

# Universal Service and Competition

## The Cook Islands and Australia

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This is the author's version of the work. The definitive version of the work as certified and accepted after peer review has been published in the Journal [volume 9, issue number 3, September 2021] and is available from the Society at <https://telsoc.org/>

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**Abstract:** The author is advising the Cook Islands on how to introduce mobile competition, drawing on the experience of Australia. In both countries the impact of infrastructure competition on mandated geographically uniform pricing is being (or proposed to be) addressed with a levy. The different approaches to measuring costs and setting the levy are contrasted.

The paper proposes that a universal service levy has to be coupled with consistent access pricing to have efficient competition consistent with universal service policy. Interconnection between networks is free but the pricing of resold wholesale services should be consistent with the aims of the levy; to ensure universal service and efficient competition.

**Keywords:** universal service, wholesale, ECPR, levy, access pricing

## Introduction

Under a monopoly it is possible to have geographically uniform pricing even though the cost to serve will vary geographically. With competition, a new entrant will first address the most profitable segments of the market. The incumbent operator cannot be expected to continue serving loss-making locations voluntarily if it faces competition in the locations (and for the customers) that have funded loss-making activities.

Currently, Vodafone Cook Islands (VCI) has a monopoly of the fixed and mobile markets. The government intends to licence a mobile competitor. The Cook Islands Regulatory Authority (CRA) is required to produce a universal access plan (UAP) that will support geographically uniform pricing and maintain the existing levels of service to the unprofitable locations in the presence of competition.

Cook Islands comprises 15 small islands, spread over 2.2 million square kilometres, between American Samoa and French Polynesia, south of Hawaii. The islands have small and declining populations. About 75% of the population of 17,500 is on Rarotonga and another 11% on

Aitutaki. The remaining islands are known as the Pa Enea. Only the two main islands plus Pukapuka and Nassau have more than 50 people per square kilometre. The two main islands would clearly be targeted by a new entrant.

The Cook Islands context has similarities to the introduction of a broadband levy in Australia where the last 7% of end customers can be served only by costly fixed wireless or satellite connections.

This paper looks at how both countries deal with this issue.

## The Bypass Issue

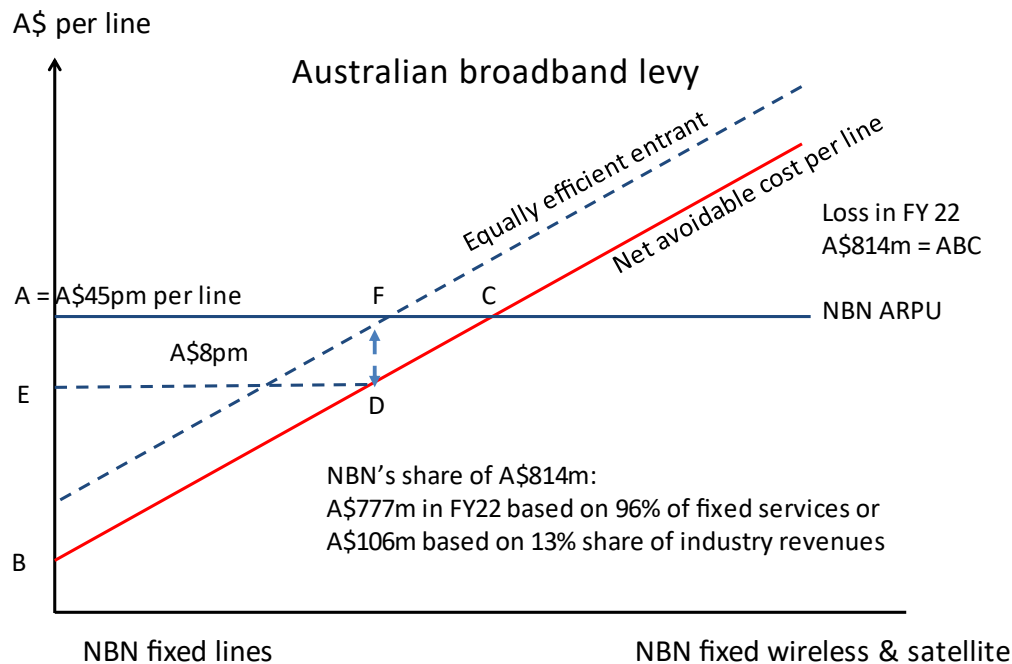
In Australia, the Government feared that the National Broadband Network's (NBN) internal cross-subsidy of its fixed wireless and satellite connections would be eroded by infrastructure competition in low-cost metro areas. It tasked the Bureau of Communications Research (BCR, now the Bureau of Communications, Arts and Regional Research, BCARR) with estimating this cross-subsidy and how it might be addressed in the presence of infrastructure competition.

Ideally, for economic efficiency prices should be cost-based to ensure efficient bypass decisions. However, the geographically uniform prices set by the NBN conceptually contain two elements: cost and a contribution to the deficit incurred in serving non-commercial customers.

There is an economically inefficient incentive to bypass the NBN when the new entrant's cost is less than the uniform NBN price. But, if a contribution from the new entrant is obtained through an 'excise tax' or levy, this can reconcile the objectives of universal access and the recovery of costs by the NBN in the presence of infrastructure competition (i.e., bypass of NBN's access network).

Laffont & Tirole ([2002](#), p. 119) say that in some countries "*such a tax is politically unlikely and is almost never mentioned in the regulatory debate, even though it could in principle be repackaged as a tax on the whole industry (as will be the case for the funding of universal service) in order not to make it look discriminatory*". This is the approach adopted in Australia and is recommended by the author for the Cook Islands.

The figure below is drawn from data in the BCR's report ([BCR, 2016](#)) to the Australian Government, which implemented the BCR's recommendations. The horizontal axis shows users ranked by cost to serve, which is correlated with geography.



**Figure 1. Australia's broadband levy, forecast for 2022**

In Figure 1, the levy is A\$8 per month per broadband line (the difference between F and D). Neither NBN Co.'s costs nor its prices need to change to accommodate the Bureau's proposed solution and end users between A and F can still be targeted profitably by the new entrant. Note also that, with a uniform levy, the proceeds (AEDF) are still smaller than the actual internal cross-subsidy (ABC).

The net avoidable cost for FY2022 (when the roll-out was expected to be complete) was forecast to be A\$814m. The BCR's A\$8 pm<sup>i</sup> levy is applied to every fixed broadband line capable of at least 25Mbps. Since the NBN was expected to account for 96% of such services, it would bear A\$777m of the forecast FY2022 cost, with the remaining A\$37m provided by other providers of fixed broadband infrastructure.

The BCR considered an alternative levy based on industry revenues, including from mobile services. This would have reduced the NBN's share to \$110m (13%) and the levy would have been about 2.5% of revenue for every operator.<sup>ii</sup>

## Cost Concepts

How should one measure the cross-subsidies that will be eroded with bypass? That depends on how the results are to be used. A classic example is the difference in opinion between the

Bureau of Transport and Communications Economics (BTCE, now the BCARR) and Telecom (now Telstra) in the costing of Telecom's Community Service Obligation (CSO). The BTCE ([BTCE, 1989](#), p. 6) acknowledged that:

*“Two possible purposes were apparent from the Ministerial Statements of 25 May 1988:*

- A. to determine the magnitude of the level of national resources being devoted to meeting its CSOs; and*
- B. to take account of the cost of CSOs adequately in setting Telecom's financial target in the corporate plan (and in measuring the achieved rate of return ex post)”.*

This led the BTCE to costing CSOs on both an avoidable cost and fully distributed cost basis to address A and B, respectively.

Two other possible public policy purposes concern whether the amount of CSOs is so large:

- C. that introducing competition would undermine internal cross-subsidies; and*
- D. that the enterprise should be kept in the public sector.*

The BCR (now the BCARR) was directed by the Australian Government ([DOC, 2014](#)) to focus on C above.<sup>iii</sup> This is also the focus for the Cook Islands. The notional question is: what losses would be avoided if VCI was not obliged to provide loss-making services in the Pa Enuua? It is a hypothetical question.

The BCR ([BCR, 2015](#), p. 28) struggled with the definition of avoidable costs. In its final consultation paper, it shied away from its *“proposed costing on a ‘commercially focused’ basis, with full distribution of common or indirect cost”* (also known as fully allocated cost, FAC). It settled on directly attributable costs including a share of common costs used in providing fixed wireless and satellite services.

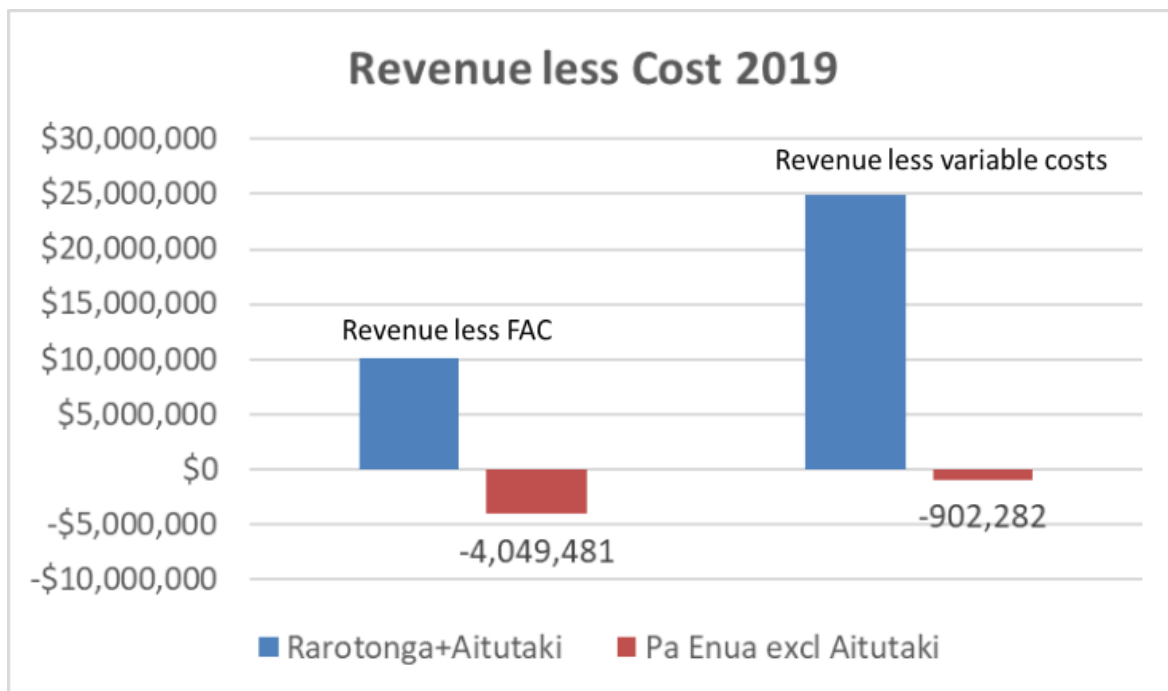
Like the NBN, VCI's financial records do not identify incremental or direct costs. But we can identify both the difference between revenue and variable costs and the difference between revenues and fully allocated cost (FAC).

Using variable costs is correct only *“under conditions of market stability”* ([Rodriguez & Storer, 2000](#), p. 289) – without market liberalisation. With prospective liberalisation, Rodriguez & Storer suggest looking at the impact on internal cross-subsidies under a range of alternative liberalisation and regulatory scenarios. This is clearly demanding and speculative in terms of the assumptions that would be needed to do that.

Using FAC assumes that the Pa Enuua is making a contribution to all fixed costs, which may seem odd if the Pa Enuua is not covering its own variable costs. But, echoing Rodriguez & Storer, the NBN ([NBN, 2015](#)) argued that the broadband service levy on entrants must include the contribution to the incumbent's fixed and common costs when such entry displaces the

incumbent, citing Armstrong (2008) and also the support by the ACCC (2015) in the same consultation on the use of FAC for measuring net losses on non-commercial services in other industries including Australia Post.

In the Cook Islands depreciation and staff costs are not included in variable costs but account for over 60% of fixed costs. Beyond that, it is difficult to say what share of common costs should be included. For the BCR “Avoidable costs are measured as directly attributable costs and a share of common costs that would be avoided if the fixed wireless and satellite networks were not rolled out” (BCR, 2015, p. 27). The BCR does not report what difference this share of common costs makes to avoidable costs. The ACCC’s update of the BCR report used a “proportional mark-up” (ACCC, 2020, p. 8) on direct costs without saying how much it was.



**Figure 2. The range of net costs in the Cook Islands, 2019**

The difference between the minimum and maximum for the Cook Islands is illustrated in Figure 2. The NZ\$4.05m and NZ\$0.9m net cost figures are based on FAC and variable cost, respectively. The ratio is about the same as found in the original costing of Telecom’s CSO.<sup>iv</sup>

## Costing Losses in the Pa Enea

Cost modelling can be bottom-up or top-down. The former is a complex exercise which is beyond the resources of the Cook Islands.<sup>v</sup> A big advantage of top-down cost modelling is that all costs can be reconciled to audited costs and revenues.

Both the Cook Islands and Australia use a top-down modelling approach. When the BCR did its cost calculations, the NBN was only half-way through its broadband roll-out, so the BCR used the NBN corporate plan and extrapolations to 2040 to estimate the net present value of cash flows associated with the provision of fixed wireless and satellite services.

The infrastructure in the Pa Enea is established, so actual costs and revenues from 2019 were used to get a pre-COVID assessment of the internal cross-subsidy in VCI. A retail product costing model had been developed for VCI for 2019. In this model, all GL (General Ledger) revenues and costs are split in the product dimension, essentially creating one P&L (Profit and Loss) for each product. This product cost model was repurposed to estimate the internal cross-subsidy within VCI for the UAP. The main adjustments were:

1. Disaggregating the existing model by each of the inhabited islands in the Pa Enea using a geographic code for each of the 12 inhabited islands that is used when booking costs or revenues to the GL;
2. Excluding services that are not part of the UAP by excluding products that are not included in the broad definition of universal access which includes not only commercial fixed, mobile and Internet services but also emergency, operator and postal services;
3. Developing a replacement cost asset base so that a return on capital can be estimated;
4. Adding the return to capital as a mark-up on revenue.

## Asset valuation

The correct asset valuation for the maintenance of operating capital is depreciated replacement cost. This can be estimated from a bottom-up (long-run incremental cost, LRIC) cost model or obtained from top-down current cost accounts (CCA).

The British telecommunications regulator (Ofcom) uses fully allocated cost (FAC) and current cost accounting (CCA; assets valued at replacement cost) as “*we consider that the use of BT’s CCA FAC (or a similar approach such as LRIC+) provides efficient build and buy signals as it reflects the current replacement costs of BT’s assets*” ([Ofcom, 2018](#), Clause 2.50).

VCI and the NBN use standard historical cost accounting (HCA; assets valued at depreciated actual costs) rather than CCA. As a short-cut, the Cook Islands looked to British Telecom, which reports on both CCA and HCA. It reports the ratio of CCA capital employed to HCA capital employed at the same date as 1.058 ([Ofcom, 2019](#)).

Using a single ratio is a shortcut and there is a complication. Over time, VCI has invested over NZ\$54m. With depreciation and disposals, the depreciated actual cost (DAC or written down value) in the HCA books is \$16.64m. However, NZ\$18.67m of investment that has been written-off is still in service. It is not 'free' where it will need to be replaced. For these assets which will need to be replaced, the replacement cost is simply the historical cost multiplied by the same BT revaluation ratio. It is not 'double-dipping' to charge depreciation against existing assets that have been fully depreciated because it is needed to ensure productive capacity is maintained to continue service; which is why a bottom-up cost model would also value these fully depreciated assets at replacement cost.

On this basis, the depreciated replacement cost of VCI's assets is NZ\$37.4m. This can be rolled forward into future years by adding investment and subtracting depreciation and disposals (the 'building block model') in order to calculate the return to capital.

## WACC

The weighted average cost of capital (WACC) is a measure of what the regulated entity needs to earn in a competitive market to service its debts and satisfy its owners. Even if costs exceed revenue for any island, the owner of assets providing services is entitled to an imputed return, which would have the effect of increasing losses on that island.

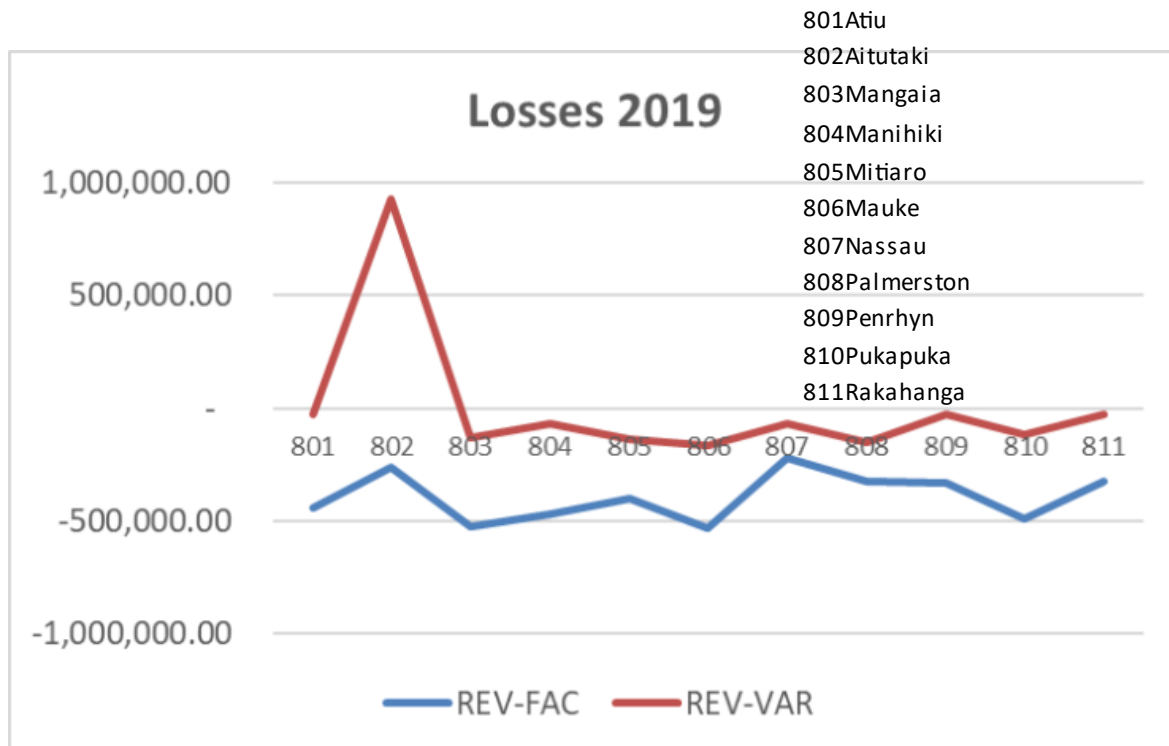
Choosing a WACC is complex and contentious. Developing countries are less integrated in global markets, so asset returns are not well correlated to world returns, and there is country risk associated with developing countries ([Jacobs & van Vuuren, 2015](#)).

Assuming a 13% WACC, the return to capital generates NZ\$4.8m. In 2019, VCI paid no interest and dividends (the return to equity) do not appear in its GL, as they are taken out of net profits. Note that VCI can pay whatever dividend it chooses but the CRA must form its own estimate of the return to capital for regulatory purposes.

Rather than changing the GL, the return can be applied as a mark-up on costs. The 13% WACC (NZ\$4.8m) translates into a 15% mark-up.

## Cost Results

The net cost per head of providing services in each of the inhabited islands of the Pa Enea is shown in Figure 3. Only Aitutaki (and, of course, Rarotonga) covers its variable costs – see the red line in Figure 3.



**Figure 3. Net losses in each of the Outer Islands, 2019**

The corollary of these results is that the islands of the Pa Enea are not attractive markets for new entrants because the markets are small and prices are below cost. Ideally, prices would rise to cover costs, but this could make services in the Pa Enea unaffordable and that is politically unacceptable. The UAP will try to reconcile commercial and political needs.

## Funding Options

The current internal cross-subsidy that funds UAP services for the Pa Enea needs to be replaced with a different, sustainable regime.

### Cross-subsidy

UAP services in the Pa Enea have been funded by an internal VCI cross-subsidy, which we now know to be worth up to NZ\$4m in 2019. This worked well until COVID knocked a hole in



tourism and VCI's revenues and reduced its ability to cross-subsidise the Pa Enea. The internal

cross-subsidy cannot be expected to work in a competitive environment where its competitor(s) target VCI's most lucrative market segments.

## Government

The Cook Islands Government requires VCI to maintain universal access services in the Pa Enea with uniform pricing while liberalising the market, making the current internal cross-subsidy unsustainable. It could pay VCI directly out of taxes. That would be appropriate in the situation where the cross-subsidy mechanism broke down with COVID. More generally, for developing countries the tax system is not ideal for transfers and is subject to political vagaries.<sup>vi</sup>

## Foreign aid

The New Zealand Government has generously provided a once-off NZ\$3m contribution towards a UAP fund. This will be needed to cover the administration of the UAP scheme over time and could also be used to fund new projects proposed by groups of end users which could also be made contestable in supply.

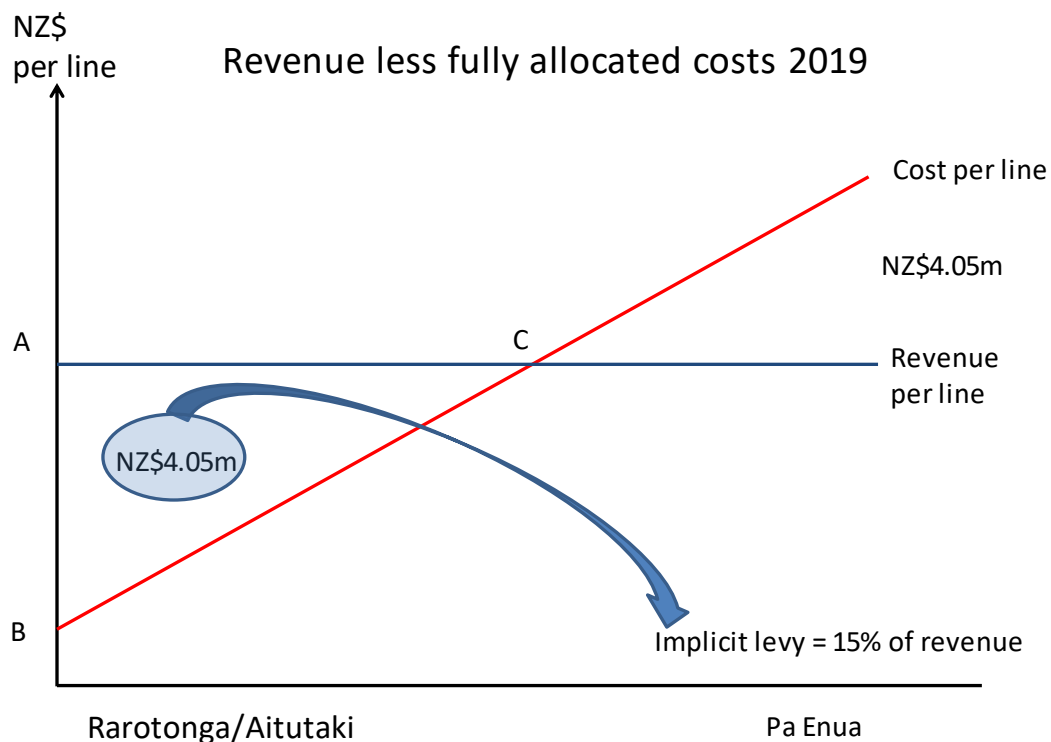


Figure 4. The Cook Islands levy, 2019

## Industry levy

As noted above, the current internal cross-subsidy can be seen as a component of retail prices. The BCR expressed the NBN's cross-subsidy as a levy on all broadband lines. Expressing a levy in terms of revenue was considered and is the same as the approach used in Australia for the standard telephony USO, which is recovered as almost 1% of eligible revenues from each industry operator.<sup>vii</sup> For the Cook Islands in 2019 (Figure 4), VCI is the industry and the NZ\$4.05m net cost of service for the Pa Enea is offset by the internal cross-subsidy (ABC in Figure 4). This amount is effectively 15%<sup>viii</sup> of the revenues of Rarotonga plus Aitutaki.

VCI and its competitor(s) could contribute 15 cents in every dollar of revenue in profitable areas to meeting the net costs of providing universal access services in the Pa Enea.

## Universal Service and Access Pricing

Receiving 15 cents in every dollar of revenue that VCI loses is not going to guarantee universal service is sustainable.

Universal service and competition have to be approached holistically, looking at both the UAP and access pricing. The universal service levy makes the internal cross-subsidy explicit while competition erodes the cross-subsidy. While imposing the levy on new entrants helps, regulated access pricing complements this to support efficient competition. Below, we look at how wholesale pricing of domestic roaming and interconnection could be treated in the Cook Islands.

Opportunity cost underpins the approach to costing the UAP and it also underpins the 'retail minus' approach for resale to be used in the Cook Islands.

This is unlike Australia where the approaches to costing the USO and costing of access prices are completely different. The former is managed by the Australian Communications Authority (ACA, now ACMA), which uses the net avoidable cost approach taking account of foregone revenues. Access pricing is managed by the Australian Competition and Consumer Commission (ACCC), which looks only at long-run incremental costs (TSLRIC); unless the outcome is too high, when retail-minus was used for local calls.

Even though the cost of the USO was less than Telstra thought it should be,<sup>ix</sup> others thought it was too high and clamoured for contestability in the provision of the services and areas covered by the USO scheme. The ACCC told the 2004 inquiry into the future funding and contestability of the USO ([DCITA, 2004](#)) that there was an arbitrage opportunity because the access prices that a contestant paid Telstra to provide services were lower than the USO

subsidy. In fact, when competitive tenders were issued for two large pilot areas in 2001, nobody applied. Either USO subsidies were too high or access prices too low – take your pick.

## Domestic roaming

Domestic roaming is an example of access pricing important to a new mobile entrant. It would allow a new entrant's end users to make or receive calls anywhere in the Cook Islands using VCI's network.

The islands of the Pa Enua are too small to justify requiring any new entrant to roll out network there, so domestic roaming will be necessary to provide coverage and VCI will have to be the designated Universal Access Provider.

The CRA can specify how resale prices such as roaming charges are set ([Government of the Cook Islands, 2019](#)). One method is a discount on retail prices, which is closely related to the efficient component pricing rule ([Baumol, Ordover & Willig, 1997](#)). The key element of the rule is that the cost of access includes not only the marginal costs (i.e., as measured by, say, TSLRIC) but also the 'opportunity cost'.

## ECPR Pricing

The efficient price of access is the marginal cost plus the opportunity cost,

$$Aec = Ca + (Pr - Cr - Ca) \quad (1)$$

where Aec is the ECPR access price, Pr is the retail price, Ca is the marginal cost of providing access and Cr is the marginal cost of providing retail service. (Pr - Cr - Ca) is the opportunity cost.

This rule ensures that the access provider cannot 'price squeeze' its wholesale customers if the access provider's retail price satisfies:

$$Pr > Cr + Aec \quad (2)$$

## Retail-Minus

The retail-minus access price is the same as (2):

$$Arm = Pr - Cr \quad (3)$$

The access fee is the efficient component price (Aec) or the retail-minus price (Arm).

Ca is the marginal cost per minute of terminating a voice call on VCI's mobile or fixed networks. This does not apply for interconnection, as the Cook Islands has legislated 'sender keeps all' (SKA). But Ca is needed for ECPR and for some call cases discussed below. The retail product cost model shows the FAC per call minute, including the 15% mark-up for WACC, as

30 cents for termination on the fixed network and 22 to 25 cents for fixed and mobile calls terminating on the mobile network.

Cr is the retail cost avoided by VCI when it is not providing the retail service. One study found “Retail costs are generally considered to lie in the range of 20-25% of retail revenues” (WIK Consult, 2012, p. 78).<sup>x</sup> For demonstration, it is assumed to be 8 cents per minute for both fixed and mobile service.

Pr is VCI’s retail price of the voice service replaced by domestic roaming. For the purpose of demonstration, it is assumed to be 38 cents per minute for both fixed and mobile calls.

**Table 1. Example parameters and calculation of Efficient Access Price**

Voice Call	Pr	Cr	Ca	Aec
Mobile to Mobile (M2M)	0.38	0.08	0.25	0.30
Mobile to Fixed (M2F)	0.38	0.08	0.30	0.30
Fixed to Mobile (F2M)	0.38	0.08	0.22	0.30

The efficient access price (Aec) is always higher than the marginal cost of access (Ca). The difference is the opportunity cost defined as retail price less retail costs less marginal cost of access (Pr-Cr-Ca). If either Cr and/or Ca is high, the opportunity cost is low. The level of Ca does not affect Aec because variations in Ca are offset by corresponding changes in the opportunity cost.

The ECPR has a negative press because it includes VCI’s foregone profits (opportunity cost) of providing access. But that aspect of ECPR should make VCI indifferent to providing the retail service itself or providing access so the new entrant can provide the service. The idea is that, if the retail cost per minute for the new entrant is lower than for VCI, it should be able to make a profit. While that might be difficult, ECPR provides strong incentives for the new entrant to build out its own network with ‘sender keeps all’.

## Network interconnection

Clause 44 of the Cook Islands Telecommunications Act ([Government of the Cook Islands, 2019](#)) specifies ‘bill-and-keep’ (BAK or SKA) as “*the primary principle for interconnection*”, subject to traffic balance with no threshold yet specified.<sup>xi</sup> It is proposed that it should not apply to all call cases.

The general case where SKA applies is where the new entrant has built a network in, say, Rarotonga and one of its customers calls another person who is on VCI’s network in

Rarotonga. SKA means that VCI terminates the call from the new entrant at no charge; and vice versa.

It should be left to VCI and the new entrant to commercially agree what the threshold for a traffic imbalance should be, over what period it is measured and what the settlement process should be.

The second case concerns the interconnection principle that terminating traffic is delivered at the point of interconnect (POI) nearest to the called party. If the new entrant's customer on its network in Rarotonga calls someone on an outer island but hands over the call to VCI in Rarotonga because it does not have a local POI in the Pa Enea, this is domestic transit. It is proposed that the Aec fee for M2M or M2F should apply. The entrant is unlikely to make any money on this call, but at least it will have national coverage.

The third case is domestic roaming where the new entrant's customer is in the Pa Enea and makes a call back to Rarotonga. Again, it is proposed that the Aec fee for M2M or M2F should apply.

The fourth case is the termination of inbound international calls. The new entrant will have an international gateway and will be able to negotiate settlement rates with international carriers, as VCI does now. VCI should be charged for termination of calls received from the new entrant's international gateway; and vice versa. The charge could be Ca or commercially negotiated. Since overseas carriers can easily and quickly switch all their traffic towards either VCI or the new entrant, this would force VCI and the new entrant to compete towards Ca.

If, say, the new entrant is handling all inbound international calls, the charge by VCI for calls terminated in the Outer Islands should still be Ca.

There are no guarantees that the reduced inbound termination rates caused by VCI and the new entrant competing for this business will flow through to the retail rates faced by overseas users calling the Cook Islands. But that would be desirable.

## Conclusions

The purpose of this paper was to compare how the Cook Islands and Australia have approached supporting cross-subsidies in the presence of infrastructure competition.

Both countries decided that the cross-subsidy implicit in uniform pricing can be made explicit as a levy. While the broadband levy in Australia is expressed as a levy on every fixed broadband line, Australia recovers the cost of the standard telephony universal service obligation as a share of each operator's eligible revenues. The Cook Islands will probably express the levy as a share of revenues.

Both countries use cost models to estimate the size of the cross-subsidy that needs to be recovered from industry operators. Both used a top-down modelling approach. The BCR used the NBN corporate plan and extrapolations to 2040 to estimate the net present value of cash flows associated with the provision of fixed wireless and satellite services. The Cook Islands repurposed VCI's financial accounts to estimate net losses by island.

There are differences in deciding how much of the common costs to include. In the context of market liberalization in the Cook Islands, it is recommended that all costs are allocated (FAC).

In Australia, the approaches to costing universal service and setting access prices are different. The former respects opportunity cost, while access pricing recognizes only marginal (TSLRIC) costs.

In the Cook Islands, the access price for interconnection is zero (SKA, subject to balanced traffic) but it is proposed that other wholesale prices are set by 'retail-minus', which includes opportunity cost. This aligns the approaches to costing universal service and setting access prices.

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## Endnotes

<sup>i</sup> The original \$7.10pm indexed at an expected CPI increase of 2.5% pa was due to begin in 2017 but with legislative delays did not start until January 2021 at a rate recalibrated by the ACCC in 2020 ([ACCC, 2020](#)).

<sup>ii</sup> Estimated from NBN revenue as 8m SIOs x \$45 x 12 = \$4,320m pa. So, \$106m/\$4.320m = 2.5%.

<sup>iii</sup> *“The Bureau of Communications Research (the policy research arm of the Department of Communications) will undertake an assessment of the costs of NBN Co’s fixed wireless and satellite services, which serve many non-commercial parts of Australia, and provide options to Government for replacing the current opaque NBN Co cross-subsidy embedded in its wholesale access prices with more transparent funding arrangements. ... The cross-subsidies which are currently embedded in NBN Co’s wholesale prices will be replaced by transparent funding provided via contributions sourced from owners of high-speed broadband access networks that target residential and small business customers – i.e. the NBN and networks in commercially viable areas that are comparable to the NBN. There will be no additional costs to consumers relative to current NBN pricing – an opaque part of the cost of the NBN will be made explicit”.* ([DOC, 2014](#), p.6)

<sup>iv</sup> The BTCE ([1989](#)) CSO estimates were: \$230m for avoidable cost and \$800m for fully allocated cost (discounting at 13.6% for both); excluding payphones.

<sup>v</sup> It would raise the issue of modern equivalent assets (MEA or what the replacement technology should be). The uncertainty that came with repeated bottom-up costing of assets is what led the industry to support the ACCC’s shift to the once-only asset valuation in its building block model ([ACCC, 2011](#)).

<sup>vi</sup> *“when fiscal efficiency is very limited ... (as) is likely to be met in many (developing countries), cross-subsidies should be encouraged as the most efficient way to bring consumers onto the network”* ([Estate & Wren-Lewis, 2009](#), pp. 749–750).

<sup>vii</sup> Divide assessed standard telephony USO levies at ACMA November 2020 ([ACMA, 2020b](#)) by eligible revenues reported at ACMA July 2020 ([ACMA, 2020a](#)). The total net USO cost for 2019-20 recovered by these levies was \$244m.

<sup>viii</sup> It is only a coincidence that the levy is 15% while the mark-up for the WACC is 15%. The former comes from the net cost and revenue on the two main islands, while the latter comes from the WACC times asset base as a share of total revenues.

<sup>ix</sup> The original \$230m was indexed to the CPI in 1995 while Telstra developed a detailed cost model. Then Telstra lodged a USO claim of \$1,828m for 1997-98. The Australian Communications Authority spent two years building its own model, yielding an estimate of \$548m, less than a third of Telstra's claim but more than twice the original estimate. The Communications Minister pre-empted the result with legislation to cap the 1997-98 claim at \$280. See Parliamentary Library E-Brief ([Jackson, 2000](#)) for details.

<sup>x</sup> An earlier 2007 study ([Kim & Seol, 2007](#)) quotes estimates for S. Korea ranging from 20% to 27%.

<sup>xi</sup> For voice calls, there is a reasonable prospect that traffic will be balanced. Suppose that there are two networks with 10 and 90 customers. If the probability of any customer calling any other is the same, then the traffic each way will be equal. There is a 90% chance that customers of the smaller network will make off-net calls and a 10% chance that customers of the larger network will make off-net calls. However, probabilities will be altered by various plans (e.g., get your friends on the same network to exploit the free-hour) or customer type (some make more calls than they receive).