Industry Research

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For RADVISION

IP-ISDN Videoconferencing
Total Cost of Ownership Comparison

In this research paper, we explain how one calculates the cost of implementing and offering videoconferencing in two network implementations that will effectively meet the same usage scenario. The strategic implications–above and beyond costs of the two network choices–are also considered.

Introduction

Today, a modern organization is connected via an IP network resembling a "hub" between dedicated connections in multiple remote offices. Employees use the IP network for text-based communications, meet regularly via telephone and frequently travel to remote offices for face-to-face meetings. When at their desks, employees have both Intranet services and access to the public Internet.

It's also safe to assume that management, in all industries and organizations, seeks to increase employee productivity and reduce time to market. Videoconferencing is being explored as a technology that can improve group and individual communications and thereby affect both these strategic objectives. Calculating return on investments associated with videoconferencing for companies of all sizes is not possible, since each company faces unique challenges and begins with different resources. One of the important components of calculating ROI, however, is to understand the costs of a new technology. Demonstrating the steps necessary to estimate costs and benefits associated with two popular network options will reduce the confusion associated with establishing ROI and with deciding when and how to deploy videoconferencing.

Connectivity Options

In the past, network options for videoconferencing were simpler. Heavy users placed endpoints on a common "private network" of switched circuits leased from a telecommunications carrier. Most companies preferred to connect videoconferencing endpoints to a public network via Integrated Switched Digital Network (ISDN) connections obtained from the local exchange carrier.

As a result of the improved ability to guarantee quality of services in packet networks, the ubiquity of switched local area Ethernet networks, and the release of numerous products for business quality H.323 videoconferencing, IP-based networks are now firmly on the list of videoconferencing connectivity options.

Since the quality of experience available to ISDN users is reproducible on IP networks, the costs of these two network options are compared, here, in detail side by side. However, due to differences in their original design, stages of evolution and popularity, IP and ISDN differ in a number of other respects that will impact the final evaluation and should also be considered when ordering networks for real-time video applications.

Table 1. Comparison of IP and ISDN Benefits other than cost

Benefit	IP	ISDN
Number of hardware-accelerated endpoints connected to this network (note: gateways permit users on either network to communicate with one another)	Over 50,000 in business environments; approximately half of these are desktop systems; if counting software-only endpoints and including consumers, the number exceeds 1million	Over 250,000 group videoconferencing endpoints in business use are currently connected to ISDN
Network can be used for other applications when not used for videoconferencing	Yes, easily if the applications are internal to the organization	In theory, but not in practice
Deployment bandwidth options	Telecommunications providers offer “fractional T1” (usually a half or quarter of 1.5Mbps) or full T1. DSL and cable are options. Once bandwidth is deployed, its usage is very efficient, only using that which is necessary and under the management of the gatekeeper	Few, each Basic Rate ISDN line is 128kpbs; 384k is minimum for business quality meetings. The systems require symmetrical bandwidth usage
Available for deployment over DSL (digital subscriber lines) or cable modems	Yes, IP traffic suitable for videoconferencing can be supported on alternative services, however, the service needs to be at least 384kbps “upstream” and “downstream” to provide business quality videoconferencing	No, ISDN also uses standard copper lines but does not co-exist with common Internet access technologies
Support for advanced “telephony-like” features such as call forward, call transfer and hold	Yes, provided that the network has been provisioned with appropriate software (e.g., gatekeeper)	No
Ease (and cost) with which one may add or move an endpoint to the network once the system is in place	Small increment, requires assigning an IP address to a new system and maybe no action at all for a move	Each additional system costs the same (in time and materials) as initial implementation to purchase and install
Web-like management and scheduling interfaces	Yes, single network connection offers support for management and transport via proprietary software or gatekeepers	Yes, for certain devices that are also IP connected (requires that the device be provisioned with 2 networks), using commercial products
Focus of development effort for many new products and services	Yes	No

Given these contrasts at a strategic level, many companies recognize that over time, most videoconferencing will be based on IP networks, but some of today’s IP networks are not suitable for real-time applications, such as videoconferencing, therefore, it remains important to analyze the present-day costs of each option.

Total Cost of Ownership

The total cost of videoconferencing to increase virtual collaboration and reduce travel between offices during a given time is the sum of one-time expenses (implementation) and recurring costs (usage, management and maintenance) incurred during the period in question. Costs occur in ten categories (Table 2).

Table 2. Categories of costs associated with acquisition, implementation and use of videoconferencing

Category	IP	ISDN	Incidence
Endpoint equipment acquisition	Yes	Yes	one-time
Network equipment acquisition	Yes	Yes	
MCUs (including gatekeeper)	Yes	Optional	one-time
PRI Gateway	Recommended	No	one-time
QoS (for Routers)	Optional	No	one-time
Firewall upgrade or proxy server purchase	Yes	No	one-time
Network interfaces (termination)	Yes	Yes	one-time
Network Local Loop Installation	Yes	Yes	one-time
Endpoint and Network Equipment Implementation Labor	Yes	Yes	one-time
Maintenance Contracts on all equipment	Yes	Yes	Annual
Network access charges	Yes	Yes	Monthly, fixed
Staff costs to maintain/support users	Yes	Yes	On-going, variable
Per minute usage charges	No	Yes	Monthly, variable

In this example, an organization seeks to connect users in 10 locations across the continental United States via videoconferencing. On average, the users at each site will be connected in point-to-point conferences for 10 hours per month and in multipoint conferences for 12 hours per month.

When performing cost calculations, our model assumes that:

- No videoconferencing has been implemented to date.
- Bandwidth for ISDN calls is 384 Kbps; bandwidth usage for the same quality is 500 Kbps over IP.
- All locations have switched 10/100MB local area networks and it is possible to leverage existing IP infrastructure in half the locations for videoconferencing.
- No locations have ISDN already installed and available for this purpose.

One-Time Costs for IP

- **Equipment**

Specialized devices for videoconferencing can be broken down into network equipment (hardware and software) and endpoint systems. On average, an organization can expect to spend $7,000/facility for IP videoconferencing endpoints and, in this analysis, we add $3,000 for the purchase of ten (10) 24 inch NTSC displays. In addition, specialized videoconferencing network equipment is required. A multipoint conferencing system, gateway device and gatekeeper with optional scheduling software package is available from RADVISION for approximately $60,000. It should be noted that the gatekeeper is a scalable software solution that will serve a single enterprise deployment much larger than the one envisioned here for no additional cost.

- **Bandwidth**

The next factor to be considered in calculating fixed costs of IP for videoconferencing is bandwidth availability. Is the bandwidth currently available sufficient to support the enterprise videoconferencing application?

- If yes, then there is no cost for increasing network access bandwidth.
- If no, then what does it cost to increase the bandwidth you have or bring in new lines?
  - Local loop installation charge

The cost of bringing in additional bandwidth varies with the type of service already in existence, the physical location (e.g., distance to a central office), the regional provider and the number of months of service for which the company contracts. In this example, five of the ten locations have ample bandwidth. To increase the local loop at 5 locations, organizations should explore three potential sources: DSL, T1 and Gigabit Ethernet Metropolitan area networks provided by companies such as Yipes. The fee can be as low as $300 and as high as $5,000, depending on location and service provider options. On average, in this example, the installation cost of increasing the IP bandwidth from ISDN or DSL (appropriate for remote office business applications) to a full T1 (1.5 Mbps) at 5 locations is $2,000/location.

Having ample bandwidth is an important ingredient, but there may be other one-time equipment purchasing or upgrade costs.

- **Quality of Service (QoS)**

Since IP videoconferencing requires that packets get the best (i.e., least delay or jitter) service available on the network, often at the expense of other application traffic, QoS software must be in place. The cost to upgrade router operating systems varies with the vendor and the router model. In many organizations the correct software is available, but the QoS features have yet to be implemented. We will consider the costs of having in-house IT staff make upgrades and/or implement the QoS services. In some cases the router operating system needs an upgrade or the router needs additional memory. The most accurate cost calculation will be made after checking that the customer has software that supports priority queuing or class-based queuing software installed in all routers in the network segments where videoconferencing traffic will travel in a converged network scenario.

- **Security**

Many firewalls are not configured to permit H.323 traffic in and off the organization's network. If, as is postulated in this scenario, most usage is internal, then this is not an obstacle to deployment and there is no additional cost to make the network safe from hostile parties. For more rigorous overhead calculation, the customer needs to know the type of firewall in use and, if an upgrade is necessary, cost of the maintenance agreement (varies, depending on model of firewall and the level of service).

If an organization does not have an H.323-savvy version of software, it is also possible to use an H.323 proxy, like the Ridgeway Firewall Solution for Enterprises. The cost of these products varies with the number of sites registered and the number of facilities with firewalls.

- **Implementation Labor**

With IP network videoconferencing, implementation is more challenging and therefore requires more man-hours to deploy ISDN-based videoconferencing. The exact time necessary to upgrade routers (to make specific segments "videoconferencing ready") depends on size of network. In a pure star topology with a large router in the middle, implementation can take between 8 and 16 man-hours; each remote site will have smaller routers that also need to have QoS features implemented. In this scenario we assume that the firewalls are already H.323 savvy, but the service is not implemented. Each firewall takes approximately 2 hours to adjust and test.

Installing and completely configuring an IP endpoint system in each facility should not take more than one half hour, however, due to the complexity of the network, problems are often encountered. In order to take all trouble-shooting and re-configuration into account in this analysis, we estimate that each IP endpoint will take approximately 3 hours to configure. All told, the network and endpoints in 10 locations require approximately 76 hours to deploy.

Assuming that the IT professional doing the implementations comes with a high level of training on the specific model of video equipment being deployed, the hourly rate for that individual is estimated to be $200/hr. The total labor cost for deployment over IP is $15,200.

One-Time Costs for ISDN

- **Equipment**

The cost of endpoints with support for 384kbps ISDN services are approximately $3,000 higher than endpoints without ISDN support. This said, endpoints that support ISDN and purchased since 2000 are "dual protocol" and will support H.320 as well as H.323 traffic over IP networks. This means that if Acme were to begin by deploying over ISDN and, at a later date, decided to convert to IP for transport, there would be no replacement cost on the videoconferencing endpoints. In some current products the reverse is also true: a customer can begin with an IP-only endpoint and upgrade (at additional cost) to add support for ISDN. For purposes of budgeting endpoint purchases in the ISDN scenario, we allocate $10,000/facility. We allocate the same cost for the 10 NTSC displays ($300/monitor).

Each facility will also need to purchase an NT-1s for each BRI, or a tri-BRI NT-1. This adds approximately $300/location to the cost of implementing the network.

For multipoint conferencing capabilities on ISDN, the most cost effective product is the Avaya 12 port H.320 MCU, available for $84,350. A one-year maintenance contract on the Avaya bridge is included with the purchase price.

If MCU acquisition costs exceed videoconferencing budgets, multipoint conferencing services are available from a variety of service providers. MCU service rates range from $35/port/hour for dial in unattended services to over $65/port/hour for operator assisted dial-out in low volumes.

In contrast with IP implementations, using ISDN for videoconferencing involves few customer premise components. The endpoints rely on public telephone network infrastructure for basic services like "dial tone".

- **Bandwidth**

One thing that IP and ISDN have in common from a cost point of view is that the local loop installation charges vary greatly throughout the US and the world. They also vary with the duration of the contracted services period. Some telecommunications companies waive the installation cost for companies who agree to keep the ISDN services for one year or more. In this example, however, we assume that these promotions are not in effect. The average cost for deploying 3 Basic Rate ISDN lines (a total bandwidth of 384kbps) to each of 10 locations is $500/location.

- **Implementation Labor**

Implementing new NT-1s to new ISDN networks takes less than one half hour of IT or telecommunications staff time, if the ISDN networks are properly configured. In the real world, there is a less than 50% chance that ISDN will be configured correctly at the central office, reducing the efficiencies the customer might be able to realize. We estimate it will require 1 hour of staff time per location to implement the new NT-1s. When the services are correctly implemented, configuring an endpoint for ISDN services could also take under 1 hour, however for the same reasons, we estimate that 2 hours per endpoint is necessary. The total time required for implementing 10 locations with ISDN is 30 hours.

Assuming that a similarly high level of expertise is required, the cost of the telecommunications professional doing the ISDN implementations is the same as that of an IP expert. Total cost of all ISDN implementation labor is $6,000.

Total Acquisition and Implementation Costs

At this point we can assess the one-time costs of each network scenario summing initial equipment acquisition costs and the implementation costs.

Table 3. Initial Equipment Acquisition and Implementation costs for 10 locations

	IP	ISDN
Endpoint equipment acquisition	$73,000	$103,000
Network Local Loop Installation	$10,000 for 5 locations	$5,000 for 10 locations
Network equipment acquisition		
MCU (and gateway and gatekeeper for IP scenario)	$60,000	$84,350
NT-1s		$3,000
Implementation labor cost	$15,200	$6,000
Total	**$158,200**	**$201,350**

Recurring Fixed and Variable Costs

There are recurring costs associated with both ISDN and IP deployments. They include maintenance contracts on equipment, monthly network access charges paid to telecommunications service providers, network usage costs and staff costs.

Table 4. Categories of recurring costs

	Costs	IP	ISDN
Maintenance Contracts on all equipment	Fixed	Yes	Yes
Monthly Network Access	Fixed	Yes, but cost may be amortized across other enterprise applications	Yes
Network Usage Costs	Variable	Optional	Yes
IT staff costs	Variable	Yes	Yes

We draw the reader's attention to the Optional expenses under IP. Provided that the organization is not operating near its maximum data rate to the Internet, periodic off-net calls will probably not exceed current ISP access data rate. However, if the customer begins to place calls to offices outside the organization that exceed the ISP link capacity, an upgrade to the ISP costs to cover increased bandwidth usage may be necessary. In the present scenario, the ISP installation costs and monthly recurring costs are not included but could be estimated in other complete cost calculations.

In this scenario, where the company is not calling to endpoints "off-net" but only to other locations, in the same company, the total monthly charge for the IP scenario is $8,014. By multiplying the monthly charge times the number of months in one year, we obtain the annual recurring charge for network access of $96,168. There are no additional network usage charges.

The total monthly charge for network access in the ISDN scenario is $4,566 before network usage. By multiplying the monthly charge times the number of months in one year, we obtain the annual recurring charge of $54,792. For ISDN, there is an additional per-minute usage charge (see Table 5).

It is likely that if a company were to secure a national account contract with a nationwide long distance carrier such as Sprint or WorldCom, the costs per location would be reduced, however, most organizations have multiple service providers in place for telephony and would be forced to reassess those agreements as well to secure global discounts on all services.

Although few data are available to support the assertion, the present analysis will allocate 2 hours per week (104 hours in one year) of one technician's time to verify that all endpoints and network equipment are operating correctly. Since the equipment is distributed in 10 locations, the time allocated per endpoint is 12 minutes/week (120 minutes/10= 12 minutes) of a local person's time per week. The additional 30 minutes/week will be allocated to network operations resources who will verify and occasionally trouble shoot the endpoints, gateway and MCU configurations. Since the personnel involved in performing the above mentioned tasks are not specialists, we will calculate the total cost of IT staff on the basis of $100/hr.

▪Network Usage Costs

For the present scenario, there will be no additional IP network usage charges because all calls are on the enterprise's wide area network, however, as mentioned above, off-net calls could tax existing service level agreements and the customer could encounter additional charges for greater IP bandwidth to the Internet.

ISDN usage costs depend on how well the company negotiates discounts with a national carrier. The highest an organization should expect to pay is $0.54/min for 384k. Once a competitive (volume) rate has been negotiated, the rate may be as low as $0.36/min for 384k. Assuming that each endpoint uses 22 hours of network per month, the monthly usage cost for ISDN service (at $ 0.54/min) will be $7,128. Until a lower rate is negotiated, the organization can expect to pay $85,536 in one year of network usage charges.

Table 5. Total cost of ownership for 10 locations for one year.

	IP	ISDN
Implementation costs	$158,200	$201,350
Network Access charges	$96,168	$54,792
Staff costs	$10,400	$10,400
Network Usage charges		$85,536
Total	**$264,768**	**$352,078**

Conclusion

The purpose of this paper is to demonstrate the steps involved when trying to accurately calculate the total cost of ownership of videoconferencing in the first year on two different networks. Although we point out that the advanced services and the flexibility and scalability available in an IP-based scenario should be considered strategically important, the financial incentive to deploy IP for the present scenario is also apparent.

In each scenario, the same systematic steps were taken. By keeping as many of the variables constant and using as many real-world numbers as possible, the model is a reliable predictor of the relative costs of these different scenarios. The most cost effective solution is to deploy the IP videoconferencing using a mixture of existing local loops and backbone bandwidth. If the customer had to deploy new IP bandwidth to all 10 locations, the cost would rise significantly, possibly matching or coming much closer to costs of the ISDN-based scenario. This said, the IP in-house solution will be very tempting for companies who anticipate expanding their network beyond the first 10 group videoconferencing endpoints to include any desktop videoconferencing systems.

In the ISDN scenario, nearly a quarter of the total cost of ownership in this size deployment is attributable to network usage charges. It is possible that the customer would negotiate a lower price per minute rate, however, in most successful deployments, the usage would increase over time and the cost per month would continue to rise. This is a significant financial risk associated with the ISDN deployment option.

This said, ISDN is very popular in Europe and Asia. In other analyses with a scope involving international locations, the advantages of ISDN availability and low cost would need to be weighed with the high cost of international long distance calls.

Some will be tempted to draw conclusions that are outside of the present analyses. First, it must be pointed out that the fees quoted in this research are only applicable in the states and actual physical locations used in the model. Service providers run promotions and discounts depending on the customer's size, the number of months of contracted service and the other services they expect to offer the customer going forward. New service providers enter regions and will offer alternatives to T1, such as Symmetrical DSL and Metropolitan area Ethernet networks.

A scenario in which there is a mixture of ISDN and IP connected endpoints is one very likely scenario not explored in the present analysis but which could impact investments a company will make as part of an expansion plan.

It is also important for the customer to take the size of the network into account when extrapolating the results of the present analysis. As the size of the network decreases, the relative advantages of IP may decline. When a company only wants to deploy a single videoconferencing group system for use in business to business communications, the cost of ISDN is very attractive.

By performing cost analyses such as the one demonstrated here, the customer can take the guess work out of the financial aspects of choosing a network on which to implement videoconferencing. The results for most is that they will find the scales tip in favor of IP, not only for strategic but for immediate tactical reasons as well.

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