# IT Networks

ADDITIONAL RESOURCES

BLURB:
Computer networks are at the foundation of Information and Communication Technology. A good understanding of the main elements and functions of computer networks is therefore crucial. This program provides a comprehensive overview of: the world of networks; wireless LANs and mobile devices; key hardware and software components; wired and wireless protocols; the strengths and limitations of wired and wireless; and network security. Perfect for senior secondary and TAFE in the fields of Information Technology and business, it is also suited to viewers wanting a better understanding of computer networks. Providing up-to-date information, this program is the ideal guide to the key systems and components of IT networks.

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## *For Teachers*

## Introduction

This video presents a general overview of digital communications networking. Transmission media, protocols, the ISO stack, topologies, hardware and software and the relationships between all of these components are explained in a concise but palatable form. The types, capabilities and limitations of mobile devices connected to networks including cellular phones and tablets are included providing students with readily available examples from their own experiences. Chapter sectioning and frequent summary points allow for student note taking during presentation of information which is carefully matched to general syllabus requirements.

## Timeline

| | |
|---|---|
| 00:00:00 | Overview of networks |
| 00:02:24 | Wireless LANs and mobile devices |
| 00:05:18 | Key hardware and software components |
| 00:09:26 | Wired and wireless protocols |
| 00:13:46 | Wired and wireless strengths and limitations |
| 00:15:44 | Security threats |
| 00:19:10 | Credits |
| 00:19:57 | End program |

## Related Titles

*Developing a Website*
*ICT in Organizations*

## Recommended Resources

- http://en.wikipedia.org/wiki/Dark_fibre_network
- http://en.wikipedia.org/wiki/Computer_network
- http://compnetworking.about.com/od/networkdesign/a/topologies.htm
- http://www.infocellar.com/networks/osi-model.htm
- http://www.ehow.com/facts_7327681_power-output-usb-port_.html
- http://www.ehow.com/list_6137210_microwave-radio-communications-advantages-disadvantages.html
- http://en.wikipedia.org/wiki/Microwave_transmission

*Student Worksheet*

# Initiate Prior Learning

1. Mobile phones can be unreliable or unavailable under certain conditions. Discuss the reason for this and make a list of the causes of poor reception and how it can be overcome.

2. Make a list of all the different types of communication equipment you use in a day with or without being aware of it.

3. Research the meaning of bandwidth in communications. What future problems could arise because of the limits of available bandwidth? Who has the right to sell bandwidth?

4. Research diplomatic protocols. What are some rules of diplomacy? What are commonly understood rules when people communicate by talking face to face? Why are these rules needed? Are there rules for using a mobile phone in public or in a car?

5. Make a list of all the hardware devices that might be used when you send an email from one country to another.

## Active Viewing Guide

<u>Overview of Networks</u>

1. a) What is meant by the term 'cultural exchange'?

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b) Explain the social impact of the use of cell phones in uprisings such as the recent 'Arab spring'.

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2. Name one protocol used by wireless LANs. What makes Ethernet so popular?

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3. a) What does ISP stand for?

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b) Name one ISP with which you are familiar.

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4. Suggest some advantages of having a privately-owned connection (dark fiber).

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Wireless LANs and Mobile devices

5. What are the advantages of using a wireless connection to the internet compared to a wired network?

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6. What are the three main systems the GSM network depends on? Explain how these systems are interconnected.

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Key hardware and software components

7. a) Explain the role of a gateway in a communications network.

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b) What types of network protocols could be connected via a gateway?

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8.  Compare a policeman directing traffic at an intersection with the role of a router.

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9.  Match the following protocol functions to the descriptions.

1. Signal speed

A. Ensures data is not readable if it is intercepted

2. Compression methods

B. Can request a packet be retransmitted if it is corrupted

3. Routing information

C. Determines which direction packets are sent

4. Number and order of packets

D. Keeps track of packets ensuring they all arrive in the right order

5. Error handling

E. Enables more packets to be sent through the same bandwidth

6. Encryption

F. Ensures agreement on the rate at which data is transmitted

Wired and Wireless Protocols

10. Fill in the blanks.

The rules of transmission are called _____, which typically describe:

- the signal _____

- _____ methods used to pack the information into the signal.

- _____ information.

- _____ and order of _____ packets. To make sure they all arrive at

the destination.

- _____ in transmission.

- _____ methods which make the data difficult to intercept by hackers.

11. What does ISO stand for? What does ISO do?

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12. Name three of the protocols mentioned in this program. Explain one protocol in detail.

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Wired and wireless strengths and limitations

13. When using a wireless connection in a cafe Jim notices that access to the internet is very slow compared to the same location the day before. What are two possible causes of the problem related to the normal limitations of a wireless network?

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14. If you were setting up a new network for a growing business, would you choose a wired or wireless network to meet the needs of the business, or a combination of both? Explain your reasoning, with reference to the type of business you have assumed for your answer.

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Security threats

15. Security measures should protect, block and alert the user of any threat to the security of the system. Use your own knowledge to discuss how these three results (protect, block and alert) are commonly achieved.

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16. Denial of service attacks have been used by people with a grievance against an organization with a popular website. How does a denial of service affect the website?

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# Extension Activities

1.  Write a modern set of "rules of etiquette" or good manners for people using mobile phones. Discuss these rules with your peers and report their reaction.

2.  Research network utilities such as Wireshark and Traceroute. What do these utilities allow you to do?

3.  Write a story about your life as a packet of data on the Internet travelling from Sydney to New York.

4.  List the levels of the ISO protocol stack. Make a table that explains what happens at each level of the ISO stack.

5.  When University of Western Sydney wanted to build a microwave link between the source at Kingswood and receivers at Westmead, it was not viable because of an intervening hill at Prospect and frequent fogs in the intervening area. Why do these conditions make microwave transmission difficult?

6.  USB connections can supply power to small devices such as LEDS. Research the limitations of USB power. What would be the disadvantage of trying to run a coffee cup warmer from your laptops USB power lines? (10 lines)

7.  Make a class room "data transmission game" which uses envelopes to represent data packets. Place packets with headers and content data into the envelopes and send them around the class. Discuss methods of improving the transmission so that envelopes reach their destinations even if some of them are randomly removed during passage.

## *Suggested Student Responses*

## Initiate Prior Learning

1. Mobile phones can be unreliable or unavailable under certain conditions. Discuss the reason for this and make a list of the causes of poor reception and how it can be overcome.
   **Students may identify problems with being out of range of cell towers or inside concrete and steel reinforced buildings where signals are attenuated (absorbed) by building materials. Less commonly they may be aware that rain, like water in a microwave oven, can absorb radio waves and the energy can be converted into heat.**
   **Strategies they may identify may be to go outside of a building or up a mountain to improve signal strength.**

2. Make a list of all the different types of communication equipment you use in a day with or without being aware of it.
   **Some items may include: mobile phone, computer, landline phones, alarm systems, video surveillance systems, television and radio receivers, tables such as iPads and android devices, radio controlled toys etc.**

3. Research the meaning of bandwidth in communications. What future problems could arise because of the limits of available bandwidth? Who has the right to sell bandwidth?
   **Bandwidth is a measure of available frequencies of radio and microwave in the electromagnetic spectrum. Only limited amounts of information can be transmitted on any one frequency at a time. Bandwidth is valuable for people such as radio stations and television channels that wish to make money from transmitting content to users.**
   **Governments control the use of bandwidth and sell licenses to use parts of the spectrum.**

4. Research diplomatic protocols. What are some rules of diplomacy? What are commonly understood rules when people communicate by talking face to face? Why are these rules needed? Are there rules for using a mobile phone in public or in a car?
   **Protocols or rules for behavior when communicating are necessary for practical reasons such as making sure both parties get heard and understood. Sometimes translation is part of the communication process. New rules for using mobile phones are evolving as they are starting to cause some social problems when they interrupt other people's conversation or increase the risk of the users having an accident.**

5. Make a list of all the hardware devices that might be used when you send an email from one country to another.
   **Some items may include; microphones and speakers of many types, telephone wires, radio transmitters and receivers, hubs, routers, switches, undersea cables, optical fiber, modems, satellites, servers, personal computers, laptops and tablets, iTouch.**

# Active Viewing Guide

Overview of Networks

1. a) What is meant by the term 'cultural exchange'?
   **Cultural exchange is the sharing of culture such as music, sport, dance, literature and languages across the world.**

   b) Explain the social impact of the use of cell phones in uprisings such as the recent 'Arab spring'.
   **Mobile phones are proving to be a useful way for oppressed people to show the world the types of oppression they suffer. They can also be used as a tool of oppression by unjust regimes and terrorists to further oppress people.**

2. Name one protocol used by wireless LANs. What makes Ethernet so popular?
   **802.11b**

3. a) What does ISP stand for?
   **Internet service providers. These are organizations which connect users to the wider Internet by providing powerful servers and routers that identify the packets of information being sent to them and forward them on to other service providers until they reach their destinations.**

   b) Name one ISP with which you are familiar.
   **Answers will vary.**

4. Suggest some advantages of having a privately-owned connection (dark fiber).
   **Private ownership allows for better performance as the whole of the bandwidth is available to the one user and they can decide which protocols they will use. Wavelength division multiplexing and other methods can be used to compress much more data into the signals being sent.**

Wireless LANs and Mobile devices

5. What are the advantages of using a wireless connection to the internet compared to a wired network?
   **Wireless connections allow the user to move around in the work environment. For example: when stock taking or visiting worksites remote from the office; truck drivers can access information or entertainment as they travel; non-commercial users can enjoy using their device in more comfortable or informal settings such as an outdoor coffee shop.**

6. What are the three main systems the GSM network depends on? Explain how these systems are interconnected.
   **The switching system, the base station system and the operation and support system. The mobile device connects to the base station which controls the radio link. The base station connects to the operation and support station, which connects to the switching station where the data packets making up a call are temporarily stored, checked for errors, and then transferred to their destination.**

Key hardware and software components

7. a) Explain the role of a gateway in a communications network.
   **A gateway in a communications network connects two networks that use different protocols.**

   b) What types of network protocols could be connected via a gateway?
   **Gateways connect systems such as Ring (Token ring, FDDI, SONET) or Bus (such as Ethernet) or Mesh (internet routing).**

8. Compare a policeman directing traffic at an intersection with the role of a router.
   **Routers direct the traffic on a network ensuring packets get to their destinations in the fastest time by the shortest or most effective routes. Like a policeman a router holds up traffic (stores data for the shortest time possible) before sending it on. Routers know where data packets are headed but a policeman doesn't know where traffic is going and cannot make decisions about the best or most efficient direction to send cars.**

9. Match the following protocol functions to the descriptions.
   **1. Signal speed – F. Ensures agreement on the rate at which data is transmitted.**
   **2 Compression methods – E. enables more packets to be sent through the same bandwidth.**
   **3. Routing information – C. Determines which direction packets are sent.**
   **4. Number and order of packets – D. Keeps track of packets ensuring they all arrive in the right order.**
   **5. Error handling – B. Can request a packet be retransmitted if it is corrupted.**
   **6. Encryption – A. Ensures data is not readable if it is intercepted.**

Wired and Wireless Protocols

10. Fill in the blanks.

   The rules of transmission are called **protocols**, which typically describe:

   - the signal **speed**

   - **Compression** methods used to pack the information into the signal.

   - **Routing** information.

   - **Number** and order of **data** packets. To make sure they all arrive at the destination.

   - **Errors** in transmission.

   - **Encryption** methods which make the data difficult to intercept by hackers.

11. What does ISO stand for? What does ISO do?
   **International Organization for Standardization. Organization international de normalization. Sets the standards for the types of protocols used for communications.**

12. Name three of the protocols mentioned in this program. Explain one protocol in detail.
   **Any three of: SMTP, HTTP, MIME, TCP, IP, PPP, PPPoE, etc. Answers will vary according to the protocols listed by the student.**

Wired and wireless strengths and limitations

13. When using a wireless connection in a cafe Jim notices that access to the internet is very slow compared to the same location the day before. What are two possible causes of the problem related to the normal limitations of a wireless network?
**Answers will vary: there may be more users than the previous day; he may be sitting further away from the receiver than before; there may be some intervening object such as a car between his computer and the receiver/ transmitter.**

14. If you were setting up a new network for a growing business, would you choose a wired or wireless network to meet the needs of the business, or a combination of both? Explain your reasoning, with reference to the type of business you have assumed for your answer.
**Answers will vary but should be supported with discussion of the strengths of the option chosen for the relevant business.**

Security threats

15. Security measures should protect, block and alert the user of any threat to the security of the system. Use your own knowledge to discuss how these three results (protect, block and alert) are commonly achieved.
**Protect, block and alert. Protect by using virus detection or hacking detection and blocking methods such as using a firewall to detect packets with suspicious destinations (port) or content such as malicious code. Alert by displaying messages to the user informing them of the nature of the threat and preventing the user from continuing until a response has been made. Logging all activity so that the user / network administrator can track down the source of any threat.**

16. Denial of service attacks have been used by people with a grievance against an organization with a popular website. How does a denial of service affect the website?
**Attackers flood the website with requests for service far in excess of the capacity of the organization's servers to service the requests. The attackers typically use a "Robot" software program that generates millions of requests in a short period of time. This causes the web server to begin denying service to users many of whom may be normal users of the site.**

# Extension Activities

1.  Write a modern set of "rules of etiquette" or good manners for people using mobile phones. Discuss these rules with your peers and report their reaction.
    **Students should have a few rules such as turning phones off in public meetings or performances such as opera and theatre. Seeking permission to answer a phone when meeting with friends. Not using a phone when driving, etc and some discussion of differences in the acceptability of these rules.**

2.  Research network utilities such as Wireshark and Traceroute. What do these utilities allow you to do?
    **These utilities allow every step in a chain of Internet devices to be investigated, the time taken for signals to travel between nodes and the routing addresses of each node. These are useful tools for network administrators wishing to investigate network problems.**

3.  Write a story about your life as a packet of data on the Internet travelling from Sydney to New York.
    **Answers will vary, students should include factual data about network devices they visit and the rules/ protocols they have to follow.**

4.  List the levels of the ISO protocol stack. Make a table that explains what happens at each level of the ISO stack.
    **Students should prepare a table similar to that shown in**
    **http://www.infocellar.com/networks/osi-model.htm**

5.  When University of Western Sydney wanted to build a microwave link between the source at Kingswood and receivers at Westmead, it was not viable because of an intervening hill at Prospect and frequent fogs in the intervening area. Why do these conditions make microwave transmission difficult?
    **Radio transmission is "line of sight" and intervening hills block the waves. Fog water droplets absorb microwaves converting them into heat energy and attenuating (weakening) them.**

6.  USB connections can supply power to small devices such as LEDS. Research the limitations of USB power. What would be the disadvantage of trying to run a coffee cup warmer from your laptop's USB power lines? (10 lines)
    **The average power of a USB port is about 5 volts. Your USB device will be able to draw out a maximum of 500 milliamperes (mA), but most default to 100 mA until prompted to provide more power by the device software. If your device requires more power than 500 mA, it may work slower or not at all while plugged into laptop**
    **This means that most USB-connectible devices will power on and become accessible when plugged into the USB port of a computer as long as that computer is on. This means a coffee cup warmer would only keep your cup warm while your computer is in use, and even then may not be sufficient to keep your coffee piping hot.**

7.  Make a class room "data transmission game" which uses envelopes to represent data packets. Place packets with headers and content data into the envelopes and send them around the class. Discuss methods of improving the transmission so that envelopes reach their destinations even if some of them are randomly removed during passage.
    **Rules for the game will vary but some discussion should take place about the use of error correction methods and routing used for communication systems. An example may be keeping copies at each node, sending requests for missing packets when the total number of packets don't arrive at a node. etc.**