

Understanding the drivers of online data usage: an empirical analysis

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Abstract

This paper investigates what drives online data use in 60 public library and council sites across Victoria. The results suggest that simple measures, such as hours of opening and the number of terminals, are not sufficient to account for the variations in use across the sample sites. The results also suggest these simple measures do not provide adequate data for operational and policy planning. By analysing the Internet data used over twelve months, and through case studies analysis, this paper explores what drives Internet data usage and how libraries can take greater control of their data requirements and costs.

Introduction

The Internet is playing an increasingly important role in the provision of library services. More and more information has become digitised,ⁱ and more databases are becoming available online. Patrons are also demanding more immediate access to information; be it remote access, or on-site access within a library branch. Victorian research suggests there is “no evidence to support the proposition that the demand for public access [in public libraries] is plateauing or declining” (Hardy & Johanson 2002, p. 24) Consequently, it appears that providing Internet access points, and delivering ever greater amounts of data to support this demand, is having an impact on library resources and budgets. It is therefore important for libraries to better understand what types of patron usage drives Internet data overheads. It is also important to then determine what funds, as well as policies, are required to support the ongoing increase in online services.

Since June 2002 a growing number of the Victorian public libraries have migrated to one or more of the VICNET DSL, fibre, or wireless services that make up VICNET’s eCommunity network. With an increase in bandwidth, these libraries have found their use of the Internet has risen, and in some cases, alarmingly so. This not only places a considerable strain on their budgets, it also leads to congested connections. The congestion can occur despite the libraries significantly upgrading their bandwidth. Anecdotal information from other Australian states and territories suggests Victorian public libraries are using considerably more data than their interstate colleagues. This could be because the Victorian public libraries have migrated their branches to broadband connections earlier than their interstate colleagues. If this is the case, libraries in other parts of the country may be faced with a similar situation. For this reason, it is important to understand what has happened in Victoria. Lessons learnt from the Victorian experience should also be made available to the wider library community.

Some Victorian libraries also claimed that as the bandwidth increased, patrons’ usage changed. There is the suggestion that this change in patron behaviour increased data usage, and as a result the costs to libraries. Many of the eCommunity sites in this study migrated from the VICNET shared one-way satellite service (initially funded by the Federal Government’s Networking the Nation program and Multimedia Victoria) with ISDN back channels. When connected to this satellite service these libraries “experienced reasonably stable, or a slight growth, in bandwidth requirements.” (Feighan & Schmidt 2002, p. 611) However, the satellite connections only connected the main library branch. The other branches still used 128 K, or more frequently 64 K, ISDN connections. There were even some sites that used 64 K permanent dial up connections. The issue of whether increases in bandwidth out to branches changes patron usage, and therefore bandwidth overheads, is intriguing. Understanding these changes should enable libraries to be better informed when making decisions on communication upgrades.

Commentators such as Bill Gates (1995, p. 136) predicted that “in just the next five years the communications bandwidth available in urban business areas will grow by a factor of 100 as network providers compete to connect concentrations of high-user customers.” Though Gates’ prediction has not yet occurred for Australian public libraries, the increases have been significant. The increases have also had an impact on costs. If, as Taylor (1995 p 42-44) predicts, “far from building information motorways, we are just about to begin building some A roads and a few B roads... the computer industry is at about the same stage as the Model-T Ford,” the imperative for libraries to plan and budget for even greater data increases is of utmost importance. With the introduction of ever more online library services, incorporating data-rich multimedia, video on demand, and voice over IP, the library of the future could well look back to today’s Internet infrastructure in the same way we look back at vintage cars.

What is at stake is public libraries continued participation in the building of the information economy's infrastructure.

If as Hall (1998) notes this increase in IT infrastructure is part of Schumpeter's process of creative destructionⁱⁱ; [that also] necessarily involves bursts of ... infrastructure," libraries, whether they like it or not, must continue to reposition themselves (and the services they offer), in order to keep up with the current twenty or so year economic and technological cycle. Central to this process of strategic positioning is Porter's (2001) view that organisations must ensure their online strategies are an integral part, rather than a separate part, of their overall budget and strategic goal setting. Some libraries have already adapted this approach; "at least one public library in Victoria (Yarra Plenty Regional Library Service) now treats its Internet services as another branch and as such Internet services are staffed and budgeted accordingly." (Feighan & Schmidt 2002, p. 604)

The Australian Senate's "*Libraries in the online environment*" report of 2003 and the 2000 "*Report on a policy for public access to the Internet for Victoria*" by Trinitas for Multi-media Victoria, investigate the equity and sustainability of public Internet access. The 7th recommendation of the Australian Senate report states that:

- “(a) the Australian Government negotiate with telecommunications carriers to establish an e-rate or discount for broadband access to public libraries and that, if negotiations are not successful, consider imposing a requirement on carriers under the Universal Service Obligation; and
- (b) that further funds be allocated under an expanded National Broadband Strategy for expanding broadband access in libraries.”

The e-rate proposal in recommendation 7 is based on the US example. However, as reported by Oder (2003, p 20) in the *Library Journal*; the "*Preliminary Analysis of Public Library E-rate Data: 1999-2002*" report conducted by John Bertot et al on behalf of the American Library Association's (ALA) Office for Information Technology Policy shows that public libraries in the US have only ever received between 3% to 4 % of the e-rate subsidy. Oder also reports "because there is a federal cap to E-rate funds of USD\$2.25 billion, not all requests are fully awarded. In 2002, for example, 89 percent of library applicants received E-rate funds, but only 52 percent of the discount dollars requested were granted. Well over half the E-rate funds goes to telecomm services, while the remainder goes to Internet access and internal connections."

Similar funding caps, and restrictions, applied to an Australian e-rate scheme, would impose a considerable burden on public libraries. This would be particularly true if the Victorian experience of data increases is repeated nationally. During the 12-month study period the Victorian public libraries sampled experienced increases of between 14% and 237%" in total data usage, with the average increase being 110%. It is difficult to see Australian governments being willing to subsidise data rates if the data overheads required to support library services double every twelve months. Government may be better served by subsidising circuit costs, as these tend to be more stable. While not discounting an e-rate program for Australia, libraries should also consider strategic peering options, where the data can be transmitted free of charge. Libraries then need only pay for the circuit costs and the data sourced from outside the peering network. VICNET has already started this process with its eCommunity network. This network may prove a useful model for libraries other states and territories.

The benefit of peering for governments is that as bandwidth use increases, there is no additional burden to increase subsidies when the data is being drawn from a peering partner. The Western Australian Internet Associationⁱⁱⁱ and Victorian Internet Exchange or VIX^{iv} (of which VICNET is a member) have been proactive in establishing peering relationships in their respective states. In Victoria, peering may also play a role in the Victorian Government's Telecommunications Purchasing and Management Strategy (TPAMS) project. Nationally, NOIE^v is considering a demand aggregation broker program. Given the increased reliance on Internet data, libraries should consider what role these peering bodies or projects will play in the future. Libraries also need to consider how they will align themselves with these emerging projects.

It is also important for libraries to better understand the service elements of various broadband delivery methods and the associated costs. The Dandolopartners report by Adams and Meagher (2003) for the Australian Communication Authority identified customer awareness and lack of standardised information from vendors as one of the main reasons there is so much confusion and disputes relating to broadband service deliverables and costs. Regarding downloading, Adams and Meagher (2003, p. 8) noted "some consumers, attracted by the promise of speed, seek the best price, without fully understanding the restrictions on speed and downloading." As libraries increasingly depend on their Internet connections for mission-critical applications such as catalogue traffic and staff e-mail, understanding and dealing with the cost of bandwidth capacity is only going to become more important.

This paper focuses on the delivery and use of Internet data by a sample of the connected public libraries in both metropolitan Melbourne and rural Victoria. The study looks at what is driving the library's Internet data usage. It also looks at what network changes, and policy changes, libraries have adopted in order to take greater control over their data usage. It is hoped that by making this information available to the wider public library community, all library services will be better informed, and better placed, to protect themselves from data and budget blowouts. Libraries may also be placed to protect themselves against inappropriate, or illegal, use of their Internet connections. Furthermore, it is hoped that the libraries will be better placed to implement policies and procedures that provide a high level of online services to patrons, whilst still keeping control of costs.

Background Information

For reporting and billing purposes, VICNET uses NetFlow to measure eCommunity DSL, fibre and wireless customers' data usage. Consequently, this study uses NetFlow as the primary method of collecting raw data. It is therefore important to have some understanding of NetFlow, as well as an understanding of the VICNET eCommunity network.

NetFlow

NetFlow provides "the measurement base for Cisco's Internet and Enterprise Quality of Service (QoS) initiatives... A network flow is defined as a unidirectional sequence of packets between given source and destination endpoints. Network flows are highly granular; flow endpoints are identified both by IP address as well as by transport layer application port numbers. NetFlow also utilises the IP Protocol type, Type of Service (ToS) and the input interface identifier to uniquely identify flows"<HREF 1>. For more information on NetFlow, go to: http://www.cisco.com/warp/public/cc/pd/iosw/ioft/neflct/tech/napps_wp.htm

VICNET uses NetFlow to measure daily uploads and downloads per site. In addition, daily and monthly totals are available in real time to all eCommunity broadband customers via VICNET's Network Operations Centre (NOC) site. The NOC site is located at <http://noc.vicnet.net.au>. With NetFlow VICNET measures:

Free downloads and uploads – this is information sourced from any other eCommunity site irrespective of whether that site is another branch of the library service, another connected public library or a connected government department, NGO or community group.

Downloads and uploads – this is information that has been sourced from outside the eCommunity network. As with the other eCommunity sites, the libraries in this study are charged for downloads outside of the eCommunity network. VICNET however, does not charge for uploads.

Figure 1 Sample NetFlow Data (last 2 days of August plus monthly summary)

Site	Date	Free Down	Downloads	Total Down	Free Up	Up	Total Up
Site 1	Aug 29 2003	4.06	92.25	96.31	3.77	10.40	14.17
Site 2	Aug 29 2003	10.16	51.44	61.61	1.44	0.74	2.18
Site 3	Aug 29 2003	19.12	867.57	886.69	25.34	129.66	155.01
Site 1	Aug 30 2003	5.63	55.05	60.68	6.14	3.32	9.46
Site 3	Aug 30 2003	6.08	13.76	19.84	3.64	0.44	4.08
Site 4	Aug 30 2003	6.05	100.85	106.90	8.28	22.31	30.59

Site	Free Down	Downloads	Total Down	Free Up	Uploads	Total Up	Kbps
Site 1	492.64	23,079.86	23,572.50	525.78	3,282.48	3,808.26	66.43 kbps
Site 2	318.99	1,093.05	1,412.03	256.63	142.60	399.23	3.98 kbps
Site 3	257.63	4,735.82	4,993.46	245.08	393.20	638.28	14.07 kbps
MONTH TOTAL	1,674.28	38,280.94	39,955.22	1,613.65	4,436.02	6,049.68	

Internet connectivity is supplied to the eCommunity network, and the State Library of Victoria, via two 100 Mbps Ethernet connections to VICNET's point of aggregation in the third party peering room^{vi} at the Melbourne stock exchange. VICNET has also recently added another point of aggregation in the Sydney. For redundancy VICNET uses two upstream data wholesalers.

If a council or associated site (such as an aged care site) was linked to the library subscription, this site was included in this study. However, none of the other VICNET customers have been included in this study. Some of the libraries in this study have their own line-of-sight network, so they only connect to VICNET via their main site. This study recognises this aggregation when considering the number of terminals per 'site'.

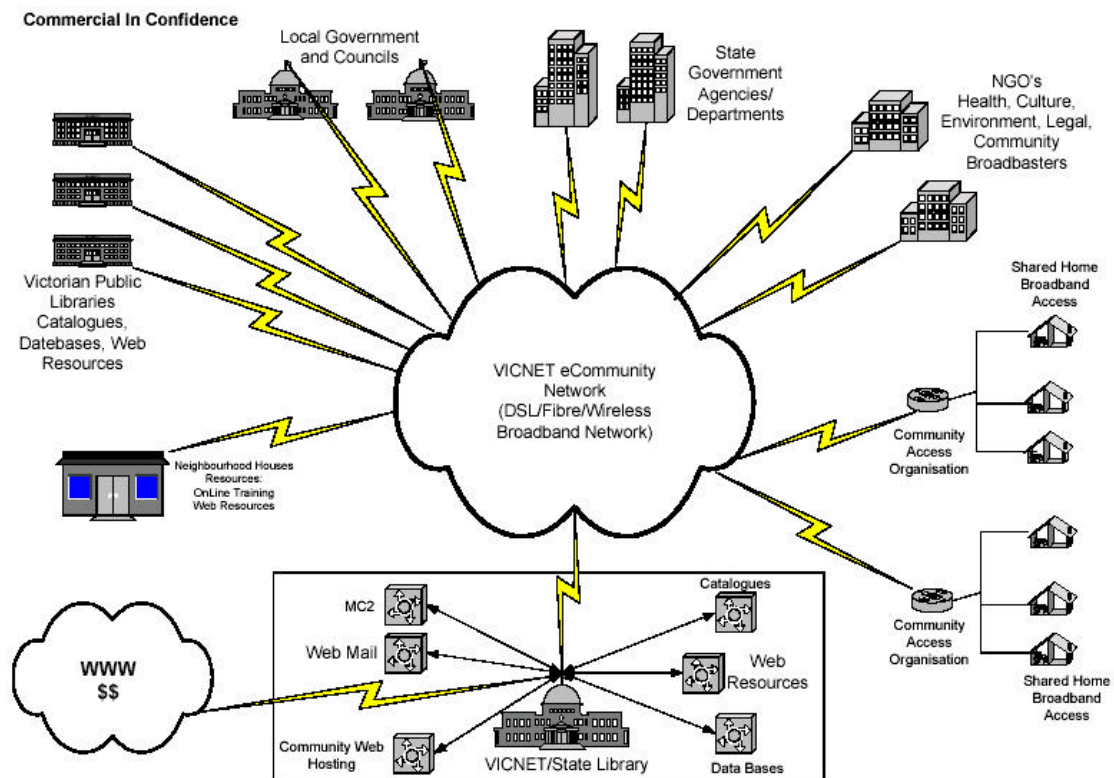
VICNET's eCommunity Network

As all the libraries in this study are linked to VICNET's eCommunity network, it is important to have an overall understanding of this network. At its simplest, the VICNET eCommunity network uses a number of VICNET's circuit wholesalers to provide DSL, fibre, or wireless connections to customers. This allows VICNET to aggregate all the customers' bandwidth. These wholesalers only charge VICNET for the circuits. Consequently, VICNET does not incur data costs, as long as the data moves between one VICNET connected customer and another. As a not-for-profit ISP, VICNET is then able to waive the charges for data between connected sites, irrespective of whether the sites belong to the same organisation. For example, a connected library can download free data from a connected government agency. If however, the data comes from outside the VICNET eCommunity network, the customer is

charged for the downloads. As a rule VICNET does not charge for uploads. It is important to note that the eCommunity network is self-funded through the paid DSL, fibre, and wireless subscriptions. As a result, the eCommunity network is independent of the uncertainties of government funding processes. One of the strengths of the eCommunity network is that it is not just restricted to public libraries. The eCommunity network connects public libraries to community groups and schools. It also links libraries to state government agencies and departments. (see Appendix A and figure 2 for details).

Figure 2 VICNET’s eCommunity Network

Internet downloads are charged but eCommunity, VICNET, and State Library of Victoria data is free.



Part 1 – Overview of data usage

The study is in two parts. The first part presents the data usage of all 60 sites. These sites support a resident population of almost 2 million people, of whom 1.568 million resided in Melbourne, or its urban fringe, and 426,545 resided in regional Victoria. It should be noted however, that some of this rural population could be considered as part of Melbourne’s urban fringe. This section of the study is interested in macro trends, such as monthly data per site and the overall changes, per library system, of data usage throughout the study period. The second part of the study looks at four of the sites in more detail. These case studies look at two single-municipality metropolitan library services, and a metropolitan regional library service that supports two councils. In addition, the case study looks at a rural-based regional library service that supports six councils. In the case of the rural library service, most branches support their entire town, as well as the community in the surrounding area. This said, three branches of the rural regional library service support one large regional centre.

Methodology

Using NetFlow, VICNET commenced monitoring the sample library and council sites in October 2002. For the following twelve months, monthly NetFlow upload and download data was gathered from the sites, collated, and then graphed. This part of the study looks at the total monthly uploads and downloads of each library network, as well as the average downloads and total monthly downloads per branch. While upload data was also investigated, VICNET does not charge for uploads, so the main focus of this paper is on download traffic usage. This said, upload traffic can have an impact, especially on library system traffic between the main library and its branches. This will be explained in more detail.

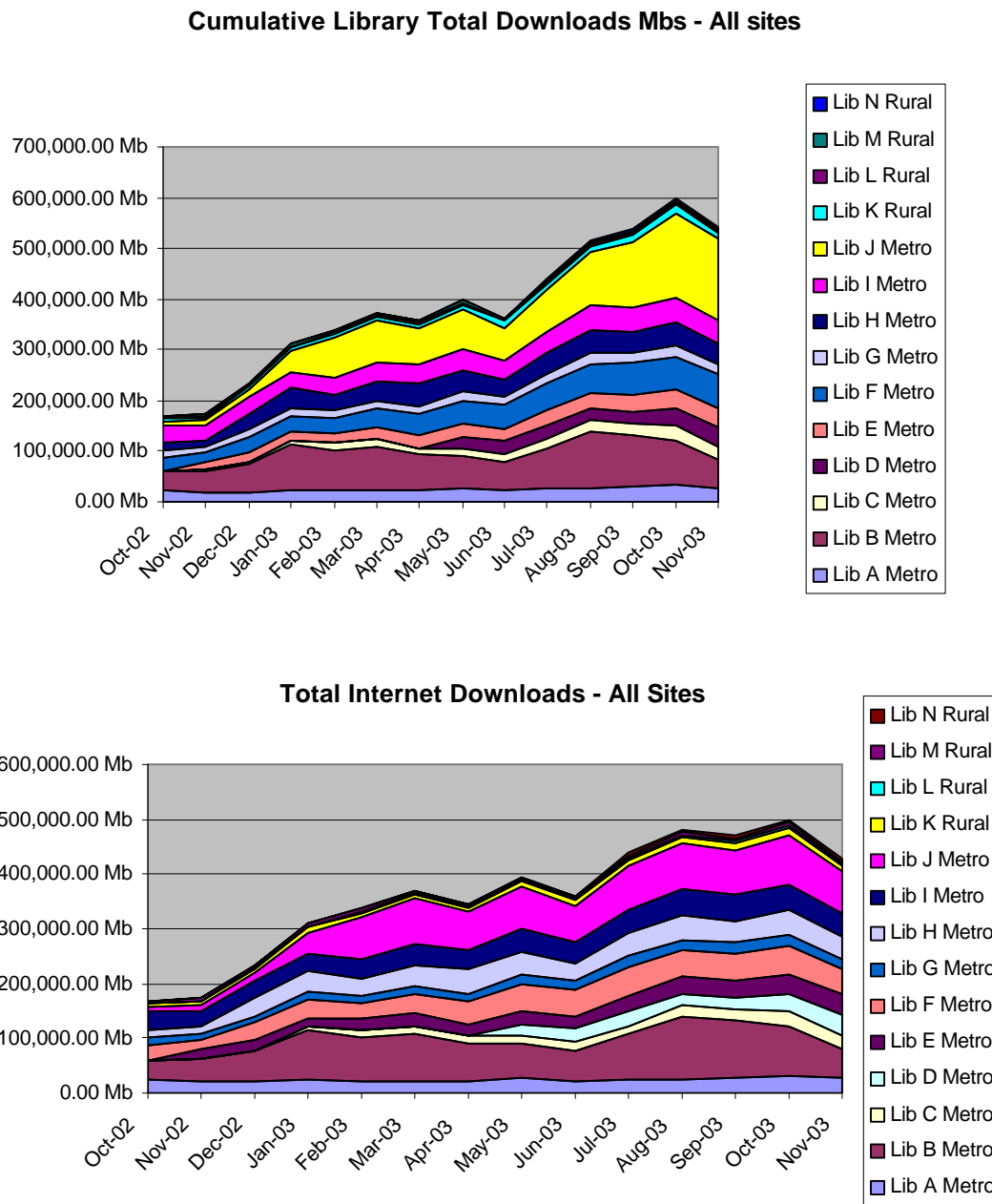
Some of the sites use the VICNET proxies, whereas others do not. For consistency, this study has focused on the total data usage per site, as well as the total Internet data used. For this study, Internet data is all data coming from outside the eCommunity network. To be included in this study, the library site must have had a VICNET DSL, fibre, or wireless connection for at least six months. To protect the privacy of the participating libraries, each library service was given a letter code (A through to N) for identification. Libraries with ISDN and or satellite connections, as well as libraries that migrated to DSL, fibre and wireless in the second half of 2003, have not been included. The exception to the selection criteria is Library N. This rural library service was included in the first part of the study because there was less rural library data available.

Findings

Growth in Data Usage

Figure 3 clearly shows that the overall bandwidth required for these sites has trebled in the 12 months from October 2002. Whereas in October 2002, VICNET could support this sample group with just under 200 Gb of data downloads a month, by the beginning of October 2003, close to 540 Gb of data was required. What this chart does not show, is that most of these sites migrated from 128 and 64 K ISDN to DSL connections in July and August 2002. As a result, between August and October 2002 the cumulative data usage for these connected sites had already grown dramatically. As mentioned in the introduction, prior to migrating from a shared satellite connection to individual broadband connections, the libraries had experienced relatively stable data usage. As a number of sites use their connections to refresh the proxy servers at each branch, the following chart (*Figure 3*) also shows the Internet only data usage.

Figure 3 Overall downloads



The overall increase in data usage is also apparent when considering the findings outlined in Table 1. This shows the change in average downloads from the start of the study in October 2002, as well as the end of the study period in October 2003. In October 2002, the vast majority of library branches connected (77%) did less than 5 Mb of total data downloads a month. By October 2003 only 44% of connected branches do less than 5Mb of total data downloads a month. By October 2003, not only do the majority of branches (56%) do more than 5 Mb of total data downloads a month; 32% do more than 10 Mb a month, and 11% do more than 20 Mb a month.

Furthermore, in October 2002 there was no noticeable difference between the total data downloads, and downloads from outside of the VICNET eCommunity network. However, by October 2003 an increasing amount of data is coming from the wider eCommunity network. A large part of this eCommunity data appears to be coming from within each individual

library system. This is especially true where the libraries use their VICNET connections to refresh the their individual branch proxies each night. As the eCommunity network grows, and more sites are connected, it appears that the use of data from other eCommunity sites is also increasing.

Table 1: Monthly total data downloads by per branch

Type of Downloads	Date	Sample Sites	Less than 1 Mb	Between 1 and 5 Mb	Between 5 and 10 Mb	Above 10 Mb
Total Data	Oct 2002	52	37%	40%	17%	6%
Internet Only	Oct 2002	52	37%	40%	17%	6%
Total data	Oct 2003	63	17%	27%	24%	32%
Internet Only	Oct 2003	63	19%	25%	35%	21%

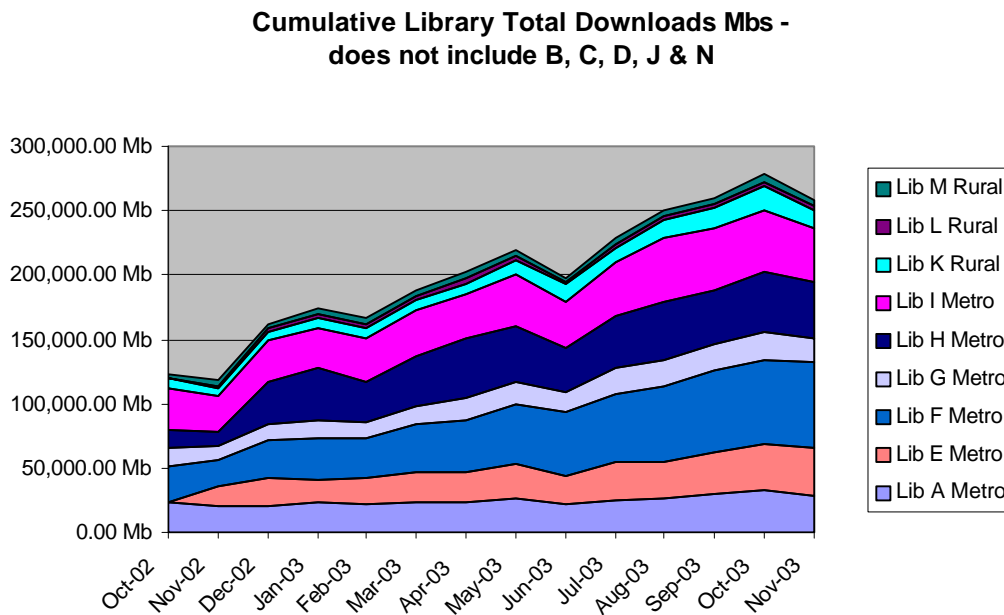
Seasonal Patterns of Data Usage

Though the overall trend is for increased data use, it is clear that there were months when data use declined, in particular; April, June and (even though it falls outside of the study period) November 2003. All of the libraries in the sample held the view that recreational Internet use by school students was one of the main drivers of data use in public libraries. Most of this student use took place in the afternoons and evening, as well as during school holidays. In 2003 the Victorian school holidays were from 11 April to 28 April, from 27 June to 14 July and from 19 September to 6 October. First term started on 28 January, and the fourth term, which included the end of year exam period, finished on 19 December. If Internet use during school holidays increases data use, this may explain the increase in January but it does not explain the decline in April. Library B however, noted that recreational Internet use by students tends to decline near the end of each school term. The view was that students are more focused on completing assignments during this end of term period. This could then explain the declines in June and November, and possibly April. Recreational Internet use such as gaming, as well as data-streaming and file-sharing, appear to have a more profound impact on library bandwidth than more ‘academically’ focused Internet usage. However, more research is required to better understand the seasonal nature of patron behaviour and Internet data use.

Diversity of Data Usage

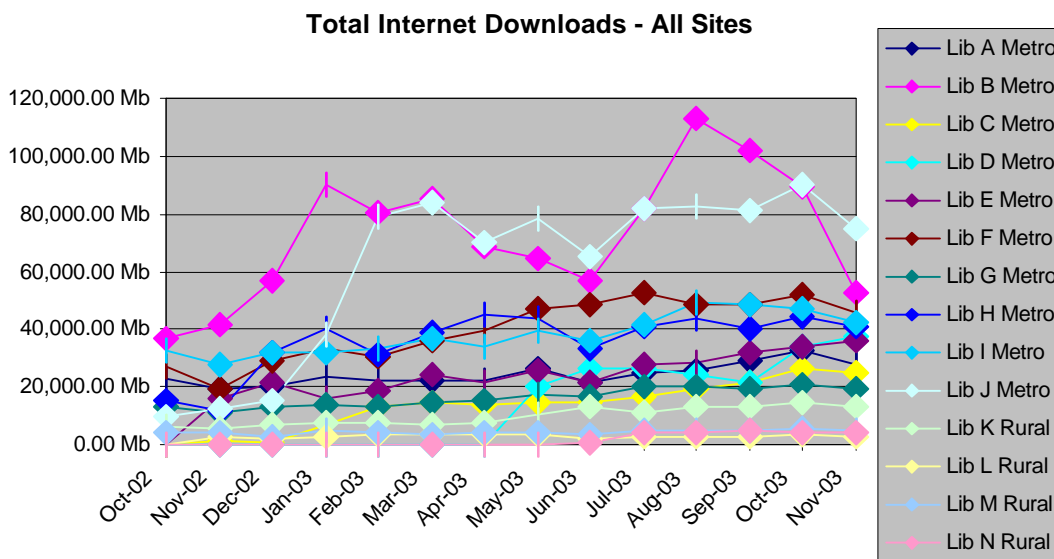
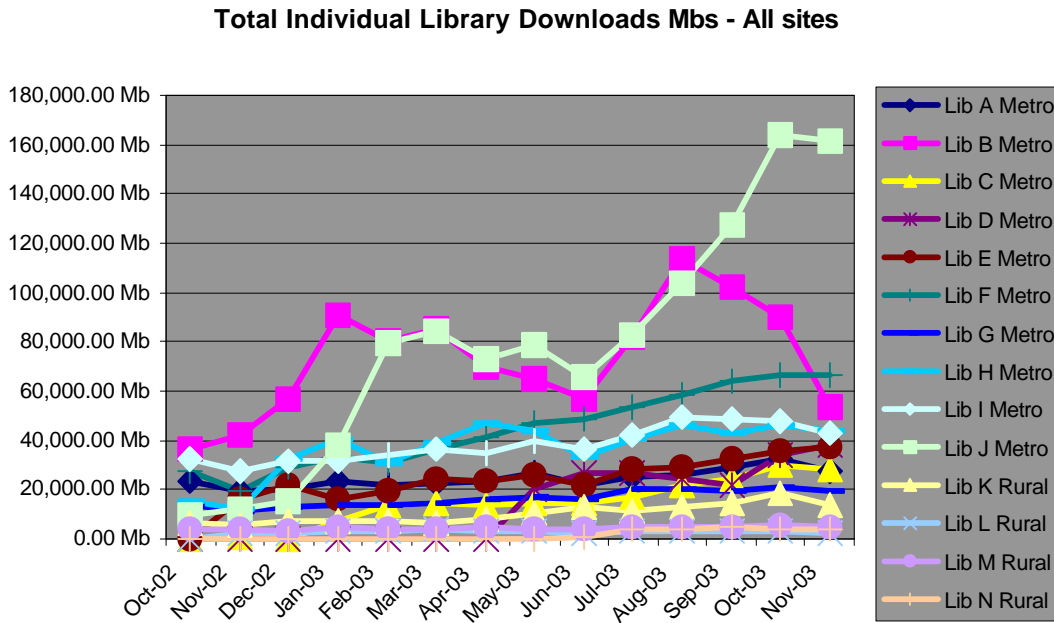
The results also show that the amount of data used by each library service varies considerably. For example, Library B (2 branches supporting 128,201 residents with 28 patron-only connected terminals) and Library J (8 branches supporting 300,543 residents with 119 patron and 106 staff-connected terminals) have consistently used considerable more data than the other library services in this sample. Interestingly, the data usage of library B and J is similar. This is despite considerable differences in the number of branches, connected terminals, and the size of their resident populations. Yet when these two very large data consumers are removed from the sample, along with Libraries C, D, and N (these other libraries came online after October 2002), the overall trend is still very much up. The remaining libraries more than doubled their data downloads in the 12 month period, going from 123 Gb in October 2002 to 259 Gb in Oct 2003. *See figure 4 for details.*

Figure 4 Overall Data downloads



A closer investigation of the data highlights other differences. Figure 5 presents the library's download usage but does not cumulate the data. This figure shows that some libraries, especially Metropolitan libraries J and B, have also experienced very erratic data usage patterns. These libraries have struggled to contain the blowout in data usage, and over the twelve months have implemented a number of changes to their networks and usage policies. Though less erratic, library H has also implemented a number of changes to the network and policies, as it tried to take control of escalating data charges. The case study in Part 2 looks at the experience of Library B and H in greater detail, in an attempt to shed light on this fluctuating demand.

Figure 5 Overall Data & Internet downloads [not cumulated]



The overall diversity of data usage is even more remarkable when one considers the findings with additional background information. For example, as mentioned previously, Library B is a two-branch single municipality metropolitan library with 26 patron terminals (staff PCs do not use this DSL connection), yet during the study period it used considerably more data than Library H. Library H is a metropolitan regional library with 7 branches with 69 patron and 105 staff PCs (not counting OPACs that also use the DSL connections). Library H also has a separate aged-care site. The second Library B branch connects to the main library via the council's line-of-sight network and both these libraries share the one 2048 / 384 kbps ADSL connection. Library H, on the other hand, uses a 2048 SHDSL connection at the main branch, plus two branches connected to a line-of-sight network. Two other large branches are supported with their own 2048/384 kbps ADSL connections and each of the remaining branches uses a 512/128 kbps ADSL connection. Despite having considerably more bandwidth overall, since July 2003 Library H has used less than 50% of the data used by

Library B. From this data it would appear that factors other than the number of branches and Internet terminals are the main drives of data usage.

Benchmarking usage

To further investigate the diversity of experiences between sites, VICNET needed to develop a way of benchmarking data use that took into account the difference in opening hours, as well as the number of terminals per site. By dividing the monthly downloads by the number of staff and patron terminals connected to each site, and then dividing this output by the hours the site is open per month, VICNET was able to provide data which can be used to benchmark library usage. The hours per month were calculated on the hours open each week multiplied by 52 divided by 12. Over the last 12 months, the libraries changed the number of terminals in their branches, so this section of the study only looked at average data usage back to June 2003.

Table 2: Average downloads per terminal per branch and per hour.

Category	Number of sites	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov 03
Metro Sites	40	2.07 Mb	2.46 Mb	2.69 Mb	2.59 Mb	2.71 Mb	2.37 Mb
Rural Sites	14	0.38 Mb	0.51 Mb	0.67 Mb	0.69 Mb	0.78 Mb	0.66 Mb
Metro Patron Only Terminals	8	5.12 Mb	6.04 Mb	6.84 Mb	6.42 Mb	6.62 Mb	5.68 Mb
Metro Patron Only Terminals #	6	4.30 Mb	4.77 Mb	4.58 Mb	4.48 Mb	5.24 Mb	5.44 Mb
Metro Patron & Staff Terminals	31	1.28 Mb	1.52 Mb	1.58 Mb	1.58 Mb	1.66 Mb	1.50 Mb

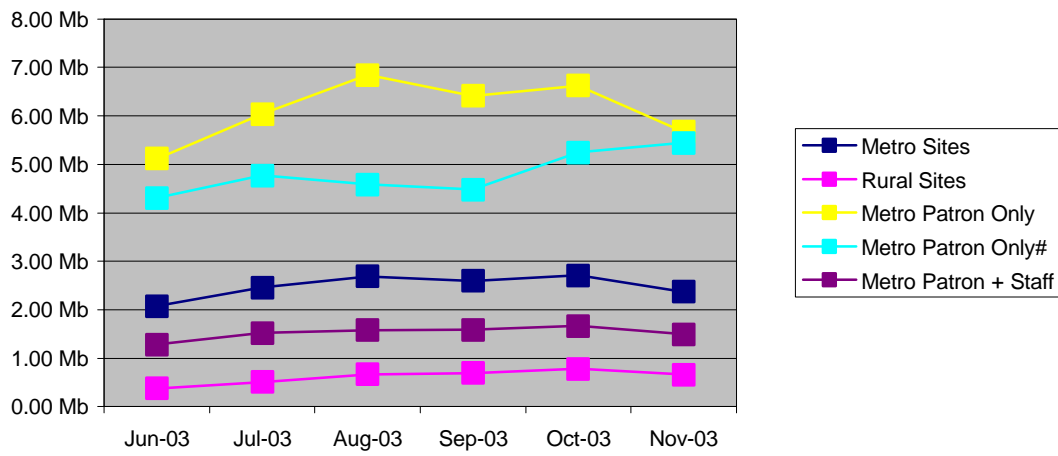
Metro patron-only terminals with Library B removed. Note that since Library B has blocked KaZaa file-sharing at a port level, and installed a proxy server, the 8 site metro patron data usage is similar to the 6 site metro patron-only data usage (*see figure 6 for details*).

NOTE: There was not enough data to determine Metro staff only terminal usage. Nor was there enough data to determine rural usage by patron-only, and staff-only terminals.

It is important to note that, irrespective of the size of the site, the connection capacity, or hours of opening; sites that include both staff AND patron terminals have a lower average hourly data download rate per terminal, than sites where the VICNET connection only supports the patron terminals. Therefore, when forecasting future data requirements it is important for libraries to differentiate between the number of patron and staff terminals per site. The Netflow data, the seasonal nature of the data usage, and feedback from the study sites, all seem to support the notion that the difference between patron and staff data usage appears to be driven by the amount of recreational Internet usage patrons do in libraries. Though, VICNET was unable to obtain a set of figures for staff only terminals, it would appear that patron terminals do in the vicinity of five times the amount of data downloads as staff terminals (*see figure 6 and Appendix D for details*).

Figure 6 Average Downloads per terminal

Average Internet downloads per terminal per hour



Part 2 – Case Studies

As mentioned earlier, the second part of the study looks at four of the sites in more detail. The following libraries were chosen because of the diversity of their Internet use, as well as diversity of their patron profiles. Unlike some of the other libraries in the first part of the study, these case study libraries all used their connections to support both Internet and library system traffic. Refer to Appendix B for additional details on these library services

Methodology

Each of the library services was presented with its data usage from October 2002 to September 2003. The libraries were also given the data usage of all 60 sites in the study. The identity of the libraries masked in order to protect privacy (*see Appendix B as well as figures 3 to 5 for details*). The libraries were also given a set of questions (*see Appendix C for details*). The results of the questionnaire were then matched up against the NetFlow data, as well as the number of staff and patron terminals using VICNET's eCommunity circuits. Finally, the results were also matched against the hours of opening per week, as well as the resident population. Population figures were taken from the June 2002 figures used by the Department of Victorian Communities: Local Government Division (DVC).

Findings

Library B – single municipality 2-branch metropolitan library service with both branches sharing a single 2048 / 384 kbps ADSL link. This library supports a resident population of 128,201. This library also supports a generally lower socio-economic outer urban population.

Table 3 Library B Data downloads results 1 June 2003 to 30 September 2003

Jun data	Jul data	Aug data	Sep data	Patron PCs	Staff PCs	Site	Hours open
33,973.63 Mb	49,114.89 Mb	68,017.51 Mb	61,054.27 Mb	16	N/A	Site 1	72 hours
22,649.08 Mb	32,743.26 Mb	45,345.00 Mb	40,702.84 Mb	12	N/A	Site 2	72 hours

Note: Site 1 admin data included in Site 1 branch data. Site 2 shares the feed of site 1. According to the library, site 2 takes 40% of the overall traffic. Staff terminals use the council's network to access the Internet.

During the study period, Library B experienced an overall increase in data downloads of 176%. This increase is well above the average increase of 110% experienced by the overall study sites. As with the other case study libraries, Library B also experienced periods where the data usage dropped, especially from March through to June 2003. Interestingly, the decline in usage for this service was longer and more pronounced than other case study libraries, especially Library H and K. Understandably, Library B has been very concerned about the amount of data its patrons have downloaded. In May and June the library trialled blocking patron file-sharing with Norton's Internet Security 2000. However, by using the uninstall program freely available from the Norton's Symantec web site, some patrons found a way around this block. . The library has since resolved this issue by blocking peer-to-peer files sharing at the port level, and the data downloads figure has reduced again since October 2003.

As a result of the two libraries sharing the one Internet feed, VICNET was unable to separate the traffic of Site 1 and 2. Consequently, it has not been possible to look closely at the difference between branches belonging to the same library service. However, site 1 has more PCs than site 2, and the library service confirmed that site 1 consistently generates 60% of the total bandwidth. The ratio of bandwidth usage would therefore appear to correlate with the ratio of patron terminals per branch. The survey questions for library B elicited the following response:

Table 4 Library B questionnaire results

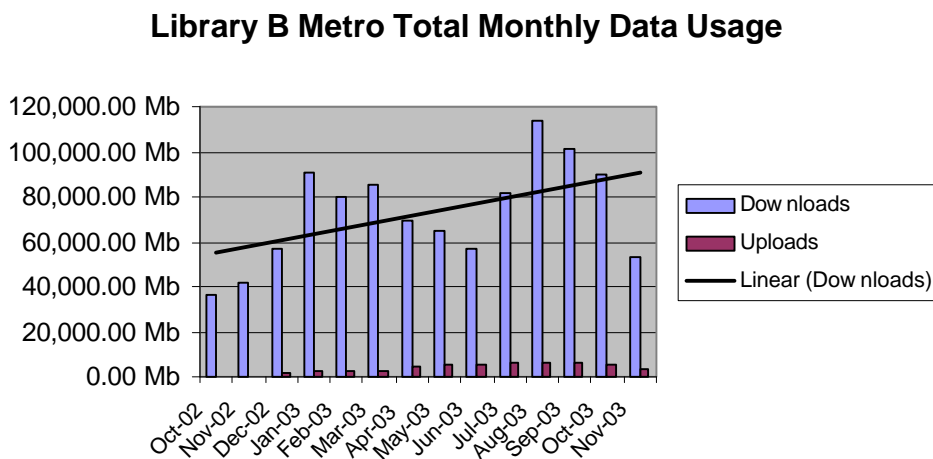
Question	Response
1. Drivers of Internet usage	Web mail; LOTE* access to newspapers and radio; general browsing; web transactions such as banking, travel bookings, online auctions; access to tertiary institutions by students; school projects; general information searching and research; data-streaming; file-sharing; employment-seeking.
2. Changes over last 6 to 12 months	Changes over the last 6-12 months include increased access to data-streaming; file-sharing. Internet games have been blocked at the PC level due to policy decision not to allow access to games via the Internet as; a) this is not seen as core library service; b) with PCs booked for games use approximately 75% of the time, there was limited access for customers wanting to use the Internet for other purposes.
3 List of staff and patron terminals	<i>Refer to Table 3.</i> Information also collated and summarised in Appendix B
4. Changes to staff / patron Internet usage policies	Added extra site blockings to current Norton's Internet Security Blocking. This had limited success. List for example: Download.com, Download.microsoft.com, KaZaa Downloading websites, and online games websites. Proxy server and firewall have been put in place to block from the port level (ports KaZaa 1214, Napster 6699, 6700, 6701 and Gnutella ^{vii}). Decision was made to block these services due to considerable download costs. The Internet Conditions of Use are under review, as well as guidelines for staff.
5. Impact of viral attacks	MSBlaster caused problems with Norton's Internet Security program and Windows applications. Another Virus created excess traffic on the network and reduced network performance.
6. Change in patron profile	Definite increase in the number of teenage boys using Internet for access to data-streaming and file-sharing. Anecdotal evidence of new users who have dial-up Internet connections at home, but prefer to use the Library's faster connection for data-streaming and file-sharing.
7. Change in patron satisfaction	Fewer customer complaints about lack of Internet access speed.
8. Change in patron expectations	Increased expectations on network speed and overall performance. There is slightly less tolerance of downtime. Downtime has increased recently, with our bandwidth at full capacity during most afternoons.
9. Changes to library staff's work and responsibility	In recent months one of our branches has required more staff surveillance of the Public Internet Access area to ensure users follow booking guidelines. As the cost of Internet access has increased substantially, as well as customer expectations regarding reliability and access, staffing resources have been required to review the network set-up, reliability, monitoring and management.
10. Any other changes	No

* LOTE: Languages other than English

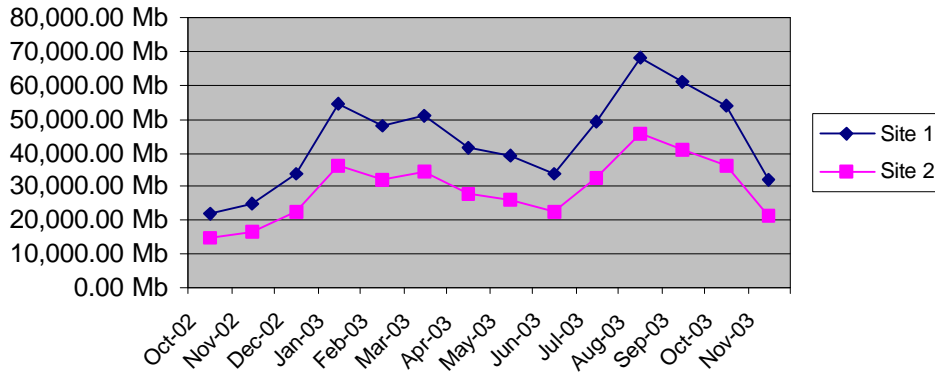
As with the other case-study libraries, Library B patrons expect faster Internet connections. Though Library B significantly upgraded the capacity of its link when it migrated from shared satellite with ISDN back channel to DSL, and this has reduced the level of customer complaints about Internet speed, there is still an expectation among patrons for even faster connections. The library also noted that there has been a change in the patron, profile with more teenage boys using the library and the Internet terminals since the DSL connections were put in place. Anecdotally, the library also mentioned that the data usage consumed by file-sharing, is driven by a small number (less than 20) of patrons. If this is true, it has important ramifications for other library services. It may only take a few patrons, over a short period of time, to have a dramatic impact on a library's data usage and costs.

Finally, Library B noted that they have had to devote more staff and resources to monitoring Internet usage, implementing policies and procedures, and then police these procedures. These are all issues that concern the other libraries in the study. Library B has been forced to be more proactive as it has faced the financial ramifications of a sudden increase in bandwidth usage. This raises the issue of the skills required by staff to manage networks and support online services. Furthermore, VICNET and Library B have spent considerable time endeavouring to take control and manage the library's data usage. Closer collaboration with vendors, and sharing lessons learned with other libraries, can only help reduce the resources required to manage Internet usage.

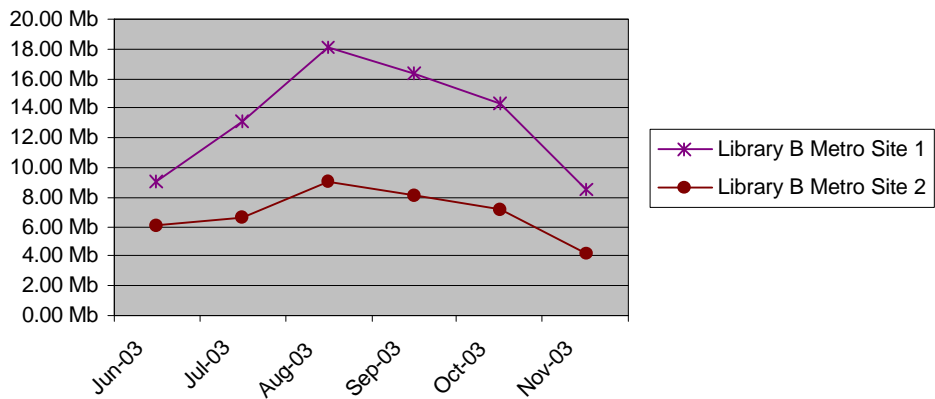
Figure 8 Library B data usage



Library B Metro Total Downloads



Average hourly Internet downloads per terminal per site



Library E – single municipality 4-branch metropolitan library service that includes 2 aged-care centres and the council’s server. This service supports a resident population of 61,615. Historically, this library service supports a low socio-economic population, yet as an inner urban municipality, parts of the municipality have become increasingly gentrified. In this study, the main focus is on Library E’s public library branches.

With the council server traffic removed, Library E’s data usage over the study period varied from the other three case studies. Unlike the other case studies (where there was an overall increase in data usage even though there were months where data usage declined), Library E experienced an increase of data from February to May. During this period the downloads were roughly 20 Gb a month. Library E then managed to reduce data usage from July to September 2003. During this latter period, the data usage was roughly 16 Gb a month. This is despite the fact that the library allows gaming (recognised as one of the larger drivers of data usage by the libraries in the study group), and the proxy server is now only being used for the Internet feed to the council servers (site 6). From April onwards, the council server downloads rose from 5 Gb to 15 Gb and uploads from 60 Mb to 5.45 Gb.

Table 5 Library E Data downloads results 1 June 2003 to 30 September 2003

Jun data	Jul data	Aug data	Sep data	Patron PCs	Staff PCs	Site	Hours open
44.98 Mb	101.26 Mb	74.67 Mb	77.14 Mb	N/A	2	Site 1	208.0 hr/pm
17,930.24 Mb	15,504.78 Mb	15,711.93 Mb	17,192.70 Mb	17	N/A	Site 2	260.0 hr/pm
195.56 Mb	432.87 Mb	516.83 Mb	490.18 Mb	1	2	Site 3	60.7 hr/pm
0.00 Mb	8.15 Mb	6.40 Mb	45.59 Mb	N/A	N/A	Site 4	N/A
0.00 Mb	5.16 Mb	6.43 Mb	17.87 Mb	N/A	N/A	Site 5	N/A
3,838.76 Mb	12,726.29 Mb	12,730.39 Mb	14,878.23 Mb	N/A	146	Site 6	260.0 hr/pm

Note: Site 2 is the main library branch, site 6 is the council server, sites 4 and 5 are aged-care centres. Staff terminals at site 2 are aggregated via site 6. Site 2 includes the aggregation of two other library branches via the council's own line of site network.

The survey questions for library E elicited the following response:

Table 6 Library E questionnaire results

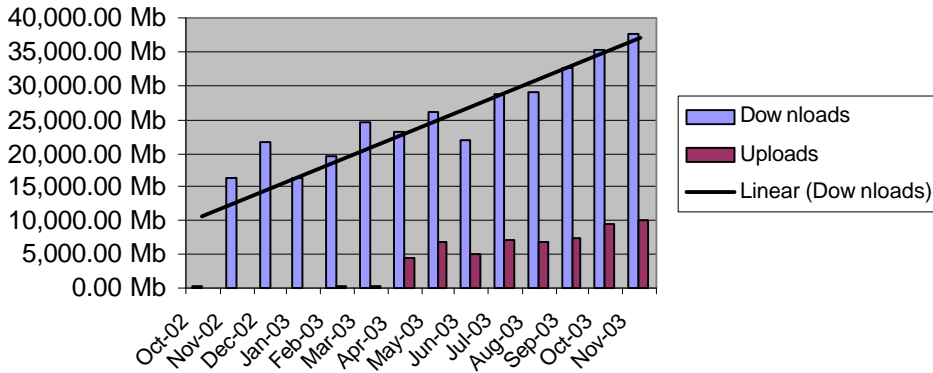
Question	Response
1. Drivers of Internet usage	Main web usage appears to be chat, gaming and internet mail (taken from random views of machines)
2. Changes over last 6 to 12 months	There does not appear to have been any change
3 List of staff and patron terminals	Refer to table 5. Information also collated and summarised in Appendix B In Oct 2003 ran 296 email users, and around 150 staff internet users. Libraries have approx. 40 public access PCs
4. Changes to staff / patron Internet usage policies	Internet feed has been split in half, one 2Mb feed for staff/mail usage, and one feed to public access (data for each feed is listed separately in figure 8). Proxy server was relocated after feed split, and is currently running on corporate network only.
5. Impact of viral attacks	Viral attacks do not appear to have made much difference to Internet usage, some regular virus attacks occur each day but are probably not contributing much to internet bandwidth.
6. Change in patron profile	UNKOWN
7. Change in patron satisfaction	Satisfaction level definitely increased
8. Change in patron expectations	Expectations of availability increased significantly
9. Changes to library staff's work and responsibility	No change
10. Any other changes	Data pattern has changed (larger downloads from internet), some staff abuse (Virgin Blue/Qantas type sites) and extremely large email attachments

As with the majority of the other libraries studied, although bandwidth has increased and this has improved levels of customer satisfaction, it has also driven customer expectations of even faster connections. The library has had periods of significant growth from January to May 2003, yet the proactive involvement of the Council IT has resulted in a reduction in library data. This said, council data usage rose during the study period.

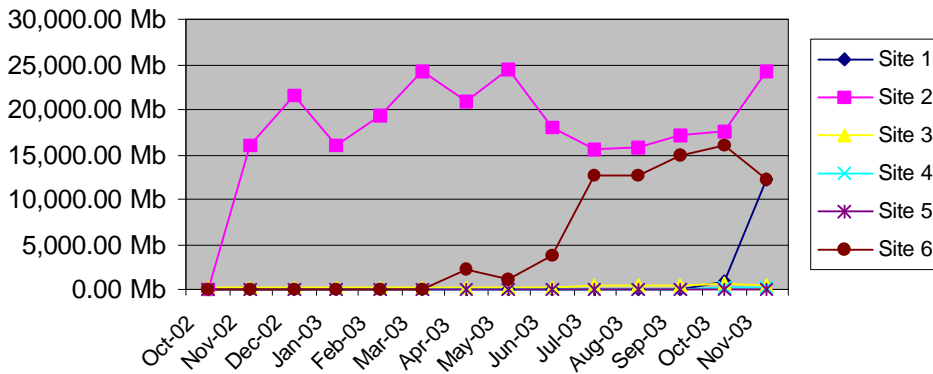
Figure 8 Part A Library E data usage

Note the difference in data usage when the council server traffic is removed

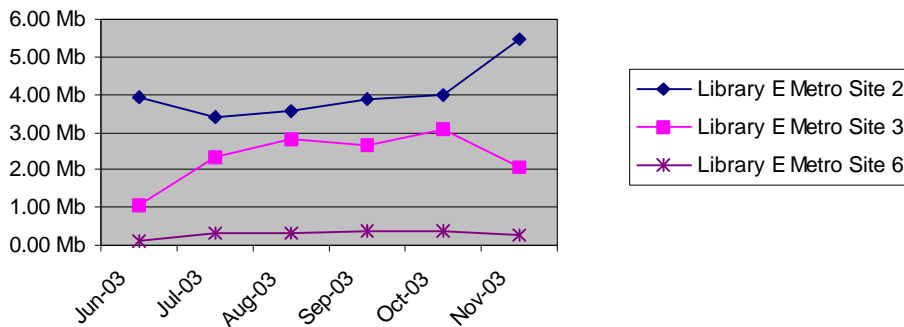
Library E Metro Total Monthly Data Usage



Library E Metro Total Downloads



Average hourly Internet downloads per terminal per site Library / Council Sites only (Site 2&3 libraries, Site 6 council)



Note that although Site 3 is small and only open 60 hours a month, the average hourly usage per terminal figure indicates that when this site is open, it is heavily used. Site 6 did comparable downloads to site 2 from July 2003 to September 2003, but as many more staff terminals use the site 6 connection than patron terminals use site 2, the hourly average per terminal for site 6 is much lower than site 2.

Library H – metropolitan 7 branch regional library service with a relatively homogeneous socio-economic outer urban population that includes a sizeable concentration of Asian Australians, especially around the main branch (site 2). In addition to the library branches, this service also includes an aged care centre. This service supports a resident population of 261,263.

Table 7 Library H Data downloads 1 June 2003 to 30 September 2003

Jun data	Jul data	Aug data	Sep data	Patron PCs	Staff PCs	Site	Hours open
37.73 Mb	50.44 Mb	85.69 Mb	1,700.48 Mb	N/A	N/A	Site 1	N/A
19,761.53 Mb	24,803.42 Mb	29,624.27 Mb	24,531.21 Mb	37	62	Site 2	273.0 hr/pm
1,048.84 Mb	962.09 Mb	1,827.32 Mb	2,032.21 Mb	8	4	Site 3	156.0 hr/pm
0.96 Mb	1.36 Mb	375.24 Mb	5,655.19 Mb	N/A	N/A	Site 4	N/A
4,193.03 Mb	5,197.28 Mb	5,932.49 Mb	2,597.53 Mb	9	12	Site 5	242.7 hr/pm
2,293.70 Mb	2,726.74 Mb	2,233.11 Mb	4,207.93 Mb	5	11	Site 6	188.5 hr/pm
3,920.98 Mb	4,811.76 Mb	4,123.72 Mb	1,752.79 Mb	6	9	Site 7	238.3 hr/pm
2,131.12 Mb	2,149.55 Mb	1,701.21 Mb	122.96 Mb	4	7	Site 8	208.0 hr/pm

Note: Site 2 is the main library branch, site 1 is an aged care centre. The staff and patron terminals at two additional branches are aggregated via site 2.

The survey questions for library H elicited the following response:

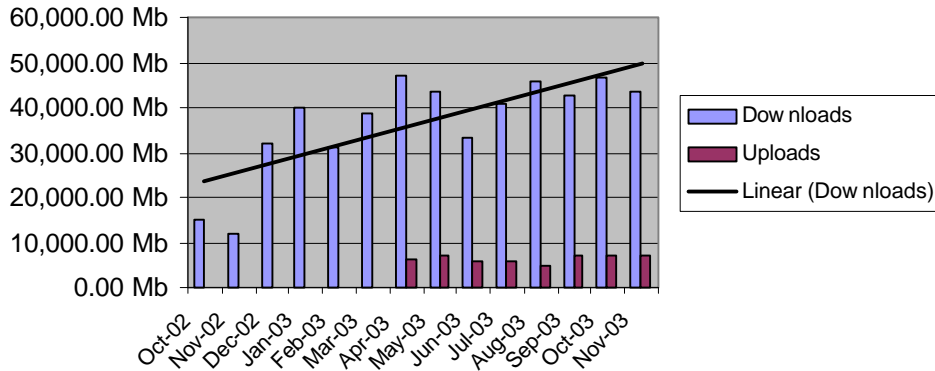
Table 8 Library H questionnaire results

Question	Response
1. Drivers of Internet usage	The main driver for internet usage within our organisation is mostly determined by our clients' usage of the various internet accessible public personal computers available at one of our eight branch libraries. The main internet usage is still internet based mail, messaging and online gaming.
2. Changes over last 6 to 12 months	We have found that internet based mail, messaging and online gaming type of usage has grown to such an extent over the last twelve months that free public access personal computers were wholly used for this type of internet access, and other types of web based usage has been suffering because of this.
3 List of staff and patron terminals	<i>Refer to Table 7.</i> Information also collated and summarised in Appendix B
4. Changes to staff / patron Internet usage policies	The organisation has tried a passive implementation to curb the proliferation of internet based mail, messaging and online gaming and is continuing to deliver internal web page based links via subscriptions to online data bases and information pages, and thus attempting to drive our clients' online usage of the internet. Furthermore we have segmented half of our personal computers at branch libraries to be for internal web page based links via subscriptions to online data bases and information pages, and have blocked access to web mail, messaging and chat sessions on these personal computers.

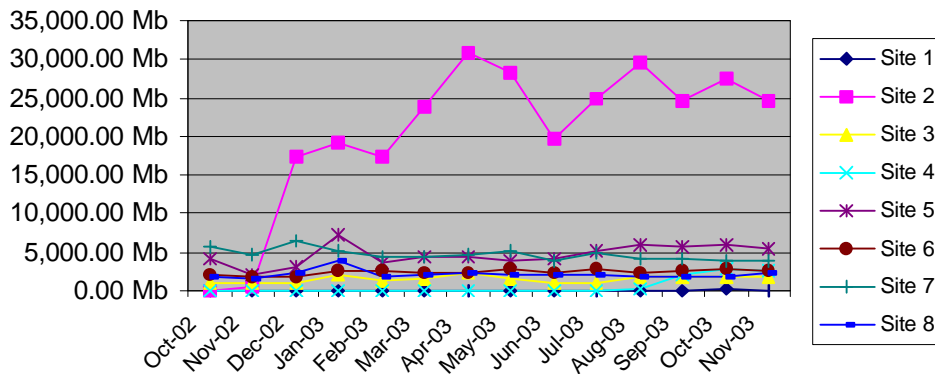
5. Impact of viral attacks	Due to the type of server operating systems and our approach to viral protection we have not suffered any viral attacks to our internal system over the past six months; however access to other sites has limited usage slightly.
6. Change in patron profile	Initially our patron profile skewed towards the younger after school person using the internet for gaming and mail access. However since we split the public internet access personal computers into mail, messaging and gaming (a pay for use service) and allowed only information searching on all other public access personal computers (a free use service) our patron profile has shown a return to a more balanced use based on age and sex. Our proxy statistics have shown that the types of information gathering by library users has changed as we moved from a satellite with 64 Kb ISDN back channel connection to DSL from each branch. Intensive data-streaming sites are being accessed that include video, radio and voice. This include sites such as, such as the ABC (News Radio) and other multi cultural sties, such as Sina.com, an Asian news sight with links to intensive data-streaming.
7. Change in patron satisfaction	With the increase in public access booking across all branches up dynamically, we feel that general satisfaction is up as a result to the implementation of the DSL.
8. Change in patron expectations	We have not done any surveying in this area so I am unable to comment.
9. Changes to library staff's work and responsibility	With the implementation of DSL we installed proxy servers at all branches with the ability to allow blocking of sites specific to a personal computer and thus the libraries' work load to police internet usage has decrease greatly.
10. Any other changes	<p>One large change that has occurred is the increased cost of providing access to the internet.</p> <p>Our download costs have doubled and we foresee this occurrence to continue in the same way over the next two years as more products go line and web sites become more interactive with the inclusion of audio, video streaming and flash product. This phenomenon of increased download cost presents our organisation with a grave problem if we are to continue to provide public access to the internet at our current level of service. Our diminishing financial resources will greatly limit our ability in the future to provide as many public access terminals as we now have, therefore we see an impending need to be downgrading of our service to be even able to provide a public internet access service.</p>

Figure 9 Library H data usage

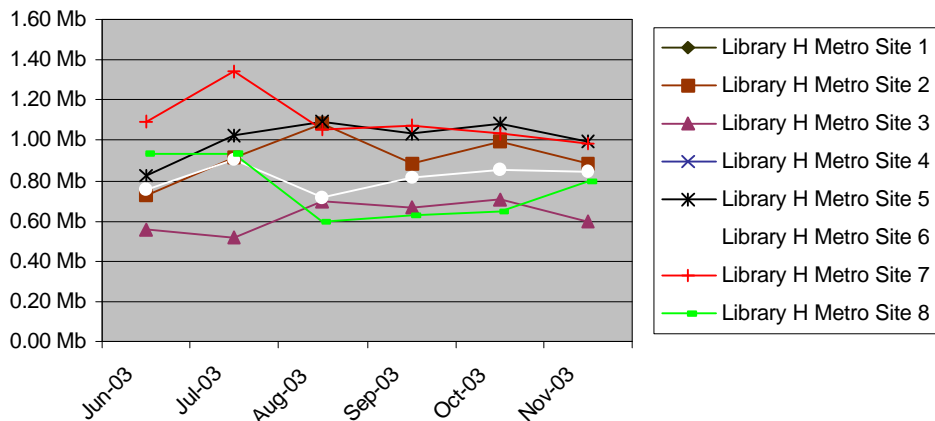
Library H Metro Total Monthly Data Usage



Library H Metro Total Downloads



Average hourly Internet downloads per terminal per site



Library H is a large heavily used metropolitan regional library service. During the study, , this library service’s downloads grew from less than 20 Gb a month to between 40 and 36 Gb a month. For most of the period covered by this research, Library H spent considerable time

and effort finding out more about patron use of the Internet, and developing procedures to manage patron use and expectations. At the same time they tried to avoid escalating data costs. The changes made by Library H include blocking chat, data-streaming, and file-sharing. When patrons try to do chat or data-streaming, they are redirected to a URL giving information on the paid public terminals in the branch. Library H has also started registering MAC addresses to stop patrons connecting their own devices to the library network. They are also about to start patron session authentication. It appears that if patrons have to supply their identity in order to commence using a library terminal, they are less likely to try to circumvent the library's Internet usage guidelines. Though these changes appear to make a difference in the short term, the long-term trend for Library H is for increased data usage.

Also of interest, is that during the study period, Library H was forced to migrate the main branch from an ADSL 6144/640 kbps ADSL connection to a 2048/2048 kbps SHDSL connection. Although 6144 kbps download capacity at the main branch was more than enough to support Internet usage and system traffic, the 640 kbps up-haul was not enough to support Internet uploads AND the system traffic from their other branches. It was found that a 2048/2048 SHDSL connection overcame the upload bottleneck at the main site.

Library K – rural 12-branch regional library service with 7 branches connected via dedicated ADSL connections per branch. The remaining smaller branches connect to the Internet by dialling into the closest ADSL-connected branch. The main library and two other branches support a major regional centre, while the other ADSL-connected branches support individual country towns and surrounding areas. Overall this library service supports a resident population of 156,310.

Although there are periods of declining data usage in February, March and July 2003, during the study period this regional rural library service experienced a 124% overall increase in downloads. For the purpose of this study, library administration data has been combined with the main branch data, as these two parts of the organisation share the main site's DSL connection. Other than the main site, the DSL connected branches have on average 2.7 patron PCs and 2.2 staff PCs per branch. Sites 1, 5 and 6 serve the same regional centre. The other branches each serve their own distinct population centre and surrounding rural district. Site 3 is also a dormitory suburb for Melbourne. After the main branch, site 2 not only has the largest number of PCs and the longest opening hours, it also recently moved into a new branch. This site generates almost twice as much download traffic as site 3, which is the next largest site by number of PCs and hours of opening (*see table 9 for details*).

From June 2003, per branch data usage roughly correlates with the number of patron terminals per branch and the hours of opening. The exception is site 3; it is unclear why this is the case. Is it because, as a dormitory suburb for a large metropolitan city, it services a slightly different and larger population to sites 4 and 7? Sites 4 and 7 each support a country town with a single branch. However, it was noted by the library service, that staff at site 3 have spent more time with the public promoting online services. This then could explain this sites usage. Further research is needed in this area.

Table 9 Library K Data downloads results 1 June 2003 to 30 September 2003

Jun data	Jul data	Aug data	Sep data	Patron PCs	Staff PCs	Site	Hours open
Note 1	Note 1	Note 1	Note 1	N/A	10	Site 1 admin	N/A
9,499.05 Mb	6,303.12 Mb	6,891.87 Mb	8,196.47 Mb	9	10	Site 1 branch	46 hr/pm
1,509.54 Mb	1,957.49 Mb	2,626.10 Mb	2,534.13 Mb	4	3	Site 2	40 hr/pm
666.17 Mb	1,029.73 Mb	1,293.21 Mb	1,346.75 Mb	3	2	Site 3	35 hr/pm
736.70 Mb	931.84 Mb	1,244.32 Mb	1,190.46 Mb	2	4	Site 6	38 hr/pm
361.65 Mb	583.18 Mb	708.30 Mb	657.29 Mb	3	2	Site 4	39 hr/pm
N/A	70.21 Mb	316.68 Mb	368.02 Mb	3	1	Site 7	21 hr/pm
148.60 Mb	168.45 Mb	205.42 Mb	273.52 Mb	1	1	Site 5	14 hr/pm

Note: Site 1 admin data included in Site 1 branch data.

The survey questions for library K elicited the following response:

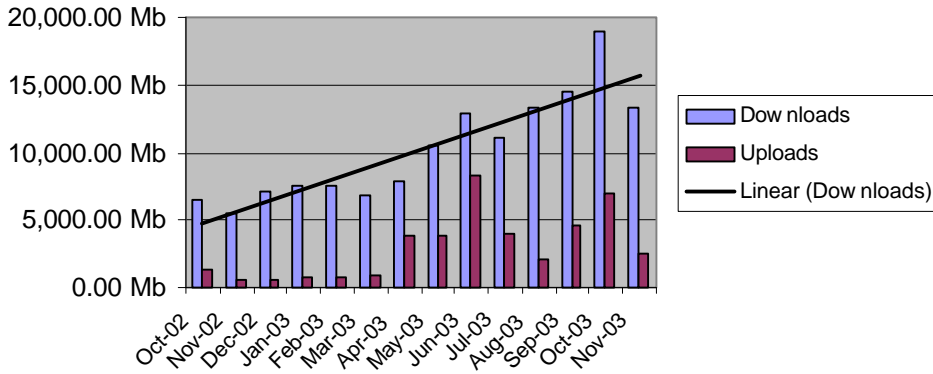
Table 10 Library K questionnaire results

Question	Response
1. Drivers of Internet usage	Email is the main driver, however some gaming and games. Also accessing Gulliver consortium full text databases.
2. Changes over last 6 to 12 months	None
3 List of staff and patron terminals	Refer to table 9. Information also collated and summarised in Appendix B
4. Changes to staff / patron Internet usage policies	
5. Impact of viral attacks	Internet PCs in the main branch have had attacks from viruses that pull down large amounts of data. These PCs have a Sherriff card in them so the updates from Vet are not kept once the machines are rebooted.
6. Change in patron profile	None
7. Change in patron satisfaction	Still get complaints about speed of connections
8. Change in patron expectations	Want Internet to be faster
9. Changes to library staff's work and responsibility	None, bookings are still done by staff; all PCs are booked out
10. Any other changes	

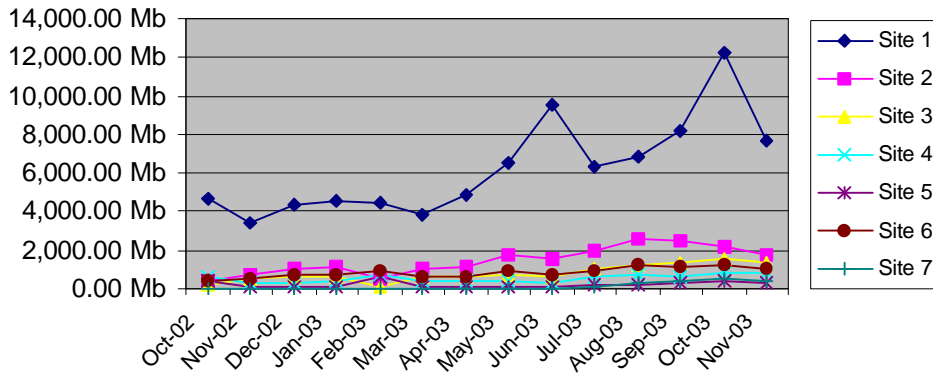
Interestingly, despite significant increases in bandwidth across the library service , the patron's expectation is for even faster connections. Another important issue addressed by Library K, is the impact on data usage if antiviral software and plug-ins are not kept up to date. Keeping PC hard drives up date when security such as HDD Sherriff cards^{viii} have been installed, imposes a significant staff overhead to library services. This issue has been noted by a number of the other libraries over the study period.

Figure 10 Library K data usage

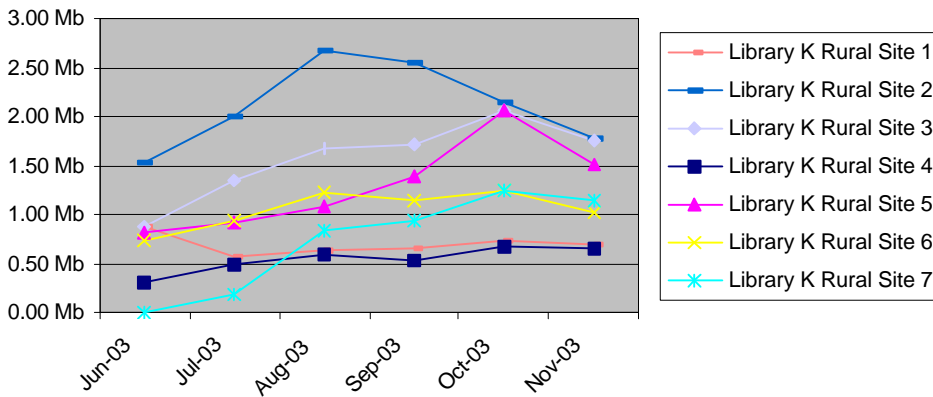
Library K Rural Total Monthly Data Usage



Library K Rural Total Downloads



Average hourly Internet downloads per terminal per site



Discussion

One of the more important findings of this study, is that it does not take very many patrons within a library service to change their online behaviour, before it starts to have an impact on the library's overall data usage and costs (*refer to library B case study*). It is also apparent from the study that, in order to support public terminals using broadband connections, libraries are required to devote more attention, and considerably more resources, to their Internet policies. Patron use can change at any time, so to respond effectively, the process for setting policies, and configuring networks, has to be fast, adaptive and flexible. When changes are made, libraries need to ensure that the changes are understood by staff, as well as communicated back to patrons. This helps manage expectations. Changes in patron use include new types of behaviours that the libraries themselves may, or may not, have foreseen. For example, the libraries studied did not foresee patrons would connect their own devices onto the library's own network in order to upload and or download files. As a result, the libraries could not have foreseen the significant impact this behaviour would have on data usage and budgets. That patrons connect their own devices to a library network, also raises a whole series of legal, and risk management issues, that libraries will have to address in the future.

As mentioned in the introduction, VICNET has had discussions with other Australian states and territories regarding the findings of this study. It would appear that the Internet data usage of the libraries in this study is significantly greater than that experienced in other parts of Australia. This could be a result of the Victorian libraries implementing broadband Internet connections sooner than their interstate colleagues. If this is the case, the findings of this Victorian study could have important implications for the roll out, and funding, of broadband Internet connections in other parts of the country. This is especially true if recommendation 7b of the Australian Senate report into libraries in the online environment (2003) is adopted. This recommendation advocates that further funds be allocated to expand the National Broadband Strategy for broadband access in libraries.

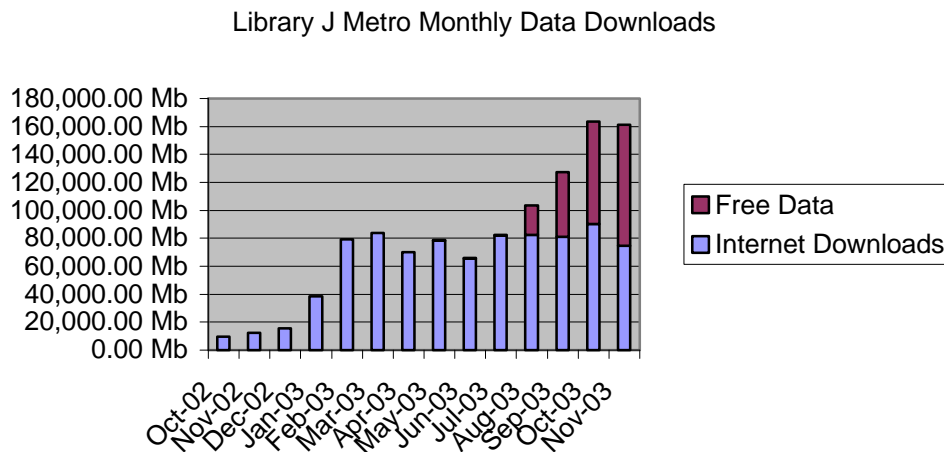
In addition to the monetary impact that comes with the increase in Internet use, there is bandwidth congestion to consider and the impact this congestion has on service delivery. For example, as mentioned in the Library H case study, the library was forced to migrate the main branch from an ADSL to a SHDSL connection to improve catalogue response times. Interestingly, the capacity of the uplink often caused more concern for the libraries. For example, Library F soon found that with their patrons increasing data use, their own catalogue also started to run more slowly. In actual fact, with the migration to SHDSL, the library H catalogue ran faster within Library F branches than their own catalogue. Subsequently, Library F installed a separate SHDSL connection dedicated to their system traffic. As more interactive broadband services become available, and libraries explore implementing services such as video conferencing and voice over IP, symmetrical broadband connections will probably play a much greater role across all branches.

The ability to accurately determine and plan for future requirements is dependent on the quality of the information libraries can access about their own usage patterns. It is also dependent on access to readily available benchmark information. The libraries in the study group found that access to an average hourly data use figure helped with benchmarking. Using this benchmark figure removed variables such as the number of terminals and the hours of opening. This study also shows that it is important to take into consideration the difference between patron and staff terminal use of the Internet.

By undertaking this study, it appears the level of debate among libraries on what drives Internet data usage has increased. Whereas providing the libraries with the results of their peers and colleagues, has established a conduit for information sharing. By learning from the experiences of the other libraries in the study group, these Victorian libraries were better informed, and arguably better positioned, to make proactive decisions on strategies. It is hoped this allows them to provide quality online resources without incurring budget blow-outs.

Although not part of the case study, VICNET spent considerable time liaising with Library J in order to get data costs down. One of the strategies Library J implemented of its own accord (and this could have benefits for the other libraries) is that Library J uses their eCommunity network connections to update individual branch proxy servers. As a result, Library J uses more data, but as this is branch-to-branch traffic, and remains on the eCommunity network, it is free data. This, together with other policy changes implemented during the study period, appears to have stabilised this library's Internet downloads. This helps with speed and congestion. Library J, and the other large libraries, have also migrated to a VICNET flat data rate. This has been done to take control of the costs.

Figure 10 Library J data usage showing free cache traffic



A number of the libraries also reported that they suspected that events such as the Rugby World Cup had a short-term impact on Internet usage. This study found no conclusive evidence to support this view. For example, the Rugby World Cup was held between 10 October and 22 November 2003. During this period the average hourly download per metro patron terminals did increase from 4.48 Mb an hour in September 2003 to 5.24 Mb an hour in October and 5.44 Mb an hour in November. However, the overall Internet-only downloads for the sample group went from 469,597.13 Mb in September to 499,849.21 Mb in October but then declined to 427,542.18 Mb in November. It should be noted, that during this period students were more likely to be focused on their end of year exams and assessments. This seems to have decreased data usage. Further research, looking at individual library branch log files for traffic to specific events web sites (such as the Athens Olympics next year), may shed more light on this issue.

Conclusions

The evidence suggests that, on their own, the number of terminals, branches, or hours of opening do not determine Internet data usage. Likewise, the capacity of the connection in itself does not determine data usage. This is apparent when one considers the difference between the average megabyte downloads per terminal, per hour, per branch. As a result, this study shows there is a considerable diversity between one library service and another. Although more research needs to be done in this area, the overall findings of the study demonstrate that Internet data usage is driven by a *number of factors working in unison*. However, the main influencing factors between different library services appears to be each library's Internet usage policies, and the resources dedicated to supporting and maintaining these policies over time. Obviously this conclusion has important ramifications for library policies, budgets and resource allocation.

The way in which libraries respond to, and address, these issues will have an important impact on the type of services they offer. It will also impact on the resources they require to deliver those services, and the level of customer satisfaction. Although it appears considerable amounts of data usage can be driven by a small group of users, the fact remains that the public in general is demanding more online services. This, together with the reality that online offerings are becoming richer, and more varied, in their content, means that the amount of data required to support the library services of the future is going to be considerably greater than what is required today. Sanders-McMaster, L. (1997) noted that "the same strategies that helped libraries get where they are today will be required to move ahead: networking, partnerships, grants, annual upgrades. Those [such as the Victorian public libraries in this study] who are positioned to be the experimenters and early adopters have opportunities and challenges."

Libraries have traditionally dealt with change through experimentation, information sharing, and a collegial approach. This approach will be important for libraries to successfully respond to the real threats, as well as wonderful opportunities, that the next generation of Internet service provide. Freely sharing Internet data sourced from different library services, community groups, NGOs, and government agencies via peering arrangements may become increasingly important. Strategic peering arrangements with commercial data-providers may also become more important. Given the increase in data usage, accessing free data through peering, rather than a subsidised community data e-rate, may ultimately prove more valuable for the library service of the future.

Bibliography

- , (2000) Report on a policy for public access to the Internet for Victoria, Trinitas, Hobart.
- (2003) *Libraries in the online environment*, Australian Senate Environment, Communications, Information Technology and the Arts Reference Committee available at: http://www.aph.gov.au/senate/committee/ecita_ctte/online_libraries/report/index.htm
- (2003) "House to continue E-rate program probe", *RCR Wireless News*; 9/8/2003, 22 (36), p12
- Adams, B. & Meagher, B. (2003) Broadband Quality of Service Issues: consumer Perspectives, a report for the Australian Communication Authority by Dandolopartners, July.
- Anderson, C (1995) The Accidental Superhighway: a survey of the Internet, *The Economist*, Insert 1 July
- Feighan, D & Schmidt, P (2002) "Gee I didn't think it was going to be that much: a report on the issues and implications of technically sustainable and affordable bandwidth for Australian libraries, *e-volving information futures, Proceedings of the VALA National Conference on Library Automation*, Melbourne 6-8 February 2002, Volume 2, , p. 611.
- Gates, W. (1995) *The Road Ahead*, London, Viking.
- Hall, P. (1998) *Cities in Civilization: Culture, Innovation, and Urban Order*, London, Weidenfeld & Nicolson. .
- Hardy G & Johanson G. (2002) "Characteristics and choices of Public Access Internet Users in Victorian Public Libraries" *Centre for Community Networking Research*, Monash University.
- Oder, N. (2003) "Libraries Get 4% of E-rate Funds", *Library Journal*; 10/1/2003, 128 (16), p. 20.
- Porter, M. (2001) "Strategy and the Internet", *Harvard Business Review*, March, 79 (3), p62.
- Sanders-McMaster, L. (1997) "Internet 2: An overview of the next generation of the Internet" *Computers in Libraries*, Mar., 17 (3), p. 57
- St. Lifer, E. (1997) "Public library budgets brace for Internet costs" *Library Journal*, Jan., 122 (1), p. 44
- Taylor, P. (1995) "The networked home: domestication of information", *Journal of the Royal Society of the Arts*, April, 41-53.

HREFS

HREF 1 <http://www.cisco.com/warp/public/cc/pd/iosw/ioft/neflct/tech/napps_wp.htm>

Appendix A: eCommunity Network

The benefits of this eCommunity network are that it:

Increases broadband connections out to community groups and library branches as many sites have migrated from 64 and 128 ISDN or in some cases 56 k dial up connections to a minimum 512 / 128 k ADSL connection,

Reduces community and library data costs by implementing data aggregation and therefore removing site-to-site data charges irrespective of whether the sites belong to the same organisation,

Allows participating organisations to free data access government and community information hosted on VICNET at www.vicnet.net.au. VICNET has offered free community hosting for almost ten years, so this represents a considerable amount of information and is recognised as one of the most successful Government sponsored community web publishing programs in the world. Example of participants include: the Victorian Woodworkers' Association, Backpackers Australia, the Australian Book Review, Young Australian Best Book Award, OzLit Australian Literature, the Dead Persons Society, Friends of the Koalas, and the Motor Neurone Disease Association of Australia. In addition to the free web hosting, VICNET also offers virtual web services. This is where organisations are hosted at VICNET but have their own domain name. Examples include: VALA, the Melbourne International Comedy Festival, the Royal Australian Ornithological Union, the County Court of Victoria, and the Equal Opportunity Commission Victoria. Access to the VICNET virtual web server sites does not incur data charges for eCommunity participants. Free hosting and virtual web hosting generated 19,897,157 visits and 395,900,327 hits in the 2002 / 2003 financial year, whereas take up of the free community web hosting is currently growing at 500 community organisations a year.

Allows connected sites free access to mc2 resources located <http://mc2.vicnet.net.au>. mc2 is a Victorian government initiative managed by VICNET. It offers free and easy to use web-based services to community groups so they can publish online, communicate online, and build their own online communities. Mc2 allows the groups to do web e-mail, web publishing, chat, forums, photo galleries, and offers virtual office facilities. The groups participating range from cultural, and sporting groups through to special interest and support and disability groups. Currently there are over 20,000 members in this program.

Allows connected sites free data access to information hosted for Victoria's Virtual Library by VICNET at <http://www.libraries.vic.gov.au>. This includes the hot topics database (a database of online current affairs issues managed by Victorian public librarians), the Victorian Biography Resource Centre, and the Victorian Library Locator. In addition to the free data, Victoria's Virtual Library provides access to a number of gateways such as Open Road (a gateway to multilingual web resources), Gulliver (full text databases) and Reference Bookshelf (Reference Bookshelf is a directory of web-based reference resources).

Allows connected sites free data access to the catalogue and information hosted by the State Library of Victoria. This includes information from the State Library's catalogue, online public programs and exhibitions, and the Australian Centre for Youth Literature.

Appendix B: Part 1 Site Overview (60 sites) # = main library branch

Site Name	Connections	Site Type	Connection (kbps)	Patron	Staff	Resident Population	Notes
Lib A Metro	Site A Metro 1 #	Library	512/128 ADSL	?	N/A	171,618	Patron terminals only 4 branches linked to this connection
Lib B Metro PART 2 case study	Site B Metro 1 Site B Metro 2	Library Library	2038/384 ADSL *	12 16	N/A N/A	128,201	Patron terminals only 2 branches linked to this connection. Site 1 does 60% and Site 2 does 40% of data traffic.
Lib C Metro	Site C Metro 1 # Site C Metro 2 Site C Metro 3 Site C Metro 4	Library Library Library Library	512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL	4 4 4 3	31 3 25 13	127,882	
Lib D Metro	Site D Metro 1	Library	2048/2048 Fibre	14	N/A	140,353	Single site patron terminals only
Lib E Metro PART 2 case study	Site E Metro 1 Site E Metro 2 # * Site E Metro 3 Site E Metro 4 Site E Metro 5 Site E Metro 6	Com. Centre Library Library Aged Care Aged Care Council	512/128 ADSL 2038/384 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 2048/2048 Wireless	N/A 17 1 N/A N/A N/A	2 NA 2 NA NA 146	61,615	Staff access in libraries uses council 2048/2048 wireless connection. Main site aggregates connection of 2 other branches
Lib F Metro	Site F Metro 1 # Site F Metro 2 Site F Metro 3 Site F Metro 4 Site F Metro 5 # Site F Metro 6	Library Library Library Library Library Library	512/512 SHDSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL	N/A 8 14 10 10 7	N/A 6 9 8 16 8	162,910	Site 1 SHDSL connection dedicated to catalogue and site 1 ADSL connection dedicated to Internet terminals
Lib G Metro	Site G Metro 1 # Site G Metro 2 Site G Metro 3 Site G Metro 4	Library Library Library Library	512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL	7 6 5 4	N/A	90,740	Patron terminals only. Staff terminals use council network
Lib H Metro PART 2 case study	Site H Metro 1 Site H Metro 2 # * Site H Metro 3 Site H Metro 4 Site H Metro 5 Site H Metro 6 Site H Metro 7 Site H Metro 8	Aged Care Library Library Library Library Library Library Library	512/128 ADSL 2048/2048 SHDSL 512/128 ADSL 512/128 ADSL 2038/384 ADSL 2038/384 ADSL 512/128 ADSL 512/128 ADSL	N/A 37 8 N/A 9 5 6 4	N/A 62 4 N/A 12 11 9 7	261,263	Main site aggregates connection of 2 other branches. Site 4 now aggregated via the main site (site 2).
Lib I Metro	Site I Metro 1 Site I Metro 2 # Site I Metro 3 Site I Metro 4 Site I Metro 5 Site I Metro 6 Site I Metro 7 Site I Metro 8 Site I Metro 9	Library Library Library Library Library Library Library Library Library	512/128 ADSL 2038/384 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL	N/A 3 7 17 3 2 N/A 4 15	23 5 7 7 5 4 N/A 6 11	123,438	
Lib J Metro PART 2 case study	Site J Metro 1 # * Site J Metro 2 Site J Metro 3 Site J Metro 4 Site J Metro 5 Site J Metro 6 Site J Metro 7 Site J Metro 8	Library Library Library Library Library Library Library Library	1500/384 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL	16 16 16 16 16 11 14 14	39 9 10 10 10 9 9 10	300,543	One site aggregated via Site 1
Lib K Rural	Site K Rural 1 # Site K Rural 2 Site K Rural 3 Site K Rural 4 Site K Rural 5 Site K Rural 6 Site K Rural 7	Library Library Library Library Library Library Library	512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL 512/128 ADSL	17 4 3 5 2 2 2	23 2 2 2 1 4 2	156,310	Other branches aggregated via main site.
Lib L Rural	Site L Rural 1 # Site L Rural 2	Library Library	512/128 ADSL 512/128 ADSL			84,623	Other branch linked to the main site.
Lib M Rural	Site N Rural 1 #	Library	512/128 ADSL			95,634	Other branch aggregated to main site.
Lib N Rural	Site N Rural 1 #	Library	512/128 ADSL	13	12	89,978	5 branches, 1 mobile library and a community library share this connection

Appendix C: Part 2 Survey Questions:

1. What does the library see as the main drivers of Internet data usage? For example: web browsing, web mail, gaming, data-streaming, file-sharing, Other (please specify)
2. Has this changed over the last 6 months? If yes what were the main drivers of data usage 6 months ago / 12 months ago?
3. Can you provide us with a list of the number of staff and patron terminals per library site? If for example the staff terminals are not using the VICNET Internet connection for e-mail and Internet access please note this.
4. What changes has the library made to patron and or staff Internet usage policies since October 2002? If possible please indicate which month the change was implemented and what systems / operational changes were put in place to implement the change. For example blocking port 6667 to block chat sessions, installing a proxy server on each site or the main branch site, filtering web traffic.
5. What Impact of viral attacks had on your Internet usage over the last six months?
6. What changes, if any, have there been to your patron profile as a result of the move to broadband DSL / fibre / wireless connections? For example – increase in usage by teenage boys.
7. What changes, if any, have there been to your patron's SATISFACTION as a result of the move to broadband DSL / fibre / wireless connections?
8. What changes, if any, have there been to your patron's EXPECTATIONS as a result of the move to broadband DSL / fibre / wireless connections?
9. What changes, if any, have there been to the library staff's work and responsibility has occurred as a result of the move to broadband DSL / fibre / wireless connections?
10. Are there any other changes not mentioned that have occurred as a result of the move to broadband DSL / fibre / wireless connections had on the library service?

Appendix D: Average Internet downloads per branch per terminal per hour

Note that sites that include both patron and staff terminals tend to do less down loads than sites that only use the VICNET connection for patron terminals. This is because patron usage tends to be more than staff usage.

Library	Branch	Speed	Hours P.W.	Patron	Staff	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03
Library B Metro	Site 1	1500/384 (A)	312.0 hr/pm	12	N/A	9.07 Mb	13.12 Mb	18.17 Mb	16.31 Mb	14.36 Mb	8.50 Mb
Library B Metro	Site 2	1500/384 (A)	312.0 hr/pm	16	N/A	6.05 Mb	6.56 Mb	9.08 Mb	8.15 Mb	7.18 Mb	4.25 Mb
Library C Metro	Site 1	512/128	260.0 hr/pm	4	31	0.813 Mb	0.964 Mb	0.999 Mb	1.465 Mb	1.813 Mb	1.63 Mb
Library C Metro	Site 2	512/128	177.7 hr/pm	4	3	0.000 Mb	0.000 Mb	0.001 Mb	0.007 Mb	0.715 Mb	1.77 Mb
Library C Metro	Site 3	512/128	260.0 hr/pm	4	25	0.578 Mb	0.639 Mb	0.632 Mb	0.669 Mb	0.737 Mb	0.62 Mb
Library C Metro	Site 4	512/128	229.7 hr/pm	3	13	0.725 Mb	0.857 Mb	1.600 Mb	0.832 Mb	0.960 Mb	0.97 Mb
Library D Metro	Site 1	2048/2048	247.0 hr/pm	14	N/A	7.68 Mb	7.71 Mb	6.97 Mb	6.21 Mb	9.78 Mb	10.93 Mb
Library E Metro	Site 1	512/128	208.0 hr/pm	N/A	2	0.10 Mb	0.24 Mb	0.18 Mb	0.18 Mb	2.10 Mb	1.37 Mb
Library E Metro	Site 2	1500/384	260.0 hr/pm	17	N/A	3.92 Mb	3.41 Mb	3.54 Mb	3.87 Mb	3.97 Mb	5.45 Mb
Library E Metro	Site 3	512/128	60.7 hr/pm	1	2	1.04 Mb	2.32 Mb	2.82 Mb	2.67 Mb	3.07 Mb	2.08 Mb
Library E Metro	Site 6	2048/2048	260.0 hr/pm	N/A	146	0.10 Mb	0.32 Mb	0.33 Mb	0.38 Mb	0.40 Mb	0.28 Mb
Library F Metro	Site 2	512/128	273.0 hr/pm	8	6	3.31 Mb	2.83 Mb	2.15 Mb	2.13 Mb	2.04 Mb	1.68 Mb
Library F Metro	Site 3	512/128	281.7 hr/pm	14	9	2.10 Mb	2.55 Mb	2.36 Mb	2.61 Mb	2.96 Mb	2.85 Mb
Library F Metro	Site 4	512/128	240.5 hr/pm	10	8	1.12 Mb	1.43 Mb	1.44 Mb	1.47 Mb	1.38 Mb	1.45 Mb
Library F Metro	Site 5	512/128	257.8 hr/pm	10	16	1.21 Mb	1.30 Mb	1.25 Mb	1.07 Mb	1.31 Mb	0.98 Mb
Library F Metro	Site 6	512/128	257.8 hr/pm	7	8	1.67 Mb	1.88 Mb	1.81 Mb	1.83 Mb	1.85 Mb	1.49 Mb
Library G Metro	Site 1	512/128	234.0 hr/pm	7	N/A	3.88 Mb	4.83 Mb	4.54 Mb	4.62 Mb	5.23 Mb	4.47 Mb
Library G Metro	Site 2	512/128	242.7 hr/pm	6	N/A	3.03 Mb	3.63 Mb	4.10 Mb	3.77 Mb	3.98 Mb	3.95 Mb
Library G Metro	Site 3	512/128	186.3 hr/pm	5	N/A	4.07 Mb	5.41 Mb	5.13 Mb	5.11 Mb	5.38 Mb	4.58 Mb
Library G Metro	Site 4	512/128	134.3 hr/pm	4	N/A	3.25 Mb	3.63 Mb	3.22 Mb	3.28 Mb	3.12 Mb	3.28 Mb
Library H Metro	Site 2	2048/2048	273.0 hr/pm	37	62	0.73 Mb	0.92 Mb	1.08 Mb	0.88 Mb	1.00 Mb	0.89 Mb
Library H Metro	Site 3	512/128	156.0 hr/pm	8	4	0.56 Mb	0.51 Mb	0.69 Mb	0.66 Mb	0.71 Mb	0.59 Mb
Library H Metro	Site 5	2048/384	242.7 hr/pm	9	12	0.82 Mb	1.02 Mb	1.09 Mb	1.03 Mb	1.09 Mb	0.99 Mb
Library H Metro	Site 6	2048/384	188.5 hr/pm	5	11	0.76 Mb	0.90 Mb	0.71 Mb	0.81 Mb	0.86 Mb	0.84 Mb
Library H Metro	Site 7	512/128	238.3 hr/pm	6	9	1.10 Mb	1.35 Mb	1.05 Mb	1.07 Mb	1.04 Mb	0.98 Mb
Library H Metro	Site 8	512/128	208.0 hr/pm	4	7	0.93 Mb	0.94 Mb	0.60 Mb	0.62 Mb	0.65 Mb	0.80 Mb
Library I Metro	Site 1	512/128	208.0 hr/pm	N/A	23	2.27 Mb	2.57 Mb	3.38 Mb	2.95 Mb	3.28 Mb	2.76 Mb
Library I Metro	Site 2	512/128	186.3 hr/pm	3	5	2.59 Mb	2.48 Mb	3.36 Mb	3.66 Mb	3.47 Mb	3.08 Mb
Library I Metro	Site 3	512/128	190.7 hr/pm	7	7	2.20 Mb	2.68 Mb	2.92 Mb	3.18 Mb	2.66 Mb	2.38 Mb
Library I Metro	Site 4	512/128	190.7 hr/pm	17	7	1.57 Mb	1.87 Mb	1.94 Mb	1.90 Mb	1.80 Mb	1.79 Mb
Library I Metro	Site 5	512/128	169.0 hr/pm	3	5	1.72 Mb	2.09 Mb	2.28 Mb	2.44 Mb	2.13 Mb	1.83 Mb
Library I Metro	Site 6	512/128	151.7 hr/pm	2	4	1.15 Mb	1.34 Mb	1.48 Mb	1.44 Mb	1.68 Mb	1.42 Mb
Library I Metro	Site 8	512/128	195.0 hr/pm	4	6	1.71 Mb	2.05 Mb	2.20 Mb	2.22 Mb	2.11 Mb	2.03 Mb
Library I Metro	Site 9	512/128	221.0 hr/pm	15	11	0.00 Mb	0.00 Mb	0.00 Mb	0.00 Mb	0.00 Mb	0.00 Mb
Library J Metro	Site 1	1500/384	268.7 hr/pm	16	39	1.10 Mb	1.29 Mb	1.09 Mb	1.08 Mb	1.41 Mb	1.12 Mb
Library J Metro	Site 2	512/128	214.5 hr/pm	16	9	1.24 Mb	1.45 Mb	1.69 Mb	1.45 Mb	1.65 Mb	1.36 Mb
Library J Metro	Site 3	512/128	214.5 hr/pm	16	10	1.29 Mb	1.62 Mb	1.60 Mb	1.43 Mb	1.67 Mb	1.38 Mb
Library J Metro	Site 4	512/128	214.5 hr/pm	16	10	2.05 Mb	2.16 Mb	2.55 Mb	2.59 Mb	2.61 Mb	2.49 Mb
Library J Metro	Site 5	512/128	214.5 hr/pm	16	10	0.69 Mb	1.84 Mb	1.80 Mb	1.63 Mb	1.84 Mb	0.78 Mb
Library J Metro	Site 6	512/128	197.2 hr/pm	11	9	1.69 Mb	1.93 Mb	1.92 Mb	1.93 Mb	2.31 Mb	2.11 Mb
Library J Metro	Site 7	512/128	179.8 hr/pm	14	9	1.84 Mb	1.99 Mb	1.91 Mb	2.29 Mb	2.05 Mb	2.05 Mb
Library J Metro	Site 8	512/128	179.8 hr/pm	14	10	1.36 Mb	1.86 Mb	2.01 Mb	2.07 Mb	2.05 Mb	1.91 Mb
Library K Rural	Site 1	512/128	268.7 hr/pm	17	23	0.88 Mb	0.58 Mb	0.63 Mb	0.66 Mb	0.74 Mb	0.69 Mb
Library K Rural	Site 2	512/128	162.5 hr/pm	4	2	1.54 Mb	2.00 Mb	2.67 Mb	2.54 Mb	2.15 Mb	1.78 Mb
Library K Rural	Site 3	512/128	151.7 hr/pm	3	2	0.88 Mb	1.35 Mb	1.68 Mb	1.72 Mb	2.07 Mb	1.76 Mb
Library K Rural	Site 4	512/128	169.0 hr/pm	5	2	0.30 Mb	0.49 Mb	0.58 Mb	0.52 Mb	0.67 Mb	0.64 Mb
Library K Rural	Site 5	512/128	60.7 hr/pm	2	1	0.81 Mb	0.92 Mb	1.07 Mb	1.39 Mb	2.06 Mb	1.52 Mb
Library K Rural	Site 6	512/128	164.7 hr/pm	2	4	0.74 Mb	0.94 Mb	1.23 Mb	1.14 Mb	1.24 Mb	1.02 Mb
Library K Rural	Site 7	512/128	91.0 hr/pm	2	2	0.00 Mb	0.19 Mb	0.83 Mb	0.94 Mb	1.25 Mb	1.14 Mb
Library N Rural	Site 1	512/128	251.3 hr/pm	13	12	0.13 Mb	0.67 Mb	0.68 Mb	0.77 Mb	0.68 Mb	0.66 Mb

Endnotes:

- ⁱ The third recommendation of the Australian Senate 2003 “*Libraries in the online environment*” report recommended “the continuation of the Department of Communication, Information Technology and the Arts Community Heritage Grants digitisation programs.
- ⁱⁱ The Austro-German-American economist Joseph Schumpeter proposed the theory of creative destruction; the innovative explosion of ideas that generates new industries and therefore economic growth as well as the building of new infrastructure. (Hall, 1998) The theory argues that as the technology dates, and the economic cycle slows down, capital needs to be diverted to develop new innovations that in turn spark a new wave of capitalist development. The new wave of development in part destroys old areas of economic activity. For example the decline of manufacturing in the western world coinciding with the rise of the service economy. PCs and the Internet are seen as driving the latest economic wave, that of the information economy. As noted, each business cycle needs infrastructure i.e. steam engines need railway infrastructure, motor-cars need roads, whereas PCs and the information economy needs the Internet and telephony in general. The successful players are those who implement strategies that take advantage of the new innovations and the associated infrastructure.
- ⁱⁱⁱ The WA Internet Exchange <http://www.waia.asn.au>
- ^{iv} Victorian Internet Exchange <http://www.vix.asn.au>
- ^v National Office for the Information Economy
- ^{vi} Peering points provide the place and mechanism for ISPs to transfer data between each other. There are a number of different business models available. For more detail refer to <http://www.isc.org/iepg/settlements.html>
- ^{vii} Gnuttella can be blocked by using port 6346, 6347 6346, and 6347.
- ^{viii} HDD Sheriff cards create an image of the hard drive, when a computer is rebooted it returns to the default hard drive. Any software that has been installed during the last period of uptime is removed. For more information go to: http://www.bitdistribution.com.au/hddsheriff/hdd_sheriff_faq.htm. Though HD Sheriff may stop software being loaded onto a PC, it does not actually provide security. It can also have a considerable impact on data overheads.