

# **Specifying a Caching Solution for K12 Schools**

Appraising the requirements for  
delivering caching

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## Executive summary

*Part of a series of bandwidth management strategy and caching whitepapers, this document appraises the specific nature of K12 web traffic in its current and expected form, and highlights the key considerations for building the necessary specification for effective and appropriate caching for K12 schools and school districts.*

*Recent research sheds light on why there is a pattern of diminishing returns from relying solely on annual bandwidth upgrades to deliver both speed and a suitable return on investment for such capacity increases. This degradation is largely down to the nature of traffic for K12 – which the research shows is quite different from that of an enterprise environment. The differences include:*

- *Demand for bandwidth dramatically peaking above average levels*
- *A vast range of data arriving at the network edge – much of it at very slow speeds*
- *A rapidly emerging imperative for speed in the classroom as K12 implements e-learning.*

### **FCC driving K12 return on investment**

*As a technology, caching turns out to be a perfect counter to bandwidth's diminishing returns. This is because caching:*

- *Accelerates slow classroom content – content that is slow even on multi-gigabit connection*
- *Enables schools to operate on a level of bandwidth sufficient for average lesson demand rather than catering for enormous start of lesson peaks which sees the bulk of capacity investment wasted.*

*Recognizing caching as an essential ingredient in delivering both value and performance in bandwidth management, the FCC included caching in E-rate funding in 2015.*

### **Is caching for schools so different?**

*The particular characteristics of K12 network traffic and educational dynamics differ considerably from those of enterprise or network service provision and thus have a direct impact on the specification of caching solutions for schools.*

*This document details those characteristics for the purposes of informing a proficient specification for service delivery of caching for K12.*

# Cost-effective handling of peak demand

K12 traffic is characterized by very large peaks in demand that come from multiple and simultaneous lesson access and, increasingly, multiple and frequent downloads of operating system updates. In any school district this can involve an array of hundreds of sites and many different device types.

These 'start of lesson' access peaks create two considerations; the ability to handle peaks, and the technological innovations that can reduce those peaks.

## Peaks

Peaks in demand for K12 web traffic typically average around 6-7 times the usual level of demand, and can be 10-20 times on occasion. That massive increase in workload for a cache would naturally coincide with peaks in demand on other network functions such as web filtering, logging, routing and so on.

Reliable caching depends on disk, RAM and processor activity because, to be effective, large numbers of users need to be served simultaneously – and instantly. In order to guarantee peak handling performance the caching function must be able to keep resources readily available for when they suddenly become needed.

## Dedicated appliance versus multi-function

Relying on a multi-function device would risk the cache becoming the new bottleneck in the network if, for example, at the start of a lesson the web filter was consuming all the resources the cache needs.

Purchasing an enormously powerful multi-function device with enough spare capacity to handle simultaneous peaks in demand across all its functions would suffice, but that overblown capacity would be underutilized most of the time, meaning a very low return on investment (ROI).

Opting for a dedicated single function device would provide the necessary resources and deliver significantly higher ROI.

## Pre-fetch and priority content management

Features that enable the fetching of content in advance of a lesson, such as a video or large e-book, mean each student won't waste valuable lesson time downloading it individually.

Being able to spread the download task across off-peak times of day or overnight takes the sting out of start of lesson peaks or inconvenient software updates.

The ability to prioritize content and cache a whole term's worth of material from publishers such as Pearson Education, Rosetta Stone and PBS can slash traffic peaks and congestion in school hours.

# Performance capabilities

Snapshots of traffic from K12 schools across America show a very wide range of sites being accessed from the classroom. This is unlike a business environment where applications are dedicated to single departments, e.g. accounts has one application, sales another. Beyond these core business traffic flows there is typically only personal web-browsing to add to the mix. In this unchanging environment a solution that 'bolts-on' general web caching to a web filter or firewall might suit the levels of performance required.

## More devices, more traffic

As K12 education continues to extend independent learning and 1:1 schemes into every corner of the curriculum, the numbers of devices needed could triple or more in the foreseeable future. Not only will there be more devices, each will be used for an increasing proportion of the school day and week, which means vastly more network traffic.

## Hundreds of websites per school

In just a single school hundreds of sites are in daily use. Each and every site's performance is critical to the teacher and the students they are engaging at that very moment.

## Multi-platform access

A typical school district today supports multiple device platforms - Windows, Chromebooks, I pads, laptops and Macs – as well as all manner of mobile devices - between them downloading a flood of software updates to keep them up and running.

## Keeping pace with change

The K12 internet has become an increasingly complex ecosystem in the last decade and caching solutions now need specialist capabilities. They must be able to cache https content which can account for the majority of a school's web traffic. YouTube, for example, has moved all of its content to secure protocol and other sites are doing the same.

A school needs to be confident that both solution and supplier are dedicated to the evolving school environment; changes in Content Delivery Networks, new providers, new protocols,

increasing use and complexity of dynamic content, video and new software delivery mechanisms – these all need to be harmonized quickly and effectively.

## Appropriate storage

To be able to manage the vast swathes of K12 traffic, any caching solution needs an appropriate amount of storage, but what is appropriate?

Many high schools have a two week curriculum cycle, meaning that all students in a set group will cover roughly the same ground as each other in the same period. Allowing for subject recaps and revision, variable stream progress rates and each individual's respective independent learning speeds, a base estimate of 3 or 4 weeks of content storage would be realistic. That's a significant amount of terabytes even with the leanest content.

When considering content by type of school, a couple of terabytes may be appropriate for an Elementary School, but a large multi-school district with a multi-gigabit internet pipe would need a solution that provides for potentially dozens of terabytes of data storage.

## Growth, additional capacity, scalability,

In an enterprise environment, it's not uncommon for all staff to be employed in computer-based working and to be online at all times. It is unlikely that a significant increase in the number of devices in that environment will be needed.

But, in K12 education, dynamic trends in innovation are demanding a rapid increase in device numbers as text books are replaced by cloud-based resources, and the benefits of independent and online learning extend across the curriculum. With the pre-requisite move towards 1:1 learning, often supported by BYOD and other programs and initiatives, more devices are being used for more of the day, and increasingly for video and other media-rich content.

An investment in a caching solution needs to take all these things into account, otherwise money spent today may need to be scrapped and replaced within an unacceptable timeframe. K12 schools need solutions that provide for additional capacity and that are scalable, so that any investment is still perfectly serviceable 4 or 5 years down the track.

# Operational dynamics

## Ease of use

The schools sector has its own significant challenges in terms of procuring, deploying, supporting and managing increasing numbers of increasingly complex technologies and equipment; and typically by an already stretched technical team.

Adding solutions that are complex to install, or require comprehensive training / knowledge to operate efficiently, is either a drain on existing resources or requires more – more hours or more specialists. A solution that has been developed to enable a technical team to quickly get up to speed with its operation, deploy it with ease and manage it 'at-a-glance' will instead maximize what a school district already has in place.

The time a caching solution consumes is also an important consideration for a single site deployment, but where a clustered solution is needed at a district level, in order to deliver a resilient service to thousands of users, it's even more important.

For very large school districts with dozens or even hundreds of buildings there's an additional dimension to consider; remote deployment.

## Remote deployment

Deploying equipment to remote schools can be a significant challenge in itself. With no technical people routinely on site, the extra costs and inconvenience of sending technicians to each location adds up to a management overhead that will only compound the problem.

When a school district is considering deploying caching appliances to large numbers of schools, they need to select a solution where on-site tech time is kept to a minimum - in both initial deployment and ongoing management. That solution needs to be simple and intuitive, and provide sophisticated but easy-to-use centralized control that delivers comprehensive visibility and reporting functionality.

## Safety, control and reporting

Young people are at the heart of K12 education so there is, by necessity, a more acute focus on safeguarding, control and reporting than in other sectors.

With safeguarding such a high priority today, and tech teams shouldering their share of that responsibility around e-safety, a school needs to be able to rely on a suite of protection features provided by their caching solution. These should include:

- HTTPS interception; the ability to cache secure protocol web content
- Integration with Microsoft Active Directory to translate IP addresses to individual users
- The ability to permanently record who went where and when (permanent logging)
- Google and other search engines' SafeSearch functionalities
- Seamless integration with all existing security regimes and content filters
- The ability for teachers to safely direct students to pre-selected content via a teacher-led portal

# Value proposition for schools

Compared with the corporate world, the considerably lower budgets and resources available to schools require solutions with a whole other level of value performance.

Schools- focused features and capabilities are vital for a school to gain maximum performance and manageability from their caching solution. But above all, it needs to be affordable; school budgets can always be spent many times over; there are always compromises and difficult choices to make.

School districts need their resources to stretch as far as possible and that means achieving exceptional returns at the lowest total price. **Return on Investment (ROI)** and **Total Cost of Ownership (TCO)** are thus central to any solution specification and decision-making.

## Need for exceptional returns

The **ROI** of a caching solution can be measured in terms of:

- bandwidth savings - a directly measurable cost reduction
- speed increases – much faster page-loads in the classroom
- accelerated adoption of internet-enabled learning across the curriculum
- raising the standards of teaching and learning
- the maximizing of existing/planned investment in learning management systems, e-Learning content and obligatory devices

## Considering total cost

**TCO** is a critical factor for schools because they need to be certain that the costs of not just purchasing but operating a caching solution are kept to a minimum. Any solution needs to score highly in both **Capital Expenditure (CAPEX)** and **Operating Expenditure (OPEX)**.

### *Optimizing CAPEX*

- Practical model range; are there appropriate models at the right price points?
- Scalability and hierarchy; suitably-sized for the job in hand. A 300-pupil remote elementary school needs a different model than a 700 pupil middle school, or for several thousand students in a busy high school, or indeed tens of thousands of students through a district hub.

### *Minimizing OPEX*

Many other key factors can have a significant impact on cost performance and should also be considered in any value specification:

- Training costs
- Annual license fees
- Annual warranties and support costs
- Speed and ease of deployment, technical resource requirements
- Product complexity and learning curve
- Ease of administration and management
- Accessible support and guidance
- Resilient product design; fast, easy hardware swap-out.

## E-rate eligibility

With K12 schools and districts currently benefitting from E-rate funding, the need for a dedicated caching solution that qualifies for full E-rate eligibility is essential. This means it should meet not only FCC-specified criteria and be appropriate to the task, but represent excellent value for money.

By ensuring E-rate Cat2 eligibility a small elementary school might pay as little as a few hundred dollars for a suitable schools caching appliance; a large district's funding could be worth hundreds of thousands of dollars, with subsequent savings in reduced bandwidth costs worth several times that figure.

## Summary

This document provides a framework for the proficient specification of a caching solution for K12 schools and school districts.

A schools-focused caching solution must be effective, efficient and affordable in the unique way a school needs it to be. To do this it needs to be:

- a dedicated appliance
- capable of caching HTTPS and continually evolving content
- storage appropriate
- easy to use
- managed centrally
- scalable
- available in a suitable range of models - small school to district core
- 100% E-rate eligible

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We hope this document will help you analyze your own situation as you plan your bandwidth management strategy for the next few years.

Please feel free to reach out to us for help with any further explanation, or for a detailed analysis of your particular circumstances.