

**GUIDANCE DOCUMENT FOR THE PROVISION  
OF  
WIRELESS NETWORK INSTALLATIONS  
IN  
POST PRIMARY SCHOOLS.**

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## PREFACE

This document has been developed to provide advice and guidance regarding Wi-Fi networks in post-primary schools in Ireland. The target audience includes school authorities, school principals, teachers who are involved in the planning, provision and support of Wi-Fi in schools and Design Teams on post primary school building projects

For easy reference the document has been divided into 3 distinct sections;

### SECTION A

- This is aimed at school Principals and teachers and outlines the potential of Wi-Fi to transform teaching and learning and to provide a greatly enhanced learning environment.

### SECTION B

- This is aimed at school Principals and school authorities and those involved in planning, provision and support of Wi-Fi installations in post primary schools and gives guidance on selection and procurement of devices and Wi-Fi equipment.

### SECTION C

- This is a technical section aimed at Design Teams, in particular Building Services Consulting Engineers and those responsible for the design and installation of Wi-Fi installations in post primary schools. It gives specific guidance on the design and make up of Wi-Fi installations appropriate for schools.

**Further advice and guidance also available from:**

**National Coordinator,  
Technology Integration,  
PDST Technology in Education  
<http://www.pdsttechnologyineducation.ie/en/Technology>**

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# **SECTION A**

# 1. INTRODUCTION

## 1.1 SCOPE AND PURPOSE

There is a significant shift **taking place** in post-primary schools where the newer computing devices being introduced by schools for learning are increasingly mobile Wi-Fi devices and not fixed or desktop computers. To support this change, school authorities will need to have suitable and fit-for-purpose Wi-Fi networks in place. This document has been created to provide advice and guidance regarding Wi-Fi networks in post-primary schools in Ireland. The target audience includes school authorities, school principals, teachers and those involved in the planning, provision and support of Wi-Fi in schools. Design Teams on all new school projects, extensions to existing schools projects and refurbishment and upgrading projects should refer to this document for guidance in the design of Wi-Fi Information and Communication Technology (ICT) installations in post primary schools. [SECTION 2, TEACHING AND LEARNING](#) should be of specific interest to teachers.

The document includes:

- Both non-technical (**SECTIONS: A & B**) and technical sections (**SECTION: C**).
- Hyperlinks to the websites mentioned for easy reference.

Wireless networking introduces many new acronyms. A list of the acronyms together with definitions is included in [APPENDIX A: LIST OF ACRONYMS](#).

The document is a working document and will be updated as required.

## 1.2 OVERALL CONTEXT

In the overall schools context two main scenarios apply, though there are variants within each of these scenarios.

### 1.2.1 BUILDING PROJECTS

In the case of a post primary school building project i.e. new school, significant extension to an existing school, refurbishment or upgrade of an existing school, the planning and design development of the ICT infrastructure should include a Wi-Fi network throughout the school based on this document. In the case of a new school, extension to an existing school, refurbishment or upgrade of an existing school the infrastructure i.e. network points and associated wiring only, will be provided as part of the building contract.

The ICT equipment associated with a Wi-Fi installation should be funded from the separate ICT Equipment Budget associated with the building project.

### 1.2.2 UPGRADING OF NETWORKS IN EXISTING SCHOOLS

In existing post primary schools where a new or upgraded Wi-Fi network is being considered the scope and extent of the works involved could include upgrading from an existing Wi-Fi network to a more comprehensive Wi-Fi solution based on this document.

In view of budgetary pressures the Department of Education and Skills (DoES) currently has no new ICT Infrastructure Grant Scheme in place to assist schools in the funding of these works.

## 1.3 WHAT IS A WI-FI NETWORK

A Wi-Fi network enables teachers and students using Wi-Fi enabled devices, such as laptops, tablets, smart phones or other Wi-Fi devices to connect to the school computer network without needing a network cable. Wi-Fi networks consist of a combination of wired and Wi-Fi elements. Schools generally have a fixed computer network in place already connected to the Internet, as well as services such as printing, and file sharing, and Wi-Fi networks connect into this network, to provide one integrated network to users. Wi-Fi networking is being deployed in schools around the world. The extent to which Wi-Fi networks are implemented varies widely, from small ad-hoc access in parts of some schools, to



schools that have a school-wide Wi-Fi network. Wi-Fi is a shared medium in that user devices share frequency channels to communicate. As such, it requires careful planning for dynamic usage patterns and capacity variations. The Wi-Fi network needs to have the capacity to handle a dynamically changing load throughout the school day.

## 1.4 HOW ICT CAN SUPPORT LEARNING

Wi-Fi networks used to support the use of mobile learning devices in schools have the combined potential to support, enhance and transform learning. In recent years there have been advancements in our understanding of how learning takes place, as well as our understanding of pedagogy and knowledge construction. As a result there is now a greater emphasis on student centred learning, and a greater acceptance of the diversity of student learning styles. It is generally accepted that using ICT improves student motivation for learning, enhances engagement, and has the potential to improve conceptual understanding. Specifically the combination of Wi-Fi networks and better access to student devices facilitate mobile and flexible access to a range of resources which were not accessible heretofore. Wi-Fi access will help to reduce demand for computer rooms, and free up computer room use for specific activities such as Computer Aided Design (CAD) which requires a specific combination of technologies in one area. Improved Wi-Fi access provides new opportunities to increase access to online resources for learning throughout the school which in turn facilitates anytime, anywhere learning.

- Wi-Fi connectivity for staff and student devices is being seen as essential in more and more schools. As the number of computing devices increases to one (or more) per student in the coming years, Wi-Fi networks will become critical to delivering high quality online content and real-time data
- Wi-Fi networks which worked in the past for a small number of mainly teacher Wi-Fi laptops will no longer be able to support increasing demand, and will need to be replaced or upgraded
- Schools don't have the luxury or funds to invest in Wi-Fi solutions that are not fit-for-purpose and instead require scalable solutions that can be developed as student demand grows

## 1.5 KEY TECHNOLOGY SHIFTS

In addition to improvements in Wi-Fi networking technologies there have been significant positive shifts to support learning in other technology areas including broadband, cloud based applications and computing devices. In a school scenario, there are strong linkages between Wi-Fi networks, broadband and the increasing use by schools of cloud based applications. Introducing a Wi-Fi network to support and connect a large number of teacher and student devices will inevitably generate greater levels of traffic and demand on the school broadband connection. As the range of cloud based applications grows there is greater demand on both the Wi-Fi network and on the broadband connection. As they are both situated between the user and the cloud based applications being used, they need to be as effective as possible in delivering data and content across the network. The 100Mbit/sec fast broadband programme for post-primary schools is critical in facilitating this to take place, especially as the number of student devices in schools increases in the coming years.

## 1.6 TABLET COMPUTERS & HYBRID DEVICES (WI-FI ONLY DEVICES)

The introduction to the market of the first tablet computing devices, in 2010 provided schools with a new and significant alternative to both desktops PCs and more conventional laptops. Unlike previous laptops these devices typically do not have a physical 'LAN port' as they are designed to operate using Wi-Fi. Tablet computing devices bring a significant number of new and additional attributes to the learning experience. These lightweight, touch screen tablets, can be turned on instantly, are highly portable and their multi-function capability is effective in supporting a range of student-centred learning activities both within and outside of the classroom. Their range of capabilities including "instant-on" and extended battery life means that tablets can be used without any start-up delays in a wide variety of situations throughout the school day. This facilitates their use in areas where ICT might not have been considered before. This coupled with their Wi-Fi capability provides them with the potential to be a more effective computing device for learning than previous computing devices. In addition to tablets, hybrid computing

devices, which include many of the features of tablets while retaining some features similar to laptops, may be relevant to schools.

## 1.7 POTENTIAL BENEFITS OF WI-FI NETWORKS

Wi-Fi networks have the potential to deliver educational benefits to support teaching and learning in a number of ways in schools. They can help to facilitate classroom situations which are more supportive of a student centred active learning model. The main benefits are:

- More flexible access to learning opportunities and online resources for teacher and student via mobile Wi-Fi devices (tablets, laptops, hybrid devices, net books, etc.)
- Teacher tablets can wirelessly share their tablet screen on the classroom digital projector (or an interactive flat screen if this was the preferred display) using the school wireless system
- Teachers can access and incorporate e-Learning curriculum relevant resources into lessons on a regular basis
- Students will be given more opportunities for mobile, flexible e-Learning, including access to curriculum relevant resources with guidance of the teacher
- Students experience e-Learning activities regularly
- Wi-Fi coverage can be extended to areas which are difficult or expensive to cable. Examples include older buildings, remote buildings, temporary classrooms, open plan areas such as halls and libraries, and outdoor areas
- Visitors to the school can be provided with internet access

## 1.8 EXPOSURE TO ELECTROMAGNETIC FIELDS

The DoES has sought the opinion of the Department of the Environment, Community & Local Government (DoECLG) on exposure to electromagnetic fields in schools.

The DoECLG set up an Expert Group to report on the Health Effects of Electromagnetic Field and they reported on this in 2007. The Expert Group examined in detail the scientific evidence relating to the potential health effects of electromagnetic fields. The conclusions of this report were accepted by the then Government.

The report concluded that the weight of scientific evidence currently available shows no adverse short or long-term health effects from exposure to the radiofrequency signals produced by base station transmitters on Wi-Fi systems. There is also no scientific evidence to date that exposure to the non-ionising radiation limits established by the International Commission for Non-Ionising Radiation Protection (ICNIRP) is damaging to health.

Refer to [APPENDIX B: LETTER FROM DEPARTMENT OF THE ENVIRONMENT, COMMUNITY & LOCAL GOVERNMENT](#) for copy of correspondence.

## 2. TEACHING & LEARNING

### 2.1 CONTEXT

The introduction of always-on Wi-Fi Internet (Wi-Fi) and tablet computers to the classroom provides teachers, subject departments and schools with the potential to transform teaching and learning and to provide a greatly enhanced learning environment.

This technology has similar potential outside the formal classroom, in social areas, in the library and generally in the environs of the school, where students can be encouraged to learn independently or collaboratively in a more autonomous context.

ICT embedded in the curriculum can serve to engage and motivate children in the learning process. It has proven to increase students' self-esteem and creates a more positive disposition towards learning as well as providing teachers with more up to date, exciting and relevant ways of presenting and engaging with the curriculum. ICT can act as a catalyst for peer teaching and learning and is hugely powerful in the development of team-work, higher order thinking skills and a collaborative learning and teaching environment. The use of new technologies can have a positive impact on teaching and learning. ICT is currently used as a resource which aims to support learning and teaching across every area of the curriculum. Digital literacy skills are acquired and developed as part of this process. Strategies for sourcing and selection of content are essential for students in making informed choices and decisions as they creatively engage with digital media.

The potential of this technology can be realised only through careful planning at each level in the school. Those who embrace the School Self-Evaluation (SSE) approach for the introduction and review of Wi-Fi ICT will be most successful in deriving full benefit for students.

Central to success is the extension of proven teaching and learning approaches to include the effective use of well-chosen Wi-Fi devices and applications. The use of Wi-Fi technology can support and enhance learning and teaching, can facilitate students in working collaboratively and can provide and enhance opportunities for independent learning. Thus, to a great extent, the aim is integration of the technology into established proven methodologies and the development of sound pedagogical approaches to enhance student learning.

Schools and practitioners will be most effective where they stay in close contact with evolving innovation in teaching methodologies, in particular by taking full advantage of the guidance of the support services and staying abreast of the extensive literature available on the choice of applications and the use of Wi-Fi in the classroom.

The Teaching Council recognises the need for teachers to have the necessary digital skills to embrace the new technology. The [“Policy on the Continuum of Teacher Education”](#) identifies ICT as a priority in initial teacher training. It states that there should be “an increased emphasis on the key strategic priorities of literacy and numeracy, ICT and inclusion”.

The [Programme for Government](#) makes literacy, including digital literacy a national priority and furthermore it prioritises the integration of ICT in teaching and learning across the curriculum. The [National Strategy for Literacy and Numeracy among Children and Young People 2011-2020](#) acknowledges that literacy includes all forms of written and printed communication from handwriting to digital literacy and that literacy skills are developed not only in language lessons but in every subject. The Strategy sets out to improve attitudes and outcomes to literacy and numeracy and includes actions to improve the development of teachers' skills.

The definition of Literacy includes the capacity to read, understand and critically appreciate various forms of communication including spoken language, printed text, broadcast media, and digital media. In each of the eight key skills that form part of the [Framework for Junior Cycle](#) there is an element that is related to digital literacy:

KEY SKILL	ELEMENT
MANAGING MYSELF	Using digital technology to manage myself and my learning
STAYING WELL	Being responsible, safe and ethical in using digital technology
COMMUNICATING	Using digital technology to communicate
BEING CREATIVE	Stimulating creativity using digital technology
WORKING WITH OTHERS	Working with others through digital technology
MANAGING INFORMATION AND THINKING.	Using digital technology to access, manage and share content
BEING LITERATE	Exploring and creating a variety of texts, including multi-model texts
BEING NUMERATE	Using digital technology to develop numeracy skills and understanding

Currently as part of the Junior Cycle Framework, a short course in Digital Media Literacy has been developed by the National Council for Curriculum Assessment (NCCA), which includes topics such as My digital world, Following my interests online, Checking the facts and publishing myself. A short course in Coding has also been developed.

Refer to [Junior Cycle Section](http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Junior_Cycle/) on the NCCA website for information on developments in these areas i.e. [http://www.ncca.ie/en/Curriculum and Assessment/Post-Primary Education/Junior Cycle/](http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Junior_Cycle/)

## 2.2 SCHOOL POLICY

School policy on ICT use will need to be reviewed and updated as necessary. The educational goals which underpin the development of Wi-Fi ICT will need to be made explicit in this policy. Clearly where existing policy precludes the use of devices that connect to Wi-Fi networks this will need to be addressed, taking all relevant factors into account, to arrive at a policy that will support and encourage innovation in the use of Wi-Fi in the classroom and in the school generally.

## 2.3 PLANNING

### 2.3.1 PLANNING AT WHOLE-SCHOOL LEVEL

Top-level planning needs to consider the resources needed, both physical resources and a knowledgeable, confident and competent staff, and how these are to be provided. Wi-Fi and tablet computer usage and applications are evolving very rapidly and teachers need to be able to respond, as their students do, to new trends in order to derive full benefit.

Eight principles underpin the [Framework for Junior Cycle](#):

- *Quality*
- *Wellbeing*
- *Creativity and Innovation*

- *Choice and Flexibility*
- *Engagement and Participation*
- *Inclusive Education*
- *Continuity and Development*
- *Learning to Learn.*

These principles will inform the planning for, as well as the development and the implementation of Junior Cycle Programmes in all schools.

Planning for the use of Wi-Fi ICT in the post-primary school is not separate to planning for teaching and learning but is integral to it. At whole-school and at subject department level, goals need to be set that are specific, measurable, attainable, relevant and time-bound in line with accepted good practice. Planning for Wi-Fi ICT, to be effective, should form an integral part of school planning and SSE and should be considered in the context of the overall effectiveness and success of the school in meeting the needs of students. Whole-school planning for Wi-Fi ICT drives planning at subject department level.

### **2.3.2 PLANNING AT SUBJECT-DEPARTMENT LEVEL**

The use to be made of Wi-Fi ICT needs to feature in planning for teaching methodologies at subject department level. The professional sharing of individual practitioners' experience of the technology, and of approaches that were particularly successful or particularly unsuccessful can help to keep the subject teachers up-to-date and to provide a valuable forum for constructive discussion. Agreed approaches and practices included in the subject plan can provide a basis for review and further improvement.

The most effective uses of Wi-Fi ICT may vary in individual subjects and this aspect of planning is best dealt with in the context of subject department and lesson planning. Lesson planning by the individual teacher provides for effective use of the technology by students.

As with other aspects of subject planning, decisions with regard to the use of Wi-Fi in lessons need to be appropriate to the age and level of the students. More advanced students can be provided with tasks that are suitably challenging and they can create portfolios of work at a level that is suitably testing to maintain their interest and to bring about high quality of learning.

## **2.4 TEACHING APPROACHES**

Mobile technologies are redefining what constitutes a learning space, one that is no longer fixed in time but based on connecting people with each other and information is shared through virtual collaborative spaces and communities. This supports anytime, anywhere learning and the facility for learners to access resources at will. Learning can become much more personalised and students can learn in ways that were impossible in the pre-tablet era.

Purposeful access to ICT across the curriculum that motivates and increases engagement and achievement in education will be essential in preparing students for the future. Research indicates that under the right conditions, the use of mobile devices in schools can significantly enhance learning outcomes and support creativity and digital literacy skills. Mobile devices provide the opportunity to access a wealth of resources and information that can support a variety of learning styles and student autonomy in learning. These devices allow the student to document, edit and create through, for example, the use of inbuilt cameras, microphones and dedicated apps.

Wi-Fi ICT will support the use of mobile devices for learning across the entire school. Wi-Fi enabled devices can free teachers from the restriction of leading from the front of the class. Teachers may wish to experiment with different classroom layouts for different scenarios: group work, class discussion, practical activities etc.

Mobile technology, including tablets as an educational tool, has a role in learning and teaching:

- Teachers have identified significant benefits in reducing their workload
- Levels of collaborative work have improved
- There have been significant cost savings on photocopying for schools

- Students are more motivated when using tablets/mobile devices
- Teachers and students found tablets easy to use
- Mobile devices support creativity
- Supports critical thinking, problem solving, decision making, and research and information fluency

Good teaching, including the use of Wi-Fi ICT, engages students in a series of activities that provide opportunities for a wide range of experiences that include collaborative learning, independent learning and personal reflection. The use of technology is integrated into lessons to provide variety, not replacing other proven and trusted methodologies but supplementing them to further enhance learning. Computer applications or apps are chosen that encourage student initiative, activity, creativity and motivation. Wi-Fi activities are differentiated to meet the varying needs and interests of students. Where appropriate, students are encouraged to explore the further use of the technology and to share their findings with the teacher and the class. Student motivation may be provided through game-play and internal reward, for instance by achieving positive outcomes by completing a level in an appropriate educational game. Electronic portfolios of work, compiled as students complete tasks over time, provide a good means of assessment while furthering student motivation.

## 2.5 WI-FI ICT, JUNIOR CYCLE REFORM & INNOVATIONS AT SENIOR CYCLE

The implementation of the [Framework for Junior Cycle](#), launched in October 2012 and for implementation in schools on a phased basis, will enable post-primary schools to provide a quality, inclusive and relevant education with improved learning outcomes for all students, including those with Special Educational Needs (SEN). The new junior cycle in post-primary schools seeks to improve learning experiences and outcomes for students. Increased use of Wi-Fi ICT provides an ideal opportunity to further this aim. Three of the eight principles underpinning the [Framework for Junior Cycle](#) in particular call for further development of collaborative and independent learning opportunities for students,

- Creativity and Innovation
- Engagement and Participation
- Learning to Learn

This is to be achieved while addressing the 24 statements of learning. These statements describe what students should know, understand, value and be able to do at the end of Junior Cycle, having fully engaged with and participated in the Junior Cycle Programme of their school. The final statement of learning: *The student uses technology and digital media tools to learn, communicate, work and think collaboratively and creatively in a responsible manner* is particularly relevant, encompassing a wider context in which Wi-Fi ICT is an integral part of effective methodologies in teaching and learning across the curriculum.

Literacy and numeracy proficiency is fundamental to a student's development right across the curriculum and across the other key skill areas:

There is a Transition Year option in relation to "[Having Fun with Computer Programming and Games](#)" which was launched in January 2012 and is being expanded nationally. The Senior Cycle curriculum explicitly supports the central role of self-directed learning, a spirit of enquiry, critical thinking and problem solving. Recently revised syllabi contain references to the student as a researcher. This requires the skills to analyse a range of data to make judgements based on the student's research. Such an approach is, in reality, at the heart of good practice in quality teaching and learning. The roll out of the "[t4 Initiative for the Technology Subjects](#)" in post primary schools has seen very significant engagement by students in digital literacy, digital numeracy and visual literacy through the use of Computer Aided Design (CAD) programmes.

# **SECTION B**

## 3. GUIDANCE FOR SCHOOLS

### 3.1 OVERVIEW

The section addresses six main areas namely:

- General Wi-Fi Network Considerations
- Pre-procurement Planning Stage
- Procurement Stage
- Implementation and Installation Stage
- Post-installation Management and Support
- Energy saving in ICT

### 3.2 GENERAL WI-FI NETWORK CONSIDERATIONS

This section covers the following areas:

- New Challenges Introduced by Wi-Fi Networks
- Communications with Stakeholders
- Selecting Mobile Devices and Ownership Models
- Centralised and Distributed Wi-Fi Architectures

#### 3.2.1 NEW CHALLENGES INTRODUCED BY WI-FI NETWORKS

Along with the potential benefits associated with Wi-Fi enabled mobile devices for staff and students there are a number of new challenges. These include:

- Management of Wi-Fi system itself
- Establishing levels of user access to management, staff and students
- Managing the additional mobile devices for teachers and students (tablets, laptops etc.)
- Managing access to online digital resources
- Increasing dependency on broadband internet access
- Classroom management issues
- Monitoring student usage
- Resolving any technical or other related issues

#### 3.2.2 COMMUNICATIONS WITH STAKEHOLDERS

In order for all school stakeholders (teachers, parents, students, management etc.) to be part of the decision making process on whether a school makes a fundamental change to engage with “Wi-Fi and Mobile Learning” it is essential to develop an engagement and communications plan. The objective of the plan should be to ensure that the overall objectives, benefits and challenges are clearly outlined, understood, and accepted by all parties.

#### 3.2.3 SELECTING MOBILE DEVICES AND OWNERSHIP MODELS

Putting in place a fit for purpose Wi-Fi network is one essential part of the solution. The other key aspect involves selecting the type of mobile learning devices which are to be used by teachers and students in the school. The main decisions to be made include:

- The type of devices to be deployed to help meet the learning objectives and outcomes. There are a range of providers available.
- The model of ownership to be used in terms of who owns the devices for teachers and for students for example :
  - One mobile device (tablet, laptop, hybrid etc.) for every teacher
  - A school owned set of mobile devices to be used as a shared resource



- One device per student (1:1)
- Pupils bringing their own devices (BYOD), which may include smart phones
- A variation of these options

The extended battery life of tablet devices should also be taken into account when selecting suitable devices.

For additional information on selecting mobile devices and ownership models refer to [Computing Devices/Tablet Section](#) of the PDST Technology in Education website i.e.

<http://www.pdsttechnologyineducation.ie/en/Technology/Computing-Devices-Tablets/>

### 3.2.4 CENTRALISED & DISTRIBUTED WI-FI ARCHITECTURES

There are a number of different WLAN architectures and the location of WLAN management, WLAN controller and access functions can differ between the different architectures. Management and control functions can be externally hosted or cloud based, on an on-site controller, distributed on local Access Points or in a hybrid of these models. Older systems where each AP acted independently are not suitable for schools and as such are not discussed here.

There are currently two main approaches or architectures used by the companies who design and build modern Wi-Fi networks, namely centralised and distributed.

In centralised WLANs, functionality or intelligence such roaming, authentication, encryption/decryption, load balancing, Radio Frequency (RF) monitoring, and performance monitoring are controlled by a Wi-Fi controller which in turn controls the Access Points (AP) in the Wi-Fi network.

In a distributed approach, the functionality or intelligence of the Wireless System is distributed among the APs themselves.

Access points within centralised systems contain relatively less intelligence and take instructions from their wireless controller, while APs within distributed systems contain relatively more intelligence and act with other APs to control the system. This is a critical area and schools are advised to seek independent advice e.g. from PDST Technology in Education, as part of their decision making process.

#### CONTROLLER - LOCAL OR CLOUD-BASED

The location of the controller can differ. Some providers use a local controller while others use a cloud based model. Some providers have different models available depending on the customer requirements.

Functionality performed by a centralised controller handles roaming, authentication, encryption/decryption, load balancing, Radio Frequency (RF) monitoring, and performance monitoring. As configuration is managed by the controller, and is standard across APs, adding additional APs for new areas or to support additional computing devices is relatively simple.

This kind of network can be characterised as follows:

- To maintain the health of the network, the controller can reconfigure AP parameters as needed, providing a self-healing WLAN (e.g. if an AP fails, neighbouring APs can increase signal strength to make up for the lost coverage of the failing AP)
- The Wi-Fi LAN controller performs tasks such as configuration control, fault tolerance and network expansion
- Support for Power over Ethernet (PoE)

As Wi-Fi LAN deployments continue to grow larger, accommodating ever greater numbers of users, there will be an increasing demand to manage a wide range of security, performance and configuration attributes as a single system from a single dashboard or software interface.

A modern fit for purpose WLAN offers many benefits, including:

- Centralised management facilitates ease of deployment and ongoing management
- Greater flexibility - it is easier to respond in real-time to changes in the network performance and spikes in user demand such as new students or temporary staff
- Fast client roaming between APs

- Enhancements in Quality of Service (QOS) ensure better performance and reliability for more demanding applications such as video streaming and voice communications [over Voice over Internet Protocol (VoIP)]

WLANs pose management challenges which are very different from those of wired networks. These challenges increase as WLANs grow in size, scope and complexity. The recommended WLAN strategy for schools is to automate as many of these wireless operational functions as possible and suitable wireless systems are well capable of operating in this manner.

### 3.3 PRE-PROCUREMENT PLANNING STAGE

This section covers the following areas:

- The Importance of Planning
- Planning for Wi-Fi Summary Process
- Summary Procurement Steps
- Procurement Related Challenges with Wi-Fi Networks
- Planning Considerations
- Costs of School Wi-Fi

#### 3.3.1 THE IMPORTANCE OF PLANNING

As with most critical decisions, proper planning is of the utmost importance. A WLAN deployment is no different. This section is meant to help schools go through the decision making process of procuring a Wi-Fi solution.

#### 3.3.2 PLANNING FOR WI-FI SUMMARY PROCESS

The plan to introduce Wi-Fi should be aligned and integrated with overall school priorities for improvements in learning outcomes. The PDST's 'e-Learning handbook' and 'e-Learning Roadmap' planning processes are available in the [Planning Section](http://www.pdsttechnologyineducation.ie/en/Planning/) of the PDST Technology in Education website <http://www.pdsttechnologyineducation.ie/en/Planning/> to assist schools in this area.

#### 3.3.3 SUMMARY PROCUREMENT STEPS

The main summary procurement steps specific to Wi-Fi include:

- Review this guideline document
  - As part of the DoES Reform Initiative the Schools Procurement Unit (SPU) was set up under the Shared Services Plan 2014-2016. It is hosted by the Joint Managerial Body (JMB) and seeks to support all schools in procurement matters. The Schools Procurement Unit (SPU) acts as the central coordinating function for procurement for all schools in the primary sector, all voluntary secondary schools, special schools and schools in the Community and Comprehensive (C & C) sector (including special schools and excluding schools under the remit of ETBs). The SPU has a central role in communicating procurement requirements and opportunities to schools, driving and measuring compliance to central contracts and managing procurement data across the school sectors. Visit their website for further advice and guidance at <http://www.jmb.ie/school-procurement>
- A Wireless Framework for Schools including a number of suitable wireless solutions from different providers will be in place in May 2016. For more details go to <http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/>
- Develop a summary outline plan for Wi-Fi deployment in the school
- Consult with stakeholders on the plan (teachers, students, parents, Board of Management)
- Where possible it is advisable to contact or visit other post-primary schools who may already have successfully implemented a Wi-Fi solution
- Develop a more detailed plan. Include items such as objectives, benefits, challenges, project plan, costs, etc.) to be shared with stakeholders

- In the absence of a suitable Wi-Fi framework tenders should be invited from a minimum of 4 or 5 companies so as to have a good spread of provider responses to help achieve best value for money
- Evaluate responses (for guidelines on evaluating responses from providers refer to the [Technology Section](#) of the PDST Technology in Education website i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/> )
- Award contract to successful tenderer
- Installation and on-going support

### 3.3.4 PROCUREMENT RELATED CHALLENGES WITH WI-FI NETWORKS

The Wireless Framework for Schools has been put in place to address the following challenges facing schools who are considering purchasing a Wi-Fi network. The main ones are listed here:

- There are a range of Wi-Fi solutions available from providers, however not all are suitable and fit-for-purpose for schools
- Wi-Fi networks are relatively new in schools, and as requirements and standards are still evolving, selecting a system that is future-proofed for the foreseeable future is critical for schools
- Wi-Fi networks are very different from fixed networks and as such there is a deficit of high quality expertise and guidance available
- The Wi-Fi requirements for post-primary schools are significantly different and more demanding than the requirements in business, home and other solutions.
  - The large number of students and associated student devices that need to be supported in relatively small areas
  - The degree of movement among students and staff that takes place in a school is very high, given that in general most users move to a different location in the school every 40 minutes. The timing and simultaneous nature of this movement (i.e. on the bell) does not have an equivalent in office/business/ home and as such this factor alone makes schools the most demanding environment to support
  - Some 'industry sector' solutions are not suitable (e.g. Wi-Fi for a large warehouse may have a wide coverage but be only required to support a small number of users)
  - There is a deficit of truly independent advice as some advisors may have associations with specific Wi-Fi vendors/manufacturers
  - Only scalable Wi-Fi solutions are recommended as fit-for-purpose for schools as more student devices will need to be supported over the coming years

As such many Wi-Fi providers may not have sufficient experience of successfully implementing Wi-Fi in schools.

### 3.3.5 PLANNING CONSIDERATIONS

When planning a Wi-Fi network to deliver educational outcomes for a school, the requirements should be carefully defined. Asking the question, "what do we want to deliver by installing a Wireless Local Area Network (WLAN)" and then breaking this down into specific questions will greatly assist a school in identifying important factors. A comprehensive and clear set of requirements will assist with both the product and provider selection process.

The planning factors to consider include the following.

#### 3.3.5.1 WHO

Which members of the school community will use the Wi-Fi network? Some options might be staff only, groups of shared mobile learning devices and laptops, certain student year groups, or for all students. Will guests and visitors to the school be catered for? Should there be separate sub-networks available for different types of users e.g., staff, students, guests etc.

#### 3.3.5.2 WHERE

What areas of the school need to have Wi-Fi? Are outdoor areas included? Will the whole school campus be completed or will it be a staged approach? A site plan of the whole school and floor plans for

buildings (to scale) are useful planning tools and will be required for the WLAN design. What are the school's future plans for growth e.g. student numbers/new buildings over the next five years?

### 3.3.5.3 HOW MANY

Understanding the location and density of users on a WLAN is critical to proper planning. It is essential to define not just the total number of users expected on the Wi-Fi network but where they may be located (e.g. if high density Wi-Fi network coverage is required for certain areas like the PE hall, assembly areas). What are the school's plans for growth in student and teacher numbers over the next five years? Given that teachers and possibly some of the more senior pupils may have one or more devices, such as tablets, smart phone or the other device in the future one cannot assume only one device per person.

### 3.3.5.4 WHAT TYPE OF DEVICES

Having a good understanding of the types of devices the network needs to support is important (tablet, laptop, hybrid device, net book, smartphone etc.). It may be that a school develops a policy of supporting a select number of different types of school owned client devices including laptops or it may consider a **Bring Your Own Device (BYOD)** policy in the future. For more information on selecting appropriate teacher or pupil computing devices refer to the [Computing Devices/Tablets Section](#) of the PDST Technology in Education website i.e.

<http://www.pdsttechnologyineducation.ie/en/Technology/Computing-Devices-Tablets/>.

### 3.3.5.5 AREAS/BUILDINGS REQUIRING WI-FI

Careful consideration should be given to the areas requiring Wi-Fi. It is important to clearly identify areas where Wi-Fi is essential (such as Priority 1 areas for teaching and learning, staffroom, classrooms, laboratories, workshops etc) and other areas which might not be as critical initially, and which might be considered at a subsequent expansion phase. Take temporary or remote buildings into account also.

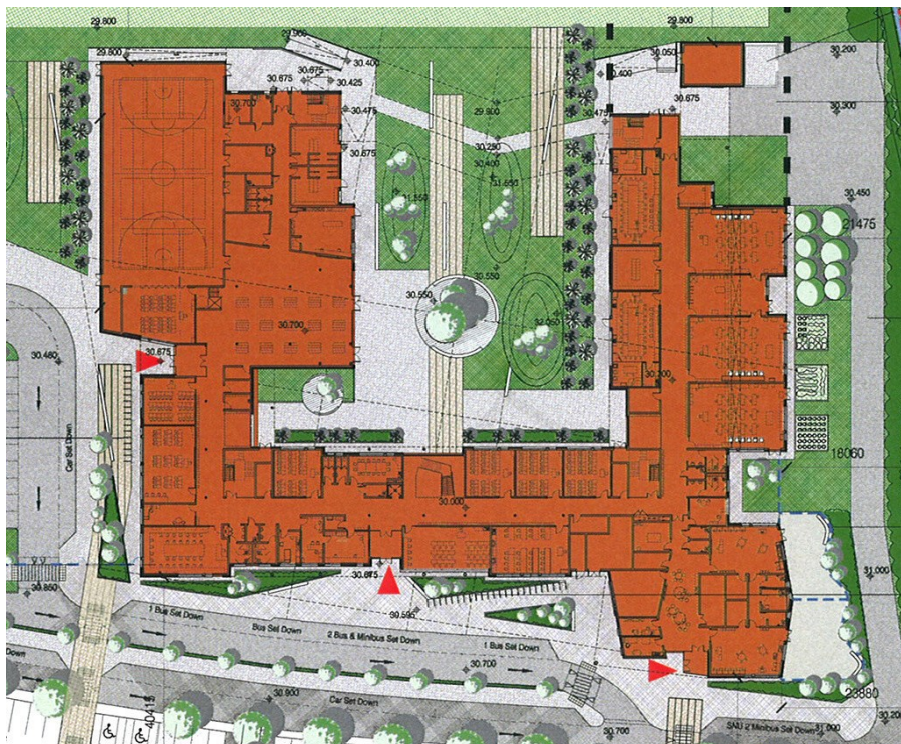


Figure 1: Typical ground floor plan of a large post primary school.

### 3.3.6 COSTS OF SCHOOL WI-FI

Costs will vary depending on a number of factors such as size of school, type of school building and building layout, age of building, thickness of walls, existing fixed infrastructure including cabling and existing network switching infrastructure.

When considering Information Technology (IT) investment, all costs need to be included, *such as* the up-front investment and on-going costs.

Wi-Fi deployments in schools can vary greatly depending on the requirements of each school. Establishing the 'total cost of ownership' in this way will minimise unforeseen expenses and complications. When budgeting for Wi-Fi technology the following factors should be quantified. These should be captured and included in the procurement process.

- Equipment Costs for Wi-Fi Controller and *Wireless* APs
- Licensing and Software Support/update Costs
- Design and Installation Costs
- Cabling (if required)
- Training Costs

### 3.4 PROCUREMENT STAGE

This section covers the following areas:

- Guidelines for Procuring ICT Equipment & a Wi-Fi Network
- Site Survey
- Other Points for Consideration

#### 3.4.1 GUIDELINES FOR PROCURING ICT EQUIPMENT & A WI-FI NETWORK

The procurement of ICT equipment in a school building project is the responsibility of the school and should be managed by the school in accordance with the requirement on the equipment grant allocation. It shall not form part of a building contract itself.

For advice on selecting suitable ICT equipment including procurement of that equipment refer to the [Technology Section](#) of the PDST Technology in Education website i.e.

<http://www.pdsttechnologyineducation.ie/en/Technology/>

Planning, purchasing, deploying and supporting a suitable and fit-for-purpose Wi-Fi network in a school is a significant step. It is also a relatively expensive process for a school.

The DoES will advise schools on the Schedule of ICT Equipment for new post primary school building projects and extension projects to post primary schools.

For more information on procuring a fit for purpose school wireless network and achieving best value for money refer to the [Networking/Wireless Networks Section](#) of the PDST Technology in Education website i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/>.

Schools may avail of a number of purchasing arrangements i.e. Framework Agreements that exist for the purchase of a range of ICT products and services. These agreements are intended to maximise volume discounts and provided reductions in administrative and transaction costs for suppliers and public sector purchases.

Details on a Wireless Framework for Schools, including a number of suitable wireless solutions from different providers is available at:

<http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/>

#### 3.4.2 SITE SURVEY

Site surveys particularly in older and listed buildings by prospective providers are an important part of the procurement process. It is recommended that all prospective Wi-Fi network providers visit the school at agreed times with the school, and carry out a detailed Wi-Fi network site survey. This is to ensure that they are familiar with the school layout, and other details which may affect how Wi-Fi will work in the school. The site survey is necessary to review the existing network set-up and to identify optimum locations for APs. A high quality site survey is much more than a simple physical walk-through of a school. An experienced Wi-Fi provider will use a combination of specialised Wi-Fi measurement and

analysis tools, their practical experience along with schools layout drawings to determine a suitable Wi-Fi network design and implementation.

The outputs from the site survey should then be used by Wi-Fi providers as input to their tender in areas such as:

1. Analysis of the physical environment for Wi-Fi deployment
2. Areas within a school building or buildings that can be supported
3. Calculation of the number of APs needed
4. Optimum placement of APs, including a map of the preferred placement of WANPs based on the site survey
5. Possible problem areas
6. List coverage areas
7. Given that most APs should be mounted at ceiling height the site survey should identify any areas where the placement of APs might be challenging and provide a proposed solution
8. To avoid risks of vandalism APs should be out of reach

### **3.4.3 OTHER POINTS FOR CONSIDERATION**

Choice of Wi-Fi systems, cabling requirements, building structure and powering of APs are other important considerations.

#### **3.4.3.1 CHOICE OF WI-FI SYSTEMS**

School situations differ widely from small schools with a small number of mobile Wi-Fi devices to very large schools with a very high number of mobile Wi-Fi devices. It is important that schools not just consider their current situation but also consider the number of mobile Wi-Fi devices that may be used in the coming years and to select Wi-Fi systems including wireless Access Points (APs) that are suitable to the school's future and evolving needs.

The most demanding school situations are where schools have a high number of mobile devices (i.e. high density situations) and in addition where users move between classrooms frequently within the school (i.e. high mobility). In general post-primary schools are high density and high mobility environments.

Also not all APs are the same or can support the same amount of simultaneous users.

Most Wi-Fi providers have APs which can support low, medium and high density environments. As expected APs that are only capable of supporting a lower number of simultaneous users are available at a lower cost compared to higher density APs, which can support higher numbers of simultaneous users, and are relatively more expensive.

As already mentioned in this document PDST Technology in Education provides independent advice to schools. If schools have queries regarding the type of Wi-Fi systems and APs that may be suitable to their needs, they should seek advice and guidance from PDST Technology in Education by sending an email including their particular school situation (maximum number of users, maximum number of devices that may be used etc) to: [ictadvice@pdst.ie](mailto:ictadvice@pdst.ie)

#### **3.4.3.2 POWERING OF ACCESS POINTS**

Power over Ethernet (PoE) should be used to power all APs. APs are powered directly via the Cat 6 network cable and avoids the need and associated costs for a separate power socket to power each AP.

#### **3.4.3.3 CABLING REQUIREMENTS**

Each AP requires connectivity to a Power over Ethernet (PoE) switch on the network. This may require additional or new cabling runs. Where this is the case Cat 6e or a higher rated cable should be used to future proof requirements. Using Cat 6e instead of Cat 5, for example, ensures higher data rates can be supported. The distance between an AP and its PoE switch must also be considered. The standard maximum length for school network LAN cabling (100BaseT Ethernet) is 100 metres per cable run.

### 3.4.3.4 BUILDING STRUCTURE

This can be a significant area of challenge for schools. Most schools are constructed with concrete or brick walls, both of which attenuate (i.e. decrease the signal strength) of WLAN signals. Furthermore, when deploying WLAN into older or listed buildings, attenuation and cabling problems can dramatically increase and may require the deployment of more APs than initially planned, and as such a detailed site survey of school buildings is required to address these matters.

## 3.5 IMPLEMENTATION AND INSTALLATION STAGE

This section covers the following areas:

- [Managing User Access](#)
- [Wi-Fi Security Considerations](#)
- [Key Areas Regarding Wi-Fi Security Policy](#)

### 3.5.1 MANAGING USER ACCESS

All users of a schools wireless network will require network access. As such usernames and passwords for all users may be required to access the school network.

### 3.5.2 WI-FI SECURITY CONSIDERATIONS

Because of the nature of Wi-Fi signals, it is impossible to stop anyone within the signal range from attempting to access a school wireless network (WLAN). This is the nature of Wi-Fi technology. Fortunately, there are security measures that can be put in place to address these concerns. It is typically a matter of policy, will and budget. In reality, not all WLANs are configured and deployed in an ideal manner with secure access and authentication. As such, one of the main issues with these WLANs is unauthorised access to network resources and unnecessary traffic.

The inherently open nature of Wi-Fi access, compared to the wired world, creates additional security concerns, chief among them, user authentication, rights enforcement and data encryption. The security solution must provide Network Access Control in different ways for different types of users (teachers, pupils, visitors etc.) who may require to connect at the same school. Different levels of access may be provided to the various user groups. Generally teachers may have access to specific teacher resources or a specific content filtering level, while students may be limited to a lower level of access. Generally visitor are not allowed access to the school network, but just allowed access to the internet.

Deploying Wi-Fi to a school introduces new security issues. In order to manage these additional aspects of security schools need to review their school policies relating to ICT and security. When deploying Wi-Fi it is vital to take steps to lock down Wi-Fi security by implementing written policies to guide users and administrators alike. It is essential to running a secure WLAN. If a policy is already in place, review and expand this policy to ensure it includes Wi-Fi specific and mobile user centric aspects.

A school policy broadly consists of a set of statements which define what should happen in relation to the level of access or permissions that certain groups have to data or resources within and outside of the school. Wi-Fi solutions should provide standards-based authentication and encryption methods that satisfactorily address security concerns including authentication and data privacy.

Refer also to the [PDST Technology in Education](http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/) website for further advice and guidance i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/>

### 3.5.3 KEY AREAS REGARDING WI-FI SECURITY POLICY

#### 3.5.3.1 IDENTIFY USER GROUPS

Clearly identify groups (or individuals) who can use the WLAN and what level of access each particular group of users will have to both your local school network and the Internet. Use the existing school policy as a starting point.

#### 3.5.3.2 ACCEPTABLE USAGE

After identifying the Wi-Fi network user community, identify the type of information that users can and cannot send over the Wi-Fi network. This may already be detailed in the school [Acceptable Usage Policy](#)

(AUP). Schools may wish to refer to AUP guidelines which are contained on the Webwise website at [www.webwise.ie/WebwiseAUPGuidelines.pdf](http://www.webwise.ie/WebwiseAUPGuidelines.pdf).

### 3.5.3.3 SECURE THE PHYSICAL INSTALLATION

Determine who will have physical access to the Wi-Fi equipment and to the WANPs. Ideally, try to place your wireless APs in **out of** areas where they will not be tampered with. Direct the Wi-Fi provider to adjust Wi-Fi coverage areas to within the external school boundary, and not beyond, especially not into public areas such as nearby roads as this reduces the risk of unauthorised Wi-Fi access.

### 3.5.3.4 ESTABLISH WI-FI SECURITY STANDARDS

Define the minimum security levels on the Wi-Fi network and enable the specified levels of Wi-Fi authentication and encryption. Providers will advise schools in this area.

### 3.5.3.5 TRAINING OF STAFF & USERS

Two levels of training are generally required. School staff that may have specific roles in relation to the management or administration of the Wi-Fi system need to be trained in order to carry out these functions. Alternatively this could be managed by the provider. Also end user training needs to take place for staff and students on how to access the system via their Wi-Fi mobile devices.

### 3.5.3.6 STANDARD OPERATING PROCEDURE/DOCUMENTATION

The provider should provide copies of all relevant specifications, operations and management user manuals for the Wi-Fi solution being provided.

### 3.5.3.7 GUEST ACCESS

Guest WLAN access is convenient for visitors who increasingly require internet access to do their jobs. This could include temporary administrative staff or substitute teachers, or other visitors who may need internet access.

## 3.6 POST INSTALLATION, MANAGEMENT AND SUPPORT

This section covers the following areas:

- [New Challenges Introduced by Wi-Fi](#)
- [Selecting Mobile Devices and Ownership Models](#)
- [On-going Operational Support Considerations](#)
- [On-going Support of the WLAN](#)
- [On-going Security](#)
- [Mobile Device Management Solutions \(MDM\)](#)

### 3.6.1 NEW CHALLENGES INTRODUCED BY WI-FI

Along with the potential benefits associated with Wi-Fi enabled mobile devices for staff and students there are a number of new challenges. These include:

- Management of the Wi-Fi system itself
- Controlling levels of user access to management, staff, students
- Managing the additional mobile devices for teachers and students (tablets, laptops etc.,)
- Managing access to online digital resources
- Increasing dependency on broadband internet access
- Classroom management issues
- Monitoring student usage
- Resolving any technical or other related issues



### 3.6.2 SELECTING MOBILE DEVICES & OWNERSHIP MODELS

Putting in place a fit-for-purpose Wi-Fi network is one essential part of the solution. The other key aspect involves selecting the type of mobile learning devices which are to be used by teachers and students in the school. The main decisions to be made are:

- The type of devices to be deployed to help meet the learning objectives and outcomes. There are a range of providers available
- The model of ownership to be used in terms of who owns the devices for teachers and for students for example :
  - One mobile device (tablet, laptop, hybrid etc.) for every teacher
  - A school's owned set of mobile devices to be used as a shared resource
  - One device per student (1:1)
  - Pupils bringing their own devices (BYOD) which may include smart phones
  - A variation of these options

For additional information on selecting mobile devices and ownership models refer to the [Computing Devices/Tablet Section](#) of the PDST Technology in Education website i.e.

<http://www.pdsttechnologyineducation.ie/en/Technology/Computing-Devices-Tablets/>.

### 3.6.3 ON-GOING OPERATIONAL SUPPORT CONSIDERATIONS

After the completion of a Wi-Fi installation, there will be further considerations during operation of the network. This section describes on-going considerations.

#### 3.6.3.1 ON-GOING SUPPORT OF THE WLAN

In planning for the on-going support, maintenance and management of the WLAN it is important that the WLAN is fully working and that if there are issues that there are requirements and processes in place for resolving them.

These requirements, processes and associated timeframes are defined in the Service Level Agreement (SLA).

A suitable sample SLA for schools can be accessed in the [Technology Section](#) of the PDST Technology in Education website i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/>.

#### 3.6.3.2 ON-GOING SECURITY

Security is always a balance between risks (perceived and actual) and mitigation costs. Various factors need to be considered including the vulnerability of the network, the threat of attack, the value of the data to be secured and the costs involved. Wi-Fi networks are often perceived as particularly vulnerable because anyone with a suitable Wi-Fi device can detect the presence of a Wi-Fi LAN. Some risks are specific to Wi-Fi, but in general a security plan that provides good protection to a wired network will also mitigate many risks from Wi-Fi. Securing WLANs, as with all networks, needs to be seen as a continuous process rather than a one-off step. Any security solution needs to be consistently and properly implemented with regular monitoring.

The WLAN should be configured so that anyone trying to gain access has at least the same access restrictions as a wired network workstation. Schools should be implementing a comprehensive security policy and incorporating best practices standards. High quality WLAN providers will be able to meet these requirements

#### 3.6.4 MOBILE DEVICE MANAGEMENT SOLUTIONS (MDM)

Mobile Device Management (MDM) systems are designed to assist in the management of the mobile devices such as tablets, laptops etc. MDMs are generally separate to the Wi-Fi controller and Wi-Fi management system that were discussed earlier. MDM systems monitor, manage and support how mobile devices are deployed, including configuration settings on mobile devices themselves. They could be used for example to distribute applications (i.e. apps) to mobile devices. They are fast becoming important tools to manage mobile devices in schools. Some free MDM systems may be available while there are a number of **non-free** solutions available. MDM systems are especially used where a "BYOD"

model is being used. By controlling and protecting the data and configuration settings for all mobile devices in the network, MDM can assist in managing security risks.

For more information on Mobile Device Management refer to the [Networking/Wireless Networks Section](#) of the PDST Technology in Education website i.e.

<http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/>.

### 3.7 ENERGY SAVING IN ICT

This section outlines the potential for minimising energy consumption in ICT.

When purchasing ICT equipment school authorities should consider the provision of low energy equipment to reduce energy in use in relation to ICT.

As efforts are made to reduce energy use in schools, there is one area in which energy use is increasing, namely ICT equipment. Schools are purchasing computers, digital projectors and other ICTs creating a demand for electricity that did not exist a few years ago. It is essential to manage and make efforts to control this increasing demand, as it could negate any savings made in other areas, such as lighting. Fortunately many of the measures that can be taken involve little or no cost.

#### 3.7.1 IT EQUIPMENT

A lot of screens and digital projectors are in use in schools which can influence use of daylight and electric lighting. Choose quality digital projectors or interactive flat screens which are appropriate for schools. This will enable daylight to continue to be used more of the time in classrooms. Interactive Flat Screens use significantly less power than projectors. They also have a significantly longer lifespan, and don't require faulty lamp units to be replaced. For guidance on purchasing digital projectors and interactive screens schools should check the advice provided in the [Presenting in the Classroom Section](#) and [Purchasing Frameworks Section](#) of the PDST Technology in Education website i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/Presenting-in-the-Classroom/> <http://www.pdsttechnologyineducation.ie/en/Technology/Purchasing-Frameworks/>.

Schools should also refer to the Digital Projector Procurement Framework.

Peer reviewed research has established that children learn better when they have access to daylight. Refer to the Economic & Social Research Institute Research Series No 16 (September 2010), Designing Primary Schools for the Future. With dimmer and poorer images on whiteboards, there is a tendency to close blinds and put the lights on, increasing energy use and deteriorating learning ability. Where blinds are installed and used, they should not be the black-out blinds as these will require the lights to be on. Blinds should be the open weave type recommended in DoES [TGD – 031 Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD – 003 & ICT Infrastructure Guidelines TGD – 005 for Post Primary Schools, Section 5 Blinds](#). Open weave blinds are designed to reduce glare and maintain good daylight levels in the classroom.

Refer also to DoES website <http://www.education.ie/en/School-Design/Technical-Guidance-Documents/>.

When purchasing flat screen monitors or interactive flat screens schools are recommended to only purchase monitors with a matt finish to the screen. A glossy finish acts more like a mirror, and can cause “veiling reflections” of windows, necessitating blinds to be closed which, with a matt finish screen, could be open

#### 3.7.2 LOW AND NO COST MEASURES

The most significant waste of energy is due to computers being left on when not in use.

Computers can be set up, through their Power Management facility, to go into Standby or Hibernate modes if inactive for a set period. In Hibernate mode the computer uses no power at all but will, on reactivation, resume to the same state as it was in when it went into Hibernate mode. It is a good idea to set computers up to go into Standby mode if not used, say, for an hour or two, but to go into Hibernate mode overnight and at weekends. Alternatively, switch computers off at the end of each day.

Use of Power Management functions is important, it is still necessary to switch off monitors manually. Awareness campaigns are an important aid to ensuring computers and monitors are switched off at the

end of the day. In shared computer rooms, it is worth putting up a sign listing the last class in the room each day hence naming the teacher responsible for ensuring that all the IT equipment which can be switched off is switched off, especially on a Friday.

Monitors use energy even when idle and it is wasteful to leave them on when the computer is not in use, even for short periods like lunch breaks. Awareness campaigns should be implemented to encourage users to switch off monitors when leaving their computers. This is particularly relevant where computers are sporadically used by different people e.g. in computer rooms and staff rooms, where they can be left idle for lengthy periods. It is very common for staff room computers to be left on all the time, unnecessarily, because no one person is responsible for the machine.

As with computers, all office equipment should be switched off at the end of the day. Use should be made of a photocopier's energy saving functions, which will put it in power saving mode when idle. Many photocopiers will not go into power saving mode if the lid is open, so ensure that the lid is closed when not in active use.

Where Uninterruptable Power Supplies (UPS) are used, they should be switched off when the equipment they are feeding is switched off, as they will continue to use energy otherwise. In the mornings, switch on equipment when it is first needed, not routinely at the start of the working day.

For flat panel monitors the higher the brightness setting, the more power a monitor uses. Ensure that monitors are not automatically set to maximum brightness if unnecessary. A 25% reduction in brightness may not be noticeable but will save energy.

However, do not dim monitors to the point where window blinds have to be closed and lights switched on.

It's better to have a bright monitor and use daylight with the lights off rather than have the lights on.

Digital projectors and interactive flat screens should be switched off at the socket rather than left on standby.

When having digital projectors, TV monitors or other devices installed which are mounted at high level, ensure that the socket is at an accessible height so that the device can easily be switched off fully. Ensure you only buy "Energy Star" version 5 or later compliant devices. They may not use much energy, but if you have two or three such devices in each classroom, the standby energy soon adds up across the school.

Consider getting pupils to conduct an audit of all IT equipment in the school, and estimate how many hours per year the equipment is in active use, versus how many hours the school is closed. Try to estimate how much energy is wasted outside teaching hours.

### **3.7.3 MEASURES REQUIRING INVESTMENT**

For computer rooms, network software can be installed which will allow the powering down of the computers to be controlled centrally by the server. Monitors and peripherals, however, will still need to be switched off manually. All computer rooms in post primary schools have a dedicated electrical distribution board feeding the sockets through a device called a contactor (a kind of switch) controlled by a key operated isolating switch, but this is often not used as it is necessary to wait until the computers have shut down before switching off the power. Replacing this key-switch control with a 24 hour/7 day time clock will ensure that no power, even to monitors, is left on out of hours. If power is still required to a server, this can still be arranged by an electrician installing the time clock.

Peripherals e.g. printers, scanners and PC speakers are often left on even when the computer is not in use. "Intelligent" multi-sockets (extension leads) are available which switch off power to all peripherals when they sense that the main computer has been powered down. Use of such devices in conjunction with the computer's Power Management controls can provide an effective means of ensuring that a computer and all its peripherals are left in a state of zero energy usage if unattended for a prescribed period. For example, a computer going into Hibernate mode ceases to use any power. The intelligent multi-plug will sense this and automatically switch off power to all peripherals. These devices can be sourced on the internet.

When purchasing new computers it is worth considering that laptops use considerably less power than most desktops (low energy desktops are available but can be harder to source). They also have the

advantage that if they are set up to go into Standby or Hibernate if inactive, the monitor will also shut down, unlike the separate monitor used with a desktop. It is important to consider what the computer is to be used for when choosing a specification. If the machine is used mostly for web browsing and word processing then the use of a specific low energy computer may be appropriate. In particular, high end graphics cards can have larger power consumption than all the other components of the computer put together, but these graphics cards are only required for advanced 3D graphics. “On-board” graphics are normally adequate for most school uses and it is therefore not necessary to specify computers with additional graphics cards.

#### **3.7.4 SPECIFYING LOW ENERGY MACHINES.**

When purchasing new equipment, always make it clear that the school have a preference for low energy equipment. For example: Energy consumption when operating should be less than 90W and when idle shall be less than 50W, when in sleep mode shall be less than 2W.

Buying combined peripherals e.g. all-in-one scanner/printer is not only more cost effective but also more energy efficient.

#### **3.7.5 CLOUD BASED COMPUTING**

Cloud computing allows for cost and energy efficient centralization of school infrastructures. It takes advantage of cloud based server capabilities to adjust allocation based on demand. Using cloud based services and applications instead of local server based resources can save significant levels of energy, technical support and associated costs.

#### **3.7.6 VIRTUALIZATION OF MAIN SERVERS**

In the interest of reducing energy consumption the principle of virtualization of the main servers in the Data Communications Centre (DCC) to just one server should be considered. This will reduce the communications power consumption, heat gains and running costs significantly, refer also to [www.energyineducation.ie](http://www.energyineducation.ie) for further advice and guidance.

#### **3.7.7 ENERGY IN EDUCATION ENERGY FACTSHEET**

Refer also to Energy in Education Energy factsheet in **APPENDIX C: ENERGY IN EDUCATION ENERGY FACTSHEET** for further guidance.

# **SECTION C**

## 4. STRUCTURED CABLE SYSTEM /LOCAL AREA NETWORK (LAN)

### 4.1 OVERVIEW

The primary network shall be designed as Category 6a / Class E to ISO 11801: latest edition.

The network will be Gigabit Ethernet standard IEEE802.3 with auto-sensing switches.

For any new school, a specialising Building Services Consulting Engineer skilled in Local Area Networks (LAN) and Networking shall develop the cabling design.

It is not possible to define an algorithmic approach to cabling existing schools. In each case a LAN and Networking specialist must review the site and the plans.

In the case of new schools or extensions to existing schools ICT infrastructures will form part of the building contract and must be fully designed and developed at Stage 2a.

It is deemed essential that the structured cabling system be installed by suitably trained electrical contractors, or appropriately trained personnel, however only specialists contractors shall be used to install optic fibre cabling.

The ICT structured cabling system should be an integrated network to support both data and the telephony part of data.

The infrastructure shall include the structured cabling, RJ45 sockets, RJ45 patch panels and cabinets. A school authority shall be responsible for the supply of ICT equipment i.e. servers and associated UPS, switches and patch leads etc and the provision of these shall not form part of a building contract for a new school or extension to a school. (Routers are supplied to all schools participating in the [Schools Broadband Programme](#) and the [100Mbps Post Primary Schools Project](#))

The following three scenarios represent the majority of Post Primary schools.

### 4.2 SINGLE BUILDING WITHIN 90 METRES

A school comprising of one building where it is possible to reach all network points within 90 metres (actual cable run excluding patch leads) from the dedicated Data Communication Centre (DCC), which will house the Main Distribution Facility (MDF).

### 4.3 SINGLE BUILDING NOT WITHIN 90 METRES

A school comprising one building where it is not possible to reach all network points within 90 metres (actual cable length excluding patch leads) from the dedicated DCC which will house the MDF.

A building of this type will require Intermediate Distribution facilities (IDF) to interconnect the system. The connection between an IDF and the MDF within the same building shall be a fibre optic backbone cable.

### 4.4 MULTIPLE BUILDINGS

Where a school comprises two or more buildings there may be different solutions depending on the possibility to reach each network point within 90 metres (actual cable run) of the dedicated DCC housing the MDF.

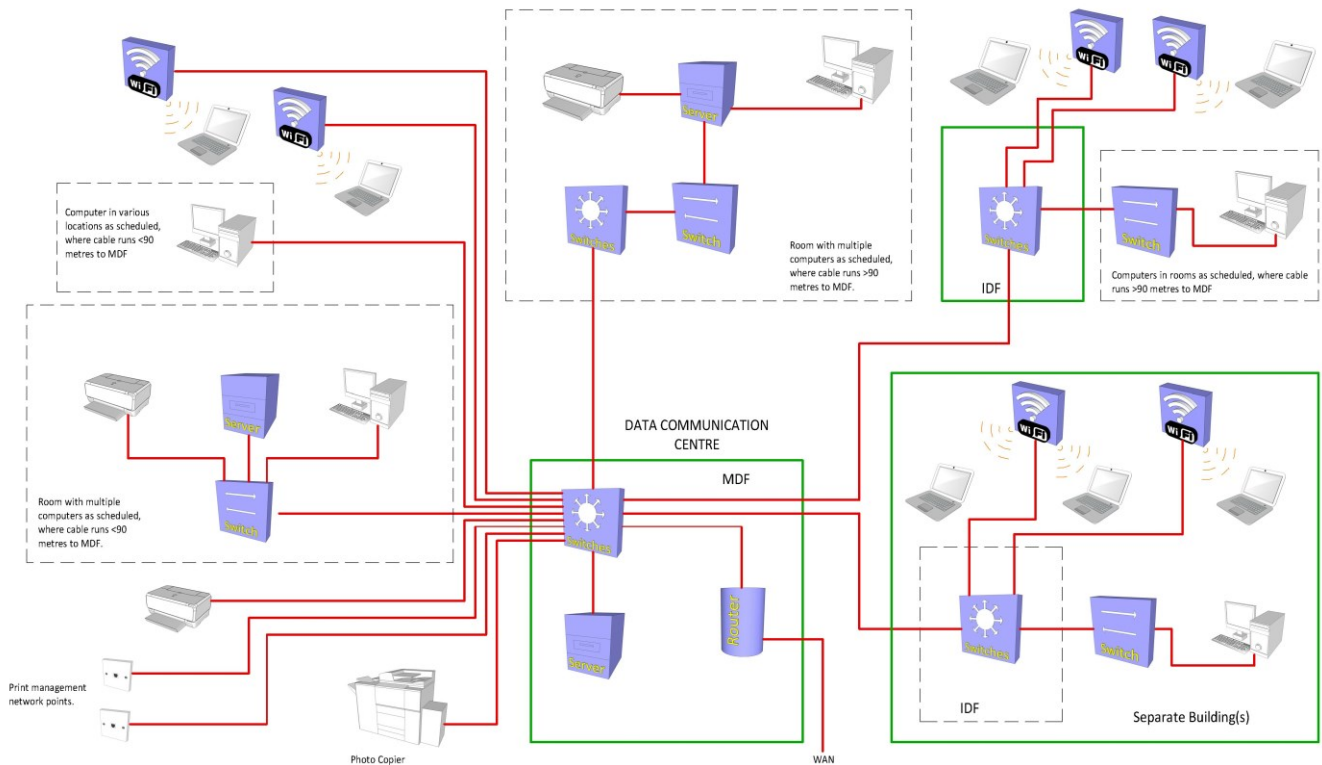
For the inter-connection between an IDF in a separate building and the MDF in the main building a multimode fibre optic backbone cable shall be considered. This is the appropriate connection for a large cohort of users located away from the main building.

In circumstances where a number of users are located away from the main school building in temporary accommodation a Wi-Fi connection shall be considered.

## 4.5 ICT NETWORK SCHEMATIC

The following Network Schematic indicates the various options depending on the computer locations and their proximity to the MDF.

The most economical and pragmatic solution should be selected.



Refer to [APPENDIX D: NETWORK SCHEMATIC DRAWING](#) for a full sized copy of the drawing.

Where a copy is required it should be printed on an A3 size sheet.

## 5. COMMUNICATIONS INFRASTRUCTURE

This section details the communication infrastructure requirements.

### 5.1 DATA COMMUNICATIONS CENTRE

A dedicated Data Communication Centre (DCC) with a minimum width of 2.5m and height of 2.17m, having no windows and matched to one of the following area shall be provided:

NUMBER OF PUPILS	DCC AREA (M <sup>2</sup> )
0 - 499	5.0
500 - 749	6.0
750 - 999	7.0
1000 plus	8.0

This room shall house the Main Distribution Facility (MDF).

The DCC shall be suitably positioned off the circulation area or off a general store and be located in the main building. The room shall be fitted with a key operated lock as part of the master key suite of keys.

It shall have a basic mechanical extract ventilation system as outlined in [SECTION 11.1.1 DATA COMMUNICATIONS CENTRE](#).

The enclosure to this room should give a 30-minute fire rating; intumescent passive fire protection shall be used where necessary.

The location should, as far as practicable, be such that the cable run (actual cable length) to all network points is within the limit of 90 metres.

Only where this is not possible shall an Intermediate Distribution Facility (IDF) as detailed below be provided.

### 5.2 MAIN DISTRIBUTION FACILITY

The MDF shall be located in the DCC in lockable floor mounted equipment cabinets as detailed in [SECTION 6.4, CABINETS](#) below. It shall be supplied with patch panels.

In the case of new schools or extensions to existing schools the school authority shall supply as part of the school's [Schedule of Equipment](#) i.e. the router, servers and associated UPS, switches and patch leads in accordance with the [DoES ICT Equipment Guidelines](#). They won't form part of a building contract.

### 5.3 INTERMEDIATE DISTRIBUTION FACILITY

An Intermediate Distribution Facility (IDF) shall be provided where the cable runs from the DCC to any primary network point exceeds 90 metres or for each separate building i.e. standalone extensions or Physical Education (PE) halls

The IDF will contain a lockable wall mounted equipment cabinet as detailed in [SECTION 6.4 CABINETS](#). It shall be supplied with patch panels.

The school authority shall supply as part of the school's [Schedule of Equipment](#) i.e. servers and associated UPS, switches and patch leads in accordance with the [DoES ICT Equipment Guidelines](#).

The IDF shall be mounted at high level in a suitable position such as a store (not a teaching or habitable space). Ideally this space should not have a window but should be adequately ventilated to adjoining



spaces. The room housing the IDF shall be fitted with a key operated lock as part of the master key suite of keys.

## 6. GENERAL STRUCTURED CABLE SPECIFICATION REQUIREMENTS

### 6.1 ELECTROMAGNETIC COMPATIBILITY (EMC) COMPLIANCE

The EMC directive applies to requirements on emission and protection from electromagnetic interference in the EU.

EN 55022 and EN55105 are the standards applicable to Information Technology.

As the structured cabling system is a passive component, the EMC directive does not apply to the system, but to the final application.

### 6.2 NUMBERING & LABELLING SCHEME

All links, cables, fibre optic or copper, shall be clearly labelled with a consistent numbering scheme. Radio, IR and Laser links shall be defined using the same numbering scheme.

In the following scheme;

“x” denotes a building number

“y” denotes an IDF; this shall be a letter.

“z” denotes an incremental number

It is suggested to label as per the following for MDF;

- Each MDF multimode fibre cable be marked as MDF MFz (MDF Multi Mode Fibre number “z”)
- Each MDF single mode fibre cable be marked as MDF SFz (MDF Single Mode Fibre number “z”)
- Each MDF balanced cable be marked as MDF BCz (MDF Balanced Cable number “z”)

It is suggested to label as per the following for IDF;

- A number, “x” will describe each building.
- Each IDF multimode fibre cable be marked as IDF x MFz (IDF for building “x” Multi Mode Fibre number “z”)
- Each IDF single mode fibre cable be marked as IDF x SFz (IDF for building “x” Single Mode Fibre number “z”)

Each IDF balanced cable be marked as IDF x BCz (IDF for building “x” Balanced Cable number “z”)

Each IDF CAT 6a cable to be marked as “xyz”; e.g. outlet number 64 from IDF distributor E in building 3 would be 3E64.

This numbering scheme shall be used to represent the wiring system when providing the client with interim and as-constructed drawings.

The following letter abbreviations may be used when describing links.

<b>MDF</b>	MAIN DISTRIBUTOR FACILITY
<b>IDF</b>	INTERMEDIATE DISTRIBUTOR FACILITY
<b>MM</b>	MULTIMODE FIBRE
<b>SM</b>	SINGLE MODE FIBRE
<b>BC</b>	BALANCED CABLE
<b>RF</b>	RADIO FREQUENCY LINK
<b>IR</b>	INFRARED LINK
<b>LR</b>	LASER LINK

### 6.3 POINT DENSITY

The density of network points shall be in accordance with the schedule in [Section 7.10 Schedule of Network Points](#) below.

### 6.4 CABINETS

Five types of cabinets are specified for general usage.

- Type 1 will be min. 42U, w. 600; d. 600. This is the smallest usable cabinet for general equipment.
- Type 2 will be min. 42U, w. 800, d. 600. This cabinet is for structured cabling where vertical cable management is required in the additional available 200mm.
- Type 3 will be min. 42U, w. 600, d. 910. This extra depth is required for rack-mounted servers.
- Type 4 will be min. 42U, w. 800, d. 910. This cabinet is for all requirements in small schools (structured cabling, equipment, servers).
- Type 5 will be min 6U, w. 600, d. 400. This cabinet is a wall-mounted unit to house switches. These items shall be selected to suit cabinet size.

U = height unit 44.5mm

All cabinets will be 19" rack mounting type of a solid and durable type. Frame shall be of min. 2mm steel, doors and panels of min. 1.5mm steel. Frame shall be seam-welded.

All floor-mounted cabinets shall be supplied with a plinth. Plinth shall have side openings in each direction.

Specified cabinets shall be suitable for computer room environments and shall conform to IP21 EN 60.529/IEC 529. Note that IP21 conformance is required on the installed cabinet after completion of installation. It is the installer's responsibility to ensure that sufficient care is taken during installation to achieve this.

Cabinets shall be supplied with lockable front doors with safety glazing. They may either be floor or wall mounted. Side and rear panels shall be of a steel construction and shall be removable. During installation, all adjacent cabinets shall be bolted together by the installer and only 2 side panels will be required in total.

Cabinets must be installed such that all equipment including patch panels may be serviced and installed from the front.

Cabinets shall be supplied with brush plates or other such entry mechanism to ensure that cable entries are tidy and sealed to IP21.

Suppliers shall declare conformance or otherwise with regard to the EU EMC directive relating to electromagnetic interference, on the completed installation, EU 89 / 363 with all amendments.

Cabinets shall be installed with full safety Earthing.

All passive metallic components in the cabinet, when fully assembled with patch panels etc. shall be bonded to provide an adequate signal ground.

### 6.5 PATCH PANELS

Patch panels are required in all cases and shall be mounted in Type 2 cabinets.

Patch panels shall be 1U per row, with 24 x RJ45 type terminations per row.

Every second patch panel shall have a 2U horizontal cable management bracket mounted underneath.

U = height unit 44.5mm.

Patch panels shall be fully accessible from the front.

## 6.6 SOCKETS

Sockets shall be of a single piece rugged construction. Modular socket assemblies will not be accepted. The supplier shall provide samples of sockets for approval.

For data sockets termination shall be on IDC style punch down connections to TSB-568-B.

## 6.7 WARRANTY

A fifteen year warranty is required on the fibre optic cable installation and all other associated fibre optic components.

A link performance certificate for horizontal cabling is required, specifying that all such cables meet or exceed the requirements of the current edition of ISO11801.

A proprietary testing device shall be used to test the installation as recommended by the cabling manufacturers and approved by the Building Services Consulting Engineer.

## 6.8 HORIZONTAL CABLES

All cabling, connections and accessories in the structured cabling system shall conform fully with ISO/IEC 11801, EN50173, Class E tested to TSB67.

Cable shall be of low smoke type and shall conform to building standards for plenum cables. Conformance or otherwise with standards IEC 332-1, 695-1, 754 and 1034 shall be requested.

Only three cable impedances are recognised by the standards: 100Ω, 120Ω and 150Ω: only 100Ω cables shall be used. Only UTP cable shall be used.

## 6.9 FIBRE OPTIC CABLES

Fibre Optic cables shall be provided between the DCC and any IDF. They shall also be provided between switches in dedicated Computer Rooms and the DCC and any IDF.

Fibre Optic links shall consist of minimum four cores.

All external fibre shall be of loose tube type. All internal fibre shall be of tight buffer type. All cores shall be terminated on each link.

In Computer Rooms or cabinets, fibre shall be terminated in 19" fibre patch panels in Type 1 cabinets. Sufficient socket space shall be left (eight per cable) to terminate all fibres, including those not yet terminated.

At other locations, fibre shall be terminated in a sealed wall box, to IP21.

Sufficient socket space shall be left (eight per cable) to terminate all fibres, including those not yet terminated.

At any termination point, proper splice trays shall be used for both terminated and un-terminated fibre.

Proper laser hazard signage is to be provided at each end of the fibre termination.

All terminations shall be SC type. Cables shall be reinforced for resistance to mechanical stress

### 6.9.1 INTERNAL MULTIMODE FIBRE OPTIC CABLES

62.5/125 μM graded index cable shall be used. Step index fibre is not to be used. Cables shall be LSHF and water-resistant. Cables shall be metal free.

### 6.9.2 EXTERNAL MULTIMODE FIBRE OPTIC CABLES

Where post primary schools comprise of more than one building it would be unusual for the buildings not to be relatively close to each other. In view of this 62.5/125 μM graded index cable should be considered as first choice of application.

If a site has specific conditions that require a higher specification this should be referred to the Technical Staff in the DoES Planning & Building Unit with recommendations on the most appropriate server solution. Step index fibre is not to be used. Cables shall be water resistant and metal free.

Outdoor splicing is to be avoided, except where cable breaks have occurred after handover.

In the case of new schools or extensions to existing schools issues of this type should be raised by the school and its Design Team at the Pre-stage 1 meeting with the DoES Technical Staff and guidance sought.

## 7. NETWORK POINTS

This section details the various types of Network Points (NP), the approved provision of network points in various rooms and areas in post primary schools and the approved density.

NPs shall be connected directly to the MDF or connected via the IDF whichever is more economical, wired in Cat 6e cable and terminated in RJ45 type sockets.

In specialist rooms NPs shall be grouped in pairs to facilitate the use of both twisted pairs of cables in a single Cat 6a cable and twin RJ45 type socket outlets.

Un-switched type power socket outlets at a ratio of 1.5 twin power socket outlets per network point i.e. computer station, shall be provided. Refer to [SECTIONS 7.11.1 & 7.11.2 SCHEDULE OF NETWORK POINTS](#) below for further guidance on the numbers of twin power socket outlets involved.

Power socket outlets are not required for the following types of NPs listed below:

- Wi-Fi Access Points
- IP CCTV Cameras
- Swipe Card Readers
- IP Telephones

In new schools and extensions to existing schools these shall be provided as part of the building contract.

The following is a commentary on the various types of network points which can be provided in post primary schools.

### 7.1 TEACHER POSITION NETWORK POINT

Teacher Position Network Points (TPNP) are provided as part of the digital projector installation provided on the teaching wall in all teaching spaces and in the Library in post primary schools.

Refer to [SECTION 8 DIGITAL PROJECTOR INSTALLATION](#) below for specific details of a Digital projector Installation

### 7.2 PC NETWORK POINT

PC Network Points (PCNP) shall be provided in various teaching spaces and offices in post primary schools as detailed in [SECTIONS 7.11.1 & 7.11.2](#).

### 7.3 WI-FI ACCESS POINT NETWORK POINT

Wi-Fi Access Point Network Points (WAPNP) shall be provided at high level in teaching spaces, PE hall, social areas and circulation areas to ensure high quality access from mobile devices e.g. laptops, tablets pupil devices etc. throughout the school and its environs to local and external sources.

The number and location of WANP will depend on the geography/layout and fabric of a school building.

A number of these are required in areas where a large number of people such as students or parents will gather e.g. the General Purpose/ Dining Area and the PE hall which will also be used for meetings etc.

These shall be powered using Power of Ethernet (PoE) and incorporated into the ICT infrastructure being provided as part of a building project.

In teaching spaces where a digital projector is being provided the WAPNP shall be provided at high level in the dado trunking on the teaching wall in the space. Refer to [APPENDIX E, DIGITAL PROJECTOR INSTALLATION DRAWINGS](#) below for further guidance

In rooms without a digital projector WAPNP should be provided at high level on the corridor wall in the room.

In circulation spaces 5m of coiled cable shall be provided at each WAPNP to facilitate its relocation should the need arise in the future,

## 7.4 DIGITAL PROJECTOR NETWORK POINT

In all spaces where a digital projector is being provided a Digital Projector Network Point (DPNP) shall be provided adjacent to the projector's power socket outlet i.e. in the dado trunking on the teaching wall or on the ceiling.

This connection will also facilitate power management of the digital projectors.

Where a digital projector is cabled to a school data network, this could facilitate Teacher Tablets sharing their screen on the digital projector (or an interactive flat screen if this was the preferred display) using the school wireless system.

## 7.5 SERVICES NETWORK POINT

Services Network Point (SNP) as outlined in the [SECTION 7.11 SCHEDULE OF NETWORK POINTS](#) below should be provided in the boiler house and at the main switchgear location.

## 7.6 IP CCTV CAMERA NETWORK POINT

As part of the design development of the IT infrastructure consideration should be given to the provision of CCTV Network Points (CCTVNP) in suitable locations in corridor areas and locker spaces to facilitate the provision of internal IP CCTV camera coverage of these areas by others in the future.

In the case of new schools or extensions to schools:

- External IP type cameras shall form part of the CCTV camera installation being provided
- An intention to provide internal CCTVNP should be raised a school authority at the Pre-stage 1 meeting with DoES Technical Staff
- Provision of IP CCTV cameras will not form part of the building contract

## 7.7 SWIPE CARD READER NETWORK POINT

As part of the design development of the IT infrastructure consideration should be given to the provision of Swipe Card Reader Network Points (SCRNP) in the main entrance areas to a school to facilitate the provision of swipe card/FOB readers by others in the future.

A commentary on these should be included as part of the Stage 2a submission for a building project.

The intention to provide swipe card readers as part of a new school or school extension project should be raised by a school authority at the Pre-stage 1 meeting with the DoES Technical Staff.

This should also be fully detailed, costed and justified in a Stage 2a M&E submission for a building project

## 7.8 PRINT MANAGEMENT NETWORK POINT

Managed print solutions incorporating Printer Network Points (PNP) in various locations in post primary schools e.g. Photo Copying Room, printing stations on each floor etc. should be considered.

Where this is being provided Printer Network Points in specialist rooms will not be required and shall be omitted from the design development.

PNP as outlined in the [SCHEDULE OF NETWORK POINTS](#) below shall be provided in specialist rooms for printers and plotters where a managed print solution is not envisaged.

In the case of new schools or extensions to schools the Building Services Consulting Engineer should liaise with the school authority and the Architect at an early stage in the design with a view to identifying suitable locations for printing stations.

The intention to install PMNP as part of a new school or school extension building project should be raised by a school authority at the Pre-stage 1 meeting with the DoES Technical Staff and be fully detailed, costed and justified in the Stage 2a M&E submission.

In specialist rooms where a local printer is being provided direct local access to it from the devices in the particular room shall be available.

## 7.9 ELECTRONIC NOTICE BOARD NETWORK POINT

Electronic Notice Board Network Points (ENBNP) to facilitate the provision of electronic notice boards by other in the future shall be provided at high level in the main entrance area in a school, the GP Area, the Staff Room and the main entrance area to Special Needs Accommodation.

An un-switched twin type power socket outlet shall be located beside each ENBNP to provide power to the ENB.

## 7.10 IP TELEPHONY NETWORK POINTS

Where suitable broadband connections are available school authorities may wish to consider the provision of a Voice over Internet Protocol (VoIP) type telephone system instead of a PABX system.

One of the main benefits to be gained by the provision of this type of system is that the number of incoming telephone lines can be rationalised there by contributing to savings in annual line rental charges etc.

With a VoIP type telephone system phones are used in a similar way to traditional telephone systems but instead of connecting to a telephone network they connect to the internet via IP Telephony Network Points (IPTNP) i.e. it allows one to make telephone calls over the internet instead of traditional phone lines.

Typical features of a VoIP phone system include:

- Auto attendant
- Direct Inward Dialling
- Call ID, Call Transfer, Call Waiting & Forwarding,
- Conference Calling
- Voicemail

It also facilitates expansion of the system in the future i.e. anywhere there is an internet connection a phone can be deployed.

In the case of new schools or extensions to schools a school authority should liaise with the Building Services Consulting Engineer on the Design Team at an early stage in the design development and advise them of the preferred type of telephone system to be provided in the school. Where a VoIP type telephone system is proposed:

- Telephone points outlined on the DoES room layout drawings for post primary schools should be incorporated into the ICT infrastructure
- The school should raise this at Pre-stage 1 meeting with the DoES
- This should be fully detailed, costed and justified in the Stage 2a M&E submission



## 7.11 SCHEDULE OF NETWORK POINTS

Classification of Network Points in post primary schools:

<b>LOCAL AREA NETWORK (LAN) POINTS.</b>	
<b>TPNP</b>	Teacher Position Network Point
<b>PCNP</b>	PC Network Point
<b>WAPNP</b>	Wi-Fi Access Point Network Point
<b>DPNP</b>	Digital Projector Network Point
<b>SNP</b>	Services Network Point
<b>IPCCTVNP</b>	CCTV Camera Network Point
<b>SCRNP</b>	Swipe Card Reader Network Point
<b>PNP</b>	Printer Network Point
<b>IPTNP</b>	IP Telephony Network Point
<b>ENBNP</b>	Electronic Notice Board Network Point

### 7.11.1 NEW SCHOOL BUILDINGS

The DoES is currently rationalising the number of different rooms sizes provided in post primary schools and drafting new room layout drawings for these spaces.

These are being implemented in the design of new post primary schools building.

The following **SCHEDULE OF NETWORK POINTS** should be provided:

<b>SCHOOLS ENTERING DESIGN DEVELOPMENT POST APRIL 2014</b>		
<b>TYPE OF SPACE.</b>	<b>NETWORK POINTS.</b>	<b>ASSOCIATED SINGLE POWER SOCKET PROVISION**</b>
<b>GENERAL CLASSROOM (30 STUDENTS)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>GENERAL CLASSROOM (20 STUDENTS)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>MUSIC ROOM</b>	1 TPNP, 4 PCNP, 1 WAPNP & 1 DPNP	17
<b>MULTIMEDIA ROOM</b>	1 TPNP, 30 PCNP, 1 WAPNP, 1 DPNP and/or 4 PNP	95 and/or 4
<b>SCIENCE LABORATORY (24 STUDENTS)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>SCIENCE PREPARATION AREA.</b>	2 PCNP*	3
<b>ART/CRAFT ROOM (30 STUDENTS)</b>	1 TPNP, 6 PCNP, 1 WAPNP & 1 DPNP	23
<b>HOME ECONOMICS ROOM (24 STUDENTS)</b>	1 TPNP, 1 WAPNP & 1DPNP	5
<b>TEXTILE ROOM</b>	1 TPNP, 2 PCNP, 1 WAPNP & 1 DPNP	11

<b>SCHOOLS ENTERING DESIGN DEVELOPMENT POST APRIL 2014</b>		
<b>TYPE OF SPACE.</b>	<b>NETWORK POINTS.</b>	<b>ASSOCIATED SINGLE POWER SOCKET PROVISION**</b>
<b>DESIGN &amp; COMM. GRAPHICS ROOM</b>	1 TPNP, 26 PCNP, 1 WAPNP, 1 DPNP and/or 4 PNP	83 and/or 4
<b>CONSTRUCTION STUDIES/ WOOD TECHNOLOGY ROOM. (24 STUDENTS)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>TECHNOLOGY ROOM (24 STUDENTS)</b>	1TPNP, 1 WAPNP, 1 DPNP & 2 PNP	7
<b>TECHNOLOGY PREPARATION ROOM</b>	None	-
<b>ENGINEERING (24 STUDENTS)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>LIBRARY &amp; ANCILLARY STORES</b>	1 TPNP, 1 WAPNP, 1 DPNP & 1 PNP	7
<b>DEPUTY PRINCIPAL'S OFFICE.</b>	2 PCNP*	3
<b>PRINCIPAL'S OFFICE.</b>	2 PCNP*	3
<b>GENERAL OFFICE.</b>	4 PCNP + 1 PNP	14
<b>GUIDANCE OFFICE.</b>	2 PCNP*	3
<b>PASTORAL &amp; SPECIAL TUITION OFFICE.</b>	2 PCNP*	3
<b>STAFF ROOM</b>		
200 – 499	1 WAPNP, 4 PCNP, 1 PNP & ENBNP	16
500 – 799	1 WAPNP, 4 PCNP, 1 PNP & ENBNP	16
800 PLUS PUPILS	2 WAPNP, 6 PCNP, 1 PNP & ENBNP	22
<b>MEETING ROOM.</b>	1 WAPNP & 1 NP/PNP	3
<b>FIRST AID ROOM</b>	2 PCNP*	3
<b>CARETAKER WORK AREA</b>	2 PCNP*	3
<b>PHOTOCOPIER ROOM</b>	2 PCNP	2
<b>P.E. OFFICE</b>	2 PCNP*	3
<b>GENERAL PURPOSE AREA</b>	1 WAPNP, 2 NP & 1 ENBNP	4
<b>FITNESS SUITE</b>	None	0
<b>MAIN SWITCH ROOM</b>	2 SNP*	0
<b>BOILER ROOM</b>	2 SNP*	0
<b>P.E. HALL</b>	5 WANP & 2 PCNP*	3
<b>SOCIAL AREAS (PER FLOOR)</b>	1 WAPNP	0

## Notes:

\* These NPs shall be terminated in a twin RJ45 type sockets. Additional power socket outlets to ensure compliance with the DoES requirement for 1.5 twin power socket outlets per NP are not required in these location. 1.5 twin power socket outlets will suffice.

\*\* Twin socket outlets to be used where possible for even numbers

**7.11.2 EXISTING SCHOOL BUILDINGS**

Where a Wi-Fi ICT installation is being provided in an existing school building which contains old room layouts, the following **SCHEDULE OF NETWORK** points should be provided:

<b>SCHOOLS IN DESIGN DEVELOPMENT PRIOR TO APRIL 2014</b>		
<b>TYPE OF SPACE.</b>	<b>NETWORK POINTS.</b>	<b>ASSOCIATED SINGLE POWER SOCKET PROVISION*</b>
<b>GENERAL CLASSROOM (49M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>LECTURE ROOM. (109M<sup>2</sup>)</b>	1 TPN P, 1 WAPNP & 1 DPNP	5
<b>GROUP ROOM. (29M<sup>2</sup>)</b>	1 TPNP + 1 WAPNP	3
<b>MUSIC/DRAMA AREA. (80M<sup>2</sup>)</b>	1 TPNP, 4 PCNP, 1 WAPNP & 1 DPNP	17
<b>LEARNING SUPPORT ROOM. (55M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>BUSINESS/COMMERCE ROOM. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>GUIDANCE CLASSROOM. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>LANGUAGE ROOM. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>RELIGION ROOM, MEDITATION AREA.(78M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>MATHEMATICS ROOM. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>SOCIAL STUDIES ROOM. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>HOME SCHOOL COMMUNITY LIAISON CLASSROOM. (49M<sup>2</sup>)</b>	1 TPNP, 2 PCNP, 1 WAPNP & 1 DPNP	11
<b>BUSINESS/COMPUTER ROOM. (80M<sup>2</sup>)</b>	1 TPNP, 30 PCNP, 1 WAPNP, 1 DPNP and/or 4 PNP	95 and/or 4
<b>MULTIMEDIA LEARNING LABORATORY. (80M<sup>2</sup>)</b>	1 TPNP, 30 PCNP, 1 WAPNP, 1 DPNP and/or 4 PNP	95 and/or 4
<b>WORD PROCESSING/ KEYBOARDING SKILLS ROOM. (80M<sup>2</sup>)</b>	1 TPNP, 30 PCNP, 1 WAPNP, 1 DPNP and/or 4 PNP	95 and/or 4
<b>SCIENCE LABORATORY. (80/100M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>PREPARATION AREA. (21/40M<sup>2</sup>)</b>	2 PCNP*	3
	2 PCNP*	3
	2 PCNP*	3
<b>DEMONSTRATION ROOM. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP, 1 DPNP	5
<b>ART/CRAFT ROOM &amp; STORE. (100M<sup>2</sup>)</b>	1 TPNP, 6 PCNP, 1 WAPNP & 1 DPNP	23
<b>HOME ECONOMICS. (100M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>DRESS DESIGN. (80M<sup>2</sup>)</b>	1 TPNP, 2 PCNP, 1 WAPNP & 1 DPNP	11
<b>COMMERCE/COMPUTER ROOM. (80M<sup>2</sup>)</b>	1 TPNP, 30 PCNP, 1 WAPNP & 1 DPNP and/or 2 PNP	95 and/or 4

<b>SCHOOLS IN DESIGN DEVELOPMENT PRIOR TO APRIL 2014</b>		
<b>TYPE OF SPACE.</b>	<b>NETWORK POINTS.</b>	<b>ASSOCIATED SINGLE POWER SOCKET PROVISION*</b>
<b>BUSINESS STUDIES/COMMERCE. (63M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1DPNP	5
<b>DESIGN &amp; COMMUNICATION GRAPHICS. (80M<sup>2</sup>)</b>	1 TPNP, 26 PCNP, 1 WAPNP, 1 DPNP and/or 4 PNP	87
<b>TECHNICAL GRAPHICS ROOM. (80M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>CONSTRUCTION STUDIES/ WOOD TECHNOLOGY ROOM. (136M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>TECHNOLOGY ROOM. (136M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP, 1 DPNP & 2 PNP	7
<b>** TECHNOLOGY ROOM (NEW). (136M<sup>2</sup>)</b>	1TPNP, 1 WAPNP, 1 DPNP & 2 PNP	7
<b>WOOD/TECHNOLOGY MACHINE &amp; PREPARATION AREA. (65M<sup>2</sup>)</b>	None	-
<b>ENGINEERING/METAL TECHNOLOGY ROOM. (136M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP & 1 DPNP	5
<b>LIBRARY &amp; ANCILLARY STORES (100 M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP, 1 DPNP & 1 PNP	6
<b>LIBRARY &amp; ANCILLARY STORES (136M<sup>2</sup>)</b>	1 TPNP, 1 WAPNP, 1 DPNP & 1 PNP	6
<b>DEPUTY PRINCIPAL'S OFFICE.</b>	2 PCNP*	3
<b>PRINCIPAL'S OFFICE. (22M<sup>2</sup>)</b>	2 PCNP*	3
<b>GENERAL OFFICE. (20M<sup>2</sup>)</b>	2 PCNP* + 1 PNP	4
<b>GENERAL OFFICE. (30M<sup>2</sup>)</b>	4 PCNP + 1 PNP	13
<b>CHAPLIN'S OFFICE. (15M<sup>2</sup>)</b>	2 PCNP*	3
<b>GUIDANCE OFFICE. (15M<sup>2</sup>)</b>	2 PCNP*	3
<b>HOME SCHOOL LIAISON OFFICE. (15M<sup>2</sup>)</b>	2 PCNP*	3
<b>PASTORAL OFFICE. (10M<sup>2</sup>)</b>	2 PCNP*	3
<b>STAFF ROOM (120M<sup>2</sup>)</b>	1 WAPNP, 4 PCNP, 1 PNP & ENBNP	15
200 – 499	1 WAPNP, 6 PCNP, 1 PNP & ENBNP	21
500 – 799	2 WAPNP, 8 PCNP, 1 PNP & ENBNP	27
800 PLUS PUPILS		
<b>MEETING ROOM. (34M<sup>2</sup>)</b>	1 WAPNP & 1 NP/PNP	3
<b>FIRST AID ROOM</b>	2 PCNP*	3
<b>CARETAKER WORK AREA. (15M<sup>2</sup>)</b>	2 PCNP*	3
<b>PHOTOCOPIER ROOM. (6M<sup>2</sup>)</b>	2 PCNP	2

<b>SCHOOLS IN DESIGN DEVELOPMENT PRIOR TO APRIL 2014</b>		
<b>TYPE OF SPACE.</b>	<b>NETWORK POINTS.</b>	<b>ASSOCIATED SINGLE POWER SOCKET PROVISION*</b>
<b>P.E. OFFICE. (9M<sup>2</sup>)</b>	2 PCNP*	3
<b>GENERAL PURPOSE AREA. (180M<sup>2</sup>)</b>	1 WAPNP, 2 NP & 1 ENBNP	5
<b>FITNESS SUITE</b>	None	-
<b>**MAIN SWITCH ROOM</b>	2 SNP*	3
<b>**BOILER ROOM</b>	2 SNP*	3
<b>**P.E. HALL</b>	5 WANP & 2 PCNP	3
<b>**P.E. BALCONY</b>	2 PCNP*	3
<b>**SOCIAL AREAS (PER FLOOR)</b>	1 WAPNP	-

## Notes:

\* These NPs shall be terminated in a twin RJ45 type socket. Additional power socket outlets to ensure compliance with the DoES requirement for 1.5 twin power socket outlets per NP are not required in these location. 1.5 twin power socket outlets will suffice.

\*\* No room layout drawings for these spaces.

## 7.12 ROOM LAYOUT DRAWINGS

Refer to the [Design Guidance](http://www.education.ie/en/School-Design/Design-Guidance/) of the DoES website [School Building & Design](http://www.education.ie/en/School-Design/Design-Guidance/), i.e. <http://www.education.ie/en/School-Design/Design-Guidance/> for copies of both the new and old room layout drawings.

Where a copy of a room layout drawing is required it should be "Printed to Fit" on an A3 size sheet.

## 8. DIGITAL PROJECTOR INSTALLATION

Two different types of digital projector installations i.e. short throw wall mounted and ceiling mounted can be found in post primary schools.

Short throw type projectors are preferred and recommended over ceiling mounted ones in all teaching spaces in post primary schools.

A digital projector shall be provided in all teaching spaces, the Library and PE hall in post primary schools.

In teaching spaces they shall be provided on the teaching wall.

Infrastructure consisting of dado trunking incorporating network points and a Projector and Audio Faceplates (PAF) to facilitate final input connections from a computer, and output connections to a digital projector shall be provided on the teaching wall. Refer to DoES drawing [RT-ICT-A-100 Wi-Fi Short Throw Digital Projection Installation](#).

Some specialist rooms in existing schools may have ceiling mounted digital projection systems and may also contain a rostrum at the teacher's base within the room. Refer to DoES drawings [RT-ICT-A-101 Wi-Fi Ceiling Mounted Digital Projectors in a Room with a Rostrum](#) and [RT-ICT-A-102 Wi-Fi Ceiling Mounted Digital Projectors in a Room without a Rostrum](#) for further guidance on the digital projector installations in these teaching spaces.

Copies of these drawings can be found in [APPENDIX E: DIGITAL PROJECTOR DRAWINGS](#).

Depending on which configuration i.e. required a PAF shall consist of a combination of some of the following:

- 1 No. Video Graphics Array (VGA) socket
- 1 No High Definition Multi-media Interface (HDMI) socket
- 1 No Mini stereo jack plug audio input socket
- L&R Audio-output Phono type sockets

Refer to prevailing DoES [TGD-031, Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#) for specific details of what is required.

The school authorities will be responsible for purchasing and having the digital projectors installed by others. They are not part of the contract for a new school or extension.

Proper choice of digital projectors and white boards eliminates the need for black out blinds in teaching spaces and specialist rooms.

For information on digital projectors and presentation options in classrooms refer to the [Presenting in the Classroom Section](#) of the PDST Technology in Education website i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/Presenting-in-the-Classroom/>.

Where a digital projector is cabled via a computing device to the school data network, Teacher and Student Tablets can share their screen on a digital projector (or interactive flat screen if this was the preferred display) using the school wireless system.

In the case of new schools or extensions to existing schools the Building Services Consulting Engineer shall liaise with the school authority to see if ceiling mounted digital projectors are being considered. He should also liaise with the Architect to ensure that a suitable anchor point is provided in the ceiling for any digital projector being provided.

## 9. INTERACTIVE FLAT SCREENS

The option of providing interactive flat screens instead of digital projectors for display in post primary schools may be considered by school authorities.

Refer to [Presenting in the Classroom Section](http://www.pdsttechnologyineducation.ie/en/Technology/Presenting-in-the-Classroom/) of the PDST Technology in Education website i.e. <http://www.pdsttechnologyineducation.ie/en/Technology/Presenting-in-the-Classroom/> for advice and guidance on screen sizes for interactive flat screen in teaching spaces.

School authorities should note that based on current prices these are currently more expensive than digital projectors. However as the demand for interactive flat screens increases this may change in the future.

In the case of new schools or extensions to existing schools where school authorities are proposing interactive flat screens as the preferred means of the display in some or all of the teaching spaces they should make their intentions known at the Pre-stage 1 meeting with the DoES Technical Staff.

They should also liaise with their Design Teams, in particular the Architect and Building Services Consulting Engineer at an early stage in the design process and advise them of this.

The provision of interactive flat screen has implications for:

- The layout and locations of the secondary white boards on the teaching wall
- The layout of the ICT infrastructure required for an interactive flat screen

The layouts as detailed on the relevant DoES room layout drawing will need revision to cater for interactive flat screens. For example where an interactive flat screen is being provided on a teaching wall in lieu of a ceiling mounted digital projector the ICT infrastructure i.e. the DPNP, PAF and power socket outlet, associated with a digital projector will have to transfer to the teaching wall.

The provision of interactive flat screen may also have implications for the layout of the ICT dado trunking on teaching walls.

The Design Team shall seek guidance from the DoES at the Pre-stage 1 meeting on how to address the issues involved. Any resulting changes to the ICT layout in teaching spaces must be fully detailed, costed and justified at Stage 2a.

## 10. TESTING COMMISSIONING & RECORD DRAWINGS

Test set up and test equipment specification as per TSB 67 October 1995 or to most recent standards where applicable.

Test results shall be supplied to the consultant and client prior to acceptance of the installation. Results shall be supplied as a word file, in printed and electronic format.

Optical attenuation on all fibre optic links shall comply with current edition or most recent standards where applicable of ISO11801.

As a minimum the following results shall be provided per fibre optic cabling link, Connection Map, Length, Attenuation.

Horizontal cabling links shall be tested to TIA/EIA 568A Basic Link.

As a minimum the following results shall be provided in a link performance certificate per horizontal cabling link;

- Connection Map; Length (or propagation delay)
- DC loop resistance/Pair; Capacitance per pair
- Attenuation per pair (0-100MHZ); ACR per pair
- Near End Cross Talk (NEXT) per each pair combination (0-100MHZ)

On completion, the supplier shall provide full test results in a bound paper form and on a CD.

On completion, the supplier shall provide as constructed drawings in AutoCAD 2014 or latest addition format as detailed above.

## 11. M&E SERVICES INFRASTRUCTURE

This section details the Mechanical and Electrical (M&E) services associated with a Wi-Fi ICT infrastructure

### 11.1 SERVICES TO PRIMARY DATA COMMUNICATIONS EQUIPMENT

The following outlines the requirements for services to the primary data communication equipment

#### 11.1.1 DATA COMMUNICATIONS CENTRE

The Data Communications Centre (DCC) shall not contain elements of the mechanical installation in the school i.e. no pipe work or duct work shall be routed through this space under any circumstances.

A basic mechanical extract ventilation installation shall be provided in the DCC. It shall consist of a suitably sized fan located at high level in/on the ceiling of the DCC to extract hot air from the DCC into the corridor area. It shall be controlled by a lockable room thermostat set at 25°C. A passive air intake from outside shall be provided dropping to low level in the DCC to provide make up air to extract system.

In the interest of reducing energy consumption the principle of virtualization of the main servers to just one server should be considered. This will reduce the communications power consumption, heat gains and running costs significantly, refer also to [www.energyineducation.ie](http://www.energyineducation.ie) for further advice and guidance.

Refer also to [APPENDIX C: ENERGY IN EDUCATION ENERGY FACT SHEET](#).

When purchasing ICT equipment the school authority should also consider the provision of low energy equipment in the DCC.

A local electrical sub distribution board shall be provided in the DCC. The design capacity will need to be established on site but as a minimum a 35 Amp single-phase electrical supply shall be provided.

A small Uninterrupted Power supply unit shall be considered for the main server to back up the electronic equipment. This unit shall be supplied and installed as part of the school's [Schedule of ICT Equipment](#) and not form part of a building contract.

Where 3-Phase power is available only one phase shall be used per room.

A dedicated earth from the main earth bar at the main LV switchboard shall be provided to the DCC to serve each of the data cabinets. The design capacity will need to be established on site.

A dedicated line (ExchL) from the telecommunications provider for Internet (WAN) connection shall be located in the room.

A fire extinguisher shall be provided of suitable class for electrical equipment.

A smoke detector shall be located in the room.

As automatic fire suppression system will not be provided to protect data or equipment, a local management system shall be put in place to protect important stored information.

#### 11.1.2 MAIN DISTRIBUTION FACILITY

Power supply to each cabinet shall be via a separate industrial type plug and socket outlet to IS/EN 60309 from a dedicated MCB so as to eliminate the risk of nuisance tripping. This shall be terminated in a switched spur, with a trailer lead directly connected and mounted in the cabinet.

Electrical power socket outlets shall be provided. The number of power socket outlets can be calculated by dividing the number of network points by twenty four. At least two additional power socket outlets shall be provided for expansion.



Surge protection shall be considered at the input to the LV board. In new schools this shall be provided on the main incoming electrical supply to the school and will not be necessary at this board.

### 11.1.3 INTERMEDIATE DISTRIBUTION FACILITY

A local electrical sub-distribution board shall be provided. The design capacity will need to be established on site but as a minimum a 35 Amp single-phase electrical supply shall be provided.

Power supply to each cabinet shall be via a separate industrial type plug and socket outlet to IS/EN 60309 from a dedicated MCB so as to eliminate the risk of nuisance tripping. This shall be terminated in a switched spur, with a trailer lead directly connected and mounted in the cabinet.

Electrical power socket outlets shall be provided. The number of power socket outlets can be calculated by dividing the number of network points by twenty four. At least two additional socket outlets shall be provided for expansion. A minimum of eight power socket outlets shall be provided.

A fire extinguisher shall be provided of suitable class for electrical equipment.

A smoke detector shall be located in the room.

### 11.1.4 SURGE PROTECTION

Surge protection is required on the electrical installation associated with Main Distribution Facilities (MDF) and Intermediate Distribution Facilities (IDF) in schools.

In the case of new schools or extensions to schools this is provided on the main switchboard, on the local sub-distribution board in a Data Communication Centre, on local sub-distribution boards associated with IDF and on local sub-distribution boards in computer rooms as part of a building contract.

In the case of existing schools consideration should be given to the provision of surge protection on similar distribution boards as part of the Wi-Fi ICT installation.

## 11.2 SERVICES TO TEACHING SPACES & OTHER ROOMS

The following outlines the requirements for the M&E services to the General Classrooms, Computer Rooms, Specialist Rooms and other rooms and areas where network points are required.

In new schools they shall be laid out as per DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools and the DoES room layout drawings for post primary schools](#).

In existing schools the layout of network points and associated M&E services may need to be adapted to suit the spaces involved. Where this is the case this should be discussed and agreed with the school authority at an early stage in the design development.

### 11.2.1 SERVICES TO GENERAL CLASSROOMS

In new schools 3 network points as outlined on the DoES [RT – 001 Wi-Fi](#), Digital Projector Installation drawing [RT- ICT - A 100 Wi-Fi](#) and described in [SECTION 8 DIGITAL PROJECTOR INSTALLATION](#) above shall be provided. Refer also to [APPENDIX E: DIGITAL PROJECTOR INSTALLATION DRAWINGS](#).

In existing schools the position of new network points shall be agreed with the school authority prior to design development. Possible glare and reflections on the screen should be borne in mind when deciding on the network point locations

Local distribution within the room shall be via three-compartment trunking and in the ceiling space.

The trunking shall drop directly from the services void above or rise directly from the services ceiling below.

The network points shall connected directly to the MDF or via the IDF whichever is more economical.

The power socket outlets shall be wired on a dedicated circuit incorporating RCD & MCB protection from a local distribution board.

The power socket outlet fixings used on the trunking shall be of the range recommended for the trunking.

The light installation shall be as outlined in the DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#)

### 11.2.2 SERVICES TO COMPUTER ROOMS

The layout of the network points and associated power socket outlets shall be as outlined on the relevant DoES room layout drawings, the relevant digital projector installation drawing and in [SECTION 8 DIGITAL PROJECTOR INSTALLATION](#) above. Refer also to [APPENDIX E: DIGITAL PROJECTOR INSTALLATION](#).

The network points shall be connected directly to the MDF or via the IDF whichever is more economical.

The position of network points in existing schools shall be agreed with the school authority prior to design development.

A key lockable type local electrical sub-distribution board shall be provided in all Computer Rooms. In new schools and extension to schools surge protection shall be provided on the sub-board as part of the building contract.

In Computer Rooms in existing school buildings where there is no surge protection on the electrical supply consideration to the provision of this on the input to the sub-board.

A key operated isolating switch with no emergency knock off facility, controlling the power supply to all computer power socket outlets only in the room sockets, shall be located at the entrance to the room.

Local distribution within the room shall be via 100 x 50mm three-compartment dado trunking. Power sockets and fixing used on this trunking shall be of the range recommended for the trunking.

The trunking shall drop directly from the services void above or rise directly from the services ceiling below.

Three number un-switched 13Amp power socket outlets shall be allowed per computer station.

No more than four computer stations (12 socket outlets) shall be powered per RCD with appropriate MCB protection or whatever number of computer stations is recommended by respective manufacturers so as to eliminate the risk of nuisance tripping.

Lighting shall be as detailed in [Section 12.11 LIGHTING INSTALLATION](#) below and as outlined in the DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#).

The ventilation and heating services shall be as outlined in the DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#)

### 11.2.3 SERVICES TO SPECIALIST ROOMS

The layout of the network points and associated power socket outlets shall be as outlined on the relevant DoES room layout drawings, the relevant digital projector installation drawings and in [SECTION 8 DIGITAL PROJECTOR INSTALLATION](#) above. Refer also to [APPENDIX E: DIGITAL PROJECTOR INSTALLATION](#).

The position of network points in existing schools shall be agreed with the school authority prior to design development.

The network points shall be connected directly to the MDF or via the IDF whichever is more economical.

Local distribution within the room shall be via 100 x 50mm three-compartment dado trunking. The final position of network points and power socket outlets shall be above desk height. Power sockets and fixing used on this trunking shall be of the range recommended for the trunking.

The trunking shall drop directly from the services void above or rise directly from the services ceiling below.

Three number un-switched 13Amp power socket outlets shall be allowed per computer station and one printer (as scheduled).

No more than four computer stations (12 socket outlets) shall be powered per RCD with appropriate MCB protection or whatever number of computer stations is recommended by respective manufacturers so as to eliminate the risk of nuisance tripping.

Computer station power socket outlets shall be served from the local sub-distribution board in the specialist room and shall be controlled by a key operated isolating switch located near the teacher's base

Lighting shall be as outlined in the DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#).

#### **11.2.4 SERVICES TO OTHER ROOMS & AREAS**

The layout of the network points and associated power socket outlets shall be as outlined on the relevant DoES room layout drawings and the relevant digital projector installation drawing. Refer also to [APPENDIX E: DIGITAL PROJECTOR INSTALLATION](#).

The position of network points in existing schools shall be agreed with the school authority prior to design development.

The network points shall connected directly to the MDF or via the IDF whichever is more economical.

Where necessary, local distribution within the rooms shall be via 100 x 50mm three-compartment dado trunking. Power sockets and fixing used on this trunking shall be of the range recommended for the trunking.

The trunking shall drop directly from the services void above or rise directly from the services ceiling below.

The final position of network points and power socket outlets shall be above desk height.

Power socket outlets shall be wired on a dedicated circuit incorporating RCD & MCB protection from a local distribution board.

Lighting shall be of the direct type only using linear fluorescent fittings as per DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#).

## 12. ELECTRICAL SPECIFICATION

### 12.1 GENERAL REQUIREMENTS

All cableways (cable trays, trunking, conduit, wall boxes and dado trunking where appropriate) shall be completely installed by the Electrical Contractor prior to the beginning of the structures cabling installation.

In general, cable trays shall be specified as wide and flat, rather than deep. In no case shall cables be laid more than six deep into a cableway.

No cableway shall be filled more than 60% after the initial installation.

Maximum loading for a cableway after upgrades and additions is 75%.

Gutter bolts shall be secured with the head inside and the nut outside.

For fibre optic cable, basket and tray are acceptable: it is not normally possible to guarantee the bend radius required for fibre in trunking. Conduit shall not be used for fibre optic cable, except for completely straight runs.

Carrier systems shall be bonded using flat-earth straps in accordance with current standards.

Where cable trays are used or vertical runs are required, cables shall be clipped to trays using loosely attached cable ties. Where cable ties are used to secure structured cables, they shall be tied in bundles. Bundles shall be no greater than ten cables per bundle. Under no circumstances shall cables be tied tightly.

The shortest possible routes shall be used; drops and rises shall be minimised.

Power may not be run in the same compartment as structured cabling, under any circumstances.

Lift or elevator shafts may not be used as routes for wiring.

Where crossovers exist, some cross-sectional area of cableways may be lost. All calculations of required cable tray dimension refer to the minimum dimension of the tray, including crossovers.

Where trunking or conduit passes through fire compartment walls, floors and ceilings, holes must be sealed with sealing compound giving appropriate rating of fire stability, to BS476 Part F.

### 12.2 POWER SOCKET OUTLET REQUIREMENTS

The use of double adaptors to connect one or more computers or monitors to a single power socket outlet is not permitted. Each computer station application shall have power socket outlets as outlined earlier.

The final position of the data and power socket outlets shall be above desk height.

Power socket outlets and fixings used on this trunking shall be of the range recommended for the trunking.

Where equipment will be permanently plugged in and the plug will not be readily accessible then either a flush dual power socket outlet without switches or a flush single power socket outlet without switches shall be specified.

In general where equipment will be plugged into accessible power socket outlets then either a flush un-switched type twin power socket outlet with dual earth terminals, or a flush un-switched type single power socket outlet with dual earth terminals shall be specified.

Power socket outlets in laboratories and specialist rooms shall be un-switched, power socket outlets in general classrooms and offices shall be double pole switched type. These shall be specified on accompanying drawings. Separate power socket outlets shall be provided for cleaner's usage.

### 12.3 ELECTRICAL DISTRIBUTION BOARDS

All computer and equipment power socket outlets are to be serviced using 20 amp MCB/30mA RCD's for radial circuits.

Each Computer Room should have its own sub-distribution board dedicated to that room only.

In dedicated Computer Rooms no more than four computer stations (12 power socket outlets) shall be powered per RCD with appropriate MCB protection or whatever number of computer stations is recommended by respective manufacturers so as to eliminate the risk of nuisance tripping.

All DCC's shall have a dedicated distribution panel.

### 12.4 MAIN DATA CABLE-WAYS

Many different cable tray types exist for use in data installations. Each has its own characteristics and benefits; each has its appropriate application.

The Building Services Consulting Engineer must establish compatibility between the cabling and the carrier system

### 12.5 STEEL TRUNKING

Steel trunking may be used for structured cabling in floor and ceiling voids and in ducts, or for direct mounting of outlets, in areas where additional durability is required (e.g. plant spaces and service areas)

### 12.6 FLOOR TRUNKING

Floor trunking and outlets shall be avoided in schools due to trip hazards and spillage over time from cleaning etc.

### 12.7 CABLE TRAY

Galvanised cable tray is the most commonly used cableway for main runs. Ensure tray is well supported.

As cables shall be run no more than six deep, cable trays shall be specified as wide and flat no more than 50 mm deep.

### 12.8 BASKETS

Baskets may be used for fibre optic cables, RF and audio-visual cables, but are not recommended for structured cabling (the mesh only makes contact with the cabling at points, potentially causing a pressure point on the cable).

### 12.9 COMPARTMENT TRUNKING

In all cases where dado trunking is being provided, care shall be taken to ensure that adequate clearance exists around the trunking for safe and easy insertion of power socket outlets and data sockets. Co-ordination between furniture and electrical installer may be required.

To allow for flexibility three-compartment trunking shall be used in all areas.

The bottom of the trunking shall be 150 mm above desk height. Both power socket outlets and data sockets and fixings used on this trunking shall be of the range recommended for the trunking.

For under-bench areas, or areas where aesthetic qualities are not critical, box trunking may be used.

Where power and up to fifteen data cables are to be run, 100x50 mm trunking may be used (assumes no socket box deeper than 35 mm).

Where power and up to thirty data cables are to be run 100x100 mm trunking with a cable divider may be used (assumes no socket box deeper than 35 mm), power and data cables must be kept separate by the divider; alternatively three compartment trunking may be used with two of the compartments used for data.

Where greater than thirty cables will be run, separate trunking must be provided for power and data.

The Electrical Contractor as part of the infrastructure contract will provide RJ45 data sockets and patch panels for connection at local switches.

## 12.10 STEEL CONDUIT

Steel conduit shall be used to drop to individual points and for AV usage. The exact depth of wall boxes must be agreed with the structured cabling installer prior to installation. This may be critical for the mechanical properties of some modular outlet systems.

With UTP cable on straight runs, it is possible to pass four UTP cables through 20 mm conduit and up to six UTP cables through 25 mm conduit. Cables shall be pulled in one operation; if cables are not pulled together, new cables being pulled through a conduit may damage existing cables.

Care shall be taken to remove all burrs and sharp edges; glands, grommets etc. shall be used at ends of conduit to ensure no damage to cables.

Any conduit run shall have no more than two bends between inspection boxes and the bends shall not exceed the bend radius of the cable.

Conduit drops and runs shall be co-ordinated with locations of chalkboards, whiteboards, pin boards etc

## 12.11 LIGHTING INSTALLATION

The guidelines in this section relate to dedicated Computer Rooms only. Lighting in all other teaching spaces, offices etc shall be as per DoES [TGD-003 Mechanical & Electrical Building Services Engineering Guidelines for Post Primary Schools](#) and [TGD-031, Rev. 1 Amendments to the M&E Building Services Guidelines \(2004\) TGD-003 & ICT Infrastructure Guidelines TGD-005 for Post-primary Schools](#).

### 12.11.1 GENERAL LIGHTING GUIDELINES

It is important that, when designing a lighting environment, the display equipment must be sufficient to meet the required standards. All monitors etc. must adhere to the minimum requirements of EN29241/ISO9241 (Ergonomic Requirements for Office Work with VDU's)

Anti-glare filters on monitors are generally not required where a proper approach has been taken to lighting. These should only be used in exceptional circumstances to alleviate a particular or unique problem.

The ideal luminance of the area visually surrounding a monitor will be similar to the luminance of the monitor itself. Luminance in the visual field around a monitor shall not exceed the luminance of the monitor by more than 10:1.

Care shall be taken to ensure that large differences in luminance levels are not present in the field of view whilst using a monitor. For example bright white walls or ceilings or benches with reflective surfaces may be an issue.

With regards to the colour of materials in a Computer Room, persons unfamiliar with ergonomics will request bright cheerful colours with good contrast; this would be normal in a classroom environment. From an ergonomic point of view, it is important to have pastel colours, colours of similar brightness and as few eye-catching effects as possible. The Building Services Consulting Engineer shall advise the school authority and the Architect, where one is employed on a new school or school extension project of this issue at an early stage in the design development.

Care shall be taken to ensure worktops are not excessively reflective and that the colour and luminance of bench worktops does not greatly contrast with the rest of the room environment.

Care shall be taken to ensure walls are not excessively reflective and that the colour and luminance of the walls does not greatly contrast with the rest of the room environment.

It is becoming more common in computer environments to have:

- Plain cement finish (unpainted)
- Plain block finish (unpainted)
- A matt vinyl paint finish

### 12.11.2 NATURAL LIGHTING

Windows in Computer Rooms shall be designed as wide and low rather than narrow and high to minimise the area of bright, visible sky.

The use of reflective coatings on windows or tinted glass shall generally be discouraged as they rarely provide a solution in isolation. They may be necessary on existing south facing sections of buildings.

On a new school design the Computer Room shall be located on the north facing elevation.

For all but north facing windows, special care must be taken to ensure that direct sunlight can be limited. Night-time effects such as reflectance of internal lighting from windows may also cause problems

### 12.11.3 ELECTRIC LIGHTING

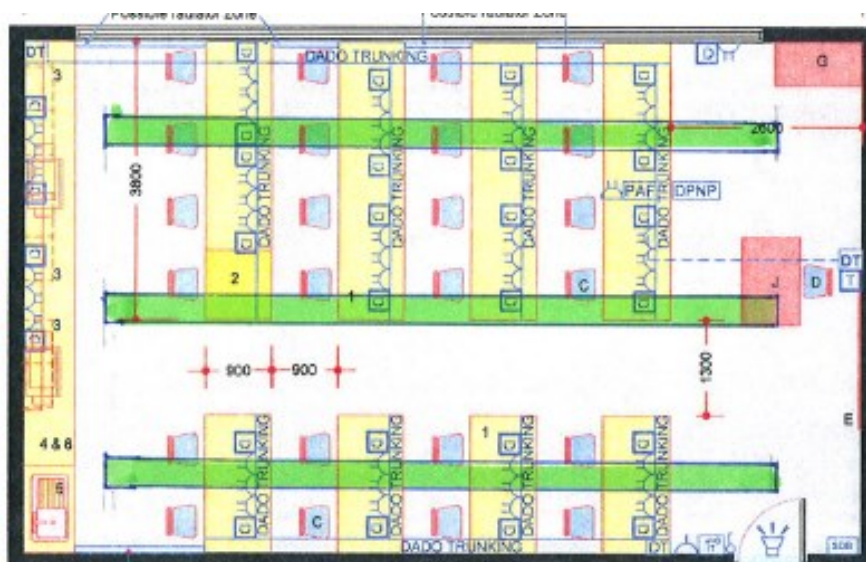
Lighting designs shall be based on direct lighting (no up lighting). While light levels in specialist rooms shall be 500 lux a light level of n300 lux is satisfactory in Computer Rooms.

Luminaires shall be high frequency linear fluorescent lighting.

A luminance limit of 200cd/m<sup>2</sup> at 65° elevation shall be provided in Computer Rooms in accordance with EN 12646-1:2002.

In a Computer Room automatic lighting controls shall be based on manual On/Off switching, absence detection and day lighting sensing so that lights will need to be switched on manually and will then dim/turn off automatically depending on the signals from the automatic controls.

### 12.11.4 LIGHTING LAYOUT



Lighting zone to incorporate local control on light fittings nearest the teaching wall ( see TGD-031)

Fig. 3, typical lighting layout in a computer room.

Layout is of critical importance. By placing monitors at right angles to the source of light, glare and reflections are reduced or avoided. The layout below shows a Computer Room with 3 benches and a window. The benches (and therefore the monitor screens) are positioned that the window and fluorescent light fittings shall have minimum reflections.



## APPENDIX A: LIST OF ACRONYMS

The following is a glossary of the acronyms used in document.

ACRONYM	MEANING
<b>ACR</b>	Attenuation-to-Crosstalk Ratio
<b>AP</b>	Access Point (the wireless equipment that communicates to wireless devices)
<b>APP</b>	Application Software, a computer programme designed to run on smartphones, tablet computers and other mob. devices
<b>AUP</b>	Accepted Usage Policy
<b>BC</b>	Balanced Cable
<b>BYOD</b>	Bring Your Own Device
<b>C&amp;C</b>	Community & Comprehensive
<b>CAD</b>	Computer Aided Design
<b>DCC</b>	Data Communications Centre
<b>DPNP</b>	Digital projector Network Point
<b>ENBNP</b>	Electronic Notice Board Network Point
<b>ETB</b>	Education and Training Boards
<b>HDMI</b>	High Definition Multi-media Interface
<b>ICT</b>	Information and Communication Technology
<b>IDC</b>	Insulation Displacement Connector
<b>IDF</b>	Intermediate Distributor Facility
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>ICNIRP</b>	International Commission for Non-Ionising Radiation Protection
<b>IPCCTVNP</b>	IP CCTV Camera Network Point
<b>IPTNP</b>	IP Telephony Network Point
<b>IPv4</b>	Internet Protocol Version 4 (existing IP networking standard)
<b>IPv6</b>	Internet Protocol Version 6 (new IP networking standard)
<b>IR</b>	Infrared link
<b>IWB</b>	Interactive Whiteboard
<b>JMB</b>	Joint Management Board
<b>LAN</b>	Local Area Network (i.e. the school network)
<b>LR</b>	Laser Link
<b>LSHR</b>	Low Smoke Halogen Free
<b>MDF</b>	Main Distributor Facility
<b>MDM</b>	Mobile Device Management (software for managing devices)
<b>MM</b>	Multimode Fibre
<b>NCCA</b>	National Council for Curriculum Assessment
<b>NCTE</b>	National Centre for Technology in Education

<b>NEXT</b>	Near End Cross Talk
<b>NIC</b>	Network Interface Card
<b>NPS</b>	National Procurement Services
<b>PABX</b>	Private Automatic Branch Exchange
<b>PAF</b>	Projector and Audio Faceplate
<b>PC</b>	Personal Computer
<b>PCNP</b>	PC Network Point
<b>PDST</b>	Professional Development Service for Teachers
<b>PNP</b>	Printer Network Point
<b>POE</b>	Power Over Ethernet (allows APs to be powered electrically via the Cat 6 network cable)
<b>QOS</b>	Quality of Service
<b>RF</b>	Radio Frequency
<b>RFT</b>	Request for Tender
<b>SAR</b>	Segmentation and Reassembly of data packets in a computer network
<b>SC</b>	Subscriber Connector
<b>SCRNP</b>	Swipe Card Reader Network Point
<b>SEN</b>	Special Educational Needs
<b>SLA</b>	Service Level Agreement
<b>SM</b>	Single Mode Fibre
<b>SNP</b>	Services Network Point
<b>SPU</b>	School Procurement Unit
<b>SSE</b>	School Self Evaluation
<b>SSID</b>	Security Set Identifier
<b>TPNP</b>	Teacher Position Network Point
<b>UPS</b>	Uninterruptable Power Supplies
<b>UTP</b>	Un-insulated Twisted Pair
<b>VDU</b>	Visual Display Unit
<b>VGA</b>	Video Graphics Array
<b>VoIP</b>	Voice over Internet Protocol
<b>WAPNP</b>	Wireless Access Point Network Point
<b>WAP</b>	Wireless Access Point
<b>Wi-Fi</b>	Wireless Fidelity (is used regularly in place of the term 'wireless')
<b>WLAN</b>	Wireless Local Area Network
<b>WNIC</b>	Wireless Network Interface Card
<b>WEP</b>	Wired Equivalent Privacy (older wireless security standard)
<b>WPA2</b>	Wi-Fi Protected Access version 2 (more recent wireless security standard)

**APPENDIX B: LETTER FROM DEPARTMENT OF THE ENVIRONMENT, COMMUNITY & LOCAL GOVERNMENT**



Comhshaol, Pobal agus Rialtas Áitiúil  
Environment, Community and Local Government



Karan Murtagh  
ICT Policy Unit  
Department of Education & Skills  
Marlborough Street  
Dublin 1

Dear Ms. Murtagh,

I refer to your letter of 15 August 2013 and your colleague's request of 21<sup>st</sup> May 2015 for an updated response by the Department of Environment, Community & Local Government regarding concerns raised about exposure to electromagnetic fields from Wi-Fi systems.

- The issue of the potential health effects of electromagnetic fields was the subject of an Expert Group Report commissioned by the Government and published in March 2007. This report, entitled Health Effects of Electromagnetic Fields, which considered issues such as digital signals, microwaves and mobile phone masts, is available for download on my Department's website at:  
<http://www.environ.ie/en/Publications/Environment/EnvironmentalRadiation/>.
- The Expert Group reported that the majority scientific opinion was that no adverse short or long-term effects have been demonstrated from exposure to electromagnetic fields at levels below the limits recommended by the International Commission on Non-Ionising Radiation Protection (ICNIRP). Extensive international research on the issue continues to be co-ordinated through bodies such as the World Health Organisation (WHO).
- A substantial volume of further research on this issue is being carried out internationally by bodies with responsibility for monitoring the health effects of electromagnetic fields, including the European Commission's Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). This Committee recently published a Final Opinion on Potential Health Effects of Exposure to Electromagnetic Fields, updating its previous opinions from 2009 and taking account of the many studies undertaken in the intervening years. The Report can be found at the following weblink:  
([http://ec.europa.eu/health/scientific\\_committees/emerging/docs/scenihr\\_o\\_041.pdf](http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf)).
- The findings of this research are being monitored by the (WHO) EMF Project; it is expected that a report will issue from the WHO in 2016. This Department continues to monitor this and other scientific evidence as it is made available and will consider any policy implications in this context.
- In addition, this Department recently commissioned a study on international developments in non-ionising radiation (NIR) and electromagnetic fields (EMF) research since publication of the 2007 Expert Group Report. The study is also examining how the issue of NIR/EMF is dealt with in other jurisdictions and is expected to be completed in the coming weeks. The analysis and findings of this study will be used by a Steering Committee, convened and chaired by this Department, to make specific proposals relating to the future management of these

matters including, inter alia, any consequent legislative amendments and provision of appropriate technical expertise and associated resources.

- The International Commission for Non-Ionising Radiation Protection (ICNIRP) has established limits for general exposure to non-ionising radiation. There is no scientific evidence to date that exposure up to these limits is damaging to health. The ICNIRP reference limits find widespread international acceptance such as by the World Health Organization and the European Union. They are science-based and have been agreed by the majority of the best international scientific minds with knowledge of the latest research. There is a minority view held by some scientists as expressed in the report *Safe Schools 2012* that the limits are not adequate and that exposure to very low level electromagnetic fields is injurious to health. There has been ample opportunity for this view to be reconsidered by scientific meetings and committees but the fact remains that the ICNIRP limits have near universal acceptance.
- Wi-Fi systems transmit at low power levels and are in widespread use. All modern short range radio systems such as Wi-Fi, Bluetooth or Ultra-wide Band are assessed for safety by the strength and frequency of their radio emissions. These emissions are then compared with the limits allowed by the International Commission of Non-Ionising Radiation Protection. If the radio system emits fields less than these limits, they are considered safe. Thus the advantage of having adopted international exposure limits is that they provide information on safe levels of electromagnetic field exposure from any existing device or any device produced in the future, but also provides manufacturers with the exposure limits within which they must manufacture their devices. Within the European Union, devices having the “CE” mark are considered to be safe for their intended purpose.
- It should be remembered that exposure from Wi-Fi systems is considerably less than that from using a mobile phone. In the report *Health Effects from Electromagnetic Fields* (April 2012), the UK Health Protection Agency (HPA) has included the results of studies of Wi-Fi in schools. These have found for example that with 15 laptops and 12 access points operating at 2.4 GHz, the maximum power density values for the laptops and access points at 0.5 metre distance were 22 and 87 milliwatts per square metre. At 1 metre distance these figures dropped to 4 and 18 milliwatts per square metre. These power densities are considerably lower than the ICNIRP reference level of 10 watts per square metre. In addition, an estimate of the Specific Absorption Rate of power by a sitting child was modelled and this found the level of SAR for the head to be less than 1% of the calculated SAR for typical mobile phone exposure. Another scenario involving 30 laptops and an access point transmitting maximal power indicated personal exposure to a power density of 16.6 milliwatts per square metre, a very small fraction of the ICNIRP level. These values were measured and estimated under the assumption of continuous transmission. However the nature of real Wi-Fi usage as measured in a sample classrooms (primary and second level) by the HPA means that laptops and access points are usually receiving far more frequently than they are transmitting and time-averaged exposure is likely to be even lower in practice.
- The Department sees no reason at this time, based on existing scientific research, why Wi-Fi should not continue to be used in schools. This view is widely shared by, among others, the HPA (UK) and Health Canada.

Yours sincerely,

Emmet Fahy

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## **APPENDIX C: ENERGY IN EDUCATION ENERGY FACTSHEET**

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## IT EQUIPMENT

As efforts are made to reduce energy use in schools, there is one area in which energy use is increasing, namely Information Technology (IT) equipment. With the assistance of funding schemes schools are purchasing computers and interactive whiteboards (IWBs), creating a demand for electricity that did not exist a few years ago. It is essential to manage and make efforts to control this increasing demand, as it could negate any savings made in other areas, such as lighting. Fortunately many of the measures that can be taken involve little or no cost.



A lot of screens and digital projectors are in use in schools which can influence use of daylight and electric lighting. Choose quality interactive whiteboards and projectors which are appropriate for schools. This will enable daylight to continue to be used more of the time in classrooms. For guidance on purchasing Interactive whiteboards and digital projectors school should check the advice on the NCTE website. Specifically they should refer to the Digital Projector Procurement Framework.

Peer reviewed research has established that children learn better when they have access to daylight (Source: See references at end of document). With dimmer and poorer images on whiteboards, there is a tendency to close blinds and put the lights on, increasing energy use and deteriorating learning ability. Where blinds are installed and used, they should not be the black-out blinds as these will require the lights to be on. Blinds should be the open weave type recommended by the Department of Education and Skills. Open weave blinds are designed to reduce glare and maintain good daylight levels in the classroom. When purchasing flat screen monitors, only buy monitors with a matt finish to the screen. A glossy finish acts more like a mirror, and can cause "veiling reflections" of windows, necessitating blinds to be closed which, with a

matt finish screen, could be open.



Choose matt screens to reduce reflection

### Did you know?

#### Screensavers

Screensavers were designed to save the older CRT monitors from damage. They do not save energy and can actually reduce the life of a flat panel monitor by keeping the backlighting on unnecessarily.

#### Brightness

A monitor with a high brightness setting uses more energy. Reducing the brightness by 25% may not be noticeable but would save energy, provided it does not result in blinds being pulled and lights being switched on more often.

#### Standby mode

A computer still uses some energy in Standby mode but none in Hibernate mode. A computer in Hibernate can even be unplugged without affecting its status. Always use Hibernate overnight rather than Standby. Use Standby during idle times during the day.

#### Photocopier power saving

A typical photocopier may use 230W in standby and only 17W in power saving mode



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## Low and no cost measures

The most significant waste of energy is due to computers being left on when not in use.

- Computers can be set up, through their Power Management facility, to go into Standby or Hibernate modes if inactive for a set period. In Hibernate mode the computer uses no power at all but will, on reactivation, resume to the same state as it was in when it went into Hibernate mode. It is a good idea to set computers up to go into Standby mode if not used, say, for an hour or two, but to go into Hibernate mode overnight and at weekends. Alternatively, switch computers off at the end of each day.



- Use of Power Management functions is important, it is still necessary to switch off monitors manually. Awareness campaigns are an important aid to ensuring computers and monitors are switched off at the end of the day. In shared computer rooms, it is worth putting up a sign listing the last class in the room each day hence naming the teacher responsible for ensuring that all the IT equipment which can be switched off is switched off, especially on a Friday.
- Monitors use energy even when idle and it is wasteful to leave them on when the computer is not in use, even for short periods like lunch breaks. Awareness campaigns should be implemented to encourage users to switch off monitors when leaving their computers. This is particularly relevant where computers are sporadically used by different people e.g. in computer rooms and staff rooms, where they can be left idle for lengthy periods. It is very common for staff room computers to be left on all the time, unnecessarily, because no one person is responsible for the machine.



Turn off monitors

- As with computers, all office equipment should be switched off at the end of the day. Use should be made of a photocopier's energy saving functions, which will put it in power saving mode when idle. Many photocopiers will not go into power saving mode if the lid is open, so ensure that the lid is closed when not in active use.



Make sure photocopier lids are closed so they go into power saving mode

- Where Uninterruptable Power Supplies (UPS) are used, they should be switched off when the equipment they are feeding is switched off, as they will continue to use energy otherwise. In the mornings, switch on equipment when it is first needed, not routinely at the start of the working day.
- For flat panel monitors, the higher the brightness setting, the more power a monitor uses. Ensure that monitors are not automatically set to maximum brightness if unnecessary. A 25% reduction in brightness may not be noticeable but will save energy. However, do not dim monitors to the point where window blinds have to be closed and lights switched on. It's better to have a bright monitor and use daylight with the lights off rather than have the lights on.

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- Overhead projectors, Interactive whiteboards, and large flat screen TV's should be switched off at the socket rather than left on standby. When having overhead projectors, TV monitors or other devices installed which are mounted at high level, ensure that the socket is at an accessible height so that the device can easily be switched off fully. Ensure you only buy "Energy Star" version 5 or later compliant devices. They may not use much energy, but if you have two or three such devices in each classroom, the standby energy soon adds up across the school.



Make sure sockets are easy to reach

- Consider getting pupils to conduct an audit of all IT equipment in the school, and estimate how many hours per year the equipment is in active use, versus how many hours the school is closed. Try to estimate how much energy is wasted outside teaching hours.

## Top tips

- Make use of the Power Management settings on a PC. Use the Portable/Laptop option even on desktops and set the computer to Standby after a set period and Hibernate after a longer set period.
- Switch off the monitor when leaving a computer even for a short period.
- Ensure by means of an awareness campaign that all computers, peripherals and office equipment are switched off at the end of the day, especially Fridays.
- Use Power Management

## Measures requiring investment

- For computer rooms, network software can be installed which will allow the powering down of the computers to be controlled centrally by the server. Monitors and peripherals, however, will still need to be switched off manually. Many computer rooms have a dedicated electrical distribution board feeding the sockets through a device called a contactor (a kind of switch) controlled by a key, but this is often not used as it is necessary to wait until the computers have shut down before switching off the power. Replacing this key-switch control with a 24 hour/7 day time clock will ensure that no power, even to monitors, is left on out of hours. If power is still required to a server, this can still be arranged by an electrician installing the time clock.
- Peripherals e.g. printers, scanners and PC speakers are often left on even when the computer is not in use. "Intelligent" multi-sockets (extension leads) are available which switch off power to all peripherals when they sense that the main computer has been powered down. Use of such devices in conjunction with the computer's Power Management controls can provide an effective means of ensuring that a computer and all its peripherals are left in a state of zero energy usage if unattended for a prescribed period. For example, a computer going into Hibernate mode ceases to use any power. The intelligent multi-plug will sense this and automatically switch off power to all peripherals. These devices can be sourced on the internet.
- When purchasing new computers it is worth considering that laptops use considerably less power than most desktops (low energy desktops are available but can be harder to source). They also have the advantage that if they are set up to go into Standby or Hibernate if inactive, the monitor will also shut down, unlike the separate monitor used with a desktop. It is important to consider what the computer is to be used for when choosing a specification. If the machine is used mostly for web browsing and word processing then the use of a specific low energy computer may be appropriate. In particular, high end graphics cards can have larger power consumption than all the other components of the computer put together, but these graphics cards are only required for advanced 3D graphics. "On-board" graphics are normally adequate for most school uses and it is therefore not necessary to specify computers with additional graphics cards.

**energy in education**  
promoting energy efficiency in schools

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- Specifying low energy machines. When purchasing new equipment, always make it clear that the school have a preference for low energy equipment. For example: Energy consumption when operating should be less than 90W and when idle shall be less than 50W, when in sleep mode shall be less than 2W
- Rather than using one PC per workstation, there are multi-user systems available which allow a single PC to be shared by several users i.e. the PC box is connected to several screens, keyboards and mice. In a primary school classroom, for example, only one PC would be required instead of five, with up to an 80% reduction in energy usage. The number of PC's in a computer room could be greatly reduced as one PC can be shared by between 6 and 8 users.
- Buying combined peripherals e.g. all-in-one scanner/printer is not only more cost effective but also more energy efficient.

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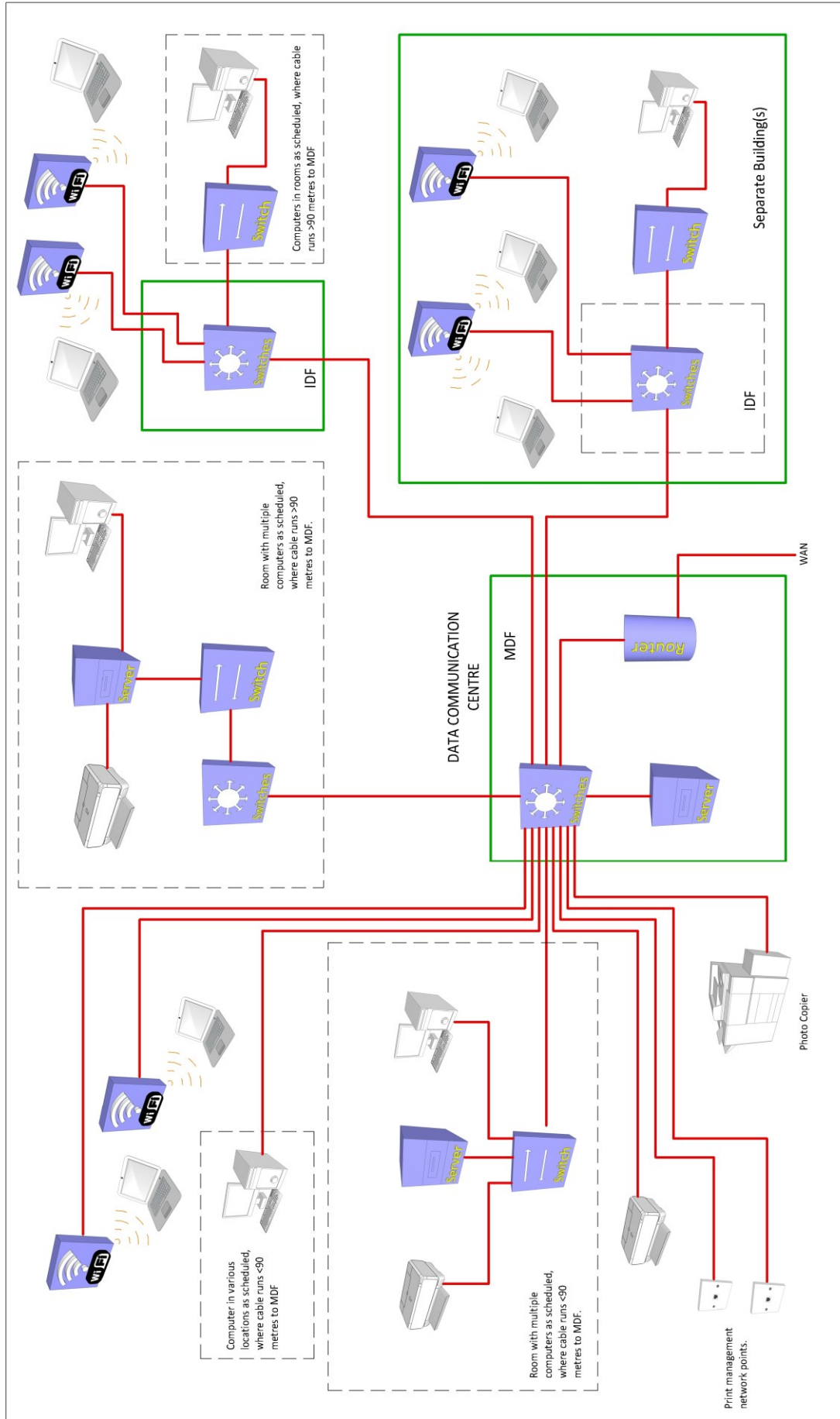
[http://www.pge.com/003\\_save\\_energy/003c\\_edu\\_train/pec/daylight/di\\_pubs/SchoolDetailed820App.PDF](http://www.pge.com/003_save_energy/003c_edu_train/pec/daylight/di_pubs/SchoolDetailed820App.PDF).

#### References

- Wall, K., Dockrell, J. and Peacey, N. (2008), *Primary Schools: The Built Environment*, Cambridge: University of Cambridge.
- Jago, E. and Tanner, K. (1999), *Influence of the School Facility on Student Achievement: Lighting; Colour*. Athens, Ga.: Department of Educational Leadership; University of Georgia, Available online at:  
<http://www.coe.uga.edu/sdpl/researchabstracts/visual/html>
- Benya, J. R. (2001), *Lighting for schools*. Washington DC: National Clearinghouse for Educational Facilities, Available online at:  
<http://www.edfacilities.org/pubs/lighting.html>, accessed 9.11.2007.
- Lemasters, L. K. (1997), *A Synthesis of Studies Pertaining To Facilities, Student Achievement, And Student Behaviour*. Blacksburg: Virginia Polytechnic and State University, Educational Leadership and Policy Studies, ERIC Document Reproduction Service No. ED447687.
- Heschong Mahone Group (1999), *Day Lighting in Schools: An Investigation into the Relationship between Day Lighting and Human Performance*. Fair Oaks,



## APPENDIX D: NETWORK SCHEMATIC DRAWING



AN ROINN OIDEACHAIS AGUS SCILEANNA  
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Planning and Building Unit

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POST-PRIMARY SCHOOL ROOM LAYOUTS:  
Typical Post Primary School ICT Network Schematic

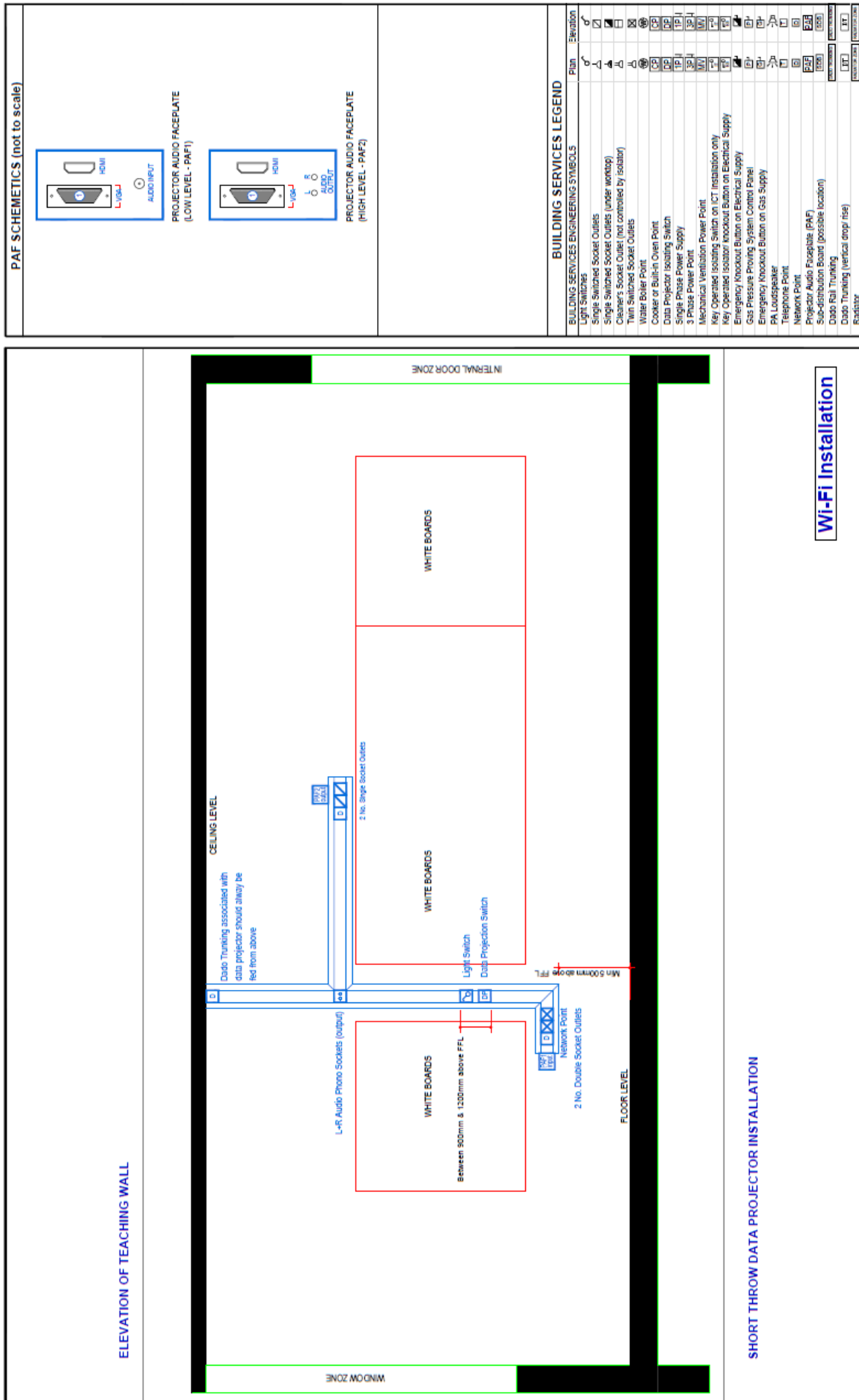
DICE NO: RT-ICT-A-103	ISSUE NO: 01	SCALE: Not to Scale	DATE: May '16
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**GENERAL NOTES:**

1. This schematic drawing is for information and reference only, and should be read in conjunction with Department's Guidance Document for the Provision of Wireless (WiFi) Network Installation in Post Primary Schools.
2. MDF = Main Distribution Facility
3. IDF = Intermediate Distribution Facility
4. MDFs housed in the Data Communications Centre (DCC)

## **APPENDIX E: DIGITAL PROJECTOR INSTALLATION DRAWINGS**



**SHORT THROW DATA PROJECTION INSTALLATION**

**RT-ICT-A-100 Wi-Fi**

ISSUE NO: 01

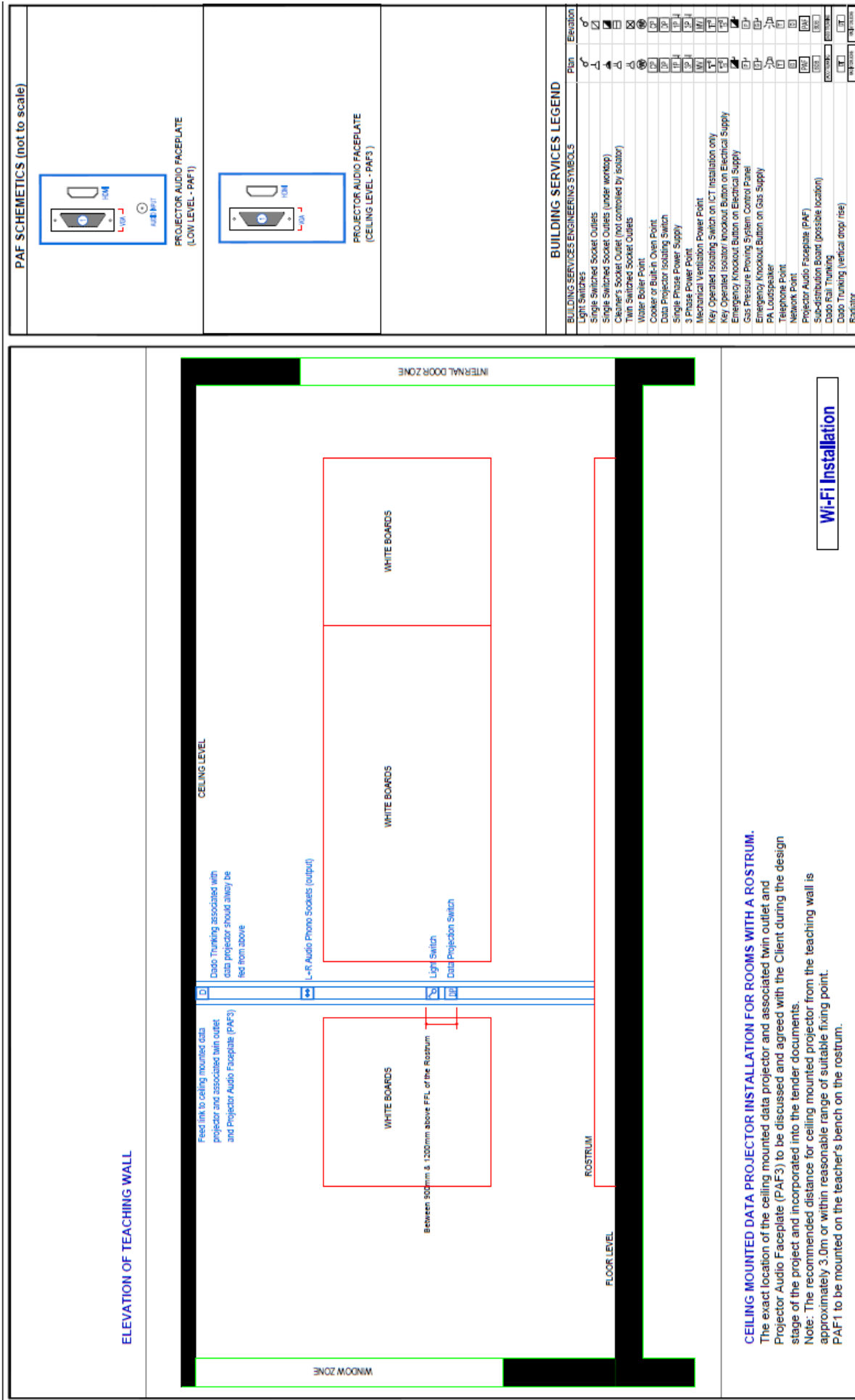
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DATE: Sept 2013

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**BUILDING SERVICES LEGEND**

Plan	Elevation
Light Switches	Light Switches
Single Switched Socket Outlets	Single Switched Socket Outlets
Single Switched Socket Outlets (under worktop)	Single Switched Socket Outlets (under worktop)
Cleaner's Socket Outlet (not controlled by isolator)	Cleaner's Socket Outlet (not controlled by isolator)
Twin Switched Socket Outlets	Twin Switched Socket Outlets
Water Boiler Point	Water Boiler Point
Cooler or Built-in Oven Point	Cooler or Built-in Oven Point
Data Projector Isolating Switch	Data Projector Isolating Switch
Single Phase Power Supply	Single Phase Power Supply
3 Phase Power Point	3 Phase Power Point
Mechanical Ventilation Power Point	Mechanical Ventilation Power Point
Key Operated Isolating Switch on ICT Installation only	Key Operated Isolating Switch on ICT Installation only
Key Operated Isolator Workout Button on Electrical Supply	Key Operated Isolator Workout Button on Electrical Supply
Emergency Knockout Button on Electrical Supply	Emergency Knockout Button on Electrical Supply
Gas Pressure Proving System Control Panel	Gas Pressure Proving System Control Panel
Emergency Knockout Button on Gas Supply	Emergency Knockout Button on Gas Supply
PA Loosening Point	PA Loosening Point
Telephone Point	Telephone Point
Network Point	Network Point
Projector Audio Faceplate (PAF)	Projector Audio Faceplate (PAF)
Sub-distribution board (possible location)	Sub-distribution board (possible location)
Door Nail Trunking	Door Nail Trunking
Door Nail Trunking (vertical ongr/ riser)	Door Nail Trunking (vertical ongr/ riser)
Rostrum	Rostrum

**CEILING MOUNTED DATA PROJECTOR IN A ROOM WITH A ROSTRUM**

RT-ICT-A-101 Wi-Fi 01

SCALE: 1:25 @ A3

DATE: Sept 2013

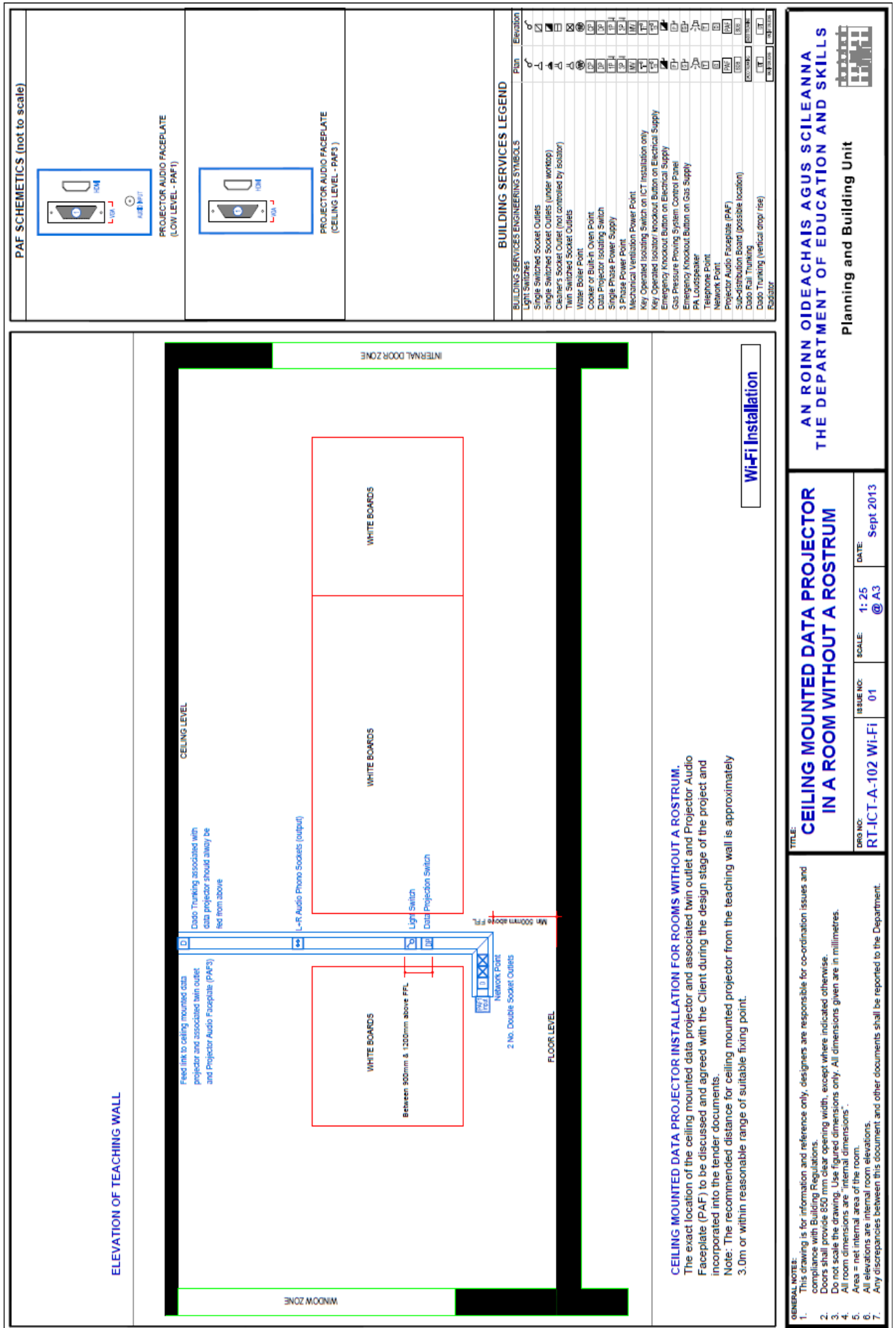
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**Planning and Building Unit**

**GENERAL NOTES:**

- This drawing is for information and reference only, designers are responsible for co-ordination issues and compliance with Building Regulations.
- Doors shall provide 850 mm clear opening width, except where indicated otherwise.
- Do not scale the drawing. Use figured dimensions only. All dimensions given are in millimetres.
- All room dimensions are "internal dimensions".
- Area = net internal area of the room.
- All elevations are internal room elevations.
- Any discrepancies between this document and other documents shall be reported to the Department.





**CEILING MOUNTED DATA PROJECTOR IN A ROOM WITHOUT A ROSTRUM**

**RT-ICT-A-102 Wi-Fi** ISSUE NO: 01 SCALE: 1:25 @ A3 DATE: Sept 2013

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