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Spectrum shortage and merger by any other name in South Africa

Bronwyn E Howell* and Petrus H Potgieter†

10 June 2021

Abstract

Radio spectrum is a key input for mobile operators and the structure of the industry is strongly related to and influenced by the ownership of spectrum licenses. Spectrum is usually allocated for a limited duration and may or may not be tradable which further complicates the interaction between spectrum ownership and the retail market for mobile services. The adoption of a new constitutional system in 1996 in South Africa created the opportunity for importing a fresh set of recommended institutions and policies for telecommunications. This eventually included an independent telecommunications regulator (ICASA), the budget for which nevertheless comes from the responsible Minister.

ICASA announced an auction of spectrum in the 2.6 GHz and 3.5 GHz bands in May 2010 and issued a tender for the design of the auction, but this was postponed several times and finally abandoned (Song, 2011). The same thing happened again in 2016 (Paelo & Robb, 2020). Late in 2020, the regulator again announced an auction, due to take place during 2021 but by the beginning of the year, two of the four national operators had already announced that they would go to court to stop the auction.

A shortage of spectrum (or, inefficient assignment of it) is blamed for South Africa's relatively slow LTE speeds, among other things. The response of operators has been to innovate using roaming and network sharing agreements. By historical accidents, the country has two wireless networks in addition to the four licences mobile operators.

The paper looks at how the de facto industry structure has been determined by spectrum holdings and sharing arrangements and asks how spectrum management could be improved. We observe that although the number of mobile operators has effectively been reduced to 3 (a number which would raise concern in some circles) there exist a variety of arrangements between the 3 and also other spectrum and network operator. The smallest of the 3 mobile operators is still not able to offer a nationwide mobile service without a roaming agreement but at the same time the two larger operators depend critically on spectrum and roaming agreements themselves, mainly with the two physical data network operators that function as wholesale providers.

Keywords

Spectrum auction, network sharing, South Africa, ICASA

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1 Introduction

Radio spectrum is a key input for mobile operators and the structure of the industry is strongly related to and influenced by the ownership of spectrum licenses. Spectrum is usually allocated for a limited duration and may or may not be tradable which further complicates the interaction between spectrum ownership and the retail market for mobile services. The demand for spectrum is determined largely by data services and continues to grow strongly. Governments have a short-term incentive to maximise revenue from spectrum auctions and excessive prices realized at auction contribute to the problem of sunk costs in the industry. If spectrum is allocated on a national basis and there are coverage and other obligations associated with the radio frequency use, the situation becomes even more complicated. An increase in spectrum ownership concentration is however not necessarily associated with a decrease in consumer welfare or other performance measures such as prices and employment (Woroch 2020).

The adoption of a new constitutional system in 1996 in South Africa created the opportunity for importing a fresh set of recommended institutions and policies. This eventually included an independent telecommunications regulator (ICASA), the budget for which nevertheless comes from the responsible Minister. There are four national mobile networks offering telephony (among which the former incumbent was the last entrant) as well as a data-only network, a quasi-fixed wireless operator and prospectively a wireless open access network. Spectrum rights cannot be traded and assignment of new spectrum has happened rarely and haphazardly, with a range of consequences. Although ICASA announced an auction of spectrum in the 2.6 GHz and 3.5 GHz bands in May 2010 and issued a tender for the design of the auction, this was postponed several times and finally abandoned (Song, 2011). The same thing happened again in 2016 (Paelo & Robb, 2020). Late in 2020, the regulator again announced an auction, due to take place during 2021 but by the beginning of the year, two of the four national operators had already announced that they would go to court to stop the auction.

A shortage of spectrum (or, inefficient assignment of it) is blamed for relatively slow LTE speeds, despite good 4G coverage. The response of networks has been innovative roaming and network sharing arrangements. Given

- the history of failed auctions over the past 11 years,
- strange and unusual requirements of bidders and conditions on winners in the auction announced for 2021, and
- constant debility of one of the four national mobile operators,

the main focus of this paper will be to answer the following questions.

1. To which extent have innovative roaming and network sharing arrangements changed the de facto industry structure?
2. How can South Africa's spectrum management best be improved to increase industry output and dynamic efficiency?

The research methodology comprises the synthesis of publicly available information and comparing the spectrum management approach with other jurisdictions in order to reach a list of policy recommendations that are forward-looking and take into account particular challenges that will be posed by 5G network diffusion.

The paper proceeds as follows. First, we provide a brief background on the current state of the South African mobile market, which is hampered by severe spectrum constraints. We then discuss the role of spectrum in mobile markets, and document the catalogue of failed attempts to make more spectrum available over the past fifteen years. Next we discuss the specific challenges posed to the industry by the combination of legacy spectrum allocations, a digital policy both

evolving after, and at odds with, historic spectrum allocations and industry investment, with the policy strongly favouring a single wholesale open access network rather than infrastructure competition, and the repeated failure to complete the broadcasting migration from analogue to digital. This interaction culminated in the most recent failed spectrum auction attempt in 2020/2021.

We then discuss how, despite the repeated policy and regulatory failures, industry participants have responded creatively to the spectrum shortage with roaming and infrastructure sharing agreements to maximise the use of scarce resources so as to enable South African consumers access to, if not world-leading, then at least adequate functional telecommunications and broadband services at prices that are not much more expensive than in comparator countries. We conclude with some recommendations for the industry going forward, based on our finding that the current industry structure has evolved in the absence of an effective policy to have not one but two wholesale-only networks and two effective (with a third possible) nationwide full service network operators. As it is unlikely that a third wholesale-only operator will have much effect on industry performance, the current imperatives are, just as they were fifteen years ago, to release more spectrum and complete the analogue-digital migration to free up valuable low-frequency spectrum for 4G and 5G network expansion.

2 Background

In May 2021, South Africa’s ICT market was served by four licensed mobile network operators (MNOs): Cell C, MTN, Telkom and Vodacom. A further two operators of nationwide mobile networks using the same technology, Liquid Telecom and Rain, provide wholesale and data services. Slightly over 40 percent of shares in Telkom are held by the South African government. The majority of sector investment is private but there is significant governmental ownership of the two oldest and largest networks: the Public Investment Corporation (PIC) is the largest known shareholder of MTN and one the PIC’s clients, the Government Employees Pension Fund is the second-largest shareholder of Vodacom. This is fairly normal in SA, given the large sums that these entities have to invest. As in many other countries, the “revolving door” has not broken down. The chair of the MTN board is a former deputy minister of finance, that of Vodacom was briefly a member of parliament for the ruling party and chair of the Parliamentary Portfolio Committee on Communications. The Broad-Based Black Economic Empowerment Act 2013 (BBBEE) imposes (inter alia) minimum black ownership and employment obligations on all firms (BEE). General BEE preferences pervade economic policy: in June 2021, for example, the Competition Commission blocked the sale of a majority Black holding company’s share of Burger King to an American investor on the grounds that it would leave Burger King without “Black” shareholders.

At September 30 2020, national population coverage by 3G networks was 100 percent; 4G/LTE coverage was 100 percent in urban areas and over 90 percent in all but one rural area. Mobile subscriptions exceeded 94 million (160 per 100 population), of which just over a third (32.4 million) were 3G/LTE (ICASA 2021). By retail market share, in 2019 the largest operators were Vodacom (circa 43%) and MTN (circa 30%); Cell C (circa 17%) and Telkom (circa 10%) were smaller (ICASA 2019a). Only Vodacom and MTN have a national network footprint. However, by share of traffic, it is believed Vodacom and MTN deliver around 80 percent of service. SA is somewhat unusual in that the incumbent fixed-line operator Telkom did not initially receive a mobile licence but was a passive shareholder in Vodacom. After divesting from Telkom, it was the fourth mobile operator to be licensed.

The industry is overseen by an independent regulatory agency, the Independent Communications Authority of South Africa (ICASA). ICASA (inter alia) registers telecommunications

providers and is responsible for the allocation of radio spectrum. The Department of Communications and Digital Technologies (DCDT) oversees sector policy, while the Competition Commission is responsible for the implementation of competition law with the aim of achieving equity and efficiency. In principle, these arrangements conform to those recommended by international agencies such as the World Bank and the International Telecommunications Union (ITU) (e.g. ITU 2020).

A 2019 market inquiry by ICASA into mobile broadband services in South Africa (ICASA 2019a) found highly-concentrated retail markets (measured using the Herfindahl-Hirschman Index). Despite good coverage of both 3G and LTE, concerns are frequently expressed about South Africa's prices being "too high". In the 2019 review, ICASA reported South Africa's prices being higher than BRICS comparator countries, although they were around average for African countries. Nonetheless, high prices, particularly for data, are generally held to be discriminatory and preventing low-income users from accessing the benefits of the digital economy (Gillwald et al. 2018), a problem persisting despite Competition Commission intervention in 2019 whereby Vodacom and MTN were instructed to lower their retail prices (Research ICT Africa 2020). The market inquiry reports that South Africa does appear to have assigned comparatively little spectrum compared to reference countries. Yet despite these local findings, international industry analyst firm BuddeCom reports "the cost of mobile devices and calls has fallen in line with effective competition from four key network operators", and notes the degree of comparative sophistication of the South African industry compared to other countries in the same class, due to its widespread and growing LTE network investments (Lancaster 2020).

2.1 Spectrum allocation

While there is no such thing as an ideal spectrum for all uses, as a general rule, spectrum in lower frequencies (such as the 700-900MHz bands) is suitable for covering relatively larger geographical areas 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. The most efficient means for a mobile network operator to provide a satisfactory service across an entire country with highly variable population densities is to obtain access to both high-frequency and low-frequency spectrum (called "spectrum pairing").

In all countries, legacy uses of spectrum across a range of activities (including radio and television broadcasting as well as other communications purposes) have both supported and constrained the ability for network operators to deploy sufficient capacity to meet growing demands as new and more capable network technologies (2G, 3G, 4G/LTE, 5G) became available. Until the late 2000s, common regulatory practice linked the use of particular frequencies to the production of a specific service using a prescribed technology. Thus, radio broadcasting technology using 10 MHz of spectrum in the 550 MHz frequency band was prescribed to transmit TV signals, while the use of GSM radio technology employing 2x11 MHz in the 900 MHz frequency range was detailed to transmit GSM voice. However, regulatory restrictions tying spectrum to specific uses, and limiting the ability to transfer ownership of the rights to use it from one owner to another, is inefficient as it reduces flexibility to redeploy the spectrum when new uses for it become available. A particular issue pertains to the fact that the spectrum previously assigned for analogue TV is particularly suitable for rolling out lower-cost rural broadband networks. The faster that analogue TV usage can be converted to digital, the more rapidly it is possible to redeploy the spectrum to provide high-quality cost-effective rural broadband services.

2.2 Failed auctions

The most significant salient feature of South Africa’s spectrum markets over the past twenty years has been the government’s repeated announcement and then suspension, deferral or cancellation of plans to release more spectrum and complete the transition from analogue to digital broadcasting. Severe constraints on spectrum availability have been identified as important barriers to development of the South African mobile industry as early as 2006.

In 2006, ICASA announced plans to release 800 MHz (from television channels 65 and 66) and 2.6 GHz spectrum. This process stalled. In 2008, the Department of Communications, responding the ITU recommendation for full digital migration by 2015, announced “analogue signal is switched off on 1 November 2011” (DC 2008). In 2009, ICASA issued invitations to apply for 2.6 GHz and 3.5 GHz spectrum. However the terms of participation imposed onerous Black Economic Empowerment (BEE) provisions rendering acquisition effectively uneconomic for network operators (FMF 2021), so the process was aborted in 2010 (Lewis 2020b).

In 2011/12, ICASA unveiled plans to bundle 800 MHz spectrum (first proposed for release in 2006) with 2.6 GHz spectrum for auction. Spectrum would be assigned for wholesale networks. No new network operators would be permitted to sell services in the retail market. The auction was withdrawn in 2012.

In July 2016, ICASA issued an invitation to apply to participate in an auction to provide broadband services in both urban and rural areas using 700 MHz, 800 MHz and 2.6 GHz spectrum. The auction was planned for January 2017. However, in September 2016, the Minister’s bid to the North Gauteng High Court to set the spectrum auction aside was upheld (Case 2016/59722).

On 1 November 2019, ICASA initiated a licensing process (ICASA 2019b). Initially, it was planned to complete the process by the end of 2020 but as a consequence of the Covid emergency, this was deferred to 30 March 2021. The Invitation to Apply was issued on 2 October 2020 (ICASA 2020) with applications planned to close on 28 December and the auction held no later than 20 March 2021. The auction date was subsequently pushed back to 30 March 2021. Submissions to the October invitation were received from the six existing license holders; a seventh application was rejected as it arrived too late. By early March 2021 the auction had been halted by a High Court application from Telkom.

2.3 Roaming and sharing

Roaming agreements permit the customers of one network to make (send) and receive calls and data over another operator’s network. This requires the operators to agree the terms of such use and may be entered into on a commercial basis or mandated by a regulator. Network sharing agreements (NSAs) have been demonstrated to lead to improvements in quality and lower prices (because of reduced costs to operators) but has direct implications for competition policy. In the absence of free spectrum trading and given the hostility of regulators and competition authorities to mergers (especially of 4 operators to 3), roaming and sharing are the easiest responses available to operators to respond to changes in demand for spectrum that might be due to underlying changes in technology, demand, costs or all of the above. In South Africa, the prominent arrangements in this regard are between Cell C and MTN (network sharing as well as roaming) and Vodacom and Rain (mainly roaming).

The two smaller MNOs, Cell C and Telkom, were each launched with mandatory roaming on one of the original operators in order to enable them to offer national service from the start. Today, South Africa’s two largest MNOs between them hold rights to only 27 percent of spectrum issued by ICASA, and have acquired no new permanent rights since 2005. Their ability to meet customer demand has necessitated a range of innovative agreements with other operators.

The voluntary roaming and network sharing agreements are a pragmatic response to the lack of access to spectrum. They have enabled the (close to) best use to be made of the allocated spectrum, at least in respect of higher-frequency spectrum, by enabling sharing of the benefits of intensifying network coverage. In SA, a significant part of roaming and spectrum sharing is now no longer aimed at enabling smaller operators to satisfy customer demand but rather the only available option for the large operators to do so.

3 Challenges

The dominant feature of South Africa’s spectrum markets over the past twenty years has been the government’s repeated announcement and then suspension, deferral or cancellation of plans to release more spectrum and complete the transition from analogue to digital broadcasting. A pattern has emerged of continual tensions between the regulator ICASA and the government (via the Minister and Department). ICASA’s imperative to allocate spectrum to enable new network and service development have clashed with government (Ministerial) preferences for how the industry should be structured and therefore how and to whom spectrum should be allocated. However, industry development is crucially dependent upon private sector investment.

3.1 Current spectrum allocation

We start by discussing the origins of the current spectrum allocation to mobile operators in SA. Vodacom and MTN were licensed in 1993 while negotiations around a new constitution were still ongoing. Both were granted 900 MHz band spectrum for this. The process was bitterly opposed by the current ruling party, especially by its chief negotiator, current president Ramaphosa. By 2002 Ramaphosa was chair of the MTN board however, a position which he would hold for 10 years.

In 2001, Cell C was granted a licence to operate in the 900 MHz and 1800 MHz bands as a third MNO. Vodacom and MTN were given temporary access to 1800 MHz spectrum in exchange for providing free SIM cards to the poor in 2003 and this access was made permanent with licences granted in 2005. A feature of these, and subsequent, licenses is that rights to use the spectrum are permanent (i.e. not time-limited) but cannot be transferred to other parties without ICASA’s permission. In 2003, Cell C, Vodacom and MTN were granted 3G spectrum licences in the 2.1 GHz band. Whereas Vodacom and MTN launched 3G services in 2005, Cell C did not do so until 2010. Neotel was granted a licence to operate fixed wireless services in the 800 MHz band in 2007, primarily as a means of providing local competition in voice markets to the government-owned incumbent fixed-line operator Telkom. It used geographic numbers and users were not allowed to receive or make calls outside their dialling code areas. This spectrum is now owned by Liquid.

In 2009, spectrum for WiMAX and/or HSPA/LTE was granted on a “use it or lose it” basis to iBurst and the state-owned broadcast signal distributor Sentech (2.6 GHz) as well as to Telkom and Neotel (3.5 GHz). Neotel’s spectrum is now owned by Liquid; iBurst’s spectrum is now owned by Rain; Sentech’s spectrum was returned to ICASA in 2013 (Vermeulen 2013). Cell C was granted an additional 5MHz of 2100 MHz spectrum in 2011 to complement its existing 3G holding.

Table 1: spectrum allocations prior to the Covid-19 lockdown on 27 March 2020

Fixed Spectrum Assignment	700/800	900	1800	2100	2300	2600	3500/3700	Total
Vodacom		22	24	35				81
MTN		22	24	40				86

Fixed Spectrum Assignment	700/800	900	1800	2100	2300	2600	3500/3700	Total
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	164	609

The notable feature of these allocation arrangements are:

- the last allocation of permanent spectrum to any operator took place in 2011;
- the last spectrum allocation to the largest firms by market share (Vodacom and MTN) took place in 2005;
- the two largest firms (market share in excess of 75%) between them control only 27 percent of allocated spectrum;
- the smallest firm by market share (Telkom, less than 10%) controls 23 percent of allocated spectrum; and
- 37 percent of spectrum is controlled by firms not licensed as mobile network operators.

In response to unprecedented increases in demand for mobile services during the recent Covid-19 pandemic, ICASA gazetted Information and Communications Regulations on 20 April 2020 assigning temporary licenses relating to 446 MHz of spectrum. These licenses were to expire three months after termination of the Covid national state of disaster or 30 November 2020, whichever occurred first. 800MHz band licenses were granted to Vodacom, MTN and Telkom; 2300 MHz band to Vodacom and Telkom; 2600 MHz band to Vodacom, MTN, Telkom and Rain; 3500 MHz band to Vodacom, MTN, Telkom and Liquid. These temporary allocations are detailed in Table 2.

Table 2: emergency spectrum assignment in 2020

Fixed Spectrum Assignment	700/800	900	1800	2100	2300	2600	3500/3700	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	0	40	170	116	446

Table 2 shows that the majority of the temporary spectrum (67%) was allocated to Vodacom and MTN. However, comparing Tables 1 and 2 reveals that only 66 MHz (15 percent) was allocated to operators in bands where they already held spectrum. Consequently, only 15 percent of the emergency spectrum was immediately employable as only these firms would have the necessary base stations and other infrastructure (including spectrum utilization plans) suitable for its immediate deployment. Neither of these were the firms serving the largest proportion of consumers - Vodacom and MTN. Given the temporary nature of the assignments, it would be unlikely that the firms receiving spectrum in bands where they had not already invested would sink the necessary capital in new capital in order to utilize the allocations (unless, of course, given the government's past erratic performance, delays in rescinding the licences might be expected).

Furthermore, the emergency spectrum allocated in the 800 MHz band was effectively unusable due to the failed digital migration. The effort needed to first ascertain the degree of interference on a region-by-region basis and then build the necessary infrastructure is both time-consuming and costly. Nonetheless, by October 2020, one firm had deployed five new base stations in this band, albeit nominally for testing purposes.

3.2 Digital migration

South Africa is a notable laggard in the conversion of analogue broadcasting to digital. Despite an agreement with the International Telecommunications Union to complete the transition by June 2015, the failure to meet multiple self-imposed deadlines has seen the digital migration project described as a “slow-motion train wreck” (McLeod, 2020) and “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” (Moyo 2019).

3.3 5th generation (5G) mobile networks

5th generation (5G) mobile networks allow very high-speed wireless connections with low latency that allow for many and innovative applications. These features require very dense networks of cells and high backhaul capacity at the same time as 5G networks allow for further network virtualization and spectrum sharing. 5G is not simply an upgrade of the current product and market (as 4G was of 3G) which can be analyzed in the same way. Deployment of cells will be different and more specialized and linked to wildly diverse spectrum and backhaul requirements and is likely to feature some degree of self-provisioning by some users. It will bring additional investment requirements and risk-taking in the discovery of demand for new services. It will also bring opportunities for networks to share infrastructure more easily. The availability of spectrum and the flexibility of spectrum arrangements regarding trading, sharing and other conditions that might have been imposed by regulators, will strongly influence the outcomes. In addition to answering the main research questions, we summarize the key points in South African policy and the 2021 auction for the future of 5G.

3.4 Rolling failed auctions

In 2006, ICASA announced plans to release 800 MHz (from television channels 65 and 66) and 2.6 GHz spectrum. This process stalled. In 2008, the Department of Communications, responding the ITU recommendation for full digital migration by 2015, announced “analogue signal is switched off on 1 November 2011” (DC 2008). In 2009, ICASA issued invitations to apply for 2.6 GHz and 3.5 GHz spectrum. However the terms of participation imposed onerous Black Economic Empowerment (BEE) provisions rendering acquisition effectively uneconomic for network operators (FMF 2021), so the process was aborted in 2010 (Lewis 2020b).

In 2011/12, ICASA unveiled plans to bundle 800 MHz spectrum (first proposed for release in 2006) with 2.6 GHz spectrum for auction. Spectrum would be assigned for wholesale networks (including in a Managed Spectrum Park)¹. No new network operators would be permitted to sell services in the retail market. The auction was withdrawn in 2012, amidst claims of confusion between the precise ICASA ITA requirements and the draft Ministerial Policy Direction issued concomitantly, with its more general injunction to “facilitate the licensing of spectrum in 800 MHz based on a wholesale open access network” (Lewis 2020b).

In July 2016, ICASA issued an invitation to apply to participate in an auction to provide broadband services in both urban and rural areas using 700 MHz, 800 MHz and 2.6 GHz spectrum.

¹Government Gazette 558 No. 34872 December 15 2011 <<https://www.ellipsis.co.za/wp-content/uploads/2012/01/ICASA-Draft-High-Demand-Frequency-Licensing.pdf>>2011 accessed 2021-05-28

The auction was planned for January 2017. However, in September 2016, the Minister’s bid to the North Gauteng High Court to set the spectrum auction aside was upheld (Case 2016/59722). The Minister, who favoured the establishment of a single nationwide wholesale-only mobile network (WOAN), asserted that ICASA’s plans had pre-empted the government’s finalising of its spectrum policy (in the ICT Policy White Paper (DTPS 2016), approved by Cabinet on the day before the Court’s ruling), and unduly benefited “big companies with deep pockets” (McLeod 2016). The court observed that if the auction had proceeded, firms could have sunk investments that subsequently became stranded due to changes in government policy.

3.5 Spectrum Policy and the Wholesale Open Access Network

Spectrum policy in SA has, on the surface, been influenced considerably by the decision to establish a wholesale open access network (WOAN). WOANs operate using technological and business models that separate physical access to the network from the delivery of services to consumers. They can emerge in markets where firms opt to specialise and contractually engage with each other (e.g. Rain and Liquid Telecom with Vodacom and MTN respectively in South Africa) or by regulatory/legislative fiat, when network operators are prohibited from engaging in retail activities (e.g. NBN Co in Australia and New Zealand’s UFB operators).

Commercial adoption of the WOAN model has been claimed to be more attractive to later entrants, arguably because they do not have to take account of legacy infrastructures (Godlovitch et al. 2020). The strong incentives these later entrants face to acquire large customer numbers quickly in order to take advantage of network scale economies is also reflected in their willingness to service MVNO operators, even if they still offer their own retail products (Howell & Potgieter 2020). Regulatory/legislative use of WOANs derives from their purported benefits in enabling more extensive retail competition and lower costs amongst firms sharing access to a single network acquired under common (non-discriminatory) terms. While having found favour, particularly with governments funding the infrastructure (as the model avoids the need to “pick winners” from amongst existing integrated operators to build and operate the subsidised infrastructure), there is to date scant evidence of their long-term benefits. A significant weakness is that WOANs protected from competition are slow to adopt both technological and commercial innovations, compared to vertically-integrated comparators. Moreover, their inability to work directly with consumers and prohibitions on offering different terms to different consumers further constrains the potential for consumer innovations that require differentiated network access (Howell et al. 2010; Frontier 2014; GSMA 2019).

The South African WOAN proposal has indeed proved controversial. Lewis (2020b) traces the genesis of the concept to ICASA’s 2011 spectrum ITA, which included proposals for both a spectrum park (open access to spectrum, apparently inspired by New Zealand’s arrangements operating since 2006) and an open access network (using framing and phraseology apparently sourced from a 2007 submission to the United States FCC). The concept acquired political patronage and became a key pillar of the 2013 national broadband strategy where a principal action item was the “creation of an open access wireless network”, alongside the development of “models, design and roadmap [sic] towards a fibre rich Open Access National Broadband Network (NBN)” (DoC 2013). Political support carried through to the recommendations of the 2015 national ICT Policy Review Panel, which took effect in the Minister’s 2016 policy that derailed ICASA’s spectrum auction.

The WOAN provisions of the 2016 policy proved the most controversial of all. Its effect, consistent with the political ethos of the ruling party, was to impose the most stringent of WOAN models - a “single WOAN”, protected from competition by all other networks. The expectation that “all high demand spectrum will be assigned on an open access basis” was interpreted as the government’s intention to recall spectrum already allocated to mobile operators - that

is, effective nationalisation of the resource (Gillwald 2016). This intention was confirmed in draft legislation specifying that high-demand spectrum previously assigned to incumbent mobile licensees was to be returned to the regulator for reassignment to the WOAN (Lewis 2020). The huge outcry due to the disruption this would impose on the industry, in order to implement a model unproven in any other jurisdiction internationally (GSM 2019), led ultimately to the Department commissioning an independent review of the WOAN and associated spectrum allocation policies by the Council for Scientific and Industrial Research (CSIR).

In July 2019, following the CSIR review, DCDT published a new Policy on High Demand spectrum and Policy Direction of the Licensing of Wireless Open Access Networks (DCDT 2019). The new policy clarified that while the government still wished to give preference to the WOAN by reserving some spectrum in the 700 MHz, 800 MHz and 2.6 GHz bands, the remaining spectrum could be assigned to other applicants, with a number of wholesale access, universal service and WOAN procurement obligations imposed, and restrictions placed on the total amount of spectrum individual licensees would be able to hold. Early antipathy to the WOAN has softened somewhat following these reassurances that the WOAN will compete with, rather than replace, existing operators (Muller 2020).

3.6 Design of the 2021 (non-)auction

On 1 November 2019, ICASA initiated a licensing process (ICASA 2019b). Initially, it was planned to complete the process by the end of 2020 but as a consequence of the Covid emergency, this was deferred to 30 March 2021. The Invitation to Apply was issued on 2 October 2020 (ICASA 2020) with applications planned to close on 28 December and the auction held no later than 20 March 2021. The auction date was subsequently pushed back to 30 March 2021. Submissions to the October invitation were received from the six existing license holders; a seventh application was rejected as it arrived too late.

The terms of the auction included

- spectrum “floors” designed to ensure that South Africa has at least five credible operators (including the WOAN) – notably, that the third and fourth operators have sufficient spectrum to be credible independent nationwide operators;
- spectrum “caps” limiting operators to at most 2x21 MHz (including existing holdings) of sub 1 GHz spectrum and an overall spectrum cap (including existing holdings) of 184 MHz (18% of total spectrum issued);
- licenses valid for 20 years from time of issue;
- in respect of sub 1 GHz lots:
 - one lot of 2X10 MHz 800 MHz spectrum carried an obligation for the purchaser to cover 99.8% of the population within 5 years of license issue, with at least 95% coverage across a specified range of underserved municipalities/areas;
 - any tier 1 (i.e. Vodacom or MTN) operator winning any other sub 1 GHz spectrum to cover 97% of the population in 5 years, with 92% coverage in the specified underserved areas, with coverage being on an outside-in basis (deployment first in underserved areas and major cities last);
 - any tier 2 operator to provide coverage to 80% of the population within five years; no outside-in provisions to apply in this instance;
- successful Tier 1 operators to provide reference offers for site access;

- all successful operators to provide open access to MVNOs with 51% ownership held by persons from Historically Disadvantaged Groups;
- all successful operators to procure a minimum of 30% national capacity from the WOAN, within five years of its commencement (aggregate across all operators, in proportion to the share of spectrum obtained in this auction); and
- a ‘use-it or lose-it’ clause ensuring deployment within 5 years of licence issuance.

The conditions appear reasonable and not very unusual. Nevertheless, Telkom filed papers in the Pretoria High Court on 22 December seeking an interdict to stop the auction. Telkom’s argument was that ICASA had “disregarded or had given insufficient weight to the promotion of competition as a material consideration in the licensing of high-demand spectrum” by designing the ITA “in a manner that disadvantages Telkom as the only credible infrastructure competitor to the monopoly of the two larger players” and because “caps proposed in the ITA disregard the fact that spectrum is available to the duopoly already through spectrum arrangements between themselves and smaller licensees” (Faku 2020). Telkom believes that the arrangements will entrench the “dominance” of Vodacom and MTN (McLeod, 2020). On March 9 2021, ICASA was ordered by the High Court to halt the auction process pending a hearing of the Telkom case and a separate pleading by broadcaster ETV (Mingas 2021). ICASA has indicated its intention to appeal (Reuters 2021).

The substantive issue voiced by Telkom pertains to the inability to use the 800 MHz spectrum in the auction, given the failed digital transition (Vermeulen 2021). While Vodacom and MTN have holdings in the 900 MHz band, Telkom’s lowest frequency holding is in the 1.8 GHz band. If Telkom is to compete on a level playing field nationwide with Vodacom and MTN, then it must acquire at least some of the 800 MHz in the auction. But until the digital transition is completed, ICASA cannot offer unimpeded access to the purchaser, so the ability to generate a return on investment will be compromised. This underpins Telkom’s claim that the auction terms are flawed and unduly favour the larger operators Vodacom and MTN.

The issue is further complicated by the requirement that once the auction is completed, no firm may hold more than eighteen percent of all spectrum issued (including all existing holdings). While not explicitly raised in its pleadings, this places further constraints on Telkom (FMF 2021). As shown in Table 1, Telkom already held 23 percent (142 MHz) of issued (609 MHz) spectrum. Following the auction, total allocated spectrum (excluding WOAN) would be 935MHz, of which Telkom would be restricted to purchasing no more than 42 MHz. While in the first instance, this appears to merely place the underprovisioned operators on a more level footing with Telkom, as Telkom needs to focus on acquiring 700/800 MHz spectrum (best for rural), it has little room to increase its holdings in the higher frequencies (best for urban). Meanwhile, Vodacom (103 MHz) and MTN (98MHz) have much greater flexibility to acquire spectrum in the higher frequencies best for serving urban communities (2.3 MHz and above, where they currently have no holdings and Telkom is well-endowed) - and where they currently rely on roaming and sharing agreements with Rain and Liquid Telecom in order to serve their customers.

4 Analysis

In this section, we consider the arrangements on the ground that have enabled operators to cope with the hiatus of more than 12 years in assigning new spectrum. We also look, by comparison, at the spectrum allocation in Mexico, a country roughly twice the size of South Africa with a similar geography and population density but around 50% higher GDP per capita in order to highlight the unusual situation pertaining in SA. Both countries have kept abreast with technological change and have implemented broadly pro-competitive policies in telecommunications markets

(Atiyas et al. 2017). Furthermore, Mexico’s Altán Redes open access wireless network might be used to bolster the case for the WOAN (Lewis 2020b).

4.1 Consolidation on the ground

As illustrated by Table 1 and the above discussion, South Africa’s two largest MNOs between them hold rights to only 27 percent of spectrum issued by ICASA, and have acquired no new permanent rights since 2005. Their ability to meet customer demand has necessitated a range of innovative agreements with other operators - notably Rain and Liquid Telecom.

Rain, rebranded in 2017 from Wireless Business Solutions (WBS), holds spectrum originally issued to iBurst. WBS won the bid to become the IT and telecoms backbone for the national lottery and began rolling out a national cellular-based wireless data network in 1999. In 2003, ICASA amended WBS’s licenses to allow it to provide pilot broadband services under the iBurst brand. Services were launched in 2005. In 2006, Vodacom acquired 10% of WBS, increasing the stake to 24.9% in 2008. Vodacom and WBS partnered to deploy a commercial WiMax network using the spectrum granted to iBurst in 2009. In 2010, Vodacom announced its intention to divest its WBS/iBurst stake in order to participate in the forthcoming (2011/12) ICASA spectrum auction. However, challenges to WiMax posed by increasingly more capable 3G cellular technology rendered iBurst’s network increasingly uncompetitive. Following failed discussions with both Vodacom and MTN to build a 4G network, private investors bought the financially failing company in 2015, deploying a new nationwide 4.5G LTE-A data network beginning in 2016. (MyBroadband 2019; Gilbert 2017).

Liquid Telecom acquired Neotel, the second national fixed line operator licensed by ICASA as a competitor to Telkom in 2001, in 2016. London-based Liquid is majority owned by Econet Global which grew out of Zimbabwe’s first private mobile network operator, and has expanded throughout the continent with investments in both satellite and terrestrial fibre (including trunk and backhaul) infrastructure. Neotel, originally owned by Eskom and Transnet, first offered services in 2007, and acquired 3.5 GHz spectrum rights in 2009 to build a WiMax network. By 2011, Tata Communications of India had become the majority shareholder. In May 2014, a bid by Vodacom to buy the company was accepted by shareholders, and although approved by ICASA, the sale was challenged and overturned in court in 2016. Tata then sold to Liquid, which commenced building its 4G network in 2019 (Liquid 2018).

When ICASA’s attempt to auction spectrum in 2017 failed, the operators began to work around the problem of spectrum allocation. The new owners Rain and Liquid invested significant sums building new network capacity which was sold on a wholesale basis. Vodacom and MTN entered into “roaming” agreements with Rain and Liquid respectively, which substantially compensated for their inability to invest in required network densification in urban areas. The agreements, approved by ICASA, effectively amount to the sharing of infrastructure (base transceiver stations, antennas, tower space, sites) and spectrum. For example, although Vodacom pays Rain to roam on its network, Rain pays Vodacom to co-locate on some of its sites. The collaborative partnership is enabling Rain to expand its network faster and with less debt than would otherwise be the case. Meanwhile, Vodacom gets access to spectrum that it cannot otherwise acquire due to the continually-stalled auction process. Similar arrangements also exist between MTN and Liquid (Liquid 2019). While Telkom has alleged these arrangements amount to effective mergers, neither the Competition Commission nor ICASA appears concerned. Indeed, ICASA has deemed the agreements pro-competitive (ICASA 2019). Meanwhile, Cell C has been roaming on MTN’s network (and indeed slowly but surely morphing into an MVNO) while Telkom has been roaming on Vodacom’s network.

The voluntary roaming and network sharing agreements are a pragmatic response to the lack of access to spectrum. They have enabled the (close to) best use to be made of the allocated

spectrum, at least in respect of higher-frequency spectrum, by enabling sharing of the benefits of intensifying network coverage. Thus, to some extent, the costs of providing services to South African consumers are reduced, relative to the costs if such arrangements were prohibited. However, no matter how one looks at it, spectrum in total is scarce, preventing even more densification from occurring in all areas, but especially so in those areas best served by lower-frequency spectrum. This must necessarily be reflected in South Africa’s retail prices. While regulatory intervention in wholesale markets to constrain roaming charges has been recommended (Competition Commission 2019), such intervention cannot address the necessarily higher costs imposed by the artificial spectrum scarcity and the second-best contractual arrangements firms have been required to enter into in order to meet burgeoning demand.

Any actual merger of operators (as established by the courts in the case that blocked a proposed merger between Vodacom and Neotel) would be risky and require the involvement of ICASA as well as the competition authorities. In SA, operators have managed to consolidate through spectrum and network sharing agreements (to the point of near merger in the case of Cell C and MTN) in order to spread the risk of investment and to invest in new infrastructure and technology (dynamic efficiency).

The 2019 mobile data market inquiry (Competition Commission 2019) found, on the contrary, that there was inadequate competition at retail level. Although there is explicit acknowledgement of first-mover advantage only oblique reference is made to Vodacom and MTN’s respective networks being better and more innovative. It also acknowledges that Cell C and Telkom have brought many lower priced products to market but that Vodacom and MTN have been able to maintain their prices nevertheless. This is somehow ascribed to “market dominance” but the mechanism is not specified. The vast majority of users are pre-paid and mobile number portability has been fully implemented and voice calls are increasingly being made only on WhatsApp and other over-the-top services.

One of the most comprehensive and practical assessments of the concept of workable or effective competition can be found in a 2016 paper in the journal *Review of Industrial Organization* by Delp and Mayo (2020) who write as follows.

“When we take these considerations together, a market can be said to be effectively competitive when:

1. Firms exhibit overt rivalry in their quest for consumer patronage;
2. Consumers have choices among vendors, readily demonstrate their ability to change vendors, and vendors (either incumbents or de novo entrants) have the ability and propensity to expand output to satisfy consumer demands; and
3. Rivalry among vendors manifests itself in desirable economic performance metrics, including price, output, quality, investment, and innovation.

Finally, in a policy context and in light of the fact that policy interventions are neither costless nor perfectly efficacious, a market can be said to be effectively competitive in a policy context if:

4. No clearly indicated and cost-effective policy change can improve upon prevailing economic performance in the market at issue. Under conditions of effective competition, sector-specific regulatory asymmetries can be confidently removed in lieu of general economy-wide consumer protection regulations that apply to all firms.”

That is, a market is effectively competitive when all of 1, 2 and 3 hold or when only 4 holds. There is no doubt that 1 and 2 hold in SA and many, including these authors, would contend

that 3 also holds in full. Among the metrics in 3, only price is contentious at all. Hypothetically then, assume 3 does not hold in total. Is there then any clearly indicated and cost-effective policy to reduce prices? We contend that the only intervention possibly meeting these criteria is the release of new spectrum to the operators.

4.2 Spectrum allocation

First, we compare the spectrum allocation in SA to that in Mexico using data from Lopez-Lopez et al. (2020). Mexico has three nationwide MNOs which have their own infrastructure as well as Red Compartida (operated by Altán Redes) which is a wholesale network currently covering around half the population of the country.

Table 3: spectrum assignment in Mexico

Operator	Total allocation (MHz)
AT&T	200
Telcel	189
Telefónica Movistar	105
Altán Redes	90
Total	584

Telcel is by far the largest operator with over 60% of the market and AT&T is slightly smaller than Telefónica Movistar. As in SA, the smallest operator has more spectrum than each of the others but the differences are not nearly as dramatic. Indeed it was reported at the end of 2020 that AT&T had returned some of its spectrum to the regulator. Telcel’s 189 MHz dwarfs Vodacom’s 81 MHz official allocation (Table 1) and furthermore, the wholesale network has less spectrum than each of Liquid and Rain.

A December 2020 submission by Telkom to ICASA (Telkom 2020, figure 11), calculates the effect of the spectrum sharing and roaming agreements to arrive at how much spectrum each of the three effective operators have (non-exclusive) access to.

Table 4: effective operator spectrum access in SA

Operator	Total access (MHz)
Vodacom	176
MTN	176
Telkom	142

Table 4 shows how arrangements between operators have resulted in access to spectrum that is similar to that pertaining in Mexico. That is, arrangements between operators have substituted for spectrum (re)allocation. Since spectrum in SA cannot be traded, this has been the only option for operators to gain access to this critical resource.

5 Recommendations

After the virtualisation of Cell C’s network, SA remains with three real MNOs. Only Vodacom and MTN are really nationwide operators and their coverage superiority is the result of historical circumstances. Their initial licence conditions included coverage obligations that did not apply

to the two later entrants. In addition, very high mobile termination rates have for a very long time effectively reduced competition (Hawthorne 2015). These high termination rates generated very high revenues from voice services for the original two operators since the vast majority of mobile users never had a fixed-line connection.

These factors that allowed Vodacom and MTN to build extensive networks will never pertain again and although Telkom has a need for low-frequency spectrum to improve its coverage in certain areas, it has no medium-term intention for site deployment to substitute completely for roaming arrangements. ICASA's interventions in recent years to substantially lower the termination rate has boosted competition in the pricing of voice calls to the extent that it will never again be a major source of revenue.

In the light of the preceding analysis, we formulate policy recommendations in the following subsections.

5.1 Clear digital dividend spectrum

The migration to digital terrestrial broadcasting in SA has been an unmitigated disaster, now spanning almost two decades. Every deadline has been postponed or missed yet low-value broadcast services occupy spectrum that would be useful to the operators and especially to Telkom. The main problem in this regard is not the state-owned television broadcaster's user of the spectrum as this entity is essentially not a going concern. The real issue relates to the one over-the-air privately owned television and the fact that the state owns the distribution network. This network was a co-applicant of Telkom in the court case that halted the 2021 auction.

Simply switching off terrestrial broadcasts might not be realistic even though a great many South Africans are already watching mainly satellite television or using internet based content services. Had spectrum been tradable (which would require changes to legislation), it would have been possible to make this problem simply go away, as the broadcast operators would have found the payments for spectrum direct from the telecommunications network operators likely both more lucrative and more timely than government compensation. Arguably, delays in digitalisation more likely reflect the government's stronger desire to micromanage distribution of revenues associated with the digital dividend than to maximise the social benefits from its reallocation.

5.2 Drop the state-owned WOAN

As discussed in the FMF report (Free Market Foundation 2021), SA already has two wholesale networks in everything but name – Rain and Liquid. Although other countries have embarked on the path of reintroducing state ownership in telecommunication infrastructure (Howell & Potgieter 2020) the experience elsewhere as well as the history of Telkom and other state-owned enterprises is not encouraging. A state-owned WOAN operating with objectives other than long-run commercial viability is unlikely to contribute to a more competitive market. At worst, it may undermine existing competitive interactions and lead to a less-competitive industry and poorer long-run outcomes for South African consumers.

Vodacom and MTN evidently do not need the WOAN and it appears to serve little other purpose than to provide Telkom with a possibly cheaper roaming option than its current arrangement with Vodacom. This is an object that could be achieved through ICASA regulating some kind of national roaming rate – something already recommended in the recent Competition Commission review. However, this option requires considerable caution, as mandatory national roaming is highly deleterious to investment (dynamic efficiency).

5.3 Simplify the “2021” auction

In principle, it is difficult to fault the intention of holding an auction to release spectrum. However, the 2021 auction has been specified with several baroque conditions, including the meticulous calculation of operator market shares in each municipality (which makes no sense as the market is national). The aim of these provisions is to specify what Vodacom or MTN (on the one side) and Telkom are allowed to bid for without naming them. These conditions are convoluted and open to challenge.

Telkom has halted the auction through court action, largely on the basis that the design is insufficiently geared to “promote competition”. By this it apparently means to provide a virtually guaranteed outcome that favours Telkom. Nevertheless, Telkom’s argument around this is sound: if the “pro-competitive” step is to auction low-frequency spectrum but that spectrum is full of television broadcasts, then there is no “pro-competitive” step.

The fact is that if the low frequencies are excluded from the auction, then there is hardly a “pro-competitive” (i.e. pro-Telkom) step to be divined as Telkom already has a lot of spectrum in this range.

5.4 Hold an auction as soon as practicable

The design and circumstances of the current auction has definite flaws but the 2020 emergency spectrum allocations have already been extended far beyond the time originally specified (and beyond the original “not beyond” date of 30 November 2020, most recently to 31 August 2021). ICASA is appealing the judgment halting the 2021 auction but it might be more efficient, in view of the rolling extension of the emergency spectrum assignment, to have an auction of the spectrum that is actually available, as soon as possible.

It is hard to argue that an auction is not more pro-competitive than a temporary assignment as allocated spectrum will give operators the certainty that is required for investment in network expansion. While it is true that static efficiency in the form of a non-market intervention resulting in greater price competition on products of the existing technology might result from any outcome that boosts the fortunes of a smaller operator, this could harm long-run infrastructure based competition (dynamic efficiency).

Could ICASA simply drop the contentious 700 MHz and 800n MHz bands from the spectrum and proceed with the rest of it?

6 Conclusion

We now return to the two questions with which this paper started.

1. To which extent have innovative roaming and network sharing arrangements changed the de facto industry structure?

It is clear that through network sharing and roaming as well as by using fortuitous early spectrum awards to smaller players, mobile operators in SA have been able to successfully negotiate a monumental spectrum allocation drought. One of the roaming and sharing agreements has gone so far as to reduce the number of real mobile network operators from 4 to 3 and there is little relation between the distribution of spectrum ownership and the industry structure.

2. How can South Africa’s spectrum management best be improved to increase industry output and dynamic efficiency?

We are in general agreement with a study by the Free Market Foundation that argues in favour of tradable spectrum rights. However, this requires legislative changes and is unlikely to happen in the medium term. The WOAN is an unnecessary distraction and there is an urgent need to free up low frequency (digital dividend) spectrum. At the moment, any auction would be preferable to none or to a protracted legal dispute that might stretch out the spectrum allocation drought to a full 15 years.

Although it is undeniably true that access to low frequencies is the possibly the only way that Telkom will be able to expand its physical network, a strong notion that the market structure can be manipulated directly by looking at spectrum ownership has to be disabused by looking at the current spectrum ownership where the two dominant operators own barely one quarter of the allocated spectrum.

ICASA's failure in avoiding "to repeat exactly the same mistakes as it has done after these had been spelt out in very clear terms a mere five years ago" (in the words of Judge Baqwa²) will not change this. However we have observed that ICASA's good intentions and competence have been undermined by factors beyond their control. This was pointed out more than ten years ago by Moyo and Hlongwane (2009) and continues to this day. We shall be exploring the mechanism of this disfunctionality in follow-up work.

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²Telkom SA Soc Limited and Another v Independent Communications Authority of South Africa and Others (66778/2020) [2021] ZAGPPHC 120 (8 March 2021)

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