Digital Video Editing and its impact on Network Performance

A white paper on network management

A1 COMPUTING SOLUTIONS

Introduction

The implementation of Digital Video editing to a school's curriculum introduces a new level of complexity to the network. Digital video files are, by their nature, very large before the final rendering. It is not unusual for these files to be in the order of one to two gigabytes.

When files of this size are being accessed across a network, it is not hard to see that other users will have access to very limited bandwidth and the general performance of the network will decline (usually in proportion to the increase in frustration levels).

Overview

This paper addresses the issue of increased demand for bandwidth by software now commonplace in schools, the decline in network performance experienced in many instances and an appropriate network topology to minimise the impact of such software.

It is not so long ago that schools had limited resources in the area of computing and networks were generally small, if indeed one existed at all. It is now common for schools to be maintaining large networks with a significant number of computers and printers, sometimes spanning multiple campuses and now requiring data transfer rates that only a few years ago would have been considered unachievable.

Networking technologies are commonly rated in megabits per second (mbps).[1]

The challenge is to provide an infrastructure that will ensure that the investment in technology (ICT) delivers maximum benefit, and that includes delivering maximum megabits per second.

What has changed?

Network infrastructure is far more sophisticated than it was, with the once commonplace coaxial cable replaced by optic fibre backbones and unshielded twisted pair (UTP) cabling capable of delivering high speed data transfers. Wireless networking has become commonplace, and whilst not yet delivering the data transfer performance of cabling, is delivering data transfer rates well in excess of that provided by early networks.

Simple hubs broadcasting to every computer on the network have been replaced by programmable/intelligent switches designed to manage the flow of data around the network.

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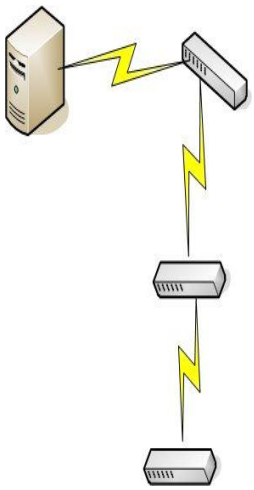
[1] Many people confuse mbps with megabytes per second. A megabyte is just over one million bytes of data (1,048,576) and is abbreviated as MB/sec. It takes eight megabits to equal one megabyte:

8 mbps (megabits per second) = 1 MB/sec (megabytes per second)

How does topology impact on performance?

Consider a typical network that, having developed over a period of some years consists of a server, connected via a one gigabit port to a 24 port switch with output of 100 megabits per port. This switch is fully populated with 22 PCs attached and one port cascading to another identical switch. Again, let's assume that this switch is fully populated with 22 PCs and one port cascading to another identical switch which is fully populated with 23 PCs. (Don't forget that the remaining port on each switch is used for the uplink back to/from the server.)

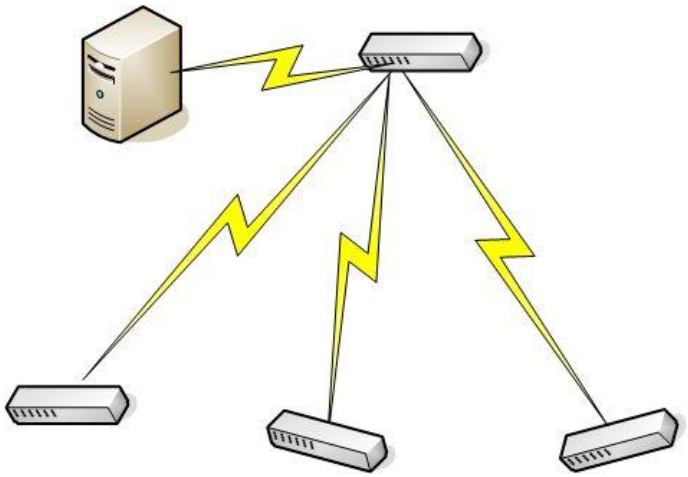


It is relatively simple mathematics to show that even though the links from switch to switch might be short, the 100 megabits per second leaving the first switch is shared by all 23 ports on the second switch. That is, each port on the second switch will have 100/23 = 4.35 mbps. If this then cascades to the third switch, each port on that switch will have only 4.35/23 = 0.19 mbps of available bandwidth. Is it any wonder that the network seems slow (and slower the further we get from the server)?!!

Now try opening or rendering a one gigabyte digital video file and it is no surprise that the impact on the network performance is dramatic.

Is there a better design?

To optimise available bandwidth, we need to avoid the temptation to allow multiple 'hops' whereby the available bandwidth is shared at each 'hop' and rather, link each switch directly to a primary switch in what is called a star configuration. In this way, each switch deployed across the network will receive the maximum bandwidth available at any time. Further, if the server has a one gigabit per second network card and connects to a switch with both gigabit in and out capability rather than one with only 100 megabit output, then switches on the network will receive bursts of up to one gigabit per second to divide among the PCs connected.



Mathematically, we see that the end user PC now receives 1,024/23 = 44.52 megabits per second, a ten-fold improvement.[2]

For typical network activity, a star configuration will provide a significantly faster and more efficient working environment than that provided by cascading switches, but there are still activities that will bring a network to a halt, and foremost among these is digital video editing.

How does Digital Video editing impact on a network?

Digital Video files are, by their nature, very large before the final rendering. Typically in the educational environment, they can be between one and two gigabytes. In order for students to be able to work with and edit these files, it is generally a requirement that the user have access to a local hard drive (i.e. one physically attached to the computer on which they are working.) Quite simply, as evident from the examples above, it is not possible to work on Digital Video files that are stored on the File Server as the access speed is simply too slow.

This produces a quandary, because in many schools, the required security paradigm denies students access to the local C drive on the workstations.

This can be overcome by either (a) partitioning the single drive into two partitions, or by installing a second physical drive into each of the computers that will be used for Digital Video editing. The second option is the preferred option, but does involve the purchase and installation of new drives, a cost some schools will have difficulty affording.

Whichever option is chosen, the computers will now have a D drive which the students can access, while C drive (normally containing the Operating System and Program Files) is secured.

[2] A gigabyte is a unit of information equal to 1,073,741,824 bytes (2^{30} bytes) or 1024 megabytes and hence, one gigabit per second is equivalent to 1024 megabits per second.

Separate to the 'working files', but still critical to network performance, are the Digital Video files and their storage.

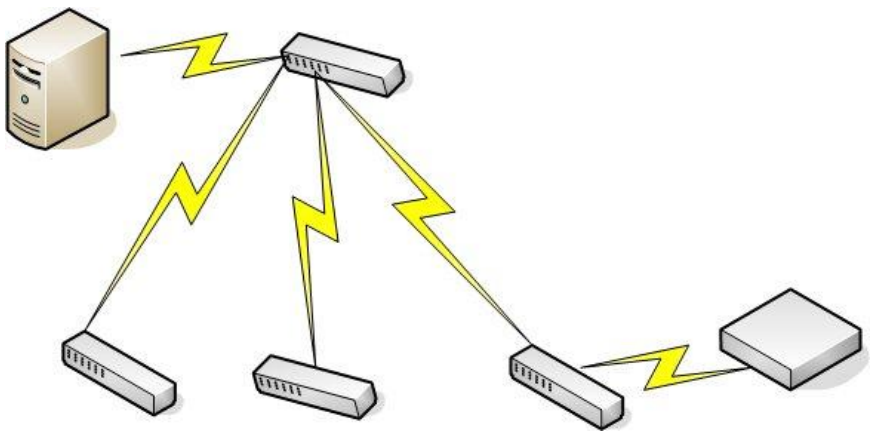
As with the working files, it is not feasible to store them on the network's file server. Access times for copying the files to and from the file server during lesson times would be prohibitively long and would slow the rest of the network down so much that it would be virtually unusable.

A very neat solution to this problem would be to introduce a new item of hardware, namely a Network Attached Storage device (NAS) for storage of the Digital Video files.

Our network design now resembles the star configuration outlined above, with a primary switch attached to the server and providing one gigabit per second connectivity to each switch on the network.

The computers to be used for digital video editing and the NAS are connected directly to one switch and this switch is connected directly to the primary switch which is in turn connected to the file server. (Budgetary constraints might make it necessary to cascade from some switches, but wherever possible this should be avoided and it is imperative that there is no cascading in the link from the primary switch to the switch connecting the computers on which digital video editing is to occur.) With technology advancing as quickly as it has in recent years, it is usually wisest to buy the fastest devices the budget will allow for in order to provide maximum future-proofing.

Because of the way switches work, the network traffic generated by the data being copied to and from the NAS device will be limited to the switch. This means that the rest of the network will not become congested and that the access to the NAS device within the digital video editing suite will be at the maximum possible speed.



What's the best way to proceed?

If you need to review your current network infrastructure and topology, contact A1 Computing on (08) 8272 3027 or email us at info@a1computing.com.au