Economic Factors on International Internet/Intranet Telecommunications[1]

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Abstract

This paper presents an overview of several of the key issues regarding the operational implementation of Internet and Internet like telecommunications. The paper focuses on the current implementations and the ability to address the application of Internet voice in a commercial setting. The paper presents the operational elements and the regulatory elements and then proceeds to an analysis of the financial implications of this approach.

1. Overview

The development of voice on the Internet has taken over twenty five years. The author, while doing research at MIT Lincoln Laboratory, was involved in the development of packet voice to be used in the ARPA Net in 1974. At that time the voice was compressed in the 2 Kbps range and was used for tactical military purposes. The issue at that time was the development of a protocol that could have a synchronization capability so that the IMPs, the Internet Message Processors, the predecessor the what we now call routers could have a priority to voice packets and reassemble them into a coherent format. The quality of the voice was recognizable but not identifiable. The approach was to use a linear predictive codec, LPC, device, which is a predecessor of the Code Book Excited Linear Codecs, CELPs, that are now used.

In 1975 when the author went to COMSAT he was directly involved in the deployment of the first international ARPA Net circuit between Edom, West Virginia and Goonhilly in the UK.[3] The circuit was deployed in 1976 and was the first international circuit using a predecessor of TCP/IP call C-PODA. It established an international packet voice connection.[4] In 1978, the author established the first direct connection by satellite to a non-authorized user, Sandia Laboratories from an earth station in McMinnville, TN to sites in other parts of the world for the purpose of monitoring nuclear testing. It also included a voice circuit.[5]

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[1] Presented at MIT Research Program on Communications Policy Conference Internet Telephony Interoperability Forum, Bristol, England, June 11, 1997.

[2] Affiliate and Member of Advisory Council of MIT Conference Internet Telephony Interoperability Forum.

[3] McGarty, Communications Satellites; Looking to the 1980s, IEEE Spectrum, December, 1977

[4] McGarty, Multiple Access Techniques for Low Data Rate Satellite Communications Systems, National Telecommunications Conference, Los Angeles, CA, 1977.

[5] McGarty, Unattended Earth Stations for Global Data Collection, International Communications Conference, Boston, MA, 1979.

Twenty years latter, technology has become faster, cheaper, and of better quality, international communications is now becoming de-regulated, and the market for introducing new technologies is upon us. This paper discusses the approach that the author started twenty years ago and shows how it can be implemented in a real system.

The author in 1990 discussed the implementation of a fully distributed network using routers and packet protocols for the replacement of the standard telecommunications network.[6] The author stated:

> *"Let us consider a second example of the impact of world view on architecture, specifically the difference between the ISDN architecture and the architecture embodied in Local Area Networks, LANs. ISDN is an architecture consistent with a voice dominated, hierarchical world view of single points of control. LANs are architectures of world views that reflect both end user self empowerment and the environment of a data driven utility. Figure 4 depicts the LAN embodiment as well as its extension in the CATV architecture of voice communications using a LAN world view. This evolution in thought is critical to understand the impact of world view. The LAN is an embodiment of empowerment of the individual view, developed in the context of the 1960's and 1970's. The LAN concept, originating at such locations as XEROX PARC, was driven by the developers needs to enable and empower the end user with computing capabilities heretofore unavailable. Out of this view came the LAN architecture of a fully distributed system, using a coaxial transport mechanism to do nothing more than provide bandwidth. The transport mechanism is a broad enabler. The actual implementation of the details is done at the users terminal in hardware and software. This is in sharp contrast to ISDN, where the ISDN central switch does the enabling. In ISDN, bandwidth is not provided, rather it is a voice based data rate, 64 Kbps or multiple thereof."*

The architectures discussed were key. Two different ones were presented:

> *"Centralized: A centralized architecture is similar to a hierarchical system in that the control function is centralized. However, the transport elements are not in a hierarchical format. This is shown in Figure 10. The hierarchical structure is no longer present, but there is a single point of control. The control element covers all other elements in the system. A typical example of this type of network is that of a large bank in a metropolitan area. Part of the network is the local ATM (Automated Teller Machine) network and the voice network for the bank. Each are separate but the bank controls both from a single point of control.*
>
> *Distributed: The distributed system has distributed control, distributed interconnection and flat transport alternatives. This is shown in Figure 11. Here we first note the reduction in concatenated switch and transmission elements. The network is much less dense and the switch is actually co-located with the interface. The LAN networks are typical example of distributed designs."*

The author then stated the concept of moving the intelligence to the end user, this is what we do in Internet telephony:

> *"Changes in technology show that interconnection can be migrated to the customer premise. As we have indicated, the capability of a single fiber is adequate to handle all of the telephone users in the United States. The interconnection in this system may be done by assigning each user a separate frequency and using a laser tuned circuit to perform the switching function. Thus the switch is at each customer telephone, and all that is necessary for the transmission*

[6] McGarty, Alternative Networking Architectures, Pricing, Policy and Competition, January 19, 1991, Presented at John F. Kennedy School of Government, Harvard University, Cambridge, MA, November 30, 1990.

function is a single strand of fiber. Point of fact, there is research under way at MIT and other institutions to develop just such systems. In extremis, this approach reduces the public switched network to a commodity based transport only facility. If we accept the validity of this alternative world view, then we can dramatically see the changes that may occur in the national network."

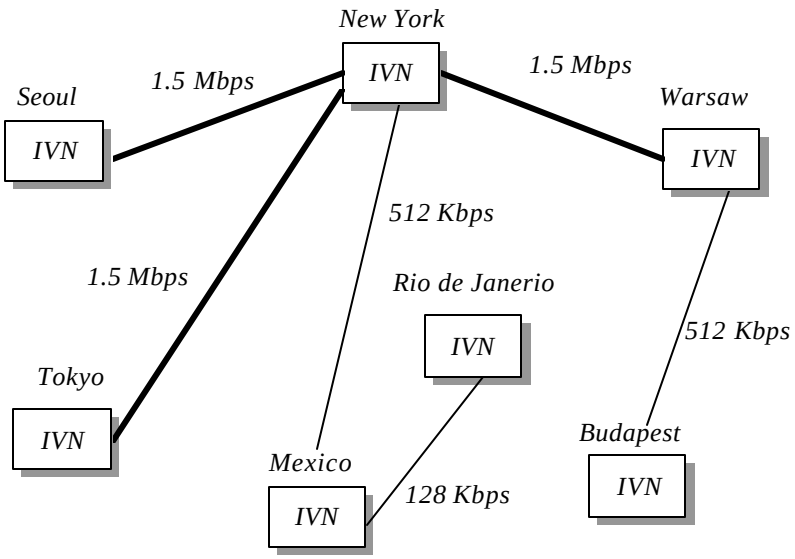
This paper focus on the changes that have occurred and the fundamental paradigm change in moving intelligence to the periphery of the network and enabling the end user to have the most expensive possible form of telecommunications.

2. Architecture

The overall system architecture is shown below. The node, IVN, in each country must have access to an IntraNet backbone or even the IntraNet via an IntraNet Service Provider, ISP. The Intranet backbone is a compilation of links between countries. The links are high speed dedicated links between the countries.

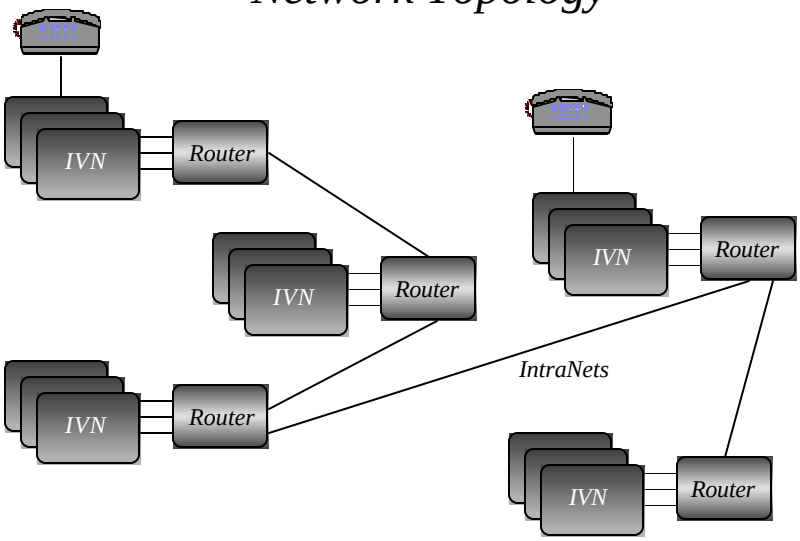
A proposed network connectivity diagram is shown below. The network hubs, the IVNs are shown in the listed cities. They are connected via a backbone IntraNet using 1.5 Mbps, 512 Kbps, or 128 Kbps links. Using the above IVN configuration, and assuming a 4 Kbps voice compression algorithm, a 64 Kbps line can support 16 simultaneous calls. If the callers call 200 minutes per month this is a busy probability per customer of 1%. Thus a 64 Kbps line can handle 1,600 customers at peak loading. A 128 Kbps line can handle 3,200 customers. Similar scaling can be performed on higher data rates.

2.1.1 Sample IntraNet Configuration



The detailed description using an Intranet design with linked routers is shown in the following.

Network Topology



LCU: The Line Control Unit, LCU, is the interface between the telephone network and the IVN. The LCU provides for call initiation and termination. The initial LCU is a Dialogic card which provides for signaling to and from the local telephone network. The use of the Dialogic cards can be customized for each local markets telephone interface elements.

PCU: Process Control Unit, PCU, provides the capability of controlling the processes of a general nature such as network management, billing, and the IVN provisioning capability. The PCU has an SNMP agent for network management and a billing control unit, BCU, for the management of calling cards and other similar elements.

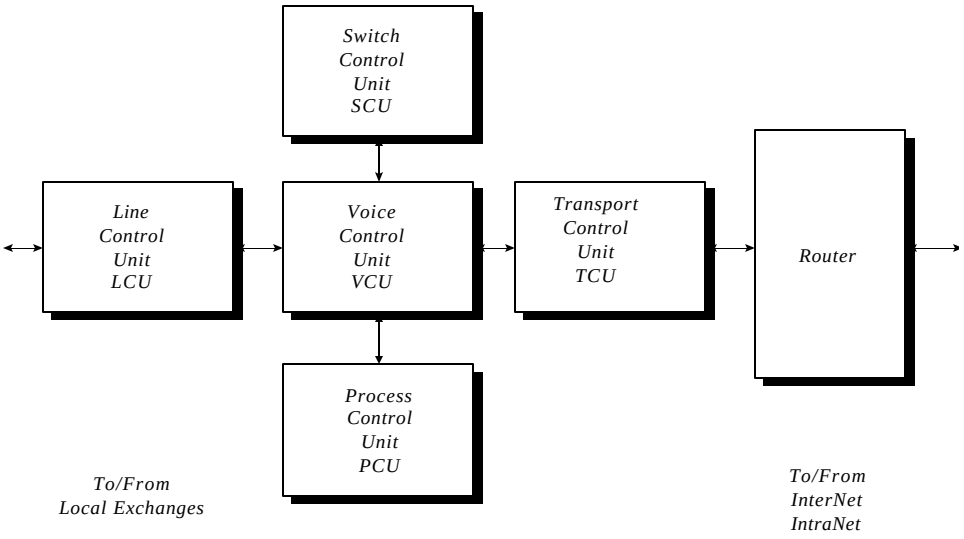
SCU: The SCU, or switch control unit, provides for the conversion between the telephone number for dialing and the TCP/IP address for IntraNet connectivity. On initiation, the IVN sends the SCU the telephone number to be called. The SCU converts the telephone number into an IP address and the SCU inserts this in the transmitted packet. On receive or termination the SCU converts the IP address and other header information into the terminating called number. The SCU sends this to the LCU which then connects this to the local exchange.

VCU: This is the IntraNet Voice Processor or the voice card. It is made by companies, including VocalTec, Analogics, and Vienna Systems, and there are various versions by other companies. It compresses or decompresses the speech, turns it into a packet, and sequences, schedules, and protocol converts it for IntraNet access. It also converts between a local telephone number and an IntraNet address. The VCU compresses the analog voice signal into a digital signal. The current system converts the voice in an 8 Kbps signal. The Company believes that it can achieve a 4 Kbps compression in a year and a 2.4 Kbps compression in three years. This means that more subscribers can be supported on the same IntraNet backbone network.

TCU: The Transport Control Unit, TCU, provides for the packet synchronization between transmit and receive. It is the scheduler of the packets on transmit and the synchronizer of the packets on receive. It also provides for the sorting out of the packets on transmit and receive. The TCU interfaces with the Router via an Ethernet interface.

Router: This is a standard router such as provided by Cisco.

This is shown below.



3. Operations Elements

The ability to deliver a system and service is dependent on providing all of the elements necessary for the deployment of a telephone service. This section highlights several of these elements.

3.1 Network Management

The national and international backbone network must be managed and controlled in a real time fashion. Operating entities, at all levels of operation, must have the capability of being monitored as to operational effectiveness, network performance, and impact on their interconnecting network elements. The Network Manager must be able to determine the locations of any and all outages or system degradation points in the network, or in any other network that a customer may have access to. The NMS combines the interfaces from several subsystems. The overall functions of the NMS are as follows;

Fault Management: This allows for the detection, isolation, identification, and repair of any system faults. This set of functions will be presented in detail in this Specification. Fault Management assumes that there are sub-network managers which can generate fault recognition and transmit them in a common format to the NOC. The NOC then takes these fault reports and combines them from all of the subnetwork managers. The following Figure generically depicts how this process functions.

Accounting Management: Accounting functions allow for the provision and complete sourcing of any and all elements necessary for an audit trail on the faults in the system. The accounting function provides for the necessary process of managing the capital asses base. The accounting function may be integrated into the overall NOC functionality and it is essential if it is to support the configuration database. Zephyr does not provide any Accounting Management functions.

Configuration Management: This is the capability to assure that all elements in the system are properly configured and identified in this process. The configuration management process allows for the full and complete knowledge and updating of any and all parts in the system. This is a mapping of the overall accounting function for actively deployed parts and system elements. Configuration management is an essential element in the process of repair dispatching as well as the process of inventory management.

Configuration Management requires the critical control of installation as well as operations and maintenance. Any time a unit or object is installed, replaced, modifies, or in any other way changed, the configurations system must track it. Zephyr provides this functionality at the NOC via the MDSI field service wireless unit and the MDSI Field Service manager, which is in and of itself a SNM.

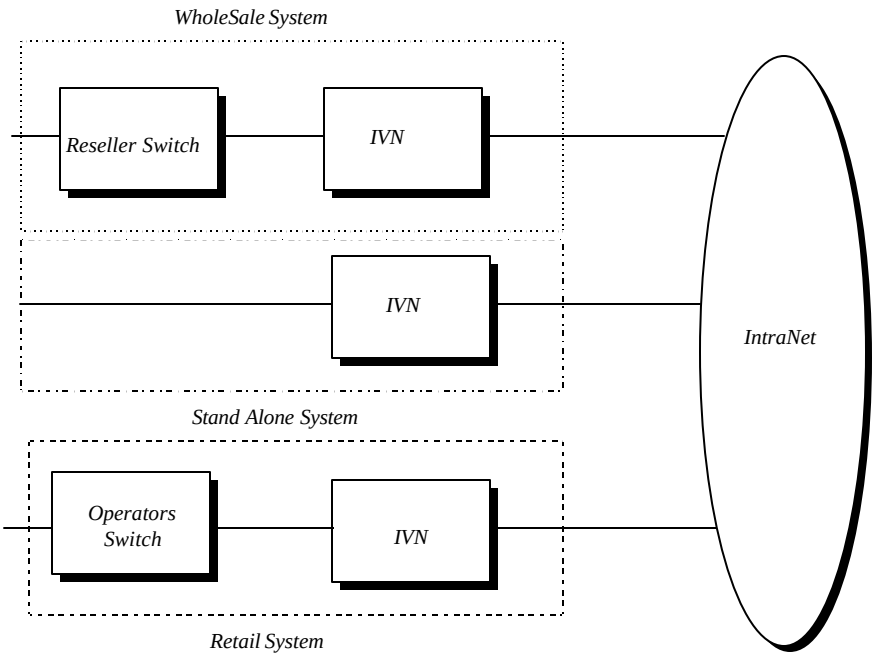
Performance Management: This function allows for the optimization of the system. In the current specification we address the inclusion of both "hard" and "soft" trouble tickets for the tracking of faults and for measuring of performance. The current Zephyr NOC does not perform overall performance optimization but does provide reports on performance analysis and trend analysis. It is capable of isolating performance factors and can, combined with the Fault Tree system, help isolate overall system Performance factors.

Security Management: The management of the security and integrity of the system is assured by means of a fully integrated and protected system design. There are three levels of security that the system will support; physical, software and database, and system access.

3.2 Billing

The following Figure reflects the options for billing system interconnection. There are three shown. The first is directly to a reseller who has their own switch and the end user traffic is billed out of the Reseller Switch. There is still the reconciliation problem that must be addressed but that is done onbulk minutes and may very well be resolved on a fixed pricing basis.

The second connection is a direct IVN connection. This assumes a bulk buy per user. This shows that this can be accomplished via trunk sales and that any reconciliation is limited. The third approach is the use of the Company's own switch and the use of the AMA tape on that switch. This is the opening approach in the retail area.



The types of billing that the IVN will support are shown in the following Table.

Type	***Functions***
Wholesale	
Bulk Buy	This system allows a retailer to buy bulk minutes from the system on a link by link basis. The system must monitor each link traffic and at a certain level of usage is reached, say 80%, then the system must notify the retailer. At 100% usage the system must terminate all future incoming calls.
Unit Buy	This system allows the retailer to buy in units and to either pre pay or post pay. It generates a bill on a link by link basis.
Retail	
Pre Paid Cards	The system must support any form of pre paid card on the retail basis. It must recognize the card, have a security protection system, allow for the debiting of the card amount, and have the ability to reissue additional credit to the card on a credit card basis.
Credit Cards	The system must allow for the establishment of a credit card billing approach. This means that the system must have real time links access for credit card validation using such systems as provided by the card vendors. The cards must be at a minimum the major credit cards as well as the telephone calling cards. All calling records must be obtained on this basis.
Bulk Buy	The customer must also be able to obtain a bulk calling capability as

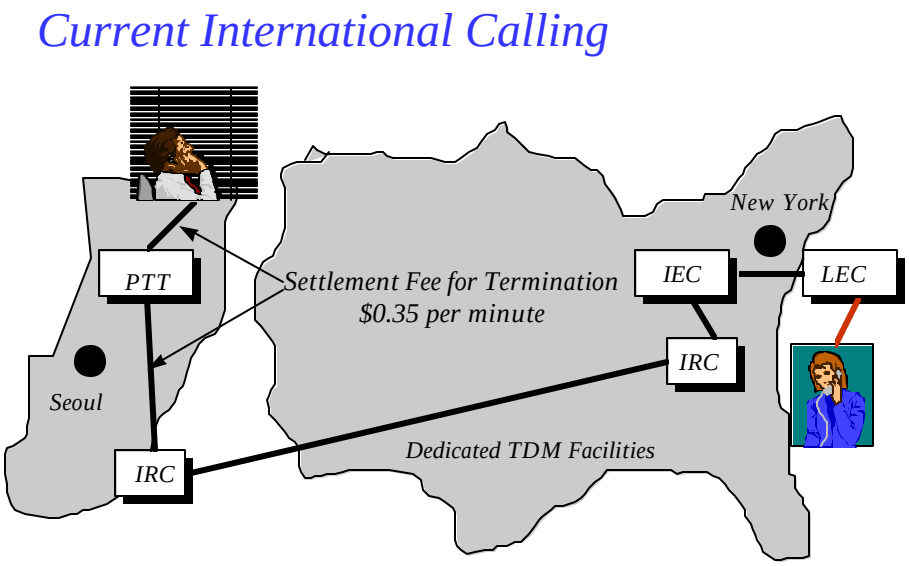
Type	*Functions*
	if it were a retailer. The approach is as above for retailers.
Unit Buy	The customer must also be able to obtain a unit calling capability as if it were a retailer. The approach is as above for retailers.

3.3 Customer Services

The Customer Service function will provide customer service capabilities supporting such areas as billing, service quality, inquiries, service features, service upgrades, and complaints. Customer Service is the most important part of the provision of service. The customer only needs Customer Service when the service is not totally transparent and thus when the service is not meeting the customers needs. Therefore, Customer Service is the MOST critical function that can be provided and must be provided with utmost care and effectiveness.

4. Network Elements

The network is the second portion of the service. The typical network is shown in the following figure. It connects from a telephone to a local phone comp any to the long distance company to the international record carrier then to a PTT, both long distance and local, and then to the terminating users. The most significant element of the costs is the settlement fee, which we shall discuss latter.



4.1 Transport: Internet vs. Intranet

We first focus on the costs of transport. There are two options for a packet TCP/IP type of network. The first is the Internet itself and the second is an IntraNet approach. We focus on the latter. The former is

subject to great delays, unpredictable costs, and total lack of security. Consider the following Table. It presents the costs for a 256 Kbps link for 6 months between the U.S. and the terminating countries at the rates of several carriers.

4.1.1 Table: Traffic from US to Country (6 month, 256 Kbps)

Carrier	***Poland***	***Czech Republic***	***Romania***	***Germany***	***England***
AT&T					
Sprint					
Teleglobe					
Global One					
France Telecom					
General					
MCI					

The goal of any network designer is to select the carriers to provide the minimal costs per minute of use to the network.

4.2 Termination and Settlements

The current International Record Carriers, IRCs, enter into bilateral and possibly multilateral agreements with other IRCs, namely the PTTs of the foreign entities to agree to settlement or accounting rates between each other. Generally these are bilateral agreements performed one at a time. The following is the FCC's current estimate of the size of the settlement process.[7]

> *"The United States paid roughly $5 billion in settlements to the rest of the world in 1995, up from $2.8 billion in 1990. The U.S. out-payment results in part from the fact that U.S. consumers make more telephone calls to foreign countries than foreign consumers make to the United States. In fact, the size of the imbalance between U.S.-outbound and inbound minutes has accelerated in recent years, as the chart in Appendix C demonstrates. To the extent that these settlement payments exceed the actual costs foreign carriers incur in terminating U.S.-originated calls, they represent a significant subsidy to foreign carriers. Based on our estimate of the costs of international termination services, we estimate that at least three-quarters of the $5 billion in out-payments is such a subsidy from U.S. consumers, carriers and their shareholders to foreign carriers."*

The system works in the following fashion. One carrier negotiates with another for the right to terminate traffic. For example Canada negotiates with the Ivory Coast. They agree on a settlement rate of say $0.40 per minute. This applies only to voice traffic. Say it is Teleglobe Canada and the Ivory Coast PTT. Now any traffic between he two is a $0.40 per minute. At the end of the year they add the traffic up and if there is more traffic from Canada to the Ivory Coast then the difference must be paid by Canada to the Ivory Coast at $0.40 per minute.

[7]Federal Communications Commission, FCC 96-484, Washington, D.C. 20554 In the Matter of International Settlement Rates , IB Docket No. 96-261, Adopted: December 19, 1996, ¶ 17.

Now let us assume that Teleglobe Canada wants to place a call to Uganda. It places the call in transit through the Ivory Coats which charges a transit fee of say $0.020 per minute and the Ivory Coats has an agreement with Uganda for terminating at say $0.15 per minute. The Teleglobe gets charged the sum.

The following is Teleglobe Canada perception of this process:[8]

> *For an international telecommunications service provider international telecommunication accounting practices distinguish between remuneration of the corresponding carrier in the country of destination or transit for the delivery of its traffic and the charge in national currency collected by an operator from its customers for the international facilities and services provided. According to CCITT Recommendations D.150 and D.155, which concern tariff and accounting practices in the international telephone service, the carrier in the destination country can be remunerated on the basis of a flat-rate price per circuit, on the basis of the traffic units carried, or through a procedure whereby accounting revenue is shared between terminal operators. Under the flat-rate price and traffic unit price procedures the carrier at the destination establishes its prices broadly based on the cost of the international circuit section it provides, the use of its international exchange (gateway) and the national extension. Under the accounting revenue division procedure the value of traffic in each direction between two corresponding international carriers is multiplied by a mutually agreed tariff or "accounting rate" to give an accounting revenue which is "in principle, shared equally between the (carriers) of the terminal countries in respect of each traffic direction". In theory, international carriers can agree on other than equal shares when their costs or the extent of the facilities that each provides vary significantly; however, in practice accounting rates are shared 50/50. If during a given settlement period (say a month or a quarter) there is more traffic flowing in one direction than the other, the carrier which receives more traffic than it sends will receive a greater amount of compensation from the corresponding operator for delivering its traffic than it has to pay out. The direction of the traffic imbalance, therefore, determines which operator has to pay its partner in a bilateral relation more than it receives. If, for example, the accounting rate between Canada and a given foreign destination is SDR 1.66 and the accounting rate is divided 50/50 then Canada pays its foreign partner 1/2 x 1.66 = SDR 0.83 per minute of traffic to deliver that call to its destination from the mid-point (say mid Atlantic) to the destination subscriber; to facilitate accounting, however, partners in a bilateral relation look at the sum of the traffic in both directions for a given period and apply the accounting rate only to the difference. If, therefore, during the period there are more minutes of traffic flowing out of Canada than flowing in, the imbalance obtained by multiplying by half of the accounting rate gives the "traffic settlement" which is due to the foreign administration. The greater country's traffic imbalance with another country, the greater its net payments outflow.*
>
> *If traffic levels are equal in both directions the out-payments are the same in both directions. In certain relations where traffic levels are more or less equal, carriers may agree to not exchange international accounts. Contrary to the result of most other international trade in goods and services transactions where a net export results in a net payment inflow in international telecommunications a net outflow of traffic will result in a net payments outflow from the country that "exports" that traffic. Collection charges are considered to be a purely national matter fixed by the provider of the international services subject to government, regulatory, financial and competitive constraints. The International Telecommunication Regulations like*

[8] See: “THE INTERNATIONAL TELECOMMUNICATIONS SETTLEMENTS PROCESS: WHAT'S NEEDED? DESTROY AND REPLACE IT OR ADJUST IT?”, Peter A. Stern, Teleglobe Canada Inc., Montreal, IIC Telecommunications Forum, 25 - 26 October 1990. Washington.

CCITT Recommendation D.150 emphasize the need "to avoid too great a dissymetry between charges applicable in each direction of the same relation". 10

The countries of Europe and the Mediterranean Basin have established somewhat more detailed provisions for determining the compensation for facilities made available by one international carrier to another for transit and for delivery of a call through its national network. CCITT Recommendation 300.R establishes prices to be charged on a per circuit or per channel basis according to per minute utilization and distance.

The key issue however is that Teleglobe has an agreement that any traffic that it terminates is voice and that it will pay the Ivory Coast at the agreed to rate. It cannot generally go back and say, this is Internet voice and I do not want to pay the Ivory Coast. A new entrant can start that way but an existing entrant places their existing agreements in jeopardy. Thus there is a general agreement that if there is an existing settlement agreement between two parties that the Parties shall honor the terms of the agreement and that any termination or transit of traffic shall be via the agreement and thus will require the payment of the pre-agreed settlement fees. This therefor places and existing carrier at jeopardy in view of attempting to get Internet terminations.

The FCC states that the accounting rate system has the following characteristics:[9]

The current accounting rate system was developed as part of a regulatory tradition that international telecommunications services were supplied through a bilateral correspondent relationship between national monopoly carriers.[10] An accounting rate is the price a U.S. facility-based carrier negotiates with a foreign carrier for handling one minute of international telephone service. It was originally intended to allow each carrier to recover its costs for terminating an international call.[11] Each carrier's portion of the accounting rate is referred to as the settlement rate. In almost all cases, the settlement rate is equal to one-half of the negotiated accounting rate. At settlement, each carrier nets the minutes of service it originated against the minutes the other carrier originated. The carrier that originated more minutes of service pays the other carrier a net settlement payment calculated by multiplying the settlement rate by the number of imbalanced traffic minutes.[12]

There is also some discussion of the sender keeps all system or the bill and keep approach. This has been discussed by Tarjanee the head of the ITU as follows:

Call termination fees offer a methodology which fits well with the World Trade Organisation's trade liberalisation framework. They fulfil many of the principles defined earlier for accounting rate reform. The idea would be that each country, or operator, would define one standard charge for terminating calls, irrespective of where those calls come from. The call termination charge would be comparable to the national interconnection charge levied, for instance, on mobile operators interconnecting with the public telephone network. The system would be

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[9] Federal Communications Commission, FCC 96-484, Washington, D.C. 20554 In the Matter of International Settlement Rates , IB Docket No. 96-261, Adopted: December 19, 1996, ¶ 6

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[10] We note that this tradition is not compelled by the international legal regime. *See* Article 9, International Telecommunication Regulation (Melbourne, 1988) and Article 31, Constitution of the International Telecommunication Union (Nice, 1989).

[11] *See, e.g., Regulation of International Accounting Rates*, CC Docket No. 90-337 (Phase II), *Second Report & Order and Second Further Notice of Proposed Rulemaking*, 7 FCC Rcd 8040, n.3 (1992).

[12] Every carrier is required to file a copy of its settlement agreements with the Commission. 47 C.F.R. § 43.51.

transparent, flexible, non-discriminatory and (hopefully) cost-based. The latter will probably depend on the degree of market competition which is allowed in each national market.

Call termination fees have received the blessing of the OECD and are currently under discussion in the WTO and the ITU. They are opposed by some carriers who are unwilling, or unable, to disclose their cost structures for terminating calls. They are also opposed by those carriers who feel that they should not be required to pay more for having their calls terminated in foreign countries than they themselves charge for terminating calls. But the fact is that providing telephony service is more expensive in some countries than others. The accounting rate system, which is based on a 50/50 revenue sharing agreement, implicitly assumes that costs are equal in all countries. This is patently not the case. The possibility exists for countries to agree on a split which departs from 50/50 but in practice this is never adopted except in "sender keeps all" arrangements. A system, such as call termination fees, which does not pretend that costs are equal in all countries would be much to the advantage of developing countries.

Conclusion : Thus under the existing settlement agreement, bilateral and multilateral, the existing carriers have generally affirmed and agreed to pay settlements on their voice circuits and that any change by them directly or otherwise would put their agreements in breach and could result in the immediate termination of their traffic from their home locations to the countries with whom they have agreements. The existing agreements are generally and in most cases expressly for the provision of voice traffic and have followed the generally accepted terms in existence for the past one hundred and thirty years.

The foreign PTTs, via their countries, generally have entered into the WTO agreements that generally place voice in the settlement arena and data in the non-settlement elements. The World Trade Organization (WTO) is the principal international body concerned with solving trade problems between countries and with negotiating trade-liberalizing agreements. WTO takes the place of the former General Agreement on Tariffs and Trade (GATT) and is the embodiment of the results of the 1986-1994 Uruguay Round of trade negotiations conducted under the GATT. The Director General of the WTO is Renato Ruggiero of Italy.

A new international organization, WTO has a cooperative relationship with the United Nations but is not a UN specialized agency. It was established on January 1, 1995 as a result of the implementation of the Uruguay Round results. The WTO encompasses previous GATT legal instruments as they existed when the Uruguay Round was completed (known as GATT 1994), but also extends new disciplines to economic and trade sectors not covered in the past. Whereas the GATT's scope was limited to trade in goods, the WTO also covers trade in services, including such sectors as banking, insurance, transport, tourism, and telecommunications sectors as well as the provision of labor. In addition, the WTO covers all aspects of trade-related intellectual property rights (copyrights, patents, trademarks, etc.). Furthermore, while the GATT had a relatively ambiguous status as a multilateral agreement without any institutional provisions, the WTO is an international organization with a stature commensurate with that of the World Bank or International Monetary Fund (IMF).

WTO's precursor, the GATT, was established on a provisional basis after World War II. When the agreement took effect in 1948, it was expected to be the forerunner of the International Trade Organization (ITO) which would have been a UN specialized agency. But plans for the ITO were abandoned when it failed to get U.S. congressional approval, and the GATT remained the only international instrument laying down rules accepted by nations carrying out most of the world's trade.

For 47 years the GATT provided the main international framework in which countries could discuss trade problems and, if need be, use the General Agreement's dispute-settlement provisions to solve trade disputes. The basic principles and rules of the WTO are much the same as those for the GATT, but with a

broader scope, a more solid legal and institutional basis, and enhanced decision-making provisions which preserve individual members' national sovereignty while precluding the damaging single-country blockages which plagued GATT's dispute settlement system.

WTO/GATT Principles: Like the GATT, WTO embodies many reciprocal rights and obligations for trading countries, and its core principle is the Most-Favored-Nation (MFN) clause. Under this, trade must be conducted on the basis of nondiscrimination -- all members are bound to accord each other treatment in tariffs and trade as favorable as they give to any other member-country.

A second principle common to both WTO and GATT is that, to the maximum extent possible, trade protection should be given to domestic industries only through the customs tariff and not through other measures (i.e. non-tariff measures such as quantitative restrictions, arbitrary technical standards, and health regulations), so that the extent of protection is clear and competition is still possible.

One of the most important accomplishments of the Uruguay Round was the establishment, for the first time, of a set of rules governing trade in services. GATT economists estimated in 1990 that services -- such as banking, insurance, tourism, construction, or telecommunications -- accounted for as much as 20 percent of total goods-and-services world trade. The GATS agreement establishes a multilateral framework for trade in services and provides a specific legal basis for future negotiations aimed at eliminating barriers that discriminate against foreign services providers and deny them market access. The principal elements of the GATS framework agreement include the most favored nation (MFN) treatment, national treatment (each government shall treat foreign services and service suppliers no less favorably than its own), market access, and free flow of payments and transfers. The rules are augmented by annexes addressing the special situations of individual service sectors (financial services, telecommunications, air transport, and movement of labor). The GATS' strong provision on national treatment specifically requires GATS countries to ensure that domestic laws and regulations do not tilt
competitive conditions against foreign firms. Complementing the GATS rules are binding commitments to market access and national treatment in service sectors that countries schedule as a result of bilateral negotiations. These commitments became effective upon entry into force of the WTO.

Data is generally free from settlements. This is the accepted result of the WTO negotiations and has been opined on by various entities. The FCC states its position in the following in the following:

> *"There are other technological developments that accentuate the market distortions caused by above-cost settlement rates. For example, the routing of bilateral traffic through third countries has become increasingly prevalent as a means to arbitrage settlement rate differences. Such re-routing can be helpful in undercutting the settlement rate system, but it can also lead to inefficient traffic routing patterns that are not aligned with underlying economic network costs. Use of the Internet also has emerged as an alternative to higher priced IMTS. Though internet traffic and switched voice traffic are carried over virtually identical facilities, the price for internet service is far cheaper because switched traffic is subject to international settlement rates, while internet traffic is exchanged outside of the traditional accounting rate system."*[13]

The Organization for economic Co-Operation and Development, part of the European Common Union, ECU, in its recent report further opines on the introduction of Internet type telephony and its advantages in its ability to have zero settlements. The OECD Study states the following:[14]

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[13] See: Federal Communications Commission, FCC 96-484, Washington, D.C. 20554 In the Matter of International Settlement Rates , IB Docket No. 96-261, Adopted: December 19, 1996, ¶ 17.

[14] Organization for Economic Co-Operation and Development, Paris, 1997, "New Technologies and Their Impact on the Accounting Rate System", p. 35.

"In the previous section, the call-back services which were examined provided service within the framework of the accounting rate and collection charge system. In this section, services which by-pass the international telecommunications charging system are examined. These services include international simple resale, which is already being offered in some countries. Other services, such as telephony using packet switched networks, including the Internet, would also be included in this group of services.

An overview of the different charging and settlement for a number of technologies is shown in Table 9. The services where there is no settlement are to a large extent used mostly by large business customers, but they are becoming increasingly available to the smaller customers given developments in technology, and regulation.

In general, the pricing structure for telecommunication services other than telephony does not depend on time and distance, and does not normally incur a settlement between the operators 12 . Telephone collection charges have also shown a trend toward being less time and distance related reflecting the digitalization of networks. There is, therefore, precedence for using systems other than accounting rates. Despite different charging frameworks many of these other services based on technologies other than the PSTN are profitable.

Table 9. Collection Charges and Settlement for Different Services[15]

Service	***Technology***	***Collection Charge Type***	***Settlement***
		Subscriber Line/ Trunk Line	
Telephone	*Switched Line*	*Time/Flat/ Time/Distance*	*Accounting rate system*
Packet	*Packet*	*Time/Volume/ Volume*	*Settlement by traffic volume*
X 400	*Store-and-Fwd*	*- /Volume*	*No settlement*
Leased line	*Leased Line*	*Flat*	*Half split (No settlement)*
Frame Relay	*FR, ATM*	*Flat*	*Half split (No settlement)*
Internet	*Packet / Others*	*PSTN, ISDN, L. lines, etc. / Flat*	*No settlement*

The above table depicts the WTO agreements as reflected in the Uruguay round of GATT talks. Namely that Internet, namely TCP/IP, is free from settlements and is the only one free on a full circuit basis.

Tarjanee, head of the ITU has also stated:[16]

"If market distortion were the only fault with the accounting rate system, it could probably survive. After all, economists usually agree on only one thing, namely that no market is ever perfect. The difficulty is that there are a growing number of other pressures for reform. ***An increasing share of traffic bypasses the accounting rate system completely because it is carried by just one operator instead of two (end-to-end service),***

[15] FR stands for Frame Relay Service. Source: OECD

[16] Rome, 25 March 1996, How will the accounting rate system need to be modified in a liberalised market? Liberalisation & Privatisation of the European Telecommunications Sector Preparing for 1998 & Beyond, Dr Pekka Tarjanne, Secretary-General, International Telecommunication Union (ITU),An International Conference arranged by IBC UK Conferences Ltd.

because it travels over private networks, or because it travels over theInternet. *Increasingly, owners of infrastructure wish to provide service directly to end-users instead of relying on correspondent partners. Furthermore, at the local level, callback operators and resellers exploit the fact that tariffs are not cost-based by arbitraging different prices between countries."*

The OECD report goes on to state:[17]

"Internet Telephony

The ability to provide voice services based on packet switched network technology is increasingly providing a competitive threat to traditional public switched telecommunication networks. Although the use of this technology for voice is only emerging, there is considerable interest in its potential. This interest is being fuelled by the fact that time-based usage charges are not traditionally used for packet switched networks. The Internet is providing the underlying infrastructure to begin experiments with providing international voice communications over networks based on packet switched network technology. Although initially voice communications tended to be computer to computer communications, developments are now emphasizing computer to telephone communications. The advantage of packet switched networks also includes, as well, the ability to handle integrated voice, data, and video services which many customers are increasingly requiring for day-to-day business. The fact that there are no international usage charges and only the price of local calls is paid is evidently providing an impetus to Internet telephony. Although arguments have been made that existing Internet capacity will not be able to handle an explosion of voice communication on these networks, it is not evident that the required capacity will not be forthcoming if the demand for services is there.

The development of Internet telephony (see Information Infrastructure and Pricing: The Internet, OECD/GD(96)73 for a comprehensive overview of pricing on the Internet) threatens the viability of the existing accounting rate system. The fact that telecommunication operators, and many governments, seem to continue to support high collection charges (and accounting rates) is in fact accelerating the development of new technologies which help by-pass the existing payments system. Long-term strategy by operators, if they wish to maintain their viability, would argue for lower, more competitive prices which would serve as well to slow down the development and diffusion of alternate calling procedures.

Governments, given the increasing liberalisation of data networks and in PSTN markets, will have difficulty in regulating the entry of many new services which use packet switched network technology, including voice communications. First, there is the problem in differentiating one type of digital message from another. Second, there is the difficulty in disrupting communications with any one 40 relation in that re-routing of traffic is a simple procedure. Third, there is the policy emphasis that many governments have placed on the diffusion of broadband infrastructures to create the information infrastructures of the future. To have an economic impact, usage prices on these infrastructures need to be low otherwise new services and on-line applications will be slow to develop. ***Many of these new services will gravitate to packet switched networks becauseof price advantages****."*

Furthermore Tarjanee further states:

[17] OECD p. 39-40.

"But such dependence on settlement payments is an unwise strategy. Experience shows that traffic stimulation and creating an attractive investment climate are more effective strategies for telecommunications development. By keeping charges high, developing country PTOs create incentives for callback and other forms of bypass which erode their competitive position. Furthermore, a new threat is emerging in the form of Internet telephony. The Internet famously does not employ the usage-based tariffing schemes on which the financial structures of PTOs are based, but instead employs flat-rate tariffs. Furthermore, the Internet has developed without any revenue-sharing mechanism between operators. In so far as there are payments from end-users, they are retained by service providers on a "sender keeps all" basis.

Internet telephony is based on packet switched rather than circuit switched networks. It would probably cost more to trace and bill the preciseroute taken by each data packet across the network than it would to send the call in the first place. The current state of the art in Internet telephony is quite primitive, attractive mainly to hobbyists and enthusiasts. But one can envisage a rapid evolution over the coming months. Already callback operators are offering to terminate calls originating from computers. Soon, those callback operators and resellers will use the Internet itself as a backbone for their calls.

If we lived in a rational world, few consumers would choose to have their conversations garbled by computers. But the prevailing price structures in international telephony are not rational. The ultimate commodity being sold is bandwidth. Voice traffic uses tiny amounts of bandwidth but is charged a high price. Data traffic uses huge amounts of bandwidth but is charged a low price. Consequently, "cross-over" technologies, such as voice over data networks, exploit these economically irrational tariff structures."

Conclusion : Thus under the WTO and under the generally agreed to terms of the WTO agreements on services, especially in telecommunications, data is free from both transit fees and settlement fees, and TCP/IP is defined as a form of data and is thus free from such fees. If a country who is a signatory to the Uruguay rounds decides to unilaterally violate that terms then it subjects itself to the severest penalties under the WTO.

5. Security

The IVN must also provide certain network security functions. These functions are listed below.

Function	***Details***
Unauthorized Access Control	The system shall be designed so that there shall be no unauthorized access of any IVN, router, switch, or IntraNet backbone element. The IVN shall provide for total and complete firewall capabilities to insure secure access and shall not permit any unauthorized packet flow through any IVN connected router.
Billing Control	The IVN shall provide for a complete secure billing collection system with complete and full real time redundancy. It must also provide alarms for any attempt to penetrate the system in an unauthorized fashion and shall provide for a complete and secure keyed access system for company access.
Wiretapping Implementation	The system shall allow for any and all legally authorized wiretaps to be implemented on the system. The taps must be in a standard format and

	must be able to be obtained in a secure and compartmentalized format.
Remote Instantaneous Cutoff	The system must have the capability of remotely and instantaneously being cutoff to prevent any unauthorized breach of security.
Packet Streaming Control	The system must prevent packet streaming. Namely the system must prevent the unauthorized use of the routers, whether they are connected via an IntraNet or Internet, by others for the purpose of sending packets over the network or through the routers. The IVN must have the capability to authorize each and every packet before transmission.
Network Management Compartmentalization	The network management system must be fully compartmentalized from the system. Any access to any voice channel must be monitored and must have a key control access capability. No user of the system may access any voice circuit in any fashion without having that access monitored.
Code Key Control	The system must use a secure code key access technique for any access to, modification of, reconfiguration of, or any material change to the system, its configuration, connections, or any other operational function.

6. Cost of Service Summary

A simple mode for Internet Voice processing is based upon the following assumptions. The costs are;

- *Operations costs including billing, customer service, network management, and other operations support system s costs: $6.00 per month per subscriber. This is $0.0100 per minute.*

- *IP Access costs for 600 minutes per month at the rate of $6.00 per month per user in bulk buys. This is $0.0100 per minute.*

- *Sales costs of 15% the gross revenue based upon a commission based sales force. If we sell the service at $0.0400 per minute, in competition with the lowest cost domestic long distance, this is $0.0050 per minute. If the price is $0.10 per minute then the sales cost is $0.0150 per minute.*

- *Local Access Fees of an amount that is equal to all other providers or zero, whichever is selected. We shall assume zero for the moment.*

- *Capital per Subscriber of approximately $50. This is based upon a $1,000 per line cost, with a 5% loading factor. The means an average monthly amortization, at 16% interest and 5 year payout, of $1 per month per user and for 600 minutes this is $0.002 per minute.*

- *This means a cost of between $0.0270 and $0.0370 per minute. If we add access, at say $0.0350 per minute, then we can sell anywhere to anywhere domestic long distance at $0.0600 to $0.0800 per minute. This is 5% to 20% less than the existing bulk buy long distance rates. This is not a great margin!*

However, the same numbers apply to international wherein the opportunity lies.

7. Conclusions

The is a significant future for Internet Voice and many companies will be possible leaders in that market. The business will focus on two areas; the home PC user and the business PC user, and the service bureau player. Where the ultimate success will be is uncertain. However, the challenges will continue to be regulatory and not technical. We see voice modems and codecs reducing the delay to less than 40 msec and that access to the High Speed backbone will reduce transport packet delay to a similar numbers. Voice quality will have low delay and high recognizability. Access to INet voice will also be a mad simpler with IVN architectures. Finally, pricing will make this highly costs competitive to the existing alternatives, however the major conclusion is that the INet architecture enables multimedia communications via TCP/IP more than SS7 will ever be able to do. TCP/IP is a “natural” effect of integrating voice and data. The existing Telco architecture is archaic and will not survive. The author presented this case in 1990 at Harvard and the only conclusion is that it is even more so now than it was then.