



Significance of Building a Computer Network for Schools

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Abstract: Education is communication. If schools are going to provide the best possible education, then schools need to be able to communicate in the best manner possible. Networks are currently one tool that can provide for that means of communication. Students of today live in a world where exchanging ideas and information is a way of life. To live effectively in that environment, the skills to exchange those ideas and information should be taught. Networks can provide an efficient and effective way of exchanging those ideas and information. Although some will resist the change and the awkward beginnings of using a network, or anything new, the potential benefits will eventually be realized, far outweighing those initial apprehensions. Networking technology is not a unique and independent discovery but is dependent on many things that most computer users are already familiar with. The computer network has historical ties to the telephone and telegraph which provided the underlying technology of networks. Basically a network is simply a way of exchanging information and ideas very rapidly.

Keywords: Computer network, communication, schools, technology, stakeholders

1. INTRODUCTION

One of the big problems with technology in schools is buying technology simply for the sake of having it. While simply having the technology will provide some benefit, simply by being used just because it is there, a great deal of time, energy, and money can be saved if some time is spent at the beginning of the process (Derfler & Freed, 1993). Determining what you have, what you would like to have, where you plan to be in the future, and will this technology help you get there are important questions that need to be addressed. Networks are no exception. It is certainly possible for a school to simply hire a company to install a network in the district and have everything work the way it is desired. The chances of that happening are not high without some school input and effort in the planning. One of the difficulties in incorporating technology in schools is the rapid changes that are taking place and the expenses that go along with them. Some planning and goal setting at the beginning of the process will go a long way to resolving problems in the future (Lowe, 2021).

Planning certainly won't eliminate all the problems, but with a clearly defined goal that a school is striving toward, it will be much easier to make decisions that will be beneficial to the school and help keep decisions focused on that goal. With all the technology that is out there it is easy to lose focus and begin purchasing items that may be "neat" but may not be used by the network users. Before putting in a network a school needs to ask the question "what do we need a network for?" This step should not be the first technology related decision that the school will make. A technology plan should already be in place. A plan that has been well thought out involving all the stakeholders in the school, the 5 teachers, the administration, the students, community members, and business should all have an opportunity to voice their opinions and a committee of members from each group should reach some consensus and establish district goals. This technology plan will normally include some type of mission statement and a series of long and short term goals that the district has for using technology in the school, how technology will fit in with the other educational goals of the district, and what the schools long range plans are for the future. Once this has been accomplished the process of setting up a network can begin (Lowe, 1996).

By looking at the school's technology goals and how a network can aid in the process of reaching those goals should aid in the decision whether the school needs a network and how it can meet those established goals. If networking does not address any of those items then one of two things is true,

either it does not need a network, or it needs to revisit the technology goals for the district. Once it has been established that a network will help in meeting the goals of the school or a need has been established it then becomes necessary to focus on what specific aspects of networking are most important for the school and what the school needs the network to do. Will the network primarily be used to allow students to access various programs or applications from different workstations? Will it be used to allow teachers to check attendance and input grades? Will the network be used by the administration to communicate more effectively with different buildings? Or, will it primarily be used as a means of hooking up to the Internet? Perhaps it will be used for all of these. The main thing is that before the choice of what networking system that will be used, some prior planning and investigation of what the main uses of the network will be can help tailor the network to best meet the school needs both in the present and in the future (Lowe, 2021). The various aspects of networking that require attention by the planners are discussed in the following section.

2. INVENTORY

For any assessment to be truly effective there is need to take an inventory of what materials are currently in the school, both hardware and software. It is difficult to get "there" if the school doesn't know where it is "now". Not all computers and programs will work with the same efficiency, or at all, put on a network. Fortunately, communication problems are decreasing with implementation of standards by the industry which allow different systems to talk to each other (Lowe, 2021). But, there are still machines out there that just won't work very well and there may just be a bunch of them in the school. So what specific information needs to be known about the school computers. One thing is the processor type and clock speed.

Now certain that a network is needed, a clear picture of what the network should do for the school both long and short term, and a look at some other schools to see what will and will not work has been completed. Ready or not it is now time to get into the nuts and bolts of building the schools network. Don't be concerned about not knowing everything. Remember technology is always changing it is impossible to know everything and if a coordinator waits schools will never have any technology. What Exactly is a Network? One of the biggest problems with implementing technology in schools is the fear that potential users have of the technology. Many feel uncomfortable with something new. and will feel embarrassed if their students know more about the process than they do, with networks this is a likely scenario as it is an emerging technology one most students have grown up with while many teachers have not. Many people view networks as a magical wire connected to a black box and if things do not work smoothly, frustration with the technology will quickly develop. Although there are some technical aspects to networks, they are not nearly as magical or complex as many view them. Networking technology is not a unique and independent discovery but is dependent on many things that most computer users are already familiar with. The computer network has historical ties to the telephone and telegraph which provided the underlying technology of networks. Basically a network is simply a way of exchanging information and ideas very rapidly (Derfler & Freed, 1993). Once a cabling system is selected a way of running the whole process is needed this is commonly done on a computer called a server. The three most common types of servers are, print server, file servers, and communications servers, on a server based LAN. A server based system provides good control, backup, and management.

3. SERVER-BASED NETWORKS

Powerful server-based networks offer security, excellent data management, fast response, and room to expand. A server usually makes the network run more quickly and effectively but is not required. The alternative to a server based network is a peer to peer network which does not have a dedicated server. They offer lower start-up cost, simplicity, and enough power to meet the needs of most organizations (Derfler & Freed, 2018). One can quickly see that network set-up can be a fair amount of work. For this reason, it must be remembered what a network can do for a school. There are three primary purposes or uses for networks (Lowe, 2021). Networks allow computers to share information. For example, a school could have the grading program or application loaded up on a computer in the guidance office and instead of having each teacher record their scores by hand or on a separate disk and then have to input them into the main system. With a network the grades could be automatically added to the main system. The second main reason for networking is to share resources. In schools this can be a very strong bargaining tool in favour of networking the districts computers. A network

will allow a system to share 15 printers, disk space and CD-ROM drives. As anyone who has ever worked in a school system knows, cost is always a consideration. And in the long run the bottom line is networking can save money by allowing the sharing of resources. The third and final reason for networking is that it allows for the sharing of programs. Instead of needing to load a specific program in each student's workstation networking allows the instructor to simply load a properly licensed program on the server and it is readily available to all students that need access to it. This can be a huge time and cost saver to a district and an individual teacher. It is for these reasons, just as in the business world, that most schools find it beneficial to network their computers. Whatever network system you choose to install some network management program is probably needed. This gathers statistics on the movement of data and watches for conditions that exceed programmed limits. When a problem is detected the central system will be alerted and information rerouted or a call for human intervention will be made (Derfler & Freed, 2018). After establishing a LAN, the next logical progression is to connect that LAN to other LANs, or the network of one school building to another. This can be accomplished through the use of repeaters, bridges, and routers. A repeater is typically a little box that connect two segments of networking cable it then repeats, retimes and regenerates the digital signals and sends them down the line. They are usually inexpensive and are easy to install. A bridge is a little more complex. and expensive. Bridges read the address on each packet of information to determine its destination, it does not look inside the data, merely at it destination and sends it on its way. A router takes the process one step further. A router reads the information in the packet, determines its destination, discards the outer package, repacks it, and retransmits the data. When a LAN is connected with routers the hardware does not matter because multi-protocol routers are available. This makes routers especially valuable when connecting an Ethernet network to a Token Ring network (Derfler & Freed, 2018). One organizational possibility of connecting LANs is a Metropolitan Area Network or MAN. This a method of connecting a LAN within a city or campus. The most common method of linkage is the phone line, this however usually carries speed limitations and charges. Thus there are other ways to meet this need. The two most common being FDDI which uses two rings of fibre to carry the data. And IEEE802.6 which is a metropolitan utility serving a large number of organizations across several miles. An alternative that is fast gaining in popularity is networking over microwaves or a wireless network.

4. ALTERNATIVES TO LAN SET-UPS

Two alternatives to LAN to LAN set ups are: Circuit-Switched Digital Services; which allow the user to dial up to make a connection for a limited amount of time, this is usually less expensive than leasing a dedicated line, or Packet Switching Networks; in which you pay a flat monthly fee and a fee based on how much data is received by each of your ports. This method can be much more attractive than the full period leasing when you are only transferring data a few times a day. One of the particularly useful aspects of networking is workgroups, or students working together on a common project. One way this can be accomplished is On-line Information services. Examples of this include CompuServe, Prodigy, and America Online. These services normally operate on a large mainframe computer system and allow subscribers to access a host system via a local phone line (Derfler & Freed, 2021). This can allow for connections worldwide and is one way of getting your school connected to the Internet, although most schools find a less expensive method through an area education agency or working something out with a local Internet service company. 17 Another particularly attractive feature of this interconnectivity is Electronic mail or e-mail. An e-mail system can create, read, forward, reply, track, and log messages. The e-mail program can simplify information sharing tasks and help alleviate the problem of phone tag. An e-mail system is vital cog in information sharing and can greatly increase the efficiency of sharing information over a fairly large geographic area. Finally, the idea of client/server computing is addressed. This method makes it possible to produce useful, yet small, programs from computers to provide on-call capabilities. This allows for workgroup programs that can store and retrieve data, appointments, manage projects, and to control and schedule the flow of work within the organization (Derfler & Freed, 2021) Finalize the Plan Now familiar with the history of network component and the basics of a computer network it is now time to begin the serious nuts and bolts planning of making the network best suit the district needs. The technology planning already established a need for the network and set some goals of what the district would like the network to do, now comes the planning of the topology or network mapping, cable selection, network arrangement, selection of a network operating system, and set up of

servers. The need to begin with an inventory of what computers and other equipment you currently have which should include some detail as to the capabilities of those computers and what networking capabilities they have has previously been mentioned. This step cannot be emphasized enough and needs to be regularly updated. The importance of always keeping in mind why it is the school needs a network in the first place and having the plan fit those needs, as there are many different capabilities that networks can do and each of those capabilities usually has a price tag of some form that goes with them, must always remain the focus. 18 So the district now has three very important decisions to make; what operating system to use, what server arrangement will you use, and how will the network be connected. One additional decision that needs to be made is a designation of the network manager. Regardless of how simple the network is things can and will go wrong. For this reason, it will normally work best if a single person is responsible for managing your network.

The manager does not have to be an expert in every aspect of the network, but more importantly, needs to be well organized and keep the network that way. He/she should have some network problem solving skills and perhaps more importantly know when to call in the real networking expert. That expert should likely be consulted or at least informed of the three big decisions that you are about to make. Now back to the decision making. Which operating system to select The network operating system or NOS is the program or application that will end up running your network (Lowe, 2016). One option that may be made is to use the Apple Talk application that is already installed in the Macintosh computers. This built in system can handle many of the normal networking functions adequately, when the network is not very large or overly stressed by use. It can also be improved by installing an Ethernet card enhancing the capabilities and efficiency of the network. This may be your best networking option but when considering the likelihood that the network will be growing in the future and will eventually become a much larger monster to handle. Most schools do not find this system as the best long term solution to developing a school network. It is a system that can easily be out grown.

Some of the other most popular network operating systems currently being used are Novell's NetWare, Windows NT Server, Artisoft's LANtastic, Microsoft's Windows for Work groups and Windows 95. 19 They all have their own advantages and disadvantages the key being to find the one that best meets your needs. Novell's NetWare is by far the most popular NOS. It can be used for very large and very small networks. NetWare is known for the following advantages. Seeing that DOS had its own limitations when it comes to networking Net Ware does not run DOS NetWare itself is the operating system, thus able to eliminate the network limitations of DOS. Net Ware servers need to be dedicated, in other words the server cannot also be used as a workstation thus making the network run more efficiently. NetWare's file server is far superior to DOS in the way its file server and directories are organized. NetWare also provides a special filing system which allows you to purchase specialized software for running a school network. NetWare also has the ability to keep working even in the event of a hardware problem because of a feature called system fault tolerance. And perhaps most importantly for schools NetWare can be used on DOS, OS/2, or Macintosh computers (Lowe, 2021). On the down side of NetWare, it is more complex than other network systems. It is usually more expensive because of the need for the dedicated server and the way it is sold. Windows NT is the Microsoft version of NetWare and has many of the same features as NetWare the only difference being that Net Ware has been around a little longer and is thus a little better tested. LANtastic, Windows 95 and Windows for Workgroups are of the simpler peer to peer network variety. The reason they are usually considered simpler is that they do not require a dedicated server, they usually do not include some of the extra feature so fewer things can go wrong, and they can usually be purchased in kits that allow for an easier start up (Lowe, 2021). 20 With these pluses naturally come some negatives. Peer-to-peer networks are generally not as efficient as the NetWare or Windows NT Networks, they don't provide many of the extra feature like network security, and although on a single computer basis it may be cheaper if you have over 20 computers the difference is not significant (Lowe, 16). Because of its ability to handle both DOS and Macintosh systems equally well most schools find the best choice to be Novel11s Net Ware. Because of this it is the one that will be examined in more detail when the discussion the software installation is addressed. Even if the school is all Macintosh most libraries receive their information from a DOS system and sooner or later you will likely need to connect to a DOS computer. This is not to say Net Ware is the best choice for everyone. Simply, that this is currently the most popular choice. So that is the one that will be used for

the more detailed installation explanation. After selecting a NOS, next decide how the servers will be set up. It has already been stated that if you decide on Net Ware then you must dedicate a server while LANtastic, Windows 95 and Windows for Workgroups or any peer-to-peer network do not need a dedicated server. If at all possible, the network will run more smoothly when a server is dedicated to just running the network. Some things to keep in mind once you have decided a dedicated server is the way to go.

Most networks will quickly run out of disk space no matter how much you start out with so your network manager will need to keep a close eye on this. Train your users that space is not infinite and must be used wisely. Remember a server computer will be doing just that so it does not have to have a top notch monitor, but when it comes to the processor chip, memory, and disk drive the better you have the better your network will work. Finally, if you will be doing a great deal of printing on your network you may consider dedicating a separate server just to handle that task. 21 The server can be located almost anywhere as long as it is clean, dry, has electrical outlet, and can be accessed if need be. And another thing that should definitely be included is a UPS or uninterruptible power source. This can be a life saver if for some reason, and "some reasons" usually happen, the power goes out. A UPS can prevent losing data, and provide time to get users logged off the network and shut things down in an orderly fashion. This will make it much easier to restore things with the least amount of difficulty when the power returns. Now that a NOS and server arrangement have been decided upon it is time to decide how the network will be connected. The most common of which is Ethernet briefly explained earlier. Ethernet is the method in which the computer listens to see if the line is clear. If it is the information is sent. It then listens to see if a collision occurred. If it did, then it will try sending the information latter. This is called CSMA/CD or carrier sense multiple access with collision detection. Token Ring and ARCnet both have their own merit but since Ethernet is the most common it is the one that will be explored when it comes to cabling.

5. NETWORK TOPOLOGY

There are three basic ways that a network topology or layout can be set up. The bus network in which the computers are connected in a straight line one to the next. This is the simplest method with the drawback of a line break anywhere and the entire network will be down. The ring is similar to the bus with the exception of connecting the last computer to the first forming a continuous loop. Finally, the star. In this arrangement all computers are connected to a central point called a hub. This requires more cable but if one line is broken the other computers will still be able to function. You need to decide what will work best for your situation and budget. The decided on layout or topology should then be carefully mapped out including where the server will be located, where hubs are, 22 and what computer will be hooked in where. Ideally this will be part of the well-organized inventory and kept up to date when any changes are made.

Although some will resist the change and the awkward beginnings of using a network, or anything new, the potential benefits will eventually be realized, far outweighing those initial apprehensions. This research has provided a set of basic steps and information for setting up a network in a school setting. Networking is not a complicated concept but its implementation can be cumbersome. When a school looks at the potential benefits of sharing information, resources, and programs that networking can provide it will likely recognize a need to get involved with networking. As the paper has pointed out the key to making a smooth transition into the world of networking includes a well-organized plan for implementing that change. Details discussed included the following steps: assessing your needs, setting goals, getting organized, making your plan, installing the system, and managing the network once it is installed. Following these steps will make the transition of networking a school more effective. Everything you need to know about network installation is not what this paper is about. Networks, what they can do and how they work best, like all technology, are rapidly changing and improving so although the informational details on specific networks may change it 28 is the process that you go through in implementing the technology that ultimately determines its degree of success. Schools are often criticized for being out of touch with the "real world" and networks can be a critical tool in reducing this problem. With the speed and range of connectivity networks can provide they have become an integral part of society and need to become an integral part of the schools preparing students for that society. Although setting up and installing a computer network is a time consuming an initially expensive endeavour, it is a step that schools must be willing to explore. By following the

steps outlined in the paper the likelihood that a school system or district will successfully implement a network system that will meet its needs will be dramatically increased. A network system that will work for the present and allow for growth and expansion in the future and beyond should be a part of that goal. Putting in a computer network is not a decision that should be taken lightly. It is a decision that each district should examine with the input of many people, people that have been previously mentioned. Each district must take inventory of where they currently are in terms of technology and education, and where they would like the district and its students to be in the future. Schools should not get technology just so they can say they have it. This is a mistake that many districts have made in the past. By carefully examining goals of the district the district will increase its chances of selecting a system that will best fit its individual needs and the needs of its students and teachers. When it comes time to purchase technology the district goals are often lost in the shuffle. If these goals remain the focus and the reason for implementing the technology addresses those goals the technology has a much greater chance of doing what it is intended to do, improve education. 29 References Derfler, F & Freed, (2018). How networks work. Emeryville, CA: Ziff-Davis Press. Lowe, (2021). Networking for dummies (2nd ed). Foster City, CA: IDG Books Worldwide. Rains, A & Palmer, M., (2014). Local area networking with Novell software (2nd ed). Danvers, MA: Boyd & Fr

6. CONCLUSION AND RECOMMENDATIONS

Schools are often criticized for being out of touch with the "real world" and networks can be a critical tool in reducing this problem. With the speed and range of connectivity networks can provide they have become an integral part of society and need to become an integral part of the schools preparing students for that society. Although setting up and installing a computer network is a time consuming an initially expensive endeavour, it is a step that schools must be willing to explore. By following the steps outlined in the paper the likelihood that a school system or district will successfully implement a network system that will meet its needs will be dramatically increased. A network system that will work for the present and allow for growth and expansion in the future and beyond should be a part of that goal. Putting in a computer network is not a decision that should be taken lightly. It is a decision that each district should examine with the input of many people, people that have been previously mentioned. Each district must take inventory of where they currently are in terms of technology and education, and where they would like the district and its students to be in the future. Schools should not get technology just so they can say they have it. This is a mistake that many schools have made in the past. By carefully examining goals of the school the school will increase its chances of selecting a system that will best fit its individual needs and the needs of its students and teachers. When it comes to time to purchase technology the school goals are often lost in the shuffle. If these goals remain the focus and the reason for implementing the technology addresses those goals the technology has a much greater chance of doing what it is intended to do, improve education.

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Citation: Rosewitha Mbiriyaakura. "Significance of Building a Computer Network for Schools" *International Journal of Humanities Social Sciences and Education (IJHSSE)*, vol 10, no. 12, 2023, pp. 54-596. DOI: <https://doi.org/10.20431/2349-0381.1012005>.

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