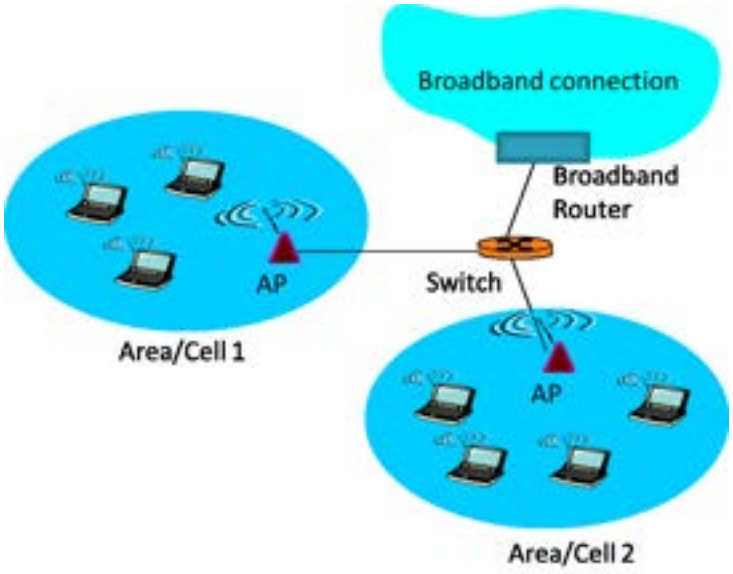

GUIDANCE DOCUMENT FOR THE PROVISION OF A WIRELESS NETWORK INSTALLATION IN PRIMARY SCHOOLS.

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PREFACE

This document has been developed to provide advice and guidance regarding Wi-Fi networks in 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 primary school building projects

For easy reference the document is 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 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 primary schools. It gives specific guidance on the design and make up of Wi-Fi installation appropriate to 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

SECTION A

1. INTRODUCTION

1.1 SCOPE AND PURPOSE

There is a significant shift taking place in 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 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 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 section **(SECTION C)**.
- Hyperlinks to the websites referred to in the document 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.

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 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 and will be provided as part of a building contract.

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

1.2.2 UPGRADING OF NETWORKS IN EXISTING SCHOOLS

In existing primary schools where a new or upgraded Wi-Fi network is being considered the scope and extent of the works involved should allow for a more comprehensive Wi-Fi solution based on this document.

1.3 WHAT IS A WI-FI NETWORK

A Wi-Fi network enables teachers and pupils 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 connect the Wi-Fi work to the fixed network and as such consist of a combination of wired and Wi-Fi elements. Schools generally have a fixed computer network in place already to connect 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, 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 have the potential to deliver educational benefits to support teaching and learning in a number of ways in primary schools, primarily in further facilitating pupil-centred centred active learning in schools.

The main benefits include:

- More flexible access to learning opportunities and online resources for teacher and pupils via mobile wireless devices (tablets, laptops, hybrid devices, net books, etc.)
- Teachers can access and use online curriculum-relevant resources in lessons on a regular basis
- Pupils will be given the more opportunities for mobile, flexible e-Learning, including access to curriculum-relevant resources with the guidance of the teacher
- Pupils will experience e-Learning activities regularly
- Network 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

The Primary School Curriculum promotes the use of ICT to enhance teaching and learning across the curriculum.

The Introduction to the Primary School Curriculum states:

> *"Technological skills are increasingly important for advancement in education, work, and leisure. The curriculum integrates ICT into the teaching and learning process and provides children with opportunities to use modern technology to enhance their learning in all subjects."*
> *Primary School Curriculum,* 1999, p. 29

Since the launch of the Primary School Curriculum in 1999 support for the use of ICT by the Department of Education and Skills has resulted in increased availability of ICT in schools, as well as increased opportunities for teacher professional development regarding the use of ICT for teaching and learning. In this context, individual teachers have exploited the potential of ICT to complement their own pedagogical practices, and to extend their pupils' learning. The use of wireless networks and mobile devices has the potential to extend this practice and increase the impact of the use of ICT on learning even more in primary schools.

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 pupil 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 delivering data and content across the network. The availability of a fast broadband service in primary schools is critical in facilitating this to take place, especially as the number of pupil 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 pupil-centred learning activities both within and outside of the classroom. Their range of capabilities including extended "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, and 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 pupil 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 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
- Pupils will be given the more opportunities for mobile, flexible e-Learning, including access to curriculum relevant resources with guidance of the teacher
- 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 Department of Education and Skills (DoES) has sought the opinion of the Department of the Environment, Culture & Local Government (DoECLG) now known as the Department of Housing, Planning, community and Local Government 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 for copy of correspondence from DoECLG.

2. TEACHING & LEARNING

2.1 CONTEXT

The introduction of always-on Wi-Fi Internet (Wi-Fi) and tablet computers to the classroom provides teachers 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 pupils can be encouraged to learn independently or collaboratively in a more autonomous context.

Where ICT is embedded in the curriculum it can serve to engage and motivate children in the learning process. It has proven to increase pupils' 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. Evidence shows that the use of new technologies has had a positive impact on teaching and learning. ICT is currently used as a resource which aims to support learning and teaching. Digital literacy skills are acquired and developed as part of this process. Strategies for sourcing and selection of content are essential for pupils 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 Information and Communication Technology (ICT) will be most successful in deriving full benefit for pupils.

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 pupils 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 pupil 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.

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 pupils do, to new trends in order to derive full benefit.

Planning for the use of Wi-Fi ICT in the primary school is not separate to planning for teaching and learning but is integral to it. At whole-school 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 pupils.

2.3.2 PLANNING AT SUBJECT LEVEL

The use to be made of Wi-Fi ICT needs to feature in planning for teaching methodologies. 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 is best dealt with in the context of lesson planning. Lesson planning by the individual teacher provides for effective use of the technology by pupils.

Decisions with regard to the use of Wi-Fi in lessons need to be appropriate to the age and level of the pupils. More advanced pupils 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 pupils can learn in ways that were impossible in the pre-tablet era.

Purposeful access to ICT motivates and increases engagement and achievement in education *and* will be essential in preparing pupils 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 pupil 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
- Pupils are more motivated when using tablets/mobile devices
- Teachers and pupils 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 pupils 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 pupil initiative, activity, creativity and motivation. Wi-Fi activities are differentiated to meet the varying needs and interests of pupils. Where appropriate, pupils are encouraged to explore the further use of the technology and to share their findings with the teacher and the class. Pupil 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 pupil's complete tasks over time, provide a good means of assessment while furthering pupil motivation.

2.4.1 How can ICT Support Learning of the Curriculum in Primary Schools?

Wireless networks used to support the use of mobile learning devices in schools have the combined potential to support, enhance and transform learning. Irish education places a very strong emphasis on pupil-centred learning and an acceptance of the diversity of learning styles in all classrooms.

It is generally accepted that using ICT improves motivation for learning, enhances engagement, and has the potential to improve conceptual understanding. Specifically the combination of wireless networks and better access to devices among pupils facilitate mobile and flexible access to a range of resources which were not widely accessible heretofore.

Improved wireless access provides new opportunities to increase access to online resources for learning throughout the school, enabling more lessons to incorporate ICT use more frequently.

Across the subjects of the Primary School Curriculum wireless devices and peripherals can be used in a very stimulating way for direct teaching of new content knowledge. The use of wireless devices has also the potential to support differentiated learning of curriculum objectives, where each pupil can engage with learning activities in support of achieving particular objectives at their own pace.

In language the use of wireless devices in general can act as a powerful stimulus for pupils' talk about their learning experiences and can support their oral language development in English. Applications can be used to support reading skill development and help with the learning of spellings. Educational software for Irish (Gaeilge) can provide opportunities for pupils to exercise control over their own learning by choosing the content, pace and methods of learning. In Mathematics there is potential for wireless devices to support enquiry-based approaches and also revisit concepts to ensure that they are practised and reinforced.

In Social, Environmental and Scientific Education (SESE) pupils can use devices for frequent access to the internet to retrieve appropriate information to be used when researching topics. They can access simulation applications on tablet devices to support learning in History, Geography or Science. In Arts Education, the use of wireless devices can support music creation by the pupils, can enable access and personal response to visual art of many kinds and be used to record role play in Drama, to explore complex and exciting scenarios, discuss them and come to understand them better. In SPHE, pupils can be enabled to use online resources and applications to enable them gain a deeper understanding of themselves and the wider world.

There are also very clear advantages to using wireless tablet devices to support the learning of pupils with special educational needs (SEN): the devices motivate pupils to learn and they enable more personalized learning.

2.4.2 ICT Requirements in the Primary Classroom and Other Teaching & Learning Spaces

The requirements for using wireless devices for teaching, are common to all present-day primary classrooms. A large screen display device such as a digital projector or a large interactive flat screen is needed. This display needs to be connected to a network, either by cable and/or wirelessly, and should also be accessible from pupils' devices so that pupils can also play a teaching role; presenting material to their peers from their own devices. All classrooms also need a cabled network point for teacher use.

The requirements for learning using ICT in all classrooms can be met in technical terms by means of a wireless network access point. The application software used to support learning across the subjects of the Primary School Curriculum is run on a variety of hardware including desktop and laptop computers and tablet devices. The data flow to and from these applications can be efficiently transferred across a wireless network in a normal classroom situation.

With the advent of tablet computing, all the social and general-purpose areas in the school become learning spaces. Access to Wi-Fi in these areas is a requirement.

Based on the above the requirement is for three cabled network points in each classroom used, respectively, for data projector/display screen access, for teacher access and wireless access.

2.4.3 Potential Applications for the Use of Mobile/Wi-Fi Enabled Learning Devices, Wireless ICT Devices & Wi-Fi devices:

The following is a commentary on potential applications for the use of mobile/Wi-Fi enabled learning devices in the learning and teaching of the subjects of the Primary School Curriculum and for their application for pupils/pupils with Special Educational Needs.

The Primary School Curriculum promotes the use of ICT to enhance teaching and learning across the curriculum. Enabling individual pupils to use mobile ICT devices more often during lessons permits teachers to recognise individual difference more and realise the potential of learning through ICT in more authentic ways. ICT in the 21st century classroom embraces mobile devices such as tablets, e-book readers, laptops, phones, Nintendo DS, MP3 players and portable media players as a means to facilitating a better learning experience, i.e., one that is based on collaboration, communication and creation. This more authentic way of learning is considered crucial in developing pupils' ability to think critically and creatively.

The following sections highlight some suggested uses in different areas of the curriculum. They are not exhaustive lists of the uses and there could be others.

2.4.3.1 Cross-curricular Application

- Tablets and peripherals can be used in a very stimulating way for direct instruction. At a basic level, the tablet can be used in conjunction with a projector or large-screen television to present material in different subject areas. For example, a teacher might use a tablet and Apple TV (or other similar technologies such as Chromecast) to present a topic in History or Science to a senior class or to explore an interactive book together with an infant class. (Connecting a tablet device to a projector using a VGA cable removes the portability of the device and confines the teacher to a 'top of the room' instructional position.) In a more sophisticated way, it is possible for the teacher to combine text, graphics, sound and video in bespoke multimedia presentations.
- It is strongly indicated that mobile ICT devices, and the stimulating methodologies facilitated by their use, can act strongly to motivate pupils in their learning.
- If used carefully by teachers mobile ICT devices have the potential to support differentiated learning of curriculum objectives, where each pupil can engage with learning activities in support of achieving particular objectives at their own pace. In this way the whole class can be engaged in common activities, but each pupil engages at their own pace.
- Using individual mobile ICT devices, pupils may use word-processing software to write in different subjects: using multimedia authoring or presentation applications to create and display work, multimedia software to produce a video clip or animation, concept mapping software to organise ideas, or simulation software to solve a problem.
- Desktop publishing software on mobile ICT devices provides pupils with templates, graphics and other resources to present their writing in attractive and sophisticated formats e.g., for posters, signs, labels, captions, and class or school projects.

- Using Apps that facilitate blogging and tweeting about school work, school events, whereby specific skills in writing for the web are enhanced (such as summarising, editing, proofing and writing for multiple audiences etc.)
- The use of Skype/Facetime via mobile phone or tablet (connected to the IWB) enables communication with schools both locally and globally as part of subject specific project work or to converse in another language such as Gaeilge.
- Apps on a tablet or mobile phone that enable pupils to create animations, multimedia presentations, film, video based on the content of a lesson follow the constructivist approach to learning by allowing pupils to personalise learning and make the process more meaningful. For example, pupils could use the "Story Creator" App which incorporates text, audio and video to record a science experiment or capture and explain the attainment of a difficult skill in PE.
- The Nintendo DS may be used for motivating pupils and providing a stimulus to lessons through the use of brainteasers, word games and other problem solving puzzles.
- The use of MP3 players to record songs, poems, narrative or other subject specific audio for easy upload to blogs, twitter or web-based multimedia presentations such as EduCanon.
- Using e-book readers to access subject related books, magazines, libraries and dictionaries across many disciplines, interests and levels of differentiation.
- Programmable bricks are now Wi-Fi enabled and may be used to build and programme objects and characters based on stories, ideas and processes across all subject areas.

2.4.3.2 SUBJECT SPECIFIC APPLICATIONS

LANGUAGE: GAEILGE/ENGLISH

- The use of mobile ICT devices in general can act as a powerful stimulus for pupils' talk about their learning experiences and can support their oral language development. Educational software for Gaeilge can provide opportunities for pupils to exercise control over their own learning by choosing the content, pace and methods of learning, thereby promoting a more positive attitude to Irish generally and to the learning of Irish. Access to sites like www.focloir.ie give pupils access to an online dictionary with inbuilt sound files.
- Articulating and exchanging ideas with other schools by sending and receiving e-mail, Skyping or participating in a threaded discussion to communicate in Gaeilge.
- Recording and editing samples of speech using multimedia apps on mobile ICT devices to publish sound files for language learning in both English and Gaeilge.
- Applications on mobile ICT devices can provide word banks that can be used to develop and reinforce sight vocabulary. Children can record their own reading using the device's camera/inbuilt microphone. The speech-to-text function, if available, can be used by reluctant readers. Creating and reading their stories can be supportive to less-able readers.
- Interactive books on mobile ICT devices can act as a very useful resource or reinforcement material to develop English reading skills. Interactive books provide, particularly for reluctant readers, which a stimulating and interactive context for prediction, questioning and language development. The use of interactive books can enable children to participate in collaborative group discussion about the meaning of text. In-application activities often are designed to support the development of word identification skills.
- The explicit objective in the English curriculum for third and fourth classes: that the pupil should be enabled to develop his/her ability to write using information technology – word processing. The use of individual mobile ICT devices can facilitate the sequence of drafting, editing, and redrafting which is

essential for the writing process in the primary school curriculum. Pupils can enhance the presentation of their writing using appropriate graphics and images. The film making process can also realise this objective as pupils envision, storyboard, draft, redraft their stories prior to capturing and editing video images.

- There is potential for mobile ICT devices to be used for spelling exercises in both languages, using software programmes and games that can be individualised to the needs of the individual learner.
- Applications on mobile ICT devices can be used, with sufficient care and preparation, to support the development of pupils' phonemic awareness and their phonological skills and to generally improve rhyming, matching ability, and to practice sound/word recognition.

MATHEMATICS:

- A range of mathematics applications for mobile ICT devices provides an extensive array of practice problems and workouts, and can provide varied levels of feedback to children based on their performance.
- There is potential for mobile ICT devices to support enquiry-based approaches in mathematics learning through supporting open-ended problem solving.
- In Mathematics pupils at times need to work independently to revisit concepts previously learned and ensure that they are practised and reinforced (for example, using reinforcement Apps in the different strands in Mathematics), or to enrich their learning using more complex learning tools like simulations and multi-level problems.
- In data pupils can record survey data using spreadsheet software, and interpret data using multiple representation formats (e.g., pie charts, bar graphs etc.) available from different applications.
- It is indicated that there is potential for mobile ICT devices to be very useful in infant classrooms for pre-number work and early mathematical activities and also for developing understanding of number operations among less able pupils.
- At a relatively basic level mobile ICT devices can very usefully act to consolidate acquisition of concepts being taught and to offer opportunities for reinforcement of skills to pupils. In general, interesting applications on mobile ICT devices can support the extension and consolidation of classroom learning, e.g. reinforce matching, grading, number, shape and practising basic skills in number in interesting and stimulating activities that still could be regarded as simple drill and practice.
- The integration of Scratch via laptops to introduce pupils to basic coding and promote critical thinking and problem solving skills in attaining learning outcomes relating to angles, coordinates and so on.
- Easy access from laptops or tablets to Census at School can support the study of statistics while also allowing pupils to contribute to meaningful census data.

HISTORY:

- Using mobile ICT devices pupils can create complex presentations using text, audio, video and images to create and display projects. Multimedia authoring software can be used to present findings of historical research (working as an historian) using text, graphics from the Internet, photographs from the device, music from online sources, movie/video clips from the device camera or from online sources, and speech recordings using the device microphone. Historical footage available on video sharing platforms (YouTube, Vimeo etc.) can be punctuated with multiple choice and open ended questions to be viewed and engaged with by pupils (such as found in EdPuzzle, EduCanon).
- Pupils can use mobile ICT devices for frequent access to the internet to retrieve appropriate information to be used when researching on historical topics or to access archived records directly,

for example by accessing census data or e-mailing the local library or newspaper office. Mobile ICT devices can be readily used for accessing documentary evidence online through museum archives, gallery collections etc.

- Pupils can use mobile ICT devices to reconstruct the past in story or drama or by constructing models; and recording the drama or model using the tablet device's video camera to present and communicate to others. Simulation applications on tablets can be useful in History where the learner can 'go back in time'.
- There is immediate access to Google's Historic moment's collection whereby source documents relating to history can be sourced in collections.
- Easy access to content is offered free through Scoilnet, e.g. The Dictionary of Irish Bibliography, The Irish Times Digital Archive and Encyclopaedia Britannica.
- Pupils can explore and interact with 3D artefacts, simulate a virtual excavation or take a virtual walk in a street of another era through museum apps and apps such as Virtual History, Street Scene or 3D Pyramids.
- Pupils can create timelines via a timeline app or interactive web-based timeline tools on a mobile ICT device.
- Pupils can record audio based interviews of local historians via MP3 player or mobile phone and upload to multimedia presentations or e-project portfolios based on an online file sharing platform such as Dropbox etc.
- Pupils can use various current and obsolete technological devices as primary sources or artefacts as a means of identifying items of change and continuity "in the line of development".

GEOGRAPHY:

- Using mobile ICT devices pupils can create complex presentations using text, audio, video and images to create and display projects.
- Using mobile ICT devices there is potential for enhanced collaboration with other schools, organizations, and agencies to compare different physical features e.g. rivers/ lakes/ mountains in different locations- both in Ireland and abroad -using their videoconferencing potential.
- Simulation applications on tablets can be useful in Geography where the learner can simulate travelling in and exploring other lands.
- Teachers can access Scoilnet Maps for quality Ordnance Survey Ireland (OSI) maps, historical Irish maps, aerial photographs and world maps. The service is offered free in schools.
- There is immediate access to Google Earth, which facilitates study of physical geographical and other features and also allow for interaction with the location through Street View.
- There is immediate access to Google World Wonders project giving virtual access to a large collection of geographical wonders of the world (with 360 degree imagery).
- Learners can capture their own 360 degree images of Geographical features and publish under teacher supervision to Google Maps.

SCIENCE:

- Science exploratory simulation applications can facilitate pupils to investigate the implications of scientific action such as controlling angles, forces, and motion, and aid pupils in transferring what they have learned to a real-life situation.

- Using concept-mapping applications: Concept mapping is recommended in the science curriculum as a tool to assess the pupils' understanding of scientific ideas and processes.
- Working as a scientist: developing complex queries to retrieve information from online databases using a range of criteria.
- Documenting, editing, and presenting about a field trip using a mobile ICT device's camera and its multimedia and/or presentation software.
- Reference software for researching a topic or idea in Science, and exploratory software for simulating a science experiment, for example on the Science Hooks website.
- Simulation applications in Science – exploring scientific concepts such as forces etc.
- Record investigations in Science for future reference using the camera function.

MUSIC:

- Pupils can be enabled to use multimedia technology to control, manipulate, or communicate musical information, create sounds and sequences of sounds, recording their own voice or the sounds from their environment using the device, investigate music and composition using different applications, research musical instruments, composers, and a wide variety of types of music from different cultures using the internet.
- Mobile ICT devices can be used to download lyrics and music of songs; to record performances, to provide experiences of using musical instruments and to access information on the history of music and various composers, and support the objectives of the Primary School Curriculum in respect of music appreciation.
- Apps or interactive websites via mobile ICT device may be accessed to examine instruments and the sounds they produce in the context of identifying and manipulating tempo, tone, pitch and so on. For example, a grand piano app allows pupils to play the keys on a piano, composing and performing their own piece.

VISUAL ARTS:

- Mobile ICT devices have clear potential for use in the Visual Arts focused to look at art and artists work via pictures and online galleries and software programmes produced by art galleries, allowing pupils to engage both individually and chorally with works of art. This can provide ready access to the work of artists abroad and the widely available applications allow children to merge technology and the creative process.
- Software and mobile ICT device applications can be used to design and print cards and to paint and colour and draw with different levels of sophistication.
- Providing a good breadth of visual arts experiences for pupils can be facilitated through enabling them to engage in creating animations based upon their work in the strands of clay or in construction.
- Tablets, mobiles and laptops can be used to access video content and support material on the I Am an Artist website.
- Explore artists' works at a level of minutia otherwise impossible by zooming in to brushstrokes, for example examining the technique of pointillism in the work of Georges Seurat via the Google Art Project website.
- Using a camera phone children's artwork may be photographed and immediately published on an online art gallery such as the Children's International Art Gallery.

- There is immediate access to Google Cultural Institute giving the learner virtual access to most of the large art galleries in the world.

DRAMA:

- Using mobile ICT devices to film record and respond to drama, role-play, and real life situations in the classroom.
- Pupils' engagement with drama can be videoed and linked to self-assessment by the pupils if they are given some input/choice as to what they want to include in their portfolio.
- Pupils can record sounds effects on MP3 players for inclusion in various fictional dramatic contexts.
- Pupils can create animations using applications such as Animoto or Animate Me to analyse, develop and capture fictional relationships between characters.

SOCIAL, PERSONAL & HEALTH EDUCATION (SPHE):

- Pupils can be enabled to use online resources and applications to enable them gain a deeper understanding of themselves and the wider world.
- Accessing video resources to help pupils come to a better understanding of abstract or complex topics such as on citizenship.
- Pupils can use mobile ICT devices to carry out surveys and represent results of a survey of attitudes to a topic in SPHE.
- Using Apps such as My Story to create multimedia based personal profiles in the context of collaborating with other schools and conducting a comparative study of children's lifestyles in different settings.

ASSESSMENT & PUPIL SELF-REFLECTION:

- The use of mobile ICT devices provides opportunities for pupils to document their learning activities, through audio or video or both, and record their learning for later reflection and discussion.
- The use of presentation and authoring software on mobile ICT devices can enable the publishing and sharing of examples of pupils' work across Primary School Curriculum areas in an electronic portfolio.
- Many online apps now have excellent learning analytics embedded assisting in assessment of and for learning.

SHARING OF RESOURCES THROUGH SCOILNET:

- Ease of access to mobile ICT devices should make it more straightforward for teachers to share teaching resources through Scoilnet. The re-developed Scoilnet portal allows registered teachers to upload and share their teaching resources online - all resources are tagged to specifics within the Irish curriculum.

2.4.3.3 POTENTIAL SPECIAL EDUCATIONAL NEEDS APPLICATIONS

The following list of suggested uses in meeting the needs of pupils with SEN is not exhaustive:

- There are two very strong benefits of mobile ICT devices for pupils with SEN: they motivate pupils to learn and they enable more personalized learning, as it is easier to individualize instruction and track progress and to erase, change, customize content to suit individual pupils' needs.
- The use of mobile ICT devices can help differentiate between different styles of learning and learning abilities and give alternative ways of accessing and presenting knowledge to those pupils that struggle with traditional ways of accessing knowledge.

- The touch screen interface of the wireless tablet device offers multiple advantages to pupils with special needs. Pupils with SEN can access a tablet much more effectively than a PC.
- Emerging technological developments related to "wearable technologies" are of particular importance to pupils with SEN.
- Using a touch screen interface offers immediate feedback to pupils with SEN as what is seen and heard emanate from where the fingers are on the device. The ability of tablets to react to shaking, rotating and other movements is advantageous. This immediate feedback helps to keep pupils engaged who may get bored or frustrated easily with delayed feedback.
- The touch screen interface offers a variety of sensory input and experiences. The most successful teaching with children with special education needs involves visual, auditory and kinaesthetic or tactile learning.
- An appealing aspect of the use of mobile ICT devices for pupils with special educational needs is their contributing to inclusivity: they can serve to bring them closer to their fellow pupils. One finding of the 2013 UK report The Tablets for Schools report is that “with the right apps, SEN pupils were able to keep up with other pupils in the class and do assignments using the same device as their peers, in addition to receiving immediate feedback”.
- Tablet devices have the capacity to include a comprehensive array of and travel with the person as an assistive technology whatever the individual needs of that person may be. For example, pupils with autism or a specific speech and language disorder can use tablets with voice output or communication board app instead of a traditionally used communication board (Schaffhauser, 2013). Also, using tablets and free applications is much less expensive than traditional assistive technologies. They are easier and quicker to replace in case of loss.
- For pupils with autism (ASD) these devices provide for relative ease in use and act as a centre of attention that attracts pupils. Tablets provide instant feedback, which is particularly important for pupils with autism. They can help autistic pupils to communicate, learn socialization skills and structure their daily environments, no matter where they fit in on the autism spectrum. (One example of how to use tablets to structure daily routines is a program where a screen changes colour to show elapsed time that pupils likely would not understand otherwise).
- As children with autism often have trouble communicating, apps are of particular interest to parents and teachers as they can provide alternative ways of communication and to simplify interaction: interaction with an app is predictable.
- For pupils with a Visual Impairment (VI) pre-installed features like VoiceOver and Talkback and apps like Brailletouch render tablet devices of great use. While VoiceOver reads out everything on the screen, Brailletouch allows visually impaired pupils to type, using a touchscreen braille keyboard. Talkback is a preinstalled screen reader that provides spoken feedback, e.g. when an app is opened. In addition, vibration feedback can be set up and sounds assigned to different actions. For some visually impaired pupils, the same setting options to change font, size and background colours that benefit dyslexic pupils can be very helpful.
- Digital technologies generally are having a huge impact on learning, particularly in terms of nurturing the independence of pupils with VI, as they learn to develop the skills to self-manage and self-direct their learning. Mobile ICT devices are enabling some pupils to take charge given the ease with which a pupil can capture an image of a whiteboard or other resource using the camera, zoom the text, brightness contrast so they can gain access to it independently. It is also likely that tablets help reducing stigma, as visually impaired pupils use the same tools as their peers.

- Pupils with a Specific Learning Disability (SLD) [Dyslexia] may benefit from using personalized settings and predictive text/speech output on mobile ICT devices and having more control through the interface to set up the options they need, e.g. the font size and colour, background, colour and speech support, alongside with the easy to highlight words, and the ability to zoom in to see more detail.
- Pupils with SLD who have difficulty reading can listen to the text and comprehend as much as possible. Moreover, pupils who are challenged with writing can use speech recognition programs that allow them to transcribe anything with their words.
- Specific applications may also benefit pupils with attention deficit disorders (ADD or ADHD), who could benefit from mind mapping and visual based organization tools, for example visual timetables, that help to organise thoughts in a visual way. Some Apps uses memory-by-association and multiple pair comparison tools to walk users through complex thought processes. These exercises are designed to help users learn how to organize unrelated complex thoughts and better manage changing priorities, which are ongoing challenges for pupils with ADD or ADHD.
- Teachers can use wireless microphones to differentiate for pupils with a hearing impairment.

SECTION B

3. GUIDANCE FOR SCHOOLS

3.1 OVERVIEW

The section addresses five 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 will cover 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 pupils there are a number of new challenges. These include:

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

3.2.2 COMMUNICATIONS WITH STAKEHOLDERS

In order for all school stakeholders (teachers, parents, pupils, 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 pupils in the school. The main decisions to be made are regarding:

- 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 pupils 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 pupil (1:1)
    - Pupils bringing their own devices (BYOD), which may include smart phones
    - A variation of these options

The extended battery life of tablet or hybrid 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 ARCHITECTURE

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, cloud based or on an on-site controller, distributed on local Access Points (AP) 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 as roaming, authentication, load balancing, encryption/decryption, Radio Frequency (RF) monitoring and performance monitoring are controlled by a Wi-Fi controller which in turn controls the AP in the Wi-Fi network.

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

AP's 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 together with other APs to control the system. This is a critical area for a school 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 is 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 network offers many benefits, including:

- Centralised management facilitates with 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 pupils 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 will cover 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. The following will help you 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 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 supports 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://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, pupils, parents, Board of Management)
- Where possible it is advisable to contact or visit other 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
- Evaluate responses (for guidelines on evaluating responses from providers refer to the Technology Section of the PDST Technology in Education website 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 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 primary schools are significantly different and more demanding than the requirements in business, home and other solution:
    - The large number of pupils and associated pupil devices that need to be supported in relatively small areas
    - The degree of movement among pupils and staff that takes place in a primary school is not very high
    - 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 or for all pupils. Will guests and visitors to the school be catered for? Should there be separate networks available for different types of users e.g., staff, pupils, guests etc.

3.3.5.2 WHERE

What areas of the school need to have Wi-Fi network available? Are outdoor areas included? Will the whole school be completed in one go 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. pupils 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). What are the school's plans for growth in pupil 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, 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 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.

Figure 1: Typical ground floor plan for a large 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 will cover 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 the 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 ICT Equipment grant available for new primary school building projects and extension projects to primary schools.

It will be based on the cost allowances outlined in the table below

SCHOOL SIZE	COST
UP TO 12 CLASSROOMS	€6,700.00 per classroom
13 TO 24 CLASSROOMS	€6,300.00 per classroom
24 CLASSROOMS AND OVER	€6,000.00 per classroom

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.

A Wireless Framework for Schools including a number of suitable wireless solutions from different providers will be in place from May 2016. For more details go to: http://www.pdsttechnologyineducation.ie/en/Technology/Networking-Wireless-Networks/

3.4.2 SITE SURVEY

Site surveys 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 an agreed time 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 the Wi-Fi providers as inputs to their tender in areas such as:

1. An 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. The optimum placement of APs, including a map of the preferred placement of WAPNPs based on the site survey

5. Possible problems areas
6. List coverage areas
7. Given that most APs should be mounted at ceiling height (to maximise coverage and minimise vandalism) the site survey should identify any areas where the placement of APs might be challenging and provide a proposed solution

3.4.3 Other Points for Consideration

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

3.4.3.1 Choice of Wi-Fi System

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 schools 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 primary schools there is minimum mobility of pupils during the school day.

Also not all AP 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 future needs, they should seek advice and guidance from PDST Technology in Education by sending an email including their particular situation (maximum number of users, maximum number of devices that may be used etc.) to *ictadvice@pdst.ie* .

3.4.3.2 Powering of Access Points

Power over Ethernet (PoE) should be used to power all APs, as it 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 to be added. Where this is the case CAT 6a or a higher rated cable should be used. Using CAT 6a instead of Cat 5, for example, ensures higher data transfer 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 WLANs into older or listed buildings, attenuation and cabling problems can dramatically increase and may require the deployment of more APs than initially planned, therefore a detailed site survey of school buildings is required to address these matters.

3.5 IMPLEMENTATION AND INSTALLATION STAGE

This section will cover 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. Usernames and passwords for all users will be required to enable access to 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. As such, one of the main issues with those 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 pupils 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 needs 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 schools. 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 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.

3.5.3.3 SECURE THE PHYSICAL INSTALLATION

Determine who will have physical access to the Wi-Fi equipment and to the WAPNPs. Ideally, try to place your *wireless APs* in out if reach 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. 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 pupils 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 will cover 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 pupils there are a number of new challenges. These include:

- Management of the Wi-Fi system itself
- Controlling levels of user access to management, staff, pupils
- Managing the additional mobile devices for teachers and pupils (tablets, laptops etc.,)
- Managing access to online digital resources
- Increasing dependency on broadband internet access
- Classroom management issues
- Monitoring pupil 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 pupils in the school. The main decisions to be made are regarding:

- 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 pupils for example :
- One mobile device (tablet, laptop, hybrid etc.) for every teacher
- A schools owned set of mobile devices to be used as a shared resource
- One device per pupil (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 a 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. MDMs are generally separate to the Wi-Fi controller and Wi-Fi management system that was 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 allowed. 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 significant longer lifespan and don't require faulty lamp units to be replaced. For guidance on purchasing Interactive whiteboards and digital projectors school 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 – 030, Rev 1 Amendments to the M&E Building Services Guidelines (2004) TGD – 002 & ICT Infrastructure Guidelines TGD – 004 for 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. It is worth putting up a sign to remind the teacher in the classroom to ensure that all the IT equipment 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.

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 or interactive flat screens 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 or 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 6th class 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

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.

Peripherals e.g. printers, scanners, visualizers 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). Laptops 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 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 for further advice and guidance.

3.7.6 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 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.

3.7.7 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 6 enhanced / 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.

The following three scenarios represent the majority of 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 (DDC), 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.

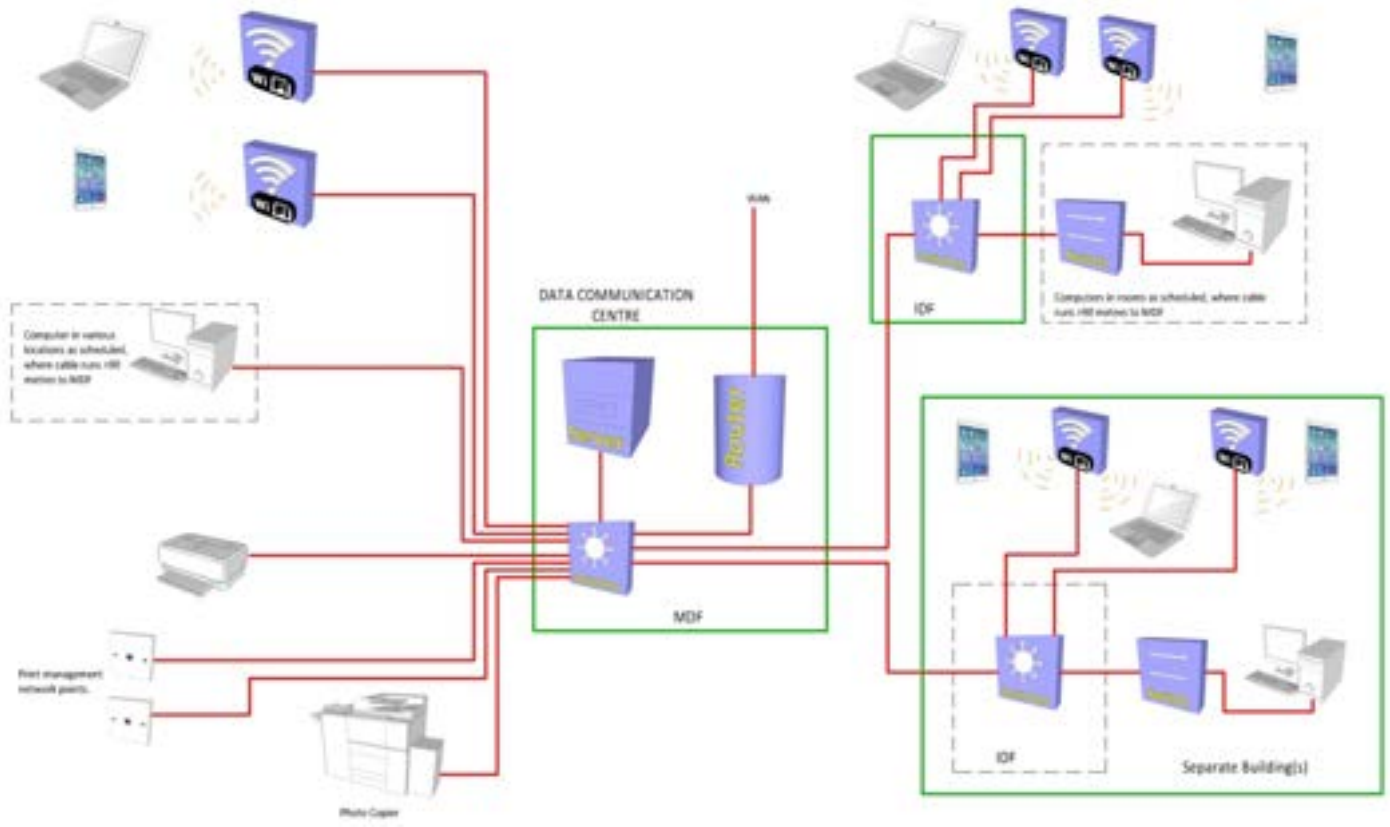
For the inter-connection between an IDF in a separate building and the MDF in the main building a multimode fibre optic backbone cable shall be considered. This is the appropriate connection for a large cohort of users located away from the main building.

In circumstances where a small 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, length 2m and height of 2.17m, having no windows should be large enough for most primary schools.

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 below.

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.

The IDF will contain a lockable wall mounted equipment cabinet as detailed in SECTION 6.4 CABINETS below. 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;

(a) Each MDF multimode fibre cable be marked as MDF MFz (MDF Multi Mode Fibre number "z")

(b) Each MDF single mode fibre cable be marked as MDF SFz (MDF Single Mode Fibre number "z")

(c) 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) A number, "x" will describe each building.

(b) Each IDF multimode fibre cable be marked as IDF x MFz (IDF for building "x" Multi Mode Fibre number "z")

(c) 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.

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

6.3 POINT DENSITY

The density of network points shall be in accordance with the schedule IN SECTION 7.9 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. 1070. This extra depth is required for rack-mounted servers.
- Type 4 will be min. 42U, w. 800, d. 1070. 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.

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.

Fibre cables 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 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 primary schools and the approved density. It also addresses the numbers of power socket outlets associated with these.

Network points shall be connected directly to the MDF or connected via the IDF whichever is more economical, wired in CAT 6a cable and terminated in RJ45 type sockets.

In the Library and Resource Area 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 7.9 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

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 primary schools.

7.1 TEACHER POSITION NETWORK POINT

Teacher Position Network Points (TPNP) are provided as part of the interactive data projector/interactive whiteboard installation provided on the teaching wall in all teaching spaces in primary schools.

Refer to APPENDIX E: WI-FI ROOM LAYOUT DRAWINGS for further guidance.

7.2 PC NETWORK POINT

PC Network Points (PCNP) shall be provided in some teaching spaces Library & Resource Room, Staff Room and offices in primary schools.

Un-switched type power socket outlets at a ratio of 1.5 twin socket outlets per PCNP shall be provided.

Refer also to "Note 4" in SECTION 7.9 below.

7.3 WI-FI ACCESS POINT NETWORK POINT

Wi-Fi Access Point Network Points (WAPNP) shall be provided at high level in teaching spaces, GP Room, Staff Room, some offices and where necessary in 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 WAPNP will depend on the geography/layout and fabric of a school building.

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

In classrooms the WAPNP shall be provided at high level on the teaching wall in the space.

In other smaller teaching spaces i.e. Multi-purpose Room, SET room, Staff Room and offices the 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 an interactive digital projection system/interactive white board installation is being provided a Digital Projector Network Point (DPNP) shall be provided adjacent to the projector's power socket outlet on the teaching wall.

This connection will facilitate power management of the data 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 SECTION 7.9 SCHEDULE OF NETWORK POINTS below should be provided in the boiler house and at the main switchgear location.

Refer also to "Note 4" in SECTION 7.9 below.

7.6 IP CCTV CAMERA NETWORK POINT

As part of the design development of the IT infrastructure in primary schools with over 12 classrooms, consideration may be given to the provision of CCTV Network Points (CCTVNP) in suitable locations in corridor areas to facilitate the provision of internal IP CCTV camera in 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 by a school authority at the Pre-stage 1 meeting with the DoES Technical Staff
- Provision of internal IP CCTV cameras will not form part of the building contract

7.7 PRINT MANAGEMENT NETWORK POINT

Managed print solutions incorporating Printer Network Points (PNP) to facilitate the provision of local printers should be considered in large primary schools e.g. one on each floor in larger primary schools.

7.8 ELECTRONIC NOTICE BOARD NETWORK POINT:

Electronic Notice Board Network Points (ENDNP) 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 main entrance area to Special Needs Accommodation.

In primary schools with over 12 classrooms an ENBNP shall be provided on the corridor wall inside a Staff Room.

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

7.9 Schedule of Network Points

Classification of Network Points in primary schools:

Local Area Network (LAN) Points.	
TPNP	Teacher Position Network Point
PCNP	PC Network Point
WAPNP	Wi-Fi Access Point Network Point
DPNP	Digital Projector Network Point
SNP	Services Network Point
IPCCTVNP	CCTV Camera Network Point
PNP	Printer Network Point
ENBNP	Electronic Notice Board Network Point

The following is a Schedule of Network points for a Wi-Fi ICT installation in primary schools.

Type of Space.	Network Points.	Associated single Power Sockets.
General Classroom	1 TPNP, 1 WAPNP & 1 DPNP	5
Classroom Safe Base (SNU)	1 TPNP, 1 WAPNP, & 1 DPNP	5
Library & Resource Area [1]	1 TPNP, 4PCNP & 1 WAPNP	15
General Purpose (GP) Room [2]	2 WAPNP	-
Multi-purpose Room	1 TPNP, 1DPNP & 1WAPNP	5
SET Room.	1 TPNP, 1 DPNP & 1WAPNP	5
Home Liaison Room/Parent's Room [3]	1 NP	3
Administration/General Office	1 PCNP[4], 1 PNP & 1 WAPNP	5
Principal's Office	1 PCNP[4], 1 PNP & 1 WAPNP	5
Deputy Principal's Office	1 PCNP[4], 1 PNP & 1 WAPNP	5
Staff Room 0 to 15 Classrooms	1 WAPNP, 1 ENBNP, 2PCNP[4], 1PNP	7
16 to 23 Classrooms	1 WAPNP, 1 ENBNP, 2PCNP[4], 1PNP	7
23 to 32 Classrooms	1 WAPNP, 1 ENBNP, 2PCNP[4], 1PNP	7
Main Entrance Lobby	1 ENBNP	1
Plant Room	2 NP[4]	0
Main Switchboards Area	2 NP[4]	0
Photocopier Area	2 NP[4]	2
Printing Stations (Large Schools)	2 PNP[4]/floor	2

Notes

[1] Where the space involved can be split in two by a folding partition the DoES has no objections to consideration being given to sharing the network points and associated socket outlets between the two spaces should a school require this layout

[2] Where a double sized GP Room space is being provided in larger schools 4 WAPNP shall be provided i.e. 2 WAPNP in each space

[3] Where an 80m² space is being provided in lieu of a 20m² one e.g. in a DEIS primary school, network points similar to those in a typical classroom above shall be provided

[4] These NPs shall be terminated as 2 twin RJ45 type sockets (i.e. 4 network outlets). 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.

7.10 ROOM LAYOUT DRAWINGS

A number of room layout drawings for primary schools incorporating Wi-Fi provision in line with the network points outlined in SECTION 7.8 SCHEDULE OF NETWORK POINTS above have been developed by the DoES. Refer to APPENDIX E, WI-FI ROOM LAYOUT DRAWINGS for copies of these.

Where a copy of a room layout drawing is required it should be printed on an A3 size sheet.

8. DIGITAL PROJECTOR INSTALLATION

An ultra-short throw interactive digital projector and ordinary white board or an inter-active white board and ultra-short throw digital projector or interactive flat screen shall be provided on the teaching wall in all classrooms in primary schools.

These are the preferred type of projection system for use in primary school teaching spaces. Ceiling mounted digital projectors should be avoided.

Network points and associated socket outlets to facilitate the provision of these in other spaces in the future e.g. Multi-purpose Rooms, SET Rooms, Library Resource shall be provided as part of a school building contract. In the case of new schools and extensions the Design Team shall liaise with the school and identify the teaching wall in these spaces at an early stage in the design process.

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

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

Careful selection of digital projection systems will ensure there is no need for black out blinds in teaching spaces.

For more information of digital projectors, interactive flat screens 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/.

9. INTERACTIVE FLAT SCREEN TELEVISION

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

Refer to Presenting in the Classroom Section 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.

In the case of new schools or extensions to existing schools where school authorities are proposing interactive flat screen 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 white boards in teaching spaces
- The layout of the ICT infrastructure required for an interactive flat screen

The layouts as detailed on the relevant DoES room layout drawing may need revision to cater for interactive flat screens.

The Design Team shall seek guidance from the DoES at the Stage 1 meeting on how to address the issues involved and any resulting changes to the ICT layout in teaching spaces must be catered for and addressed by 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.

In primary schools with up to 15 classrooms the Design Team shall ensure that adequate natural ventilation via a number of suitably sized high and low level intumescent (if required by the Fire Certificate) wall vents in the corridor walls or an external vent to atmosphere is available in the DCC. Due care should be taken to maintain any necessary fire compartmentalisation.

In 16 classroom primary schools and over a basic mechanical extract ventilation installation shall be provided in the DCC. It shall consist of a suitably sized in-line fan located at high level in/on the ceiling of the DCC to extract hot air from the DCC via a suitably sized duct and intumescent grill into the corridor area. The fan 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. An insect filter shall be provided on the low level outlet to the DCC to facilitate future maintenance etc. High and low level wall vents are not required in the corridor walls.

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 for further advice and guidance.

Refer also to APPENDIX C: ENERGY IN EDUCATION ENERGY FACTSHEET.

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 (UPS) 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 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 power 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 electrical services to teaching spaces and habitable rooms where network points are required.

In new schools they shall be laid out as per DoES TGD-002 Mechanical & Electrical Building Services Engineering Guidelines for Primary Schools and TGD-030, Rev. 1: Amendments to the M&E Building Services Guidelines (2004) TGD-002 & ICT Infrastructure Guidelines TGD-004 for Primary Schools and the DoES room layout drawings for 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 and fully detailed at Stage 2a.

11.2.1 Services to General Classrooms

In new schools, 3 network points as outlined on the DoES General Classroom drawings TGD 022-D01 Wi-Fi and TGD 022-D02 Wi-Fi and described in Section 8 Data Projector Installation above shall be provided. Refer also to Appendix F: Room Layout 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

Three compartment dado type trunking shall be provided at low level on the teaching wall in classrooms.

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

The power socket outlets shall be wired in steel trunking in the ceiling space, in wall mounted conduit and three compartment dado type trunking where necessary on a dedicated circuit incorporating RCD & MCB protection from a local distribution board.

The light installation shall be as outlined in the DoES TGD-002 Mechanical & Electrical Building Services Engineering Guidelines for Primary Schools and TGD-030, Rev. 1: Amendments to the M&E Building Services Guidelines (2004) TGD-002 & ICT Infrastructure Guidelines TGD-004 for Primary Schools and the DoES room layout drawings for primary schools.

11.2.2 General Purposes Room

Two WAPNP, one at each end, shall be provided at high level in this space.

In larger schools where a doubled sized GP Room is provided two WAPNP shall be provided in each space i.e. a total of 4 WAPNP in the space.

11.2.3 Services to Other Rooms & Areas

The layout of network points and associated power socket outlets shall be as outlined in DoES TGD-002 Mechanical & Electrical Building Services Engineering Guidelines for Primary Schools and TGD-030, Rev. 1: Amendments to the M&E Building Services Guidelines (2004) TGD-002 & ICT Infrastructure Guidelines TGD-004 for Primary Schools and the DoES room layout drawings for primary schools and on relevant DoES room layout drawings. Refer to APPENDIX F: ROOM LAYOUT DRAWINGS.

The network points shall 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.

In the Administration/General Office in large schools consideration may be given to providing local distribution within 100 x 50mm three-compartment dado trunking. Power socket outlets, data outlets and fixings used on this trunking shall be of the range recommended for the trunking.

The trunking shall drop directly from the services void above.

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-002 Mechanical & Electrical Building Services Engineering Guidelines for Primary Schools and TGD-030, Rev. 1: Amendments to the M&E Building Services Guidelines (2004) TGD-002 & ICT Infrastructure Guidelines TGD-004 for Primary Schools and the DoES room layout drawings for 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 structured 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 in all offices.

Where trunking is used power socket outlets and fixings used 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 a switch or a flush single power socket outlet without a switch shall be specified.

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

Dedicated power socket outlets associated with network in general classrooms, teaching spaces and offices shall be double pole switched type.

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.

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 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.

12.6 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).

12.7 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 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. 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.

12.8 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.

12.9 LIGHTING INSTALLATION

Lighting in all teaching spaces, offices etc. shall be as per DoES TGD-002 Mechanical & Electrical Building Services Engineering Guidelines for Primary Schools and TGD-030, Rev. 1: Amendments to the M&E Building Services Guidelines (2004) TGD-002 & ICT Infrastructure Guidelines TGD-004 for Primary Schools and the DoES room layout drawings for primary schools.

APPENDIX A: LIST OF ACRONYMS

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

ACRONYM	MEANING
ACR	Attenuation-to-Crosstalk Ratio
AP	Access Point (the wireless equipment that communicates to wireless devices)
APP	Application Software, a computer programme designed to run on smartphones, tablet computers and other mob. devices
AUP	Accepted Usage Policy
BC	Balanced Cable
BYOD	Bring Your Own Device
CAD	Computer Aided Design
DCC	Data Communications Centre
DPNP	Data Projector Network Point
ENBNP	Electronic Notice Board Network Point
HDMI	High Definition Multi-media Interface
ICT	Information and Communication Technology
IDC	Insulation Displacement Connector
IDF	Intermediate Distributor Facility
IEEE	Institute of Electrical and Electronics Engineers
IPCCTVNP	IP CCTV Camera Network Point
IPTNP	IP Telephony Network Point
IPv4	Internet Protocol Version 4 (existing IP networking standard)
IPv6	Internet Protocol Version 6 (new IP networking standard)
IR	Infrared link
IWB	Interactive Whiteboard
LAN	Local Area Network (i.e., the school network)
LR	Laser Link
LSHR	Low Smoke Halogen Free
MDF	Main Distribution Facility
MDM	Mobile Device Management (software for managing devices)
MM	Multimode Fibre
NCCA	National Council for Curriculum Assessment
NCTE	National Centre for Technology in Education
NEXT	Near End Cross Talk
NIC	Network Interface Card
NP	Network Point
NPS	National Procurement Services

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

APPENDIX B: LETTER FROM DoECLG

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 21st 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).

- 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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promoting energy efficiency in schools

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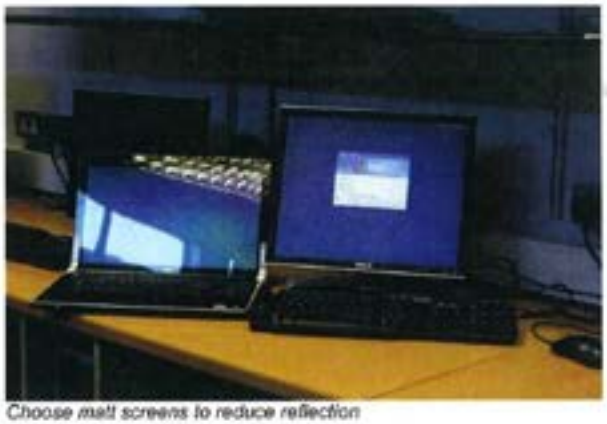
IT EQUIPMENT

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.

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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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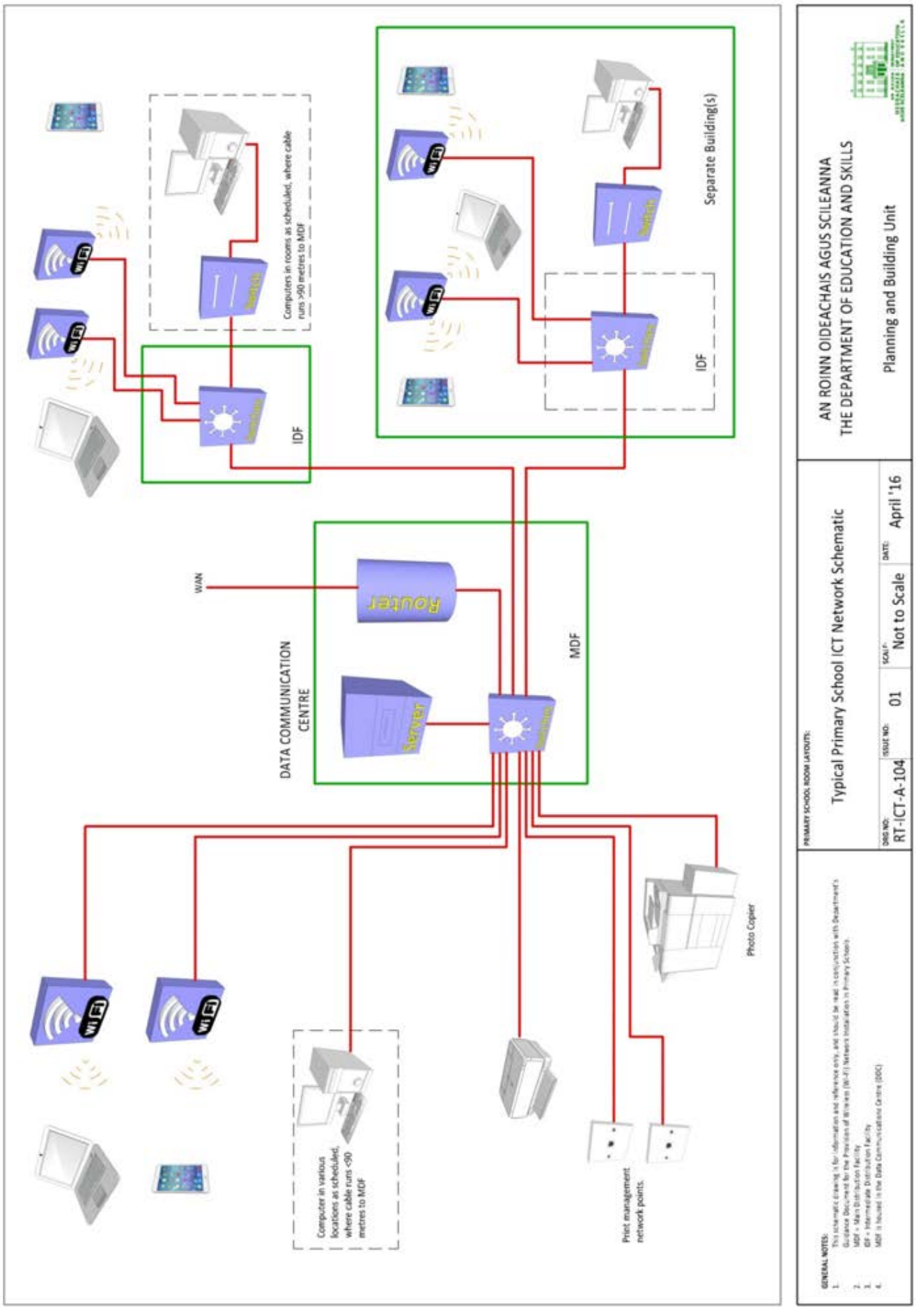
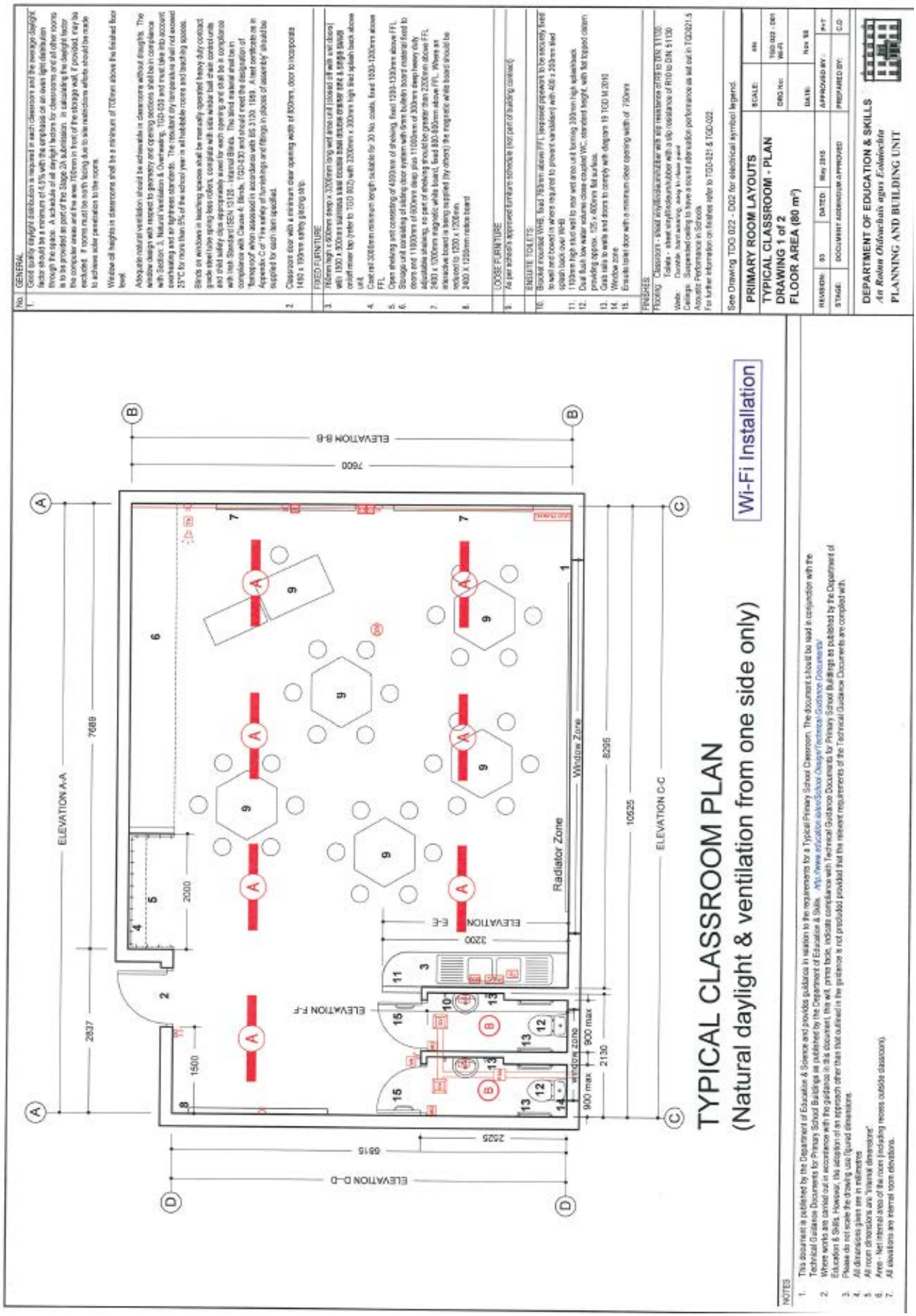
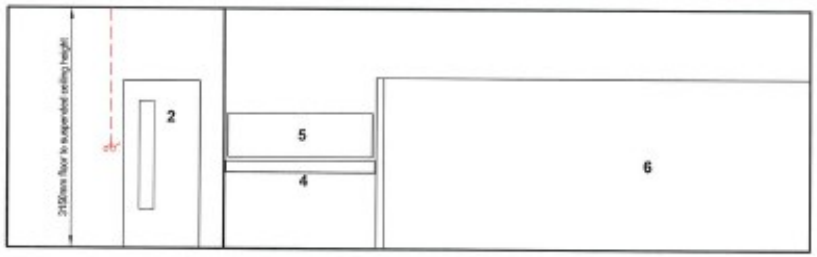
APPENDIX D: NETWORK SCHEMATIC DRAWING

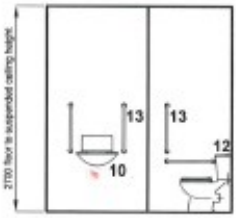

Separate Building(s)
IDF
Computers in rooms as scheduled, where cable runs >90 metres to MDF
IDF
WAN
Router
DATA COMMUNICATION CENTRE
Server
MDF
Photo Copier
Computer in various locations as scheduled, where cable runs <90 metres to MDF
Print management network points.
AN ROINN OIDEACHAIS AGUS SCILEANNA
THE DEPARTMENT OF EDUCATION AND SKILLS
Planning and Building Unit
PRIMARY SCHOOL ROOM LAYOUTS:
Typical Primary School ICT Network Schematic
DRG NO: RT-ICT-A-104
ISSUE NO: 01
SCALE: Not to Scale
DATE: April '16
GENERAL NOTES:

APPENDIX E: WI-FI ROOM LAYOUT DRAWINGS

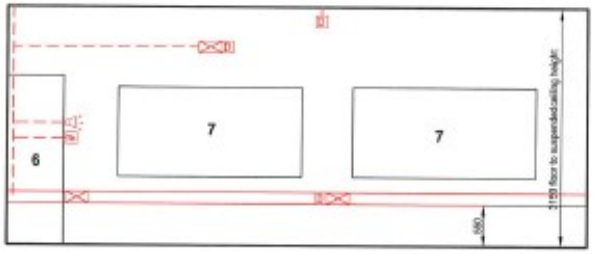

TYPICAL CLASSROOM PLAN
(Natural daylight & ventilation from one side only)
Wi-Fi Installation
PRIMARY ROOM LAYOUTS
TYPICAL CLASSROOM - PLAN
DRAWING 1 of 2
FLOOR AREA (80 m²)
DEPARTMENT OF EDUCATION & SKILLS
An Roinn Oideachais agus Eolaíochta
PLANNING AND BUILDING UNIT
Radiator Zone
Window Zone
ELEVATION A-A
ELEVATION B-B
ELEVATION C-C
ELEVATION D-D
ELEVATION E-E
ELEVATION F-F
7600
7089
2837
2000
1500
8295
10525
2130
900 max
2225
6515
3200



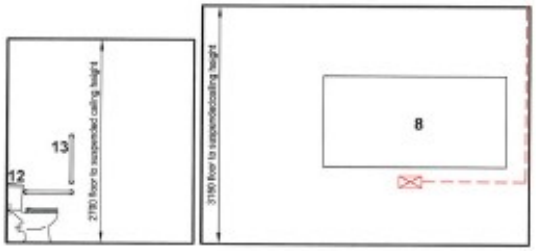
ELEVATION: A-A



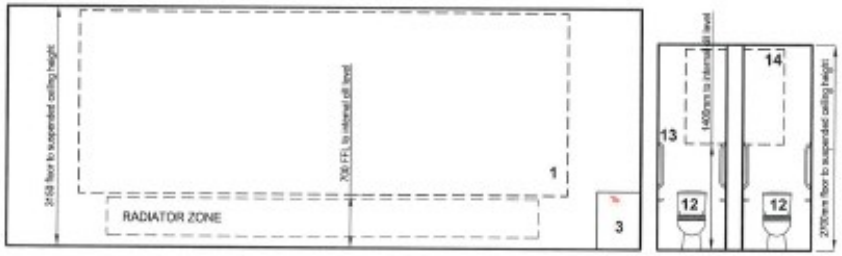
ELEVATION: F-F



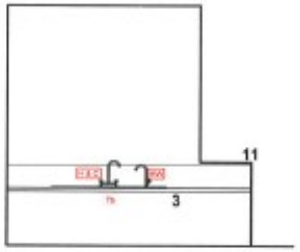
ELEVATION: B-B



ELEVATION: D-D



ELEVATION: C-C



ELEVATION: E-E

Wi-Fi Installation

NOTES

1. This document is published by the Department of Education & Science and provides guidance in relation to the requirements for a Typical Primary School Classroom. The document should be read in conjunction with the Technical Guidance Documents for Primary School Buildings as published by the Department of Education & Skills. http://www.education.ie/en/School-Design/Technical-Guidance-Documents/
2. Where works are carried out in accordance with the guidance in this document, this will, prima facie, indicate compliance with Technical Guidance Documents for Primary School Buildings as published by the Department of Education & Skills. However, the adoption of an approach other than that outlined in the guidance is not precluded provided that the relevant requirements of the Technical Guidance Documents are complied with.
3. Please do not scale the drawing use figured dimensions.
4. All dimensions given are in millimetres
5. All room dimensions are "internal dimensions".
6. Area - Net internal area of the room (excluding recess outside classroom).
7. All elevations are internal room elevations.

Mechanical and Electrical Services for Typical Primary Classroom - *to be read in conjunction with TGD 002, TGD 004 and TGD030.*

Each teaching space shall be controlled via two port motorised valves with electrically powered digital thermostats with a lockable range of 21 degrees Celsius + / - 3 degrees.

All thermostatic mixing valves on the hot water services to be connected as outlined on the "Thermostatic Mixing Valve Installation drawing RT-TMV-001" of TGD-30.

Separate mains water supply required at the classroom sink.

All lights fitted with automatic lighting controls must also have a manual on / off switch.
Lighting control in classrooms/ teaching spaces should be such that all lights in the space are linked to one sensor such that all lights respond in the same manner to the control signals.
Lighting controls in classrooms are to be are based on absence detection to turn off lights and daylight sensing to dim lights as required to off, in response to the daylight sensor.

Lighting Controls in ensuite toilets to be based on manual on/off switching with automatic absence detection only. One linear high frequency fluorescent fitting per cubicle and lobby will suffice.

The teaching wall shall have one thermostat, one two-way PA loud speaker, a horizontal run dado rail trunking incorporating two twin socket outlets and one network point. The dado rail trunking shall be run at a height of 550mm above FFL.

The exact location of the network point and associated socket outlet at the teacher's base shall be agreed with the school Principal at an early stage in the design development. Where there is no Principal the Department 's Technical Staff shall be contacted for advise and guidance.

1 no. twin socket outlet and 1 no. network point above the whiteboard for Data Projector. 1 no. network point centred on teaching wall at ceiling level.
No other sockets are required.

BUILDING SERVICES ENGINEERING SYMBOLS	Plan	Elevation
Light Switches (fixed 1100mm above FFL)		
Mechanical extract switch with pilot light		
Twin switched 13 A socket outlets		
Public Address Speaker (fixed 1600mm above FFL)		
Dado trunking		
Network point		
Water supply (hot & cold water)		
Mains water tap (see TGD-030 1)		
Radiator		
Room Thermostat (fixed 1500mm above FFL)		
Thermostatic blending valve		
1 x 49w surface mounted fluorescent c/w high efficiency T5 lamps and prismatic diffusers. Automatic dimming version		
1 x 35w surface mounted fluorescent c/w high efficiency T5 lamps and prismatic diffusers		
Ceiling mounted daylight/ movement sensor		
Movement Detector		
Extract Fan		
Ceiling vent		

See Drawing TDG 022 - D01 to reference numbers on elevations with general description.

PRIMARY ROOM LAYOUTS	SCALE:	n/a	
TYPICAL CLASSROOM - ELEVATIONS DRAWING 2 of 2	DRG No:	TGD 022 - D02 Wi-Fi	
	DATE:	Nov '08	
REVISION: 04	DATED: May 2016	APPROVED BY:	P+T
STAGE: DOCUMENT ADDENDUM APPROVED		PREPARED BY:	C.D

DEPARTMENT OF EDUCATION & SKILLS
An Roinn Oideachais agus Eolaíochta
PLANNING AND BUILDING UNIT