L1 Computing - Unit 3 - Computer Hardware Systems and Networks

Relevant LINKS

BACK TO COMPUTING UNITS **[1]**

Handbook home page **[2]**

Overview

Computer Science at Silver Level requires the candidate to use appropriate hardware and networking systems to enhance projects that involve programming . As a result of reviewing their work, they will be able to identify and use automated methods or alternative ways of working to improve programming and using computers. They will also be aware of issues relating to intellectual property rights. Unfamiliar aspects will require support and advice from other people.

A work activity will typically be 'straightforward or routine' because:

The task or context will be familiar and involve few variable aspects. The techniques used will be familiar or commonly undertaken.

Example of context – designing, planing, implementing and testing a basic program for controlling a physical system.

Support for the assessment of this award

Example of typical Computing work at this level (Coming Soon)

Assessor's guide to interpreting the criteria

General Information

QCF general description for Level 1 qualifications

- QCF general description for Level 1 qualifications
- Achievement at QCF level 1 (EQF Level 2) reflects the ability to use relevant knowledge, skills and procedures to complete routine tasks. It includes responsibility for completing tasks and procedures subject to direction or guidance.
- Use knowledge of facts, procedures and ideas to complete well-defined, routine tasks. Be aware of information relevant to the area of study or work
- Complete well-defined routine tasks. Use relevant skills and procedures. Select and use relevant information. Identify whether actions have been effective.
- Take responsibility for completing tasks and procedures subject to direction or guidance as needed

Requirements

- Standards must be confirmed by a trained Level 1 Assessor or higher
- Assessors must at a minimum record assessment judgements as entries in the online mark book on the INGOTs.org certification site.

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- Routine evidence of work used for judging assessment outcomes in the candidates' records of their day to day work will be available from their eportfolios and online work. Assessors should ensure that relevant web pages are available to their Account Manager on request by supply of the URL.
- When the candidate provides evidence of matching all the criteria to the specification, subject to the guidance below, the assessor can request the award using the link on the certification site. The Account Manager will request a random sample of evidence from candidates' work that verifies the assessor's judgement.
- When the Account Manager is satisfied that the evidence is sufficient to safely make an award, the candidate's success will be confirmed and the unit certificate will be printable from the web site.
- This unit should take an average level 1 learner 50 hours of work to complete, with 40 hours of learning under specific teacher presence.

Assessment Method

Assessors can score each of the criteria N, L, S or H. N indicates no evidence and it is the default setting. L indicates some capability but some help still required to meet the standard. S indicates that the candidate can match the criterion to its required specification in keeping with the overall level descriptor. H indicates performance that goes beyond the expected in at least some aspects. Candidates are required to achieve at least S on all the criteria to achieve the full unit award. Once the candidate has satisfied all the criteria by demonstrating practical competence in realistic contexts they achieve the unit certificate.

Expansion of the assessment criteria

1. The candidate will understand computer hardware

1.1 I can identify the main hardware components in computing devices

Candidates should be able to identify CPU, micro and standard USB ports, audio and video ports, RJ45 network ports, SD Cards, Memory modules, USB memory, hard drive, keyboard, mouse, displays for commonly used computer devices.

Evidence: from assessor observations, internal testing and documentation in portfolios.

Additional information and guidance

Candidates should be familiar with commonly used hardware components through hands on use. Raspberry PI, building a PC or taking apart disused machines will all provide experience. A good little game is to provide a hardware specification for a computer and ask the candidates to use the web to source the parts at the best possible price. The winner is the one who can get the components to build a machine at the best price. If you want to make it more difficult take shipping costs into account and say you need 50 pieces. This will make it less likely that shipping costs will swamp the costs if components are bought from different suppliers.

1.2 I can match components in computing devices to purpose

Candidates should be able to match a component to a description of its purpose

Evidence from internal testing and portfolios.

Additional information and guidance

Candidates should know the different purposes of common components. CPUs for processing instructions, USB ports for connecting peripherals, RAM for storing programs and data that is in operation, SDRAM and hard discs for storing programs and data while not being used. A heat-sink is for taking heat away from active components to stop them being damaged by getting too hot. Heat-

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sinks might incorporate a fan. Power supplies to convert mains voltages to the lower levels needed in the devices, Batteries for portable power. Main board to hold and enable connections between the components.

1.3 I can classify hardware on the basis of purpose

Candidates should be able to group hardware devices that have common purposes.

Evidence: from internal tests and content of learner portfolios.

Additional information and guidance

Candidates should be able to recognise that for example, SD Cards, USB pen drives and hard drives all have the primary purpose of holding programs and data before use. They should be able to see that internal power supplies. external power supplies and batteries all provide the energy to make the computer work. Keyboards, mice and touch screens are all input devices, Screens, printers, plotters and CNC machines are all output devices.

1.4 I can compare hardware components on the basis of their properties

Candidates should be able to use the physical and performance properties of components to make comparisons.

Evidence: From internal testing and portfolios

Additional information and guidance

Candidates should be given many opportunities to compare components and devices carrying out testing where possible. Do all computers start up in the same time? If not why not? Are all USB ports equal when transferring data? Are differences in price justified? Does over-clocking a RaspberryPI really make much practical difference? Is it worth paying more for a hard drive for capacity that is unlikely to ever get used? These are opportunities to reinforce and develop numeracy with simple calculations to quantify differences. At Level 1 structured support will be needed in keeping with the overall level descriptor.

1.5 I can identify power consumption and performance as key limits on hardware

Candidates should appreciate the tension between computer performance and power consumption.

Evidence: From assessor observations and learner portfolios

Additional information and guidance

One of the most fundamental technical limits on technological progress is power management. Portable devices require light weight and long battery life but they also need increasing processing power and hi-resolution displays. If the speed of a processor doubles the energy it consumes doubles. If the voltage at which a processor operates doubles its power consumption goes up 4 times. So it is important to run processors at a low voltage and the processing power in every tick of its clock is also very important. Particular strategies to reduce power consumption include.

- Variable speed processors so that the processor only runs fast when it is needed
- Multi-core processors to reduce the need for increasing the clock speed in order to keep processing power up Using low power cores in a multi-core processor design to handle some not so demanding tasks
- Low voltage designs
- Efficient chip designs with fewer transistors to get the same processing power.

It is worth noting that the ARM processor in the RaspberryPI, designed by technologists in Cambridge

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and originally at the heart of the Acorn Archimedes computers, is one of the most power efficient in the world. Similar designs are used in the vast majority of mobile ‘phone and portable devices such as iPads. While there is probably more publicity given to the very power hungry Intel and AMD CPUs in Windows desktop computers, 4 times as many ARM processors are currently being sold and that looks to increase as people start to use mobile
devices as their main computers.

Improving battery technology will also help as would improving the efficiency of software. This is another reason to learn to write efficient code. It is better for energy efficiency and therefore better for the environment.

Candidates should have the opportunity to explore power and energy considerations perhaps in conjunction with other assessment criteria and there are some excellent opportunities to link to the English, science and mathematics curriculum.

1.6 I can identify cost as an issue in performance

Candidates should appreciate the tension between computer performance cost.

Evidence: From assessor observations and learner portfolios

Additional information and guidance

In general high performance components are disproportionately more expensive than low cost components. Add this to branding in a technically complex field and you have a potential for users to be at the mercy of salesmen! If a particular component is a limiting factor in a performance critical application it might be justified to pay a big premium on that component but often this is not the case.

Salesman will use terms such as “future proofing” to persuade people to part with their money. Take a state of the art processor costing £500 and one with say 80% of the performance costing £100. There will be no obvious difference to the user in many applications and in time other factors will probably be just as important such as the amount of memory in the machine, its power consumption or the resolution of its screen. A similar situation applies to network switches and new products. New products often command a premium price as much because they are technology fashion accessories as because of their real functionality. Often in a year or two prices are half and functionality doubled. Smart users do the sums and work out cost benefits. In most cases costing is simple arithmetic. It is understanding the real benefits if technologically illiterate that is the problem. Of course some people will be happy to pay a premium for fashionable brands but at least young people should be educated to be aware of why they are deciding to make purchases. A useful debate would be “Is their school getting good value from its technology suppliers?”
How would they know?

2. The candidate will understand the role of network servers

2.1 I can identify a server in a network diagram

Candidates should be able to appreciate the server in relation to other components in the network.

Evidence: local testing, portfolios

Additional information and guidance

Candidates should be able to identify a server in a network diagram by considering size, shape and position in relation to other components.

2.2 I can identify a range of servers and services provided by servers to networks

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Candidates should know that a server provides a range of services including running programs and presenting results to clients, storing client data and information, enabling communication between clients.

Evidence: From local testing and portfolios

In the early days of microcomputers, servers were often called file servers because that was their main function. They stored files and shared them between clients subject to permissions to access them. They would provide shared printing services and perhaps email but they did not run general applications programs. Increasingly servers do both jobs. They run programs and the results are displayed on the client computer and they store files and handle e-mail. It is very expensive to have software applications stored and run individually on every network client, not only in the cost of multiple software licenses but in having to manage the software on every machine. Even though to an extent this management can be made more efficient using the server to update machines, in practice constantly upgrading hardware with different specifications that can not all cope with exactly the same software results in expensive complexity.

Running everything from servers is potentially much more efficient and much less expensive but two things made this difficult. One is that the servers needed to be very powerful (expensive) to cope with running very large applications often designed at the limit of hardware capacity and the other is that the network connections have to be fast too.

The internet has changed the way we think of servers and the key is the web browser. Web browsers can run client side applications in the client eg in Javascript and also support transactions on the server side eg executing PHP code to process database information and then present it on the client through the browser. It is very much easier to manage a large server farm with consistent software than to manage many distributed client computers, scattered all over the world each running an unpredictable range of applications. The browser has effectively standardised the operating platform removing licensing fees and enabling competition based on service. At the time of writing we are in a transition to mobile clients where power consumption is just as important as performance and perhaps more so when servers can provide almost unlimited storage and raw processing power. Clients can still run their own apps but the main productivity tools can be provided and managed centrally.

For this criterion, candidates need to be able to distinguish between servers processing data, storing and making information available and enabling communications.

The most obvious case of programs running locally is the client operating system such as Windows installed on the local machine. An example of a server running the program on behalf of the client is a search engine like Google. You make the query in the web browser and the search engine somewhere on the web then runs a program to find things linked to the query and returns the results in the local browser. An obvious data server is a file sharing application such as Dropbox. Dropbox enables the sharing of data files over the internet. The distinctions
between running programs locally and running them on the server is now much less clear-cut than at any time in the past. Web pages use HTML files to tell the browser what to display but there is generally no interaction for the user. To provide that Javascript is built into the browser. Programs that run in the browser are running locally but these are usually small and could be downloaded into the browser from the server or they could be a plug-in on the local machine. The cooperation between server and client in running programs has become much more closely linked with the internet. Peer to peer systems are effectively making any machine on the network a potential server. The trend is to racks of many low cost machines, often just the main boards and components, sharing the tasks and so what is represented as a server by a box on a diagram might in fact be very many servers not just one machine.

2.3 I can identify key services provided by internet servers

Candidates should be familiar with internet services provided by servers, including web servers for sending out web pages, proxy servers for caching information locally, database servers and video servers.

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Evidence: From assessor observations and portfolios

Additional information and guidance

Server based services is a complex area and at this level it is sufficient for candidates to know that web servers are responsible for hosting web sites. One server can host many web sites sending out pages when requested. On the other hand a very busy site such as the Google search facility can be spread over many servers. Local proxy servers can store often used information locally so that it can be retrieved quickly rather than being limited to the slower and contended bandwidth of the wider internet. Most of the web is supported by databases. A web site of any complexity is a data base on a server with web pages through which information is presented in a web browser. Since the software protocols and associated technologies to link the data to the web page are free and open for all to use, the systems encourage competition between technology companies resulting in all web browser software being free of charge. There are commercially licensed applications built on these free and open technologies and the language for database software development (SQL) is common to both free and proprietary software. This generates a rich, varied and competitive market that has accelerated innovation and reduced costs.

Video is a sort of holy grail in that it is so data intensive that if a server can handle video streaming it can probably handle anything else. Google owns around 1 million servers at the time of writing. Probably a very significant proportion is used by You Tube. This is why it is better to make links to a site like You Tube than to host your own videos if these are likely to be used intensively. Google’s servers run on Linux, imagine how much they save in license fees by using open source software on 1 million machines. Note that servers on the internet do not have to run any particular operating system as long as the information comes to them and leaves them in standard formats. This is the reason for HTTP (HyperText Transfer Protocol) ftp (File Transfer Protocol) and smtp (Simple Mail Transfer Protocol.) They are standard ways of transferring information independent of particular server technologies.

2.4 I can identify key factors that can affect server and network performance

Candidates should be familiar with the following key factors. For servers, processor speed, RAM, and speed of getting data into and out of the machine. For networks the rate of data transfer and the way data is routed through the network.

Evidence: Assessor observations and portfolios.

Additional information and guidance

Three fundamental factors governing server performance are the speed of the processor, the amount of RAM in the machine and the capacity to get data into and out of the machine. It won’t matter how fast the processor is if the machine runs out of memory and starts trying to access information from its hard drive. This is because the speed of getting information from a hard disc is much slower than from RAM. Approximately 200ns (nanoseconds) to access RAM compared to 12,000,000 ns to access the hard drive. This is equivalent to what's normally a 3.5 minute task taking 4.5 months to complete! RAM is expensive and a lot of the time it is not used. This is why sharing RAM across a million servers is much more economic than having a million individual machines any of which might run out of RAM while several neighbours are empty. Load balancing across multiple servers minimises the chances of using their RAM inefficiently. A simple game to illustrate the point. Get 10 children to partner 10 others. One partner leaves the room the other holds as many sweets in one hand as they can. Now get them to put the sweets in a box. The sweets represent the full capacity of the children together. Now bring in the partners and say they have to get as many sweets from the box into the hand of their partner as possible, if they drop any the sweets are lost. It is likely that they will try to grab more sweets than their partner can hold so some sweets will get lost while others will have spare capacity. We know that if they are careful and work cooperatively they can all get the maximum amount of sweets but if they all come in a rush to one box and try to distribute to their partner they won’t be able to cope with them even though some of their colleagues will have spare capacity. At the end say they can share equally the sweets that all

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have safe. If they knew that at the beginning would they have done things differently? This demonstrates the value of load balancing (and also human cooperation).

If the data coming into and out of the server is such that the connection of the server to the network is saturated this will also over-ride the speed of the processor or the amount of RAM in the machine. Let's say the machine has 4GB of RAM free and data is coming in at 100 MB per second. How long before the RAM is full and data has to be swapped to the hard drive? about 40 seconds. At this point the speed of transfer to the hard drive is likely to be the limit because this will be hundreds of times slower than taking the information into RAM. Of course if the entire Database is capable of fitting into RAM and that is all you are dealing with the hard drive might never need to be accessed and so the processor and the network connection would be the only things to consider. If the application required a lot of complex calculations the processor could be the limit. If not the connection speed could be the limit. Candidates should appreciate that it is impossible to say exactly what will be a limit unless you know exactly what the server is going to be doing. Simple games can be devised to illustrate these points. Get one candidate to bring books 10m across the class for three others to pick up and put on a shelf next to them. To speed up the process will it help to add a person to the three or to the one? The three children represent the processor working well within capacity. Adding another will make no difference if the supply of books is not increased. Now if the shelf is full and the shelf stackers have to transfer books to the library at the other side of the school before any more can be accepted, this is the equivalent of memory being full and having to transfer data to the hard drive. If they can take 3 books at a time to the library it will be faster than taking one but still won't make much difference until the shelf can be refilled.

These principles also apply to routing data through network switches. If switches know where to send data specifically it is much more efficient than if they just broad cast it everywhere so the relevant data does reach its target device but also slows every other device down by having to check irrelevant data.

2.5 I know about permissions and basic server security

Candidates should know that servers usually provide a variety of permissions for users to enable them to have ownership of their information and to selectively share it. They should know the importance of secure passwords and the need to respect other people's information and privacy.

Evidence: Assessor observations and portfolios.

Additional information and guidance

At this level it is sufficient for candidates to know that there are roles for most server applications with each role having permission to access different subsets of the information on the server. The concept of a super user who can access everything should be understood as well as the responsibilities that go with that role. Two clear types of permission are read and write access. They should know that it is possible to provide read but not write access and why this might be useful. They should also realise that different applications can have different sets of permissions for the same user. The need for strong passwords and keeping them secure should be emphasised.

3. The candidate will be able to identify factors affecting network performance

3.1 I can compare the performance of cable and wireless connections

The candidate should be able to make comparisons between wireless and cable network connections and their appropriateness in different circumstances.

Evidence: Portfolios

Additional information and guidance

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Candidates should be aware of the term bandwidth meaning the capacity to transfer information and that it is generally highest in fibre optic cables, then copper cables then wireless. The main advantage of fibre optic cables is that they can carry signals a long distance with very high bandwidths but they are expensive. Copper cables are inexpensive but become unreliable at high bandwidths at lengths over 100m. Wireless has the lowest bandwidth but is very versatile in that it spreads everywhere and is essential for mobile technologies. It should be easy to demonstrate that for a few clients wireless is a good solution but if many access the network all at the same time they only share the bandwidth and performance will fall. Mobile phones work because not everyone is using their phone at the same time. When there is an emergency and everyone tries to access the network is can fail to provide connections. Note that a mobile phone is a small computer and a mobile phone network is a computer network. A good practical exercise is for candidates to make up a fly lead using a piece of UTP cable, RJ45 plug and a crimp tool. They can see how easy it is to make up a cable network. Plugging the cable into a RJ45 socket on the network and their computer connects them to the network. A home network is easy to wire up. A switch plugged into a server and then the clients plugged into the switch. Wireless is easier but wireless performance reduces with distance from the wireless access point and also if there are walls and things in the way. In a house it is not likely to be a limiting factor.

3.2 I can relate bandwidth to data transfer capacity

The candidate should be able to use the term bandwidth in situations where data transfer is important..

Evidence: From portfolios.

Additional information and guidance

Bandwidth is commonly used as a generic term for data transfer in bits/second. This is because data bits/second represents a frequency similar to oscillations in analogue systems where frequency is measured in Hz. A direct example is in processor speed. A processor bandwidth of 2 GHz is 2 billion clock cycles in one second. If the processor has several cores it might well be possible to do several operations in one clock cycle and these could involve scores of bits. In a network with a bandwidth of 54 Mbits/second, (eg wifi 802.11g) the maximum possible data transfer rate is 54 Mbits/sec. In practice it is likely to be less than this. Since there are 8 bits in a byte, the maximum number of bytes that could be transferred would be 54/8 = 6.75 Mbytes. However, data transmission requires routing and other information to go with the data so the actual throughput will always be less than this. The details are much too complex for this level but candidates should know that the standard wireless bandwidth of 54 Mbits/second is likely to transfer data more slowly than a 100 Mbits/second cable.

In general terms they should be able to associate bandwidth with network data transfer speed and processor speed in simple cases.

3.3 I can explain the term "contention"

The candidate should be able to explain contention as competition between many systems sharing the data transfer capacity of a system.

Evidence: From portfolios

Additional information and guidance

It is very common for internet services to be advertised based on the maximum bandwidth available when in fact the actual amount depends on how many other people are using the system. Where several people are using the same link to a service provider they are “contenders” for the available bandwidth. If for example the contention ratio is 50:1 it means there could be 50 people having to share that connection. If they all decide to download a video file at the same time the performance is likely to collapse! But on average over a 24 hour period this is
unlikely and if one user happens to be the only one on the system at the time it will be very quick. It

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is possible to rent uncontended lines but they tend to be much more expensive. In a school where there is a wireless access point serving a class of laptops, the same problem arises. One way to solve this is to have several access points but then all the laptops might connect to just one of them so a system to balance out the connections is needed. This again adds cost. If we take the main server in a school and its connection to the internet we have effectively the whole network through one link that is a lot slower than the connections between the clients and the server. This is where a proxy server can be useful. If information that is regularly used is downloaded once on the proxy server all users can use it locally from the proxy server instead of having to keep getting it from that single internet connection that could also be contended with other schools and local businesses. Of course contention also takes place for the server. More people requiring high intensity services from the server can eventually reduce the performance.

At level 1 the main thing is for candidates to know the word contention and its meaning so they recognise what it means when used in for example ISP sales and advertising literature.

3.4 I can identify potential bottlenecks in network designs

The candidate should be able to identify bottlenecks in networks in simple cases.

Evidence: From local testing, portfolios

Additional information and guidance

Obvious bottlenecks occur where many people are in contention for a limited amount of bandwidth in any part of a network. If the network speed between the client and a network switch is 100 Mbits/sec and the switch is connected to the server at 100 Mbits/sec there is no bottleneck if there is only one user. If there are 100 users each consuming 10 Mbits, their connection to the switch can handle this easily but the connection from the switch to the server will be saturated. This is why the fastest network speeds are needed closest to the server. Typically a level one candidate should be able to identify on a diagram where a bottleneck is likely to occur given the appropriate data on the components.

3.5 I can distinguish between local and wide area networks

The candidate should be able to associate a local area network with a specific location such as a school or office building and a wide area network with links joining buildings at significant distances apart.

Evidence: From portfolios

Additional information and guidance

Usually local area networks have a server connected to clients through structured cabling built on fast switches with distances between nodes no more than 100m. They don’t have to be confined to a single building but usually external building links are fibre optic cable a) because they can have greater distances without needing a switch or repeater to boost the signal and b) because metal cables are more vulnerable to lightning strikes. It gets difficult and expensive making these external links if they have to go over public roads or other people’s property. Once buildings are spread out by more than a few hundred metres, it is usual to use existing infrastructure for carrying the signals eg an internet service provider. Networks that span large distances are called Wide Area Networks (WANs) those using entirely their own cables, switches and access points are Local Area Networks (LANs). LANs can carry data faster and the owner has freedom to customise it any way they want but this is also expensive in management and maintenance. WANs can be centrally managed and benefits from economies of scale in principle reaching anywhere on Earth. The problem with WANs is simply the relatively slow connection between buildings separated by large distances. It is possible to get a fast connection but it tends to be expensive. The internet has driven wide area connection technology to become faster and less expensive. Another significant factor is designing software to work efficiently over a network using many smaller applications working together rather than one massive one. The internet is effectively a global wide area network with parts localised for specific

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uses.

Your home hub is connecting your computer directly to the service providers server(s). You don't need a server at home. Computers like the Google Chromebook are intended to work through a web browser. All of these changes are gradually chipping away at the original concept of a local PC connected for communications to being an network device that happens to be able to do some things locally. The traditional view of LANs and WANs might well change as more local needs can be satisfied by "cloud computing" where a client is connected to a website somewhere out on the internet. Of course that web site is hosted on a server or servers somewhere. There is commercial pressure as it is a lot less expensive to run eg a school's IT infrastructure from the "cloud" but there is also pressure from the rise in mobile computing where people expect to get their information anywhere any time. It will take time to change because many of the people with decision making power find changing the way they work and the associated technologies difficult but it is clear that the question is more how long will all this take rather than if it will. For younger learners we need to consider the world in 10 years time not now and one thing is for sure, things are going to keep changing so learning how to cope with change is important.

3.6 I can identify protocols used in networks

The candidate should know what a protocol is and be able to give some specific examples such as HTTP, FTP, TCP/IP and SMTP.

Evidence: From portfolios

Additional information and guidance

A protocol is a way or method of doing something. In life outside technology, protocols are used so people can work collaboratively without offending each other! For example, it is part of the protocol for meeting the Queen not to turn your back on her. When giving a business card to a Japanese business person you should hold it in two hands to pass it to them and when you receive their business card you should read it carefully and put it safely in your wallet. In technology protocols enable different systems to communicate each other. Imagine you are a program and you need to send a message to another program. The other program needs to know there is a message, who it is from, where it starts, where it ends and so on. We do this ourselves with language all the time. One of the protocols of spoken communication is to use a language the two people talking to each other both understand. If you were talking to your boss at work you will automatically adjust the way you talk to be different to how you talk to your friends in a social setting. All of this is using protocols you have generally picked up growing up. Of course it is learnt because an immature toddler often gets the protocol wrong. This is often amusing and we make allowances for it. In fact these learnt human protocols are a lot more complicated than machine protocols but machine protocols have to be precise.

There are far too many protocols to learn about all of them so let us look at two that are at the heart of the internet. HTTP and TCP/IP. HTTP is Hypertext Transfer Protocol. You make an HTTP request when you put a web address into your web browser - http :// www. gmail.com. This involves connecting to a port on the server using TCP (Transmission control protocol). An http server will be listening on that port for requests. This is where protocols come in. The http server has to know what it is listening for and distinguish it from any old random noise coming along. Once the connection is made information is sent in defined methods and received by a server that understands those methods. We won't get into all the details. The main thing is for candidates to understand why protocols are needed and in general terms, what they are. FTP, file transfer protocol is used for sending and receiving files and SMTP - simple mail transfer protocol is used for sending mail messages.

In a nutshell all these protocols are about sending and receiving information so that sender and receiver both understand the message.

At level 1 it is sufficient to know a protocol is a way of providing information in a standardised format so that all devices that understand the format can send and receive the information reliably. They

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should recognise the names of some common protocols but do not need to know how they work.

4. The candidate will contribute to good network security

4.1 I can work to support an acceptable use policy

The candidate should show that they can work consistently to an acceptable use policy over a prolonged period.

Evidence: From assessor observations.

Additional information and guidance

The INGOT community learning site has a simple acceptable use policy and schools usually have one of their own. Either of these is suitable. If a candidate abuses the system they should be expected to show several months “good behaviour” before this criterion can be safely awarded. Assessors should relate this to e-safety and citizenship.

4.2 I can choose a strong network password and keep it secure

Candidates should know the characteristics of a strong password and apply these to their own passwords.

Evidence: From assessor observations

Additional information and guidance

Password strength depends on the number of characters and the variety of types of character. 8 characters or more and including upper and lower case letters, numbers and characters like $ and %. Passwords can be strong and memorable. eg MyDogSpot£75 or LeavesAre80%Green. Writing a password on a piece of paper is not a problem if you don’t leave the paper lying around since no computer can access that piece of paper. Candidates should not share their passwords with anyone else. This should also be part of the acceptable use policy.

4.3 I can identify encryption as a way of making information secure

The candidate should know what encryption is and some simple methods.

Evidence: Internal testing, portfolios.

Additional information and guidance

The simplest methods of encryption are to substitute the characters in a message for a different but related set of characters. eg This is a message replaced by Uijt jt b nfttbhf. This is just moving the letters on one place in the alphabet. This is not difficult to crack! In practical encryption such as GPG [3] the computer uses random numbers to generate a key code which the user keeps secret. The message is encrypted to very complex patterns that can only be undone if you have the key code. You only give the key code to the people you want to be able to read your message. GPG is free so it is possible to try this out. This is a resource [4] aimed at children and another [5]. There are a lot! Just use a search!

4.4 I can identify ways of minimising spam and eliminating malware

Candidates should be able to identify basic ways of reducing spam and avoiding viruses and other malware.

Evidence: From assessor observation and portfolios

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Additional information and guidance

Spam is unsolicited e-mail. If your e-mail address is unknown it can't be "spammed". A fundamental principle is not to leave your e-mail address in a machine readable format on a web site. Making an image of an e-mail address is a much better way of presenting it if it needs to go on a web site because it is much more difficult for a robot to realise that an image is actually an address. Internet searches will find many tips on reducing spam. An exercise might be to get children to work in pairs and use searches to find and then list say 5 actions to reduce spam in the order they think most important and present back to the rest of the class.

4.5 I can identify a firewall and explain its purpose

Candidates should be able to identify a firewall on a network diagram and say why it is important.

Evidence: Local testing and portfolios

Additional information and guidance

A firewall is a software or hardware network security system that controls the incoming and outgoing network traffic by analysing the data packets and determining whether they should be allowed through or not. This is in some ways related to protocols in that the order and nature of the data in the packet will determine what happens.

Moderation/verification
The assessor should keep a record of assessment judgements made for each candidate and make notes of any significant issues for any candidate. They must be prepared to enter into dialog with their Account Manager and provide their assessment records to the Account Manager through the online mark book. They should be prepared to provide evidence as a basis for their judgements through reference to candidate e-portfolios and through signed witness statements associated with the criteria matching marks in the online mark-book. Before authorizing certification, the Account Manager must be satisfied that the assessors judgements are sound.

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