

# Rock solid: School servers in Powys county, Wales, UK

To provide its pupils with Internet and email access, Powys county council in 1999 implemented an open source-based server solution in schools. Council staff were already familiar with free software, since the council had used LAMP web servers since 1997. The solution was upgraded for greater capabilities in 2004/05.

[Introduction](#)

[Organisation and political background](#)

[Budget and funding](#)

[Technical issues](#)

[Legal issues](#)

[Change management](#)

[Cooperation with other public bodies](#)

[Evaluation](#)

## Introduction

The County of Powys covers a huge area but has only 132,000 inhabitants, resulting in a very low population density of 25 people per square kilometre. This presents some unique problems for service delivery. Most of the county's 110 primary and special schools are very small by urban standards, typically having under 100 pupils. The distances involved (over 3 hours travel from top to bottom of the county) mean that visiting schools to maintain IT services is costly.

Another problem relates to educational funding. Most funds are allocated on a per-pupil basis, whereas many IT facilities such as network links have to be provided on a per-school basis. An urban council with similar pupil numbers may only have to provide services to a handful of large schools. In Powys county, the challenge is to provide equivalent services to over 100 schools for the same money.

The main goals were to connect every school of the county to the Internet, and to provide every pupil with email access. The county council's IT and education teams worked together to enable Internet and email connection to all schools in this rural area.

The first major programme was a GNU/Linux server and a set of free software applications used to provide email and internet access for all schools in 1998/99. This effort reached 103 schools, the majority on dial-up connections

### Quick facts

<i>Name</i>	Powys school servers
<i>Sector</i>	Education
<i>Start date</i>	2005
<i>End date</i>	n.a.
<i>Objectives</i>	Provide web- and email access plus file storage to students and teachers of 110 schools in Powys county. Schools typically have less than 100 pupils each.
<i>Target group</i>	Students, teachers
<i>Scope</i>	local
<i>Budget</i>	n.a. A savings estimation on server licenses is important.
<i>Funding</i>	national. local
<i>Achievements</i>	Extremely stable server solution at low cost

originally managed by the server over the public telephone network. Today, all schools have broadband connections of at least 2 Mbit/s.

In 2004/05, IT systems were upgraded. In addition to hardware renewal and a complete update of system software, newly added facilities include web-based email (plus IMAPS for desktop clients) with full support for Welsh and English; web-based management of mailing lists; increased reliability and resilience through rolling backups, comprehensive self-diagnosis checks and email notifications of potential faults that cannot be fixed automatically; central configuration and software update service; and increased security including SSL services for web, email and remote administration.

Since this update, there is a GNU/Linux server into every Powys school which provides comprehensive email service for all pupils and teachers; managed Internet proxy and cache service; Intranet servers for web applications and file-sharing; and a web administration system for school staff to manage users and services. The servers use leading open source applications. The web-based administration system (PHP) and the server control system (shell scripts) were written in-house.

[\[top\]](#)

## **Organisation and political background**

Email and Internet access for all pupils and teachers was a key objective of the National Grid for Learning programme which ran from 1998 to 2006. The effort to get Powys' schools connected to the Internet took place in the framework of the "National Grid for Learning", an effort by the British government that ran from 1998 to 2006. As one of its key objectives, the programme supported British authorities in providing schools with Internet connections and offered educational resources through a web portal. (Along with a few other regional efforts, [NGfL Wales](#) is still running.) During the early part of this programme, Powys deployed a Linux server to each school. Powys was the first council in Wales to meet the NGfL educational targets, and remains a leader in provision and use of the Internet in Schools.

By 2004, the hardware of those original servers was no longer up to the performance requirements, and was beginning to show its age through increasingly frequent failures. The opportunity to address this came through the Wales Assembly Government's "Lifelong Learning Network" programme. This provided the resource to review the system and deploy new hardware.

The educational brief for the upgrade came from teachers familiar with the original system and members of the Council's Education Advisory team. Powys IT staff used their experience of supporting the original servers to propose changes to enhance reliability and maintainability.

IT staff at Powys county council were already familiar with free software. The council web servers have been running Linux/Apache/PHP/MySQL ("LAMP") since 1995. The primary internal DNS server, set up in 1997, was only replaced in 2007 after running on the same hardware (a Pentium 75) for 10 years with the original GNU/Linux OS. The server also provides LDAP and time services to the network, with typical uptime measured in years.

Two important criteria for the update emerged. The administration interface should be largely

unchanged to minimise training requirements; and the changeover in the schools should avoid disrupting key curriculum and administrative services.

The prime requirement was to update email facilities, in particular to provide webmail (allowing pupils to use any available computer to access their email) and IMAP (to support different email clients where chosen by the school). The system had also to allow for secure access to school email systems from home Internet connections. Many of the features that had made the original servers a success were kept, especially the ability for non-technical staff in schools to manage users and control the services provided by the server.

[\[top\]](#)

## **Budget and Funding**

Part of the funding for the original solution came through the British Government's National Grid for Learning programme. The rest of the money was provided locally by the county. With budgets for ICT in schools notoriously fickle, Powys county's open source strategy provides a clear advantage. If funding were to dry up, the county's Educational Authority would not be saddled with long-term contracts forcing it to pay license fees for the software on its servers.

The use of free software for the solution resulted in significant savings for the county. "We are saving hundreds of pounds in each school. We can buy a low-spec PC, put all the open source software on and we have a completely functional email system, web host, Novell-emulated server in every primary school for £300. We couldn't contemplate that if we were using Windows NT5. We couldn't get near it (a Microsoft-equipped equivalent would have cost him around £1,000). I have no interest in the partisan operating systems war. I am partisan about education", says Martin Williams then the co-ordinator of ICT support services with Powys Education Authority, in an article published in the Times Educational Supplement in 1999.

Unlike many other local authorities in the UK, the Powys county council has contracted out the IT support for its schools to a local company, instead of taking on this task in-house. This firm, Ian Prior Computing, delivers support for primary and special schools in the county. Secondary high schools are big enough to have their own full-time IT technician.

Ian Prior, the director, started his company specifically to support the schools, after having noticed that IT support in schools often relied on parents volunteering, and was poor at best. Most schools in Powys county have less than 100 students, with some providing education to as few as 20 pupils, says Ian Prior. The budgets of these schools are too small to afford their own IT support.

Prior's company employs six people, five of them full-time technical staff, to cover approximately 110 schools with roughly 2500 PCs and 1000 printers, having one GNU/Linux server each.

Though licence costs are a significant burden on schools' tight budgets, Prior says he hasn't seen this as an impulse for schools to become interested in Free Software solutions on the desktop.

[\[top\]](#)

## Technical issues

From the user's perspective, the solution has three basic functions: Web access through Apache, email (through SquirrelMail) and the Samba file server.

Desktop computers in the schools in Powys county typically are Microsoft-based. Most of them run Windows XP on their desktops, with Windows Vista being deployed in some instances. About 50% of the schools use OpenOffice, the rest uses Microsoft's proprietary office suite. Ian Prior ponders whether this might change in future: "There's a feeling that the schools should think very seriously about moving to OpenOffice, but that's entirely a decision of the local teaching staff."

The GNU/Linux distribution used as the basis of school servers is Slackware. The Council has a decade's experience working with this distribution and the Slackware philosophy of simplicity and modularity lends itself readily to customisation.

Today, Slackware may seem an unusual choice. Most current deployments are based on the Debian, Ubuntu, RedHat or SUSE varieties of GNU/Linux. Actively developed since 1993, Slackware is one of the oldest distributions of the operating system that is still being maintained. Though it is not known for being easy to install and set up, the distribution has a reputation of being flexible and transparent.

Ian Prior explains the choice of Slackware: "If you go back eight to ten years, Slackware was one of the most stable distributions." Though it may not offer many tools with graphical user interfaces, "for the server-based system, you just wanted something that was extremely stable and would just keep on going." The county council chose Slackware at that point in time, and developed its own applications around it.

Support provider Prior is happy with the choice: "Slackware has proved very, very effective. In all this time, I have had no problems whatsoever with the GNU/Linux software. It just runs 24/7, in quite a hostile environment in schools - it's dusty, dirty, and kids kick things - , and it has run extremely well."

The system's resource requirements are low. The servers are "basically just grown-up PCs", he says, rather than specialised machines. The only problems that occur are related to hardware: "Hard disk failures are the typical issues now. They've been running round the clock for five or six years, so hard disks are starting to fall over."

Prior says that the solution has rarely been upgraded "because it works. It's something of a museum piece, but it just works".

Exim mail transport agent	easy to configure, standards compliant, easy to integrate third-party modules such as virus scanners
Squid cache/proxy server	Internet access from schools runs via the Squid proxy, which stores popular sites and provides them to users, making the most out of limited bandwidth connections. Also makes it possible to filter inappropriate content.
Samba file server	Configured to provide a file-sharing set-up requiring no local administration. Samba accounts are automatically managed by the web administration system.
MySQL database server	Holds extended user information, and enables deployment of Intranet applications needing a database back end.
Apache web server with PHP	Hosts the school Intranet. PHP is used for the web-based administration system, and provides access to thousands of open source web applications, including the chosen webmail package.
SquirrelMail	Webmail application. Additional modules for extended functionality, such as Welsh language support, spell-checking in Welsh and English, calendars, to-do lists, LDAP directories and file management. Mailer modified so that pupils cannot change "From" or "Reply-To" settings.

*Table 1: Key applications on Powys school servers*

According to Prior, the Samba file server in particular has become extremely important especially for the smaller schools, since it provides pupils with a central point to save their work. Since children typically work on a different PC during each lesson, each one of them has to have her or his work available on any of the machines. "Kids from the age of five to eleven have no difficulties whatsoever in finding their work on the server", he says.

The county council's IT staff has developed a web administration system for the servers in PHP. The system lets school staff

- manage users - creating, deleting or suspending users, changing passwords, etc.
- set up email aliases - useful for handling email for "head@..." or "secretary@...", or to support email addresses in the style "Forename.Surname@..."
- manage mailing lists - schools can create moderated lists for groups such as governing bodies, parents, parent-teacher associations
- view logs of email transfers, Internet use, etc. - providing evidence of educational attainment as well as potential misuse
- override normal time limits for Internet access, email deliveries, etc.

The server management system is mostly written using shell scripts and includes a number of scheduled procedures that accomplish configuration changes, software updating and time synchronisation from central servers. They also allow for integrity checking and correction of the

file system and important system files, and perform nightly rolling backup to a second hard drive (other mechanisms were discounted in favour of this approach, which requires no user action in the school). Daily backups are followed by weekly and monthly backups. Backups are held for about three months. This way, in case someone e.g. accidentally deletes an email, it can be restored.

On start-up the system performs comprehensive self-checking and rebuilds all important configuration files. In event of major failure, as long as at least one valid system backup is available, restoration of user data and account settings can be done in minutes by swapping the backup drive to a replacement server.

The school servers interoperate with central network services including

- schools' email hub. Implemented using Exim and Sophos anti-virus, this provides a single point through which all email going to or coming from local school servers is subjected to virus checking, statistical reporting and policy controls
- configuration server. Essentially a database of server profiles. Changes made here are automatically propagated to school servers
- software update service. Using the Slackware package system, we can automatically deploy upgrades or new applications to school servers
- LDAP directory service. Whenever users are added or deleted locally on school servers, details are fed back to a master LDAP directory (using OpenLDAP). This provides a self-maintaining directory of email addresses across all schools. SquirrelMail is preconfigured to search this directory as well as any local address books set up in the school.
- the cache hierarchy. Central proxy servers, also using Squid, provide policy-based controls on school Internet access and the cache hierarchy optimises use of network bandwidth

## Legal issues

None of the people contacted for this case study was aware of legal difficulties related to the solution.

[\[top\]](#)

## Change management

Powys county IT staff undertook a 3-month pilot with two local schools, and made numerous small but worthwhile changes and additions as a result. The main roll-out was undertaken by contractors who provide IT repair and maintenance services to schools.

The new servers were built and tested by Powys IT, then collected and distributed by contractors in weekly batches. The old servers were later returned, and their disks copied to DVD in case anything had been missed. Thanks to detailed planning, the project was completed within the time foreseen. The typical changeover time in each school was less than an hour. This included transferring all user account information from the old to the new servers.

Prior says that users received no training when the solution was deployed, and that this hasn't led to

any problems. All services are accessed through the browser: "It's fairly natural, and intuitive even for the little ones." Only with the Samba server, people had to learn to save their files in their own directories on the server. This involved telling people that they have to use a program's "save as" function, rather than simply "save", which Prior says caused no problems.

After the upgrade, demand for technical support dropped significantly. Although both county IT staff and support contractors had anticipated a flood of enquiries following the changeover, this has not happened - schools have found the new features easy to use.

## Cooperation with other public bodies

Though the solution has been functioning for almost a decade, its impact has remained local. An [article](#) describing the solution and the advantages of free software for schools appeared in the Times Educational Supplement on Oct. 15, 1999.

[\[top\]](#)

## Evaluation

### *Achievements / Lessons learned*

The solution, originally deployed in 1999 and thoroughly upgraded in 2004/05, has provided the schools of Powys county with an extremely stable, adaptable, low-cost IT solution for almost a decade. Both county IT staff and a support contractor confirm that almost all problems the system experienced during that time were due to hardware failures or power outages rather than software problems. Support provider Ian Prior says that "the solution is absolutely right. The hardware is the weak link, not the software". The system works with minimum maintenance, "so much so that [the schools] just take it for granted. It's like the telephone, it just keeps on working."

The solution, even though it is limited to the servers, as well as the in-house knowledge of IT staff have provided the county with a degree of independence from proprietary software suppliers. In the 1999 Times article, Martin Williams said: "The operating system is free, so we are not in hock to Microsoft for Windows NT mail accounts. A massive worldwide community is turning out software. You can post a technical query on the web and in an hour have a dozen replies. All that is for free. Contrast that with the service level agreements you might have with consultants. There is a kind of moral agenda, a commitment to helping each other in a non-commercial environment. There is an ethical strand because the open source community believes in the values that underpin this. It says: there is an alternative; you can go this way; you do not have to go that way."

In 2005, the project won a [UK Linux Award](#) in the category "Public Sector Linux/open source Implementation".

Developing the server solution has deepened the expertise of the county council's IT staff. It increased their experience of Linux as platform, in particular the scheduling and scripting environment, as well as their knowledge of open source applications for mail, web, database, LDAP, and networking applications.

One success factor was the strategy to maintain a clear separation between the desktop and the middleware and back-end systems. This makes it possible to mix and match free and proprietary software with relative ease.

IT procurement has a key role, as standards compliance needs to be written into procurement specifications. In the case of Powys county, these have variously required suppliers to support MySQL, LDAP authentication and browser-agnostic web applications. Procurement has also followed government guidelines, which call for OSS options to be evaluated.

Staff skills are another decisive success factor, since the people involved need a thorough knowledge of the software they are dealing with, and have to know how to find additional information on the web. Yet it is equally important for them to be able to communicate with non-technical users, striving understand their requirements and bringing a “can do” mindset to the task.

### ***Future plans***

Prior thinks that the solution will need a major revision in about two years' time. The present solution, over its life span of seven to nine years, "has done the job very effectively and very cheaply", says Prior.

There are currently no plans to deploy GNU/Linux and other open source software on the schools' desktops. A small pilot using the Ubuntu distribution was run in 2007. Although the software involved turned out to be “extremely stable and effective”, according to Ian Prior, two issues arose. Some educational software was only available for the Microsoft Windows platform. Teachers and students were also afraid of potential interoperability problems between the school computers and the Microsoft-based PCs they were using at home.

### ***Conclusion***

For over a decade, GNU/Linux and open source have helped Powys county deploy technically appropriate solutions where the cost of proprietary software would be difficult to justify for the scale and numbers involved. The open source platform not only helps to provide affordable solutions - it also provides scope to adapt applications to best meet the county's requirements.

In using free software to set up a solution of local servers in schools, connected to a central server, Powys county went down a different route from most other schools in the UK. One factor for this difference is the very rural setting, which requires some creative solutions to deliver cost-effective IT services to the schools. The other is that according to Prior, the county council in 1998 developed a comprehensive plan for the IT infrastructure of the region's schools, while most other local authorities in the UK did this in a piecemeal way.

Although targeted at primary schools, the system has also been deployed in three (larger) secondary schools and performs well with over 1000 users.

During the upgrade of the solution in 2004/05, the county's IT staff and the support contractors achieved a smooth changeover, with schools experiencing virtually no interruption to email and Internet access.

The project has raised awareness of open source software in education. Through its demonstrable



reliability and functionality it has paved the way for broadening the use of open source software in Powys schools, though there is as yet no clear prospect of a GNU/Linux roll-out on the desktop.

Martin Williams commented after the 2004/05 upgrade that “email and Internet access are indispensable to education is no longer in doubt, and this new system provides an excellent facility for both staff and children. Using the system raises children's general understanding of computers, imparting confidence and skills we know they will need in their future lives, specially those that go on to have careers in IT. Those of us responsible for the IT curriculum in Powys schools are convinced that pupils *should* know about and experience open source software. So we are delighted to see how universally popular SquirrelMail has become with its most important users - the children. Its deployment offers those who teach IT skills a natural opportunity to discuss open source, explain its benefits, and explore wider implications of open source in society.”

[\[top\]](#)

## Links

- [Powys County Council](#)
- [Believe it or not there is a PC alternative to Microsoft Windows](#). Article in Times Educational Supplement, 15 Oct 1999.
- Former site of the [National Grid for Learning portal](#), which was closed in 2006.



*This case study is brought to you by the [open source Observatory and Repository \(OSOR\)](#), a project of the European Commission's [IDABC project](#).*

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*This study is based on input from and interviews with Maldwyn Pryse, School Improvement Officer; Nick Talbott, Information & Performance Manager; Steve Partridge, Seconded Practitioner for ICT and IT, all at Powys County Council; and Ian Prior, Director of Ian Prior Computer Services.*