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**Internal Assessment Resource**

**Digital Technologies & Hangarau Matihiko Level 3**

This resource supports assessment against Achievement Standard919051

**Standard title:**  Use complex techniques to develop a network

**Credits:** 4

**Resource title:** Set my (3D) printer free!

**Resource reference:** Digital Technologies & Hangarau Matihiko3.6B

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| This resource:   * Clarifies the requirements of the standard * Supports good assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | December 2018 Version 1  To support internal assessment from 2019 |
| Authenticity of evidence | Teachers/kaiako must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

*1Achievement standard 91905 is derived from both The New Zealand Curriculum and Te Marautanga o Aotearoa.*

**Internal Assessment Resource**

**Achievement standard:** 91905

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**Teacher/Kaiako guidelines**

The following guidelines are supplied to enable teachers/kaiako to carry out valid and consistent assessment using this internal assessment resource.

Teachers/kaiako need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students/ākonga against it.

**Context/Te Horopaki**

The assessment activity requires students, using complex techniques, to build a microcomputer-based (or similar) router to connect a wireless print server to serve multiple users on a LAN using either their own devices or configured wireless devices. Students will increase the convenience, flexibility, and usability of the (3D) printers the same way they do with other networked printers.

Students will need to build and configure a microcomputer to act as a print server. Students will then need to demonstrate their ability to configure both the print server and the other devices’ settings to allow them to connect to the print server. This needs to be done in the context of a network. For example, devices could include a file server, tablets, phones, PCs, a modem/router using WIFI or switches and cabling etc. as required.

This assessment can be added to or modified in several ways; for example, adding an internet camera to watch the print job, adding sensors to monitor the print jobs, or configure and manage your microcomputer from another computer on the network through SSH. (The basic installation comes with an SSH server, removing any obstacles for an SSH-based installation.) Other suggested contexts for assessing this standard are given below.

While this task assumes configuration of a 3D printer, any USB printer will suffice.

**Conditions/Ngā Tikanga**

It is recommended that students should have at least two identified checkpoints with their teacher as they work through this assessment activity to ensure they have an opportunity to ask questions and gather feedback.

The format of the final outcome is recommended to be a concise document drawing together all the development, research and refinement of the student’s process. Evidence can come from print screens, photos, reflections etc. The format of the evidence is not assessed by this achievement standard.

Conditions of Assessment related to this achievement standard can be found at <http://ncea.tki.org.nz/Resources-for-Internally-Assessed-Achievement-Standards>

**Resource requirements/Ngā Rauemi**

This task will allow students to investigate, select, install (hardware components and software) and then configure and troubleshoot the outcome.

In this assessment, the outcome is to set up and configure a microcomputer (Raspberry Pi or similar) print server (wireless or wired). Most of the hardware for this project is fairly easy to get a hold of, you may well have most (or even all) of the bits and pieces you need in your classroom already, or they can be purchased at a reasonable cost.

For this assessment you will need, for example, depending on the context:

**Basic Hardware selection:**

Microcomputer or similar

Wireless USB adapter

SD card

Appropriate power supply

Printing peripherals e.g. 3D printer

Switch or a router

**Basic Software selections:**

An appropriate OS

An appropriate printing system e.g. CUPS (Common Unix Printing System)

**Basic configurations:**

Booting the microcomputer

Configuring the microcomputer

Configuring the network router switch etc

Configuring other devices

Download, build, and install the printing system

Connect and test the setup to confirm its functionality

Connect other devices to the network

Use information gained from testing to improve the quality of the network

Other possible contexts:

*Note: If assessors intend to modify the context they will need to also modify the task to ensure that the context will still meet the requirements of the standard.*

* Web server access to home networks through the internet
* 3D printer controller
* NAS File server
* IRC server
* Ebook server
* Minecraft or other gaming servers
* Email server
* Home automation
* Network scanner
* Git server
* VPN server
* Samba server
* Voice over IP
* Webcam server
* Digital signage
* LAMP/Apache/PHP server

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**Student/Akonga instructions**

**Introduction/Kupu Arataki**

This assessment activity requires you to develop, troubleshoot and configure a microcomputer-based wireless print server to connect a (3D) printer.

You will also need to include the setting up and connecting to other devices in the network e.g. the tablet, PC or other device that is needed for sending the information to the printer. This may also require some configuration of routers, servers and other hardware or devices to make the printer functional.

You can access help and are encouraged to do so. This assessment is about your ability to show the how and why of what you are doing not your ability to follow an internet tutorial.

Teacher note: Insert due dates and timeframes

**Read this information first**

Teacher note: Modify this tasks list depending on how you have taught the class, and the process you wish the students to follow.

You will need to:

* Investigate a range of hardware and software that would be appropriate for this project. You will need to consider the purpose and function of both the hardware and software to be used for the outcome and justify your selection of the parts and components, taking into account relevant implications such as accessibility and price.
* Make some software and hardware selections based on how you develop your outcome.
* Use appropriate tools, procedures, protocols and techniques when installing and configuring hardware (including peripherals) and software
  + Examples of protocols include: SMB, NTP, DNS, IPV4/IPV6, IP addressing and ICMP
* Diagnose, test configure, and troubleshoot your hardware and software throughout the development process using appropriate testing procedures such as:
  + configuring and booting the computer hardware
  + configuring the wireless USB adaptors
  + building and installing the printing system
  + configuring and testing networking components (router etc.)
  + connecting and testing the setup to confirm its functionality
  + adding other devices onto the network to send print jobs.
* Demonstrate understanding of the networking concepts and the underlying OSI framework including:
  + the Open System Interconnection (OSI) model
  + ICMP (Internet Control Message Protocol)
  + data transmission modes (Unicast, Broadcast, and Multicast).
* Show clear evidence of the procedures, decisions and your thinking as you develop this outcome.
* Show that you recognise and address any relevant implications.
* Regularly check in with your teacher to demonstrate your learning.

Teacher note: Edit list of materials to be provided

Your teacher will provide you with a selection of equipment to investigate and select from for this assessment, or you can provide your own.

You will also be expected to:

* + install and configure an appropriate OS
  + configure a networking router
  + configure a print server
  + connect and configure other devices.

You will be assessed on your ability to:

* show an understanding of the parts and components selected, through explaining the purpose, function and behaviour of the parts and components
* explain the networking concepts used to develop the network, including specific reference to the layers of the OSI model and the impact this has on the design of the network
* independently and accurately install, test and configure your selected hardware to ensure the outcome meets end user requirements
* independently and accurately install, test and configure your selected software to ensure the outcome meets end user requirements
* demonstrate that you have considered and addressed relevant implications
* evaluate the information gained from testing procedures, diagnosing and troubleshooting configuration errors and apply this information to improve the quality of your wireless print server evaluated and apply information gained from testing procedures, diagnosing and troubleshooting to inform development and improve the quality of your network
* ensure your outcome is fit for purpose by justifying your selections of parts and components (hardware and software).

You may work with others to help generate ideas and develop those ideas. However, you will be expected to show your own thinking and evidence of how you discussed and combined ideas together to write and submit your own assessment evidence.

**Task/Hei Mahi**

You could follow this sequence of steps to complete in order to configure your wireless print server to connect a (3D) printer to the network:

Investigate a range of hardware and software that would be appropriate for this project. You will need to consider the purpose and function of both the hardware and software to be used for the outcome and justify your selection of the parts and components, taking into account relevant implications such as accessibility and price.

At each stage of development identify and explain the relevance this has on the OSI model, why it is relevant, and how this will impact the design of the network. This will be needed as evidence for the presentation of your outcome to your class.

Ensure that at each stage of development you use appropriate testing procedures to evaluate, diagnose and troubleshoot any configuration errors to ensure your outcome will be fit for purpose for the end users.

Configure the microcomputer hardware and boot the selected OS.

Configure the router and any other devices in your network.

Investigate and determine the best way to connect to the WIFI network and give reasons for your selection. Ensure the solution is configured and working.

Configure your microcomputer to enable a number of configurations as set by your teacher (e.g. assigning a different static IP address, configure DHCP etc.).

Secure your device appropriately.

Install and configure the printing system.

Edit network/interfaces.

Connect to the network and carry out standard configuration practices as determined by your teacher. Test on client machines, and the selected printer.

Ask your teacher to check your network.

Produce a simple presentation that maps your project stages against the OSI model to illustrate how your project links to each stage and allows your teacher or peers to critique your understanding and your process. Your teacher will check your network.

Your presentation should include:

* an explanation of the purpose, function and behaviour of the parts and components used and why you used them
* an explanation of the networking concepts used to develop the network, including specific reference to the layers of the OSI model and the impact this has on the design of the network
* how you used testing procedures to evaluate, diagnose and troubleshoot configuration errors to improve the quality of your network print server
* why your outcome is fit for purpose including a justification of your selection of parts and components used (hardware and software)
* how you have considered and addressed relevant implications.

**Assessment schedule/Mahere Aromatawai: Digital Technologies & Hangarau Matihiko 91905 – Set my (3D) printer free!**

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| **Evidence/Judgements for Achievement/Paetae** | **Evidence/Judgements for Achievement with Merit/Kaiaka** | **Evidence/Judgements for Achievement with Excellence/Kairangi** |
| Use complex techniques to develop a network.  The student has:   * explained networking concepts   **For example (partial evidence):**  *“I put together a presentation to my class which my teacher recorded. In it I talked about the different stages and where they aligned with the OSI model. One point I made was about the Datalink Layer which ensures that messages are delivered to the proper device and translates messages from the Network layer into bits for the Physical layer to transmit.*  *I needed to query the DNS to get confirmation of the printer address, so I used NSLOOKUP.*  *I researched DHCP to determine whether I should use DHCP to assign names or to use Static addressing. I decided that although DHCP is an efficient way to manage IP addresses rather than static address assignment, I knew I would be rebooting the Pi regularly so I assigned a static IP so other devices on the network will know where to find it..”*   * used appropriate tools, procedures, protocols and techniques when installing and configuring hardware, software and peripherals   **For example (partial evidence):**  *"In the Raspbian image, which you can download from the Internet, NTP is already installed. However, as I wanted to use the Pi as a time server, I might want to change the different servers to the NTP pool defined in the config file. I needed to edit the /etc/ntp.conf file and add servers to the NTP pool.*  *E.g. I found that name resolution on your own server is more than three times faster than resolution by external DNS servers.*  *I queried google, and my internal server and found that the internal server was much quicker."*  *"Then, I configured my wireless access point, I used a file called hostapd.conf.*  *I opened “sudo nano /etc/hostapd/hostapd.conf” and typed in these lines:*  *interface=wlan0 bridge=br0 ssid=miniProjects hw\_mode=g channel=7 wmm\_enabled=0 macaddr\_acl=0 auth\_algs=1 ignore\_broadcast\_ssid=0 wpa=2 wpa\_passphrase=pa55word wpa\_key\_mgmt=WPA-PSK wpa\_pairwise=TKIP rsn\_pairwise=CCMP*  *The value assigned to the ssid is the name I wanted the access point to use to broadcast its existence. My last couple of lines are about the authentication and security of my access point. Value of wpa\_passsphrase is used as login password which is the very common and not recommended Pa55word!"*   * undertaken a range of appropriate testing, diagnosing and troubleshooting procedures to identify and resolve setup and configuration errors   **For example (partial evidence):**  *"I had a problem with the CUPS installation I researched around permissions. First I double checked the devfs(8) permissions, then I checked the actual permissions of the devices created in the file system. I went to the Administration section of the CUPS web interface to manually backup the main CUPS configuration file located at /usr/local/etc/cups/cupsd.conf"*   * investigated the parts and components (hardware and software) to be used   **For example (partial evidence):**  *“I decided to use a Raspberry Pi because there were a lot of tutorials online and forums I could refer to when setting the system up. I researched CUPS and how this works as a standard Linux based print server."*  *As evidenced by student investigating the errors above.*   * addressed relevant implications   **For example (partial evidence):**  *The student looked at the implications and identified functionality, end user requirements, and usability. They explained these and then explained how they addressed them.*  *"I determined that the print server needed to be reliable for the end user because.... I addressed this by" “I added the location to the share information to make it easier for the users to identify the correct printer.”*  *The examples above are indicative samples only* | Use complex techniques to develop an informed network.  The student has:   * explained the OSI model and the impact of layers in the design of the specified network   **For example (partial evidence):**  *“I put together a presentation to my class which my teacher recorded. In it I talked about the different stages of my project and where they aligned with the OSI model. I talked about the router and its settings. I think routers are on the third layer, the Network layer. They are used to connect networks together. The Internet is made up of many routers. Our small network is like a small version! When using a network protocol, like TCP/IP, a router can move data from one thing to another. For example, when a user sends a print job for a printer, the router in the local network will check its routing table and decide where to resend that job.”*   * evaluated and applied information gained from testing, diagnosing and troubleshooting procedures to inform development and improve the quality of the network   **For example (partial evidence):**  *“I realised that the Windows machines couldn’t access the print-server. Upon further research, I realised I needed to configure Samba correctly. After changing the configuration file, I was able to print from Windows machines.*  *When I open up the Printers dialog, I got an error message "Printing service not available. Start the service on this computer or connect to another server". The start service button is greyed out.*  *I have tried*  *$ sudo service cups start start: Job is already running: cups*  *After a bit of searching and playing around, I finally found that there is a default configuration file which should be installed in /usr/share/cups/cupsd.conf.default.*  *I ran*  *sudo cp /usr/share/cups/cupsd.conf.default /etc/cups/cupsd.conf sudo service cups restart*  *and since then it worked. The reason I think was when CUPS got corrupted it had corrupted my hplip service as well and restoring CUPS did not restore the service. I have made note of this if it happens again for the users."*   * explained the purpose, function and behaviour of the parts and components (hardware and software) used   **For example (partial evidence):**  *“I looked at software that I could use to set up a print server. I had a look at CUPS as it provides a mechanism that allows print jobs to be sent to printers. The print-data goes to a scheduler which sends jobs to a filter that changes the print job into a format the printer will understand. CUPS uses IPP and HTTP. It checks the messages and then if they pass they get sent to the client module."*  *The examples above are indicative samples only* | Use complex techniques to develop a refined network.  The student has:   * independently and accurately used tools, procedures, protocols and techniques when installing and configuring hardware and software to ensure the network meets end user requirements   **For example (partial evidence):**  *Teacher notes on student observation: I was able to observe the student configuring the router to put the Pi on the network. The student identified the router and was able to look up how to configure the settings. The student was able to go directly to the relevant fields and enter the information. She chooses to use IPv4 instead of IPv6. I asked her why she did that, she was able to tell me the differences, and decided that on this network it would make little difference. Most operating systems actually support IPv6, but many routers don't support it, making a connection between a device with an IPv6 address to a router or server that only supports IPv4 impossible. The router we have is only IPv4 capable, so that meant my hands were tied.*  *I had to set DHCP background process not to automatically configure wlan0 and eth0 interfaces so that they would not auto-configure so that I could edit /etc/network/interfaces.*   * justified the selection of parts and components (hardware and software)   **For example (partial evidence):**  *“I used a Raspberry Pi with Raspberrian for this task. I think the Raspberry Pi was good because it is small and compact, it supports Linux, which makes software licensing more accessible. I confirmed that I made the right choice with CUPS by testing and configuring the other devices on the network to connect to it. I was able to print from a range of devices. I tested my Linux machine that was running Gnome. I added a network printer on a Windows device and configured a Mac also to access the printer. After a lot of research, I determined that CUPS has better support, giving access to the 3D printer features. I could have installed an alternative, but that would mean I would need to tune them quite a bit to get extra features working.*  *CUPS 2.1 added a “3D printer” capability bit to allow 2D and 3D print queues to co-exist on a computer. There is no explicit, out-of-the-box support for 3D printers."*  *The examples above are indicative samples only* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the achievement standard