Regulation of retail mobile prices in Papua New Guinea

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1 Summary

This report comments on economic issues raised in NICTA's recent Discussion Paper proposing a Retail Service Determination (RSD) that will restrict Digicel's ability to set different prices for on-net and off-net calls and SMS in PNG (such pricing is referred to as "on-net pricing" in this report).

In PNG there are significant differences between Digicel and its competitors in terms of mobile network coverage and services offered. The key question is whether the proposed RSD will be the determinative factor that changes the state of competition in the PNG mobile market. In my view this is unlikely, for reasons outlined below.

The Discussion Paper justifies the proposed RSD largely on theoretical grounds, referring to the economic literature. Overall, this literature offers mixed results about whether on-net pricing is beneficial, neutral, or harmful for competition and consumers. It is difficult to draw conclusions from the literature that can directly support retail price regulation to restrict on-net pricing.

While the theoretical literature is a guide to the possible effects of on-net pricing, in my view the proposed RSD must be carefully analysed in the local market context in PNG, taking account of other factors aside from pricing that may affect the intensity of competition among mobile networks and other market outcomes.

The Discussion Paper focusses on certain theoretical results showing that on-net pricing can be harmful, while dismissing other results showing that on-net pricing can be beneficial or neutral, on the basis of the assumptions used to generate the results. All economic models use assumptions and selecting results on the basis of assumptions alone is generally not helpful. Instead it is important to consider the overall contribution of each research paper to our understanding of the economics of on-net pricing.

The Discussion Paper takes particular issue with the assumption of two-part pricing, which is used in much of the theoretical literature. I argue that the assumption of two-part pricing does not make results irrelevant for markets such as PNG where the majority of consumers use prepaid services. Instead, there are features of prepaid services that are similar to fixed fees in two-part pricing, and, in my view, results derived under a two-part pricing assumption still have some relevance for predominantly prepaid markets.

Given the mixed results from the theoretical literature on on-net pricing, it is important to consider empirical evidence. Unfortunately, the empirical literature is much more limited, but what is available does not support the case for retail price regulation. One study that directly addresses the issue estimates that a ban on on-net pricing implemented in Chile in 2012 was harmful for consumers. Other empirical results question the real-world importance of "tariff-mediated network effects" (i.e. network effects induced by on-net pricing) in consumers' choice of mobile network, which calls into question the justification for regulating on-net pricing.

The Discussion Paper fails to properly recognise the trade-off created by regulating on-net pricing. While in some cases reducing tariff-mediated network effects can promote competition, there is a risk that higher on-net prices will make consumers worse off. Data provided by Digicel shows that recent "unlimited" bundles it has offered to prepaid customers have stimulated a large increase in

on-net calling, with corresponding gains in consumer welfare. In practice, the proposed RSD may result in changes to on-net bundles and promotions, rather than an increase in the standard on-net price per minute. In any case, the proposed RSD risks the gains from "unlimited" prepaid bundles and other innovative pricing for the sake of uncertain and unquantified competition benefits.

The proposed RSD effectively replaces an earlier RSD from 2012 that also constrained Digicel's ability to engage in on-net pricing (up to a 40% differential between on-net and off-net prepaid prices was permitted while postpaid prices were not regulated). Using network activity data from Digicel I find that the earlier RSD appears to have had no impact on market outcomes such as market shares and the proportion of calls made by Digicel's customers that are on-net.

In particular, the proportion of on-net calls made by Digicel's postpaid customers has been consistently lower than the proportion of on-net calls made by Digicel's prepaid customers, despite the fact that the 2012 RSD applied only to prepaid pricing. This suggests that customer characteristics are more important than retail price regulation in determining the propensity to make on-net calls and another RSD will again have little or no impact on the calling patterns of Digicel's customers.

Similarly, while expiry of the 2012 RSD and subsequent pricing changes including the introduction of "unlimited" prepaid bundles have led to a large increase in on-net calling by Digicel customers, market shares have not yet changed, and inter-network traffic volumes are constant.

All of this evidence suggests that other factors such as coverage, network quality and reliability, and customer service, have been much more important than the 2012 RSD in determining consumers' choice of mobile network in PNG. Digicel has built around four times as many cellsites in PNG as either bmobile or Telikom and this coverage advantage likely explains much of Digicel's market share advantage. It also explains why Digicel has a higher proportion of on-net calls than its market share, as in many areas outside the main urban centres in PNG, Digicel is the only available network.

The Discussion Paper does not demonstrate how the proposed RSD will offset the difference in coverage and service quality caused by Digicel's greater investment in its mobile network compared to the other two networks. This raises doubts about whether the proposed RSD will be beneficial for competition and consumers in PNG. Based on the historic effects of the 2012 RSD, and changes in market outcomes after its expiry, the proposed RSD runs the risk of reducing consumer welfare while having little or no impact on competition.

The Discussion Paper also includes a high-level analysis of the benefits and detriments of the proposed RSD. In my view, the Discussion Paper does not contain sufficient analysis for NICTA to be satisfied that the proposed RSD meets the criteria in section 158 of the Act. Very little has been done to tie this analysis to the commercial realities of the mobile market in PNG. Among other issues, the benefits and detriments analysis:

- misunderstands the general impacts of price discrimination on consumers and profits;

- lacks any quantification of benefits versus detriments;

- does not recognise that the proposed RSD creates risks for Digicel that will reduce its incentive to offer innovative pricing such as "unlimited" bundles; and

- does not recognise potential detriments to Digicel's customers of the proposed RSD arising from changes to bundles and promotions in order to increase the effective on-net price per minute to satisfy the conditions of the proposed RSD.

If it is implemented, I also argue that two years is a more suitable duration for the proposed RSD, given the uncertainties around its effects.

2 Background and scope

Digicel PNG has asked me to comment on economic aspects of a Retail Service Determination (RSD) that NICTA has recently proposed in a Discussion Paper. This report reflects my own independent views and Digicel may have different views.

Many mobile network operators around the world choose to price calls and SMS that terminate on their own network lower than calls and SMS that terminate on other networks, for a variety of reasons. In this report I refer to this practice as "on-net pricing". It is also known as "on-net/off-net price discrimination", and "on-net discounting".

The proposed RSD will restrict Digicel's ability implement on-net pricing in PNG. The key features of the proposed RSD are that it:

- requires Digicel to earn equal or greater average revenue per unit of on-net calls and SMS as it earns from off-net calls and SMS;
- requires Digicel to earn average revenue per unit of all calls and SMS that is equal to or greater than the relevant interconnection charge per unit;
- applies to both prepaid and postpaid calls and SMS, with average revenues for each service calculated separately; and
- it applies only to Digicel.

The proposed RSD effectively replaces a 2012 RSD that expired in October 2017. The 2012 RSD allowed Digicel to have up to a 40% differential between on- and off-net prices. The 2012 RSD also only applied to prepaid calling, however given that over 95% of mobile customers in PNG use prepaid services, the 2012 RSD effectively applied to the entire market.

In this report I focus on three things:

- what the economic literature tells us about the theoretical and empirical effects of on-net pricing on competition and consumers in communications markets, and the effects of prohibiting such pricing via regulation;
- what actual outcomes in the PNG mobile market reveal about the effects of the 2012 RSD and the likely implications for the proposed new RSD;
- commentary on the analysis in the Discussion Paper of the benefits and detriments of the proposed RSD.

3 Theoretical and empirical effects of on-net pricing

In section 4 of the Discussion Paper, NICTA explains its concerns about the competitive effects of on-net pricing with reference to some of the economic literature on this topic. Below I summarise this literature and comment on NICTA's interpretation of it.

3.1 Key points

- When assessing the effects of regulating the prices of mobile networks on consumers, we must consider likely changes in both the size of the network and all retail prices.

- On-net pricing has complex effects on consumer welfare and the strategic behavior of mobile networks, and some of these effects work in opposite directions.

- The theoretical economic literature does not reach a definitive conclusion about whether on-net pricing is beneficial, neutral, or harmful for consumers and competition among mobile networks.

- All theoretical economic models of on-net pricing make many assumptions and it is not helpful to dismiss any model on the basis of its assumptions alone. Each model must be assessed in terms of its overall contribution to our understanding of how on-net pricing affects consumers and competition.

- There is only very limited empirical evidence about the effects of on-net pricing or the effects of regulation to prevent such pricing. What evidence is available does not support the case for regulation.

3.2 The basic economics of on-net pricing

NICTA's analysis is based on the premise that "The economic welfare of mobile phone users is maximised by enabling them to call and receive calls from as many other mobile phone users as possible" (paragraph 4.1.1 of the Discussion Paper).

It is true that an increase in the number of users that can be contacted on a network will increase the welfare of the users of that network, everything else equal. However, the simple size of the network is not the only factor that matters for the welfare of consumers that use it. It is easy to see that welfare of consumers who belong to a smaller network could be greater than from a larger network if the price of using the small network is sufficiently lower than the price of using the large network.

When considering the effects of regulating networks, including restricting on-net pricing, we must therefore consider how regulation will change prices as well as network size. This is a fundamental trade-off at the heart of much of the economic literature on network competition and regulation.

If we assume that consumers make calls in a random fashion, then one effect of on-net pricing is that consumers prefer to belong to a larger network, everything else equal, as they will be able to make more calls at the cheaper on-net price. Even if networks are interconnected, on-net pricing

creates a type of network effect known in the literature as a "tariff-mediated" network effect. In reality, consumers do not make calls randomly, so the interaction between on-net pricing and network effects is more complicated (this is discussed further below). But under the simple random calling assumption, on-net pricing generates network effects.

The Discussion paper asserts that network effects created by on-net pricing (known as "tariff-mediated" network effects) "effectively reintroduces the type of direct network externality that would exist if the networks were not interconnected" (paragraph 4.1.6). In my view, this is not a correct interpretation of the impact of on-net pricing in real-world markets, and it will lead to distorted conclusions about the effects of such pricing on competition and consumers.

In particular, the pricing to create tariff-mediated network effects generally involves a lower price for on-net calling than if prices for on-net and off-net calling were equal, and lower on-net pricing benefits consumers. Regulation to eliminate tariff-mediated network effects by restricting on-net pricing involves an effective price increase for on-net calls, creating an offsetting detriment for consumers. In practice, rather than an explicit increase in the on-net price, this may take the form of changes in bundles, discounts, and promotions that increase the effective price of on-net calls. Thus, we cannot simply say that consumers will be better off if tariff-mediated network effects are eliminated, and the trade-off between pricing and network effects must be considered.

In other words, tariff-mediated network effects created by on-net pricing and the network effects that would be created by a complete lack of interconnection between networks are not equivalent and need to be analysed using a different framework. While interconnection is generally regarded as being beneficial for competition and consumers, the same is not true for eliminating on-net pricing due to the trade-offs discussed above.

The general point is that on-net pricing has complex effects on consumer welfare and firms' strategic behaviour (discussed in more detail below), and some of these effects work in opposite directions. Accordingly, a considerable body of economic literature has developed around this issue. Each paper in the on-net pricing literature makes some different assumptions and looks at the issue in different ways. In my view, no single paper provides a definitive answer about the effects of on-net pricing or the effects of controlling such pricing via regulation, and the literature must be assessed as a whole. This is because theoretical economic models of competition among communications networks are complicated and no single model is able to make realistic assumptions about all aspects of demand and competition. Instead, each model contributes to our understanding of on-net pricing by examining it in different ways, each with strengths and weaknesses.

3.3 The theoretical evidence on the effects of on-net pricing is mixed

Some of the literature on on-net pricing concludes it is neutral or beneficial for competition and/or consumers, and other research has shown that it is harmful. The key contributions to this literature are as follows:

- Armstrong and Wright (2009) show that on-net pricing creates network effects and this increases intensity of competition between symmetric networks, reducing profits and increasing consumer welfare, everything else equal.

- Hoernig (2007) shows that on-net and off-net prices depend on firms' market shares, and larger networks will tend to set higher off-net prices. In some cases, this arises from anti-competitive behaviour of the larger network, but in other cases it is simply the profit-maximising pricing behaviour that arises if firms take account of the value that consumers get from receiving calls. Hoernig notes that "the distinction between the predatory and [non-predatory] scenarios is not easy in practice. The difference between the two is quantitative rather than qualitative, and regulators or competition authorities very likely do not possess the necessary information to make an informed judgement."

- Hoernig (2009) examines the welfare trade-offs of regulating on-net pricing and concludes that there are trade-offs between efficiency, networks' profits, and consumer surplus. Hoernig shows that the total welfare effects of regulating on-net and off-net pricing differentials are ambiguous and depend on demand characteristics. The Discussion Paper discounts Hoernig (2009) on the basis that it assumes two-part pricing (i.e. fixed and per-unit charges). I discuss the role of assumptions and the two-part pricing assumption in particular below.

- Hoernig (2014) provides a sophisticated model of network competition with many realistic features such as elastic subscriber demand, on-net pricing, calling externalities (i.e. consumers value receiving calls), and asymmetric costs and market shares between networks. Hoernig shows that on-net pricing arises as a profit-maximising behaviour in some circumstances, and it is not always anti-competitive and not always harmful to consumers. Again, the Discussion Paper discounts this paper on the basis that it assumes two-part pricing, but, in my view, it is an important contribution because it relaxes many of the other restrictive assumptions used in other research.

- Hoernig, Inderst, and Valletti (2011) allow for the realistic assumption that consumers tend to make calls to small groups of contacts, rather than randomly to all subscribers of a network as assumed in many other research papers. The authors show that the effects on consumer welfare of a ban on on-net pricing are ambiguous and depend on demand-related characteristics. This paper also assumes two-part pricing, but it makes a very useful contribution by relaxing the restrictive random calling pattern assumption.

- Jeon, Laffont, and Tirole (2004) consider the implications for network competition if consumers are assumed to value receiving calls and if call receivers can affect the duration of calls. They conclude that on-net pricing is a "mixed blessing" because it leads to on-net prices that internalise the value obtained by call recipients, but it also leads to higher off-net prices that limit, or in some cases eliminate, cross-network calling.

- Lopez and Rey (2016) consider competition between an incumbent network and an entrant and consider whether the incumbent can profitably foreclose the market by setting a high access charge. They show that such foreclosure is only profitable with on-net pricing, but even with on-net pricing foreclosure is not always profitable. In addition, in their model, foreclosure is only profitable when it completely deters entry. This means that if we observe that on-net pricing has not deterred entry in a real-world market, it is unlikely that any on-net pricing in that market was used with anti-competitive intentions.

- Muck (2016) shows that for on-net pricing to be effective, consumers have to be well informed about firms' market shares. In contrast, all other literature assumes that consumers have perfect knowledge of market shares. Muck shows that if consumers' information about market shares is not perfect, on-net pricing can be either beneficial or harmful to small networks.

- Rojas (2015) looks directly at the welfare effects of a ban on on-net pricing. He shows that a ban increases the price of on-net calls and reduces the price of off-net calls, so the overall welfare effects are ambiguous. Using a calibrated model, Rojas estimates that the ban on on-net pricing adopted in Chile in 2012 reduced consumer welfare.

- Sauer (2011) shows that consumers benefit from on-net pricing as the induced network effects make firms compete more intensely. The model assumes two-part tariffs but allows the market size to be variable (i.e. elastic subscriber demand), which relaxes a restrictive assumption used in other papers. The pro-competitive effects of on-net pricing are shown to be stronger when the market size is not fixed.

- Zucchini, Claussen, and Trüg (2013) show that on-net pricing can be used both by large networks to harm smaller rivals, or by small networks as a pro-competitive response and as a strategy for gaining market share. They show that in Germany between 2001 and 2009, larger networks were more likely than small networks to offer on-net pricing, suggesting that tariff-mediated network effects were the main cause of on-net pricing.

The theoretical literature summarised above demonstrates that on-net pricing can be beneficial, harmful, or neutral for competition and consumers in different circumstances and under different assumptions. In my view, the only robust conclusion from this body of literature is that it is not possible to justify regulation of retail prices out of theoretical concerns about the effects of on-net pricing, and careful empirical analysis is needed.

Unfortunately, most of the published research on on-net pricing is theoretical and there has been very little empirical work on the impacts of such pricing or regulation of retail prices in real-world markets. I discuss the few empirical studies that exist below, but regulators are in the difficult position of having to assess on-net pricing on largely theoretical grounds. This suggests applying a cautious approach in practice, to avoid unintended consequences and risks of regulation.

3.4 The role of assumptions in the theoretical literature

Before turning to the empirical literature, it is useful to briefly discuss the role of assumptions in the theoretical literature. The Discussion Paper discounts the results of Hoernig (2008, 2014), Sauer (2011), and Hoernig, Inderst, and Valletti (2014) on the basis of the assumptions used. As described above, all of these papers showed that on-net pricing can increase consumer welfare in some circumstances.

Theoretical models of competition among telecommunications networks are analytically complicated owing to the complexity of the services provided and the interactions between networks created by interconnection. Every paper in the literature makes many simplifying assumptions that do not apply in real-world markets, to get tractable results. Earlier contributions

to the literature (e.g. Jeon, Laffont, and Tirole, 2004, and Armstrong and Wright, 2009) made relatively restrictive assumptions to focus on the core economic issues, and subsequent research has explored what happens if some of those assumptions are relaxed. However, no published research has yet been able to relax all of the restrictive assumptions simultaneously, due to the mathematical difficulties in obtaining results in such a complicated model.

Instead of relaxing all assumptions at once, it has been necessary to make some assumptions more restrictive when others are made less restrictive, to keep the models from becoming too complicated. Thus, as described above, papers such as Hoerning (2008, 2014), Sauer (2011), and Hoerning, Inderst, and Valletti (2014) relax restrictive assumptions used in other research such as symmetry among networks, elastic demand for joining networks, random (uniform) calling patterns, and that consumers do not value receiving calls. To simplify the models and get useful results under those more realistic assumptions, these authors assume that networks compete by setting two-part retail prices, which reduces the complexity of the models for various technical reasons. Other simplifying assumptions regarding firms' cost functions and the characteristics of demand are also used.

The Discussion Paper dismisses these models on the basis that two-part pricing is an unrealistic assumption for the PNG market, where 95% of customers use prepaid services, and that the models use other restrictive assumptions such as balanced calling patterns, and symmetry of network cost structures. In response, I note the following:

- As described above, these papers make important contributions to the economics of on-net pricing by relaxing restrictive assumptions made in earlier literature. Models with linear pricing (i.e. call pricing per unit only with no fixed fees) are analytically complicated for technical reasons, so an assumption of two-part pricing is used to simplify the models and allow results to be obtained if other restrictive assumptions in the models are relaxed.

- Two-part pricing is arguably a reasonable assumption in a market where the majority of customers are pre-paid. While pre-paid customers only pay an explicit price for calling, they face other costs of belonging to a network that are similar to the fixed fees assumed in two-part pricing models. For example, customers must obtain a handset and SIM card, and the prices of these could be thought of as fixed fees in a static model. Alternatively, pre-paid customers must periodically "top up" their credit, and there is a cost associated with the time and effort required to do so. To the extent that networks can influence that time and effort, such as by making the top-up process easier or by having sales outlets in more locations, it can be thought of as equivalent to a recurring fixed fee. Thus, in my view, models that assume two-part pricing are still relevant for markets in which the majority of customers use pre-paid service.

- The other assumptions for which the Discussion Paper criticises Sauer (2011) and Hoernig, Inderst, and Valletti (2014), such as symmetry of networks' cost structures and that there are only two competing firms, are also used by many papers that reach the opposite conclusion that on-net pricing can be harmful. For example, Jeon, Laffont, and Tirole (2004) assume (among other things) that there are only two firms with symmetric costs, use a highly simplified cost function, and focus on symmetric outcomes where the two firms behave in the same way.

Similarly, Lopez and Rey (2016) assume (among other things) two-part pricing, and that the incumbent and entrant have symmetric costs.

In my view, the review of the economic literature in the Discussion Paper gives the impression of favouring results that show on-net pricing can be harmful to competition or consumers while minimising the relevance of alternative results that do not support regulation of on-net pricing. The Discussion Paper appears to overlook the reasonableness of assumptions used to generate theoretical results about possible harms of on-net pricing, while also discounting results that show on-net pricing may be neutral or beneficial on the basis of assumptions. This is despite the fact that many of the results on both sides of the argument rely on similar assumptions.

Instead, in my view, the only reasonable interpretation of the theoretical literature is that it gives mixed conclusions about the effects of on-net pricing. In practice this means the effects of on-net pricing, or of a ban on such pricing, will be heavily determined by market-specific factors and empirical analysis is needed.

3.5 Empirical studies of on-net pricing

There is a limited amount of empirical economic literature that has tested the role of network effects created by on-net pricing and/or the effects of restricting such pricing via regulation. Empirical analysis is difficult because market outcomes are affected by many other factors. For example, there are many reasons that could cause firms' market shares to be different, such as differences in network coverage and quality, brand loyalty, and consumer perceptions. Empirical analysis in general, and any specific analysis of on-net pricing in PNG, needs to separate the effects of on-net pricing from such other factors.

Despite these difficulties, the following empirical studies are useful for understanding the effects of on-net pricing:

- Birke and Swann (2006) investigate the role of network effects in consumers' choice of mobile phone network and calling patterns. They show that even if on- and off-net prices are identical, the existence of "pure" network effects unrelated to pricing means that consumers will make a disproportionate amount of on-net calls. Thus, an observation that the majority of calls are on-net cannot be attributed entirely to the effects of on-net pricing. Birke and Swann also show that individuals' choice of network is heavily influenced by the choices of other people in the same household.

- Confraria, Ribeiro, and Vasconcelos (2017) use discrete choice experiments to decompose consumer preferences for mobile networks into calling club effects, "pure" network effects, and the effects of commitment periods, monthly fees, and on-/off-net prices. They found that "pure" network effects unrelated to pricing have statistically significant effects on network choices, reflecting the findings of Birke and Swann (2006). Confraria, Ribeiro, and Vasconcelos also found that network choice was more sensitive to on-net prices than off-net prices, which they hypothesised could be due to tariff-mediated network externalities, or due to network size acting as a signal for network quality if consumers cannot observe quality directly.

- Haucap and Heimeshoff (2011) empirically analysed how consumer behaviour is affected by on-net pricing. They found evidence of a "price differentiation bias", i.e. that people tend to over-estimate how much they will save from reduced on-net prices, due to inaccurately estimating how many on-net and off-net calls they will make. Haucap and Heimeshoff conclude that on-net pricing does not automatically raise competition concerns, as smaller networks may find it beneficial to introduce such charges to take advantage of such biases in consumer behaviour, and they advocated against an outright prohibition on such pricing.

- Karaçuka, Çatik, and Haucap (2012) used survey data from Turkey to analyse the factors that affect consumers' choice of mobile network. They found such choices are significantly affected by the choices of other consumers with whom the consumer is more likely to interact. Such "local" network effects were shown to be more important than the overall size of the network.

- As described above, Rojas (2015) empirically estimated that a ban on on-net pricing in Chile in 2012 reduced consumer welfare, while Zucchini, Claussen, and Trüg (2013) found that in Germany between 2001 and 2009 on-net pricing was more likely to be used by large networks.

The main lessons from this limited empirical literature are that real-world outcomes in telecommunications markets and the impacts of on-net pricing are not clear-cut. Market outcomes such as market shares and calling patterns can be affected by other factors such as a preference for belonging to the same network as family members (regardless of pricing), or cognitive biases that lead to "pure" network effects and a disproportionate amount of on-net calling.

It is also worth noting that the empirical results generally do not favour restricting on-net pricing via regulation. The one empirical study that has looked at this question directly (Rojas, 2015) estimated that banning on-net pricing in Chile in 2012 reduced consumer welfare. Other empirical studies call into question the importance of tariff-mediated network effects as a factor influencing consumers' choice of mobile network. I am not aware of any empirical studies that have quantified any harms from on-net pricing or that have empirically demonstrated that regulating on-net pricing has been beneficial.

3.6 Conclusions from the literature

The results from the theoretical and empirical literature on the effects of on-net pricing are mixed. Whether on-net pricing is beneficial, harmful, or neutral for consumers and competition appears to depend on market specific factors. It is very difficult to draw conclusions from the literature that can directly support regulatory intervention to restrict on-net pricing in any single market. While the literature is a guide to the possible effects of on-net pricing, in my view the proposed RSD must be carefully analysed in the local market context in PNG, taking particular account of other factors that may affect the intensity of competition among mobile networks.

4 Mobile market outcomes in PNG and lessons from the 2012 RSD

The RSD proposed in the Discussion Paper will significantly restrict Digicel's ability to differentiate between on-net and off-net prices for all calls and SMS. The Discussion Paper argues that this restriction will promote competition in the retail mobile services market in PNG. To evaluate whether that is likely, it is useful to look at the effects of the 2012 RSD, which also constrained Digicel's ability to differentiate on-net and off-net prices for almost all customers (i.e. all prepaid customers).

In particular, patterns and trends in the PNG mobile market while the 2012 RSD was in effect, and following the expiry of that RSD in October 2017, give some insight as to whether a new RSD is likely to have a significant impact on competition.

4.1 Key points

- The available evidence suggests that the 2012 RSD was completely ineffective at changing key market outcomes such as market shares and the proportion of calls made by Digicel's customers that are on-net.

- It is much more likely that the difference between Digicel and its competitors in terms of market share is due to Digicel's superior coverage and quality of service, than due to on-net pricing.

- Significant pricing changes after the expiry of the 2012 RSD appear to have not yet had an impact on market shares, while the introduction of "unlimited" on-net calling has stimulated a large increase in calling volumes by Digicel customers and generated significant gains in consumer welfare.

- After the expiry of the 2012 RSD, the volume of traffic between Digicel and other networks, and the estimated number of customers on other networks in PNG have remained stable.

- The available evidence suggests that the proposed RSD will be similarly ineffective as the 2012 RSD at changing market outcomes, while putting at risk the consumer welfare gains from "unlimited" on-net pricing.

4.2 Possible drivers of mobile market outcomes in PNG

As demonstrated in the literature summarised above, retail pricing is only one of many factors that can affect consumers' choice of mobile network. Other significant factors include availability of coverage, service quality and network reliability, customer support, availability and ease of "topping up" credit (for prepaid customers), brand loyalty, and which network a consumer's frequent contacts belong to.

This leads to two possible hypotheses about the drivers of outcomes in the PNG mobile market and the likely effects of the proposed RSD:

1. On-net pricing by Digicel is a critical factor inhibiting competition in the PNG mobile market. If this hypothesis is true, we should have seen some substantial changes in the competitive positions of Digicel and its rivals while the 2012 RSD was in effect. Similarly, upon expiry of that RSD in October 2017, we should also have seen further substantial changes in competitive positions in the opposite direction.

2. Alternatively, on-net pricing by Digicel is not a critical factor and competition is instead mainly driven by differences between Digicel and other networks in terms of coverage, quality, reliability, and the other factors listed above. If this hypothesis is true, then we should not see substantial changes in competitive positions under the 2012 RSD or upon its expiry.

To test these hypotheses, I have analysed detailed confidential data provided by Digicel about the daily activity on its network over the past two years, and information about its coverage and network investment. While network activity varies from day to day due to a variety of factors, it also shows trends over time and the daily data allows careful analysis of what has happened in the market in the three months following the expiry of the 2012 RSD.

When interpreting this data in the period following the expiry of the 2012 RSD, it is important to note the following changes in Digicel's retail pricing:

- 29 September 2017: The prepaid off-net calling price was reduced to 60T/min, equal to the on-net price.

- 9 October 2017: Digicel introduced "unlimited" bundles ("1Tok+" plans), offering unlimited on-net calling bundled with SMS and data allowances.

- 27 October 2017: The prepaid off-net price was increased to 100T/min (the standard on-net price remained at 60T/min).

- 26 November 2017: The prepaid on-net peak time (6AM to 10PM) calling price was increased to 80T/min (the off-peak price remained at 60T/min).

4.3 Analysis of market outcomes

The following graphs are based on confidential daily data provided by Digicel covering the past two years.

Digicel's estimated market share

Figure 1 shows that Digicel's estimate of its market share was stable for much of 2015 at around [REDACTED]%, then its share began to decline gradually during 2016 before stabilising again in early 2017. After the expiry of the 2012 RSD in October 2017, Digicel's estimated market share has remained more or less constant at just under [REDACTED]%, despite the significant pricing changes noted above.

This suggests that Digicel's retail pricing and the 2012 RSD had little, if any, impact on market shares. If hypothesis (1) above is correct and the 2012 RSD had been the decisive factor in stimulating competition, then I would have expected Digicel's market share to be lower than [REDACTED]%

three years after the implementation of that RSD. I would also have expected the expiry of the 2012 RSD in October 2017 and the subsequent pricing changes listed above to have caused a noticeable increase in Digicel's market share if on-net pricing was a crucial factor in consumers' choice of network and if tariff-mediated network effects are strong.

Instead, the trends observed in Figure 1 seem much more likely to be consistent with hypothesis (2) above, i.e. that that market shares of mobile networks in PNG are driven by coverage, quality, reliability, etc, rather than on-net pricing.

Figure 1 Digicel's estimated share in the PNG mobile market, on a daily basis.
[REDACTED]

Source: Digicel

On-net calling

Figure 2 shows the daily proportion of call minutes originated by Digicel's customers that terminate on-net. Over the past two years, for prepaid customers this proportion has been very stable at around [REDACTED]%, with some brief fluctuations that are likely due to short-term promotions or other one-off events. For postpaid customers, the proportion of on-net calls has been more variable on a daily basis but has also generally been stable [REDACTED].

After October 2017, the on-net ratio for prepaid customers has increased slightly to around [REDACTED] while the ratio for postpaid customers has remained stable [REDACTED]. As will be shown below, the increase in the on-net ratio for prepaid customers is because the unlimited "1Tok+" bundles that Digicel introduced in early October 2017 stimulated a significant increase in the volume of on-net calling, while the volume of off-net calling remained largely unchanged.

Two conclusions can be drawn from this analysis of the proportion of on-net calls:

- The stability of the proportion of calls made by prepaid customers that terminate on-net over this two-year period is much more likely to be consistent with hypothesis (2) than (1). It is clear that the 2012 RSD did not substantially change the calling behaviour of Digicel's prepaid customers such that they made a greater proportion of off-net calls.

- The 2012 RSD did not include postpaid pricing, and yet the proportion of on-net calls made by postpaid customers has consistently been *lower* than the proportion for prepaid customers. This likely reflects differences in the characteristics of prepaid and postpaid customers, i.e. that postpaid customers are more likely to be business customers or other heavy users that have broader calling patterns than prepaid customers. This illustrates that other factors aside from the 2012 RSD are more significant in determining customers' calling patterns. If the 2012 RSD was effective in changing calling patterns we should have seen a lower proportion of on-net calls for prepaid customers than postpaid customers, when in fact the reverse is true.

Figure 2 Proportion of call minutes originated by Digicel customers that terminate on-net.

[REDACTED]

Source: Analysis of Digicel data

To examine the slight increase in the on-net ratio after October 2017, Figure 3 shows the daily on-net total call minutes originated by Digicel's prepaid customers. The daily volume is volatile (e.g. weekend and weekday calling volumes are quite different), but the overall pattern is generally stable until the introduction of the unlimited "1Tok+" plans in early October 2017.

Figure 3 Daily volume of on-net call minutes originated by Digicel prepaid customers.

[REDACTED]

Source: Digicel

As can be seen, "1Tok+" stimulated approximately an [REDACTED]% increase in the daily number of on-net call minutes originated by Digicel prepaid customers. In the last seven days of September 2017, prior to the introduction of "1Tok+", Digicel prepaid customers made an average of [REDACTED]. In the last seven days of December 2017, this had increased to an average [REDACTED].

It is clear that "1Tok+" generated significant welfare benefits. For example, if we assume that on average these additional on-net calling minutes are valued by consumers at 30T/minute, i.e. half of the standard on-net price,[1] the additional [REDACTED] minutes per day of on-net calling stimulated by "1Tok+" are associated with welfare of around [REDACTED] million per day.[2]

In contrast, despite some short-term fluctuations, from January 2015 to September 2017 the volume of on-net calling originated by Digicel prepaid customers, and corresponding welfare, was much more stable.

The data shown in Figure 3 suggests that the 2012 RSD was not effective at changing the on-net calling behaviour of Digicel's prepaid customers. After the expiry of this RSD, "1Tok+" pricing has stimulated significant on-net calling activity and corresponding welfare gains. Under the proposed

[1] The additional call minutes stimulated by "1Tok+" must be valued at something less than the on-net price, otherwise these calls would already have been willingly made. Assuming an average value of 30T/minute is equivalent to assuming that the value of the additional call minutes is uniformly distributed between 0T/minute and 60T/minute.

[2] This assumes that Digicel faced no marginal cost to provide these additional minutes. If It needed to upgrade its network to handle the additional volumes, the costs of any upgrades would offset some of these welfare benefits.

RSD there is a risk that some of these welfare gains will be lost, if the "1Tok+" pricing cannot be sustained. In particular, Digicel may find itself needing to increase the effective on-net price per minute via introducing limits on usage or other changes to the "1Tok+" bundles. This is a direct example of the type of trade-off discussed earlier, where regulating on-net pricing to eliminate tariff-mediated network effects may also be detrimental to consumers via an increase in the effective on-net price per minute.

Inter-network communication

Figure 4 shows the daily number of call minutes originated by Digicel's prepaid customers that terminate on other mobile networks in PNG. This shows an apparent decrease in the volume of off-net calling after October 2017, however at least some of this decrease appears to be a continuation of a trend that started much earlier in 2017.

Figure 5 shows the daily volume of off-net calls from other mobile networks in PNG that terminated on Digicel's network. This shows a similar pattern to Figure 4, suggesting that the trends in the volume of voice traffic between mobile networks in PNG is largely driven by factors specific to Digicel's competitors, rather than Digicel itself. From Figure 5, it is also apparent that Digicel's pricing changes after October 2017 have not significantly affected the volume of calls originated on other mobile networks that terminate on Digicel's network. This suggests that, to date, those pricing changes have not had an impact on the competitive positions of Digicel and other networks.

Figure 4 Daily volume of off-net call minutes to other mobile networks originated by Digicel prepaid customers.

[REDACTED]

Figure 5 Daily volume of off-net calls from other mobile networks terminating on Digicel's network.

[REDACTED]

Source: Digicel

Activity on other mobile networks in PNG

[REDACTED]

- The number of customers on bmobile's network increased rapidly during 2016, more than doubling from around 95,000 at the end of 2015 to 195,000 at the end of 2016. This significant increase reflects the decline in Digicel's estimated market share shown in Figure 1 above, and it occurred about four years after the 2012 RSD was put in place. Thus, this trend is very unlikely to have been caused by the 2012 RSD. Instead, it most likely reflects improvements to bmobile's coverage and services, causing it to increase its customer base faster than Digicel did over the same period.

- The expiry of the 2012 RSD in October 2017 and pricing changes by Digicel around the same time do not appear to have affected the number of customers on the two other networks. The number of customers on bmobile's network stabilised at around 200,000 in mid-2017 and remained around that level after October 2017. The number of customers on Telikom's network slightly increased after October 2017, continuing a trend that started earlier in 2017.

In my view, this data shows that changes in market shares of mobile networks in PNG are primarily driven by differences in investment, network quality, coverage, and services, than by retail pricing. Certainly, these factors appear to be much more important than the 2012 RSD in driving market outcomes in recent years.

[REDACTED]

Non-price characteristics of mobile networks in PNG

As described above in hypothesis (2), in evaluating the proposed RSD we must consider whether differences in market shares and calling patterns are driven by non-price attributes of the services that consumers receive from the competing mobile networks in PNG, such as coverage and service quality. If so, the proposed RSD does not change these characteristics, and it will not be effective at changing market shares and calling patterns.

Figure 7 and Figure 8 show comparisons provided by Digicel of the distribution of its cellsites in PNG versus that of Telikom and bmobile. In total Digicel has built [REDACTED] cellsites in PNG, in comparison to Telikom's 387 and bmobile's 350. Importantly, Digicel's sites are widely distributed throughout the country including in non-urban and remote areas, while Telikom's and bmobile's are concentrated on more densely populated urban areas.

There are several important implications of this difference in coverage:

- The significant difference in coverage makes it not surprising that Digicel has substantially greater market share than Telikom and bmobile. For people living in many areas of PNG, Digicel

is the only option for mobile service.

- In areas of PNG where only Digicel has coverage, there will be a very high proportion of on-net calls, regardless of pricing. As shown in the literature reviewed above, people tend to make most calls to a small circle of family members and acquaintances. If these people live in the same area, they will also be Digicel subscribers.

[REDACTED]

Differences in network quality and reliability are also relevant. While I do not have comparable information for Telikom and bmobile, Figure 9 shows the evolution of Digicel's network technology in PNG since its launch in 2007. This shows that Digicel has rapidly expanded its services and coverage and introduced advanced new technology. To the extent that the other networks have not kept pace with these developments, their market shares will be lower, regardless of pricing.

[REDACTED]

4.4 Conclusions and implications

Taken as a whole, the analysis presented above suggests that:

- The 2012 RSD did not significantly change the competitive positions of Digicel and other mobile networks in PNG.

- Pricing changes after the expiry of the 2012 RSD have stimulated large volumes of additional on-net calling on Digicel's network, and generated corresponding welfare gains, but there has not been a corresponding shift in market shares, suggesting that factors such as coverage and network quality are much more important in consumers' choice of network than on-net pricing.

- Comparing the proportion of on-net calls made by prepaid customers with the same proportion for postpaid customers suggests that the 2012 RSD was not effective at changing calling patterns of Digicel customers.

- The competitive positions of other mobile networks aside from Digicel and the volumes of inter-network traffic appear to be mainly driven by factors specific to those other networks, than by Digicel's pricing.

- Observed calling patterns in the market are consistent with Digicel's market share and its superior coverage. Digicel estimates its current market share at around 92%, and the

proportions of on-net calls by prepaid and postpaid customers are around [REDACTED]% and [REDACTED]% respectively. Thus, the proportion of on-net calls made by Digicel customers is only slightly higher than can be explained by its market share. As noted in the literature review, consumers have a tendency to join the same network as their frequent contacts, independent of any price advantage for on-net calls. It is very likely that this tendency can explain the small difference between the actual proportion of on-net calls on Digicel's network and the proportion that can be explained by Digicel's market share.

Overall, in my view, there is no clear evidence that the 2012 RSD was effective at changing the nature of competition in the PNG mobile market. Furthermore, unlimited "1Tok+" pricing has generated significant welfare benefits that may be at risk under the proposed new RSD. This raises doubts about whether the proposed RSD will be beneficial for competition and consumers in PNG. Based on the historic effects of the 2012 RSD, and changes in market outcomes after its expiry, the proposed RSD runs the risk of reducing welfare while having little or no impact on competition.

5 Effects of the proposed RSD

5.1 Key points

- The assessment in the Discussion Paper of the effects of the proposed RSD is, in my view, not sufficiently detailed for NICTA to be satisfied that the proposed RSD meets the retail regulation criteria in section 158 of the Act.

- The assessment of the effects of the proposed RSD on Digicel's profitability and its wider benefits and detriments are almost entirely qualitative and based on broad-brush assumptions about how competition in the PNG mobile market works.

- The analysis includes a number of claims that are wrong on theoretical grounds or need to be quantified before NICTA can use them to assess whether the retail regulation criteria are satisfied.

- Given the uncertain effects of the proposed RSD, if it is implemented, a two-year period would be more appropriate than five years. This would give enough time for effects of the RSD to be observed, while limiting the exposure of consumers to potential detriments.

5.2 Assessment of effects

The Discussion Paper provides a high-level assessment of the effects on Digicel and the overall effects of the proposed RSD (paragraphs 5.2.2 to 5.2.12), as required by the retail regulation criteria in section 158 of the Act. Key requirements of this section of the Act are that NICTA be satisfied that the RSD will not prevent the targeted operator from "achieving a return on assets during that period sufficient to sustain investment necessary to supply the retail service" (section 158 (c)), and that "the aggregate likely benefits of making that retail service determination outweigh any aggregate likely detriments" (section 158 (d)).

The assessment of these factors in the Discussion Paper is almost entirely qualitative and contains no attempt to quantify the impacts of the proposed RSD on Digicel's profitability, or to quantify the benefits and detriments in the PNG mobile market more broadly. Despite this lack of substantive analysis, the Discussion Paper reaches the conclusions that "Digicel will not be prevented from achieving a return on its assets that is sufficient to sustain investment" (paragraph 5.2.9) and that "Overall the likely benefits of the draft determination will, in the view of NICTA staff, outweigh to a significant degree the possible detriments" (paragraph 5.2.12).

In my view, the Discussion Paper does not contain sufficient analysis for NICTA to be satisfied that the proposed RSD meets the criteria in section 158 of the Act. The analysis is based on high-level views about how the RSD will impact Digicel and how its competitors and consumers will respond. Very little has been done to tie these views to the commercial realities of the mobile market in PNG.

The analysis in this section of the Discussion Paper also makes several claims that are either wrong on theoretical grounds or need to be quantified before they can be included in an assessment of benefits and detriments to reach the conclusions quoted above.

In particular, I note the following:

- The Discussion Paper asserts that "Without the draft determination, Digicel's on-net/off-net price discrimination will result in a deadweight loss, preventing pricing from being efficient as an allocator of resources to their most valued uses" (paragraph 5.2.6). As a general point, it is not always the case that price discrimination reduces welfare. In many cases, price discrimination can increase welfare by reducing prices to some consumers in the market, increasing the quantity consumed, and increasing welfare. This is one of the effects at work with on-net pricing, i.e. lower prices for on-net calling increase the volume of such calls and that increased volume is valuable to consumers. As was demonstrated above in the case of Digicel's "1Tok+" pricing, such welfare gains can be considerable.

- It is also claimed that the proposed RSD will be the determinative factor between a less competitive and highly competitive mobile market in PNG (paragraphs 5.2.7 and 5.2.8). As has been demonstrated above, the 2012 RSD does not seem to have had a significant impact on the market, and outcomes are much more likely to have been driven by differences between Digicel and other networks in terms of their investment levels, coverage, and service quality. It is unclear how the proposed RSD will succeed where the previous RSD has failed. It is also not clear how the proposed RSD will overcome the significant disadvantages caused by bmobile and Telikom's lack of coverage.

- Digicel's returns are claimed to be unaffected by the proposed RSD because it "does not set or impose any price but instead only regulates the relationship between on-net and off-net prices" (paragraph 5.2.9 (a) and a similar claim is made at paragraph 5.2.10 (c)). This does not appear to be correct given that the proposed RSD prevents Digicel from implementing any pricing such that the effective on-net price per minute is less than the interconnection charge (paragraph 6 of the draft RSD). This is a direct constraint on the effective on-net price per minute irrespective of the relationship between the effective on-net and off-net prices.

- In addition, the Discussion paper claims that "preventing price discrimination does not in itself reduce profitability" (paragraph 5.2.9 (b)). In general, this is not correct. The essential feature of price discrimination is that it enables firms to charge relatively low prices to consumers with low willingness to pay while maintaining higher prices to other consumers with higher willingness to pay. Compared to uniform pricing, this increases profits as it allows firms to capture some value from consumers with low willingness to pay that would otherwise be priced out of the market, while maintaining the prices charged to other consumers with higher willingness to pay.

- Reductions in "switching costs" and "lock-in" are listed as separate benefits (paragraphs 5.2.10 (d) and (e)) when these refer to the same thing. No attempt is made to quantify these benefits relative to the potential detriments arising from, for example, changes to Digicel's effective on-net price via changes to bundles or promotions.

- A claimed benefit of the proposed RSD is "Potential for a Digicel review of its pricing structure to stimulate increased competition in the retail mobile services market ..." (paragraph 5.2.10 (f)). It is unclear why Digicel, as a rational profit-maximising business, would review its prices in

a way that cause it to face additional competition.

- The Discussion paper notes the risk that "Digicel may significantly increase its on-net prices to comply with the draft determination" (paragraph 5.2.11 (a)). As discussed above, such an increase may not take the form of a simple increase in the on-net price per minute, but it could take the form of changes to bundles or promotions to increase the effective on-net price per minute, to the detriment of consumers. The Discussion Paper dismisses such concerns as "it would risk investigation as a potential anti-competitive exercise of market power" (paragraph 5.2.11 (a)). It is unclear how such anti-competitive conduct could be attributed to changes to Digicel's bundles or promotions. For example, it seems highly unlikely that changes to the "1Tok+" bundles that increase the effective on-net price per minute could be classified as anticompetitive conduct. It is also inconsistent to claim that low on-net prices are anti-competitive while also claiming that increasing on-net prices would be anti-competitive.

- The Discussion paper notes that the proposed RSD "may limit innovation in and development of certain types of price packaging" but dismisses this as "doubtful given that the constraint is expressed in terms of effective average prices" (paragraph 5.2.11 (b)). In my view, it is likely that the proposed RSD will limit such innovation, by increasing the risk that Digicel faces from certain types of pricing. For example, under "unlimited" pricing such as "1Tok+", the volume of calls, and hence the effective average price per minute, is difficult to predict and control. This type of pricing exposes Digicel to the risk that the effective average price per minute for on-net calls will fall below either the effective average price per minute for off-net calls or the mobile termination rate. This risk will weaken Digicel's incentive to adopt new and innovative types of pricing where it cannot accurately predict and control usage levels the effective average on-net price per minute.

5.3 Duration of the proposed RSD

It is also surprising that NICTA proposes a duration of five years for the RSD. As noted above, the 2012 RSD applied for five years and there is no evidence that it was effective at changing outcomes in the mobile market in PNG during that time. Given that the effects of the proposed RSD are, at best, highly uncertain, in my view a shorter duration would be prudent. If the proposed RSD is effective at changing the competitive dynamics of the PNG mobile market, this should be clearly observable within two years. Similarly, a shorter duration would limit the exposure of consumers to the potential detriments of the RSD discussed above.

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7 Curriculum Vitae for Dr Aaron Schiff

Education

PhD in economics, The University of Auckland, 2005

MCom in economics (first class honours), The University of Auckland, 2000

BCom in economics, The University of Auckland, 1998

Work history

Principal, Schiff Consulting, October 2014 – Present

Data Counsel, Figure.NZ, July 2015 – Present

Economist, Covec, 2002-06 & 2008-14

Visiting Fellow, Centre for Air Transport Research, University of Otago, 2009-10

Lecturer, Department of Economics, University of Auckland, 2002–06 & 2008-09

Visiting Researcher, Institute of Economic Research, Hitotsubashi Univ., 2006-08

Examples of relevant experience

Competition economics: Economic advice for a merger clearance application in manufactured wood products markets. *NZ Commerce Commission, 2017-18*

Competition economics: Economic advice for a merger clearance application in optical products markets. *NZ Commerce Commission, 2017*

Telecommunications: Fixed and mobile termination rate benchmarking. *Competition Commission of Kiribati, 2017*

Competition economics: Expert report on market definition and dominance analysis in Samoa. *Digicel Pacific, 2017*

Telecommunications: Economic analysis of mobile number portability in Papua New Guinea. *Digicel PNG, 2017*

Empirical policy analysis: Investigating pass-through of regulated changes in wholesale costs to retail telecommunications prices. *Commerce Commission, 2016-17*

Telecommunications: Advice on spectrum pricing in Vanuatu. *Digicel Pacific, 2016*

Transport policy: Estimating the effects of "open skies" on Australian aviation markets. *Austrade, 2015-2016* (with the Fresh Information Company and CAPA Consulting)

Telecommunications analysis: Measuring the impacts of New Zealand's telecommunications sector. *Telecommunications Carriers Forum, 2015* (with Sapere Research Group)

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