White Paper on Running Nature of Science Visit Series over a LAN

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This white paper discusses the issues related to running the Nature of Science (NOS) Visit Series on a Local Area Network. There are two titles in the Nature of Science series. They are 'At the Seashore' and 'Through the Woods'. When you install either one of these you get the 'Visit' program and the 'Guide' program. The Guide program is very conventional in the way it is installed and the load it places on your file server and LAN. The Visit programs allow students to take virtual field trips that use full motion video and audio. Full motion video and audio place great strains on file servers and LANs and you should plan for this load.

The data streams for each MPEG-2 (Video and Audio combined) data stream is 2.5 Mb (megabit) that must be received at the workstation. This must be received continuously at the workstation to avoid stuttering video or broken audio. Any Pentium 233MHz workstation with a 10Mb Ethernet adapter is fine for the workstation. The challenge is to configure the file server (hard disks, RAID5 controller and network adapter) and LAN hardware (switches not hubs) to handle the load. The good news is if this is a new installation you are probably configuring the right stuff already, except for a few extra hard drives.

Major Factors affecting performance of the NOS Visit Series:

1. LAN Speed: Use Gigabit Ethernet (or ATM) on the file server. If 25 computers are all getting 2.5Mb at once then the total bandwidth for NOS will be 62 Mb. This is obviously too much for 10 Mb networks, is at the very edge of 100 Mb networks but is well within the capability of 1 Gb networks (1Gb=1,000Mb). If one or more students download a program other than NOS from the server at the same time 25 students are downloading NOS videos then the bandwidth for the NOS workstations suffer. That is why Gb Ethernet is superior to 100 Mb Ethernet.

2. LAN Electronics: Here Switches are preferable to Hubs. Hubs have data paths that are shared by multiple nodes and data is sent in a broadcast to everyone mode. Switches send a data packet only to the node that it is addressed to. The server MUST be hooked up to a full duplex port on a SWITCH. The workstations should have at least 10Mb of available bandwidth available. This means that workstations must be on 10Mb switch port or on a 100Mb hub port (if less than 10 workstations are on the same hub port). It is important that these switches be the modern ones with high bandwidth capability across the backplane. There must be no routers, servers or hubs between the workstations and server.

3. Disk Controller: The controller must be a dedicated RAID5 controller. IBM calls their controllers SERVRAID adapters and each company has equivalent adapters. This allows the MPEG-2 data to be stored evenly across multiple hard drives

4. Hard Disks: This is probably the most important part. Data is stored evenly across the RAID5 disk array and the server needs lots of disk heads to service lots of requests. The more drives the better. For light use (up to 5 MPEG-2 data streams at a time) three drives are the minimum. For large networks (up to 30 MPEG-2 data streams) use at least six drives in the RAID5 array. These drives can be of any size.

5. Server: The server should be one of the modern ones (64 bit PCI slots for network adapter and disk controller) with Pentium-4 or XEON processor and 2GB of memory. The excess memory will help with disk caching (Microsoft or Novell).So to put that all together you want:

To summarize the network should have:

- New Server (Pentium 4, 2GB of memory, 64 bit PCI)
- Gigabit Ethernet Adapter
- RAID5 controller
- Six SCSI drives
- Fully switched network (1Gb for server, 10Mb for workstation)

You may be able to get away with lesser equipment but it is hard to know where the breakpoints are. IBM tested these kinds of servers and LANs delivering full motion video continuously to 30 workstations at the IBM Networking Center in Raleigh. The reason you need servers and LANs that exceed the minimum specs is because there will be other workstations also needing service from the server and LAN. For example in a school with 100 workstations the other 70 machines may all be doing something at the same time your lab is running NOS. They won't notice if the server or LAN is slow because it might take an extra five seconds to load a program or web page but the NOS workstations need their bandwidth!

The good news here is it is nearly impossible to get 30 students to do something all at once. They will be in various stages of exploring including navigating to different locations, viewing still pictures, listening to audio, looking at still pictures, giggling, capturing their pictures as well as downloading full motion video. Also, these requirements are related to the VISIT program only. The GUIDE portion is a low bandwidth application. Students normally spend more time in the guide than they do in the visit. On the other hand, if your server or LAN is not up to the task you can install NOS (1.2 GB) to each workstation in the lab and have no LAN or file server issues at all.