



CHAPTER 19

TELECENTRE TECHNOLOGY

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INTRODUCTION

This chapter discusses the range of technology options and technology issues that need to be considered in planning and developing technology for telecentres. It covers determining the users' needs and the applications to meet those needs, putting the infrastructure in place, and selecting, installing, managing and maintaining the various technological components of a telecentre system.

Technology lies at the core of the telecentre concept and can undoubtedly bring enormous benefits to communities. But it is important to avoid falling victim to “technology determinism,” the pressure to be fashionable and have the latest technology. Funding is usually scarce and is needed not just for equipping the centres, but for staffing, training and running the system. It is therefore essential that the networks, hardware, software and other priorities be guided by the community requirements and centre's strategic plans, rather than by sales pitches or false expectations of what can be achieved.

RADIO SYSTEMS

Portable, low-cost FM transmitting stations and digital radio systems that transmit via satellite and/or terrestrial cellular networks are being implemented in many parts of the globe. Internet streaming audio software technology allows a global audience to listen to news from various countries, and wind-up and solar portable radios free conventional radios from the need for expensive power sources in remote and rural situations (see, for example, Freeplay Energy [formerly Baygen Power] at www.freeplay.net). In designing a sustainable telecentre model, it may be useful to look to such technologies.

To establish a Commonwealth of Learning–supported telelearning centre in northern Uganda, the first step was to set up an FM radio station. This was seen as an invaluable means of giving a sense of identity and focus to the community, preserving the local culture and language, providing emergency medical services, and delivering formal and non-formal education and agricultural extension programmes for farmers and agro-food processors. It was also seen as a way of generating revenue by, for example, broadcasting community-based announcements and market and commodity prices. It is hoped that the income stream from, and interest generated by, these services will lead to computing and other services.

TELEPHONY

Telephone lines

The primary objective of many telecentres is to create public telephone access and then introduce a range of other services dependent on this backbone, such as fax, e-mail and Internet/Web access.

The minimal set-up for a basic telecentre is usually three lines: one for voice, one for fax and one for Internet access. However, if the telecentre is small and phone services are not to be major part of its operation, it may be possible to start with a single phone line for voice, fax and Internet services. It is possible for up to 10 computers to share the same phone line for simultaneous Web access. But, since a single line will not allow concurrent use of voice, fax and the Internet, this resource will have to be carefully shared. If e-mail can be provided off-line (for example, via a batched data communications protocol called UNIX to UNIX Copy [UUCP] provided by an Internet service provider [ISP]), then the phone line will only be needed for short periods for sending and receiving e-mails.

Telephones

If the telecentre intends to offer audioconferencing, then hands-free and speaker phone facilities will be required, through the use of headphone-microphone headsets or a loudspeaker telephone set. Audioconferencing can help build group relationships and understanding, and sessions can be initiated at fairly short notice. However, applications are time- and place-dependent for the users and the connection costs may stretch the budgets of some providers. A combined telephone/answering machine unit will be useful, especially if the centre is only to be open at certain times of the day.

Some telecentres may find need for additional long-distance cordless phones such as those operating in the 2.4 GHz waveband. With a range of up to 5 kilometres, these can be loaned out, for example, to the house-bound, and used by centre managers and staff when travelling from the centres. With some models, call time is indicated on the handset. Other systems allow up to eight handsets on the same base station to communicate directly with each other without using the phone line. If cell coverage is available, a mobile cellular telephone can be used in the same way, employing pre-paid cards with a magnetic strip or a chip (often called “SIM cards”). Cellular links are very expensive and are probably better avoided unless a special tariff can be negotiated with a provider. However, where no land lines are available, cell phones may be the only option.

Call accounting systems

Telecentres dependent on basic telephone access for a major part of their revenue may need to install specially designed call management units attached to the telephones. These provide digital read-outs of the accumulated call charges as they are incurred and can be attached to a call accounting system at the reception desk or other payment point. The call accounting system normally accommodates pre-payment and post-payment accounting options and provides printouts of the cost of each call. To provide such functions for a number of phone lines, a small PBX or software PBX running on the computer server will be needed.

There are more basic call accounting systems, but they have a number of limitations. A separate meter is needed for each line and must be paid into by the user and cleared and reset each time a call is made. There is no facility for attaching the meter to the cash/transaction register or using debit “smart cards.” Records are only stored for one day and printed out at the end of each day in a shift report. With such systems, charging for voice calls, faxes and dial-up Internet access and tracking usage (an essential requirement for sound business planning) can be extremely time-consuming and prone to error.

Call accounting systems normally require the availability of the pulse-per-unit service provided by the telecom operator. It is possible to manually load tariffs into the call accounting system, but this requires inputting rates for every dialling code, including international codes, and these must be changed every time the operator changes the tariffs.

Systems that connect to a PC-based billing system are available from the U.S. and Canada, but these are often not adapted to use the local telecom operators’ method of signalling the cost for call accounting through, for example, a pulse-per-unit system.

Fax

There are now many integrated fax/printer/scanners on the market. However, a stand-alone Group 3 fax is recommended because this can be used without having to interrupt or await a print job.

A line dedicated to fax may be necessary in larger telecentres, but sharing the fax number with one of the voice lines may be possible if there is no requirement for unattended reception of faxes.

The number of low-cost Internet-based fax services which can substantially reduce usage costs is increasing. Services such as Fax4Free (www.fax4free.com) provide free faxes, including Microsoft Word documents of up to 250 K, to anywhere in North America, the UK and Australia. Free incoming fax numbers can also be set up which will translate the incoming faxes and send them via e-mail as attachments.

COMPUTER SYSTEMS

Some telecentres may be forced to start out with only one computer, but more commonly centres are equipped with several machines. In a multi-computer environment, one machine will normally be dedicated to administration, the sales or service desk or other staff use, and the others made available to the telecentre users.

It is now possible to purchase standard multimedia computers for less than US\$1,000. Many telecentres use machines with a minimum of 4 Gb hard drive, 64 Mb of RAM (random access memory), sound card and a Pentium II processor. A more detailed minimum specification for a telecentre's computer is:

- Pentium 350 MHz CPU
- 32 Mb RAM
- 4 Gb hard drive,
- 24X CD-ROM
- 1 Mb PCI video card
- 10/100BaseT Ethernet port/card
- Sound Blaster compatible full duplex sound card
- diskette drive
- 14-inch monitor
- keyboard
- microphone
- speakers and headsets (to reduce noise)
- mouse
- UPS (uninterruptible power supply) and surge protector (where the power supply is unreliable and to protect electrical equipment and computers from damage caused by power surges, storms and lightning)

As it becomes necessary to increase the number of computers, it may be possible to add older or recycled machines. These may be donated by companies upgrading their equipment or purchased from computer recyclers for about US\$100 – \$150. Such machines may not provide all the services of a full multimedia PC, but they can be more than adequate for users requiring only word processing and access to the Internet.

One recent development that will certainly reduce start-up and operating costs is the network computer (NC). This is similar to a PC, but has no moving parts and relies on a central server for all of its software and data storage. The NC environment provides access to all standard applications and usually comes with free Internet applications (word processing, videoconferencing, voice mail, spreadsheet, e-mail, Web browsing and Web authoring). Because these NCs are so much simpler to manufacture, they can be obtained and maintained at a significantly lower cost than standard PCs. Stripped-down Windows Compatible NetPCs without hard drives now cost less than US\$500. At the time of writing, one South African retailer was marketing an NC for US\$300 (it uses a TV set as the monitor and accesses the Internet and other applications residing on a server stationed at the ISP). Some NCs cost as little as US\$200. Most NC set-ups can now also provide video and audio on demand if there is sufficient disk storage space. An NT server can also be added to provide access to Microsoft Office applications if necessary.

Internet/Web access

Telecentres without any form of telephone link will only be able to provide stand-alone computer-based services, TV and radio, and possibly downloaded news, weather and market prices via a satellite broadcast link using DSTV (digital satellite television) or WorldSpace, a commercial digital satellite radio service. Such services can be a vital

first step in the life of a telecentre, after which it is hoped the other telecommunication services will follow.

Where it is impossible to obtain Internet access by local telephone call, there will probably be more focus on e-mail services than Web access. It is extremely expensive to make long-distance calls to access the Internet. If there is a large enough number of Internet/Web users to justify this cost, it may be cheaper to install a permanent Internet link via wireless or leased line. In remote areas where there is no prospect of lines becoming available, although the set-up costs are higher, cell phones or VHF/HF radio or low-earth orbit (LEO) satellite-based e-mail links to a hub can provide sufficient connectivity.

Some countries do not allow private entities to sell access to telephone or Internet services to third parties, but most do not place any restrictions on the private resale of telecommunications and related services. Some countries have progressive tariffing policies. In Senegal, for example, private telecentres receive a 40% discount on call tariffs. Unfortunately, to date, very few other telecom operators have developed a tariff policy that specifically encourages the development of privately run public access services. This means that telecentres often have to pay standard residential tariffs for calls made, leaving little room for mark-up.

Local area network (LAN)

If only two or three PCs are being used, they can be linked at low cost with either standard co-axial Ethernet cable or a small 4-port hub. As demand for computing facilities grows, it is recommended that the PCs and/or NCs be linked via a 100BaseT 16-port Ethernet hub (a 16-port hub is recommended because this is only marginally more expensive than a 8-hub port). A second hub can be daisy-chained to the first hub if further expansion is necessary. Machines will need 100BaseT Ethernet cards and 100BaseT Category-5 (CAT-5) cabling. The 100BaseT is now the accepted standard and will provide future upgrading options for videoconferencing applications and NC operation.

Wireless LANs are becoming increasingly popular. These allow easy expansion and connectivity with neighbouring buildings without the use of cabling. Currently, these are significantly more expensive than a self-installed cable network, but compared to contracting a company to lay cable, the self-install wireless option is considerably cheaper. With the use of small antennas, buildings up to a few kilometres away can be linked into the same network, providing they are visible from the telecentre. Adding amplifiers, wireless networks of up to 70-kilometre radius can be achieved, as long as they still have “line of site.”

Computer use management systems

As with the telephone system, manually recording online computer use is time-consuming and prone to errors. For accounting and billing associated with Internet access and related services, telecentres may wish to install a management billing system. This is especially useful where there are users who come in every day for just a few minutes to check their e-mails.

There are various computer use management systems on the market, some software- and some hardware-based. The preferable solution is to use smart card technology to

identify and bill the user. This reduces the administrative burden of billing, as the user has only to be billed each time the card needs recharging or the system credits are used up. It also provides roaming ability, ease of use, and greater functionality and convenience (the smart card contains the users log-in and password, Web browser bookmarks and other personalised application information). With NC technology, this is done relatively easily via a built-in smart card reader on each NC. The smart card identifies the system's user on the server, which tracks minutes of usage through the existing administrative system and can be programmed to terminate access after a pre-set time. An add-on smart card reader and administrative system is available for standard Windows machines from France-Telecom's I-Card division. In this system, a smart card is issued to each user, charged with the credits they have bought or been given. For US\$200, a smart card reader is plugged into the serial port on each PC. The I-Card administration software allows the cards to be recharged with credits at the rate defined by the centre, controls which applications the user can access and can charge each software programme at a different rate.

Another possibility is to use one of the growing number of public-access kiosk systems with built-in smart card and coin readers. Some of these also provide a touch screen and printer. Examples of these include the South African Post Office's Public Information Terminal (PIT) and the US PatLink System.

Printers

Some telecentres operate with a printer attached to a single PC. In a multi-PC environment, there should be one printer to every 8 – 10 computer systems, all linked via the LAN. There is a wide variety of different printers to choose from, and choice will depend on price and the type of work to be done. The old dot-matrix printer is no longer acceptable because of the poor quality of its output. Ink-jet printers are popular, costing much less than laser printers, but their cartridges are expensive. If centres plan to offer printing services, it is cheaper in the long run to purchase a laser printer. Telecentres providing desktop publishing services for their local communities will need printers capable of providing commercial quality and output levels.

Modems

Modems enable computers to send and receive data over telephone lines and gain access to the Internet/Web. Modem speed is measured in bits per second (bps) or Kilobits per second (Kbps). The higher the rate, the quicker the transmission. To receive graphic images, a rate of 14.4 Kbps or higher is normally required, but text can be received at even 2,400 bps through high frequency (HF) or LEO satellite links, ideally in compressed format, which results in an effective through-put of about 7.2 bps. More recent modems should be able to operate at 33.3 Kbps or 56.6 Kbps, depending on the quality of the local telephone network. In some areas where there is a lot of interference on the lines, or a Wireless Local Loop system has been installed by the telecom operator, it may not be possible to operate at speeds greater than 7.2 Kbps.

Videoconferencing

Videoconferencing has all of the advantages of audioconferencing plus the advantage of letting the users see the people, objects or visuals at the other site. It can achieve major savings in travel costs. However, it also incurs high investment and high connection

costs and few telecentres will have the demand or resources to justify these, at least at the start-up stage.

High-quality videoconferencing requires a digital line, typically ISDN (integrated service digital network), which is rarely available in remote and rural areas. However, there is now increasing use of Internet-based videoconferencing. This uses standard dial-up phone lines and only requires the addition of a small VideoCam, costing US\$50 – \$100, to the PC. The quality of desktop videoconferencing is variable and certainly not as good as standard ISDN 128 Kbps or 384 Kbps videoconferencing, but it represents an affordable option where there is need for this form of communication.

Software

The most common computer applications in telecentres are desktop publishing (for local businesses, community groups, schools, adult education programmes and so on), spreadsheets, and Internet- and Web-based activity.

Centres are making increasing use of the public domain LINUX operating system, which comes complete with a number of free applications such as Netscape, WordPerfect and StarOffice (an MS-Office look-alike). The South African SchoolNet Programme uses Taxis, a public domain e-mail software package based on UUCP, which runs on both old and new computers and cuts phone costs with its high-speed protocol. For older PCs (such as 286's, 386's, etc.) which have trouble running the full suite of Microsoft Windows and Office products, there are other options such as LINUX, and the New Deal or QNX packages which provide a full suite of e-mail, word processing and Web-based applications.

There has been much discussion about developing software for different languages. However, research indicates that users in all countries prefer productivity tools with English menus, except for recreational software, which they prefer to be in their own languages. There are a variety of free or "shareware" packages available to assist users whose first language is not English.

Computer training aids

Telecentres have a key role in training people in computing and need to develop a range of resources for those users who are willing and able to learn and practise on their own or with minimal guidance.

Most software packages come complete with their own manuals. There are also many commercial "at a glance" step-by-step guides for the more popular software applications (e.g., the *For Dummies* series).

Computer-assisted materials providing self-paced tutoring and remediation are also increasingly available, ranging from programmes designed to familiarise first-time users with the basic functions and operations of the computer, to packages providing comprehensive training and trouble-shooting for every aspect of computing. Games such as Solitaire can also be useful for familiarising users with basic computing skills, while programmes such as Print Shop show beginners how to produce greeting cards, pamphlets, letterheads and personalised calendars.

For those lacking in typing skills, there are software-based typing tutors. The best of these give feedback and provide tests appropriate to user skills levels. Both Mavis Beacon or Typing Tutor are very popular.

Audiotapes can be used for self-instruction in computing or typing. These can be played in a Walkman or tape recorder with a headset, are relatively inexpensive, and allow the trainees to stop, rewind or fast forward as required while working at the keyboard. The major disadvantages of these aids are that they require users to follow set sequences and do not provide personalised advice, remediation or answers to questions.

Videotapes are not as effective as might be expected for computer training because the users have to continually shift attention from the TV to the computer screen. And unless the users wear headsets, the sound is distracting to others. Also, as with audiotapes, the users cannot ask questions or seek help for their problems.

Educational and training software

Educational and training software is developing rapidly in sophistication and capacity to allow users to express their ideas, access the content they need and receive individualised feedback. An increasing amount of educational and training content is also now delivered via the Web, rather than stand-alone software. However, many users are unsure of their capabilities and unused to self-managed learning, so they often still need the support of skilled trainers or facilitators. It is therefore advisable to regard such material as augmenting face-to-face instruction or demonstration, rather than taking the place of it.

It is important to check with others what is best for particular uses or applications. It is also a good idea to see what scope there is for sharing courseware with other local providers to minimise costs and ensure that any packages brought in or specially developed bridge the gaps in, or supplement, the existing provision.

Communications software

Access to the Internet will continue to be another priority activity for telecentres, in all likelihood via dial-up rather than leased line. Ideally, centres should be able to access the Internet for the cost of a local telephone call. Centres at a distance from the nearest Internet access point and charged for long distance calls are likely to restrict Internet usage to e-mail services. However, as the number of users grows and more local Internet points or POPs (points of presence where ISPs set up a modem bank and Internet server for local dial-up users) come online, leased line services may be added. If there are schools, clinics or other organisations within the local community needing online services, it may even be possible for telecentres to become suppliers of dial-up or leased line (via cable or wireless) connectivity to these.

To access the Internet, each computer or computer network will need a modem, phone line and account with an ISP. It is best to take out a contract with an ISP that can provide a complete set-up/installation service and guarantee good technical support. To reduce the operating costs, and thus the charges to the end-users, it is important to use the most efficient Internet protocol available, thus minimising the telephone time needed to transfer messages and data.

Ideally, the local ISP should be able to provide:

- *A dial-up PPP (Point to Point Protocol) account for access to the Web* — This single account can be shared simultaneously by multiple PC users with the installation of demand dial software such as Mailbridge/LANBridge, Diald or Wingate on the telecentre's server. Depending on the quality of the line and speed

of the upstream connection from the ISP to the national Internet backbone, a standard 33 Kbps dial-up link from the telecentre should be able to support at least four or five simultaneous Web users and possibly allow eight or more workstations (PCs/Network Computers) to be accommodated on the link (as many of the users will probably not be using it while reading or writing their e-mail).

- *One batched compressed UUCP mail account and domain-name per telecentre for e-mail* — This allows the telecentre to house, manage and create e-mail accounts locally, and optimises the use of the telecommunications link. The server will regularly pick up and send compressed e-mails, the users can work on their e-mails off-line at all times, and the compressed UUCP transfer protocol is four to eight times faster than the standard TCP-IP/POP (post office protocol) used by most e-mail clients. All of these features reduce the costs of the e-mail accounts.
- *Web-hosting services* — The ISP or other national Web-hosting agency can be asked to make provision for the Web sites of telecentre clients to be established at one central site. Alternatively, users can make use of Web-hosting provided by one of the free U.S. or European Web services, such as Tripod.com or Geocities.com.

Copyright

It is important to remember that all commercial software is protected by copyright. If a telecentre plans to share software between a number of computers by means of a LAN (local area network), it is important to ensure that the software purchases are compatible with the specific server to be used, and that the licensing agreement accepts LAN usage.

Where a telecentre has connections with business or educational institutions in the community, it is useful to establish whether these institutions have already negotiated site licence agreements that can be extended to the telecentre.

OTHER EQUIPMENT

Photocopier

Where telecentres share accommodation with other organisations, sharing the photocopying facilities may be an option. However, most telecentres will find that they need their own photocopying facilities.

The new integrated four-in-one fax/photocopier/printer/scanners may be used for low volume copying (1 – 10 copies), but a separate high volume machine may need to be installed where larger print runs are necessary.

For larger volumes, an alternative to the standard photocopier is the increasingly popular range of digital printers from RISO. These are essentially updated duplicating machines that can cope with very high volumes, provide far cheaper copy than standard photocopiers, require less maintenance, and operate in very hot or dusty conditions without the frequent breakdowns associated with traditional photocopiers. While the RISO printers cost about the same as photocopiers, they are not cost-effective for once-off copies. Therefore, a separate low-volume integrated fax/scanner/printer/copier may still be necessary.

A photocopier with a collator may well be needed in telecentres that offer large print-runs.

Binding machine

Where there is demand for copying or printing booklets and reports, a binding machine is very useful and can have income-generating potential. There are several binding systems to choose from — including velobinding, thermal binding and plastic or wire comb binding — and several types of cover material to protect the documents. The choice of system will depend on the usage levels and the types and sizes of the documents to be bound. In selecting a system and particular model, it is also very important to check out the reliability of supply and the costs of the consumables.

CD burner/writer

With a CD burner/writer costing no more than US\$200, a telecentre can record, store and distribute cultural, community and newsworthy events, archival material and musical CDs, and make back-ups, distribute Web sites, save databases and make copies of CD-ROMs.

Scanner

Hand-held scanners cannot be used effectively for books or publications. The most efficient type of scanner for scanning documents, photographs, maps and other such material is the flatbed scanner, similar in design to a photocopier. In this, the material to be scanned is placed face down on a glass slab or platen. Software for manipulating and editing scanned images and documents is also needed.

Laminator

Laminators — machines that cover documents with a thin film of plastic — can be offered as a commercial service to preserve documents from alterations, spillage and damage. There are two types of laminating. Cold laminating is ideal for wax-based or heat-sensitive material such as photographs, thermal paper and some printouts from ink-jet printers. Hot laminating is used for non-heat-sensitive material. The choice of machine again depends on the level of demand, size and types of material to be laminated and, of course, the budget.

Paper shredder

A paper shredder will be needed where there is need to destroy confidential documents and client information. Shredders range from small desktop models to large, free-standing, automated machines complete with waste bins.

Digital camera

Digital cameras allow picture files to be copied from camera to PC to create documents or e-mail attachments without the expense and time delay of film processing. This can be very useful to centres wishing to operate as e-mail post offices, provide support for archival and field work, take passport and ID photographs, record important events and provide VIPs and other visitors with permanent records of their visits. Digital video cameras are also available and make it possible for videos to be added to e-mail.

Video cassette recorder (VCR)

Having VCRs on hand allows broadcasts, videoconferences and pre-recorded educational, training, information or entertainment programmes to be viewed at a time of the user's choice. Telecentres offering dubbing services will need two machines, preferably of the same make for compatibility. A long-play function is also desirable and, in terms of picture quality, the more heads the better.

Projection equipment

If the telecentre is to provide training or be hired out for this purpose, an overhead projector and screen may be useful. However, a word of caution here. There have been many cases of centres being equipped with these and their never being used. Generously resourced telecentres may also wish to provide for slide, video and computer projection. However, if they are near major centres, it may be more economical to hire these as needed.

EQUIPMENT AND SERVICE PROCUREMENT

In acquiring any equipment, a telecentre must always consider such critical issues as:

- the users' needs,
- the income generation potential,
- the recurrent costs and costs of any upgrading,
- compatibility,
- possible redeployment at other locations, and
- maintenance and repairs.

Equipment acquisition costs can be reduced by bulk-purchasing or inviting tenders (particularly where a number of telecentres or partner organisations are involved); negotiating with manufacturers or suppliers for free, at-cost or demonstration equipment, or equipment for field-testing; and buying second-hand equipment.

On the latter point, there are many examples of centres making excellent use of second-hand telephone systems, photocopiers, computers, printers, filing cabinets and furniture acquired from various sources. The savings can be substantial. For example, one computer recycling charity in South Africa provides five reconditioned 486 PCs for US\$1,400. Technology is continuously advancing, and what is old and obsolete in one place is often still new and usable in another and can sometimes be combined with more up-to-date systems. Even the oldest PC can be used for word processing and e-mail videoconferencing.

Among the disadvantages of second-hand or recycled hardware: some users may feel they are being denied the best and most up-to-date facilities and services; the hardware may not be able to run new software versions; and maintaining the hardware and locating replacement parts or suppliers may be difficult.

While equipment is likely to be cheaper when bought in bulk and centrally, central maintenance and support agreements are generally too costly for many telecentres. Therefore, wherever possible, service agreements should be made with local providers.

Maintenance carried out by local suppliers will minimise costs, decrease down time, and help build local capacity.

Warranties and service agency support should be clearly established with the suppliers.

Equipment that fails under warranty will probably have to be returned to the original supplier or the manufacturer, possibly mediated by the local service agency.

SECURITY

Care must be taken to ensure the security of the telecentre equipment and cash. Telecentres are, by definition, public places. Internal security measures include constant vigilance, marking the equipment with special identification marks, taking careful note of the serial numbers to make it easier to detect stolen items, and possibly securing equipment to desks and benches. Strong locks, window bars and alarm systems may be necessary in high-risk areas. In some cases, where the centre is free-standing, security fencing may be needed. Some centres even find it necessary to employ guards by day and by night.

HEALTH AND SAFETY

See Chapter 17 of this book for a description of important health and safety factors.

INSURANCE

The equipment needs to be insured. This can be very expensive, but in some cases it may be possible for the sponsoring or host institution to include the equipment on its own insurance register for a small additional cost.

WIRING

It is possible to run telecentres on solar power. Further information concerning solar solutions can be found at www.siemenssolar.com. However, the start-up costs for this are substantial, so it is preferable for telecentres to be located close to the national power grid. Back-up facilities such as generators, batteries and invertors are strongly recommended for areas where power supply is intermittent.

Whether the telecentre is planned for new premises, an existing building or even a container, it is important to plan the wiring at the same time as all the other planning. Such a plan should indicate:

- the radial or ring wiring and cabling for all the technical facilities, lighting, heating and air-conditioning systems, and other appliances;
- the location of all the floor and wall electrical outlets for the computers and peripherals (a maximum of six systems per outlet), and other electrical appliances;
- wiring for the LAN; and
- the location of all telephone connections for the user services, reception area, office telephones and faxes.

There should be separate isolators/fuses for the PCs, the air-conditioner and the telephone system. It is also critical that the electrical wiring is earthed, even during the

dry season when the water table is lower. This will minimise the impact of lightning on equipment, but special lightning arrestors also need to be placed on the PCs and telephone equipment in areas prone to electrical storms. And all electrical wiring should be tested to ensure that it is earthed before any equipment is installed.

The new integrated cabling that allows a telephone or LAN port to use the same socket is ideal, but specialised skills are needed to install this and so it is likely to be costly. In many existing buildings, it will be far cheaper to simply use extension cords to stretch the required cabling from the existing power and telephone sockets.

To link the PCs into a LAN, CAT-5 cable is the standard. Ideally, this should be in ducting, but for networks of three to four PCs, it can simply be laid around the periphery of the room. Cabling can be restructured as telecentres expand and more funds become available. Alternatively, a wireless LAN system can be used. Wireless LAN network cards for the PC or laptop are more expensive than standard cable-based cards, but wireless LANs are a good alternative to getting specialist companies in to lay cables, because LANs can be installed by the local technicians.

CONCLUSIONS

This chapter has suggested ways of making the right choices and combinations of technology. It is important to remember that all media and all technologies have their inherent strengths and weaknesses. Technologies should be used where they can help communities achieve goals otherwise unachievable, and where they can be integrated into the local system and culture.

Technology is no longer exclusively top-down or centre-peripheral in its working. It enables initiatives to be taken at any point or points across the network, and it allows users to work and speak from within their own communities on the matters that are important to them. As well, technology can be cost-effective and cost-efficient. However, it also raises important issues of access and equity and there is need for collaboration to minimise costs, ensure articulation and compatibility, and share best practice.

