# Network performance

## Learning hook

Revisit (and potentially extend) the learning hook from [Computer chatter 1: Networks and data transmission](https://www.digitaltechnologieshub.edu.au/secondary-teachers/getting-started/computer-chatter).

## Learning map and outcomes

In this learning sequence, we will:

* find out about the kinds of things that can affect the performance of a network.

You could also focus on the skillset and mindsets that learners might need to adopt and use during this project, this ties in with the [Creative and Critical Thinking Capabilities](http://www.australiancurriculum.edu.au/generalcapabilities/critical-and-creative-thinking/introduction/key-ideas). Read the [effective teaching section, learning: knowledge and beyond](https://www.digitaltechnologieshub.edu.au/primary-teachers/effective-teaching/learning-knowledge-and-beyond) for further guidance on this.

## Learning input

1. Students use the '[transportation chart](https://www.digitaltechnologieshub.edu.au/docs/default-source/getting-started-years-7-8/computer-chatter/transportation.pdf?sfvrsn=2)' to compare the following types of transportation (adjust for your local context): walking, cycling, bus, tram, train, taxi, car and plane. You may want students to complete the template on paper, on a single electronic copy, or collaboratively through a collaborative document tool.

In their comparisons, they consider the following factors: speed, reliability, complexity, capacity and cost.

In addition to providing a rank for each mode of transport, students include notes on each of the factors that clarify any interesting points.

1. Explain to students that when building a network or connecting a computer to an existing network, one of the considerations is whether or not to connect using wired or wireless technology.

## Learning construction

1. Students research the following types of network infrastructure, using their experience from the 'Learning input' task to inform their process: WiFi, cellular (mobile phone networks), ethernet (copper), ADSL, cable and fibre ethernet.
2. Students complete the research in groups of three or four.

The group needs to come up with a consensus before they rank each criterion. To reach consensus they will often need to consider the factors they are using to make their decision, and this encourages them to weigh up the relative importance of these factors in each of the environments presented.

Remind them to provide a brief explanation of why they rank at the score they do.

1. Remind students that for each of the technologies, they need to consider what it is being used for – the idea of constructing networks that are 'fit for purpose' is a way of reiterating that in some circumstances expensive infrastructure isn't always necessary.

An example might be the installation of optic fibre between network infrastructure in a house – if the speed of your connection into the house is 25Mbps at its maximum over ADSL2+, then the performance of fibre between your computer and router when downloading content from the Internet would be no different to good quality copper or high-speed wireless protocols. This is because the connection coming into the house creates a 'bottleneck' in the network – as soon as traffic passes through that bottleneck, the maximum bandwidth is restricted by that possible through the ADSL2+ connection, no matter what might be possible down the fibre connection.

If, however, the communication is purely between devices on the same side of the router, the full speed of the fibre could be realised (for example, backing up to another computer on the home network). What needs to be weighed up now is whether the ability to back up your computer at high speed is worth the cost of the fibre, or if the much more affordable copper or wireless is sufficient for your typical use.

This is also a good opportunity to introduce the following terms:

* + latency ([Definition 1](http://whatis.techtarget.com/definition/latency) / [Definition 2](http://www.tcpipguide.com/free/t_PerformanceMeasurementsSpeedBandwidthThroughputand.htm))
  + bandwidth ([Definition 1](http://searchenterprisewan.techtarget.com/definition/bandwidth) / [Definition 2](http://www.tcpipguide.com/free/t_PerformanceMeasurementsSpeedBandwidthThroughputand.htm))
  + throughput ([Definition](http://www.tcpipguide.com/free/t_PerformanceMeasurementsSpeedBandwidthThroughputand.htm))
  + packet loss ([Definition](https://en.wikipedia.org/wiki/Packet_loss))
  + retransmission ([Definition](https://en.wikipedia.org/wiki/Retransmission_(data_networks)))

1. Have students consider how each of these terms can be used in their explanation for each ranking, and how the terms might align with the criteria we have used on the sheet.
2. Here are[some useful analogies](http://blog.wildpackets.com/2011/05/31/four-factors-that-affect-your-network-performance.html) to help students understand these terms.

Through this exercise, students should begin to see the merits of the various types of networking infrastructure in use today. This will also create opportunities for debate on issues such as long-term infrastructure investment, such as the decision between a fibre-to-the-premises (FTTP) NBN vs fibre-to-the-node (FTTN).  
Given that one aspect of the technologies learning area is that of students exploring preferred futures, having them understand the difference between an expense and an investment (in terms of short-term cost and long-term benefit) is an important concept that is directly applicable to decision-making and policy in this space.  
If students are having these conversations in their groups, encourage them to explore these ideas. Consider bringing them together for a whole class discussion of the issues if there is interest and merit in doing so.

## Learning demo

Whole class activity

1. Write this statement on the board:

*With recent developments in WiFi technology, there is no longer an urgent need for a fibre-to-the-premises network in Australia. This is because WiFi speeds are now more than adequate to handle the bulk of data transfer needs.*

1. Students do a 'Think, pair, share' activity using a '[Futures wheel' template](http://www.globaleducation.edu.au/verve/_resources/futures_wheel.pdf). (Instructions on use can be found [here](http://www.emergentfutures.com/wpdl/Emergent%20Futures%20Consequence%20Wheel%20Tool%20Download.pdf)). Have students use what they've learned so far about the different types of network infrastructure to decide whether or not they agree or disagree with the statement.
2. Students then pair up with another member of the class (ideally someone who holds a different view, but that’s not necessary) and discuss their position. Compare their reasons with the reasons of the other person.
   * Which of the reasons from someone in your group is the most compelling?
   * What changes might occur in technology and/or society that would make you reconsider your position?
3. Finally, have each pair share their answers to the questions above with the whole class. Students could formally record their reflection and explanation – it could be on their device, through a blog post which they then share with others, or using an online discussion forum.

## Learning reflection

1. Students identify something they have learned in the lesson, and how that has changed their outlook on some other aspect of society.

This is an effective way to see how students can take the concepts they have learned and see the implications these may have on other areas of the students’ lives. You can scaffold this process by providing them with the following statement:

Today, I learned that \_\_\_\_\_\_\_ . Because of this, I now see that \_\_\_\_\_\_\_ .

An example might be:

Today I learned that fibre optic cable can transfer data at really fast speeds. Because of this, I now see that doctors in rural areas could benefit from the NBN by having real-time access to specialists in cities to assist with their diagnosis and surgeries.

1. Encourage students to think about aspects of their lives and society beyond those directly applicable to the learning they've done. It may be useful to provide them with an example. Students can begin to strengthen their understanding of the interdependent relationships that exist between learning in various disciplines in school. They can draw on their interests and passions to see how ICT has wide-ranging impacts on all aspects of society, and identify the value of the skills and knowledge they learn through the Digital Technologies curriculum.  
   It could be useful to stimulate this thinking with a 'CS+X' story from the [Careers with Code](https://careerswithstem.com/code) magazine. High schools across Australia were sent copies of the Careers with Code magazine – see if your Careers Adviser has a copy. There have been two editions released, one in 2014 and one in 2015.

## Curriculum links

| Links with Digital Technologies Curriculum Area | |
| --- | --- |
| **Strand** | **Content Description** |
| **Knowledge and Understanding** | Explain how hardware specifications affect performance and select appropriate hardware for particular tasks and workloads [(AC9TDI8K01)](https://v9.australiancurriculum.edu.au/f-10-curriculum.html/learning-areas/digital-technologies/year-7_year-8/content-description?subject-identifier=TECTDIY78&content-description-code=AC9TDI8K01&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick).  Investigate how data is transmitted and secured in wired and wireless networks including the internet [(AC9TDI8K02)](https://v9.australiancurriculum.edu.au/f-10-curriculum.html/learning-areas/digital-technologies/year-7_year-8/content-description?subject-identifier=TECTDIY78&content-description-code=AC9TDI8K02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick). |
| **Processes and Production Skills** | Acquire, store and validate data from a range of sources using software, including spreadsheets and databases [(AC9TDI8P01)](https://v9.australiancurriculum.edu.au/f-10-curriculum.html/learning-areas/digital-technologies/year-7_year-8/content-description?subject-identifier=TECTDIY78&content-description-code=AC9TDI8P01&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick). |

For a detailed explanation of the content descriptions featured in this learning sequence, please [download this PDF](https://www.digitaltechnologieshub.edu.au/docs/default-source/getting-started-years-7-8/computer-chatter/computer-chatter---detailed-curriculum-descriptions.pdf?sfvrsn=2).

## Assessment

Below are some learning sequence specific examples of formative and summative assessment. To read more generally on this subject, you could read through [the effective teaching section](https://www.digitaltechnologieshub.edu.au/secondary-teachers/effective-teaching) of this site.

### Formative assessment

The structure of the activities provides ample opportunities for formative assessment while the learning takes place. The list below identifies the various stages in the activities where student progress can be evaluated. Note that this does not need to be a formal process, but feedback to students is always encouraged and these opportunities naturally occur in the lesson sequence:

* student responses to teacher prompts
* think-pair-share and discussion
* PMI and other reflection activities
* participation and engagement in the physical activities
* one-on-one support through the research activity
* peer collaboration
* debating alternative views and perspectives on controversial issues.

Where students struggle to articulate their progress towards the learning goals, consider intervention strategies that will support the students to overcome sticking points, or to address any skill or knowledge gaps the student may have.

### Summative assessment rubric

Present summative assessment rubrics that are tailored to meet the specific learning goals identified for any assessment item. These should be explicit, identify the specific knowledge, understanding and skills that should be demonstrated, and use measurable outcomes and language that students can understand.

The rubric below is not meant to be used as a task rubric. It has been produced to assist you to determine the appropriate level of knowledge and understanding of the key concepts presented in the activities for student achievement at each year level. This should be used alongside the Australian Curriculum achievement standards and any school or jurisdiction guidelines for summative assessment purposes.

Think of the depth of knowledge and understanding as being a continuum. Students who are operating at a relational level, for example, will also be able to demonstrate the multi-structural knowledge acquisition presented.

|  | **Quantity of knowledge** | | | **Quality of understanding** | |
| --- | --- | --- | --- | --- | --- |
| **Criteria** | **Pre-structural** | **Uni-structural** | **Multi-structural** | **Relational** | **Extended abstract** |
| **Structure and types of networks** | Can identify some of the key features of a network, but is unclear on their roles in the system or how data moves between them | Understands the route data travels between main components of a network but does not fully understand the purpose of each step; can state different types of networks | Can identify important parts of a network and distinguish between them; explains simple reasons for choosing one type of infrastructure over another | Can articulate the role of each component in the network and how the entire system is dependent on each performing a specific purpose; can rationalise choice of network infrastructure | Understands how decisions around design of networks are affected by multiple factors, and that good designs will incorporate alternative routes for data transmission and redundancy |
| **Transmission and structure of data** | Identifies that networks allow the transmission of data between computers, and that data carries some meaning | Can explain that data transmission involves more than just the transfer of information and requires metadata to be able to function | Understands the information contained within metadata and can explain how it is used to ensure messages reach their destination | Explains the type of information that is stored in metadata and the limitations this introduces in terms of the rate of transfer and the quantity of message data in each packet | Draws upon the knowledge they have learned to hypothesise about the nature of data and the challenges inherent in reconstructing it when multiple data streams are being transferred between nodes in a network |
| **Network performance** | Can identify that different types of physical media change network performance | Can explain the reasons for different physical media performing differently on a network | Can discuss the advantages and disadvantages of using different types of physical media in terms of cost, performance and other factors | Can explain why typical networks use a combination of different types of physical media for communication in terms of cost, convenience and other factors | Can draw conclusions about the choice of physical media in large networks in terms of both intra- and inter-network communications, and factors such as cost, performance, reliability and convenience |
| **Network security basics** | Understands that modern networks include security features but may not completely understand the need for it | Understands the need for security in networks to ensure data is not altered or intercepted by third parties | Can explain the need for security in networks in terms of data security and privacy, and can provide a simple description of basic techniques used | Understands that network security is achieved through a multi-layered approach, and can explain why more than one layer is necessary for the system to effectively maintain data privacy, security and integrity | Can hypothesise about the value of strong security measures to typical online activities such as banking, identity management and other critical services, and the implications of security breaches on society |
| **Approximate grade level** | E | D | C | B | A |

While teachers could use aspects of the tasks presented for summative assessment, the following activities and projects are suggested as potential assessment tasks that could be used for evaluation of student learning and generation of grades or scores as required by most jurisdictions and governments.

* Students come up with a new game, or extensions to the CS Unplugged Tablets of Stone activity, that inject additional network infrastructure (for example, routers and firewalls) or security measures (for example, encryption and security certificates), and assess them on correctness and quality of representation.
* Students present their research findings through development of a creative asset (for example, infographic, social media awareness video, podcast episode) that can be published to the wider school community.
* Students use their learning from the activities to write a persuasive letter to their local minister, urging investment in infrastructure to support their future in their industry of interest.