International Charging Arrangements for Internet Services (ICAIS)

Data Gathering (Module 2)

FINAL REPORT

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Contents of this Report

- Background
  - Key Issues and objectives of Phase 2: Why the Internet does not conform to telephony
- Data: The state of the Internet & Asia Pacific Information Infrastructure is seen in three data sets:
  - Consumer price indices for telephony and Internet services
  - Transoceanic Bandwidth Capacity
  - Peering Arrangements
- please see **notes pages** below the slides for details and discussion. (Click on the bar and move the page separator up or down).

Content of this Report - 2

- Charging Arrangements
  - Domestic Pricing Arrangements; effects on competitiveness
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- Conclusions as to the facts

Note that the Appendices (in MS Word format) set out further information that the consultants were asked to find.

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- Appendix 1 - ICAIS basic indicators
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- Appendix 3 – domestic charging arrangements
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Background

- This is the final report in the second in a series of studies on Internet charging arrangements.
- Internet charging and settlement arrangements exist but they operate on entirely different principles than in telephony. Why this is so is a vital question. (see notes page below)
- In the first study we looked at the technology of the Internet and why it does not conform to a telephony model.
- Phase 2 of the ICAIS was meant to be principally a data gathering exercise.

Background - 2

- In Phase 2 we were asked to gather data on the basic indicators.
  - bandwidth availability;
  - host counts, sites, traffic types, network access points (NAPs).
  - proportion of traffic by type, and by national/international.
  - map out regional and International connectivity;
  - set forth basic indicators of Internet penetration, costs, domestic industrial structure concerning ISPs and telephone companies;
  - describe investments in infrastructure.
- We were asked to present the information in a manner accessible to a non-technical audience.

ICAIS Terms of Reference

1. An analysis of existing international charging arrangements for Internet services, including connection charges, transit charges, bandwidth and infrastructure costs;
2. study the underlying factors contributing to the current economic model..and whether the current model is economically viable;
3. study Internet connectivity within the APEC region;
4. explore existing and emerging technologies for their effect on bandwidth requirements, connectivity and charging arrangements;
5. if and when appropriate; propose commercial or regulatory responses “to create more compatible and sustainable international charging arrangements for Internet services.”

The Internet does not conform to Telephony

- The Internet represents a fundamental reconstruction of communications technology:
  - there are are no calls, no minutes of use, only packets;
  - circuits are irrelevant;
  - the Internet does not require or provide for central control: it has no knowledge of itself, no “state”;
  - there is no guarantee of delivery - “best efforts” only;
  - packet paths can be within the control of the end user, not the provider, so that relative packet flows can be arbitrarily manipulated by a client.
- Attempts to map telephony settlement procedures onto the Internet have failed so far.

There are no rules for connecting the Internet

- The global Internet is composed of about 70,000 smaller networks.
- There are no rules or laws defining how they are to be connected.
- About 7 very large carriers dominate the Internet in the United States.
- Smaller carriers connect to them either at public exchanges or through private arrangements.
- These arrangements are kept secret.

Settlement Options

- Settlement options, including peering, can take the following forms:
  - 1. Bilateral:the call-minute is the unit of accounting; only two parties are involved;
    - The provider hosting the greater number of call-minutes pays the other party according to a negotiated rate;
  - 2. Sender Keep All (SKA):No financial settlement is payable by either party as the result of interconnection. Tier 1 ISPs allow free connection only to those who they perceive as equals.

Settlement Options - 2

- 3. Bilateral, with transit fees
  - One party invoices the other for services provided. This model applies to services provided to small ISPs by larger ones.
- 4. Third party administrator
  - a neutral clearinghouse for traffic, possibly involving settlements. One does not seem to exist for Asia-Pacific traffic.
- After a customer's traffic leaves an ISP's domain, the ISP ceases to fund the carriage of that traffic, and the cost burden is passed on to the receiver's retail service.

The Internet has resolved into a hierarchy of carriers

- Internet services providers have organized themselves into hierarchies - peers and clients.
- ISPs meter traffic volumes, but not by packets.
- ISPs historically have lacked privity of contract; a single ISP has access to all other ISPs' network resources.
- Telephone companies have adopted settlement procedures, whereby the carrier generating more traffic pays the terminating carrier for greater use of the latter's facilities. Sender pays.

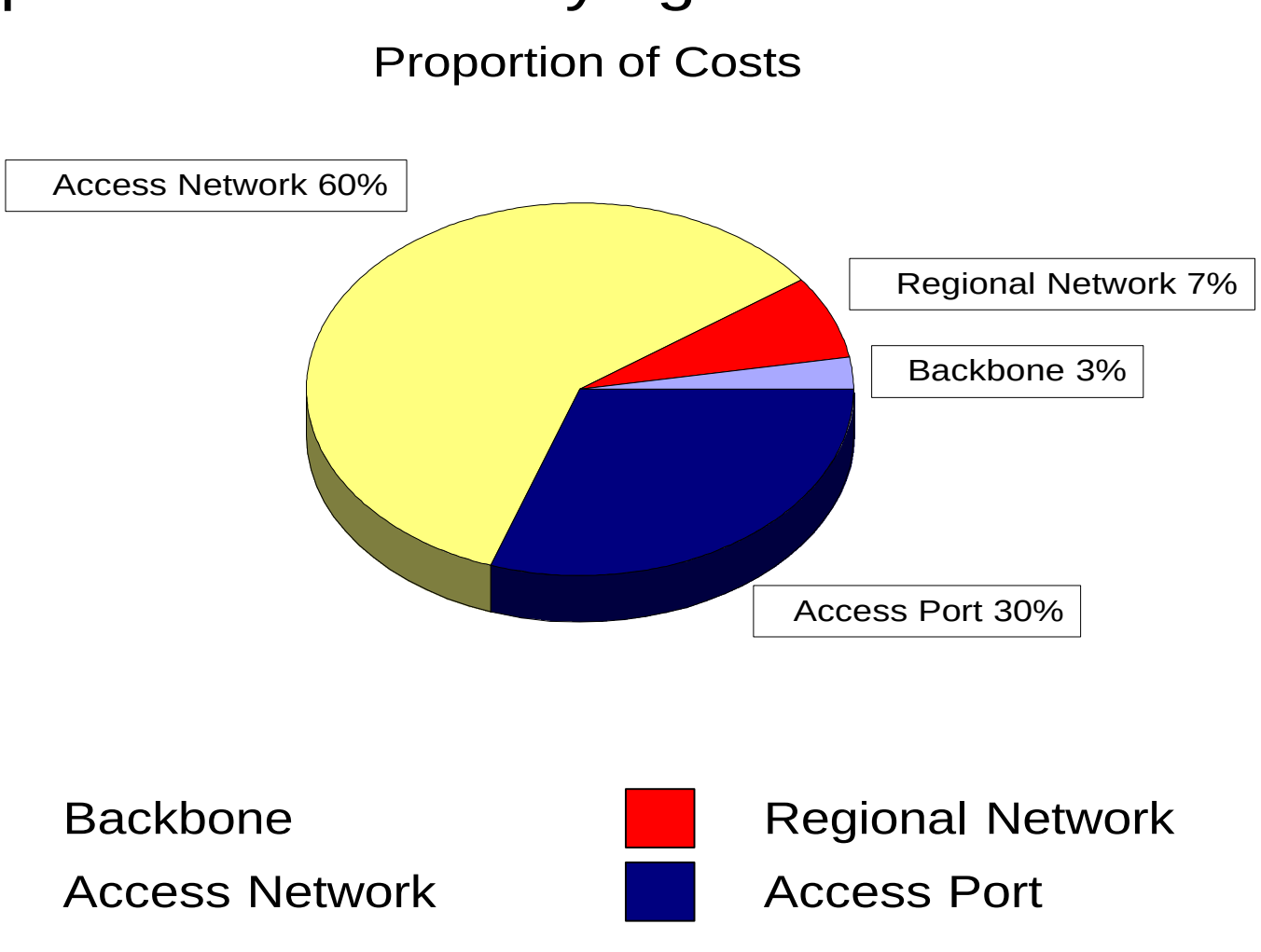
The nature of the dispute - 1

- The Asian ISPs claim that the US-based ISPs are getting a free ride on trans-Pacific links. The total cost of such links is borne entirely by Asian ISPs even though the link may carry a significant amount of traffic that was initiated by American customers (Internet traffic volumes are generally opposite in direction to the source of request).
- Even where US ISPs operate their own trans-Pacific links to Asian countries they will only offer localized peering and will not transit Asian traffic to the US. On the other hand, Asian ISPs who land in the US generally provide open peering and transit US traffic back to their originating country.

The nature of the dispute - 2

- In both telephony and the Internet, costs of distance are the largest component of all costs, but they are recovered in two different ways. In the Internet, costs of distance are averaged out among all users and recovered in the monthly charge
- If two networks of different size exchange traffic, then a settlement must be made on the relative size of the networks.
- This is complicated further because costs are still distance sensitive.
- Although the Internet is the “death of distance” it is not the “death of the cost of distance”

Proportions of Underlying Cost in the Internet



Data 1 – Basic Indicator Database

- Basic Indicator Database
  - Sustainable means of tracking rapid growth
  - Charts:
    - POPULATION
    - TELEPHONY TELEDENSITY
    - INTERNET HOST DENSITY
    - INTERNET USERS
    - DOMAIN NAMES
    - HOST SERVERS
    - ISPs
    - SOURCES
- Attached as **A P P E N D I X 1** in MSWord format

Data 1 – Reflections on Basic Indicators

- Usage growing voraciously
  - Today's figures are a 'snapshot'
  - Growth especially strong in Asia
  - Growth centres: China, Japan, Singapore, Malaysia, Hong Kong
- Domain Names
  - The inaccuracies of domain name "geography"
- ISPs: Number not growing commensurately, reflecting consolidation in sector. Telecom carriers tend to be largest ISPs outside USA.
- Strong linkage between Internet usage and Tele-Density
  - Haves and have-nots in Appendix 1 - Table 1-2

International Capacity Issues

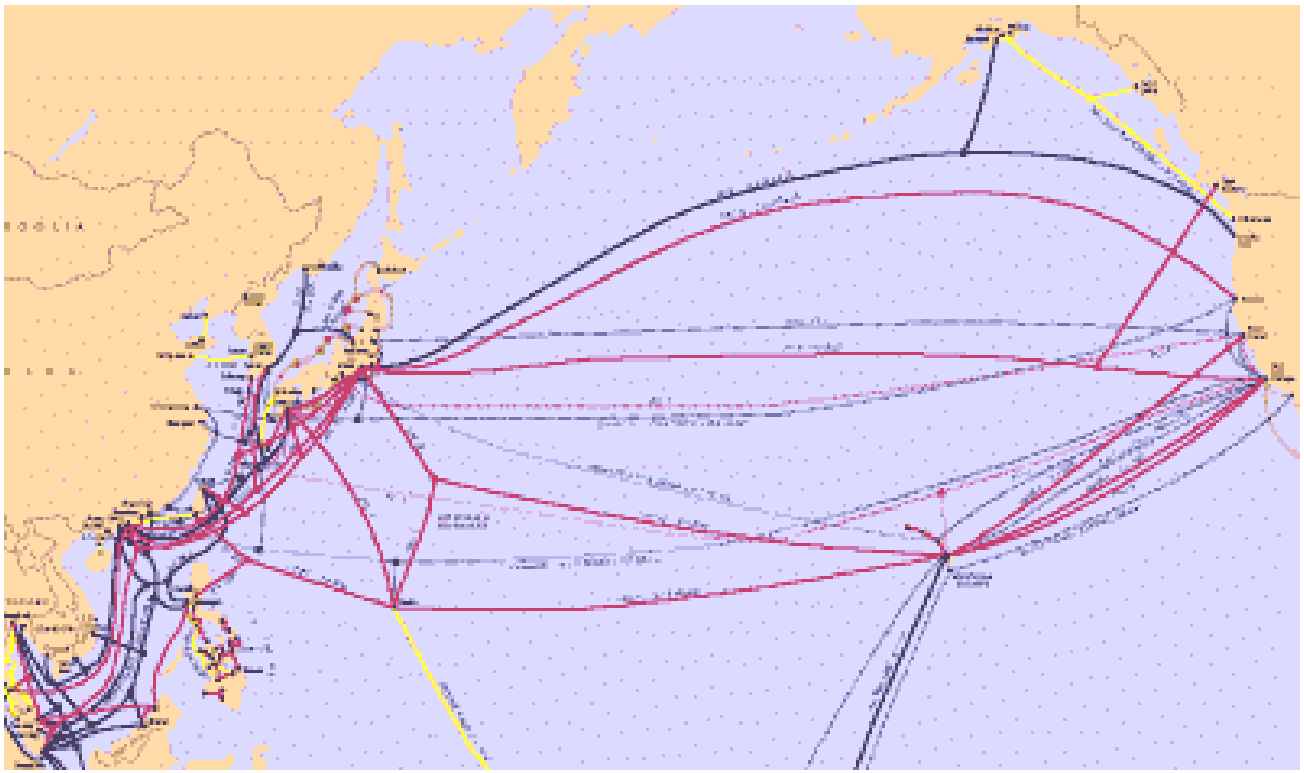
- In 1999 the Asia/Pacific region had 27 million people with Internet Access (15.8% of the total)
- In 1999 this region had access to at least 1,754 GSO satellite transponders (36 MHz eqiv.)representing approximately 785.25 Gigabits per second of uncompressed throughput;
- In 1999 the major transoceanic routes offered at least 25-50 Gbps in uncompressed throughput; future cables, using dense wave division multiplexing will offer multi-gigabit bandwidths

International Capacity is Plentiful

- Ample satellite and submarine capacity exists for long haul Internet traffic in Asia/Pacific;
- Asia/Pacific region should have access to about 1800 transponders by end-of-year 1999
- In early September the Asia Global Crossing venture was announced: an 11,000-mile network linking Japan, China, Singapore, Hong Kong, Taiwan, South Korea, Malaysia and the Philippines at a cost of $1.28 billion; over 7 $billion has been invested in in region submarine cables.
- See NEW INITIATIVES – **Appendix 2**

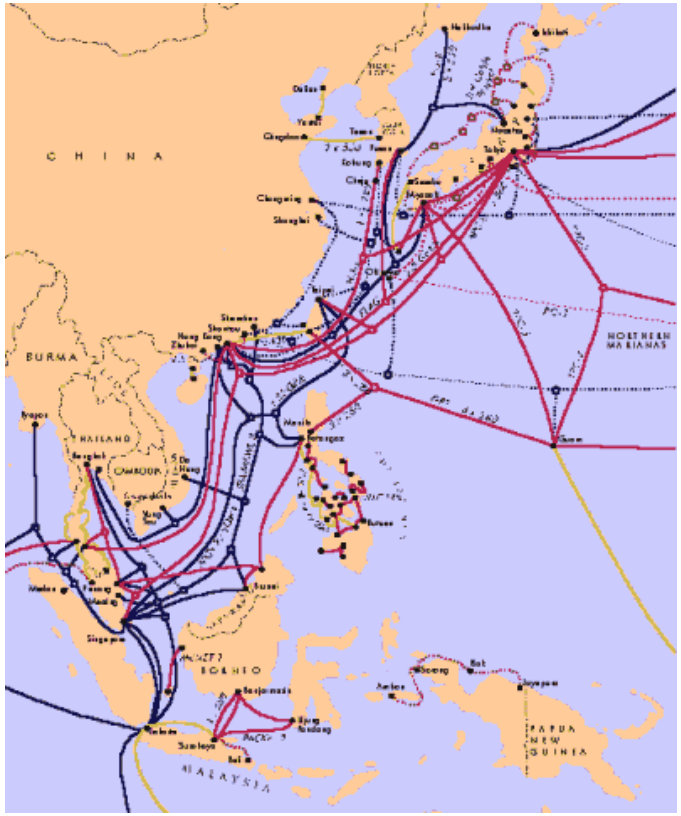
Data 1 – Capacity is Plentiful

Trans-Pacific cable systems



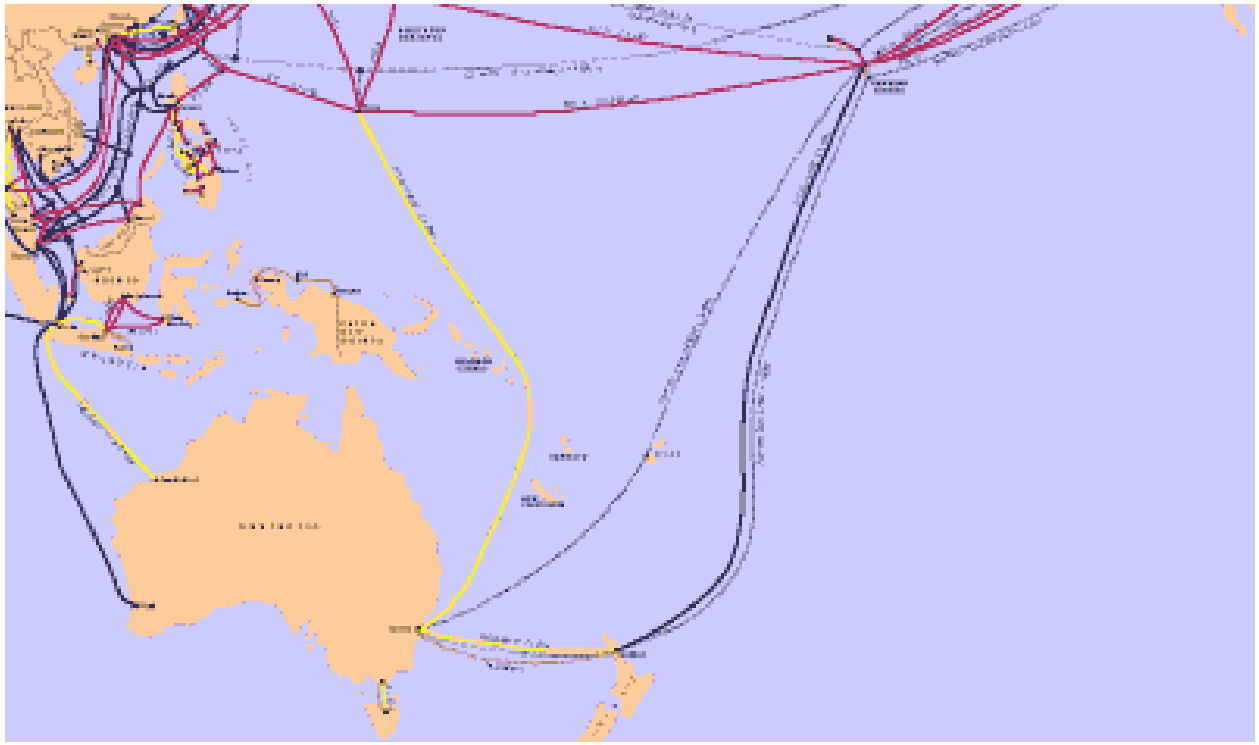
Data 1 – Capacity is Plentiful

- Asia-Pacific Intra-Regional Cable Systems



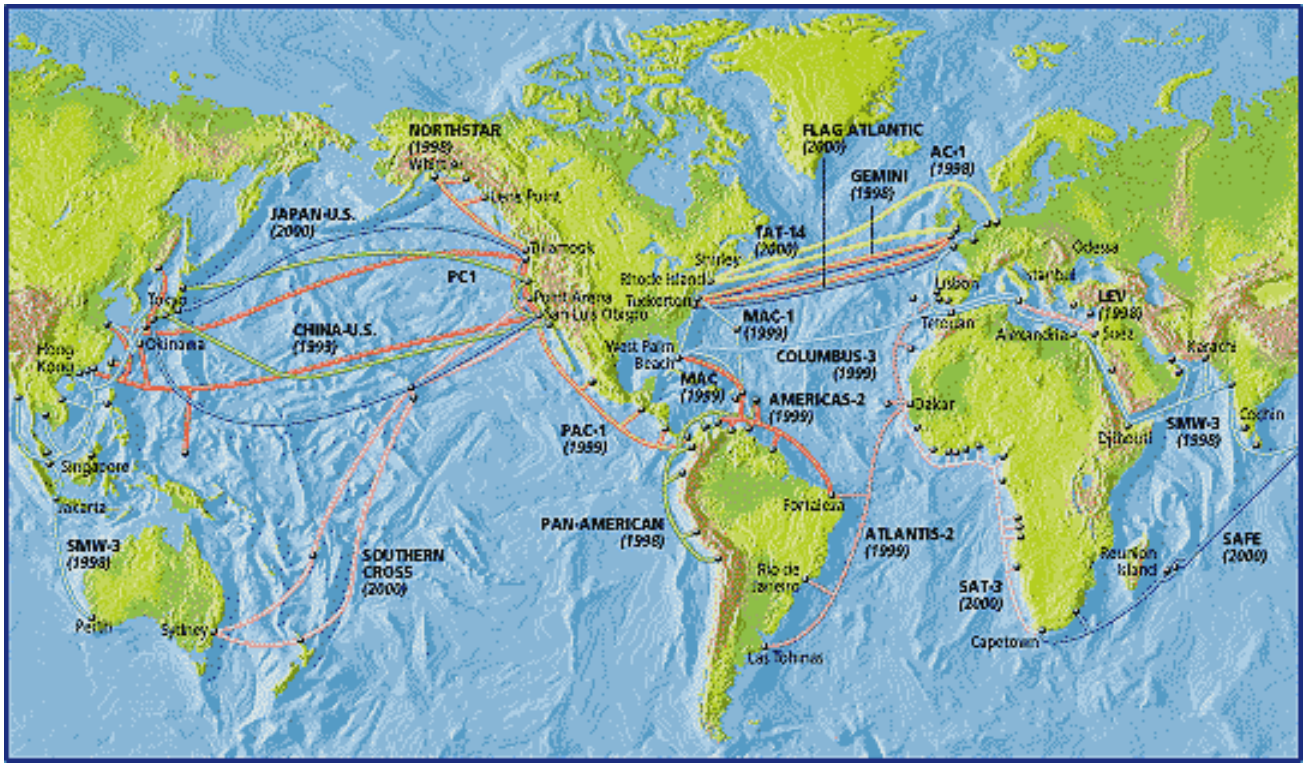
Data 1 – Capacity is Plentiful

- Australasian regional/trans-oceanic cable systems



Data 1 – Capacity is Plentiful

- Primary global cable systems



Observations on Capacity Issues

- Trans-oceanic submarine cables continue to predominate providing better and cheaper east-west network access than north-south;
- While the total number of peering sites, servers & domain registrations in-region has increased, traffic data show significant traffic to U.S./Canadian locales.
- All You Can Eat Internet access stimulates demand as does free or low cost transiting/peering services.

Findings: Long Haul Facilities

- The long haul infrastructure has ample capacity to handle Internet traffic; the current “snapshot” we have taken shows a satellite transponder glut in the region and extraordinarily high recent investment in additional submarine cables.
- However, the physical layout of long haul facilities constitutes only one of the major variables; when local (“first and last mile” connectivity) and all Internet access costs are considered, a different conclusion might result;
- Even without considering other factors, the paths of submarine cables, favour certain economies and routings, e.g., Japan-U.S and inter-regional, east-west traffic.

Findings-2: Local Access and Pricing

- Local loop pricing decisions are vital t the growth of Internet usage;
- Usage sensitive metered local service dampens demand;
- Long-haul pricing favours transiting traffic to and through North America;
- The attractiveness of US based sites will continue to draw traffic towards servers in that country;
- Asia-Pacific nations suffer a genuine competitive disadvantage (given current arrangements), some of which are self-inflicted and others which arise from nature.

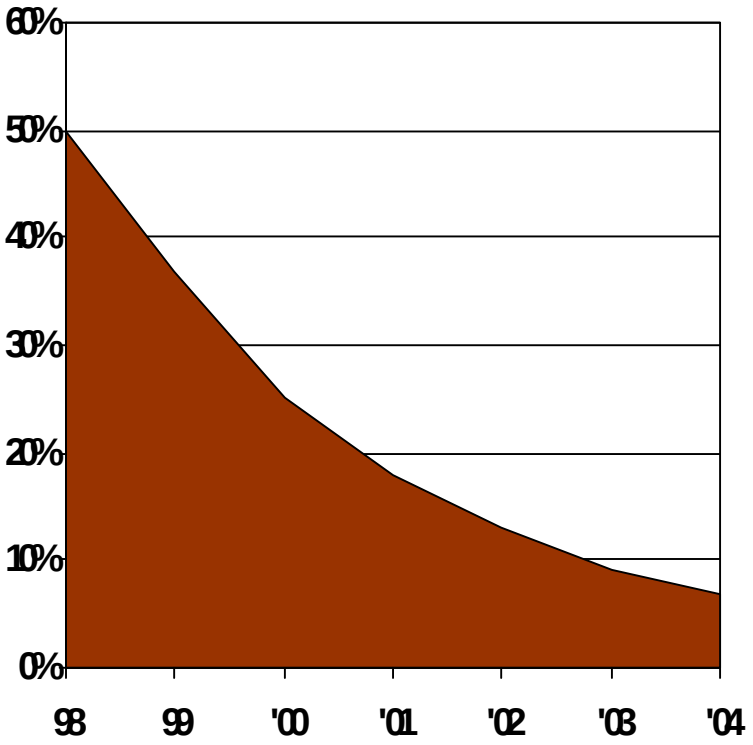
Data 2 – Traffic Flows

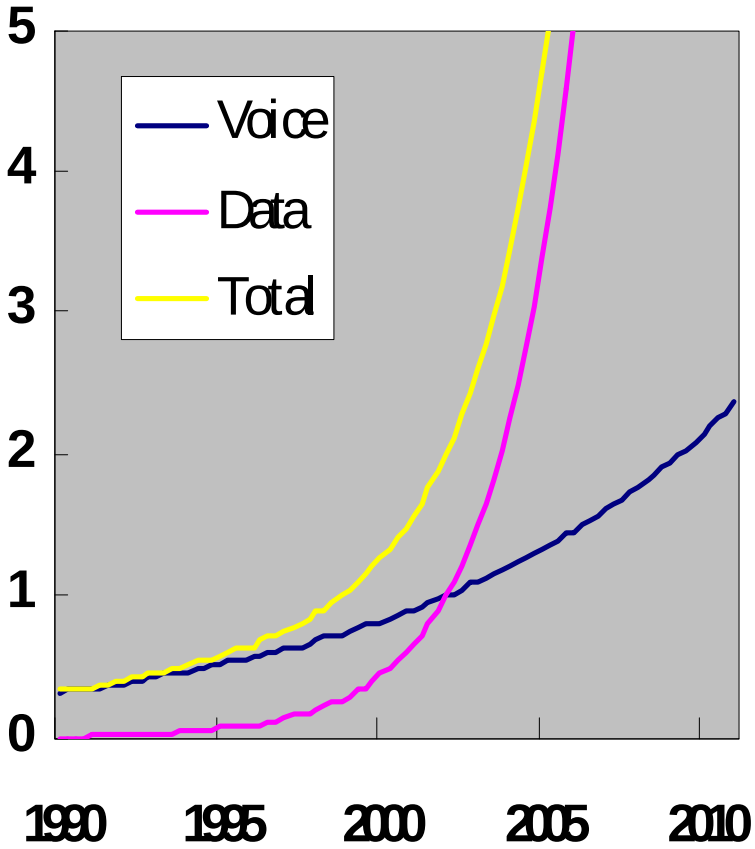
- Off-shore ISPs have responded to costs by conserving bandwidth through the use of mirrors & caching and by deploying asymmetric lines (narrower bandwidth to Tier-1 ISPs than from them).
- Trans-Pacific flow will not decrease, however, due to overall increase in demand for bandwidth, greater use of broadband applications flow (file transfer, streaming audio/video, etc) and continued preference for North American content.
- Global backbone providers) will gain economies of scale & scope making it possible to average costs globally; this could mitigate negative impact of distance-sensitive costs on APEC economies

Data 2 – Traffic Flows & Local Access

- In the U.S.in 1999 Internet traffic generated a monthly throughput of 8- 10,000 terabytes, approximately 20 percent of the voice traffic requirement, though this estimate is conservative;
- An additional traffic load of 20 percent presents challenges globally, particularly since an increasing part of Internet-mediated traffic requires broadband pathways throughout, e.g., video streaming;
- Lack of progress in local exchange infrastructure upgrades or new first mile options, e.g., cable modems, will exacerbate current bottleneck conditions.

Proportion of Voice traffic declines: Two views





Data 3 – Charging Arrangements

- Domestic charging arrangement database are found in **A P P E N D I X 3** to this report.
  - Telephone access rates (metered/flat rate)
  - Basic ISP access rates; hours included
  - Hourly charges
  - Installation fees
  - Domestic Private Line MRC/NRC charges (64k & E1)
  - Cost of Domain Name Registration

Data 3 – Charging Arrangements

- Basic ISP residential access costs are usually within US$15-$25 month in most parts of the world.
- Low bandwidth Internet access frustrates consumers, particularly ones interested in broadband applications like streaming video;
- Interconnection: Usage sensitive pricing of local loop access similarly dampens demand;
- Economies with competing local exchange, interexchange carriers and ISPs typically have lower telecom prices.

Observations on International Charging Arrangements –1

1. Backbone carriers and ISPs outside North America must provide wholly-owned circuits to North American NAPs.
2. North American carriers and ISPs may employ these same circuits to gain access to Internet data on the western side of the Pacific
3. Trans-Pacific and intra-Asian capacity is more expensive and less competitive than is the case within North America, on trans-Atlantic routes, or within Europe
4. There is only a tiny “competitive capacity market” for trans-Pacific or intra-regional capacity compared to North America or Europe.
5. North American and other backbone carriers are expanding rapidly in the Asia-Pacific region (See Appendix 2).

Observations on International Charging Arrangements - 2

6. The traditional telecommunications half-circuit charging model may be used on new routes and on some cooperative (traditional) cables between intra-regional points.

7. The rapid deployment of new capacity will dramatically reduce the unit price of international charges, irrespective of the structure of the charging arrangements.

8. Purely Internet/data carriers/ISPs are less likely to favour this model, preferring to either establish their own NAPs within the Asia-Pacific region or require international carriers to link to their North American NAPs.

9. Developing economies will suffer from a comparative disadvantage due, in part, to higher-cost ICAIS. This situation will continue as new capacity lowers costs on primary routes.

ICAIS Findings -1: Wholly-Owned Circuits

1. *Backbone carriers and ISPs outside North America must provide wholly-owned circuits to North American Network Access Points (NAPs).*
   - The negative consequences of this are enumerated in the notes below.
   - It has not been possible to estimate the significance of this relative to all other factors that affect spending on communications.

ICAIS Findings -2: Asymmetrical Flows and Rebalancing Process

2. *North American carriers and ISPs may employ these same circuits to gain access to Internet data on the western side of the Pacific, creating a perception of "free ridership" by North American users.*

- Traffic flow between Asia and North America is asymmetrical
- Asymmetry is lessening and that traffic is moving towards balance, although this trend is new.
- In larger economies most traffic is now domestic, as are the most popular websites and e-commerce entities.

ICAIS Findings -3: Pacific Bandwidth vs. Other Regions

3. Trans-Pacific and intra-Asian capacity is more expensive and less competitive than is the case within North America, on trans-Atlantic routes, or within Europe. This situation has, relatively speaking, been exacerbated during 1999 as Atlantic and European prices have plummeted

Band-X index at July 1999 (100=Oct 1998):

LA-Beijing: 92.3 (I.e. 92.3 % of Oct 98 price)

London-HK: 90.6

London-Sydney: 85.5

NY-London: 50.0

LA-Tokyo: 84.0

London-Brussels: 39.3

London-Paris: 23.8

ICAIS Findings - 4: Emergence of an Asian Bandwidth Market

4. There is only a tiny "competitive capacity market" for trans-Pacific or intra-regional capacity compared to North America or Europe.

- Presence of a vibrant reseller and second-tier facilities-based carrier market in North America and Europe has driven prices down through competition.
- Prices continue to decline despite high demand due to the emergence of a competitive capacity market.
- Such a market is only beginning to emerge in Asia.

ICAIS Findings - 5: North American Backbones Expanding in Asia-Pacific

5. *North American and other backbone carriers are expanding rapidly in the Asia-Pacific region (See Appendix 2).*

   Appendix 2 and the Capacity section of Module 2 both show the rapid expansion of capacity in the Asia-Pacific region. There will be a *twenty-fold* increase in the amount of telecommunications capacity in the region between mid-1999 and the end of 2000, with further dramatic increases as new systems come on line in 2001 and 2002.

ICAIS Findings – 6: Challenges for Module 3

6. *The rapid deployment of new capacity will dramatically reduce the unit cost of international charges, irrespective of the structure of the charging arrangements*.

7. *The traditional telecommunications half-circuit charging model may be used on new routes and on some traditional cables .*

8. *Purely Internet/data carriers/ISPs are less likely to favour this model, preferring to either establish own NAPs within the Asia-Pacific region or require international carriers to link to their North American NAPs.*

9. *Developing economies will continue to suffer from a comparative disadvantage due, in part, to higher-cost ICAIS.*

Issues for Module Three-1

- Rapidly declining bandwidth prices are not going to change the nature of the dispute .
- Companies are seeking ways of getting around the problem; governments should consider whether the problem should be addressed, avoided, monitored or ignored for the time being.

Four Factors Affect Asia-Pacific Costs

1. A small number of very large operators exercise bargaining power over *all* smaller ISPs (not just Asian) for reasons we have outlined;
2. Intra-regional peering is insufficient; local and regional charges are high;
3. Distance to the United States is great;
4. The flow of traffic tends more towards English-language sites.

Issues for Module Three -2

- Tier-1 ISPs are behaving in the way described by their critics.
- International aspects of Internet charging are only part of the cost of using the Internet.
- It is not proven that they inhibit the development of Internet usage in APEC economies.

Four Ways of proceeding

- Monitor spending by households and businesses to see whether Internet uptake is inhibited by prices.
- Take up the issue as trade dispute in WTO or OECD, and possibly establish interconnection rules for ISPs.
- Build out networks as fast as possible.
- Conduct an economic analysis of the Net.