FEASIBILITY OF SAND AND GLAVINE SYSTEMS COMPUTER NETWORK PROPOSAL

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SUMMARY

The Ministry of Transportation, Engineering Services, desires to increase the efficiency of its Vernon office. The focus is on making better use of the computer information systems by creating a local area network (LAN). Sand and Glavine Systems responded to RFP 19970219-EIS with a proposal to design and install this network.

Sand and Glavine Systems computer network proposal was assessed on the following criteria:
1. Technical considerations
2. Cost
3. Training and support.

Information for the assessment was collected from current books on the subject, staff at the Vernon Engineering office, and local businesses.

With minor changes, the proposed network will meet Engineering Information Systems requirements. These changes put the cost of the network slightly over budget. However, anticipated reductions in cable requirements and installation time should lower the cost. Overall cost of this network will be close to the proposal's quoted price.

Technically, the Sand and Glavine Systems proposed network is a simple one. Because of this simplicity, and the competence of the staff at the Vernon Engineering Office, the training provided will be sufficient.

Unlike training, support was not included in the proposal's quoted price. It was offered at additional cost through monthly service contracts. The Ministry of Transportation has qualified computer support personnel on staff. Purchasing support from Sand and Glavine Systems would be a duplication of service and add to the direct cost of this network.

Sand and Glavine Systems proposed computer network will meet Engineering Service's objective of increasing the efficiency of its Vernon office. If Sand and Glavine Systems resubmit the proposal with the requested changes, it is recommended that it be adopted.

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INTRODUCTION

Purpose of Report

This report will assess whether Sand and Glavine Systems computer network proposal is a viable choice for the Ministry of Transportation, Engineering Services. Further, if the proposal is viable, should it be adopted as is or with modifications?

Background

The Ministry of Transportation currently operates an Engineering field office in Vernon. Working as a team, the office staff produce engineering plans ranging from preliminary drawings and estimates to detailed design packages. For production, this team relies on the use of computerized engineering and drafting tools as well as traditional document producing software. To handle the high volume and variety of documents produced, the office is equipped with 7 personal computers, two plotters, and one laser printer. The personal computers have varying configurations, processors, and attached peripherals.

In a desire to make the job of the staff easier and thus the office more productive, Engineering Services made a request for proposals (RFP 19970219-EIS) for a computer network on January 6, 1997. Sand and Glavine Systems responded to this request by submitting a proposal to the Ministry of Transportation, Engineering Services on February 19, 1997.

Overview of Proposed Network

Sand and Glavine Systems proposes to install a small EtherNet peer-to-peer network. The network will use Engineering Service's existing computers, except for an older 286 class machine. This computer, which now functions as a stand alone plotter server, would be retired from use. Access to the plotters and laser printer for all computers would then be provided through the network. The quoted price of $3968 includes cable, hub, network interface cards, software, design, and installation.

The installation of the network is to take place over a weekend, within one week of Sand and Glavine Systems being awarded the contract. Installation includes Sand and Glavine Systems extensively testing the network to ensure all computers operate properly and that no software conflicts exist. After the weekend installation, a three hour staff orientation is to take place on the following Monday.

Sand and Glavine Systems offers support for this system on a contract basis. These support packages come in varying configurations and are available in addition to the quoted price.

Assessment Criteria

The following criteria were used to assess the Sand and Glavine Systems proposal.

1. *Technical consideration* – Does the proposed network meet Ministry of Transportation, Engineering Information Systems requirements?

2. *Cost* – Is the proposed network within budget and does it represent value for the money?

3. *Training and Support* – Is the proposed training sufficient? Is support required? If so, does this proposal offer fair value?

REQUIREMENTS

Equipment
To be considered, a network must use the existing Engineering Services computers and peripherals. In addition, any software installed is to be fully compatible with all existing Engineering Information Systems software.

Task Requirements
The purpose of this network is to cut productivity losses. To achieve this, the network is to provide an effective way for Engineering Services staff to share and store documents. It is essential to be able to print or plot these documents, on demand, from any computer on the network. These objectives must be met without introducing new problems or unreasonable demands on the staff.

Cost Restriction
The Ministry of Transportation, Engineering Services , has set a budget of $4000 for this project.

ASSESSMENT

Technical Considerations

The criteria used to assess the Sand and Glavine Systems network proposal were technical considerations, cost, and training and support. Areas assessed on technical considerations include:

1. cable
2. topology
3. hardware
4. software, and
5. wide area network compatibility

Cable

There are four types of cable to consider for an EtherNet network. Two are coaxial, thick and thin EtherNet, the other two are twisted pair, shielded (STP) and unshielded (UTP). The twisted pair cable type is further subdivided into categories based on its signaling rate. UTP cable has become the common choice for newer networks.

Sand and Glavine Systems proposal calls for the installation of category 5 UTP cable. Category 5 UTP cable has a signaling rate of 10 megabits per second (Mbs) with the possibility of transmitting 100 Mbs should that become a standard in the future. This type of cabling will work well with the proposed network interface cards and hub.

Topology

The proposed Ethernet bus-star configuration has become a standard in network technology. It is well suited for the needs of a small network, such as the one required by the Vernon Engineering Services office, where network traffic will be at a minimum. Using the bus-star topology builds fault tolerance into the system by not allowing the network to be come inactive due to any one computer malfunctioning.

Hardware

The switching hub (3Com 12 port) more than meets the requirements for the proposed network. While Engineering Services could likely get away with a smaller, and possibly less expensive, hub this unit will cover any future expansion and provide excellent reliability.

The 3Com Fast EtherLink network interface cards (NICs) Sand and Glavine Systems proposes to use for the LAN are highly rated. Like the 3Com hub, these NICs provide exceptional reliability and are scalable should the network ever be capable of achieving a

100 Mbs transmission rate . While the hub and NICs are superior and meet the needs of Engineering Information Systems, the proposed network layout presents a problem.

The proposal calls for each workstation to be fitted with a NIC, except for the older Wang 286. This computer, which presently serves as a stand alone plotter server, would be retired from use. In doing so, Sand and Glavine Systems saves Engineering Services the cost of one NIC. However, this saving will extract a price in performance.

The physical layout of the Sand and Glavine Systems LAN would have the plotters and printer operating through one or more of the workstations. This configuration will not cause problems, except for the workstation that is coupled with the HP InkJet plotter. This plotter sees extensive use when a project, or phase of a project, is nearing completion. This heavy use will adversely impact on the performance of either the workstation or the plotter. Which suffers the greatest degradation in performance will depend on a network priority setting for the workstation.

Any performance loss such as this is unacceptable. Engineering Services needs a system that allows the extensive use of this plotter without affecting the performance of any workstation on the network. A solution is to keep the Wang 286 as part of the network, operating as a plotter/printer server. Although this will raise the cost of the network, it will greatly enhance performance.

Software

Currently, Engineering Services operates many different types of software. This includes a mix of Windows and DOS based programs. All office documents, such as letters, memos, and estimates, are produced through Windows using Microsoft Office. However, the majority of the work performed is with three engineering software packages – AutoCAD, XLterra, and the Meteor Design System. All of these packages are DOS based and are not capable of operating through Windows.

Sand and Glavine Systems plans to use Windows for Workgroups (WFW) as the network operating system. While working in DOS, WFW restricts network nodes to client rights only. This means any computer on the network operating in DOS will not have its services (disk, printers, and plotters) available to other computers on the network. While WFW does not prevent the use of the engineering software, it does severely restrict network access while this software is in use. This defeats the purpose of the network.

Windows for Workgroups would be a sufficient network operating system if all the Engineering Information Systems software packages were Windows based. However, with such a reliance on the DOS engineering software, WFW is not the optimal network operating system for Engineering Information Systems. A network operating system that runs in DOS and can support Windows would be a better choice.

Wide area network compatibility

The Ministry of Transportation is continuously decentralizing its information systems over a wide area network (WAN). Consideration must be given to how the proposed network will function in this WAN.

The Vernon Engineering Services office operates in relative isolation from the rest of the Ministry of Transportation. This situation will not change in the near future. At this time, each computer in the office has dial-in access to the Ministry's WAN. The proposed network will have no effect on this connection.

Costs

This section considers the cost and value of the proposal. Since there are some suggested modifications to various parts of the proposal, an overall cost recalculation has been held until the conclusion. Areas assessed on cost and value include:

1. cable
2. cable installation
3. hardware
4. software

Cable

As stated in the technical considerations section of this report, UTP cable has become the common choice for newer networks. This cable type comes in two categories, category 3 and category 5. Sand and Glavine Systems proposes to use category 5 UTP. Since cost is always a consideration, an option here might be to go with the cheaper category 3 UTP cable. Table 1 displays a cost and signaling rate comparison between the two types.

Table 1. Cable Signaling Rates and Cost Comparison

Cable Type	Signaling Rate	Cost in $/Ft.	Total Cost
Category 3 UTP	10 Mbs	$0.20	$60.00
Category 5 UTP	10/100 Mbs	$0.25	$75.00

Table 1 clearly shows the saving between the two types is marginal. The insignificant savings does not justify the use of category 3 cable, as it use would eliminate the possiblity of upgrading the network to 100 Mbs without replacing cable

Cable installation

The RFP for this network did not include the physical characteristics of the building. This office is equipped with a crawl space that Sand and Glavine Systems were probably unaware of when producing their proposal. By utilizing this crawl space to install the cable, the cable requirements and installation time can likely be reduced.

Sand and Glavine Systems has presented the cost of services as a lump sum in its proposal, making it impossible to determine the cost of cable installation. Since cable installation can be a large portion of a network installation, this could significantly lower the cost. It

would be more beneficial to Engineering Services if all services and their cost were listed separately.

Hub & Network interface cards

The hardware, 3Com 12 Port Switching hub and 3Com Fast Etherlink NIC's, Sand and Glavine Systems have chosen is accurately priced at $675 and $99 per card, respectively. But, as noted in the technical considerations (page 4, Network interface cards), to implement the Wang 286 as a plotter server will require an additional NIC.

Software

Sand and Glavine Systems proposed network operating system, Windows for Workgroups, is the most cost effective choice but does not meet the technical requirements of Engineering Information Systems. For superior DOS support, it is recommended EIS use LANtastic. This software will cost more per workstation, adding to the overall cost of the network.

Training and Support

Training

As stated in the Sand and Glavine Systems proposal, "A good computer network is invisible to the operator". This was also the consensus of the many businesses interviewed for this report. The only noticeable difference for the users of the system will be additional services. The three hour orientation, scheduled for the Monday following the installation of the network, should be sufficient for the staff.

Support

Support for the network was not included in the quoted price. What Sand and Glavine Systems did offer was support that could be purchased through monthly service contracts. These contracts offered unlimited phone support with on site visits being charged at an additional hourly rate. This is not unusual within this industry. There are companies that offer support at no additional charge; however, the cost for this service is built into the quoted price.

The Ministry of Transportation already has qualified staff in place to support its many existing computers and networks. This system will fall under their jurisdiction. Purchasing support from Sand and Glavine Systems would be a duplication of services and add directly to the cost the network.

CONCLUSIONS

Performance/Efficiency Gains

It is hard to measure performance and efficiency gains of a computer network against the cost of supplying that network. Table 2 shows approximate time differences between certain tasks. The network times are based on saving, retrieving, and plotting to a local hard disk. This is similar to the results a network could produce. The non-network times are approximated, as each task is really a process involving several tasks.

Table 2. Task Time Comparisons

Task	With network	Without network
Saving original file (1.2 Mb)	7 seconds	3 minutes
Retrieving original file (1.2 Mb)	11 seconds	2 minutes
plotting file	15 seconds	4 minutes

While Table 2 shows dramatic time savings, the cost savings are insignificant due to the small amount of time involved. What the table doesn't show are the convenience and ease a network will provide for employees. This network will allow staff to focus their effort on engineering as opposed to computer file management.

Overall Cost

The quoted price for the proposed network falls under the $4000 budget set for this project. With some minor changes, Sand and Glavine Systems proposal easily meets the requirements of Engineering Information Systems. It represents one of the simplest networks to operate and administer. Because of this simplicity, additional costs are minimal.

Staff at the Engineering Services office are quite computer literate. Any cost related to learning the new system will be negligible. Training requirements are small and the cost is included in the quoted price.

The support Sand and Glavine Systems offers is in addition to the quoted price. This represents an ideal situation for Engineering Services. It is then a choice whether to purchase support or not. As noted previously (page 7, Support), the Ministry of Transportation has qualified computer support staff in place who can maintain this system. There is no need to add to the cost of this network by purchasing support.

A highlight of Sand and Glavine Systems network proposal is with the installation. The plan recommends installing the network over a weekend. This represents saving two days in down time and thus a substantial saving in production costs.

In all, there are no major additional costs attached to the Sand and Glavine Systems proposal. The overall cost will be close to the quoted price. Table 3 shows the updated cost, reflecting the changes required to meet Engineering Information System requirements.

Table 3. Updated Cost Calculations

Software	LANtastic	7 x $119	$833.00
Hardware	3Com Fast Etherlink NIC	7 x $99	$693.00
	3Com 12 Port Switching Hub		$675.00
Cable	Category 5 Unshielded Twisted Pair	300' @ $0.25/ft.	$75.00
Services	System design and installation labour		$2090.00
Total			**$4366.00**

This total does not reflect any adjustment in the cost of services. As noted previously (page 6, Cable installation), cable installation and requirements will likely be lower. It is anticipated this adjustment will offset the higher costs for software and hardware, bringing the project within, or very close to the $4000 budget.

Future Expansion

The peer-to-peer type of network Sand and Glavine Systems is proposing meets the requirements of this office. This system could grow by 5 workstations before needing additional equipment, another hub. With the addition of another hub, the system could expand by up to 10 workstations before becoming over burdened and having to be replaced with a client/server system. It is highly unlikely Engineering Services will expand enough to make this a concern. However, should this become a requirement, the hardware Sand and Glavine Systems proposes to supply is compatible with today's client/server technology.

RECOMMENDATIONS

The network proposal from Sand and Glavine Systems represents good value. With minor modifications it can meet Engineering Information System requirements. It is recommended Engineering Services adopt the proposal, if Sand and Glavine Systems resubmits it with the following changes.

1. Sand and Glavine Systems visit the Vernon Highway Engineering office to finalize cable requirements and installation costs. All services, including cable installation, are to be shown separately on the new submission.

2. The Wang 286 computer is implemented as a plotter server for the laser printer and the two plotters. If all three peripherals can not be served by the Wang 286, as a minimum, the HP InkJet Plotter should be connected.

3. Install LANtastic as the network operating system.

Further to these changes, it is recommended Engineering Services adopt the proposal without purchasing support.

SOURCES CONSULTED

Derrick, Dan. Network Know-How. Chestnut Hill, MA: Osbourne McGraw-Hill, 1992

Durr, Michael and Mark Gibbs. Networking Personal Computers. Que Corporation, 1989

Editors of LAN Magazine. LAN Tutorial. San Francisco: Miller Freeman, 1996

Gibbs, Mark. Absolute Beginners Guide to Networking. Indianapolis: Sams Publishing, 1995

Held, Gilbert. Ethernet Networks. John Wiley and Sons Inc., 1994

Kosuir, David R. How Local Area Networks Work. Englewood Cliffs, NJ: Prentice Hall Inc., 1995

Madron, Thomas W. Local Area Networks. John Wiley and Sons Inc., 1990

Tittel, Ed. PC Networking Handbook. Chestnut Hill, MA: Osbourne McGraw-Hill, 1992