



# Thin Client technology in schools

a summary of research findings





**In 2006, Becta commissioned research into the functionality, benefits, issues impact, on learning and teaching and total cost of ownership involved in implementing Thin Client technology in schools. This included a literature review, a questionnaire to schools using the technology and detailed case studies of 12 schools. This document summarises the findings from that research. A Becta survey of network infrastructure and ICT equipment in schools, conducted in late 2005, found that 5.2 per cent of primary schools and 9.2 per cent of secondary schools were using a Thin Client network<sup>1</sup>.**

## What is Thin Client technology?

'Thin Client' is a generic name for client machines on networks that deliver applications and data via a centralised computing model with the majority of processing carried out by the server(s). This is also known as server-based computing.

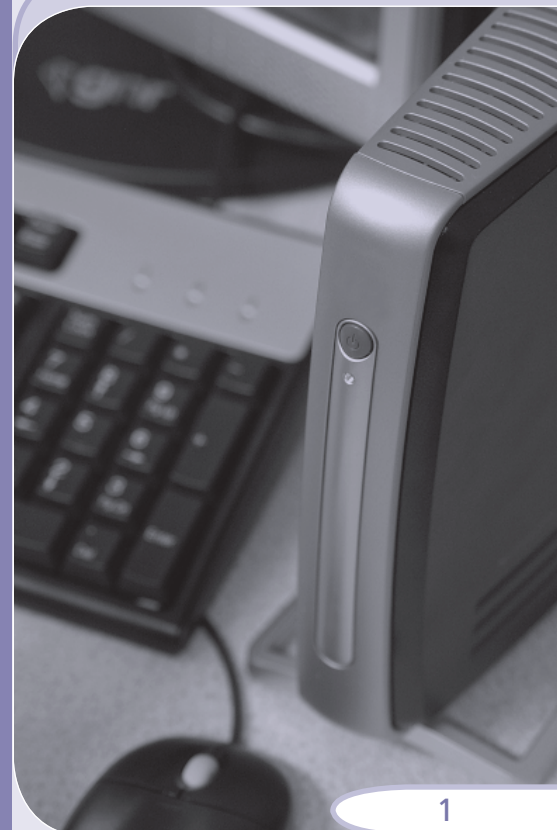
Typically, the Thin Client terminal sends key strokes and mouse clicks to the server and the server sends screen updates to the terminal device.

There is a range of Thin Client devices:

- Bespoke terminals – machines designed specifically to run Thin Client solutions, which often have no hard drive and are built around solid state technologies. They tend to be smaller, lighter, cheaper and more robust than regular PCs
- Tubby Clients – a hybrid between the Fat Client and bespoke terminal, these can accommodate some local applications
- Fat (or Thick) Clients – computers running full operating systems with locally installed applications and storage; they can be configured to run solely as a Thin Client mode or switch between Fat and Thin Client mode, and inbuilt interfaces can be disabled to emulate the 'locked down' status of a bespoke terminal
- Legacy PCs – older PCs whose specification is insufficient to be able to run modern software can often be redeployed in a Thin Client environment.

Thin Clients may include desktops and laptop devices, as well as Personal Digital Assistants (PDAs), and can be deployed to suit a school's needs. Although older bespoke terminals tend not to have ports for attaching peripherals, newer terminals offer this functionality.

There is no single 'Thin Client solution' and functionality and performance can vary with the system implemented.







## Key findings

A range of Thin Client solutions are being used by schools, with considerable variation in functionality and performance. All of the 12 case study schools used a mixture of 'Fat' and 'Thin' clients, either to maintain a separate system for administration, or to overcome limitations of the Thin Client technology. The total cost of ownership (TCO) for project schools using Thin Client compared to those only using fat clients was found to be lower for secondary schools, but slightly higher for primary schools.

### Benefits

- All the schools reported being able to provide more ICT provision for their budget through the use of Thin Client technology, widening access to ICT.
- Schools were able to extend the life of older PCs by re-configuring them as Thin Client devices.
- Centralised management and control meant that Thin Client networks were easy to run and support. Schools reported spending less time per machine supporting Thin Clients than Fat clients.
- Thin client systems were found to be very reliable and secure. The tightly 'locked down' Thin Client terminals helped keep tampering/user created support issues to a minimum.
- The consistent and uniform provision offered by Thin Clients in the schools studied increased teacher and pupil confidence in using ICT; little additional training was needed in their use.
- Thin Clients used less energy and produced less heat and noise than standard PCs, producing a pleasant learning environment.

### Issues

- All schools experienced problems delivering some multimedia applications and content over the Thin Client networks. Multimedia performance varied; newer networks and terminals tended to provide better multimedia support.
- Some software was found to be incompatible with Thin Client networks.
- None of the schools ran interactive whiteboards from Thin Client terminals. Some older bespoke terminals could not support peripherals needed for curriculum subjects.
- Many schools did not run their management information systems (MIS) over the Thin Client network either because of software incompatibility or local authority recommendations.
- Some schools underestimated the demands placed on servers needed to run the network.
- The Thin Client networks studied did not all meet some aspects of Becta's Functional Specification Institutional Infrastructure, particularly with regard to support for multimedia, supportive tools and access to administrative data.

## Research findings

### Reasons for choosing Thin Client technology

Among the case study schools, there was overwhelming agreement on the three main drivers for deciding to implement a Thin Client network:

- Cost: 11 of the 12 schools studied cited cost as a primary driver; they were able to buy a greater number of terminals for their budget
- Increased access: all schools wished to increase access to ICT
- Complementing existing resources: most schools wanted a system which would add to their existing resources, cause minimal disruption and not increase the management and operational costs significantly.

Whilst cost was seen as a prime factor for almost all the schools, other factors also influenced their choosing Thin Client technology over the more traditional networks. Thin Client systems were seen as a good alternative in overcoming the barriers to greater ICT use – lack of access to computers, teachers' lack of confidence with ICT, perceived poor reliability of Fat Client networks, and costs of technical support.

Overall, those interviewed in the schools studied pointed to a number of benefits gained from implementing a Thin Client system; while some benefits could have been obtained from a well managed Fat Client system, the schools studied were convinced that they would not have been possible with Fat client networks.

It is notable that in selecting Thin Client systems, schools largely based their decisions on their own research and advice from system suppliers.

## Learning and teaching

### Greater access to ICT

Schools reported being able to provide more ICT equipment for their budget with Thin Client technology. This enabled schools to place more computers in more locations, giving both teachers and pupils greater access to ICT. Teachers were able to use ICT to prepare lessons and for management tasks, and achieved greater flexibility of working. Where schools provided remote access, this increased flexibility yet further.

Several schools were able to augment their new Thin Client network by redeploying legacy PCs, desktops and laptops. No longer suitable as fully functioning PCs, these could be added to the Thin Client network as terminals, or provide pupils with access to ICT at home. However, some schools reported reliability problems with legacy PCs.

'The ability to deliver Thin Client sessions to low-cost machines has enabled School 11 to deliver an IT experience in the home to financially disadvantaged children who would otherwise have no access to technology outside school. They have enabled this through the use of a highly 'locked down' set of laptop devices through which children can dial up the internet using a school sponsored and funded ISP account. The laptop only enables a secure connection to school resources that will allow basic desktop applications to be used and provide access to the internet for homework research etc.'

(Becta 2006c p35)

'...the computer rooms which have the Thin Client terminals in them are more pleasant to work in because they are cooler and quieter and there is no need to install air conditioning. This creates a more conducive atmosphere for learning to take place. ...the Thin Client terminals took up much less space so that pupils had more room for their other work, such as books and handouts while working at the terminals.'

(Becta 2006c p39)

### **Confidence with ICT**

Increasing teachers' confidence with ICT in general, and the school's network in particular, was a key motivator for all the schools. Generally, schools had found their previous network expensive to maintain and/or unreliable. The varied interfaces and software offered by different computers made teachers reluctant to plan lessons around ICT. Thin Client systems made it easy to provide one consistent interface to users with a standard set of software, so teachers would know what to expect from the network. This, coupled with the network's reliability, gave teachers more confidence to use ICT in lessons.

Pupils' ICT skills were reported to have improved because of more regular and frequent use of ICT enabled through greater provision. Pupils were also able to work flexibly, especially where out of class work (homework and self-study) was concerned because they could access the network from additional locations within school and often at additional times. This also had a positive impact on collaboration between pupils on projects and homework.

### **Better learning environments**

Schools commented on the quieter and cooler environment experienced with Thin Client terminals. Because bespoke terminals have fewer moving parts, use less energy and generate less heat and noise than Fat Clients, they provide an environment more conducive for teaching and learning.

However, schools also reported a range of issues associated with the impact of Thin Client technology on teaching and learning.

### **Problems with multimedia**

All the schools had problems with delivering the full range of multimedia applications and content over the Thin Client network. Schools addressed this problem in different ways: some restricted the number of users of multimedia at any one time, but more often, schools operated multimedia through a Fat Client network. Video conferencing was also generally dealt with via a separate system. Newer networks and terminal were found to be better at handling multimedia, but could still not handle the full range of applications used by schools. These issues produced additional technical and management problems for staff in having to maintain both Thin and Fat Client systems.

### **Difficulties in using whiteboards and peripherals**

Further problems concerned the use of peripherals. Interactive whiteboards were not used on the Thin Client networks in the schools studied, and all were using Fat Client computers so that whiteboards could be used. This created additional management issues for support staff.

Where terminals did not have USB ports, this limited the range of peripherals available, whether it was digital cameras or microscopes, or devices for subjects such as design and technology. While schools reported that newer Thin Client terminals did not present this problem, some had had to overcome it by using Fat Clients instead.

### Software issues

In addition to the cost benefits anticipated from using their existing software, schools were keen to maintain continuity with the new system and enable teachers to use software they were familiar with. In the event, several schools reported that they were unable to run some existing software on the Thin Client system. In some cases, schools had been misinformed about compatibility, whilst in others the problem was caused by having inadequate servers.

It is clear that both system suppliers and software suppliers could provide more information on software compatibility with Thin Client technology.

As noted earlier, problems in running multimedia meant that schools restricted the number of active users at any one time, affecting how it was used in lessons, or operated multimedia through a Fat Client network.

As a result, several schools appeared only to be using software supplied with the Thin Client system, and therefore had access to only a limited range of subject-specific software. The researchers observed that many teachers using the Thin Client networks tended to confine their (and their pupils') uses to the generic software, such as internet, email and office software. This had an impact on the ways in which ICT was being used in the classroom.

## Management and administration

### Centralised management

All the schools found that centralised management and support with a Thin Client network had several advantages. Upgrading or installation of new software could be easier, as it was done centrally on the server rather than deployed on individual Fat Client PCs. Similarly, problems could be more easily identified and fixed centrally covering the whole Thin Client network at once. Technical staff spent little time supporting individual Thin Client terminals.

### Reliability and security

Schools reported that Thin Client networks were highly reliable. Five schools reported 99 per cent uptime on the server, which helped ensure a very consistent resource for teachers and pupils. Thin Client terminals were also reported to be more reliable and less prone to





‘School 11 found that the performance of the Thin Clients is consistently good over wireless technology for standard productivity tools and simple curriculum applications’

(Becta 2006c p24)

problems than Fat Client PCs, because they had fewer moving parts and no installed applications. Several schools reported that the time spent supporting the Thin Client network was less per terminal than the Fat Client network.

Many patches, software updates and other security measures only needed to be applied on the server, protecting the whole network at once. This helped to increase security and reduced the management burden. Security and integrity of the network was also found to be easy to maintain as terminals were ‘locked down’ by default and pupils were unable to tamper with settings. Some schools reported that terminals were less likely to be affected by viruses or other malware.

### Administration networks

Ten of the 12 case study schools reported that they maintained separate administration networks using Fat Client technology. In many cases, schools reported that this was due to local authority requirements, but schools also had problems in running some management information systems (MIS) with the Thin Client network.

## Functionality

The schools studied had difficulty meeting all aspects of Becta’s Functional Specification Institutional Infrastructure<sup>2</sup>. This states, amongst other requirements, that ‘all educators and learners should have access to a wide range of applications that allow the manipulation of text, images (including video), tables and sounds’; ‘Institutions shall ensure that educators and learners have access to a wide range of supportive tools’ and ‘Learners and educators shall be able to access appropriate curriculum resources and administration data from all computers in the institution and from all learning spaces within the institution’. All of the case study schools had to use a Fat Client network to augment the functionality of the Thin Client network in order to run some multimedia. None of the schools ran interactive whiteboards on Thin Client terminals and support for other peripherals was limited in some schools. Many of the schools studied could not run their MIS or access administrative data on their Thin Client networks. However, most MIS now allow access to administrative data through a web browser and this is a requirement of Becta’s ‘Functional requirements for information management including MIS’<sup>3</sup>.



## Costs

### Implementation and support

The case study schools reported that lower costs per terminal enabled greater access to ICT for the budget available. This meant better terminal:teacher and terminal:pupil ratios, which enabled more teachers to use ICT in their lessons. It also allowed teachers to use ICT more frequently in their lessons.

With Thin Client systems, schools found that management and support were simplified and as a result, time spent on technical support had been reduced.

In addition, Thin Client terminals were reported to be very reliable, and easy to replace when they failed. All of these represented a saving in the cost of network management, although it was not easy to quantify as all schools operated a hybrid system. Secondary schools generally did not cut back on staffing for technical support, mainly because they retained some Fat Client estate; they were, however, able to support a larger number of terminals within the same expenditure on staff.

Over half the schools studied made cost savings by using legacy computers; this not only extended the life of these computers, it also reduced the cost of establishing the new network. It should be noted, however, that schools also wished to use legacy machines because they had USB ports and serial ports which, if enabled on the Thin Client network, allowed the use of peripherals. These findings need to be considered alongside the issue of Total Cost of Ownership below.

### Total Cost of Ownership

There was a clear perception in the case study schools that the installation of a Thin Client network reduced their overall ICT costs. Detailed examination of the Total Cost of Ownership – that is, the cost of maintenance, support and staff training, and depreciation of equipment in addition to the initial expenditure – suggested that the picture was more complex.

Figure 1 shows that in the schools studied the TCO per personal computer is nearly 40 per cent less in secondary schools using Thin Client technology than in schools using only Fat Clients only. However, it also shows that in primary schools, the TCO per terminal for Thin Clients is slightly higher than for schools with a Fat Client only system.

Those interviewed in School 7 reported that more money is being spent on software than used to be. The Thin Client equipment lasts so long that money is available from the savings in maintenance and replacement.

(Becta 2006c p38)

**Figure 1**

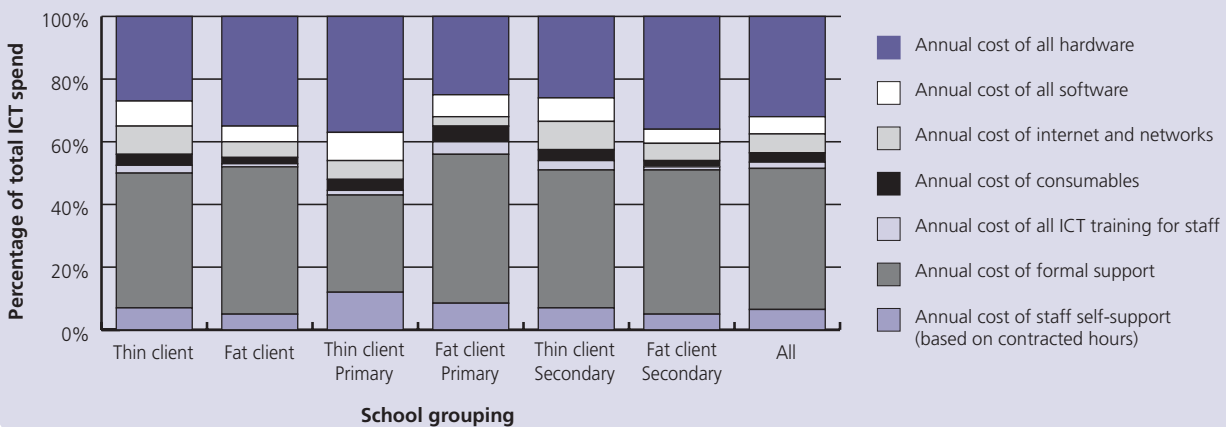
**Breakdown of TCO per Terminal or Personal Computer**



However, the Thin Client primary schools studied spent a lower proportion of their budget on support than the Fat Client primary schools studied. This may be because they outsource their support, and are therefore able to secure what they need at a lower price than if they were to provide it internally. This factor was marginal for secondary schools.

**Figure 2**

**Breakdown of annual ICT costs as a percentage of total ICT spend**



## Lessons learned by the schools

The case study schools suggested the following advice for other schools considering Thin Client technology:

- Visit other schools that have already implemented a Thin Client network and arrange a visit. Use their experience to help shape your own objectives and approach.
- Define clear objectives for what you want: will Thin Client technology deliver this? Can it be delivered in another way?
- Ensure you have appropriate experience on your team, whether this is in-house or external expertise: decision-makers in the school need robust advice. How will technical support be delivered? It is important to ensure that you have the level of support you need so the network works well and is properly maintained.
- Use a structured design process: decide what outcomes you want and ask the people with the appropriate expertise to design your system: effective network mapping needs to take place to see what is required and where to give maximum accessibility and use. Ask a trusted third party to scrutinise the planned design.
- The use of space needs to be considered before the network is installed: a good layout is needed to make full use of the Thin Client system.
- Undertake a full-scale and forward-looking audit of the school's aims and its perceived needs in three to four years' time. Use this to plan how to accommodate changes to the curriculum, and hence the school's ICT need.
- Don't underestimate the capacity of the servers required, both for initial implementation and for future expansion.
- Consider your educational software requirements: not all software is designed to work on Thin Client technology. Check with your intended network provider about the titles you wish to run on it. Ask them to organise a demonstration for you, with the software running on several machines at once, to check its speed when being used by many users.



'Students even come in at 8 am to use the library. It's quite a shock really. Culturally our school has not been one where it's cool to ask questions, do extra homework or be top of the class. Using the Thin Client as a learning aid is breaking down that culture. Pupils learn at their own pace without the social pressures from their peers and we see them concentrating and achieving more because of it.'

(Becta 2006c p42)

### Issues for schools to consider

This research confirms that there is no 'one size fits all' solution for network technology in schools. It is clear that a great deal of research and effort has been put in by staff in the schools to determine what their curriculum and administration needs were and how these could best be met. Great care was then been taken in developing a system that would suit those needs. The vast majority had implemented their Thin Client system successfully and a few had plans for further extension. It should be noted, however, that the researchers did not find any schools that operated wholly through Thin Client technology: all used a hybrid network, offering a mixture of Thin and Fat Client solutions.

Findings from this research suggest that schools considering a Thin Client system should also consider the following issues in their planning:

- Schools consistently reported problems with operating multimedia software and some peripherals such as interactive whiteboards. While Thin Client technology is developing (most terminals now offer USB access, for example), schools should make sure either that technical difficulties have been resolved, or that they can find alternative solutions.
- As with all major ICT implementations, it is essential to consult with staff and pupils in order to achieve a seamless transition. Although inclusion is not necessarily an issue on Thin Client networks, schools need to ensure that their network is able to support pupils with special educational needs in the environments where that help is needed, and with any adaptive technology that they rely on to access the curriculum.
- Consider changing the way the school functions: are there different ways of organising the school which could be supported by a Thin Client network?
- Be aware of the total cost of ownership: the case studies suggest that the total cost of ownership in primary schools may be greater for Thin Client than for Fat Client systems, although the opposite is true of secondary schools.
- Plan for the future: schools found that as the use of ICT became more sophisticated in many subjects, this increased demand yet further, particularly for multimedia use.
- Emphasise the benefits: in the schools studied, greater access and reliability have resulted in improvements in the ways in which teaching and learning are organised which is having a knock-on effect on pupils' behaviour and learning.



## About this research

This summary is based on research carried out for Becta by KPMG during 2006. This consisted of a literature review on Thin Client technology in the UK and elsewhere, and questionnaires completed by 50 schools in England that are using this technology. Detailed follow-up case studies were undertaken in 12 schools: four primary and eight secondary, ranging in size from 270 pupils to 2000. Thin Client networks were used with a variety of operating systems. Schools had had the Thin Client system in place for between one and nine years. All 12 schools operated a hybrid network – that is, a mixture of Thin and Fat Client systems; ten of the 12 schools had separate Fat Client networks for their administration.

The findings from this research are available in two reports:

*Thin Client technology in schools: case study analysis*

*Thin Client technology in schools: literature and project review*

<http://www.becta.org.uk/research/reports/thinclient>

## References

<sup>1</sup> Becta (2006a), *Survey of LAN infrastructure and ICT equipment in schools*

<http://www.becta.org.uk/publications>

<sup>2</sup> Becta (2005) *Functional Specification: Institutional Infrastructure, version A*

[www.becta.org.uk/schools/techstandards](http://www.becta.org.uk/schools/techstandards)

<sup>3</sup> Becta (2006b) *Functional requirements for information management including MIS*

[www.becta.org.uk/schools/techstandards](http://www.becta.org.uk/schools/techstandards)

Becta (2006c) *Thin Client technology in schools: case study analysis*

<http://www.becta.org.uk/research/reports/thinclient>



## Further reading

For more detailed technical information regarding requirements for implementing thin client networks please refer to Becta's Technical specification Institutional Infrastructure

- Becta (2005) Technical Specification: Institutional Infrastructure version B

**[www.becta.org.uk/schools/techstandards](http://www.becta.org.uk/schools/techstandards)**

### Other useful publications

- Becta (2006) *Managing ICT costs in schools: summary*

**<http://www.becta.org.uk/publications>**

This report summarises work done with schools to identify the total costs for ICT in schools. It will enable Head teachers, Local Authority officers and Governors to consider the impact this cost information can have on management investment decisions and developing a strategy for sustainable ICT provision in schools.

- Becta ICT investment planner

**<http://www.becta.org.uk/schools/ictinvestmentplanner>**

This tool can give schools a better understanding of the total cost of ownership of ICT. The tool highlights how the value and cost of ICT changes over time and provides a sound basis for planning future ICT investments.

- Becta's TechNews

**<http://www.becta.org.uk/technews>**

A technology news and analysis service aimed at those in the education sector keen to stay informed about technology developments, trends and issues.



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