The Value of IP Clearing & Settlement

New Revenue Opportunities for IP Carriers

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Introduction

Industry analysts forecast that bandwidth demand for data networks will soon far exceed the bandwidth demand for voice networks, (See Figure 1). As the global infrastructure for data networks grows, voice traffic will migrate from circuit switched telephone networks to data networks. Voice traffic will become one of many applications, such as video, e-commerce, and fax, provided over data networks.

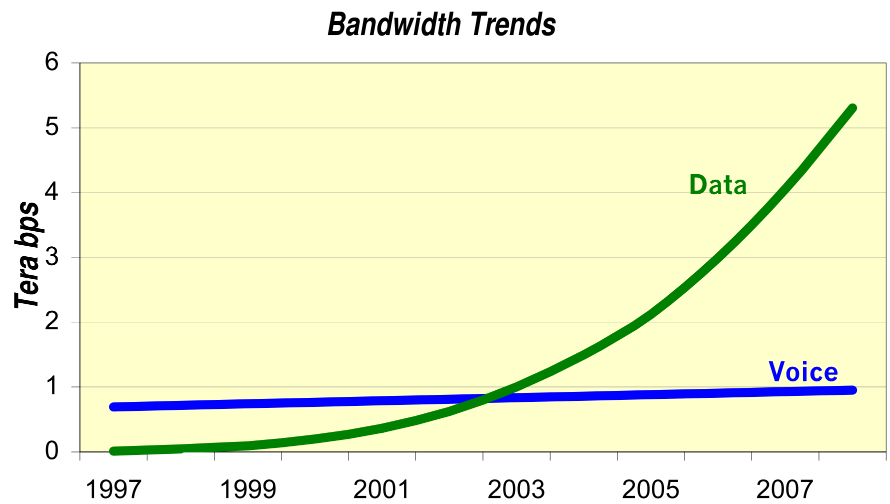

Figure 1

Source : A. D. Little

As traditional circuit switched telephony services become applications using the global IP (Internet protocol) data networks, the need for authorizing and billing inter-IP domain traffic will grow. This commercial function, known as clearing and settlement in circuit switched telephone networks, presents a major new revenue opportunity for IP carriers.

Clearing and settlement lets IP carriers duplicate the functionality of a wholesale circuit switched network, but at substantially lower costs. As Appendix 1 details, IP telephony offers a 50% cost advantage over circuit switched telephony, even before considering the benefits of available tariff arbitrage or reduced capital expense for circuit switched network equipment.

The Need for Clearing and Settlement

Clearing and settlement in the telecommunications industry is the commercial complement to physical network interconnection. It is the economic process of compensating interconnected networks for shared traffic.

To enable revenue sharing among network providers involved in the origination and termination of VoIP/FoIP (Voice over IP/Fax over IP) traffic, there must be an efficient mechanism to securely authorize, route and rate individual calls and to allocate/transfer revenue to the network providers who terminate traffic at their gateways. Clearing and settlement is the critical commercial enabler of IP Telephony. Without this tracking mechanism, there would be little revenue incentive to originate or terminate IP telephony traffic.

The following sections illustrate interconnection models for existing circuit switched telephone networks, the World Wide Web and IP telephony.

Circuit Switched Interconnection

The interconnection model for the traditional circuit switched telephone network is shown in Figure 2. This model starts with the calling party who pays for the call to be completed to the called party. The originating network operator relies on other networks to complete the call to the called party. The circuit switched telephony model works well because each network operator is compensated for carrying its segment of the call.

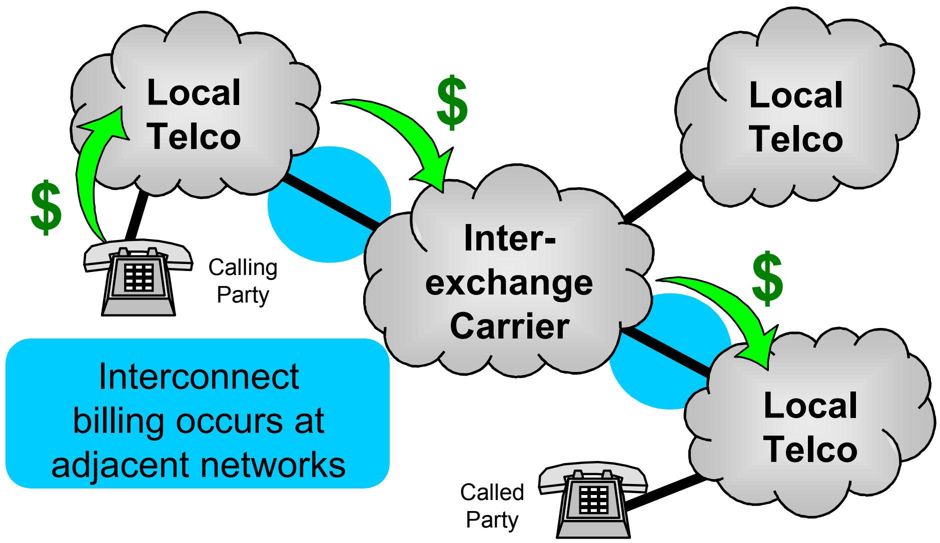

Figure 2
Circuit Switched Interconnection Model

Network operators compensate each other for the traffic they exchange through bilateral interconnection agreements. These agreements specify how two networks are physically interconnected at the network level. These agreements also specify how the networks are paid on a business level. For example, the price a network operator will pay to another network operator to complete its phone calls.

The two interconnected carriers periodically determine how much traffic they have sent to and received from one another. The traffic exchanges between the two networks are netted out to yield a net traffic flow. The net traffic flow is multiplied by the interconnection fee. The product is a net settlement payment from the net originating network (the calling party's network) to the net terminating network (the called party's network).

In the circuit switched interconnection model, network and business interconnection occurs between adjacent networks. Network security related to the exchange of traffic is simple since the networks have a direct connection between tandem switches. There is no risk of fraudulent interconnection since each operator has complete control over trunk group installation and Call Detail Records (CDRs) generated by their switch.

WWW Interconnection

The World Wide Web (WWW) interconnection model is different from the interconnection model for circuit switched telephony in two important ways. First, in the circuit switched interconnection model, wholesale network resources are paid for on a usage basis. In the WWW interconnection model, customers and operators pay for access to network resources. With simple access pricing, interconnection pricing is based on the size of the pipe used to physically interconnect networks, not the volume or type of traffic exchanged between networks. For example a T1 connection (1.54 MB access) may cost a fixed $1,500 per month regardless of the volume of voice or data traffic exchanged between the networks.

Second, in the circuit switched model, all service revenues are paid by the calling party. In the WWW interconnection model, revenue is derived from both the originating and terminating networks. As shown in Figure 3, the browsing party (analogous to the calling party) pays its ISP to get access to the Internet. The browsed party (analogous to the called party) pays its ISP to make its web site accessible to all browsers on the Internet. In turn, both ISPs pay a wholesale IP network operator for access to the Internet.

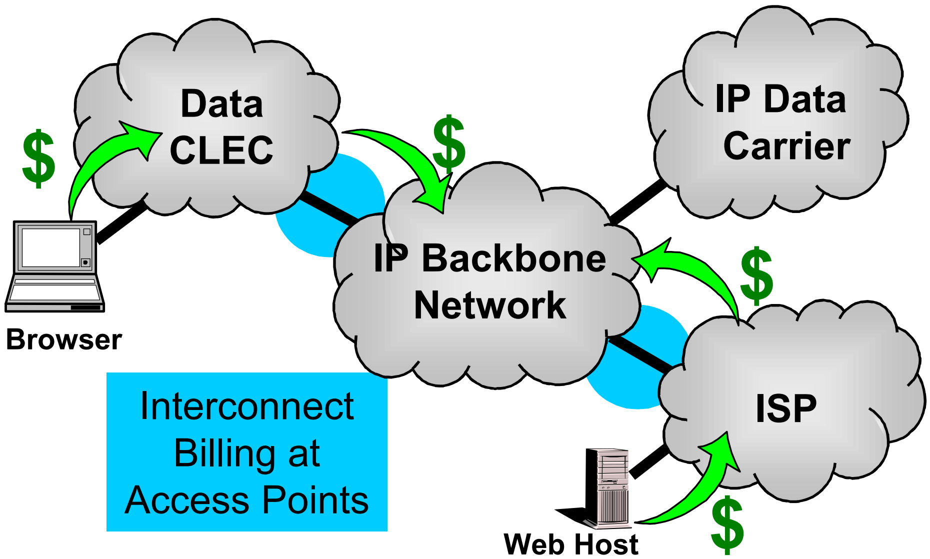

Figure 3
WWW Interconnection Model

IP Telephony Interconnection

The IP telephony interconnection model is a combination of both the circuit switched and the WWW interconnection model. At the IP network level, interconnection between the IP networks is the same as the WWW interconnection model. Smaller IP networks pay for access to an IP backbone network.

As illustrated in Figure 4 on the next page, layered on top of the IP infrastructure are VoIP (voice over IP) gateways located at the edge of the IP network. These gateways convert telephone calls into IP packets for transmission across the IP network. In a typical scenario, a telephone call will be received by an originating VoIP gateway. The originating gateway will convert the telephone call into a stream of IP packets that are transmitted across the IP network to a terminating gateway. The terminating gateway receives the IP packets and completes the telephone call to the called number. The entire voice over IP segment of the telephone call is transparent to the calling and called parties.

Like the traditional circuit switched interconnection model, all Internet telephony service revenues are generated by the calling party. Also, like the circuit switched interconnection model, network operators will not complete calls on behalf of other firms unless they are compensated for the use of their network. The WWW interconnection model ensures that the IP backbone operator is compensated for the IP traffic it exchanges with the originating network operator. However, the WWW interconnection model offers no means for the terminating VoIP operator to be paid for accepting the VoIP packets and completing the telephone call.

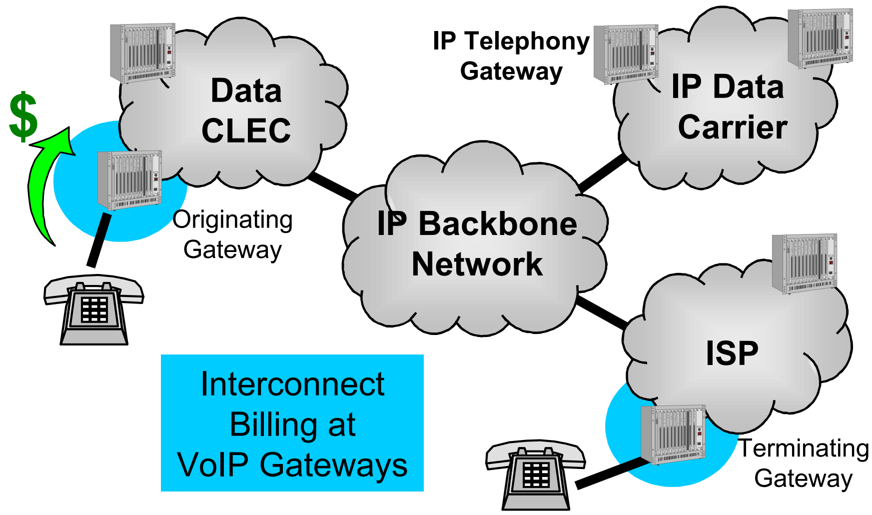

Figure 4
IP Telephony Interconnection Model

IP telephony introduces a new revenue sharing (billing) paradigm. Networks that are not directly interconnected must be compensated for their role in initiating and terminating calls. This new paradigm presents two challenges. The first challenge is a practical business problem. Since there are many IP networks worldwide that are not interconnected, the number of interconnection agreements between VoIP/FoIP operators (or ITSPs) is n(n-1)/2, where n is the number of operators. Negotiating and managing thousands of bilateral interconnection agreements is not a practical business solution.

The second challenge is technical. Billable events between two operators that are not directly interconnected must be securely authorized and rated. The process of authorizing and rating these events in real time is a new e-commerce challenge.

TransNexus has solved both of these challenges with the first highly scalable, secure, standards-based solution for global intercarrier IP telephony billing.

IP Clearing and Settlement – A New Paradigm

TransNexus believes that global adoption of IP telephony is inevitable. The universal deployment of IP telephony, however, requires both ubiquitous technical and commercial interconnection. A robust commercial interconnection model is a fundamental enabler for the success of IP telephony. The TransNexus clearinghouse solution solves the technical and business problems introduced by the new paradigm of edge-to-edge billing of IP telephony traffic between ITSPs.

Access to New Markets

TransNexus has solved the first challenge of managing thousands of bilateral interconnection agreements by designing a clearinghouse solution for intercarrier billing. Figure 5 illustrates this scaling problem of bilateral agreements with a hypothetical network in the Far East. Assume, for example, that there are twelve ITSPs exchanging VoIP traffic. Commercial interconnection via bilateral agreements requires 66 individual interconnection agreements. By using a trusted third party clearinghouse service, however, the total number of interconnection agreements is reduced to twelve. That is, each ITSP maintains only one interconnection agreement with the third party clearinghouse service instead of maintaining multiple interconnection agreements, one with each ITSP.

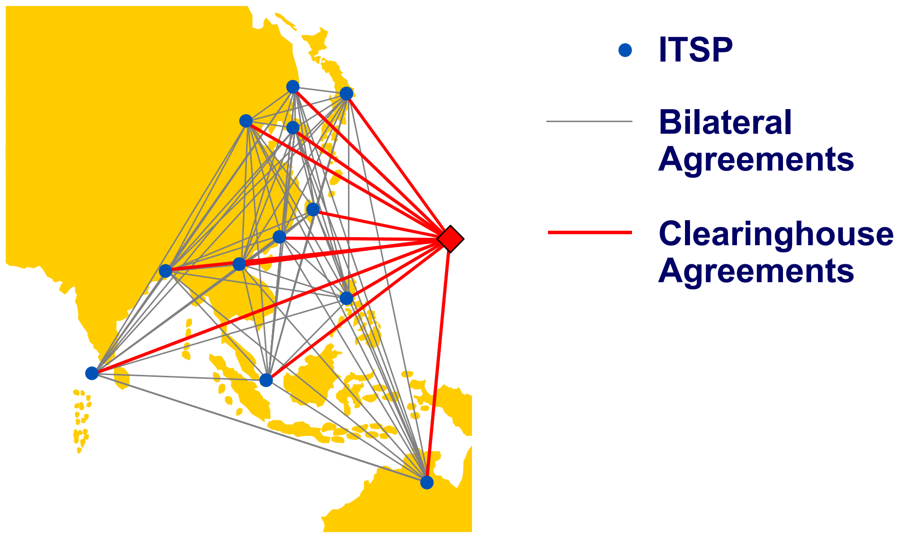

Figure 5
Illustration of Scaling Problem of Bilateral Agreements

The example in Figure 5 is a small network, but it illustrates the significant economies of scale that can benefit all operators by using a clearinghouse service. Interconnection agreements require material expense to negotiate and maintain (legal fees, auditing, billing, credit risk). Assuming that the average cost per interconnection agreement is $10,000 per year, the chart in Figure 6 illustrates how the total cost savings offered by a clearinghouse service can be very large as the number of participating networks increases.

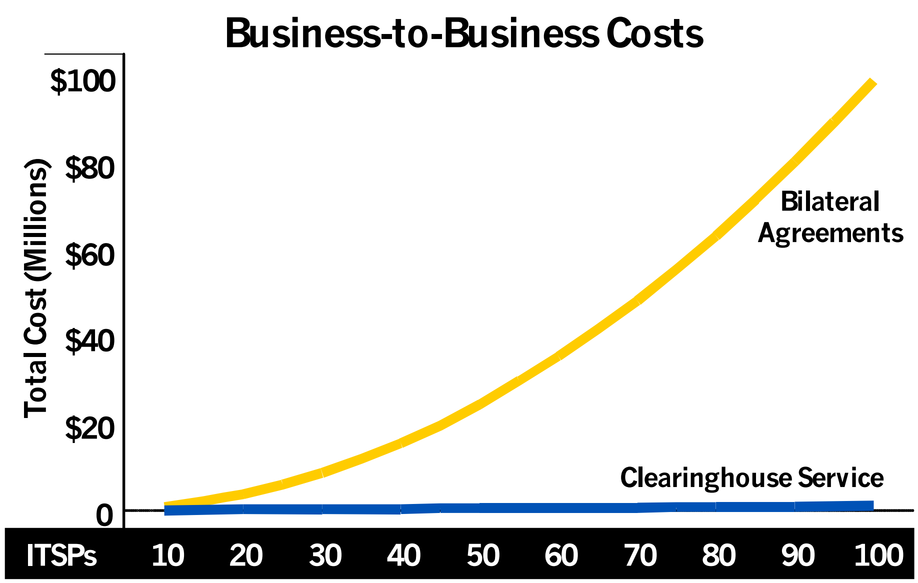

Figure 6
Illustration of Cost Savings Associated with Clearinghouse Service

The value of a clearinghouse, however, is much more than just cost savings. From a marketing point of view, the value of a clearinghouse service is access to new markets, that is, new originating and terminating networks/gateways. By subscribing to a clearinghouse service, network operators obtain the ability to expand their commercial services and increase revenues. From an economic point of view, originating network operators should expect to pay lower termination fees as commercial access to new termination points increases. Finally, terminating network operators automatically get access to a new source of traffic demand. This new source of demand is a highly lucrative opportunity to generate revenue from excess capacity during off-peak periods.

Secure Transaction Technology

The critical technical challenge for TransNexus' highly scalable IP clearinghouse solution model is the ability for the clearinghouse to act as the trusted third party without being directly involved in the communications path between originating and terminating IP networks. TransNexus has led the industry in establishing the solution to this problem with the creation of the Open Settlement Protocol (OSP).

Figures 7 and 8 illustrate the role of the TransNexus clearinghouse solution.

1. A call is received by the originating gateway. If the originating operator does not have facilities (a gateway) available to complete the call to the called number, the originating gateway can query the clearinghouse for the IP address of a gateway to complete the call. (See Figure 7.)

2. TransNexus clearinghouse servers perform a high-speed number resolution to determine the IP address of the best gateways to terminate the call to the called number. The traffic exchange criteria used for the number resolution can include price, by time of day, day of week, type of service requested (e.g., voice or fax) and quality of service required. The prioritized list of gateways is returned to the originating gateway with digitally signed, cryptographic authorization tokens for each candidate-terminating gateway. (See Figure 7.)

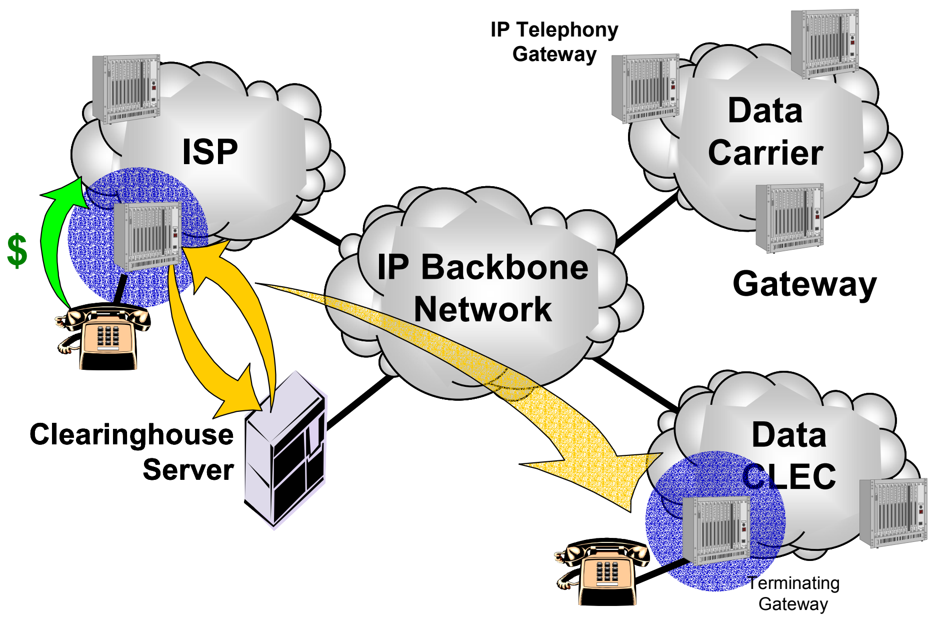

Figure 7

IP Telephony Call Authorization and Set-up

3. The originating gateway, using the routing information and TransNexus authorization token, sets the call up, peer to peer, with the terminating gateway. The authorization token is inserted directly to a standard IP telephony call set-up signal. (OSP is compatible with H.323, SIP and MGCP IP telephony protocols.) The terminating gateway operator may or may not have any commercial relationship with the originating gateway

operator, but the terminating gateway can cryptographically verify the token and recognize that the call has been authorized by TransNexus. The terminating gateway then completes the call to the dialed number. (See Figure 7.)

4. After the call is completed, both gateways return Call Details Records (CDRs) to the clearinghouse where these CDRs are reconciled and rated. A running settlement account balance is maintained for each operator (ITSP) so that authorization to originate traffic can be denied if their prepaid deposit with the clearinghouse falls below acceptable limits. (See Figure 8.)

5. Periodically, the clearinghouse executes a net settlement of funds from the net originators to the net terminators. TransNexus can execute these transactions directly or provide the billing information required for another party to execute settlement of funds. (See Figure 8.)

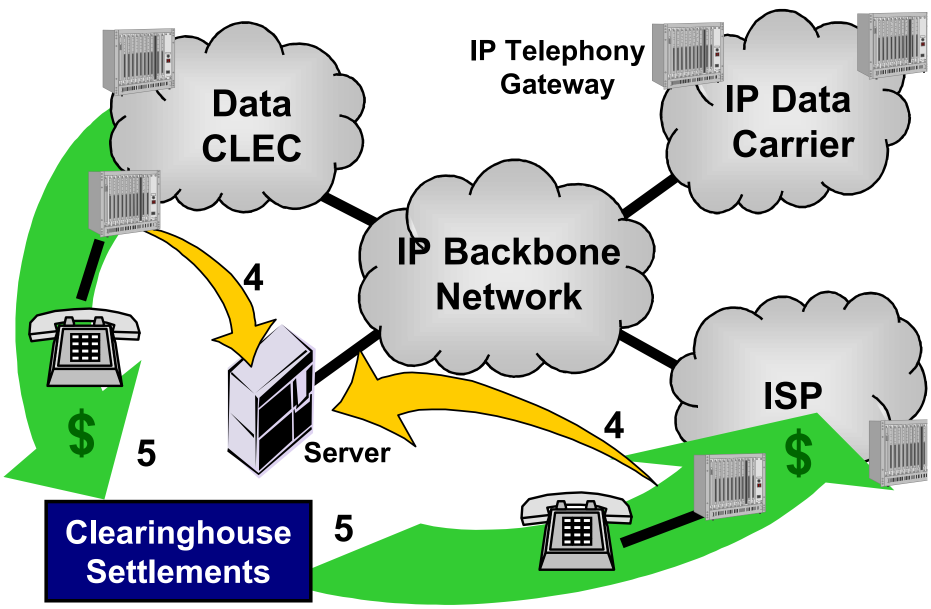

Figure 8
Call Detail Reporting and Settlement

Value of IP Clearing and Settlement

IP Carriers are well positioned to benefit from IP Clearing and Settlement

There are several reasons for which IP clearing and settlement is attractive to IP carriers (IP backbone operators):

1. The IP infrastructure of these firms is well suited for handling IP voice and fax with an acceptable quality of service.
2. IP Carriers are seeking ways to stimulate demand for their core service, that is, wholesale IP bandwidth. Clearing and settlement is a critical commercial enabler for IP telephony applications, and these applications will increase demand for wholesale IP bandwidth.
3. Clearing and settlement services enable IP carriers to provide their service provider customers (ISPs and CLECs) new value-added services. Furthermore, by clearing and settling inter-network IP voice/fax

traffic, IP carriers can effectively charge higher rates for voice/fax traffic than for commodity IP data traffic.

4. An IP carrier's installed base of ISPs and CLECs represents an existing community of users who, with a small capital investment, can immediately benefit from inter-network clearing and settlement by offering new value-added voice/fax services to their customers. (Clearinghouse can provide CDRs to ISPs and CLECs for billing retail customers.)

Network Economics

The IP telephony business model represents a significant value opportunity for an Internet Telephony Service Provider in the US market. This opportunity translates into a 1.5 cent per minute spread in average costs between the circuit switched telephony business model and the IP telephony business model. This section describes the network economics associated with both models.

Circuit Switched Telephony Business Model

Figure 9 illustrates the typical cost a Competitive Local Exchange Carrier (CLEC) would pay to an Inter-Exchange Carrier (IXC) for terminating long distance calls in the US. In the call scenario below, a CLEC customer makes a phone call to another customer outside the CLEC's network service area. In order to provide long distance service, the CLEC will have to purchase the long distance transport from an IXC. To do so, the CLEC would run facilities to the closest IXC Point of Presence (POP). Typical carrier rates to CLECs will be approximately three cents per minute or more, depending on volume commitments. In Figure 9, the call segment between the IXC and the LEC costs the CLEC three cents per minute.

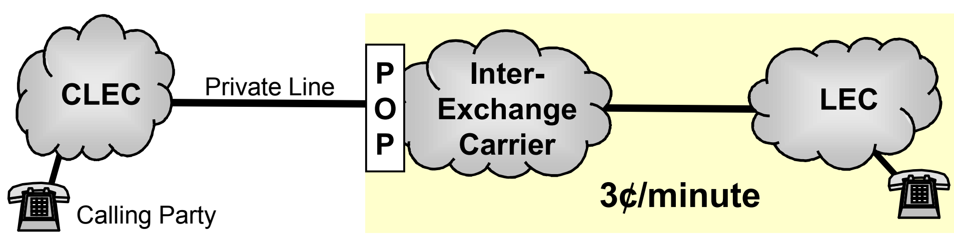

Figure 9
Circuit Switched Telephony Economic Model

IP Telephony Business Model and Cost Assumptions

Here we compare the wholesale cost of circuit switched transport to IP telephony transport on a comparable per minute basis. This analysis models the per minute costs for the calling party's CLEC to originate VoIP traffic and the per minute costs for the called party's CLEC to terminate the call to the dialed telephone number.

The starting point for this analysis is the common circuit switched architecture deployed today and its corresponding business model. A simple overview of this business model was presented in Figure 9. The key point in this model is that the CLEC of the calling party can purchase continental US termination from an Inter-Exchange Carrier for three cents per minute.

To make an accurate and conservative comparison between the costs of circuit switched telephony and IP telephony, this analysis adds IP telephony network infrastructure as an overlay to the circuit switched model. The overlay VoIP infrastructure and its cost components are illustrated in Figure 10. This IP telephony business model does not benefit from any capital savings in the circuit switched model or from tariff arbitrage. The costs used in this analysis are based on 1999 prices. Falling prices for VoIP infrastructure and IP bandwidth are positive trends which increase the value if IP clearing and settlement.

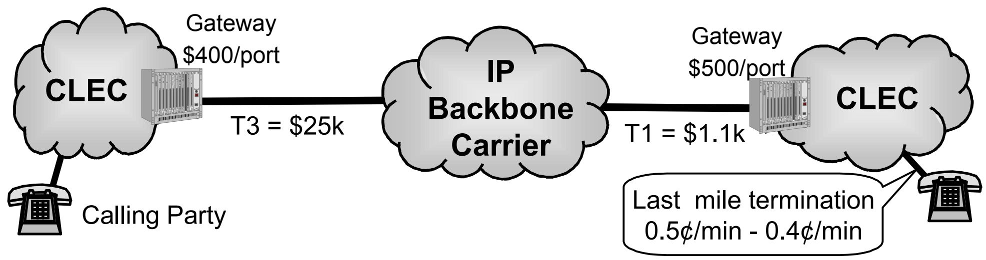

Figure 10
IP Telephony Economic Model and Cost Components

IP telephony gateways have been introduced at both the originating and terminating CLECs. These gateways are assumed to cost $400 per voice port for T3 port densities and $500 per port for T1 port densities. These gateways are incremental investments to the circuit switches required in the example above. This analysis does not assume a benefit from replacing existing network capital with IP telephony equipment. Recognized as an average benchmark cost in the industry, $500 per voice port is expected to fall to $100 per voice port, or less, over the next several years.

Also illustrated are the monthly charges for T3 (45 Mbps) and T1 (1.544 Mbps) access to an IP backbone. The prices shown ($24,750 for T3 and $1,050 for T1) are list prices for Level 3 Inc., a major IP carrier. The private lines required for T3 and T1 access to the IP backbone also have local loop charges. These costs are not included in this analysis since the same local loop private line charges are also incurred in the circuit switched telephony model illustrated in Figure 9. This analysis only presents new incremental costs which are required for IP telephony.

The last cost element is the local egress (terminating access) fee charged by the LEC to deliver the telephone call over the last mile to the dialed party. CLECs rarely have facilities (physical circuits) to the called party. So to complete the call, the CLEC will hand the call off to the Incumbent Local Exchange Carrier (ILEC) to complete the call. The terms for these interconnection agreements, which are usually in the public record, are negotiated on a carrier by carrier basis in each state. For this analysis, cost assumptions for last mile termination have been taken from the interconnection agreement between BellSouth and ICG Telecom Group. The interconnection termination rates have been set at 0.4 cents per minute for calls terminated to an end office and 0.5 cents per minute for calls terminated to a tandem (inter-end office) switch.

To complete the economic comparison between the circuit switched and IP telephony models, the IP telephony cost components have been transformed into per minute amounts. The key assumptions in the analysis to develop the cost components in Figure 11 are listed below. Please see Appendix 1 for the complete details of the IP telephony cost model.

- Installation fees for T1 and T3 data connections are $1,000 and $6,000 respectively. These are list prices from Level 3 Inc.
- Capital recovery time requirement is nine months for gateway investment and installation fees for T1 and T3 data connections.
- Maximum usable bandwidth for T1 and T3 data connections is 70% of total capacity.

- Capacity utilization for voice channels at the originating CLEC is 33% for T1 and 40% for T3 connections. Voice capacity utilization at the terminating network is 50%.
- Each voice over IP channel requires 14 Kbps of bandwidth.
- Terminating CLEC requires 50% gross margin on costs for data connection, gateway capital recovery and local termination fees.

The results of this analysis are illustrated in Figure 11.

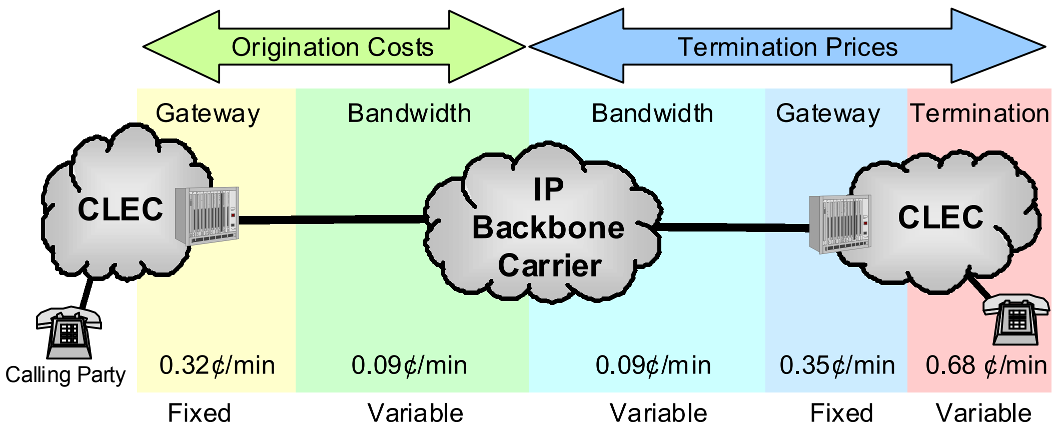

Figure 11
IP Telephony Economic Model with Average Costs

The results of this analysis demonstrate that US wholesale circuit switched long distance services costing approximately 3 cents per minutes can be provided with an IP telephony infrastructure at approximately 1.5 cents per minute. It is important to note that clearing and settlement costs are included in the circuit switched economic model, but they are not included in the IP telephony economic model.

TransNexus believes this IP telephony cost analysis is conservative for the following reasons:

- It validates the cost advantage of IP telephony in the US market, one of the most competitive and lowest cost telecom markets in the world. For international scenarios the cost advantage of IP telephony would be significantly greater.
- The IP telephony cost model does not benefit from any capital savings in the existing circuit switched telephony model. However, there are certainly scenarios where the cost savings from not deploying circuit switched equipment would give the IP telephony cost model an additional advantage.
- The IP telephony cost model does not benefit from any artificial economic advantages such as tariff arbitrage. The analysis uses publicly available rates in a call scenario completely acceptable to US regulators.
- Approximately 40% of the total IP telephony costs are attributable to recovery of IP telephony network equipment capital expenses over a nine month period. This assumption is conservative since the costs for IP telephony equipment are expected to fall and nine months is a relatively fast payback period for network assets.

Tapping the Value of Excess Network Capacity

In the IP telephony model, the 1.5 cents per minute is the *average* of all economic costs, fixed (gateways) and variable (bandwidth and LEC termination). Economic costs are defined as accounting costs plus profit margin.

This point is important because the mesh architecture of an IP network does not require direct interconnection between ITSPs to exchange IP telephony traffic. Since ITSPs are fully interconnected, the market opportunity for them to buy or sell excess capacity at *marginal* economic costs (cost + profit margin) can be very efficient and profitable for all participants.

TransNexus foresees that terminating ITSPs will make their excess network capacity available at their marginal economic cost (variable cost + margin). If this is the case, then in off-peak times when excess capacity is available, TransNexus believes the economic price for the IP telephony model above will be based only on variable costs (bandwidth and LEC termination). In this scenario, the economic cost is not 1.5 cents per minute, but less than 1 cent per minute, and the cost difference between the two models is 2 cents per minute. ISPs represent a ready market that could benefit immediately from the ability to generate call termination revenue from slack network capacity.

The economic appeal of VoIP termination is driven by two factors. First, the peak traffic load for the average ISP offering dial-up services occurs in the evening. The peak for telephone traffic occurs during the day when ISPs have excess capacity available. ISPs are a natural market for offering VoIP termination services since their traffic loads are asymmetric with telephony traffic. Second, ISPs generate approximately 1.5 cents per minute in gross revenue for dial-up services. This 1.5 cents per minute in gross revenue must cover all network, marketing and customer service expenses. ISPs would not incur marketing or customer service expenses for IP telephony termination services. For this reason, TransNexus believes that ISPs can profit from offering IP telephony termination service at a price well below 1.5 cents per minute. This assumption is even more compelling if the ISP offers VoIP termination services when it has excess capacity available.

Tapping the value of excess network capacity is not a new concept for circuit switched telephony operators. Traditional telephone companies have been profitably buying and selling excess capacity at marginal economic costs for decades. TransNexus believes, however, that an IP architecture enables the trading of network capacity between carriers at dramatically lower transaction costs. For example, the TransNexus Clearinghouse Solution can auction IP telephony traffic, on a call by call basis, in real time between thousands of IP telephony gateways anywhere in the world. This type of dynamic auction process is not feasible with a circuit switched telephony network.

TransNexus Value Proposition to IP Carriers

The TransNexus OSP Nexus and NexOSS Manager solution provides IP carriers with a complete, standards based clearinghouse solution which can be customized to meet the needs of any IP carrier. Acting as the VoIP clearinghouse, the IP carrier can set interconnection rates between its ISP and CLEC customers and keep the net difference of what is charged by the originating ISP to the end retail customer, what is paid by the originating ISP to the terminating ISP for completing the call, and the fee to TransNexus for operating the clearinghouse service on behalf of the IP carrier. Alternatively, the IP carrier can enable a real time auction process between its customers (match originating and terminating operators in real time according to bid and ask pricing) and charge a transaction fee for each call cleared and settled.

Benefits of the TransNexus IP Interconnect Solution

1. The TransNexus OSP Nexus Server and NexOSS Manager solution enables the IP Carrier to offer secure interconnect and settlement as a value-added service to its customers.
2. VoIP clearing and settlement stimulates additional demand for the IP Carrier’s core business, IP bandwidth.

3. Clearing and settlement fees provide an opportunity for the IP Carrier to generate incremental revenue.
4. Very low technology risk. The TransNexus solution is based on the Open Settlement Protocol (OSP), an international standard for inter-domain authorization and billing. OSP is compatible with both H.323 and SIP. By using an open standard that interoperates with multiple network protocols and multiple vendors, the IP carrier can maximize business flexibility and vendor choices.
5. Very low vendor risk. OSP is supported by a wide variety of VoIP vendors including Alcatel, Cisco, CommWorks, Ericsson, ISDN Communications, Mediaring, Radvision, and others
6. High scalability and reliability. The stateless architecture of OSP enables a highly distributed solution which can achieve very high levels of scalability and reliability at very low cost.
7. High security. OSP offers the highest level of interdomain VoIP security available.

Appendix 1 IP Telephony – Circuit Switched Cost Comparison

The following three tables provide the detailed analysis used to transform the IP telephony model cost components presented in Figure 10 into per minute amounts which can be compared to circuit switched costs.

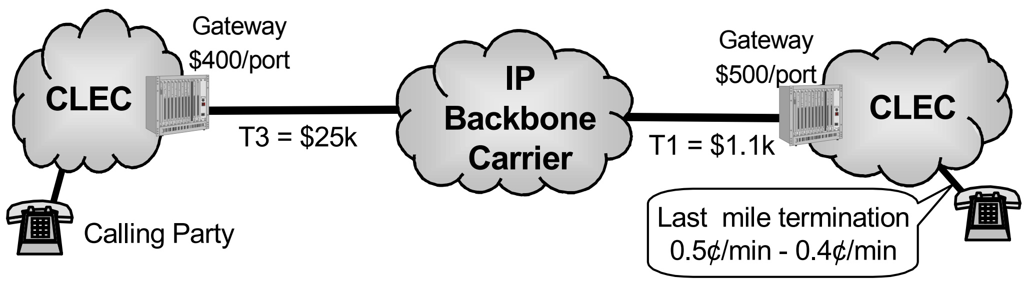

Figure 10

IP Telephony Economic Model and Cost Components based 1999 prices

		T3 Access	T1 Access	Assumption
1	Payback period - number of months assumed to recover gateway costs and T1/T3 installation fees.	9	9	Assumption
	VoIP Origination Costs	**T3 Access**	**T1 Access**	**Assumption**
2	IP Access per month	$ 24,750	$ 1,050	Level3 prices
3	Installation costs	$ 6,000	$ 1,000	Level3 prices
4	Installation cost recovery/month	$ 667	$ 111	line 3 / line 1
5	Total IP Access Cost per month	$ 25,417	$ 1,161	line 2 + line 4
6	Total capacity in Kb/sec	45,000	1,500	
7	Max usable bandwidth	70%	70%	Assumption
8	Usable Data Bandwidth in Kb/sec	31,500	1,050	line 6 * line 7
9	Bandwidth/VoIP channel Kb/sec	14	14	Assumption
10	Max simultaneous VoIP calls	2,250	75	line 8 / line 9
11	Traffic distribution assumption			
12	Total Minutes in a month	43,200	43,200	60min * 24hrs * 30days
13	Capacity utilization	40%	33%	Assumption
14	VoIP minutes per channel/month	17,280	14,256	line 12 * line 13
15	Total VoIP Minutes per month	38,880,000	1,069,200	lines 10 * 12 * 13
16	VoIP mins/month/port	17,280	14,256	line 15 / line 10
17	**IP Bandwidth cost per VoIP minute**	**$ 0.00065**	**$ 0.0011**	line 5 / line 15
18	Gateway cost per port	$ 400	$ 500	Assumption
19	Allocated port cost per month	$ 44	$ 56	line 18 / line 1
20	VoIP mins/month/port	17,280	14,256	line 16
21	**Gateway cost per minute**	**$ 0.0026**	**$ 0.0039**	line 19 / line 20
22	**Total VoIP Origination Costs**	**$ 0.0032**	**$ 0.0050**	line 17 + line 21
	Incremental direct costs incurred by the originating CLEC / ITSP.			

Table 1

IP Telephony Model VoIP Origination Cost Components

	VoIP Termination Costs	T3 Access	T1 Access	Assumptions
23	IP Access per month	$ 24,750	$ 1,050	Level 3 list prices
24	Installation costs	$ 6,000	$ 1,000	Level 3 list prices
25	Installation cost recovery/month	$ 667	$ 111	line 24 / line 1
26	Total IP Access Cost per month	$ 25,417	$ 1,161	line 23 + line 25
27	Total capacity in Kb/sec	45,000	1,500	
28	Max usable bandwidth	70%	70%	Assumption
29	Usable Data Bandwidth in Kb/sec	31,500	1,050	line 27 * line 28
30	Bandwidth/VoIP channel Kb/sec	14	14	Assumption
31	Max simultaneous VoIP calls	2,250	75	line 29 / line 30
	Traffic distribution assumption			
32	Total Minutes per month	43,200	43,200	
33	Capacity utilization	50%	50%	Assumption
34	Total VoIP Minutes per month	48,600,000	1,620,000	lines 31 * 32 * 33
35	VoIP mins/month/VoIP channel	21,600	21,600	line 34 / 31
36	**IP Bandwidth cost per VoIP minute**	**$ 0.0005**	**$ 0.0007**	line 26 / line 34
37	Gateway cost per port	$ 400	$ 500	Industry Benchmark
38	Amortization in months	9	9	line 1
39	Allocated port cost per month	$ 44	$ 56	line 37 / line 1
40	VoIP mins/month/port	21,600	21,600	line 35
41	**Gateway cost per minute**	**$ 0.0021**	**$ 0.0026**	line 39 / line 40
42	**Subtotal Bandwidth & Gateway costs**	**$ 0.0026**	**$ 0.0033**	line 36 + line 41
	PSTN Termination Assumptions to called number in $/minute			
43	CLEC Termination via tandem switch	$ 0.0050	$ 0.0050	BellSouth - ICG
44	CLEC Termination via end office	$ 0.004	$ 0.004	BellSouth - ICG
	Total Termination Costs to Called Number			
	Includes IP Bandwidth, Gateway payback and PSTN termination			
45	CLEC Termination via tandem switch	$ 0.0076	$ 0.0083	line 42 + line 43
46	CLEC Termination via end office	$ 0.0066	$ 0.0073	line 42 + line 44
	Price components for VoIP Termination to Called Number			
	Termination Costs * Gross Margin			
47	Terminator's required Gross Margin	50%	50%	Assumption
48	IP Bandwidth per minute	$ 0.0008	$ 0.0011	(1+ line 47)*line 36
49	Gateway Capital Recovery	$ 0.0031	$ 0.0039	(1+ line 47)*line 41
50	CLEC Termination via tandem switch	$ 0.0075	$ 0.0075	(1+ line 47)*line 43
51	CLEC Termination via end office	$ 0.0060	$ 0.0060	(1+ line 47)*line 44

Table 2

IP Telephony Model VoIP Termination Cost Components

Table 3 provides a summary of the IP telephony cost components calculated in Tables 1 and 2. Table 3 presents the high and low costs and an average of the two. The average costs are also illustrated in Figure 11.

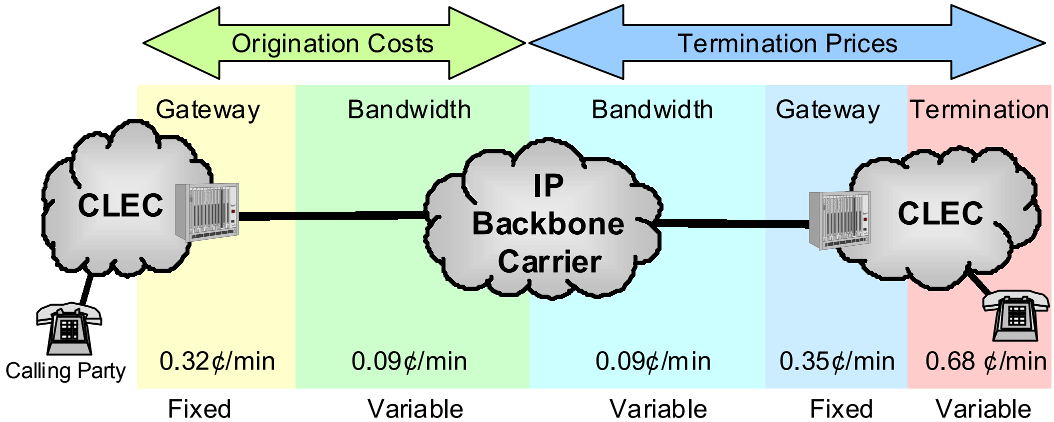

Figure 11
IP Telephony Economic Model with Average Cost Components

IP Telephony Average Cost Analysis				
VoIP Origination Costs $/minute	**Low**	**High**	**Avg**	
Gateway Capital Recovery	0.0026	0.0039	0.0032	line 21
IP Bandwidth	0.0007	0.0011	0.0009	line 17
Subtotal	0.0032	0.0050	0.0041	
VoIP Termination Prices $/minute				
Gateway Capital Recovery	0.0031	0.0039	0.0035	line 41
IP Bandwidth	0.0008	0.0011	0.0009	line 36
LEC Termination Fees	0.0060	0.0075	0.0068	line 51
Subtotal	0.0099	0.0124	0.0112	
Expense/minute to Originating CLEC	$ 0.0131	$ 0.0174	$ 0.0153	

IP Telephony Marginal Cost Analysis				
VoIP Origination Costs $/minute	**Low**	**High**	**Avg**	
Gateway Capital Recovery	-	-	-	
IP Bandwidth	0.0007	0.0011	0.0009	line 17
Subtotal	0.0007	0.0011	0.0009	
VoIP Termination Prices $/minute				
Gateway Capital Recovery	-	-	-	
IP Bandwidth	0.0008	0.0011	0.0009	line 36
LEC Termination Fees	0.0060	0.0075	0.0068	line 51
Subtotal	0.0068	0.0086	0.0077	
Expense/minute to Originating CLEC	$ 0.0074	$ 0.0097	[illegible]	

Table 3
Summary of IP Telephony Model Cost Components

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