Pricing in Abundance

The Economics of the Manatua Cable

John de Ridder
Independent telecommunications economist

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Abstract: Small island nations that have relied on satellites for international connectivity are now being connected by submarine cables that have infinitely more capacity. The hope is that these cables will lift the social and economic development of the economies connected. This hope is more likely to be realized with the adoption of wholesale traffic pricing based on the capacity abundance brought by the cable system rather than historical wholesale bandwidth pricing which assumes capacity scarcity.

Reductions in the wholesale cost of international connectivity are more likely to be passed on to end users if there is retail competition. The proposed wholesale pricing model facilitates increased retail competition.

These ideas are explored in a case study of the Cook Islands which is a member of the Manatua Cable Project.

Keywords: pricing, submarine, traffic, bandwidth, wholesale

Introduction

Cook Islands comprises 15 small islands, spread over 2.2 million square kilometres, between American Samoa and French Polynesia, South of Hawaii. The islands are home to a population of approximately 17,500 people with 75% of the population concentrated on the island of Rarotonga. There are at least four times as many Cook Islanders living in New Zealand and Australia.

Its per capita GDP is high compared to many other Pacific island countries. Tourism accounts for 60% of the GDP of the Cook Islands, well ahead of any other industry or exports. More than 160,000 tourists visited in 2017 with nearly three quarters coming from Australia New

Zealand. Aside from tourism, the Cook Islands' economy is supported by primary industries like fishing, with most exports going to Japan and Thailand.

The 3,600km Manatua One Polynesia Cable was completed in July 2020 and connects Apia in Samoa, Niue, Rarotonga and Aitutaki in the Cook Islands, and Tahiti and Bora Bora in French Polynesia. The cable will be capable of operating at up to 10 tera bits per second (10,000 gigabits per second).

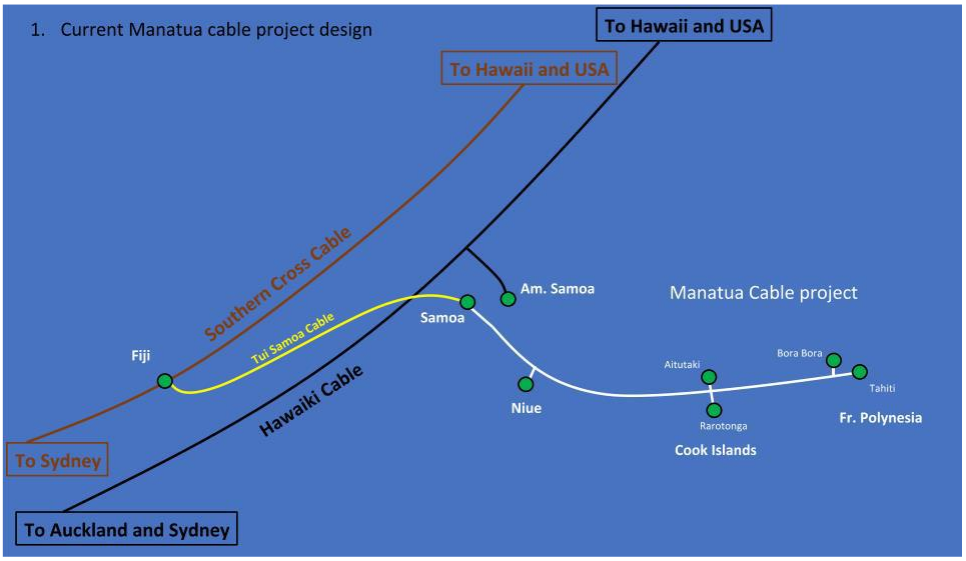

Figure 1. The Manatua Cable System

The Cook Islands had less than 2G (Gigabits per second) of satellite international connectivity and now has 200G lit out of the potential 10,000G. Adding submarine cable broadband capacity to existing satellite capacity is a move from scarcity to abundance. International capacity was the bottleneck in telecommunications - but not anymore. As demonstrated in this video, congestion occurs when only one toll booth on the information superhighway is open. With the submarine cable, the Cook Islands has a bigger information highway than it can use. It can therefore open all its toll booths. If a wholesale customer wants 1G of bandwidth, ten times more can be provisioned. Speed does not have to be constrained and there will never be an international bottleneck.

This is a structural change that requires a change in the conduct of wholesale pricing to realize significant performance benefits for the Cook Islands – and others in the same situation of abundance.

The Cook Islands

The Cook Islands has a single retail telecommunications operator, Vodafone Cook Islands (VCI, also known as Telecom Cook Islands; formerly trading as Blue Sky Cook Islands) with additional market entry envisaged under a new statutory regime.

The sector is now overseen by a new independent authority, the Cook Islands Regulatory Authority (CRA). Its first commissioner was appointed in March 2020.

Avaroa Cable Ltd. (ACL) operates the domestic submarine cable linking Aitutaki and Rarotonga as well as the Manatua Cable links to Samoa in the West and Tahiti in the East.

While ACL is to remain a crown corporate entity, it is government policy to substantially sell its remaining interest in VCI.

There are sound economic and social development arguments for a cheap link to Aitutaki. This link will be used for both domestic traffic (e.g. intra-islands communications including schools and government offices) and international traffic.

Providing international connectivity West is attractive because the Cook Islands has close legal, cultural and economic ties with New Zealand and similar ties to Australia. Also, for the best performance over a submarine cable (i.e. for 'low latency'), the best route for international connections out of the Cook Islands is via Samoa (Brewer, 2019).

The Cook Islands' participation in the Manatua Cable project is supported by a $15 million grant from New Zealand's Ministry of Foreign Affairs and Trade and a $15 million soft loan from the Asian Development Bank (to be serviced after a two year grace period ending April 2023). The more capacity or traffic that ACL can sell, the lower the unit cost.

While the cable was ready for service in July 2020, no commercial service had been launched by ACL for the single wholesale customer at the time of writing (August 2020).

The Cook Islands needs lower input costs for international connectivity to be passed on in lower prices to end users. This conduct is more likely with retail service competition than with the current retail service monopoly. Market liberalization is government policy but the form the market restructure might take is an open question, and one that is not discussed in this paper; except to say that a new form of wholesale pricing would encourage small new entrants.

Wholesale Pricing

The cost of satellite capacity consists of low fixed costs (dishes) and high recurring capacity costs. Submarine cables carry a high capital (fixed) cost and very low variable costs. For the submarine cable, the costs of depreciation and the return to capital are fixed because they are driven by the investment in the cable system. These costs usually represent two thirds or more of the revenues required to recover all costs. In the case of the Cook Islands, international soft loans and grants reduce the amount needed to pay investors and possibly the amount needed for depreciation. Even though the useful life of a submarine cable is normally 25 years, it will need to be replaced eventually, and therefore some provision for depreciation is required. But

the variable costs of submarine cable are very low. It costs no more to provide a wholesale customer with, say, 1G than 10G.

Transmission capacity has traditionally been sold on throughput measured in G (Gigabits per second) reflecting the historically or geographically limited capacity of long-haul transmission networks. Bandwidth pricing divides up the fixed bandwidth of an international transmission pipe in defined fractions. Each buyer is guaranteed a throughput speed but pays for the amount purchased regardless of how much is used. Wholesale customers must acquire more capacity than they need to meet peak demand. Using the analogy from the video above, the customer may need to pay for an extra toll booth to cater for peak demand.

Traffic pricing charges for what is actually sent though the pipe. It is simple. Just a fixed price per month plus x cents per GB (Gigabytes where 1GB is 1,000 Megabytes). It is like charging for water by the litre. Using the highway analogy, all the toll booths are open and the customer is charged for each car and truck that passes through. In the ACL case if the wholesale customer needs 1G, ACL can provision 10G which costs ACL no more and the wholesale customer pays only for the GB of traffic carried.

The two pricing approaches are illustrated below. Bandwidth pricing for the new cable system in the Cook Islands is not yet known so the prices shown are hypothetical with a minimum capacity purchase of 100Mbps. In order to compare capacity pricing these with traffic pricing, some assumptions have to be made about what traffic a given amount of purchased capacity will support. Here it is assumed that each Mbps delivers 328.5 GB per month before assuming 70% utilization of purchased capacity and adding uploads at one quarter of downloads (i.e. both-way traffic measured). These assumptions are consistent with industry practice and have been calibrated to make the costs of each pricing regime roughly comparable.

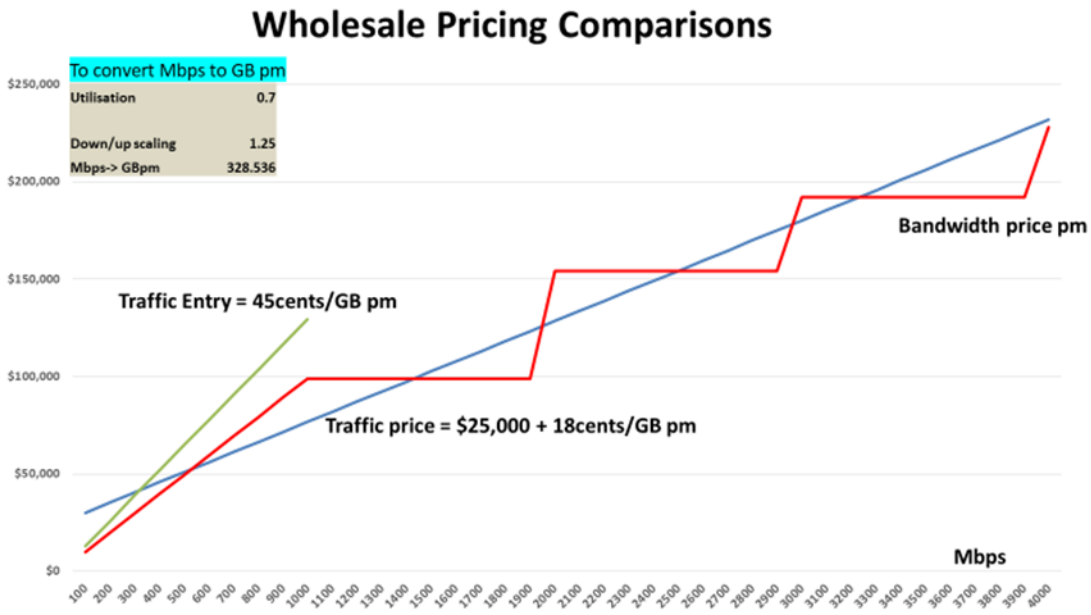

Figure 2. Illustrative comparison of bandwidth and traffic pricing

The green line in the chart above shows how the traffic pricing approach also allows for a self-selecting entry level tariff that lowers entry barriers. There will be a break-even level of traffic per month after which the normal traffic price is selected by the wholesale customer.

Importantly from an efficiency point of view, with traffic pricing there is no unused capacity for the wholesale customer. And, behind every byte of traffic is a paying retail user. Every byte is profitable. There is no need to make Retail Service Providers manage international bandwidth as there is an enormous excess of bandwidth on the new cable system.

The rate card for capacity pricing usually exhibits bandwidth multiples; such that 5 means that buying 10x more capacity costs only 5x more. From the perspective of cost-based price regulation, these volume discounts do not make sense. The unit cost is the same whether 1G or 10G is sold. Volume discounts can also lead to "one desk" where ACL might have no small customers because VCI uses its large volume discounts to resell capacity at a profit.

The main differences between the two pricing approaches are summarised below.

Table 1. Features of bandwidth and traffic pricing

Item		Bandwidth	Traffic
1	Speed	PIR constrained	No constraint
2	Retail pricing	Unlimited retail data	Unlimited retail speed
3	A paradigm shift	Tradition (scarcity)	Fibre (abundance)

1 Speed

Bandwidth pricing requires the wholesale customer to choose the guaranteed throughput (the CIR, committed information rate) and the maximum throughput (the PIR or permitted information rate). If the bursting above the PIR occurs for more than 5% of the time, there are penalties.

High prices for bandwidth put pressure on the wholesale customer to purchase less capacity. Step changes in purchase requirements discourage smaller operators and cause all operators to use contention to get more out of limited capacity. They buy only what they think they can use. The ICT consultant, Matthew Mann, has observed that for ISPs "*Their capacity management is very challenging, as they need to provision 80% of their traffic, and then when they have a growth spike they need to scramble to ensure they don't start dropping traffic due to exceeding the 95% percentile conditions on their commitment. Troublesome, but the industry is used to it*".

With bandwidth pricing VCI buys, say, 1G from ACL. This speed is guaranteed. It is the committed information rate (CIR). But with fibre, potential throughput is virtually unlimited – capacity is abundant. Why ration it?

When the international link has abundant capacity and deploys traffic pricing, wholesale customers and their end users will get faster speeds than they would under the bandwidth capacity pricing model, where wholesale customers squeeze as much as they can from purchased capacity[i].

With traffic pricing, bursting is encouraged. There is no CIR and no PIR. With traffic pricing, every GB is profitable because it is caused by and charged to a retail customer. And there is no step change in required purchase capacity so that there is a strong incentive to increase demand because it will not degrade the user experience. No traffic is dropped and services that might otherwise be throttled by the ISP will run unthrottled potentially leading to revenue growth – subject to retail pricing.

2 Retail Pricing

In Australia, retail plans were formerly priced on monthly data caps. Now few are. "Unlimited" has become standard. ISPs do this because they understand consumers are prepared to pay for certainty[ii]. But unlimited data is dangerous because charging for data is the best way not to be relegated to a "dumb pipe service"[iii].

In the Cook Islands prepaid mobile plans:

- have no excess data charges. If the allowed GB is used up before expiry of the plan, the customer sends a text to his or her provider asking for another plan.
- there are no speed restrictions. You get what you can from 3G or 4G mobile – the device is the source of constraint, not network capacity.

The following scattergram plots prepaid plans in some Pacific markets. The five sets of Digicel plans are in markets that have had international submarine capacity for some years. The Solomon Islands (Our Telekom and Bemobile) and the Cook Islands (VCI; formerly Bluesky) obtained such capacity for the first time this year.

It is not surprising that markets dependent on expensive satellite capacity have relatively expensive retail plans. Digicel PNG is the expensive exception because it is a virtual monopoly with over 90% of the market.

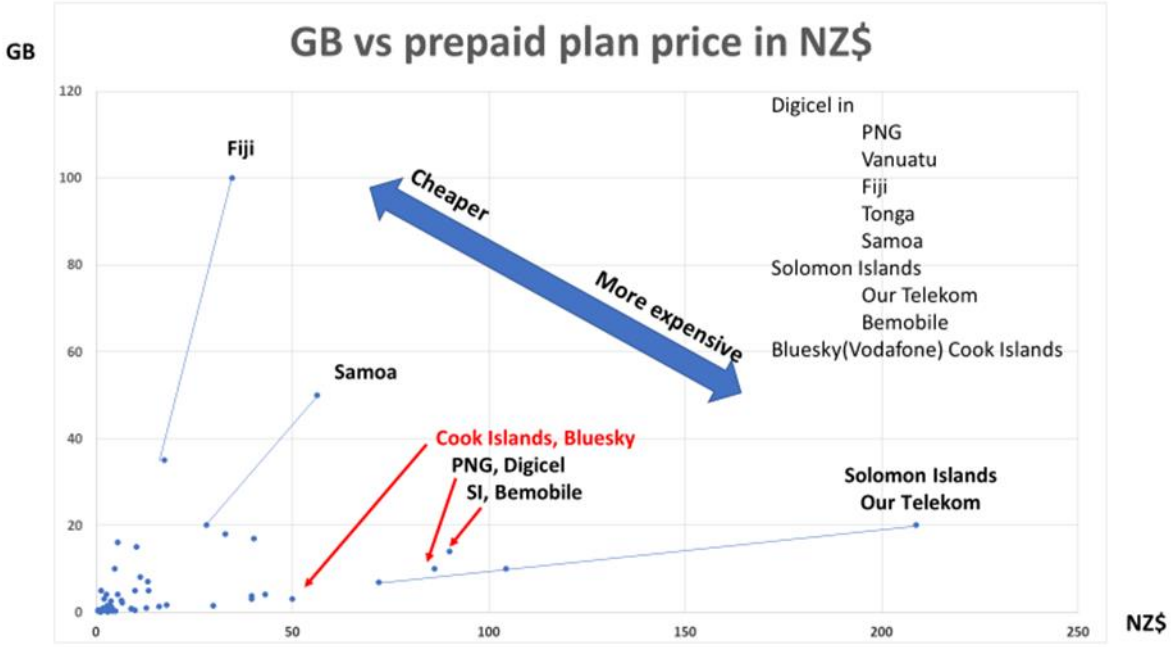

Figure 3. Prepaid pricing in selected Pacific countries (sourced from websites in May 2020)

In the Cook Islands as the sole supplier at least for the time being, VCI's monopoly provides the opportunity to hold back passing through some of the lower costs due to the transition to submarine capacity. It could conduct itself like Digicel PNG. If that happened, its conduct would limit improved performance for the Cook Islands.

Prepaid plans are usually priced for both GB data allowances and term (hours or days validity). With 'best-fit' (regression) coefficients we can make direct comparisons for a notional prepaid plan. Data is the main driver of price in most markets as shown below, with the exceptions of Digicel in Fiji and Samoa.

The chart is based on the same prepaid plans shown in the scatter plot above. The Cook Islands, Solomon Islands and Digicel PNG have the most expensive retail data; all are over $4 per GB. The simple average in four Digicel markets (excludes PNG) is $1.30 per GB; one tenth of the current price in the Cook Islands.

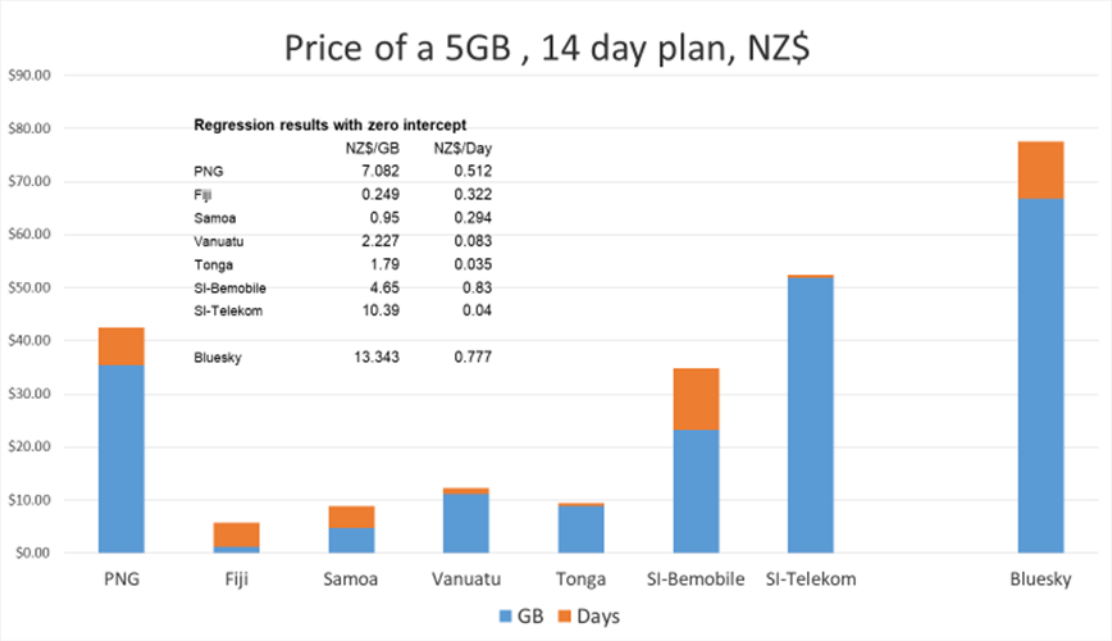

Figure 4. Decomposition of prepaid plan costs (author's analysis)

Technically, there is no reason for prepaid pricing to change with traffic pricing. Prepaid users probably feel they have good control of their budgets with this regime. VCI can continue with this form of pricing whether wholesale is priced on bandwidth or traffic; passing on savings though reduced plan prices or including more data in each plan.

VCI's current postpaid plans charge for both data and speed. Promised speeds range from 2Mbps to 12Mbps on the fixed network. Much faster speeds are possible over newer mobile technologies and there is no reason to limit speed due to international connectivity.

With bandwidth pricing of submarine cables, nothing much will change in the market. It is how satellite capacity is priced now. There will be a short-term boost from lower prices of international capacity (followed by pressure from future satellite pricing) and the speeds should be higher (constrained only by local access networks). That's it.

With traffic pricing and competition, artificial restrictions on speeds may disappear. This is what happened in New Zealand. For unbundled bitstream (broadband), Telecom New Zealand (TNZ) charged business customers more than residential customers. When the NZ Commerce Commission set a price for wholesale bitstream services supplied by TNZ, it ruled that there was no difference in cost between supplying a wholesale service intended for business versus

residential users. Faced with a single wholesale rate, TNZ was the first to make its retail prices the same for business and residential users – to forestall other operators poaching its business customers.

3 A Paradigm Shift

On the 5 August 1856 the Atlantic Telegraph Company completed the first trans-Atlantic submarine telegraph cable. It was a simple affair with seven copper conductor wires, wrapped with three coats of the new wonder material, *gutta-percha* (or as we know it today, rubber). This was further wrapped in tarred hemp and an 18-strand helical sheath of iron wires (#Huston_2020). Now there are over 400 submarine cables globally using optical fibre to carry digital data, which includes telephony, internet and private data traffic.

Bandwidth pricing is the norm only because of tradition. For decades the consortium model of cable ownership and operation prevailed. This meant that capacity pricing of the cable was determined by the consortium to preserve the market value of the cable. It led to rationing and price-fixing where the capacity of the cable was released into the market in small increments, ensuring that demand always exceeded available capacity over the lifetime of the cable, and cable prices remained buoyant.

Some cables are now funded by governments (e.g. two thirds of the cost of the Coral Sea Cable to PNG and the Solomon Islands was funded by Australia), international development organisations (e.g. Cook Islands, as noted above) and private companies (e.g. Google).

Wholesale bandwidth pricing from the era of circuit switched traffic need not apply to the current era where everything is carried as digital data and capacity is abundant. Instead of charging for bits per second (throughput or bandwidth), charge for bytes (traffic). Since data is growing fast, the unit price of traffic can fall which stimulates further growth – a virtuous circle of price reductions and demand growth.

Counting bytes takes less effort than tracking the 95th percentile and may be fairer": *"Critics of the 95th percentile billing method usually advocate the use of a flat rate system or using the average throughput rather than the 95th percentile. Both those methods favour heavy users (who have interest in advocating for changes to billing method). Other critics call for billing per byte of data transferred, which is considered most accurate and fair"*.

None of the major cloud services charge for bandwidth. Microsoft's Azure, Google and Amazon Web Services charge many other ways, including for traffic (Azure).

Uncertainty for ACL's wholesale customers would be reduced with traffic pricing. Purchasing bandwidth is not easy. With bandwidth pricing, wholesale customers have to forecast the number of customers, the mix of promised speeds, set contention ratios to throttle demand

and then round-up purchased capacity to what is required by the capacity steps on the wholesale rate card.

Traffic pricing is easy. Operators only pay for what they use – just like any utility[iv]. With traffic pricing, they have every incentive to stimulate demand - every byte is profitable. There is no cost uncertainty. They do not have to target fill ratios for purchased bandwidth.

However, there is initial revenue uncertainty for ACL. With bandwidth pricing, if it sells 1G the revenue is certain whether it is used or not. Once the initial uncertainty is overcome, demand could drop due to, say, a pandemic and while ACL's revenues would take an automatic hit with traffic pricing, but under bandwidth pricing capacity purchases would be cut.

Conclusions

The abundance of capacity that comes with an international submarine cable is a necessary but not a sufficient condition for accelerated social and economic development. If the price structure remains the same as for existing satellite capacity, nothing much will change. In particular, it is important to see the level of retail competition enhanced so that the cheaper cost of international connectivity is passed on to end users.

The proposed adoption of wholesale traffic pricing will stimulate both demand and enable new retail competition.

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Endnotes

[i] In Australia, the NBN made the mistake of using concentrating virtual circuits (CVCs, which look like bandwidth sold as leased lines) instead of traffic pricing: *"CVCs can be used as proxies for usage charging"* [p103, NBN Corporate Plan, Dec 2010]. This had the effect of introducing artificial congestion where none should exist and has been a major irritation for its customers.

[ii] In September 2015 Optus charged A$125pm for unlimited data over an NBN 100/40 line. The implicit cost of data was 45cents/GB for downloads of 100GB pm (and higher for lower volume). The best fit based on 100/40 plans that had data caps was $80 + 5cents/GB so that 100G would cost just $85 versus the $125 charged by Optus.

[iii] For example, when WhatsApp announced in Barcelona in February 2014 that it would offer voice services as well as text, the different comments from two multi-national carriers on the expected impact is instructive:

> •The CEO of Millicom, which started in Sweden and operates mobile services under the Tigo brand in Africa and Latin America, begged WhatsApp to "*take it easy -70% of our revenues come from voice*".
>
> •But the CEO of Tele2, which also started in Sweden and operates mainly in Europe, said "*Customers get voice and SMS for free. Sorry Mr WhatsApp, but it's free in the Tele2 world*". Tele2 saw the future and started charging for data in order to hitch its revenues to the growth in data and insulate itself from revenue losses due to OTT services.

[iv] When Bob James and I developed traffic pricing for a broadband access network, we dubbed it the "5th Pipe" into the home; following the electricity, gas, water and sewage utilities.