International interconnect charging

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29.4.2003

Abstract

This article deals with international interconnect charging in Internet. First it describes existing relationships and charging chemes ant then sharing of the costs, which can be seen as a problem today. Last it deals with a proposal to improve present situation in charging.

1 Introduction

Todays Internet suffers of two different defects, which makes some problems when considering charging.

First is the idea of free, open system that is the base of the Internet. There is no technical mechanisms for charging like in traditional telephony world. And Internet differs technically of telephony world so much, that same kind of charging mechanism can't be directly adopted.

Second defect of the Internet is the unequality of its geographical coverage, which is the result of its nature and rapid growth. This has led to situation where strong countries like US can dictate prices to weaker areas like undeveloped countries and even Europe and Asia.

There is a lot of work in different organizations like ITU and European Commission to improve present situation.

2 Existing relationships and charging schemes

2.1 Relationships

Internet interconnection model is hierachical in theory but in practice there are peering relations shown in figure 1, which prevents unnecessary routing via higher level in many cases.

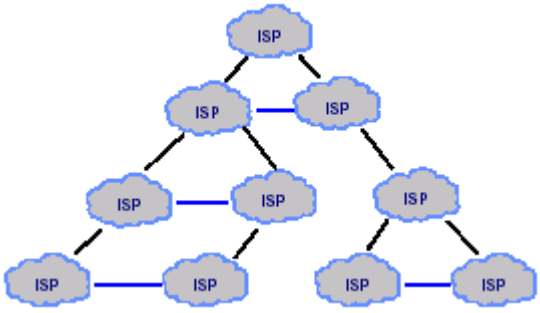

Figure 1 [5]: Practical internet interconnection model

Peering has two different forms [3]: *public peering* and *private peering*. Public peering is the NAPs among different countries as hown in figure 2.

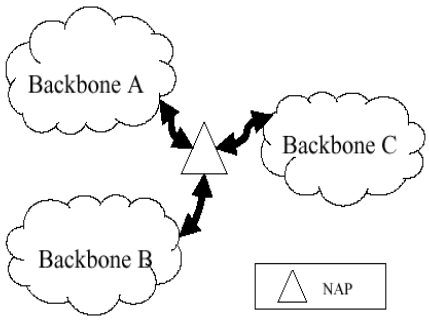

Figure 2: Public peering

However when the Internet traffic exchanged between backbones grows rapidly, the NAPs can be congested. That can be solved by private peering (figure 3), which handles high international traffic volumes.

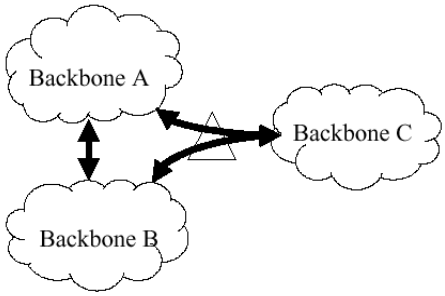

Figure 3: Private peering

Asymmetric way means that one backbone pays to another backbone for interconnection. In figure 4 backbone A in an asymmetric (tarnsit) customer of backbone C and its customers can access both customers of backbone C and B. That describes situation between China (A) and North America (C). Europe (B) is symmetric. In this case Chinese providers undertake the total cost of oversea fibers, interconnection equipments and some satellite equipments.

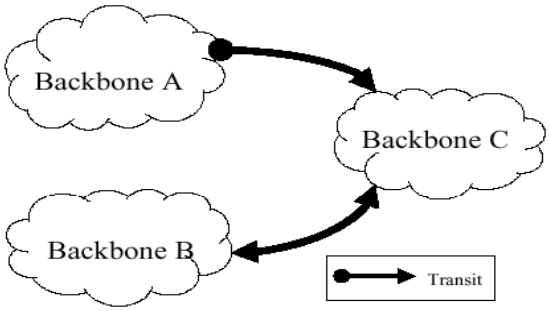

Figure 4: Asymmetric way

2.2 Charging schemes

Telephony Industry

Financial settlements have been a topic of discussion within Internet community. In order to understand it, it is good to look first at the use of inter-provider financial settlements in **traditional telephony industry** [1]:

- Bilateral settlements
- Sender Keep All (SKA)
- Transit fees

The most common international peering model is **bilateral settlement**, where a call is the unit of settlement accounting. A call is originated by a local client and the local client's service provider charges the client for the entire ent-to-end call. The call may pass (transit) through a number of providers and terminate within the network of the remote client'slocal provider. The settlement model is a cost distribution mchanism, where each provider is compensated for costs incurred in the carriage of the call through its network. In the most general case of this model the originating provider pays the next hop provider to cover the cost of termination of the call. The next hop provider then either terminates the call or undertakes a settlement with the next hop provider to terminate the call. As both parties can charge each other using the same accounting currency, the ultimate result is the net outcome of transactions.

The second general model is **Sender Keep All** (SKA) where each service provider invoices their originating client's user for the end-to-end services, but no financial settlement is made across the bilateral peering structure. SKA can be regarded as a boundary case of bilateral settlements, where both parties deem call accounting to be in absolute balance and no financial settlement is payable by either party.

The third model is that of **transit fees**, in which the one party invoices the other party for services provided. This can be seen as a different boundary case of bilateral settlement model, where parties apply call accounting in only one direction , not bilaterally.

The telephony settlement model is not stable and there is pressure to move from bilaterally negotiated call accounting rates to a more general adoption of an SKA model.

Internet Settlemets

There are number of critical differencies between the telephony interconnection and the Internet environment, which make it difficult to map telephony models to Internet environment [1]:

- **Internet interconnection is a packet-based issue**, so the currency unit is the packet. TCP session has much common with a call, but there is no state change so there is no method to identify that a call has been initiated and by which party.
- **Packet may be dropped** during transit from one provider to another. What happens if it is used as accounting unit?
- **Packet header contents are within the explicit control of the end user, not the provider**. The packet flows between two providers can be manipulated by any client if so desired.
- **Routing information is not uniformly available**. A packet may have incurred some cost of delivery before its ultimate undeliverability becomes evident. An intermediate transit provider can never be completely assured taht a pacekt is deliverable.

These points indicate that a packet-based accounting system for interconnection is the only available rational basis for an inter-provider settlement mechanism but is vulnerable too.

Settlement Models for the Internet

- Packet Cost Accounting
- TCP Session Accounting

In **Packet Cost Accounting** packet incurres more cost of each router it passes. When a packet passes across a network boundary, it is effectively sold to the next provider and the sale price increases as the packet transits through the network. Ultimately the packet is sold to the destination client.

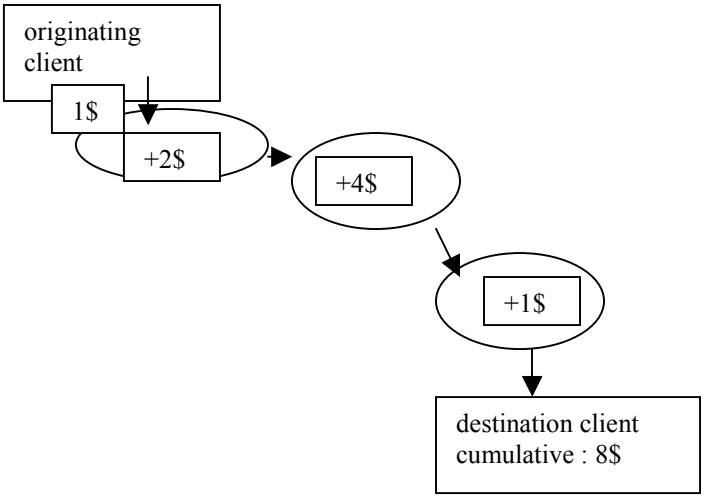

Figure 5: Packet Cost Accounting

Strenghts:

- ISP gets revenue from packets delivered on egress, not ingress -> Quality, financial pressure
- Pressure to competitive pricing

Weaknesses:

- Packet drop
- Mechanism is open to abuse.

In **TCP Session Accounting** it is possible for the router to identify TCP SYN handshake as the start of session and regard subsequent packets as a part of session. But there are great possibility to making mistakes which causes problems. The biggest problem is the diversity of retail pricing structures thet exists within the Internet today: some ISPs uses pricing based on received volume, some on sent volume, some on a mix of sent/received volume.

No Settlement and No Interconnection is a case where a mutually acceptable peering relationship cannot be negotiated and ISPs operate with dedicated upstream connection and no interconnection. For example in an Asian country traffic between two local entities in the same country could be routed through United States. This is inefficient and leads to higher prices for the consumer. However this kind of situations still exists.

SKA Settlement peering arangements are those in which traffic is exchanged between two or more ISPs without mutual charge. Typically domestic traffic transfer is SKA based but international is provided by a separate agreement because of higher costs.

Financial Settlement is an alternative to SKA, which is based on both parties effectively selling services to each other across the interconnection point, with the financial settlement undertaking the task of balancing the relative sales amounts.

3 Sharing of Costs

On national level interconnection can be made like in Finland by FICIX ry, which is a non-profit association [4]. Interconnection between members is free of charge and each member is obliged to interconnecting traffic.

Because of (semi)hierarchical nature of Internet big part of the traffic is routed via US although it is originated and terminated outside [3]. Even more than 90% of international IP connectivity passes through North America [2]. US has been dominator in Internet users, content providers, secure services and equipment. This has led to situation where existing charging arrangements have considered to be inequitable and work only for US [3]. US ISPs are using the international capacity freely allthoug it has been funded fully by other countries' carriers. This means that all ISPs and Internet users outside North America are subsidizing US ISPs and their customers. Other countrien have to negotiate with US access fees annually. North American backbones charge double interconnection fees of transferring traffic between other countries.
These problems have been noticed in Asia [3], Europe [2] and in Australia[2].

However US dominance is decreasing:

- In 1997 number of non-US Internet users exceeded US users [3].
- The advantage of English will be weaker in the future and proportion of other languageas will increase. In 2003 the proportion of English Internet users was estimated to be 29% [3].

- Number of content providers are increasing more outside US than in US [2].
- Number of connections inside Europe and inside Asia and between them is growing rapidly, so bigger part of the traffic remains there without transfer via US.

Because of this development, the whole problem of inequitability can be seen as a temporary one and can be solved [2].

4 Suggestion of Cost Sharing

LIANG et all makes a suggestion of how to improve existing charging arrangements [3] based on facts:

- US carriers should share the costs of international links, according to the two-way traffics.
- The interconnection agreements established by other countries' carriers and US ones should be open, transparent, so other countries can save their energies and decrease the deal cost.
- The network access fees should be based on cost and traffic.
- The calculation method of interconnection cost should adopt long run average increment cost (LRAIC) model.

They have created special formulas for counting costs on equal base – both US and non-US users are responsible of paying.

However ITU has made recommendation in 2000 where two providers involved reach a mutual agreement and does not prescribe any particular formula or system, thus leaving to providers their freedom to determine the forms or methodologies to be used. That voluntary recommendation suggests that parties take into account the possible need for compensation.
United Sates and Greece made reservations stating the they would not apply the Recommendation [2].

References

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