INTRODUCTION

Within IBM mainframe computing environments, much progress has been made in the area of LANs. IBM's Token Ring has recently doubled in market share and will continue its momentum to become the standard topology for most IBM customers. Mainframe graphics support on the Token Ring is a strong requirement, particularly when converting from 3270 coaxial communications where host graphics have been supported for several years. With most companies migrating towards the LAN, the discussion of using SAS/GRAPH software on the LAN becomes an important issue.

The most common methods of communicating with the host include using a LAN gateway product or the IBM 3174 controller. Both of these methods can be used to access SAS/GRAPH software from the host to the PC. Other important LAN issues discussed include obtaining graphics hardcopy from devices attached to the LAN, such as plotters and laser printers. The LAN hardcopy is of importance to both IBM mainframe and PC SAS/GRAPH software users. Other issues relating to the topic of using SAS/GRAPH software within a LAN environment are discussed during this presentation.

LOCAL AREA NETWORKS

A Local Area Network (LAN) consists of both hardware and software which is used to connect various workstations, peripherals, and other devices together to facilitate the sharing of information. The hardware components of a LAN consists of a network file server, cabling to connect the stations, and network adapters to connect the stations to the LAN cabling system. Central to the LAN, is the network File Server which controls the LAN and is used for central storage. In addition to workstations attached to the LAN, there can be many different peripherals including printers, LAN gateways to mainframe computers, and LAN bridges to other Local Area Networks or Wide Area Networks (WANs).

Benefits of Using a LAN

There are many benefits of using a LAN. The primary applications that are used on the LAN include the following:

- File Sharing
- Electronic Mail
- Printer Sharing
- Gateway to Host
- Others

There are many different types of LAN hardware on the market today. The largest percentage of LANs in use today are based on Ethernet technology. This is very popular with DEC VAX users and workstation vendors. The second largest percentage of LANs in use today are based on the IBM Token Ring technology. The IBM token ring technology is growing very fast in popularity, especially with IBM mainframe accounts.
The IBM Token Ring LAN

The IBM Token Ring is IBM's strategic LAN product. IBM recommends the Token Ring to interconnect PCs and PS/2s, as well as for interconnect of its midrange and mainframe computers, front end processors, and terminal controllers. As the name implies, tokens are used to pass information from one location to another. Information passed over the LAN contains header information indicating where this data came from and where it is going. The cabling that can be used can be either copper wire, twisted pair, or optical cable. The speed throughput of the Token Ring can be either 4 Mbps or 16 Mbps.

The IBM Token Ring hardware consists of a file server, which is usually a high speed PC or PS/2 with a large capacity hard disk to control the operation of the LAN and can be used for central storage. Of course there is cabling that must be used to connect all of the workstations together, and there must be a Token Ring adapter in every PC, PS/2, or workstation that is connected to the LAN. There are also other LAN hardware items including repeaters; MAUs (Multi-station Access Units), bridges, and gateway hardware that can be attached to the LAN.

The Token Ring software can come from a number of different vendors including IBM, Novell, Banyan, 3Com, and many others. The IBM LAN program is a very safe decision when deciding which LAN software to standardize on, although many advanced features are not provided that may be found in other LAN vendors software. Novell's Netware has the largest market share of LAN software and is recognized as the industry leader. Banyan Vines LAN software and 3COM LAN software also have a significant market share and are good products to consider.

The LAN software consists of a LAN operating system and LAN workstation software. The LAN operating system on the file server is responsible for the general operation of the LAN and is responsible for administrative functions such as error logging, and capacity reporting, etc. The LAN software that resides on each PC or workstation is responsible for interfacing the PC to the LAN, performing the LAN applications such as sharing files and disks, electronic mail, rerouting of printer ports, and providing some kind of API (Application Programming Interface) and/or NETBIOS (Network Basic Input/Output System).

LAN GATEWAYS

A LAN gateway is used to distribute mainframe terminal sessions across the LAN to individual workstations. A Lan gateway can be either a specialized hardware device attached to a LAN, or it can be a PC attached to the LAN which has specialized gateway hardware and software. IBM recommends three different methods of connecting the LAN to the mainframe using three different IBM hardware devices, which are: (1) IBM 3174 cluster controller, (2) IBM 3725 or 3745 communications front-end controller, and (3) the IBM 9370 minicomputer. A fourth method is to use an IBM PC with third party hardware and software from Digital Communications Associates (DCA) or various other micro-to-mainframe vendors.

The most common method that is being used today is to use the IBM 3174 controller with the IBM Token Ring attachment feature. The main reasons for choosing this approach is that it is an upgrade to existing hardware and IBM is a safe decision to make with LAN gateways. LAN gateway technology is a very sophisticated technology and choosing the IBM 3174 controller as a safe alternative is probably a very good decision to make.

LAN gateways are beginning to replace 3270 coax adapters, the older method of connecting PCs to mainframes. Some companies are simply discarding their old, fully depreciated IRMA boards and replacing them with IBM Token Ring adapters. Most
companies, however, are still in the beginning phase of LAN and LAN gateway implementations. Many industry experts predicted that the 3270 coax adapter market would be much smaller than it is today. Instead the 3270 coax adapter market is still growing, but at a slower pace. The LAN gateway market has taken longer than expected to take off, but is now on a fast growth trend. When comparing LAN gateways to 3270 coax adapters, there are advantages and disadvantages to both.

LAN Gateways - PROS
- New technology
- Sharing of resources
- Spread cost of peripherals

LAN Gateways - CONS
- Reliability is a concern
- Cost of initial investment
- Cost of administration and support
- High memory requirements

3270 Coax Adapters - PROS
- Reliable technology
- Inexpensive (relatively)
- Little administrative costs

3270 Coax Adapters - CONS
- Old technology
- No sharing of resources
- Mainframe access only

MAINFRAME GRAPHICS ON A LAN
When using a graphics terminal emulator on a PC or PS/2 to access the mainframe graphics, the Token Ring adapter is used instead of a 3270 coax adapter. Once a user starts up the PC LAN program, and the graphics terminal emulation program, the mainframe computer LOGON screen will appear on the PC screen. From this point on, you would simply logon to the mainframe, and run SAS/GRAPH as you normally would.

The terminal emulation program generally accesses the LAN NETBIOS to pass data over the LAN, through the gateway, and to the mainframe. The NETBIOS provides PC Network system functions, using similar methods to those functions in the DOS BIOS. Some terminal emulators may access the Token Ring adapter directly, instead of using the NETBIOS. The NETBIOS can be different on different LANs. This can create some problems, and some terminal emulators may not run on all LANs.

There are several graphics terminal emulation products on the market that can access host graphics over the LAN. These vendors and respective products include the following:
- Teknigraphics GRAPH-TEK APA
- IBM PCLK
- DCA IRMALAN APA Graphics
- Novell/CXI APA Graphics
- Attachmate Vector Graphics Option
Tekniographics GRAPH-TEK APA

Tekniographics, a company that specializes in micro-to-mainframe graphics solutions, provides APA graphics on a LAN. The product GRAPH-TEK APA provides IBM 3179G graphics terminal emulation for stand-alone IRMA and IBM 3270 coax adapters. It can also be used on a Token Ring Local Area Network with your existing terminal emulation, including those such as IBM 3270 Emulation Program version 3.0, IBM 3270 Workstation Program, Attachmate EXTRA!, and DCA IRMALAN. GRAPH-TEK APA has low memory requirements, provides full resolution hardcopy output, direct HP plotter support (full resolution and hidden line removal), and CGM support.

IBM PCLK

The IBM PCLK product is an add-on product for IBM's 3270 emulation hardware and software. It will work with the IBM 3270 Workstation Program, IBM 3270 Emulation Program Version 3.0, and IBM 3270 Emulation Program - Entry Level. PCLK also requires additional mainframe software called GDDM-PCLKF, which consists of many PC executable files which reside on the host. These files are downloaded to the PC when PCLK is used. PCLK provides graphics hardcopy only for IBM hardcopy devices, and does not provide support for HP plotters and laser printers. Since PCLK is not a true terminal emulation product, it involves hot-keying, and can be cumbersome to use.

DCA IRMALAN APA Graphics

The DCA IRMALAN APA Graphics Workstation program provides IBM 3179G graphics to those who use IRMALAN. IRMALAN provides a gateway to the host using a special PC either attached to a 3274 or 3174 controller (IRMALAN DFT) or directly to a 3725 or 3745 communications front-end processor (IRMALAN SNA). The IRMALAN, like other DCA terminal emulation products, requires a large amount of PC memory to run. The graphics software is based on the Graphics Software Systems GSS*CGI device drivers and is licensed from that company. The DCA graphics software provides low-resolution hardcopy and no direct plotter support.

Attachmate Vector Graphics Option

Novell-CXI APA Graphics

Rabbit APA Graphics

The Attachmate Vector Graphics Option, Novell-CXI APA graphics, and Rabbit APA graphics are all very similar. The graphics software for these products are all licenced from Enertronics Research. As a result, the operation and hardcopy of the graphics is very similar. The only exception is that each company does have its own 3270 terminal emulation software. The Enertronics based APA graphics provides low-resolution hardcopy, no direct plotter support, and no CGM support.

Graphics Hardcopy

Graphics hardcopy is a very important issue when discussing IBM mainframe graphics terminal emulators. Displaying graphics on the screen is only half of the total solution. Local graphics hardcopy at the full resolution of the device is a necessity. Also required, is the ability to integrate your mainframe graphics into your PC graphics, desktop publishing, and word processing programs. This is most easily accomplished using the ANSI CGM (American National Standard Institute - Computer Graphics Metafile).

Obtaining graphics hardcopy on a LAN can be accomplished rather easily. The LAN software running on the PC handles the responsibility of sharing printers and other peripherals over the LAN.

Printer Sharing

Printer sharing is the easiest. The LAN software simply redirects all output to an LPT port over the LAN to another destination. Any parallel printer can be used in the manner, including printers such as HP Laserjets, HP Paintjets, etc. When output is sent over the LAN, the print file is queued on a file server disk and then serialized with other print jobs going to the same printer. Typically, a page with the LAN workstation node name and name of file is printed out and then the actual output that was sent to the printer.
Plotter Sharing

Plotter sharing can be somewhat more difficult, if not impossible in some situations. The main reason for the difficulty is that most plotters can both send and receive information, unlike a printer which is generally an output only device. Some software may query the plotter to find out how many pens the plotter has, or the size of the graphics buffer. When there is a 2-way flow of information, plotter sharing may be impossible. If the PC software is waiting for a response from the plotter and the LAN cannot read information from the plotter, the system will hang. Some software will generate a 1-way output only data stream to the plotter. This solves the problem of not getting any response from the plotter, but there can be problems if another user sends data to the plotter when your plot is plotting. If the LAN cannot serialize the plot files sent to the plotter, the plot in progress will usually be aborted by the initialization data in the second plot.

USING SAS/GRAPH SOFTWARE ON A LAN

When using SAS/GRAPH Software on a LAN, you must have some type of LAN in place, a LAN gateway to your mainframe, a PC LAN program, a graphics terminal emulation program that will run on the LAN, and printers or plotters attached to the LAN or locally to your PC. After your PC is powered on with the LAN software in place and graphics terminal emulation software running, simply logon to the mainframe system as you normally would using an IBM mainframe graphics terminal. Once logged on, run SAS/GRAPH as you normally would.

To Display Graphics to the Screen:

GOPTIONS
DEVICE=GDDM79;
   --or--
GOPTIONS DEVICE=IBM3270PCG;

The GDDM79 device driver provides eight colors, while the IBM3270PCG device driver provides sixteen colors. The IBM3270PCG device driver may not be able to be used with all 3179G terminal emulators.

To Print Graphics:

After your SAS/GRAPH is displayed on the screen, your graphics terminal emulator should provide a method of capturing the graphics to disk and then printing the file locally from the PC. If you are using the GRAPH-TEK APA software, you simply press the ALT-PrtSc combination and the graph is automatically captured to disk using either replace, increment, or prompt modes. Other emulators typically use a multi-step process of hot-keying to the PC and executing a PC DOS capture command, then hot-keying back to the host. The GRAPH-TEK APA increment file capture mode provides the capability of automating the capture of large number of graphics files.

To Plot Graphics:

Both the IBM PCLK and Teknigraphics GRAPH-TEK APA provides direct plotter support. All others, provide local plotter support which is not desirable because of the low resolution and lack of hidden line removal. IBM PCLK can only output to IBM plotters, which is typical of IBM. GRAPH-TEK APA can output to IBM and HP plotters, as well as other HPGL compatible devices. The following GOPTIONS would be used for direct plotter support:

GOPTIONS DEVICE=GDDMLT2
   GDDMNICKNAME=PCPLOT;

GOPTIONS DEVICE=GDDMLT6
   GDDMNICKNAME=PCPLOT;

GOPTIONS DEVICE=GDDMLT8
   GDDMNICKNAME=PCPLOT;

The device drivers GDDMLT2, GDDMLT6, and GDDMLT8 correspond to 2, 6, and 8 pen plotters respectively such as the HP 7470A, HP 7475A and HP 7550A plotters. The nickname PCPLOT can be any name that is defined in your ADMDEFS PROFILE, which defines nickname for use with GDDM on your user (or system) account.
Converting Graphics from PIF to CGM

To convert your SAS graph into a format acceptable for PC graphics software, it can be captured into a PIF (Picture Interchange Format) file and then be converted into an ANSI CGM (Computer Graphics Metafile) file. Both of these graphics standards are very important in the graphics industry today; PIF being IBM’s standard, and CGM an American National Institute’s standard. One way to convert these PIF files into CGM files on the PC is to use the Teknigraphics GRAPHTEK CGM, a graphics conversion software utility. The syntax to convert PIF to CGM is as follows:

PIF2CGM sasgraph.PIF sasgraph.CGM

Once in the CGM format the SAS graph can be imported into various PC packages such as Lotus Freelance Plus, Harvard Graphics, Ventura Publisher, Aldus Pagemaker, CA-SuperImage, Ashton-Tate Draw Applause, Zenographics Mirage and Pixie, Word Perfect, and many others. Once your SAS graph is imported into one of these packages, it can then be output to a number of other formats including Postscript, Windows Metafile, TIFF, Videoshow, and others.

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SUMMARY

Today LANs are a growing trend. They are being used to increase productivity and facilitate the transfer and use of information. LAN gateways are gaining acceptance, by replacing the older 3270 coax emulator technology, providing access to mainframes and providing the sharing of other resources at the same time. SAS/GRAPH software can be accessed by using PCs or PS/2s connected to a LAN, and using a LAN gateway to provide access to IBM mainframes. Selection of a graphics terminal emulation program is a very important decision. It must be able to work in a variety of environments, provide full resolution hardcopy, and be able to integrate mainframe graphics into the PC environment. The mainframe/PC graphics integration is most easily accomplished by using PIF and CGM, two very important standards for storing graphics information.

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