International Charging for Internet Services, Module 1

Chapter Five
OBSERVATIONS, CONCLUSIONS & AREAS FOR FURTHER STUDY

This paper has endeavoured to raise awareness and understanding of this nascent "network of networks", and to assess the impact of current international charging arrangements for Internet services (ICAIS) . The authors have reviewed the emergence and growth of the Internet, explained its function and structure, outlined the various existing charging/peering arrangements, and drawn attention to the areas of research and analysis that will be required within the follow-on modules of the ICAIS study.

Observations

The technology, topologies and economics of the Internet are poorly understood, even by those most affected by this new phenomenon. This should not be surprising. The Internet is a recent development, and the widest uses of the Internet, such as the World Wide Web, only came into widespread use in the mid-1990s. It was only in 1994 that the Web overtook file-transfer protocols (FTP) as the primary use of the Internet – today the WWW comprises over 75% of Internet traffic.[1] Economists, policy-makers, regulators, telecommunications operators and new entrepreneurs are all grappling with the same questions: What does the Internet mean for my existing business? Is it an opportunity? A threat? Both? Is the anarchy of the Internet healthy or just a by-product of its infancy? Who pays for it? Is the Internet the future of telecommunications?

This last question is at the heart of APECTEL's efforts to better understand ICAIS. The authors believe the Internet changes everything, and that the circuit-switched world is now in relative decline. This is not a controversial view. As is shown in Chapter 2, global Internet (IP-protocol) traffic will overtake circuit-switched traffic within the next five years. Virtually all new undersea and terrestrial network development is being planned to accommodate IP services. Telecommunications equipment manufacturers are re-inventing themselves, eschewing voice for "webtone"[2] In most economies, established telecommunications operators are also the largest domestic ISPs, and there is evidence even in developing economies that unprecedented levels of investment are now dedicated to the development of IP and data services[3]. Indeed, a new dialogue is emerging over whether the access to the Internet should be included in definitions of "universal service" and "universal access"[4]

At present it is still true that telecommunications and the Internet exist in somewhat different cultural orbits, just as telecommunications and broadcasting have done for many decades. This is not an esoteric point. Charging arrangements for traditional telecommunications services reflect the topology of the circuit-switched network, and are based on both distance and point-to-point considerations. Telecommunications operators continue to earn almost all their revenue from traditional switched voice services. This revenue is obtained largely from international settlements, access/interconnection charges, distance-based metered consumer and business telephony services, and other regulated switch-based services. Even variations on the traditional charging structures, such as call-back, refile, international simple resale, etc, are premised upon metered minutes-of-use rate structures. Only private line (PL) services are sold on a monthly recurring charge (MRC) basis for various capacity levels (T1,T3,E1,E3) – an Internet-like all-you-can-eat (AYCE) pricing structure. However, not one major established telecommunications operator relies upon PL as a primary line of business.

The Internet still relies on at least part of the telecommunications "old world". As Chapter 3 explains, IPL services and PSTN interconnection for the last kilometer are where the Internet world of ISPs and the traditional telecommunications worlds currently converge. ISPs rely on telecom operators for "bulk transport" and for the last kilometer. For the telecommunications operator, ISPs in this instance are the same as any other customer. Both PL charges and interconnection charges are based upon traditional telephony economic and regulatory models. These models do not accommodate the requirements of the Internet and, in particular, of e-commerce[5]. But the economics of the Internet are strongly influenced by private line and interconnection issues.

As noted in the introduction, we believe it is useful to look upon the Internet as a benevolent "agent" within the telecommunications field. It is currently somewhat separate from most of a telecommunications operator activity, but it is rapidly changing how operators go about their business, and ultimately it will transform what telephone companies do and how they make their money.

The charging arrangements for Internet services within and between economies will have to adapt to reflect this reality. This can happen in a proactive manner, as seen by APECTEL's commissioning of the ICAIS study, or in a reactive, ad hoc manner, as has largely been the case so far.

Because of this growth and the economic importance of the Internet, the authors do not share the view of some Internet purists that the Internet can exist as an ungoverned scientific "community" as it did in its infancy. It is quite simply too important to the global economy. Efforts to explain and better understand the Internet are vital in order to provide a solid foundation to the APII, and the development of equitable ICAIS will, we believe, provide policy-makers, network planners, and e-commerce market entrants with a more stable, less speculative economic foundation.

There is considerable evidence that markets, like telecommunications operators, are having difficulty assigning economic values to the Internet. The recent stock market volatility of e-commerce firms such as Yahoo, Amazon.com, Broadcast.com and so forth, reflects a poor understanding on the part of the investing public of how the Internet works[6]. Likewise, telecommunications operators and undersea cable operators have invested unprecedented amounts of money in massive construction projects, all premised upon the capacity-hungry global requirements of the Internet. Such investments seem a sounder bet. After all, the Internet is consuming ever-greater bandwidth.

But the lack of established ICAIS means that telecommunications and undersea cable operators must sell and resell this capacity as traditional private lines and, without any method of traffic analysis beyond capacity sales, must base their future growth on an uncomfortably speculative basis[7].

Traditional methods of traffic engineering and network management do not translate to the IP-network world. There is as yet no per-unit traffic measure for Internet traffic that is analogous to the telecommunications Minutes of Use (MOU) gauge. Indeed, most determinations of Internet traffic are based upon the variations between employed capacity on a given route and the amount of that capacity used by measurable switched services. As voice becomes absorbed into the IP-network, even this crude gauge will be increasingly irrelevant. Other methods, such as "NetFlow" and other precise router measurements, could in theory be employed to extrapolate macroeconomic trends. However, deriving a sustainable matrix of traffic flows from "NetFlow" or similar technologies is unlikely, as these technologies are of a highly narrow, technical nature that does not lend themselves to macroeconomic analysis. Moreover, the data yielded by these technologies is of a commercially sensitive nature and its publication would raise data privacy concerns.

As detailed in Chapter 4, the development of equitable ICAIS will require an unprecedented level of analysis, cooperation and innovation. The authors believe the APECTEL ICAIS Study follow-on modules will set an important foundation for assessing current charging arrangements and establishing the viability of internationally-acceptable, equitable ICAIS.

Conclusions

In summary, this issues paper has highlighted the structural elements and economics of what is known as the Internet, and has put forward key elements to be undertaken on follow-on modules of the Study. The key issues discussed in the paper are summarized below.

Chapter Two – The Internet

- The Internet changes everything

The inventors of the airplane, the motorcar, electricity or the telephone all knew they had created something momentous – but they did not and could not envisage just how comprehensively their inventions would change the world. The authors believe the Internet is equally momentous, and will change utterly the mechanics, economics and sociology of international telecommunications.

APECTEL's ICAIS study is timely given the impact of these changes on APEC member economies and the building of the APII. In particular, the Internet will be arguably the most important element in the growth of e-commerce, the development of small and medium sized enterprises, and to the fostering of economic and technological cooperation within the region.

- The Internet is an open "network of networks", both public and private

Unlike the PSTN, the Internet is an amorphous collection of small and large networks based upon a common set of protocols. Any computer speaking TCP/IP may join. The Internet comprises over a million networks, some as small as a university campus or office tower, and others as widespread as a country or multinational corporation. The Internet grew from efforts to link otherwise incompatible computers – a vital point, as the heart of its philosophy is open communications. There is no global control of the Internet at the operations level. It was designed to be out of control.

- Internet is packet-switched: traffic flows differently than is the case with telecommunications

While telecommunications technologies have focused on building intelligence into the network, with the Internet much of the intelligence in encoded within the data. Each datum sends itself on the most efficient route via a series of "routers" that act as road signs pointing the quickest way. Data are blind to borders and geography, hence the quickest and most efficient way from Sydney to Tokyo may be via San Francisco or even London. If one route is blocked, data will find another way to get to a given destination.

There is a "grammar" to the Internet, a set of software layers, derived from the Open Systems Interconnect (OSI) model, that has become the accepted standard for Internet communications. The Internet can change and adapt without anyone needing to change the physical infrastructure communications. The foremost example of this was the rapid adoption of the World Wide Web. Internet telephony protocols may be the next major change. Consequently rapid technological innovation can occur without requiring large expenditures, if people agree to accept a new standard.

- The Internet is by nature global – barriers/firewalls/filters are difficult to establish or maintain

The traditional circuit-switched telephone network is well-suited to working within boundaries, in that each switch is its own gateway or bottleneck. By contrast, if Internet data are blocked at one telecommunications gateway they will route themselves to the destination by an alternate means. Packets lost in transmission will be resent. Various filters of varying degrees of effectiveness have been established for the use of individuals, schools, and ISPs to block offensive material. But the success of e-commerce relies upon the openness of the network, and such openness is central to the APII. Moreover, attempts to block access or establish bottlenecks would only exacerbate distorted Internet traffic patterns, as data seek to reach APEC economies via North American or European routes.

- The Internet is becoming the global telecommunications network

The IP-protocol Internet standard will supplant the traditional circuit-switched telephony model. The IP network architecture fuels current traffic distortions because of relative ease of access between Asia and North America, versus the relatively less efficient routing between most Asia-Pacific destinations. As capacity is built within the APII this should change, but greater empirical analysis is required.

- The Internet may provide a new model for doing business.

Many successful market strategies for the Internet have involved giving the product away. The goal of every Internet entrepreneur is to turn a *product* into a *standard*. This can be done by creating a vast installed base of the product, and the most effective way to do this is to give the product away, and let end users figure out its uses and advantages. Several companies are giving away the source codes to their products and letting thousands of users figure out improvements, of which Java and Linux are the foremost examples.

Chapter Three – Issues Relating to Charging Arrangements

- Internet pricing arrangements have evolved in an ad hoc manner: Lack of incentives to manage use or traffic

From the early days of the Internet most users have paid only a flat “all you can eat” (AYCE) recurring charge beyond their customary local calling charges, for unlimited use of the Internet. The Internet started as a non-commercial, public sector initiative in which governments and public agencies absorbed most costs. Subscribers have little incentive to limit their use of the net. Indeed, in economies with metered local calling charges there has been concern expressed that even these nominal charges are hindering the development of e-commerce[8].

- Lack of ICAIS and other asymmetries between cost-causer and cost-reimburser mean some ISPs bear a disproportionate share of cost

There is no method akin to telephony’s minutes of use to measure Internet traffic, hence ISPs have largely allowed interconnection without regard to traffic flows or measured settlements. Packet-switched traffic transiting over a given ISP network increases the demand for capacity that might not be related to an ISP's own traffic. Until now, ISPs have had little incentive to track or meter traffic and have been able to accommodate growth without worrying about economic "free riders" . The scale and growing commercialism of the Internet, and the need to limit the growing congestion of the net, have now created incentives for ISPs to explore pricing mechanisms..

- There is no international settlement scheme for the Internet: ISPs have historically exchanged traffic as "peers" - The Sender-Keep-All (SKA) Model

Historically, each ISP has made its money from recurring flat-rate charges to subscribers. The ISP keeps the entirety of the charge ("sender-keep all (SKA)" model). It does not pay settlements to other ISPs, and receives nothing from other ISPs. As a greater imbalance has emerged globally between large ISPs and small ISPs, the larger ISPs have shouldered the bulk of the network development costs (or have leased capacity from telecommunications carriers) and have continued to exchange traffic with one another on a peering basis.

- As the Internet grows, disparities are emerging – as is a global hierarchy of ISPs: The hierarchical bilateral and Third-Party Administrator model.

Smaller and/or more distant ISPs must now pay the circuit costs of provisioning lines to the larger ISPs' network access points (NAPs). As most Internet traffic transits North America, Asia-Pacific ISPs must shoulder the additional costs of provisioning wholly-owned circuits to North American NAPs. Larger ISPs are now favouring private peering arrangements with other large ISPs, creating additional burdens for distant and smaller ISPs.

Under this "hierarchical bilateral" model, smaller ISPs may ultimately end up paying a "transit fee" to use larger ISPs, akin to the way a telecommunications operator pays other operators for use of their networks (resale, transit, etc).

Larger ISPs may also pay a central clearinghouse to operate and manage NAPs. The US National Science Foundation performed this role in the early days of the Internet, and commercial organizations such as the Commercial Internet Exchange (CIX) are handling similar functions for ISPs who pay a flat administrative fee.

There may be a less open, less benevolent outcome as a hierarchy emerges. Only a small number of the world's ISPs belong to CIX or similar groupings. The largest global ISPs may engage increasingly in private peering and other closed arrangements in order to reduce congestion on the network and better serve their own (as opposed to transit) subscribers. Private corporate intranets may enjoy "first class" access while smaller or remote ISPs will no longer enjoy the luxury of sender-keep-all (SKA) cost-free access.

- Traffic Patterns Matter: Analysis of Traffic Patterns will determine the fate of the APII:

As long as the bulk of Internet traffic transits North America, Asia-Pacific ISPs will largely have to provide themselves with lines to North American NAPs. For the present, Asia-Pacific ISPs must shoulder the additional burden of these trans-Pacific capacity costs, creating an additional cost burden on the APII.

Further study and primary research will be required to determine whether this is a temporary phenomenon. It is possible that traffic imbalances will at least in part be redressed by the rapid growth of Asia-Pacific NAPs and local Asia-Pacific websites, and by more root and domain name servers located in Asia, fuelling intra-regional traffic growth. However, at present the majority of popular websites and perhaps more important, domain-name and root-names servers are located mostly in North America.

Chapter 4 – Methodology / Workflow and Timeline

Towards that end, the authors will work with APECTEL to distribute a traffic/IPL/tariff questionnaire for completion by telecom operators and ISPs. The data received will be used to compile an atlas of intra-regional and trans-Pacific routes. This questionnaire, interviews with policy-makers, and access to primary resources within APEC member economies will be required to maximize the utility of the study.

This is a challenging task. As noted, there is no actual means by which Internet traffic data are collected or measured beyond individual router flows. The authors believe that by working closely with APEC member ISPs, as well as with organizations such as the Asia-Pacific Internet Association (APIA) and other bodies, the consultants will be able to develop a thorough mapping of connectivity, topologies and NAPs in the region, as well as a determination of domestic, intra-regional and trans-oceanic traffic flows.

The key to the successful development of the study will be to "ask the right questions" within the data gathering stage of Module 2. After extensive consultation with APEC members at the Miyazaki (Japan) APECTEL ICAIS Seminar and at APECTEL 19, the authors believe the following baseline inventory will enable follow-on modules to put forward ICAIS options that will best assist the development of the APII:

- Development of Sustainable Information Database of ICAIS Cost Elements

    (1) Bandwidth Availability, Deployment, Charging Arrangements (International Private Lines)
    - Trans-oceanic capacity trends, bandwidth cost trends – major routes and thin routes
    - Developments in cable and satellite technologies, systems
    - Pricing and tariffing arrangements
    - Wholly-owned circuits and development of private networks
    - Peering arrangements (PoPs, peering points)

(2) Domestic Charging Arrangements as Element of ICAIS(Arrangements within APEC Economies)
- ISP basic indicators: competition, market shares, subscribers
- ISP retail pricing and cost elements
- Domestic private line, tail/local loop elements
- External gateways and peering arrangements

(3) Internet Traffic Trends as Determinant of ICAIS
- Subjectivity considerations based upon survey techniques (see 4.3.3. below)
- Economic significance of different types of traffic
- Basic Indicators: NAPs, access nodes, hosts, sites, mirror/caching arrangements
- Traffic by type (WWW, E-mail, FTP, DNS look-ups, etc)
- Breakdown of domestic versus international traffic: percentages, trends, regional breakdown
- Traffic growth by type, domestic/international

These points address the key elements that comprise Internet transport costs. The development of ICAIS must address the issue of IPL pricing (including submarine cables and satellite systems) within the region as a factor in promoting traffic distortions.In addition, interconnection, access and ISP pricing policies within member economies must be analyzed. Finally, ISPs and operators will be surveyed and interviewed to assess traffic distribution trends, and the impact of regional NAPs, caching, mirror sites and other recent efforts to reduce traffic distortions.

Empirical data are required to assess whether these developments can form part of the foundation of equitable ICAIS within the APII, or if these developments have been more focused within the boundaries of member economies or linguistic groups.

The Internet has reached a point of maturity at which analysis of the ICAIS is desirable and inevitable. The authors believe this effort will complement programs already under way within the OECD, ITU, WTO and other international organizations. In addition to providing an important working tool for APECTEL, this Study will assist ICANN, CIX and other bodies in understanding the requirements and infrastructure challenges of the APEC member economies.

Endnotes

1 K.N. Cukier,"The Global Internet: A Primer" in *Telegeography 1999* (Washington DC: TeleGeography Inc., 1998), p. 131

[2] Nortel Networks, a large Canadian telecommunications equipment manufacturer, coined this word in 1998 as a means of explaining their new business direction and manufacturing strategy. See www.nortel.com

[3] For example, CODETEL in the Dominican Republic opened the "Latin American Exchange – LIX", a Santo Domingo-based NAP, in mid-1997

[4] International Telecommunication Union, *World Telecommunications Development Report 1998* (Geneva: International Telecommunication Union, 1998), pp. 84-86

[5] For example, see W.H. Melody, editor, *Telecom Reform: Principles, Policies and Regulatory Practices* (Lyngby: Technical University of Denmark, 1997). This otherwise excellent 1997 publication barely mentions the Internet.

[6] "Internet Shares: When the Bubble Bursts" in *The Economist* 350:8104, 30 January 1999, pp23-25.

[7] Data requirements and, in particular, heavy investment by new operators such as Level 3 and Qwest (eg, in the US-Japan cable or the new Global Crossing cables), have utterly changed the heretofore clubby world of undersea cable development. So too have new undersea cable suppliers such as Global Crossing and Project Oxygen. These suppliers are offering innovative bandwidth pricing schemes tailored to hgih-capacity data users. See www.projectoxygen.ccm, www.globalcrossing.com.

[8] find