Network Design

This article is a follow-up to two articles from the 1994 Linotype-Hell Technical Information series: Network Management (pages 47-48) and Network Troubleshooting (pages 1-6). This is the final installment of a three part series.

One of the most peculiar and frustrating aspects of designing a network is that there are so many different technologies to choose from. There are usually multiple configurations which achieve the same ultimate goal of connectivity and compatibility. In order to design the right network it is vital that the user requirements for price, performance, reliability, capacity, security, expandability, and functionality are all clearly specified. On top of this, the network must also be easy to learn and easy to use. The first step in achieving this is to perform a needs analysis.

Needs analysis

A needs analysis collects information on the desired goals of the network. A needs analysis should answer the following questions:

- *How many users will be required to communicate and share data or devices on the network?* (The answer to this question will include a description of the work flow.)
- *What type of hardware and software will be used and what will they support in terms of media (i.e., cabling), topology, and protocol?*
- *What network services must be available?* (File services, print services, mail services, dial-in services, picture replacement, etc.)
- *Will someone be dedicated as the system administrator to manage and maintain the network?* (This decision plays a role in the complexity of the network as well as the level of support required from the manufacturer.)

Clearly documenting and adhering to the specifications of your networking components is the first vital step in any network design. This is particularly true in circumstances when new devices are added to a network that is already configured and running. By scrutinizing the specifications of the new components, you can better judge where a device should be placed on the network for optimum performance.

Asking yourself questions about network specifications is a bit more explicit than simply determining what type of hardware and software you will use. The specifications will clearly define how you use the network components and will further detail what the potential limitations are.

Site survey

After performing the needs analysis, the next step is to perform a site survey. As part of the site survey, check to see that the available space is adequate. Affirm that the electrical power will support the power requirements of the network. Check to be sure that local building and fire codes will be obeyed. Finally, look for any other conditions that might effect the choice of cable or the location of the equipment. For example, information learned in the site survey might help determine what type of cable to use (i.e., plenum cable in the walls and ceilings, or, metal conduit for electrical wiring.)[1]

[1] Plenum cable is protected by a teflon jacket. Metal conduit is the container that wire is placed in when the cabling is run underground or through insulation.

If you are designing a new network, a site survey should include a drawn layout of the building or space where the network is to be located. Additionally, this drawing should illustrate how the cabling is run through the building. Good network designs exhibit very explicit detail with cable

drawings and often include how a device is connected to the network, the length of cable being used for that device and brief, but, peritinent information about the device itself all printed on one piece of paper. Often overlooked, the inclusion of this information on your network layout/cable map will assist a great deal when it comes time to expand the network and doubles as an excellent tool when trying to troubleshoot problems.

Another task that should be considered for new network designs is to pay particular attention to the location of the heart of the network, often called the telephone closet. The telephone room is often a home to HUBs, management consoles, and e-mail servers that require a high level of access security. Determining whether the area is secure, whether cabling can be easily distributed from this point, and whether the closet is far enough away from direct causes of electrical interference are all things that go into determining the quality of the location of the central managment room.

If you are re-designing an existing network or just looking at an existing design to determine how the cable is routed, stick to your design goals from the needs analysis to ensure that new devices are connected to the network in the places where they provide the most benefit. Too often, devices are added to the network in random places simply because a connection already exists there. This is a bad practice. Stick to the design goals derived from the needs analysis. Learn more about the connections that already exist and then make a determination as to whether the new device will fit in properly. Always lend an eye to performance on your network. Devices that require extensive network interaction are seldom reaching their fullest potential if they are located on a network segment that already experiences an abnormally high amount of traffic. The answers to these questions are often derived from the network management process and are described in the article entitled Network Management.

Primary issues

These are the fundamental decisions to make in designing a network:

- **Media** – What type of cable should be used? Will it be coaxial, twisted pair, copper, or fiber optic? If using twisted pair, for example, will it be shielded or unshielded, plenum or non-plenum and what type (i.e. category 5)?
- **Topology** – Will it be a linear bus, star, or ring topology?
- **Protocol** – What protocol will be used? (AppleTalk®, TCP/IP, XTP, etc.)

The answers to these questions will also be effected by the standards associated with networks. Standards like IEEE 802.3 will dictate the minimum and maximum distances for a cable segment. Vendors of network hardware and software will also have limitations on the number of devices on a single segment, or on the entire network. The choice of server, routers, bridges, and hubs also plays a big part in the overall success of a network. Should it be a software or hardware solution or a combination of both? Will support be coming from one or many sources?

Estimating traffic and storage

Networks are typically broken into three categories related to size: small, medium and large. A small network usually consists of no more than 20 nodes. A medium-sized network contains 20 to 100 nodes. A large network contains more than 100 nodes. Size is commonly used to determine the amount of traffic to be expected. Unfortunately, this can be misleading unless the nature of the traffic on the network is considered.

When dealing with PostScript™ publishing and color environments where high resolution images are used, the amount of traffic will be significantly higher than in a corporate environment where users are simply sharing word processing and spread sheet documents and sending e-mails. And so, while

a LocalTalk network might be suitable for the corporate environment of 20 users, that same network would be inadequate in a 20 user color publishing environment. Ethernet is typically required in color publishing environments with as few as four to eight users. In fact, for Linotype-Hell users who are doing color, the typical network is Ethernet. (This is partly due to a decline over the past few years in the cost of Ethernet.) Today, the majority of those Linotype-Hell clients use Thinnet (a coaxial cable on a linear bus topology); however 10-BaseT (which uses unshielded twisted pair cable in a star topology) has also been gaining popularity.

When estimating storage capacity, a network designer typically allocates a minimum of 10 megabytes (MB) per user. The designer then adds space required for the network operating system (NOS) and the software application programs to be stored at the server. Finally the network designer adds 20% of that subtotal.[2] While this may be a good minimum for corporate environments, in a high resolution PostScript environment additional factors should be considered. (See chart to right.) Will pages will be stored on the server before archiving? What is the average size per page? Also, since print servers spool the data to the server's hard drive, it must have adequate storage for this spooled data, otherwise the job will not print. Thus, if a network has five users, each with approximately two jobs in the print queue at any one time, and, each job averaging 30 MB, then there must be 300 MB of free space for print spooling.

[2] This 20% is added because in general storage devices perform optimally if they are filled to no more than 80% capacity.

Storage worksheet
(Estimates based on a five user environment)

Per user allocation:
10 MB x 5 users = 50 MB
Network operating system
Approx. 80 MB
S/w applications on server
Approx. 100 MB
Subtotal = 230 MB
(Add 20% to subtotal)
.20 x 230 MB = 46 MB
Minimum amount = 276 MB

Data storage prior to archival
One hundred 30 MB jobs
= 3000 MB

Storage for spooled data
5 users x two 30 MB jobs
= 300 MB

276 + 3000 + 300
Total = 3576 MB = 3.5 GB

Ethernet and protocols

Finally, remember that just because a device is an Ethernet device it doesn't necessarily mean that it can be connected to another Ethernet network. It will only communicate on that network if the protocol and media are compatible. For example, a device with a BNC connector for use with coaxial cable will not connect to a network that uses twisted pair cabling. Similarly, a device that uses TCP/IP as its protocol will not be compatible with a network that uses AppleTalk as the protocol.

Note: While Ethernet is rated at 10-MB/sec., no single user ever gets the full band-width. Typically the average data transfer rate for an Apple Macintosh® client is about 200 KB/sec. For an AppleTalk printer it is about 100 KB/sec.

The use of routers and bridges can provide the connectivity and, in some cases, 10-BaseT HUBs allow for AUI and/or BNC connections. Once you have connectivity, remember the software application programs you use must also be able to read the file formats you are trying to exchange.

Conclusion

Network management and troubleshooting techniques can help ensure the health of any networking environment, but often system administrators are forced to address tasks that might have been better tackled during the network designing phase. If the network design is properly thought out before the first cable is put into the wall, many problems can be avoided.

OAG

The complexity of large color prepress systems requires careful planning on the part of anyone who is making purchasing or expansion decisions. Because of this, Linotype-Hell offers consulting services through the Operations Analysis Group (OAG). OAG can help you make the right system design decisions for your business. For more information, contact OAG at 516-434-2677.

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