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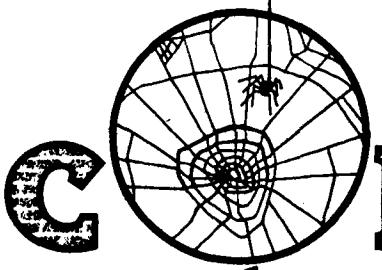

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General Session I

COMPUTER TELE/CONFERENCING - VIRTUAL NETWORKING

Thomas B. Cross

Cross Information Company

ABSTRACT

Computer teleconferencing is the ability to conduct an ongoing meeting with personnel in different geographic locations. An electronic message system is used to record communications among meeting participants. Each person involved in the meeting can access, read, and respond to these communications, regardless of whether other participants are communicating simultaneously or not. The system thus provides a verbatim log of the meeting, and the asynchronous method of participation offers extraordinary flexibility, especially if meeting members travel frequently (always there) or are in different time zones. The technique has proven to be highly effective for managing ongoing project activities."

The strategies for executive workstations are boundless. PBX manufacturer's integrate the terminal with the telephone and twisted pair cable. Computer manufacturers are racing to develop the so-called 'local area network' (e.g. IBM and TI announcement). Word processing and office product companies are hoping to be a tag-along, cost-effective plug-compatibles. The race for hardware seems as confusing as ever. Few ask the question - what are executives going to do with all this hardware?

One approach is to look at the available programs in the micro-computer market. Other than word processing, financial modelling, inventory, billing, and games, there is little else that is really exciting. From another corner, there are supposedly over 50,000 users on the various 'database' systems like the Reader's Digest - Source and Compuserve, not including the corporate users of Lockheed, SDC, New York Times and so on. Many of these companies fuel the myth that people are constantly using their services even though the majority of the people paying for the Source never use it.

Decisions are made by people not machines. The database is important, as it is the telephone directory. When you have found the telephone number you want, you call and talk with a person about solving your problem or ordering those 'special' flowers for mom. In this new era, a return to people-oriented systems will be required before extensive implementation of executive workstations can take place.

LIMITING FACTORS

How often has it been said that executives can't or won't type. It is more a myth than fact. Executives can write short notes, execute system commands, and operate complex machines. The executive has been sold short. How do you think that person got to that high position? Having the skill to adapt to many difficult situations is one reason. On the other hand, some limiting factors still facing the automated office are:

1. INDECISION. People want to put off what they don't think they need. Too many organizations are playing around with deciding who should run the railroad. They never seem to get out of the railroad station. If you keep it simple with pilot projects, just by moving along you will be a lot farther along. And most important, take office automation in small bites. Take one of the pieces, figure out if it works, modify it, learn about it, expand it, and continue to move forward. Somebody needs to drive it. Without that, the ship will wander in circles and most likely, sink.

2. LET THE MONSTER SLEEP. If you find people who don't want the new technology, ignore them. Teaching such people is like teaching a pig to sing - it wastes your time and annoys the pig. The people may change, but more likely the technology will change to be more compatible with them.

3. UNDERSTANDING THE ENEMY. The difficulty in adapting the new technology may be due to the particular job that needs to be performed. Look at the titles of the people. Nearly everyone has different job titles and with that goes specialized information. The simple reason that automation has been adapted in many manufacturing environments is that there are many people who carry the same title and do the same job. In white-collar environments, the secretarial position

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portrays a similar situation. As we move into higher and higher management positions, the jobs become so different and so complex that automation can only hope to be a 'executive helper.'

4. SELLING THE SIZZLE. Marketing is the key to office automation. A term we coined years ago - "organizational marketing" describes what is much needed today: means of selling products and services internally to the organization which differs little from the tactics and strategies used by the vendors selling the products.

5. TRAINING THE BEAST. Training will be a limiting factor until the vendors develop electronic learning systems. Training people electronically is faster and suits personal time schedules. According to noted management consultant, Mr. Clifford Barney, "one benefit of electronic training is it gets you hooked up to the keyboard so you learn about the terminal and realize it won't bite."

Now that we have gotten this far, where do we go from here? What follows is one technology for people-centered communications.

NEW FRONTIERS
WHAT'S BEYOND ELECTRONIC MAIL

In the beginning . . . there were runners, then the pony express, then there were railroads, followed by the automobile and the jet airplane. Each of these technologies moved at significantly higher speeds. With the advent of electronic 'highways' the speed of information can accelerate at significantly. It's true, as Mahatma Gandi said, "there is more to life than increasing its speed." On the other hand, most of us sit waiting for the ship to sail. Somewhere in the middle lies the answer.

Electronic mail can help us improve the great lag in getting information from one point to another or just getting it. What lies beyond electronic mail? Computer-text conferencing or teleconferencing (CT) is one of the enhancements most likely to be considered for written communications. According to Mr. Darrell Icenogle, Director of Educational Resources at the Western Behavioral Sciences Institute (WBSI) - School of Management and Strategic Studies where twice a year executives gather in La Jolla for intensive 8-day seminars, and the rest of the time they remain 'connected' to the program through special materials, and most importantly, through a computer tele/conferencing system, "only about 40% of all business telephone calls are completed, and the percentage of completions for the kind of high-level executives we have in this (WBSI) program is of course much lower. With computer teleconferencing, on the other hand, one has the confidence that a message sent is a message received. Also, communication of this kind tends to be less redundant, more precise, and less pressured. People communicate at their best because they have the time to say exactly what they mean to say."

Computer or text conferencing has all the features of electronic and something better.

FEATURES OF COMPUTER CONFERENCING SYSTEMS

- Online meeting and management conferencing features:
  desk-to-desk access to text (data) files simultaneously by different persons located in many locations, many-to-many communications with special areas for electronic meetings and discussions. These areas are accessed by people with approval of the conference manager much like a normal meeting. Discussions are held on various topics, specific interests, and work activities. In the future, calendar, scheduling, and decision support systems can be added.

- Personal notepad and work areas
  Each user has private secure (password protected) files or memo areas which are kept online for ease of use. Notes or memos can be sent either to other conferees or to the discussion file.

- Online bulletin board
- Online newsletters and journals
- Status and tracking functions
- Management reports and directories
- Electronic mail/messaging
- Search operations for text
- 'Windows' to other computer programs
- 'Real-time' meetings

As described by Mr. Bill Spencer of New Era Technologies of Washington, D.C. computer conferencing is "the ability to conduct an ongoing meeting with personnel in different geographic locations. A computer system is used to keep communications among meeting participants. Each person involved in the meeting can access, read, and respond to these communications, regardless of whether other participants are communicating simultaneously or not. The system thus provides a written log of the meeting, and the asynchronous method of participation offers extraordinary flexibility, especially if meeting members travel frequently or are in different time zones. The technique has proven to be highly effective for managing ongoing project activities."

KEY ADVANTAGES OF COMPUTER CONFERENCING

- o NO TIME RESTRICTIONS - "NEVER LATE FOR A MEETING AND NO MORE TELEPHONE TAG"
- o NO GEOGRAPHICAL LIMITATIONS "ALWAYS THERE"
- o LOWEST COST OF TELE/CONFERENCING SYSTEMS
- o ELECTRONIC FILING - "ELECTRONIC DESK"
- o NO ACTING SKILLS REQUIRED
- o ALLOWS TIME FOR 'THOUGHT' IN WORK
- o SELF-PACING AND TRAINING
- o MULTIPLE PARTICIPATION IN MANY CONFERENCES IN A DAY "NO MORE WAITING AT THE AIRPORT"

Icenogle of WBSI described the difference. "Most electronic mail systems," he said, "simply provide electronic delivery of fairly ordinary memos and letters; an individual types in a message at one end and it comes out at the other, or is placed in cue behind other messages which preceded it. A computer conferencing system provides for complex interactions among a group of people by storing the communications on a system, in one place. Any part of the discussion can be retrieved at will, enabling an individual to reconstruct the meeting at a convenient time and direct comments to the specific part of the discussion that is of interest or import at the moment.

As in any good seminar, many sub-themes and mini-conversations develop as the computer teleconference progresses. The system provides a number of ways of organizing these sub-themes and adding to them, as appropriate. A conference, though composed of the comments of many people, appears as a coherent whole on the participant's screen.

A number of different conferences can be held simultaneously, each serving a different purpose, each stored in its own "place" on the system. The single-file, lock-step delivery of electronic mail doesn't permit this kind of multi-layered group communication."

As to the experiences of WBSI in computer conferencing, "from our experiences so far we are confident that profound learning is taking place. Computer teleconferencing supplies an element that has always been missing in other attempts to educate prople at a distance - the ability to interact regularly with faculty members and fellow students," Icenogle concluded.

With computer conferencing, anyone can participate in a way far easier than with any other system. CC allows each person to participate 'at once.' Everyone can 'have the floor' at the same time, everyone from next door to the other side of the world. That is because, with CC systems, you can be there online. CC systems have the capacity to allow many people to be working on the same conference or discussion simultaneously. People 'on the road' can access the system remotely.

Where it is difficult to measure work output of 'information workers,' CC provides a record and filing system as well as a personal notepad area for private, secure work away from the conference. For the first time, we can begin to really track the progress of a project from inception to completion allowing software management, new staff, or observers to participate at any point along the way. Also, CC allows conferees to always go back to the beginning of the work and review discussions all along the way.

In managing business it is important to solicit input from others in the department or company -- CC allows many people who may not have direct responsibility or job-related activities to participate. Users, for example, are sometimes fascinated by and may have fresh ideas about the corporate environment. CC facilitates and encourages input by others because the system is designed to allow input and comments from people as 'observers.' These people can review the discussion and may add their own comments. Terminal conferencing lends itself to communications because it not only provides a written verbatim log but a means whereby clarification can be sought.

The name of each person is included when they develop a position or idea and add it into the discussion in a CC system. Each person, additionally, has full opportunity to present positions, raise issues, and even fillibuster without being supressed by the group. Correspondingly, shy or inhibited persons can participate without being worried by the meeting 'bullies' or by the 'Hollywood syndrome'.

Notes can be sent from one person to another, increasing involvement and participation without dominating or detracting from the foreward movement of the conference. Personal friendships can be developed between colleagues over long distances without the limitations of 'telephone-tag.'

VIRTUAL MEETINGS

Most often meetings must be scheduled so far in advance that interest in them, as well as their ultimate impact, are lost. With CC, the meeting is not dependent on any one person's time schedule. A meeting can go on for long or short periods of time. This is controlled and facilitated by the conference manager who

may, in fact, be located in another city. Even when the manager is down the hall, computer conferencing keeps people in touch. Assignments can be given, people can respond, argue, or discuss work without having to physically go to a meeting. Considering other forms of tele/conferencing the cost of computer conferencing is by far the cheapest.

APPLES TO APPLES COMPARISON

TELE/CONFERENCING SYSTEM	$ PER HOUR
FULL-MOTION VIDEO AT&T MEETING SERVICE (PMS)	PICTUREPHONE $2400.00*
FULL-MOTION VIDEO SPECIAL EVENT STYLE	$ 600.00**
AUDIO CONFERENCE BRIDGE	$ 110.00
SLOW-SCAN VIDEO	$ 110.00
ELECTRONIC BULLETIN BOARD	$ 66.00
COMPUTER CONFERENCING - MATRIX	$ 25.00

This comparison is to demonstrate relative comparisons, actual costs may differ.
This comparison does include the necessary hardware where applicable amortized over two years.
*Coast-to-coast only - shorter distances are less.
**Average estimate.

Neither rain, nor sleet, nor sickness, nor distance, nor time, will restrict your participation in the meeting. With CC, each person is 'always there' and everyone is 'always on time' for the meeting. Travel and other meetings are the typical causes of delays in the scheduling of meetings. Such conflicts can disrupt for weeks the scheduling and the timely impact of a meeting's purpose and 'no more waiting at the airport.' Even with the convenience and simplicity - have you ever tried to raise your hand during an audio conference?

Most groups exist to perform tasks. In meetings, the task involves information gathering, discussion, problem solving, implementing decisions, and evaluating the outcome of the group's work. Many of these functions require many other people to help support the group, such as secretaries, researchers, and writers. In addition, much of the meeting overhead is concentrated on 'getting coffee' rather than the task at hand.

CC systems provide a organized structure which facilitates the major activities such as, initiating, information seeking, information giving, opinion giving, elaborating, coordinating, evaluating, and energizing. In this way, the group can 'get down to business' rather than spending expensive time on the agenda.

CC lets people concentrate on the substance of issues, rather than the disorganized form they inevitably take. How many times have you confronted the same problem over and over? The saying that goes, "my problems are your problems," actually means that we spend most of our time attacking the same problem, over and over again without making enough headway so that, when it occurs again, we use the same approach over again to solve it.

It is an important aspect of all business management to document the work. How many times have you ever gotten minutes from a meeting or really know the status of a project? And, if/when you do get the minutes, how often do they actually convey what really took place at the meeting? CC provides a verbatim transcript. Each person's comments are in their own words, not just the meeting secretary's notes. There is no "body language" to interpret and less confusion about what somebody really meant.

How many times have you sat in a meeting and lost the drift of the meeting, wondering what the person is trying to say, as he or she jumps from point to point? CC structures a meeting in such a way that its purpose and content are not lost.

In a system like MATRIX system there is a meeting 'status' indicator letting each person know where the meeting is and what has occurred and even go back to the very first meeting, if necessary. At any point in the meeting, you can review everything that has already transpired. In addition, you can go back to the very first meeting or any one in between for reference. CC also allows a participant to read the speaker's remarks without having to respond immediately.

It is often said of committees and meetings that 'the camel was a horse designed by a committee.' And, surely, everyone at some point has been frustrated by conference participants who cannot vote without first going back and checking with the boss. CC can provide for assisting members in a way that is rarely, if ever, found in a meeting, i.e., private conferences.

And, how many times have you gone to a meeting with a colleague afterwhich been confounded with totally different impressions of what took place? The verbatim CC transcript solves the problem while allowing for electronic mail to seek clarification on confusing statements.

Computer conferencing improves internal organizational and management communications because it:

- o Improves and expedites the flow of information
- o Facilitates company team work
- o Closes gaps between top level managers and staff

CONCLUSION

Throughout history the transmission of information has been a key to progress. Computer conferencing is the first and major technology to allow for online meetings where many, many people can participate if necessary. CC provides the opportunity for managers to meet effectively and with time for thorough 'thought' in the decision-making process. CC may be something better than being there.

AUTHOR

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CROSSING PUBLIC PROPERTY: INFRARED LINK AND ALTERNATIVE APPROACHES FOR CONNECTING A HIGH SPEED LOCAL AREA NETWORK

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ABSTRACT

Crossing public property complicates the installation of a high speed local area network. Easily installed and free of RF restrictions, infrared links provide the most practical, cost-effective solution.

INTRODUCTION

Purpose.

The purpose of this paper is to evaluate infrared links and alternative methods of connecting a high speed local area network across public property.

Problem.

Currently, most published literature concerning local area networks (LAN's) have limited their discussions concerning their installations on private grounds. Up to this point, emphasis has been concentrated on optical fiber systems as the preferred means to transmit data at high speed.[1] Though this may be true for private local area networks,[2] crossing public property presents some complex obstacles for LAN installations to overcome.

In evaluating possible solutions to these obstacles, one must consider ease of installation, regulatory requirements, timeliness of installation, installation and maintenance costs, link capablilities, and growth potential. Results are summarized in Table I.

INFRARED LINK

Evaluation.

In an analysis of the possible solutions presented in Table I, infrared, laser, and microwave links optimize the criteria for effective performance. However, as a result of not having licensing requirements, infrared links adds flexibility for installation. Total installation time (1 - 2 days) for an infrared system is far lower than that of alternative connection methods. As a result, the installation of infrared links are more practical than other systems across short-distances of one to two miles.

Description .

Atmospheric infrared links are highly reliable systems. Operating from 1 KHZ to 10 MHZ frequency range infrared systems modulate non-coherent infrared light (as opposed to coherent laser). Highly directional, it is extremely difficult to intercept, inject data, or to jam such systems short of totally obstructing one transceiver. In addition, the light beams are not susceptible to interference from any high-frequency radio noise. Infrared links are capable of sending and receiving full duplex synchronous data through free space from 10.5 KBPS to 4 MBPS depending on the product. Systems feature useful ranges up to two miles. The number of channels and types of information are numerous; limited only by the infrared light spectrum.[3]

A typical infrared links consists of a pair of infrared link transceivers. Tranceivers must be within line-of-sight, affixed on either a rooftop or within a building with data transmitted through adjacent exterior windows. Relay links can be established when buildings are out-of-range or obstructed. Repeater stations regenterate the signal, eliminating any attenuation due to distance. Since infrared links are not regulated, they are excellent for temporary installations.

Each transceiver consists of a mechanical package. The mechanical package provides a rigid, dust-free environment for the optics and the electronics systems are designed to be stable to ensue minimal operating interruptions caused by high wind. In addition, the housing is waterproofed. Telescopes are boresighted to the lens of the optical transceiver and are permanently affixed to the unit, allowing visual alignment of each system.[4]

As with all systems operating in the near visible light spectrum, the infrared light level is attenuated by dense fog, severe dust, smog or rainstorms, and heavy falling or blowing snow. To partially compensate for these interferences, the link has a very wide operating dynamic range.[5] This is accomplished by a controlled automatic focusing device and electronic gain adjustment in the receiving end of each link pair.

The lenses in the optical system perform functions analogous to antennas in microwave systems. In the transmitter, the lens collimate the emitted light onto the detector. If the power

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	RANK	EASE OF INSTALLATION	REGULATORY LICENSING	TOTAL INSTALLATION TIME	DATA RATE	RELIABILITY	EASE OF MAINTENANCE	COST	GROWTH
INFRARED	1	1-2 days easy	none	1-2 days	4+MBPS	excellent	excellent	low	outstanding
LASER	2	1-2 days easy	2-6 months	2-6 months	40+ MBPS	excellent	excellent	low	outstanding but limited
MICROWAVE	3	1 week easy	2-3 months	2-3 months	3.152 MBPS	excellent	excellent	low	excellent, but limited
UNDERGROUND COAXIAL/ FIBER OPTIC	4	1-18 months mod. to hard	6-18 months	7-24 months	50+MBPS	excellent	fair to good	mod. to expensive	outstanding
AERIAL COAXIAL/ FIBER OPTIC	5	moderate 1-6 months	6-18 months	7-24 months	50+MBPS	excellent	good	mod. to high	excellent
SATELLITE	6	1-2 days easy	6-18 months	6-18 months	various	excellent	poor to excellent	expensive	limited
Leased Lines	7	easy 1 week	None	1 week	56 KBPS	poor to fair	excellent	fair to high	limited

Table I. EVALUATION OF SHORT RANGE LINKS ACROSS PUBLIC PROPERTY

to the unit fails, the sun blind shutter will close to prevent damage when the unit is facing the sun. Automatic temperature compensation and gain controls move the detector in and out of focus in order to maintain proper light levels. This ensures maximum dynamic range and the best signal to-noise ratio.

The electronics package consists of all the circuitry to interface the data bus to the infrared transceiver and provide sensing, control, and display of operational parameters. Infrared systems operate at low power (25 - 30 watts). The electronics package focuses the optics automatically, controls the unit's internal environment, protects if from undesirable signal levels, arbitrates the data to and from the unit and compensates for any changes in the optics resulting from temperature variations.[5]

Infrared systems are transparent to the computer and to software. Any equipment with published interfaces, except frequency-devision multiplexing, can be linked using this equipment. Networks can be entirely infrared or can be interfaced to other types of LAN equipment. Systems can be used for applications such as: connection of single or multiple remote terminals to central computing facilities or for interconnection of processors in distributed systems or connection of remote facilities for sharing data bases.[6]

Infrared Link Case Histories.

In May 1980, the Marine Corps Air Station, Cherry Point, NC, needed access to a naval facility three-fouths of a mile away. Because of the need to avoid strining wires that would endanger low-flying aircraft, the phone line would have to go underground at t one-time expense of $13,000. An infrared installation, which met the same need, cost about $2,400.[7]

In another case, Phillips Petroleum leased office space in numerous building within Bartlesville. The Information Management Division of Phillips Energy Resources Group began experiencing space problems due to continued growth of its operations. Sixty people were moved in January 1981, from the Frank Phillips Building to a temporary building approximately two blocks away. In order to begin immediate data transmission between the two sites, an infrared link was installed on the roof of each building, which were separated by approximately 700 feet.[8]

In recent years, the military has begun utilizing infrared links on a limited basis. The USAF has developed an infrared optical communications link called the Optical Communicator System (OCS) which is used to transmit and receive data in a Research, Development, Test and evaluation (RDT&E) effort during in-flight testing of aircraft sensor pods. The OCS is capable of handling 140 independent, simultaneous data channels under realistic environmental conditions. Maximum range is 50 feet.[9]

ALTERNATIVE METHODS

Besides infrared links, there are a number of possible alternative solutions. Depending upon the method, installations vary from simple to complex.

Leased Line Evaluation.

The greatest advantage to using leased lines is the ease of installation. Typically, systems can be installed within a week. However, since phone lines are usually asynchronous narrowband lines, they are limited to communicating either voice, video or data. In addition, the maximum data rate currently offered is 56KBPS which is much slower than requrred for a high speed network. Utilizing multiple lines, statistical multiplexers, and advancespacket-switching techniques, data rate can be increased somewhat but not to the required speed. There is also a one-time cost of interface hardware (i.e., modems and multiplexers) and a monthly charge for leased line usage. With the exception of using additional iines, growth is limited. As a result, the leased line approach will most likely not meet communications requirements, and thus is unacceptable.

Aerial Coaxial or Fiber Optic Cable System Evaluation.

The major advantage of an aerial cable installation is that both coaxial and fiber optic cables will provide up to 50 MBPS data rate. Each can simultaneously transmit voice, data, and video. Growth potential is tremendous.[9]

The primary drawback to this approach is the installation itself. In order to install such a system, right of way must be obtained from the local public utility companies in order to use existing utility poles. In addition, such installations must typically be approved by local, state and federal regulatory commissions. Often it can take up to 18 monts to obtain such approval. If utility poles must be moved for proper system installation, additional costs and delays can be expected.

Once approval is secured, coaxial cables are easily installed. However, fiber optical aerial cables have some unique installation problems. While conventional cables can tolerate strains on the order of 1%, optical fiber cables cannot[10]

To ensure a consistent datarate, special buffer designs are required to minimize cable bending and fiber elongation caused by environmental changes such as wind and temperature. This translates into additional cost and time required for installation and maintenance.

Underground Coaxial or Fiber Optical Cable System Evaluation.

Advantages are the same as in aerial installations. Delays and costs in regulatory requirements remain the same. Installation is usually more costly for this approach, especially if any tranches are required on public property. Accurate knowledge of the existing conduit system, complexity of this system and difficulty in properly

securing cables must be considered in the installation schedule.[11]

If approval for using existing conduits is denied, there is a mirage of "red tape" and required permits to dig trenches across a highway. Local telephone companies and local governments can provide assistance in this area.[12] The bottom line effect is that such an installation will take up to 36 months to complete given these regulatory requirements.

Satellite Link Evaluation.

Satellite communications provide the great capability providing high data rates at both short and long range. However, there are not presently enough communication satellites in orbit aroun the earth to meet all the ground station requirements in the world. Ground station locations are selected upon frequency band assignments, possible RF interferences and orbit of the desired satellite. Therefore, it is presently highly improbable to locate two ground stations at the required sites. Though easy to install, FCC licensing can take 6-18 months. As more communication satellites are placed in orbit, the use of satellites in a point-to-point information exchange within a LAN will become more practical.[13] On the other hand, with the ever-increasing number of ground sattions, it may become more difficult to locate one at the desired site. Overall, satellite links are probably better suited for long range than short range communications.

Laser Link Evaluation.

In recent years, practical applications for diode laser communications have created a fast growing industry. Constrained by line-of-sight, weather, and background, open-air laser links can operate at 40 MBPS. Present applications include remote utility meter reading[14] and experimental inter-satellite laser communication.[15] Operating on low power (2 watts), new short-haul systems have nominal ranges of 2 to 4 miles. Installation procedures are similar to those infrared systems.[16]

The major difference between infrared links and laser links is the regulatory requirements. The Food and Drug Administration requires that laser hardware, which emits low-level radiation, be properly shielded. The licensing process takes approximately 2 to 6 months. Overall, laser links are a practical alternative to infrared systems in many applications.

Microwave Link Evaluation.

Recent technological breakthroughs have allowed the utilization of low-powered short-range 23 GHZ band microwave links as a practical and effective alternative to infrared links. A major advantage of using microwave links is their ability for immediate growth; borrowing experience gained from other microwave systems. In addition, microwave links may also be less suspectable to environmental effects than laser and infrared links.

These low-powered (20MW) microwave systems are highly directional and quite efficient up to ranges of three miles. Utilizing time division multiplexing (TDM) systems provide a 48 channel high data rate (3.152 MBPS) capacity. Generic transceiver setups are analogous to laser and infrared links. Similarly, installations are easy. The major difference is that microwave transceivers can only be mounted externally to a building.[18]

As with all RF systems, FCC licensing is required. The time for frequency search and FCC licensing presently takes approximately three months. However, this time period is misleading. As years progress and more 23 GHZ systems become more prevalent, it is highly probable that future users of short-range microwave links will be subjected to competition for frequency assignments, a situation which exists today in other microwave systems. Coupled with RF restrictions, time for licensing of these short-range microwave could increase from 6 to 18 months.

FUTURE CONSIDERATIONS

In the near term, laser and microwave links will remain practical alternatives to infrared links. However, the potential of increased licensing and RF restrictions may stifle their growth. The possibility for short-range satellite links also appear remote for similar reasons.

In the long term, the replacement of existing copper telephone lines with fiber optical cables will probably negate the need for any of the aforementioned systems, including infrared systems for high speed local area networks.[19]

However, even when such systems become commonplace, potential users should probably weigh this type of installation against their required long and short term benefits (i.e., temporary versus permanent requirements).

SUMMARY

Crossing public property complicates the installation of a high speed local area network (LAN). The evaluation of the present methods indicates that all RF systems including laser, satellite, and microwave are viable solutions in a sterile RF environment. However, they are often plagued with RF interference restrictions and the long, arduous process of obtaining a license and registration. Fiber optic installations are confronted with the added expense and time of obtaining right of way, purchasing cable, contracting for trenching, and laying of cable.

Contrarily, infrared link systems provide an economical and labor and time saving alternative. Since infrared links utilize noncoherent light, no licensing is required. Multi-channel capable, infrared links systems can reliably transmit data at rates up to 4.0 MBPS and at ranges up to two miles. Restricted only by the near-visible light spectrum and extreme weather conditions, infrared links have great potential for further applications.

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