Chapter **Six**

Development and the Regulation of a Access Technologies: Wireless and VoIP

–Fuatai Purcell, Samudra Haque and Onno Purbo

Basic affordable access to Internet infrastructure remains one of the most fundamental levels of the "digital divide". Many of the discussions about Internet use, the information society, or e-business make assumptions about the "global" nature of the network and minimal (or approaching minimal) traffic costs. However, while this may be the situation in more-developed cities, it is not the case in many remote or less developed areas. The Small Island States of the Pacific are a particularly good example: in the ORDIG discussions, a user in Fiji mentioned paying for their 128 Kb/s connection at US$ 3500/month. These issues have flow-on effects to end-users. For example, in New Zealand, the flat rate for unlimited dialup Internet access is NZ$ 24.95 (approx US$ 17.50) per month[105] whereas in Samoa, the cost of dialup Internet access is US$ 89 per month which includes free 500 MB and extra MBs at US$ 0.21 per MB.

When asked about the high cost of basic access compared to other countries in research by Fuatai Purcell, Pacific ISPs explained that they have little flexibility in pricing. As WGIG pointed out, "the primary mechanism for interconnection and peering are private negotiated arrangements or contracts between the owners of the physical infrastructure and do not generally fall under the rubric of international governance mechanisms."[106] Those who own capacity and bandwidth have all the power to set pricing for others to connect. Adam Peake has noted that this "money flows upstream" model of the Internet means that developing nations and smaller ISPs pay for the full cost of connectivity to the Internet, and they regard this as unfair. "Comparison with the most commonly used traditional telecommunications settlement regime only makes matters worse. International telecommunications settlements tend to favour high cost monopoly carriers over those operating at lower costs in competitive markets."[107] Thus, uncompetitive markets such as those of many Pacific Island countries lose both ways: they pay through the nose for Internet connectivity and lose an established revenue stream.

For developing countries in the Asia-Pacific, settlement revenue may form a large proportion of overall telecommunications revenue. Samoa, for example, had 40.8 percent of

[105] 1 http://www.telecom.co.nz

[106] WGIG background report, para.59

[107] Peake, A., 2005, "Internet Governance: Urgent issues for Asia Pacific" in Chin, S.Y. (ed.) Digital Review of Asia Pacific 2005/2006, Penang: Southbound, p.18 http://www.digital-review.org,

telecommunications revenue attributable to traditional telephony accounting rates in the late 1990s[108] The shift from traditional telephony to VoIP, for example, will reduce that income, much as callback services are also contributing to this decline. According to WGIG, the ITU estimates that, between 1993-98, "net flows of telecommunications settlement payments from developed countries to developing ones amounted to some US$ 40 billion."[109]

As in many developing nations, the state of the telecommunication infrastructure in Small Pacific Island States is very poor. This is due to the fact that most are still a government monopoly and it is not unusual that telecommunication infrastructure has not been upgraded for at least five years. In three Pacific countries, the ISPs explained that telephone cables have a relatively short life because there are no casings to cover the cables. They were laid directly into the ground, which causes the cables to deteriorate quickly. Most of the cables and other telecommunication assets have passed their use by date and it is too expensive to replace them.

WGIG notes that "the lack of adequate national and regional backbone may reflect market/public policy failure and require public policy intervention both in terms of funding and policy reform."[110] In some parts of Africa, publicly-owned or consortium-owned backbone operators with a development remit are being supported, with the potential of creating an 'open access' regime to provide transparent low-cost bandwidth to all comers.[111] While the island states of the Asia-Pacific may have logistical issues that prevent precise replication of these examples, the opportunities for regional cooperation on bandwidth provision are nevertheless under-utilized.

Internetworking Possibilities

The Internet, as we now know, embodies a key underlying technical idea, namely that of *open architecture networking*. In this approach, the choice of any individual infrastructure technology was not dictated by a particular network architecture but rather could be selected freely by a provider and made to work interactively with the other networks through a meta-level "Internetworking Architecture". The Internet as a network relies on two principles – firstly, an open architecture that allows each computer to freely communicate with any other (the "end to end principle"); and secondly, the creation of open, voluntary standards that are freely available to all who wish to connect to the network.

Therefore, the Internet is not a homogenous network, and it does not rely upon any concept of key infrastructure; in fact it is simultaneously a network where individual networks are established and organized in a haphazard manner; and it is also a proper distributed hybrid communications network. Each network operator and server operator connects to another network operator in order to obtain connection. The networks that make up the Internet are

[108]Guermazi, Boutheina. 1999. *International Accounting Rates, Developing countries and the World Trade Organization: The Dilemma and a Possible Solution*. International Journal of Communications Law and Policy Issue 3 (Summer). p12

[109] WGIG background report, Box 2 para 7.

[110] WGIG background report, para. 197

[111] infoDev (2004), *Leveraging New Technologies and Open Access Models: Options for Improving Access in Developing Countries (With a Focus on Sub-Saharan Africa)*. Published 17 September, 2004 http://www.infodev.org/files/1035_file_infoDev_Open.Access.Study_TOR_.pdf Accessed 6 April 2005.

privately owned and autonomously operated. They are held together by a common set of open protocols and standards. There is a tacit understanding that all communication between networks will be carried, not only bi-laterally, but also third party and multi-party traffic relayed from the networks that each of the partners may be connected to themselves. Note, however, that widespread de-peering in some areas is placing this tacit understanding under some pressure.

So while the distributed nature of the network makes it difficult to achieve public policy aims, it also provides a number of opportunities for enterprising groups to create their own networks in ingenious ways. This can be seen in the growth of wireless networking in developing regions of the Asia-Pacific, and the emergence of VoIP.

Factors in the unwiring of the Internet

Telephony traditionally takes place on circuit-switched wired networks, a type of communications in which a dedicated channel (or circuit) is established for the duration of a transmission. It links together segments to create a single unbroken line for each telephone call. Circuit switch networks are complex, labour intensive and expensive to maintain, built on a legacy of technology that exists from the telecommunication provider's central office to the local loop delivering service to the customer premises. These can be very expensive, particularly in providing service to remote areas. They are also inefficient, in that infrastructure connecting individual premises to the network lies dormant for much of the time.

Wireless networks use shared infrastructure for a number of end users. Wireless networks can cover long distances (typically, 1-30 km) and provide a healthy amount of bandwidth for roughly half the same cost of fibre-optic cable in terms of equipment and infrastructure, and does not need expensive trenching and explicit legal *Right of Way* (for cable-laying), which would usually be negotiated by the operator for crossing over each roadway, path, property to reach the destination points on their network. On the other hand, some "right of way" is required in the sense of spectrum – as users must either have a right to use particular wireless spectrum, or open spectrum must be available.

The principal benefit of the choice of Wireless over Wired connection is the speed at which a service provider "turns-up" or "commissions" service. Since most of the radio infrastructure is reused each and every time when a new subscriber is connected, the time to provision a service is measured in minutes, rather than hours or days. Subscribers must give up some things when they choose wireless radio services, such as bandwidth–radio services can deliver less bandwidth per capita than equivalent wired services exclusive access–radio service communication devices have to contend for access to the infrastructure via shared channels individual service – radio services are (typically) dependent upon the facilities of a shared transmission network, any fault and the whole network may fail and stop working sensitivity to natural environment – in certain geographic areas with high humidity and variations in cold/hot climates, radio transmission is affected by the portion of the radio spectrum in use, and the ambient environment – which does not typically affect wired connections.

In the developed world, wireless radio services are usually used for *mobility* when you are connected to the network, as the lifestyle in developed markets demand constant and aggressive work schedules and always-on connectivity. In the broader parts of the developing world, however, reducing the disparity in *connectivity* is the main driver force for choosing to go wireless rather than wired.

Roles of actors in the wireless network environment

Researchers, manufacturers, engineers, and consumers all drive the development process of the technology that allows Wireless radio to be used with as a transmission medium for Internet service. The thrust of the technology development, however, comes from the research and academic side of the industry, which must have proper laboratory facilities to develop new hardware, software, firmware that will allow a collection of semiconductors to generate a signal that, after transmission across a distance, will be received and utilized at a similar node elsewhere.

There are significant questions about who influences key policy decisions in the arena of spectrum allocation, that influences so much of the debate on what radio frequency technology to use and how. These discussions are carried out at the ITU under ITU-R[112] , with technical and policy research on spectrum allocation. While market issues relating to wireless are highly advanced in the United States, both WiFi and WiMax are standardized under the IEEE. While corporate research and development labs play a key role in development of new wireless technologies, in many cases the policy environment creates the conditions for uptake (as can be seen from the rise of the mobile GSM network to critical mass through European policy).

Voice over Internet Protocol (VoIP)

In light of the above, an argument could be made that attempts to regulate innovation of emerging technologies (of the future) would always be futile, as limits to the advancement of technology are being removed every day, so that by the time regulation is proposed to "manage" the introduction and use of technology, it would be obsolete and ultimately marginalized. An equally valid alternative argument is that the regulations and practices that are in place today, are in fact the catalyst that drives entrepreneurs and innovators to likely develop one example that circumvents the limitations, which often leads to new inventions. One example of such a an invention is the development of Vo IP, which was created by the private telecommunications service provider community to ensure more telephone conversations could be cheaply carried over existing fixed telecommunication networks that have been put in place for Internet traffic. One of the authors of the early generation O'Reilly book *Practical VoIP using VOCAL*, and co-founder of VOVIDA, Luan Dang candidly admits in an interview in 2002:

> In the US, it took 80 years to create the PSTN and it is excellent. However, in China the requirement is to build the system in one-tenth the time, to serve ten times the number of customers at one-tenth the cost. That adds up to

[112] http://www.itu.int/ITU-R/

> many constraints to meet at the same time, and we believe that VoIP is the only way to accomplish those goals.[113]

However, China's network is still SS7 based, with extensive VoIP being deployed more in telco backbones than in service delivery to end users.

What is VoIP?

VoIP is a protocol for exchanging voice data via Internet, using IP. It basically allows long distance call services through the Internet at the rate of normal Internet browsing, which is often cheaper than standard circuit-switched PSTN calls. Country population plays a significant role in reducing the VoIP tariffs as operators trade minutes and bandwidth. Thus, the larger the population the higher the minutes and bandwidth and, thus, it is easier to reduce VoIP tariffs. China and India, with very large populations, have comparatively cheap rates. Unfortunately, the Pacific islands have the highest VoIP tariff in the Asia-Pacific. This is an example of where policy frameworks may be needed to fulfil universal service obligations for those in the Pacific Islands and similar small island states.

The benefit of VoIP is not purely cost, however, as placing calls from a computer network that also sends email, and instant messaging traffic allows new applications and relationships between these forms of information. For example, VoIP can be used in tandem with text-based chatting (useful for sending codes or long numbers that must be exactly received) in ways that are much more difficult in the traditional telephony environment.

There are a number disadvantages to VoIP in comparison to PSTN. The main ones are:

1. The need for **electricity** at the end point of calling, whereas traditional phone networks can provide service to end users from power sources located at the exchange. This is particularly important for the role of emergency services, which may be required when power sources are not available.

2. Quality of Service (QoS). IPv4 has no mechanism for ensuring that packets are not lost or delayed en route to their destination, and if this happens, VoIP users experience drop-outs or degraded signal quality. While on broadband networks this is less likely to be a problem, on 256 Kbps or less connections in many homes, it is far from ideal.

3. Identification. PSTN and cellular networks use the E.164 system for identifying calling devices on the network, but no equivalent exists for VoIP, which uses a range of different standards depending on the service provider. Further, calls cannot be located geographically which also presents challenges to emergency services that sometimes may not be able to receive location information from their callers.

These issues would commonly be resolved through regulation and standards in a classical telecommunications environment. In an environment of competitive global platforms, issues

---

[113] http://www.oreillynet.com/pub/a/network/2002/08/06/voip.html?page=2

of market position, technology, and regulation are deeply intertwined and regulation itself will have difficulty in addressing these issues.

There are two major VoIP protocol families:

- SIP – Session Initiation Protocol developed by IETF.
- H.323 – developed by ITU.

H.323 is an earlier protocol and has been heavily adopted by many PC operating systems, such as, Windows NetMeeting. Unfortunately, it is not an easy task to use H.323 in a Network Address Translation (NAT) device used in many office configurations and mobile networks. As a result, SIP appears to be rapidly becoming the *de facto* standard for public VoIP networks.[114] Private networks use a range of protocols, usually developed in the private sector. Also popular is Skype, a proprietary, peer-to-peer protocol which uses the resources of its clients to route calls over the network. It is particularly popular in China and Taiwan.

It is possible under VoIP infrastructure to get a personal number that can be called from the old PSTN network. The subscribers will receive the call over Internet without having to connect to any single PSTN line. Surprisingly, there are several free PSTN to VoIP gateways in the world that provide free interconnection between VoIP and the PSTN. They are not located in the Asia-Pacific. However, anyone, including one in the Asia-Pacific, can practically own their very own PSTN number from these providers, such as FwdOUT, which lets uses share their local phone lines, and other people will let the user share theirs. Under free local calling regimes this makes calling effectively free of charge.[115]

Framework for encouraging VoIP

VoIP regulation generally covers the following aspects:

- Classification
- Approval mechanisms for VoIP equipment
- Licensing for VoIP service providers
- Interconnection mechanisms to PSTN/cellular services
- Universal service obligations
- E.164/number allocation for VoIP providers
- Tariffs
- Privacy and security
- Quality of Service

The first three are the bare minimum for a VoIP regulatory framework, while better frameworks also cover the last two. Within the Asia-Pacific only four countries; namely, Indonesia, Malaysia, Sri Lanka and Singapore seem to have an explicit Internet Telephony Service Provider (ITSP) licensing mechanism. However, only Singapore and Malaysia explicitly provide the required licensing fee. Both Malaysia and Singapore are fairly transparent and list the licensed operators

[114] http://www.fokus.gmd.de/mobis/siptutorial/ contains a good tutorial on SIP.
[115] A number of private number providers can be found at http://www.voip-info.org/wiki-VOIP+Service+Providers

on their Web. Service based operators in Singapore can be checked through the IDA website.[1116] Australia is currently in a process of discussion regarding its VoIP policy.[117] India seems to have no explicit policy in ITSP licensing. However, it seems to be possible to use international carrier licensing as an ITSP licensing mechanism in India. Malaysia and Singapore have relatively clear, explicit and transparent approval mechanisms for telecommunication equipment including VoIP equipment.

In the case of number allocation, only Indonesia and Malaysia explicitly allocate a specific phone number for ITSP. However, it is not a single step dial to reach a VoIP destination. It involves a two-step dial process to reach the destination. There are no countries in the Asia-Pacific which are known to allocate phone numbers or a prefix for the VoIP infrastructure in the country. Interconnection regulation in Singapore seems quite transparent and it is possible to allocate a phone number for VoIP endpoints by VoIP operators.

An experimental trial SIP-based VoIP and ENUM is currently being tested in the Asia-Pacific by Asia-Pacific Engineering ENUM Taskforce, APEET[118], and demonstrated in various Asia-Pacific Advanced Network (APAN)[119] meetings. China, Japan, Korea, Taiwan, Australia and Singapore are taking the lead in establishing a test bed. The goal appears to be a common ENUM root server in the Asia-Pacific region in coordination with Asia Pacific Network Information Centre (APNIC).

With regard to tariffs, only Singapore has a fairly open telecommunication tariff mechanism. It seems that the annual license fee in Singapore is the lowest and in the Asia-Pacific, at S$ 200 for three years. The license fee is one of the most difficult to find in most regulatory regimes. Only Singapore and Malaysia found to transparently publish their license fee online on the Internet. Further, in Singapore, no application fee and approval fee is required to get a VoIP services based operator license. Thus, Singapore is able to reduce the overhead cost of many VoIP operators.

Interconnection in VoIP infrastructure

Interconnection is a key element to successful deployment of VoIP infrastructure in a country. The existence of

- a clear interconnection scheme, with equal treatment to any operators;
- a clear telecommunication tariff mechanism;
- a network interface disclosure requirements; and
- a comparably efficient interconnection requirement for competitor networks.

are essential elements to enable a healthy VoIP infrastructure in a country.

[116] http://www.ida.gov.sg/idaweb/pnr/infopage.jsp?infopagecategory=licensing:pnr&versionid=1&infopageid=I1249
[117] http://www.dcita.gov.au/tel/internet_and_broadband_services/emerging_voice_services
[118] http://www.apenum.org
[119] http://www.apan.net

Telecommunication equipment certification/approval

Telecommunication equipment certification/approvals are required to ensure that the telecommunication infrastructure meets a certain standard. A common issue is the differences in tariffs between classification schemes for equipment approval.

One can easily probe the barriers to VoIP by looking at the number of providers in a country. It is interesting to note that there are 67 VoIP providers in Bangladesh, and 36 in India. A healthy VoIP industry can be found in Australia, China, Hong Kong, Indonesia, India, Iran, South Korea, Malaysia, the Philippines, Pakistan, Singapore and Thailand. However, a large number of VoIP providers does not necessarily mean a lower VoIP tariff. Bangladesh has an average PC to phone VoIP tariff at around US cent 18.2 per minute, far from the cheapest in the region, even though it has a high number of VoIP providers.

Ultimately, while VoIP results in cheaper calling, its overall effect on the telecommunications policy environment raises significant questions for developing regions. Interconnection may be difficult to achieve as a small medium business and community-based VoIP infrastructure takes a bottom-up approach and uses a different paradigm than the PSTN and cellular industries that are more regulated. Singapore has demonstrated an early stage of practical convergence. It may take some time before such approaches are propagated among other Asia-Pacific countries.

Conclusions

The challenges to universal access to the Internet are complex and significant. Compared to the traditional telephone system, the economic model of interconnection for Internet networks is much more favourable to developed countries and industries. This means that funds that previously went to the fringes of the network to encourage its extension, now flow back to the centre to develop bandwidth between already connected sites. There is a clear need for significant new mechanisms to address the public policy goal of access for all. Technologies such as Wireless and VoIP have potential in reducing the end user costs for Internet connectivity, but there are a complex set of policy concerns that emerge around these new technologies:

Much of the leadership in these areas is coming from the private sector and market demand. There is a tremendous pressure on individual governments to allow popular access technologies from overseas to be used, even if they have not yet been officially adopted as standards, due to the greatly increased flow of people, media, and information between nation-states. Suppressing certain technologies to preserve monopolies, for example, may have significant negative economic consequences.

Further, the pace of standards development in these areas creates challenges for public investment in infrastructure, and other activities designed to achieve public policy objectives. Issues such as Quality of Service and Universal Service Provision are much more complex than for standard telecommunications networks.

The paradox of the new access technologies is that the flexibility that makes them affordable also increases gaps between the haves and the have-nots. While new technologies such as VoIP and Wireless have a mixed role in achieving development objectives, they both highlight the new communications environment under which we must find solutions for reducing inequality.