoretically, dynamic pricing could manage demand so as to avoid congestion and violation of QoS obligations. A more efficient way to balance demand patterns is the dynamic allocation of spectrum, in the form of either managing carrier-owned spectrum resources within a network or sharing spectrum resources across firm boundaries. The more flexibly carriers can allocate their assigned spectrum across frequency bands, and the more flexibly they can adjust spectrum usage to market demand, the lower, ceteris paribus, investments in network infrastructure will be. If spectrum could be dynamically shared among mobile carriers, an even more cost-effective rollout of network infrastructure would ensue. The regulatory framework of licensed shared access, which GSMA (2013) advocates as a way to access complementary spectrum, supports flexible spectrum usage.[89]

With increasing network densification, spectrum (and infrastructure) sharing, and virtualization of radio networks, traffic planning and spectrum management will become ever-more automated. Currently, the densification of 5G networks is still a stepwise process planned by radio engineers and commercial departments of individual carriers based on demographics, income levels, and user profiles. This will (have to) change in the future. The generally accepted yardstick for the capacity of what experts consider an ideal-type 5G network is 100 Mbps everywhere, which would be needed to fulfil the speed, capacity, and latency requirements of the upcoming use cases (GSMA 2019a). As can be seen in figure 3, 5G use cases are typically divided into three main usage scenarios—massive IoT, mission-critical control, and enhanced mobile broadband—each of which comes with distinct user requirements (see Schafer 2019).

FIGURE 3: 5G MAIN USAGE SCENARIOS



Source: Qualcomm (Schafer 2019)[90]

As very high capacities will require significant investments in outdoor and indoor coverage, dynamic spectrum sharing between LTE and 5G (within one licensed network), infrastructure sharing (towers, DAS), RAN sharing, and spectrum sharing and pooling (across carriers) all hold the promise of significant cost reductions and would reduce the investment risk arising from the fact that the commercial prospects for the use cases are nowhere near the stage at which they could be forecasted with any reasonable accuracy. GSMA (2019c) estimates that sharing will be one of the most significant cost mitigators and can potentially deliver savings of up to 40 percent in instances in which operators share spectrum, active infrastructure, and passive infrastructure across the site, radio, transport, and core network domains. The abolishment of regulatory hurdles would increase investment certainty and hold the promise of lower network-rollout costs, thus accelerating 5G deployment and uptake of IoT use cases.

It is generally accepted that the single-most important raison d'être of regulation is the facilitation of voluntary exchange through the creation of an institutional environment that facilitate voluntary exchange between consumers and entrepreneurial entities thereby supporting them to achieve their goals. Governments around the world decided in the 1990s to entrust the mobile telecommunication sector to be guided by consumer choice and entrepreneurial performance. Given the fact that at the beginning of the 1990s not even one out of a hundred households had access to telecommunication services, the success of mobile markets is nothing short of remarkable. This could not have been achieved without strong competition on the demand and supply side.

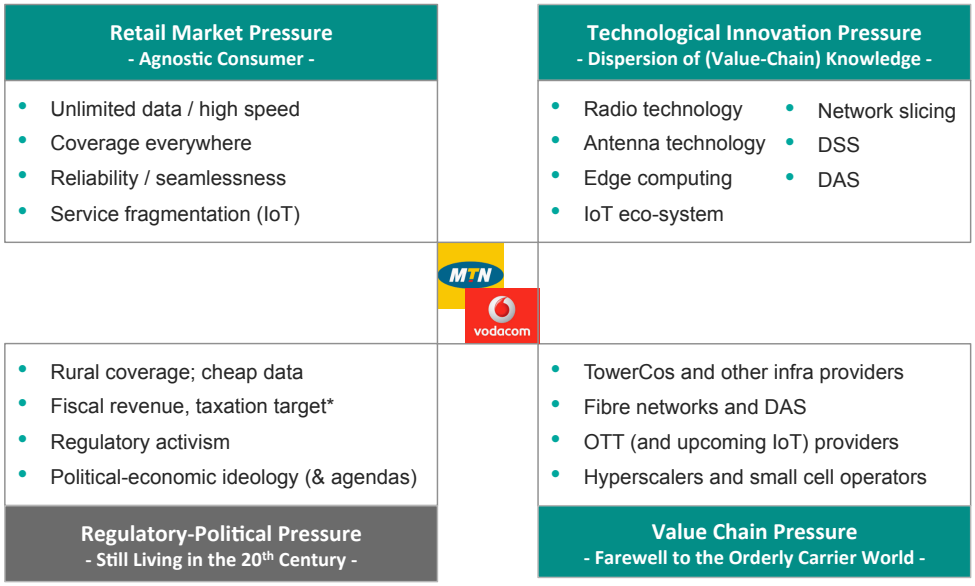
The more a sector's produced goods and services are guided by consumer choice and the more a sector's productive eco-system is contestable by technological and commercial innovation, the lesser the need for regulatory intervention. In contrast to what political representatives and certain public studies quoted in this SEIA invoke, the South African mobile market has been characterized by strong competition among MNOs to capture higher shares of the retail market. As consumers are largely agnostic as to who provides them with voice and data services, MNOs have to compete on price and quality of service, as displayed in the top-left box of below figure 4. Competition induced by the choices of consumers, however, is only one of the three transmission mechanisms through which consumer choice puts MNOs under market pressure.

The second pressure is induced through technological innovation. Here it is important to understand that the firms involved in the mobile eco-system base their decisions just as much, if not more, on the wants of the consumer as MNOs. They know that MNOs must adopt better technology. This is not so much because MNOs expect to increase their market share. It is because they will lose market share if they don't do so. Since the emergence of the first GSM-based data standard (GPRS) at the end of the 1990s to 5G, MNOs have introduced at least four generations of radio standards: Edge (2.5G), UMTS/HSDPA (3G/3.5G), LTE (4G), 5G. With the introduction of new radio

technology, consumers not only got ever more megabits for the same one Rand but also a massively diversified offering of content and applications that shape a significant part of our daily dealings, from WhatsApp, over Uber, to mobile banking and electronic tickets.

Against this background, the following statement from the White Paper (already quoted in section 4.2) that the "enforcement of an open access regime [through imposing a WOAN] will facilitate lower costs and more efficient networks that use the latest technologies and are able to deliver a multitude of services" is mind-boggling. What the statement says is that it needs government intervention to create more efficient networks than ones created by hundreds of local and global industry players. Whether this claim is presumptuous or simply naïve, it is a prime example of *The Pretence of Knowledge* that FA Hayek has warned against in his 1974 Nobel Prize speech.[91]

FIGURE 4: COMPETITIVE AND REGULATORY-POLITICAL PRESSURES



One of the forms in which technological knowledge diffuses markets is through increasing standardization and modularity. This has the virtuous effect that it eliminates the opportunity to reap excess profit margins. The upcoming virtualization of network functions (NFV) and software-defined slicing of networks will intensify the trend that entrepreneurial profits in the mobile broadband market to an ever higher degree will be a result of new knowledge in the form of software, applications and content, as opposed to a result from the operation and ownership of physical infrastructures.

The third competitive pressure comes from two groups of players. The first group seeks to carve out parts from the operators' value chain, such as tower providers or data centre operators. Carriers outsource network functions and assets to improve to free up cash flows for investments in other areas and generally to operate their networks more cost

effectively (that is, to improve their competitiveness). While the outsourcing does lessen MNOs' power over the mobile value chain, they largely retain control over their overall network. The competitive pressure from the second group of players is far more threatening, perhaps even existentially so, because they attack the core of mobile offerings. The first, and successful, attack was struck by OTT providers. The fact that consumers buy data to consume content and use applications has shifted market power to OTT providers. The next wave of attacks in the area of edge computing, launched by hyperscalers such Google and Amazon, is underway. The fact that Verizon and Vodafone both have entered partnership agreements with Amazon (AWS) to use the latter's mobile edge computing platform shouldn't lead one to believe that things are under control. There is a veritable threat that IoT providers, fibre network providers and small cell operators join forces and divert data traffic off the networks of mobile carriers.

In contrast to the opinions expressed by government officials, MNOs face strong and effective competitive pressures for the benefit of consumers. However, there is a great risk that further regulatory failure and ideology-driven interventionism will weaken competitive dynamics in SA's mobile market at the expense of consumers.

The scope of the SEIA study is to show the harmful effects of Government's spectrum policies as well as its misleading understanding of competition economics. In addition to the three competitive pressures, 15 years of spectrum withholding, the failed digital migration and the pursuit of sectoral policies approaches ignorant of economic realities (e.g. the planned WOAN), have continuously thrown spanners in the works of MNOs the costs of which are borne by the consumer. The upcoming commercial and technological developments described in this section will make the mobile broadband market even more competitive. This will make it even more difficult for regulators to keep up with the increasing diversity of business models and fragmentation of the value chain. It is probably not an insult to interpret the spectrum policies of the past more than ten years and the tumultuous failure of the digital migration as a fair indication of overwhelmed government authorities.

6.2. The Overwhelmed Regulator . . .

Kliks *et al.* (2017) give an overview of the concepts related to resource sharing in 5G networks and analyze the technical and operational challenges. They particularly stress the risk of country-specific regulations and restrictions. Because the expectations of the owners and users of different network layers tend to differ and vary in time, the models of cooperation are continually evolving. The authors refer to national regulators' different takes on the effects of infrastructure sharing but suggest that there is more consensus among operators and regulators that "shared spectrum access is desirable" (ibid., 616) with respect to recently implemented regulatory schemes in the USA and UK: "Implementing such a scheme effectively moves away from traditional licensed and

unlicensed frequency bands and provides a first step towards dynamic and efficient frequency allocation" (ibid., 617). This indeed is a first step. Yet the very idea that regulators can implement and regulate such sharing schemes in some spectrum bands (but not others) clashes with the fact that how spectrum is employed to cater to the diverse use cases (along the dimensions discussed above) is continuously evolving. If the goal of regulators is to enable the best utilization of spectrum, and evidence is mounting that the dynamic, highly uncertain nature of future 5G/ICT use cases will compel operators to economize on network infrastructure and spectrum, then regulators must cede ground to market participants.

The regulator's challenge, it is usually held, is to release the spectrum in a way that is in the best interest of society—for instance, by ensuring certain rural 5G coverage and capacity levels or by ensuring carriers compete on a level playing field. The regulator will not be able to fulfil this role in the medium to long run because, bearing in mind that the business models of the concrete uses cases depicted in figure 3 are far from being understood, the envisaged users of the spectrum, the MNOs, are largely ignorant about their own future spectrum needs and, even more so, the opportunity cost of spectrum licenses. The intention of the previous paragraphs is to illustrate the range of possible future radio technologies and network-sharing arrangements and what this implies for spectrum usage and sharing. As I understand current developments, MNOs are not in the driver's seat anymore. To the contrary, third-party infrastructure providers—such as equipment suppliers, tower companies, data centres, and local fibre providers, on the one side, and content providers and platform operators, on the other—are venturing into 5G/IoT space.

Because the first regulatory frameworks were applied to a nascent market with a limited product portfolio of voice services and rudimentary data services provided by a clearly defined set of market actors, regulators were able to assign spectrum licenses in line with initial market needs. Fast-forwarding thirty years, this is not the case anymore. Given that use cases will vary widely along geographic and demographic dimensions and that ownership and sharing arrangements of active and passive network infrastructure will trigger the convergence of mobile- and fixed-network infrastructures, the hope of achieving an adequate and timely spectrum assignment based on current regulatory stances is unrealistic.

6.3. . . . and the Overwhelmed MNO

That said, the biggest driver of (dynamic) spectrum sharing might well result from MNOs themselves becoming overwhelmed by the number of ways to fulfil the promise of IoT while at the same time ensuring financial viability. As to spectrum use and ownership, MNOs suffer fundamental uncertainties about the value of spectrum in different spectrum bands because the revenue and return expectations of future 5G/IoT use cases are

basically unknown. It is not yet understood what will be the MNOs' revenue and return potential in accommodating time-critical use cases in the areas of mobility automation and industrial control. The justified fear of MNOs is that content- and IoT-based applications will attract superior margins compared to nondifferentiable data services. It is safe to assume, however, that MNOs will be able to charge premiums for prioritizing traffic generated by use-case providers whose business model rests on low-latency and high-bandwidth applications.

This presents a catch-22. MNOs know that they will need much more spectrum to densify their RAN footprint cost-effectively, yet they have a very limited understanding of the concrete use cases of 5G infrastructure and, thus, limited understanding of what revenue and returns to expect. Again, MNOs will be rewarded for providing the infrastructure required for vastly increased traffic and use-case diversity. Yet the concrete business models and associated cash flow patterns are not understood, implying that MNOs have no clarity about when and how they will recover their investments. Given this uncertainty, any bid for spectrum is a shot in the dark from the perspective of MNOs. I conjecture that MNOs will be loath to bid the high amounts they have in the past. It will be very difficult to assess spectrum value in the absence of the robust cash flow models that typically underpin bidding processes. The current licensing regime—assigning spectrum in fixed blocks to individual carriers for extended periods through time-consuming, contrived auction processes—may well have had its day. If regulators press ahead with auctioning off spectrum to licensed carriers in piecemeal fashion and block the release of spectrum held by industries whose value contribution is but a fraction of what MNOs would generate, they are likely to severely damage the development of 5G/IoT markets.

Current developments in the mobile markets reasonably support to conjecture that the days of regulatory spectrum assignment are numbered. Why would service providers want to dispose of exclusive (national) spectrum when they need it only at specific times, for specific customers, at specific locations, and for specific use cases?

Two observations that emerged from discussions with executive personnel in strategy departments of large MNOs seem to corroborate the point that MNOs are overwhelmed. Firstly, as discussed in the previous paragraph, carriers do not have a financial model that would capture the cost of 5G network rollouts vis-à-vis future revenue streams. MNOs are only able to plan 5G-network capital expenditures based on current traffic patterns. Their conjecture is that investments in 5G-radio infrastructure will pay off in places where current traffic and revenues are high. This guess is bold yet valid because there is little else upon which MNOs can premise their capital expenditure planning. Their strategy departments do not have a crystal ball that would reveal users' demand profiles and willingness to pay for future use cases. Thus, MNOs will first roll out new infrastructure in dense urban areas, where 5G/IoT use cases are likely to flourish first.

Whether MNOs will be able to disburse dividends that satisfy their shareholders (given the significant financial uncertainty about whether they will be able to achieve above-average margins) is another matter.

In the greater scheme of things, any near-term dreams of ubiquitous 5G/IoT landscapes are overblown. We are possibly ten years away until 5G/IoT use cases will achieve significant scale, certainly on the African continent where 4G-uptake is barely over 10 percent of all subscriptions. That said, there is no doubt that these developments will happen. ICT is a long-term game and the large OTTs and hyperscalers are investing their abundant cash flows into global telecommunication infrastructure that used to be the domain of carriers. MNOs have read the writing on the wall and are grudgingly recognizing the much higher profit margins (and capital values) of the big tech companies whose content portfolios make use of carrier networks. In light of this financial uncertainty, the danger is that insufficient assigned spectrum and inflexible regulatory regimes will be detrimental to 5G network rollouts in less affluent suburban and rural areas.

The second observation concerns the MNOs' justified fear of becoming a dumb pipe offering nondifferentiable services in a competitive broadband-data market to the subscriber who happily pays premiums to content providers but shops around for the best data deal. To avoid such a scenario in the 5G/IoT market, MNOs hope to participate in high-margin markets either by developing their own 5G/IoT offerings or by striking strategic partnerships. This is unlikely to work on a broad scale for a host of reasons. One reason is that the large international content providers and platform operators are endowed with enormous financial capital. The generally borderless nature of OTT content providers[92] contrasts with the licensed-carrier model, which artificially fragments the carrier market in economically and technically meaningless ways, robs carriers of scale economies, and burdens carrier groups with an astonishing diversity of regulatory regimes. Yet, even ignoring these points, the question is why we should consider local MNOs to be more qualified to venture into innovative use cases than non-telecom firms.

Forward thinking MNOs have already started shifting their focus from connectivity services to becoming a digital lifestyle service provider in partnership with many other innovation houses such as OTTs, hyperscalers, financial and entertainment specialists, travel and IoT service providers. In the longer run, today's MNOs might even disintegrate into the cloud with infrastructure specialists running the physical parts of the network and content providers making use of specific network parts as needs be. As this study is about spectrum, the question arises who in such a scenario would own the spectrum when its employment is fully determined by concrete use cases.

7. Conclusion of SEIA of South Africa's Spectrum Policy: Hurting the Consumer

In Appendix I, the addressee of this study finds the outcomes of the Socioeconomic Impact Assessment (SEIA) in official format. For a condensed overview, the reader is kindly referred to Part II of the study where the key questions that guided this study and respective results are discussed. The key results can be summarized in a few bullets:

- 15 years of spectrum withholding inflicted—and continues to inflict—great harm on consumers, particularly on the rural population lacking access to broadband and on low-income earners in urban areas.
- The government's failure to complete the analogue to digital migration in accordance with international recommendations implies that even after a (hopefully) successful auction in March 2021, carriers will be unable to utilize the digital dividend spectrum in the 700 and 800 MHz frequency range until 2023.
- Consumers will continue to suffer from a lack of affordable broadband in rural areas and unnecessarily costly network infrastructure in dense-urban areas until the spectrum is freed up. This means that consumers will not reap the digital dividend associated with rolling out rural LTE-800 networks at much lower investment cost and utilizing carrier aggregation in dense-urban areas.
- In addition to the long period of spectrum withholding and the failed analogue to digital migration, the government's competition policies and regulatory interventions have created investment uncertainty, not least because regulatory systems encourage market laggards to capture rents through regulatory channels that they are unable to earn by competing. The ANC government must develop a culture of evidence-based policymaking and shed their culture of ideological policy-making inspired by lofty goals of 100% broadband penetration and muddle-headed notions of sharing, open (or fair) access or non-discriminatory pricing that are at odds with market reality.
- The market reality in South Africa is that the spectrum crunch suffered by MTN and Vodacom and the recapitalization of two ailing entities that became Liquid Telecom and Rain have paved the way for the industry to create the market-based equivalent of a WOAN. The difference to a government planned WOAN is that the "roaming" agreements, which constitute the contractual basis of the joint utilization of network resources, have been agreed at arm's length and without the violation of property rights or any type of coercive "incentive" structure. Taking into account that Cell C is roaming on MTN's network since 2019 (slowly but surely morphing into an MVNO) and, also since 2019, Telkom is roaming on Vodacom's network, the market has been moving towards a "shared" network for

the benefit of consumers. The last thing South Africa needs is a WOAN artefact imposed on industry by government.

Regulatory paralysis has imposed an enormous socio-economic opportunity cost paid by ordinary citizens. Further development of the telecommunication market should now be left to market players who understand what they are doing and have proverbial "skin in the game". With six mobile operators operating on a competitive basis and the upcoming auction to release the spectrum resources needed, the conditions for the industry to fruition are in place. When the government eventually completes the analogue to digital migration, the industry will be well-positioned to narrow the digital divide by rolling out cost-effective rural LTE networks and reduce (effective) data prices in urban areas through carrier aggregation and spectrum sharing. The realization of these two socioeconomic goals must not be impeded by further interventions such as the WOAN, for whose success there is neither theoretical nor market evidence. To the contrary, the path towards the urban 5G networks that will open up the world of IoT services with their significant potential of increasing prosperity will impose on governments the deregulation of spectrum. It won't be long until spectrum will be utilized as any other economic resource. This is to say that spectrum utilization with be driven by consumer needs and technological possibilities.

This will also conclude an era of misleading public narratives. The idea that market-based intermediation of spectrum is prone to so-called "market failure" because of its particular characteristics is mistaken. It is supported neither by technological facts nor historical evidence—and certainly not by sound economic theory. To the extent that the economic "treatment" of spectrum presents a particularly dismal example of the shortcomings of orthodox economic theory, the general public's belief in the need for the special treatment of spectrum also demonstrates the power of tenacious enduring narratives that are demonstrably flawed. As "the market" for regulatory narratives also needs willing buyers, which players benefit from promoting such narratives?

V. SEIA IN OFFICIAL FORMAT

1 Problem statement/Theory of change

1. Summarise the proposal, identifying the problem to be addressed and the roots (causes) of the problem that will be addressed by the new rule. (Background of the proposed policy/ bill/regulations):

Problem	Root Causes
Spectrum withholding by SA Government authorities and failed analogue-to-digital migration have imposed high costs on South African consumers:	• Government's economic theory with regard to spectrum is flawed. • Government's economic understanding of competition is based on regulatory artefacts that do not reflect market reality (implying that Government does not assume a consumer-centric view). • the unavailability of spectrum in 700/800 MHz due to the failed digital migration and the withholding of 2.6 GHZ and 3.5 GHz have imposed high costs on South African consumers in two respects: o unavailability of 700/800 MHz spectrum has made mobile data services effectively more expensive as the benefits of carrier aggregation between 700/800 MHz bands and higher frequency bands (1.8 GHz to 3.5 GHz) could not be reaped o unavailability of 700/800 MHz has led to comparatively lower coverage levels of data broadband in rural areas (which has a particularly adverse impact on people with lower incomes) • the Government's distrust in markets in general and the mobile telecommunication market in particular leads to policy-activism instead of concentrating on what is the single-most important raison d'être of every government: the facilitation of voluntary exchange between consumers and economic entities through the creation of an institutional environment helping them to achieve their goals o the Government's pursuit to create an artefact "WOAN" is tantamount to a major interference in the market o creating the artefact "WOAN" means to patronize consumers and market players

2. Describe the intended outcomes of the proposal.

   This SEIA suggests that the government's spectrum politics have imposed high costs on South African consumers through the withholding of spectrum and the failure of analogue-to-digital migration.

   This SEIA advances three proposals to be realized in the short term: (i) liberalize the use of spectrum, (ii) speed up the analogue-to-digital migration and (iii) discontinue unsound regulatory artefacts.

   (i) Give MNOs free reign over using the spectrum resource assigned to them. By approving the various "roaming" agreements between MNOs, Government has effectively done this already.

   (ii) Concentrate regulatory efforts on speeding up the release of digital-dividend spectrum for the sake of giving MNOs the means to provide more broadband coverage in rural areas at lower rollout costs and to capture the benefits of carrier aggregation in dense-urban areas.

   (iii) Abandon plans to create a WOAN artefact. South Africa already has a WOAN: Cell C, Liquid Telecom, MTN, Rain, Telkom and Vodacom, who share their production means (incl. spectrum) and infrastructure extensively, including to independent operators.

3. Describe the groups that will benefit from the proposal, and the groups that will face a cost. These groups could be described by their role in the economy or in society. As a minimum, consider if there will be specific benefits or costs for the poorest households (earning R7000 a month or less); for black people, youth or women; for small and emerging enterprise; and/or for rural development. Add more lines if necessary.

Groups that will benefit	**How will they benefit?**
Rural population	The benefits of the digital-dividend spectrum can be fully reaped when the migration of broadcasters into lower frequencies will be completed: • Rural consumers will benefit from higher coverage levels • Rural consumers will benefit from the adoption of better technology in the 700/800 MHz bands in the form of higher bandwidths. • More coverage and better technology are tantamount to effective price reductions
Urban population	The availability of the digital-dividend

	spectrum in the 700/800 MHz band will allow MNOs to capture the benefits of carrier aggregations in urban areas: • Higher spectral efficiencies lead to significantly higher network performance and capacity • Better in-building penetration • More cost-effective means of providing broadband in suburban areas Higher spectral efficiencies, better penetration and less network rollout cost are tantamount to effective price reductions

Groups that will bear the cost	**How will they bear the cost?**
Not applicable	Not applicable

4. Describe the behaviour that must be changed, and the main mechanisms to achieve the necessary changes. These mechanisms may include modifications in decision-making systems; changes in procedures; educational work; sanctions; and/or incentives.

   The change of behaviour required must be preceded, firstly, by an acknowledgment by Government representatives of the harmful nature of their regulatory policies during the past 10 to 15 years. Secondly, the change of behaviour requires a mind-shift by (mainly) Government representatives that involves moving away from ideology-driven regulatory interference based on how the economy ought to work toward consumer-centric policies reflecting market realities (driven by consumer choice and innovation):

   i. **Correction of an "economics" rooted in blurry and untestable notions of "effective" vs. "ineffective" competition, "discriminatory" vs. "non-discriminatory" access (to rightfully acquired assets/resources), and "exclusive" vs. "non-exclusive" use of assets/resources.**
   ii. **Realization that the global prosperity that the mobile telecommunication sector has achieved, not just in South Africa but around the world, is entirely due to consumer choice and entrepreneurial ingenuity. It has to be understood that during the times of public fixed-line monopolies until the early 1990s, the median consumer in low-income and lower-middle income had no access to telecommunications.**

iii. Correction of flawed view that "spectrum" is a resource that warrants a different treatment in terms of economic theory than other means of production.

5. Identify the groups inside and outside of government whose behaviour must change to implement the proposal (add more lines if required).

Groups inside and outside Government whose behaviour must change	**Behaviour that must be changed**	**Main mechanisms to achieve the necessary changes.**
Government leadership	Move away from non-evidence based policy-making rooted in political ideology (often informed by clientele politics) towards a genuine consumer-centric regulatory approach; we must learn to trust choices of consumers instead of patronizing them.	- Stop interference through discretionary industrial policy approaches, e.g. regulatory spectrum assignment, the creation of market artefacts (such as the WOAN); - Create the institutional conditions for MNOs to compete on market-terms, that is, consumer choice and entrepreneurial innovation.
DCDT		
CompCom		
Icasa		

6. Report on consultations on the proposal with the affected government agencies, business and other groupings. What do they see as the main benefits, costs and risks? Do they support or oppose the proposal? What amendments do they propose, and have these amendments been incorporated in your proposal?

Affected stakeholders	**What do they see as main benefits, costs and risks**	**Do they support or oppose the proposal**	**What amendments do they propose**	**Have these amendments been incorporated in your proposal?**
ICASA DCDT Telkom Government at large	The "risk" is to lose a tool of political entrepreneur-ship. The benefit is higher	It is not likely that the affected public stakeholders will embrace the proposals.	To be understood	

	consumer prosperity and a more dynamic market.			
Telkom	The "risk" is that Telkom will become an independent and lose the benefits of Government patronage	Telkom is likely to oppose the proposal. Telkom's current actions go into the opposite direction, e.g. by seeking to revoke market-based roaming and infrastructure sharing agreements for their benefit at the expense of consumers and shareholders of other MNOs.	to be understood	

7. Describe possible disputes arising out of the proposal, and the system for settling and appealing them. How onerous will it likely be for members of the public to lodge a complaint and how burdensome and expeditious is the proposed dispute-settlement procedure?

   Disputes may arise from market participants that seek to achieve their business goals by other means than entrepreneurial performance and consumer satisfaction.

   If the policy-shift recommended in the proposal of this SEIA is endorsed by ICASA, DCDT and CompCom, and Government at large, members of the public will have no legal basis to appeal market results. By endorsing the multitude of existing "roaming" and infrastructure sharing agreements between all six MNOs—and other players in the industry such as tower companies and fibre providers— the Government authorities have already contributed to shaping the current market structure for the sake of the consumer.

2 Impact Assessment

1. Describe the costs and benefits of implementing the proposal to the groups identified in point 6 above, using the following chart. Add more lines if required.

Group	Implementation Cost	Cost of changing behaviour	Costs/benefits from achieving desired outcome	Comments
ICASA DCDT Telkom Government at large	The SEIA suggests that the Government of South Africa will benefit from the proposed policy-shift.	Political cost of changing direction of policy due to factional opposition and continued attempts of regulatory capture	More prosperous voters and a well-working telecommuni-cations sector	
Telkom	Opportunity cost of standing on its own feet	No cost	Benefit is that Telkom can devote itself entirely to satisfying its consumers	

2. Describe the changes required in budgets and staffing in government in order to implement the proposal. Identify where additional resources would be required for implementation. It is assumed that existing staff are fully employed and cannot simply absorb extra work without relinquishing other tasks.

   In the mid- to long-run the proposed shift in policy direction might involve fewer public employees at regulatory bodies for the benefit of taxpayers. The impact on unemployment will be marginal and greatly overcompensated by a more dynamic telecommunication sector for the sake of consumer prosperity.

3. Describe how the proposal minimises implementation and compliance costs.

   The proposals in this SEIA do not require any costly implementation. However, the correction of ideologically motivated policies might entail political costs. If the Government is committed to the wellbeing of South African citizens, mandated

by the Constitution, and the sole *raison d'être* of any government, it can find ways to popularise sound policies.

4. Describe the main risks to the achievement of the desired ends of the legislation and/or to national aims that could arise from adoption of the proposal. Add more lines if required.

   Provided that the Government authorities named in this SEIA endorse the proposal, the key risk is that the implementation will meet politically-motivated opposition.

3 Managing Risk

1. Describe the measures taken to manage the identified risks. Add more rows if necessary.

Identified Risk	Implementation Cost
The main risks to Government associated with the approval of the proposal are of political nature.	Not quantifiable in monetary terms.
The main risks to consumers and market participants in the telecommunication sector are that the proposal is not endorsed and the current interventionist regulatory approach continues to constrain prosperity and market dynamics	Not quantifiable in monetary terms.

2. Describe the mechanisms included in the proposal for monitoring implementation, evaluating the outcomes, and modifying the implementation process if required. Estimate the minimum amount of time it would take from the start of the implementation process to identify a major problem and remedy it.

   The industry will use appropriate mechanisms to implement the proposals entailed in this study.

   In fact, the market itself is the mechanism.

4 Summary

1. Summarise the impact of the proposal on the main national priorities.

Priority	Impact
Social cohesion	A prosperous society is a cohesive society. This SEIA recognizes and addresses income and wealth inequality and the challenges it imposes on policymakers. It does not view the past and envisaged regulatory policies for the mobile telecommunication sector, such as the creation of the WOAN, as an appropriate instrument for increasing social cohesion and prosperity.
Security (Safety, Food, Financial and etc.)	Not applicable
Economic growth and investment	Policy proposals contained in the SEIA are conducive to achieving economic growth—understood in this study as increases in consumer prosperity and a more dynamic mobile telecommunication market—and reducing investment uncertainty.
Economic inclusion (employment creation and equity)	A competitive telecommunication sector—that is, a telecommunication sector which serves consumers—is inherently inclusive. There is no such thing as non-exclusive or "anti-poor" competition, certainly not in the mobile telecommunication sector that has created consumer prosperity while being a net tax contributor (instead of public infrastructure providers that consume taxes in the form of recurring bailouts).
Environmental sustainability	Not applicable

2. Identify the social and economic groups that would benefit most and that would bear the most cost. Add more rows if required.

Main beneficiaries	Main cost bearers
1. South Africa's consumers	
2. South Africa's labour market	

3. South Africa's entrepreneurial eco-system	

3. In conclusion, summarise what should be done to reduce the costs, maximise the benefits, and mitigate the risks associated with the legislation. Note supplementary measures (such as educational campaigns or provision of financing) as well as amendments to the draft itself, if appropriate. Add more lines if required.

   The proposed policy-shift is in full alignment with the prevailing legislation as reflected in the regulatory code of the mobile telecommunication sector, the ECA.

   In contrast, the Competition Act requires amendments to reflect market realities, in particular the notion of a company's dominance if it has market shares in excess of 45 percent.

4. Please identify areas where additional research would improve understanding of the costs, benefits and/or risks of the legislation.

   The facts supporting the proposal are self-evident and based on sound economic theory. This SEIA will facilitate public decision-making towards implementation.

5. For the purpose of building a SEIA's body of knowledge please complete the following:

Name of the Official:	
Designation:	
Unit:	
Contact Details:	
Email Address:	

VI. BACKGROUND AND HISTORY OF SOCIO-ECONOMIC IMPACT ASSESSMENTS - SEIA

This is a very brief history of the evolution of SEIAs in SA and elsewhere:

1. 1980s: An old concept starts being taken seriously as a policy tool.
2. 1990s: UK leads the world. Recognising that quality screening is critical, the government creates a specialised Cabinet unit. Proposals may be submitted to ministers and parliament only after the unit's approval.
3. 1990s-2000s: Other countries, notably Nigeria, Australia and Japan adopt variations. Australia, having learned from the UK experience, creates a unit that produces its SEIAs. They decided, as perhaps we should, that those proposing measures are the worst people to draft SEIAs, simply because they use them as propaganda opportunity rather than a means of objective evaluation and adjustment. Other countries addressed the problem by various means of quality screening, such as Japan, where every department is invited to comment.
4. 1980s-2020s: The degree to which SEIAs are formulated and enforced is erratic – rises and falls within a given country.
5. 1997: Good Law Project created and in 1998 starts international research.
6. ±2000: DTI briefs Leon Louw to draft SEIA guidelines for SA.
7. ±2002: Department of Finance takes over based on the view that it is the overarching department.
8. ±2003: The Presidency takes over on the basis that it is more overarching than Treasury. Full-time staff are appointed to produce Guidelines that are freely available on the Presidency's website. Throughout, the FMF contributed its unique expertise.
9. 2007: Presidency approves RIAs ('implemented' 2012). Most policymakers remain unaware of the policy so that there are no SEIAs for most new policies.
10. 2010: Far-reaching labour reforms are introduced which disregard the need for SEIAs, so are not evidence-based or rationality checked.
11. 2015: Mandatory SEIAs announced. From 1 October 2015, *all* draft policies, bills and regulations *must* include and be proceeded by an impact assessment that has been signed off by the government's SEIA Unit.
    Departments must by informed and influenced by SEIA findings, which they must include in their proposals. Proposals must include a summary of the main findings of the final impact assessment as well as annexing the full assessment.
    Policies and regulations that are signed by Ministers should be subject to SEIAs.
    Updated SEIA Guidelines issued.
12. 2016: The Cabinet creates a SEIA Secretariat and decides that all laws and policies *must* be informed by high-quality SEIAs that comply with the Presidency's excellent Guidelines. The special unit is in the Planning Department. This might be problematic because (a) departments jealously guard their independence and resist interference by their peers, and (b) those proposing policies produce SEIAs instead of impartial experts.
13. June 2015-Mar 2016: 117 SEIAs are produced. Some leave much to be desired; some produced only after Bills had been tabled with Cabinet approval.
    The Cabinet often seems to forget its own requirement. It can fruitfully be reminded of its own resolution whenever considering new measures.
14. 2021: There is, however, a slow and visible improvement in the application of the Government's promising SEIA policy. As people become increasingly aware of the need for SEIAs there is likely to be ongoing improvement of quantity and quality. Sometimes when SEIAs are produced, they are not published. They should always be compliant and published.

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VIII. ENDNOTES

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[3] https://techpolicyinstitute.org/2019/11/25/telecom-and-spectrum-in-mexico-with-judith-mariscal-two-think-minimum/.

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[5] See: https://techcentral.co.za/set-top-box-saga-is-costing-sa-dearly/65780/.

[6] http://www.brainstormmag.co.za/business/14743-sa-s-set-top-box-fiasco.

[7] The term digital dividend were originally used to express the spectrum efficiency gain due to the switchover from analogue to digital terrestrial television services. See ITU (2012), *Digital Dividend: Insights for Spectrum Decisions*.

[8] https://www.verizon.com/about/system/files/investor-event-presentation/RJA%20VZ%20slides.pdf.

[9] Rain also uses 2.6 GHz but focuses on urban areas.

[10] See: https://en.wikipedia.org/wiki/Digital_television_transition.

[11] https://techweez.com/2014/12/04/safaricom-launches-4g-in-kenya/.

[12] https://www.commsupdate.com/articles/2016/06/17/tim-brasil-and-claro-launch-lte-a-using-new-700mhz-frequencies/.

[13] https://www.telecompaper.com/news/movistar-argentina-launches-lte-a-in-buenos-aires-localities--1218696.

[14] https://techpoint.africa/2016/06/27/mtn-ghana-launches-4g-lte-service/.

[15] https://450alliance.org/tele2-launches-russias-first-lte450-network/.

[16] According to Falkenberg et al. (2017) power savings through carrier aggregation are up to 31 percent.

[17] https://www.icasa.org.za/legislation-and-regulations/ita-for-the-radio-frequency-spectrum-licences-for-imt-spectrum-bands.

[18] Preakness refers to an annual race for three-year-old horses, held at Pimlico in Baltimore, Maryland.

[19] https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/innovation-through-spectrum-sharing.

[20] The market for submarine cable networks and their services is already fully denationalized. The same holds for internet peering points, data centres, and equipment markets. If we add the largely denationalized markets for end-user devices and, of course, content, there are not many national elements left on which the notion of a national carrier could be premised. Arguments in defense of national licenses have no economic and technical merit. The reasons are inherently political—for example, in the guise of social welfare (clientele politics) or national security. Note that the notion of national carriers is at the core of governments' efforts to snoop, intercept traffic, ban regime-critical content, and lock down networks in regions where people are loath to acquiesce to dictatorial regimes. And let us not forget that national licenses are congenial to establishing tax residency. If there is one thing that gives the taxman sleepless nights, it is markets in which entrepreneurial value creation defies the logic of national borders.

[21] https://data.worldbank.org/indicator/IT.MLT.MAIN.

[22] In the prebid evaluation of the merit of acquiring one of the first two GSM licenses in South Africa, a big European carrier decided not to participate in the bidding process. The reason was that even in the most optimistic scenario, the business case would deliver no return on (equity) investment within an acceptable period.

[23] Seventy-five percent of Vodacom Group's revenue comes from South Africa. The other important African markets are Kenya (via Vodacom's stake of 35 percent in Safaricom), Tanzania, DRC, and Mozambique. See Vodacom's *Integrated Report for the Year Ending March 31, 2019* (Vodacom 2019).

[24] Excessive auction prices must be regarded as being informed by carriers' opportunity costs that result from not being able to source spectrum at arm's length. The more desperately carriers have been waiting for regulators to release spectrum and the less they are able to source spectrum in the market, the more willing they are to pay high prices and accept all sorts of obligations imposed on them.

[25] https://www.techradar.com/uk/news/ofcom-opens-up-uk-spectrum-to-boost-rural-areas.

[26] The authors further discuss two bottom-up techniques for the "estimation of opportunity cost of spectrum *value*" (italics added): cost reduction and discounted cash flow. In fact, with the help of these two techniques, bidders estimate the financial value of spectrum *given* their opportunity cost, typically represented by discount factors such as the weighted average cost of capital.

[27] The important point to note is that the way the above-quoted authors approach opportunity cost does not and cannot assume the perspective of the bidder. Rather, public auctions are subject to political considerations of opportunity cost.

[28] In his paper on opportunity cost and counterfactual conditionals, Magni (2009, 121) notes that "the concept of cost has a distinctive counterfactual characterization."

[29] In fact, by licensing carriers and assigning exclusive spectrum, irrespective of whether spectrum is given away, assigned via lotteries, or assigned through auctions, regulators effectively create a spectrum cartel.

[30] Vietor (1994, 329) is of the view that incentive-based regulation such as price caps linked to productivity and innovation "certainly seem a more efficient way to regulate" compared with cost-plus regulation based on asset value. Notwithstanding that it appears to be common sense that such regulation renders superior results to a cost-plus regime, it cannot be proven. Also, such a regime might only be the less—but still very—costly option among the two nonmarket alternatives.

[31] The GSMA still holds that spectrum is a finite resource. Their view of spectrum use entails a firmly entrenched position of national regulators based on the model of licensed mobile operators. My view is that this model does not serve people best, which is what the GSMA proclaims to aim at: "GSMA believes governments and mobile industry must work together, collectively helping launch innovative services and connecting more people." See: https://www.gsma.com/spectrum/.

[32] https://www.polity.org.za/article/spectrum-is-an-inhibitor-to-lowering-data-prices-says-vodacom-mtn-2019-12-03.

[33] https://techcentral.co.za/spectrum-not-top-five-priority-for-pule/39103/.

[34] Based on the table on page 10 in PDF-document "Responses to stakeholder enquiries in respect of the IMT and WOAN ITA" on ICASA's homepage. The 10 MHz of Liquid displayed in the 900 MHz band is reported by ICASA as 850 MHz.

[35] See Rob and Paelo (2020).

[36] https://www.gov.za/sites/default/files/gcis_document/201409/31408958.pdf.

[37] https://www.ellipsis.co.za/wp-content/uploads/2012/01/ICASA-Draft-High-Demand-Frequency-Licensing.pdf.

[38] http://www.saflii.org/za/cases/ZAGPPHC/2016/883.pdf.

[39] Invitation to provide written comments on *Proposed policy and policy directions to the Authority [ICASA] on licensing of unassigned high demand spectrum*: "The Minister performed significant consultation with stakeholders on the best approach to implement this policy provision" (Gazette 41935, 27 Sep 2018).

[40] https://techcentral.co.za/no-digital-migration-before-2022-director-general/101264/.

[41] https://www.icasa.org.za/news/2019/discussion-document-on-mobile-broadband-services-inquiry-for-public-comments.

[42] https://halberdbastion.com/technology/cellular/4g-lte/lte-carrier-aggregation.

[43] ICASA Annual Report 2006.

[44] 15 Dec 2011, Gazette 34872: https://www.ellipsis.co.za/wp-content/uploads/2012/01/ICASA-Draft-High-Demand-Frequency-Licensing.pdf.

[45] https://www.samenacouncil.org/samena_trends/files/SAMENA_Trends_January_2012.pdf.

[46] https://www.ellipsis.co.za/wp-content/uploads/2008/05/eca.pdf.

[47] https://gs.statcounter.com/search-engine-market-share/all/south-africa.

[48] Clearly, the production factors with which entrepreneurs operate are heterogeneous, say, machines and computer as examples of capital goods and people and electricity as examples of variable cost. It is also clear that these heterogeneous production factors have to be used together. Heterogeneity here implies complementarity in *use*. The emphasis is on *use* because it is not technological complementarity of production factors per se that determines increases in prosperity but the concrete *use* of production factors. Ludwig Lachmann (1956, 35) states: "The mode of this complementarity, the proportions in which the various heterogeneous factors of production are being used for a given purpose, must find its expression in the Production Plan." If we take the fair

assumption that a concrete complementary *use* of production factors as represented by a firm's production plan succeeds when the outcome is *useful* to consumers and allows the firm to pay for the production factors they employ, then a production plan fails when the firm is repeatedly unable to pay its cost, as is the case with South Africa's SOEs. Technically speaking, the services might be still useful for the consumer; it is just that the continued existence of such entities is premised on the state's power to part people from a portion of their income to plug the cash-flow holes.

[49] MoC Cwele was quoted saying that "Government has no intention of running a mobile network in the country" two weeks after the White Paper was published. See: https://techcentral.co.za/cwele-defends-white-paper/69226/.

[50] https://techcentral.co.za/white-paper-will-damage-sas-ict-sector/69689/.

[51] It is the view of xxx that "government ownership" is a contradiction in terms. The government, as a fictitious entity, cannot own anything. To the degree that public entities are legal persons, there is no flesh-and-blood individual to whom title deeds could be attributed to public employees. Public employment means economic non-liability. All public assets and resources are by definition owned and employed by private parties, which is evidenced by the fact that all losses are automatically attributed to all citizens. The specious nature of public agency leads to systematic non-accountability and waste of resources for which there is no other rectification mechanism than the revocation of public mandates.

[52] Please refer to chapter 5.4 for a detailed discussion of the Vodacom-Rain and other agreements of similar nature in the context of Telkom's recent threat of legal action.

[53] http://www.governmentpublications.lib.uct.ac.za/news/discussion-document-market-inquiry-mobile-broadband-services-south-africa.

[54] On 2 December 2019, the Competition Commission published their version of the Final Report "Data Services Market Inquiry." Triple the size, it adds little to the discussion that has not been said in ICASA's Market Inquiry document while indulging in tedious empirical comparisons that fail to reflect the market realities in South Africa. Compared to ICASA's generally respectful style and cautious style of reasoning, CompCom's Market Inquiry appears to pursue a divisive approach of making mischief. The use of toxic language such as "anti-poor pricing" seems to corroborate this conjecture. Certain sections in the CompCom report, for example para 482, demonstrate a curious (in fact, twisted) logic that seems to be more informed by the Authority's wish to see MTN and Vodacom losing market share for the sake of it and not by exploring which spectrum utilization is to the greatest advantage of consumers. Another example is found in para 521 arguing that "the mere fact that infrastructure facility sharing is happening does not mean this is effective or being done on reasonable terms." The question to ask is whether the CompCom pretends to know what would be *the* effective or *more* reasonable terms. Perhaps, the Authority will ask Cell C and Telkom to make this call.

[55] People fail to anticipate the future, which creates opportunity space for entrepreneurs and regularly leads to unexpected innovations, such as the mobile prepaid platform. In the early 1980s AT&T asked management consultancy McKinsey to estimate how many cellular phones would be in use globally at the turn of the century: "The consultancy noted all the problems with the new devices—the handsets were absurdly heavy, the batteries kept running out, the coverage was patchy and the cost per minute was exorbitant—and concluded that the total market would be about 900,000. At the time this persuaded AT&T to pull out of the market, although it changed its mind later." Quoted from: "Cutting the Cord," The Economist (7 Oct. 1999).

[56] The voluminous 316-pager can be found on: http://www.compcom.co.za/wp-content/uploads/2019/12/DSMI-Non-Confidential-Report-002.pdf.

[57] It is important to note that government would have a hard time issuing treasury notes if the interest coupon were not premised on the expectation that the economy's gross income earned after having paid production factors leaves something over for governments to meet their interest obligations (and fund SOEs).

[58] See Baumol, Panzar and Willig (1982): "Contestable Markets and the Theory of Industry Structure", San Diego: Harcourt Brace Jovanovich; Baumol (1982): "Contestable Markets: An Uprising in the Theory of Industry Structure", The American Economic Review, Vol. 72, No. 1, pp. 1-15.

[59] Even in countries like Zimbabwe or Venezuela where every other economic venture is crushed in the mills of kleptocratic socialism). First, dictators also enjoy mobile telephony. Second, during civil wars the fighting oponents do not touch mobile infrastructure. Third, mobile coverage helps some big-brother regimes such as China to realize the Orwellian nightware of total control.

[60] The fact that in 2014 90 percent of towers were still owned and managed by MNOs not only documents the dynamic nature of the industry. It also demonstrates that competitive pressures compel MNOs to adopt cost-effective solutions for the sake of consumers.

https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/09/Clean_Tech_Report_R_WebSingles .2.pdf.

[61] See in Appendix I for a comparison of the value chain of fixed-line monopolies until the early 1990s with the value chain of MNOs in 2000 and 2020, the latter of which corroborates the contestability hypothesis.

[62] The fact that MNOs as we know them today are regulatory constructs subject to national licensing means that governments have created spectrum cartells who are not contestable via entry into the consumer market. Here it is interesting to understand that today's large Internet Peering Points (IPP) in Frankfurt, Amsterdam and London emerged without anybody having assigned a license to them (nor did they ask for it). They were created by ISPs on a non-profit basis with the aim to improve international traffic intermediation, which by all means they accomplished brilliantly. From the perspective of economic theory, there is no tangible reason for the national licensing of telecommunication operators. Confining firms to jurisdictional boundaries makes it of course much easier to levy taxes and implement policy frameworks.

[63] To the extent that carriers occasionally offer services at prices on a regionally differentiated basis, as recently done by MTN, it is very unlikely that such schemes are derived on the basis of rigorous margin calculations. The general absence of such pricing schemes points seems to support the conjecture that they are not popular with consumers and do not pay off. That said, this might (have to) change in the 5G-world once latency or local use cases require a more dynamic management of network and spectrum resources.
See on MTN's pricing scheme: https://businesstech.co.za/news/telecommunications/428436/mtn-launches-new-area-specific-data-bundles/.

[64] https://mybroadband.co.za/news/cellular/251471-vodacom-and-cell-c-argue-over-sharing-towers.html.
By implication, MNOs that share sites also share the fibre link up to the site, the ground and the tower structure, security services, power backup and cooling. See:
https://www.towerxchange.com/towerco-business-model-diversification/.

[65] The use of a number, in this case 45%, as a yardstick to derive the verdict "ineffective" is immoral as it condemns actions by people without considering the specific circumstances. It would be the same to label all students who score less than 45% on an exam as stupid.

[66] It is interesting to see that these typically ambitious turnaround projects feature very prominently in the annual financial statements that SOEs are obliged to publish, at least as long as turnaround projects are in the planning and early implementation stage, when the goals are bold and the tone upbeat. Latest as of the third year, the observer will realize that the turnaround project has vanished from the report without a trace. As to the many turnarounds PRASA (five since 2009) and SAA (an evergreen turnaround since 2001; in the case of SAA the term "turnaround" is used as a fig leaf to justify bailouts) have initiated, the observer will not find one annual report that summarizes the results of any turnaround exercise. As there is no shareholder with skin in the game, there is also nobody to hold the administration of SOEs or the Ministry of Public Enterprises accountable.

[67] https://www.gov.za/sites/default/files/gcis_document/202004/43207gen238.pdf.

[68] The table excludes spectrum in the 900 MHz GSM band. The 80 MHz of spectrum assigned to Rain, which is displayed in the 3.5 GHz column, is in the 3.7 GHz band and does not constitute IMT spectrum.

[69] https://www.icasa.org.za/news/2020/temporary-radio-frequency-spectrum-issued-to-qualifying-applicants-in-an-effort-to-deal-with-covid-19-communication-challenges.

[70] https://www.icasa.org.za/uploads/files/information-memorandum-for-international-mobile-telecommunications-spectrum-assignment.pdf.

[71] https://www.businesslive.co.za/bd/companies/telecoms-and-technology/2020-09-04-icasa-delays-spectrum-auction-to-march-2021/

[72] http://www.compcom.co.za/wp-content/uploads/2020/09/Competition-in-the-digital-economy_7-September-2020.pdf.

[73] https://www.hoganlovells.com/~/media/hogan-lovells/pdf/publication/201521ctlrissue1maxwell_pdf.pdf.

[74] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32009L0140.

[75] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF.

[76] https://www.iol.co.za/business-report/companies/telkom-plans-court-battle-with-icasa-over-high-demand-spectrum-7958f30b-9005-4e60-91b6-00d7d5d6bbcd.

[77] The fact that Rain has ventured into the retail space does not invalidate the fact that its business model is a wholesale business model.

[78] https://mybroadband.co.za/news/wp-content/uploads/2021/01/MTN-Letter-to-ICASA-spectrum-ITA.pdf.

[79] https://www.itweb.co.za/content/Pero37ZxaKeqQb6m.

[80] In their response to ICASA's "Policy and Policy Directions to the Authority on licensing of unassigned high demand spectrum," as published in Government Gazette 41935 on 27 September 2018, Vodacom states: "We encourage the assignment of high demand spectrum as quickly as possible and we support a competitive WOAN as contemplated by the proposed Policy Direction."

[81] https://techcentral.co.za/rain-open-to-roaming-deals-with-any-operator/84554/.

[82] https://uk.practicallaw.thomsonreuters.com/w-017-9418?transitionType=Default&contextData=(sc.Default)&firstPage=true.

[83] *The theory of economic regulation*. Bell Journal of Economic Management Science 2: 3-21.

[84] Cited from: https://techcentral.co.za/exclusive-why-telkom-is-taking-on-vodacom-and-rain/102094/.

[85] SOE Broadband Infraco (BBI) also submitted their comments to the Market Inquiry. In para 693.1 of CompCom's Market Inquiry document, BBI is quoted to submit "that, from a qualitative point of view, it appreciates the Commission's approach to the provisional recommendations 'in that both remedial measures and alternative data supply sources were put forward as means to correct the country's problem of a lack of access to data services.'" BBI is further referred to in para 709.5 noting "that if high demand spectrum is prioritised for SOCs [stated-owned enterprises] and is proportionate to the expected ARPU, BBI will not provide last mile services itself. Instead, Access Network Providers would buy wholesale wireless broadband capacity from BBI and then bundle it and on-sell it." Understanding now how the wind blows, winding down lossmaking BBI by selling off their assets to highest bidders would be an immediate and concrete remedy for taxpayers and Government's strained budget. A comparison of BBI's balance sheet on page 102 of their latest annual financial statements (AFS), dated 31 March 2019, compared to the AFS of 2009 is instructive. Of the roughly 1.64bn ZAR shareholder loans they received from Department of Public Enterprises and IDC (that is, the taxpayer), 0.85bn ZAR was received as cash injection. In the first operating years, BBI's high operating losses were smoothed by high interest incomes the firm gained from investing the proceeds from Govt shareholder loans at capital markets. That cash was mostly burned by 2015 (which soon will make additional government loans—in this case another word for bailout—necessary to keep operations going). 2019, cash is 0.095bn ZAR while retained income stood at -1.2bn. In 2009, BBI reported revenues of 306m ZAR compared to 411m ZAR in 2019. Taking into account an average inflation rate (CPI) of 5 percent p.a. and the generally above-average growth rates achieved in the telecommunication sector means that BBI's business shrunk in real terms. Assuming the reported fixed asset value of 1.05bn ZAR to be a true reflection of its market worth, selling them would still not pay the reported shareholder loan of 1.37bn ZAR. The financial situation ticks all the boxes of business failure. Note in this context, the Board of Directors' satisfaction with the going-concern assumption on page 134 in the 2019 AFS. See for financial statements: https://infraco.co.za/wp-content.

[86] "Government fails to use evidence in policymaking decisions," *Business Day*, 14 December 2020.

[87] https://techpolicyinstitute.org/2019/11/25/telecom-and-spectrum-in-mexico-with-judith-mariscal-two-think-minimum/.

[88] From Galt's Speech, in Ayn Rand's (1957) *Atlas Shrugged*.

[89] GSMA's (2013, 2) position 2, "exclusive access through appropriate market-based licensing should remain the main regulatory approach for mobile broadband spectrum," and position 5, "authorization to access additional spectrum using the LSA/ASA concepts should be given by National Regulatory Authorities (NRAs) after public consultation and agreement between incumbents and mobile network operators," however, are inherently at odds with the optimal use of spectrum. As the organization represents its members, proposing a truly market-based approach to spectrum usage does not seem to be in line with the organization's mandate.

[90] https://developer.qualcomm.com/blog/enhanced-mobile-broadband-5g-innovation-consumers.

[91] Hayek was awarded the Nobel Prize not least because he recognized that the knowledge dispersed among millions of people and firms can only exercise its prosperity-increasing effects if such individual knowledge is not overruled through public planning of bureaucrats who neither have the same level of knowledge nor respect consumer sovereignty.

[92] OTTs are getting closer to end users day by day through substantial digital infrastructure investments globally, particularly data centres and submarine fibre cables. They also drive the open source network approach (such as TIP and ORAN support) and acquiring innovative startups (such as Metaswitch) to position themselves at the core of 5G ecosystems. It is a matter of time before these OTTs begin to lower their dependency on network operators to reach end users.