



## HC1041: Information Technology for Business

Lecture: 6

Title: Business Networks and Telecommunications...



Key Topics....

This lecture is divided into the following structure:

- Telecommunications in Business
- Cellular Phones
- Videoconferencing
- Wireless Payments and Warehousing
- Peer-to-Peer File Sharing
- Networks and Protocols



Learning Objectives

- Upon completion of this lecture, you should be able to:
- Describe business and home applications of digital telecommunications
- Identify the major media and devices used in telecommunications
- Explain the concept of network protocols
- Compare and contrast various networking and Internet services

- Telecommunications: the transmittal of data and information from one point to another
  - Allows communications over large distances
- Telephone, e-mail, and the web rely on fast, reliable telecommunications
- Networking technologies have brought about several improvements to business processes

Telecommunications involves transmitting data and information between locations, enabling communication over long distances. For example, Australian businesses heavily rely on telecommunications for efficient operations, using tools like telephones, emails, and web services, resulting in improved communication and streamlined processes.

- Telecommunications-supported improvements
  - Business communication, including e-mail, voice mail, instant messaging, faxing, file transfer, mobile telephony, and teleconferencing
  - Greater efficiency: information delivery is immediate and not constrained by geographical distance
  - Better distribution of data: central storage with both local and remote access

Telecommunications-supported improvements in business encompass various communication methods such as email, voice mail, instant messaging, and teleconferencing, resulting in immediate information delivery and enhanced data distribution. In Australia, companies like Atlassian utilize teleconferencing tools like Zoom for seamless remote collaboration, while cloud storage services like Dropbox enable efficient central storage with remote access, enhancing data distribution and accessibility.

- Improvements (cont'd.)
  - Instant transactions, using web and wireless technologies
  - Flexible and mobile workforce: telecommuting and wireless connectivity for remote workers
  - Alternative channels: voice, radio, television now available via the Web also
- Network security is a challenge

Continued improvements include instant transactions through web and wireless technologies, fostering a flexible and mobile workforce, telecommuting, and accessing alternative channels such as voice, radio, and television via the web. In Australia, companies like Afterpay enable instant transactions, while remote work solutions like Telstra's 5G network facilitate a flexible and mobile workforce. Additionally, streaming services like Netflix offer alternative channels for entertainment accessible via the web. However, network security remains a significant challenge for businesses in Australia and globally.

- Cellular phones
- Videoconferencing
- Wireless payments and warehousing
- Peer-to-peer (P2P) file sharing
- Web-empowered commerce

This slide highlights modern IT advancements for businesses, including cellular phones, enabling remote communication; videoconferencing, facilitating virtual meetings; wireless payments and warehousing, exemplified by mobile payment apps like Apple Pay; peer-to-peer (P2P) file sharing, used for collaborative work; and web-empowered commerce, as seen in e-commerce platforms like Amazon Australia. These technologies have transformed the way businesses operate and interact in the digital age.

- Name is derived from areas of service, called cells
- Each cell has a computerized transceiver
  - Transmits and receives signals
- Can transmit and receive calls almost anywhere
- Cell phones provide other capabilities, including:
  - Email
  - Digital cameras
  - GPS
- Major advantage is mobility

This slide discusses cellular technology, named for service cells, each equipped with a computerized transceiver. In Australia, cell phones, like the iPhone and Samsung Galaxy, offer email, digital cameras, GPS, and mobility, enabling communication and diverse functionalities virtually anywhere across the country.

- Videoconferencing: transmitted images and speech
- Brings together conference rooms that are thousands of miles apart
- Produces savings in multiple areas, including:
  - Travel
  - Lodging
  - Car fleets
  - Employees' time

This slide focuses on videoconferencing, allowing the transmission of images and speech to connect conference rooms across vast distances. In Australia, businesses like Qantas Airways utilize videoconferencing to reduce travel expenses and enhance communication among employees and partners, saving costs on travel, lodging, and time.



- Radio frequency identification (RFID):
  - Enables rapid transactions and payments
  - Used at gas stations for payment at pump
  - Used in vehicles for automatic road toll payment
  - Used to track and locate items in warehouses
- Near-field communication (NFC): a standard communication protocol to create a radio connection between two devices
  - Mobile payment
  - Electronic wallet

This slide discusses RFID and NFC technologies. In Australia, RFID is employed at gas stations for quick payments at the pump and in vehicles for automatic road toll payments. NFC is utilized for mobile payments and electronic wallets, enhancing payment convenience and security in various applications.

- **Peer-to-peer (P2P) file sharing:** used to locate and download files from any online computer through Internet using applications such as:
  - LimeWire
  - BitTorrent
  - Vuze
- Used extensively to download music and video files, often in violation of copyright laws
- Concerns include security and malware

This slide covers peer-to-peer (P2P) file sharing, which allows users to access files from other online computers through the Internet. In Australia, P2P applications like BitTorrent have been commonly used for downloading music and video files, often raising concerns related to copyright violations, security, and malware.

- Increasingly fast communication allows organizations and individuals to:
  - Conduct business
  - Research
  - Market
  - Educate and train
  - Shop, purchase, and pay
- Entire industries have been created by the web, such as online exchanges and auctions

This slide emphasizes the impact of fast communication on various aspects of business and daily life. In Australia, practical examples include businesses conducting online transactions, universities offering remote education and training, and individuals shopping, making purchases, and paying bills online. Additionally, the growth of online marketplaces and auction platforms has led to the creation of entire industries within the country.

- Professionals should understand technology concepts:
  - To participate in decision making
  - In order to select networking equipment and services
- Bandwidth and networking media are important considerations

This slide highlights the importance of technology literacy for professionals and the significance of bandwidth and networking media in decision-making and equipment selection. In Australia, practical examples include:

1. Business Decision-Making: Professionals in Australia need to understand technology concepts to make informed decisions about adopting new software, hardware, or communication tools for their organizations. For instance, an IT manager may need to assess the feasibility of transitioning to cloud-based services.
2. Networking Equipment Selection: In the context of Australia's evolving technology landscape, businesses must select networking equipment and services that align with their specific needs and infrastructure. This may involve choosing the right routers, switches, and internet service providers to ensure seamless connectivity.

3. Bandwidth Considerations: Bandwidth plays a critical role in Australia's business operations, especially for companies heavily reliant on online activities. For instance, e-commerce businesses need sufficient bandwidth to handle high volumes of online transactions efficiently.
4. Networking Media: The choice of networking media, such as fiber optics or wireless connections, can impact the performance and scalability of IT systems. In Australia, this choice is crucial for industries like telecommunication providers expanding their networks.
5. Remote Work: With the rise of remote work in Australia, understanding technology concepts becomes essential for professionals managing virtual teams and ensuring secure and efficient communication among remote employees.

In summary, technology literacy and considerations related to bandwidth and networking media are integral to the decision-making processes of professionals across various industries in Australia.



## Bandwidth

- **Bandwidth:** speed at which data is communicated
  - Also called **transmission rate** or bit rate
- **Bits per second (bps):** unit of measure for bandwidth
- **Broadband:** communications medium that can carry multiple transmissions simultaneously
  - Examples: cable television, DSL (digital subscriber line), fiber-optic cables, and most wireless connections

This slide defines bandwidth as the speed of data communication, measured in bits per second (bps), and mentions broadband as a medium for multiple simultaneous transmissions. In Australia:

1. Bandwidth Importance: In the context of Australian businesses, bandwidth is crucial for fast and reliable internet connectivity, enabling efficient data transfer, video conferencing, and cloud-based services.
2. Broadband Services: Australia has a widespread adoption of broadband services, including cable, DSL, fiber-optic, and wireless connections. For instance, the National Broadband Network (NBN) project has aimed to provide high-speed broadband access to homes and businesses across the country.

3. Telecommunications Providers: Australian telecommunications providers like Telstra, Optus, and TPG offer various broadband packages to residential and business customers, allowing them to choose the most suitable bandwidth for their needs.
4. E-commerce and Streaming: In Australia, e-commerce platforms and streaming services heavily rely on broadband connections to offer fast and seamless experiences to users. For example, popular streaming services like Netflix and Stan require sufficient bandwidth for high-definition video streaming.

In summary, bandwidth and broadband play a vital role in Australia's digital landscape, impacting everything from everyday internet use to critical business operations and entertainment services.



bps	=	Bits per second
Kbps	=	Thousand bps
Mbps	=	Million bps (mega bps)
Gbps	=	Billion bps (giga bps)
Tbps	=	Trillion bps (tera bps)



- Several types of communications media
- Tangible media includes:
  - Twisted pair cable
  - Coaxial cable
  - Optical fiber
- Intangible media includes:
  - Microwave radio technologies

This slide discusses various communication media, including tangible options like twisted pair cable, coaxial cable, and optical fiber, as well as intangible options like microwave radio technologies. In Australia:

1. Tangible Media: Twisted pair cables, such as Ethernet cables, are commonly used in Australian offices and homes for wired network connections. Optical fiber is widely employed in high-speed broadband networks, including the National Broadband Network (NBN).
2. Coaxial Cable: Coaxial cables are used for cable television services provided by companies like Foxtel in Australia. They also play a role in some broadband connections.
3. Microwave Radio Technologies: In remote areas of Australia, microwave radio technologies are used to establish wireless communication links, especially for internet access and telecommunications in areas with limited infrastructure.
4. Intangible Media: Intangible media like microwave radio frequencies are utilized by wireless communication technologies such as Wi-Fi and mobile networks (3G, 4G, 5G) across the country.

In summary, Australia employs a mix of tangible and intangible communication media to support various network and communication needs, ranging from urban broadband services to remote connectivity solutions.



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## Networking media

Medium	Availability	Bandwidth	Vulnerability to Electromagnetic Interference
Twisted pair cable	High	Low to medium	High
Radio waves	High	Medium to high	Low (but vulnerable to radio frequency interference)
Microwave	Low	High	Low
Coaxial (TV) cable	High	High	Low
Optical fiber	Moderate but growing	Highest	Nonexistent
Electric power lines (BPL)	Very High	High	High

- **Twisted pair cable:** pairs of insulated copper wires twisted together
  - Flexible, reliable, and low cost
  - Connects devices with RJ-45 plug-in connector
- **Coaxial cable:** for cable television transmission
  - Used for Internet connections via cable
- **Optical fiber:** uses light to represent bits
  - Not susceptible to EMI (electromagnetic interference)
  - Can carry signals for long distances

This slide outlines different types of communication cables:

**Twisted Pair Cable:** Twisted pair cables, such as Ethernet cables (CAT5e, CAT6), are commonly used in Australia for both home and business networks. They connect devices using RJ-45 connectors and are known for their flexibility, reliability, and cost-effectiveness.

**Coaxial Cable:** Coaxial cables are widely used in Australia for cable television services provided by companies like Foxtel. They are also used for high-speed internet connections via cable in some regions.

**Optical Fiber:** Optical fiber technology is extensively used in Australia for long-distance data transmission, especially in high-speed broadband networks like the National Broadband Network (NBN). It's valued for its immunity to electromagnetic interference (EMI) and its ability to carry signals over significant distances.

In summary, Australia utilizes these communication cables to support a range of services, from home internet connections to cable TV and advanced broadband networks.

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- Radio frequency (RF) technologies: use radio waves to carry bits
  - Popular examples: Wi-Fi and Bluetooth
- **Microwaves:** high-frequency radio waves that can carry signals over long distances with high accuracy
  - For outside transmission, weather conditions may degrade the quality
- Microwave signals can be transmitted by satellite links

This slide discusses various communication technologies:

1. Radio Frequency (RF) Technologies: In Australia, RF technologies like Wi-Fi and Bluetooth are widely used for wireless networking. They enable devices to connect and share data without physical cables, making them essential for home and business networks.
2. Microwaves: Microwaves are utilized for long-distance communication, often in rural and remote areas of Australia. They can carry signals over considerable distances, but weather conditions can affect signal quality, particularly for outside transmissions.
3. Satellite Links: Satellite links using microwave signals are used to provide internet and broadcasting services to remote and rural areas in Australia. These links help bridge the digital divide by extending connectivity to areas where traditional wired infrastructure is impractical.

In summary, these technologies play crucial roles in Australia's telecommunications infrastructure, ensuring connectivity in urban, suburban, and remote regions of the country.

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- Electrical power lines: electrical power grid can be used for telecommunication
  - **Broadband over Power Lines (BPL)** or Power Line Communication (PLC)
- Network media acquisition considerations
  - Availability
  - Current and potential bandwidth
  - Vulnerability to EMI or radio frequency interference (RFI)

This slide addresses unconventional communication methods and network media considerations:

1. **Electrical Power Lines:** In some parts of Australia, electrical power lines have been used for telecommunications, specifically through technologies like Broadband over Power Lines (BPL) or Power Line Communication (PLC). These systems leverage the existing power grid to provide internet connectivity.
2. **Network Media Acquisition Considerations:** When selecting network media in Australia, factors such as availability, current and potential bandwidth, and vulnerability to electromagnetic interference (EMI) or radio frequency interference (RFI) are crucial. For instance, in urban areas, high-speed fiber-optic cables are readily available, while in remote regions, satellite connections may be preferred due to their broader coverage.

These considerations highlight the adaptability of communication technologies to different environments, whether urban or rural, in Australia.

- **Network:** combination of devices (or **nodes**) connected through a communication media
- Any compatible device that can transmit and receive on a network can be part of a network

This slide introduces the concept of a network:

Network Definition: A network is a collection of devices (or nodes) linked together through a communication medium.

Inclusion of Devices: Any compatible device capable of transmitting and receiving data can become part of a network.

In Australia, this concept is applicable across various contexts, such as computer networks in offices, smartphones connected to cellular networks, and IoT devices forming smart home networks.

- Computer networks are classified by reach and complexity
- Basic types of networks: LANs, MANs, and WANs
- **Local area networks (LAN)**: established by a single organization and shared among employees
  - Server-based LAN: central **server** controls communications
  - **Peer-to-peer LAN**: no central device

This slide discusses the classification of computer networks by reach and complexity, focusing on LANs (Local Area Networks):

1. **Network Classification**: Computer networks are categorized based on their reach and complexity.
2. **Local Area Networks (LANs)**: LANs are networks established by a single organization and shared among employees. There are two common types:

Server-based LAN: Central servers control communications.

Peer-to-peer LAN: No central device governs the network.

In Australia, practical examples include LANs within businesses and educational institutions. For instance, a university might have a server-based LAN for its administrative tasks and a peer-to-peer LAN for student use in dormitories.

- **Wireless LANs (WLANS)** offer advantages
  - Easier installation
  - More scalable
  - More flexible: equipment is easily moved
- **Scalability:** ease of expanding a system
- WLAN drawback: wireless networks are less secure than wired LANs

This slide discusses Wireless LANs (WLANS) and their advantages and drawbacks:

1. **Wireless LANs (WLANS) Advantages:** WLANS offer benefits such as easier installation, scalability, and flexibility since equipment can be easily moved.
2. **Scalability:** Scalability refers to the ease of expanding a system.
3. **WLAN Drawback:** One drawback of WLANS is that they are generally less secure than wired LANs.

In Australia, practical examples of WLANS include Wi-Fi networks in homes, offices, and public places like cafes and airports. While WLANS provide convenience, they may pose security risks if not properly configured and secured, which is a consideration for businesses and individuals using them.

- **Metropolitan area network (MAN):**
  - Links multiple LANs within a large city
  - Uses fiber optic or wireless broadband connections between LANs
- **Wide area network (WAN):** far-reaching system of networks composed of LANs or MANs
  - May be public or private

This slide discusses Metropolitan Area Networks (MANs) and Wide Area Networks (WANs):

1. **Metropolitan Area Network (MAN):** MANs link multiple LANs within a large city and typically use fiber optic or wireless broadband connections between LANs.

2. **Wide Area Network (WAN):** WANs are extensive networks comprising LANs or MANs and can be either public or private.

In Australia, practical examples of MANs can be found in cities like Sydney, where multiple LANs within the metropolitan area are connected to facilitate communication and data exchange. WANs, on the other hand, can include vast networks connecting organizations across the country or even globally, such as multinational corporations or government agencies with branch offices and data centers in different cities or countries.



## Networking Hardware

- Networks use a variety of devices to connect computers and peripheral devices
- **Network interface card (NIC)** connects a device to a hub, switch, bridge, or router, which connects to a LAN or WAN
- **Switch:** a common device often used as a central location to connect computers or devices to a local network
- **Bridge:** connects two networks

This slide discusses network devices and their functions:

1. **Network Interface Card (NIC):** A NIC connects a device (like a computer) to a hub, switch, bridge, or router, allowing it to join a LAN or WAN.
2. **Switch:** Switches are commonly used to connect multiple computers or devices within a local network (LAN). They efficiently manage data traffic within the network.
3. **Bridge:** Bridges connect two separate networks, helping them communicate and share data.

In Australia, a practical example would be a business office using switches to connect all computers and devices within its local network for seamless communication and data sharing. A bridge might be used to connect a company's LAN to a partner organization's LAN, facilitating secure data exchange between the two entities.



- **Router** routes data packets to the next node on the path to the final destination
- **Repeater** amplifies or regenerates signals
- **Modem** translates communication signals from analog to digital and vice versa
- **Dial-up connection:** a slower type of connection through modem, usually no faster than 56 Kbps

This slide introduces essential network components:

1. **Router:** Routers direct data packets to their next destination on the network, ensuring efficient data flow. In Australia, home and business networks use routers to manage internet connectivity.
2. **Repeater:** Repeaters boost or regenerate signals, extending the reach of a network. They're valuable in large spaces or areas with weak signal coverage.
3. **Modem:** Modems translate communication signals between digital (used by computers) and analog (used by traditional phone lines or cable systems) formats. Australians use modems for various internet connections, including DSL and cable.
4. **Dial-up Connection:** While less common today, dial-up connections, often facilitated by modems, were historically used in Australia for internet access, particularly in rural areas with limited broadband infrastructure. These connections had limited speeds, usually around 56 Kbps.



- **Virtual private network (VPN):** a public network connection that creates the illusion of a private network connection
  - Does not require leasing of lines
  - Utilizes the Internet to simulate a private network that only authorized users can access
  - Enables the use of intranets and extranets

This slide highlights Virtual Private Networks (VPNs):

- In Australia, individuals and businesses use VPNs to secure their internet connections and access region-restricted content. For instance, people might use VPNs to access streaming services not available in their region.
- VPNs allow secure remote work and collaboration by creating encrypted connections over the public internet. Many Australian organizations adopted VPNs during the COVID-19 pandemic to facilitate remote work.
- VPNs also enable businesses in Australia to establish secure connections with international partners or clients, ensuring data privacy and security when sharing sensitive information.



## Protocols

- **Protocol:** set of rules governing communication between computers
- Separate protocols are designed for:
  - WANs
  - LANs
  - Wireless communications
- Most important set of protocols for telecommunications and networks is called TCP/IP

This slide discusses protocols in IT for business:

- In Australia, the Transmission Control Protocol/Internet Protocol (TCP/IP) is the fundamental protocol suite governing communication over the internet and computer networks. It enables devices to communicate and exchange data seamlessly.
- In the context of LANs, Ethernet is a widely used protocol that defines how data packets should be formatted and transmitted over local networks. Many Australian businesses rely on Ethernet for their internal network communication.
- For WANs, protocols like MPLS (Multiprotocol Label Switching) are significant in Australia. MPLS enhances the efficiency and reliability of data transmission across wide-area networks, benefiting businesses with multiple branches or remote locations.

- **TCP/IP (Transmission Control Protocol/ Internet Protocol):** a set of related protocols
  - TCP ensures packets arrive accurately and in proper order
  - IP ensures efficient delivery of packets from node to node
- Internet **backbone:** highest speed channels
- **Host:** a computer connected directly to a backbone
- **IP address:** unique ID for each network device

This slide covers essential networking concepts:

- TCP/IP, including TCP (Transmission Control Protocol) and IP (Internet Protocol), forms the backbone of internet communication in Australia and globally. TCP ensures reliable data delivery, while IP handles routing and addressing.
- The internet backbone refers to high-speed data transmission infrastructure that connects major cities and data centers in Australia. These backbones facilitate fast and reliable internet access for businesses and consumers.
- Hosts, which are individual computers connected directly to the internet backbone, can be found in data centers and network hubs across Australia, serving various purposes such as web hosting, cloud computing, and content delivery.
- IP addresses, unique identifiers assigned to each network device, are crucial in routing data packets to their destinations within Australia's interconnected networks. They enable efficient data transmission and device identification.

- **DNS (Domain Name System):** associates a character-based name with an IP address
- **Static IP address:** a permanent address assigned to a device
- **Dynamic IP address:** temporary IP number assigned to a device for the duration of the connection
  - Provides flexibility when the number of IP addresses is limited

This slide covers key networking components:

- DNS (Domain Name System) translates character-based domain names (e.g., [www.example.com](http://www.example.com)) into IP addresses, simplifying internet access. In Australia,

users rely on DNS to access websites and services using user-friendly domain names.

- Static IP addresses are permanent and assigned to specific devices, which is common in business settings. For instance, many Australian businesses use static IP addresses for their web servers to ensure constant accessibility.
- Dynamic IP addresses are temporary and assigned to devices for the duration of their connection, allowing internet service providers in Australia to efficiently manage limited IP address resources, particularly for home users and mobile devices.



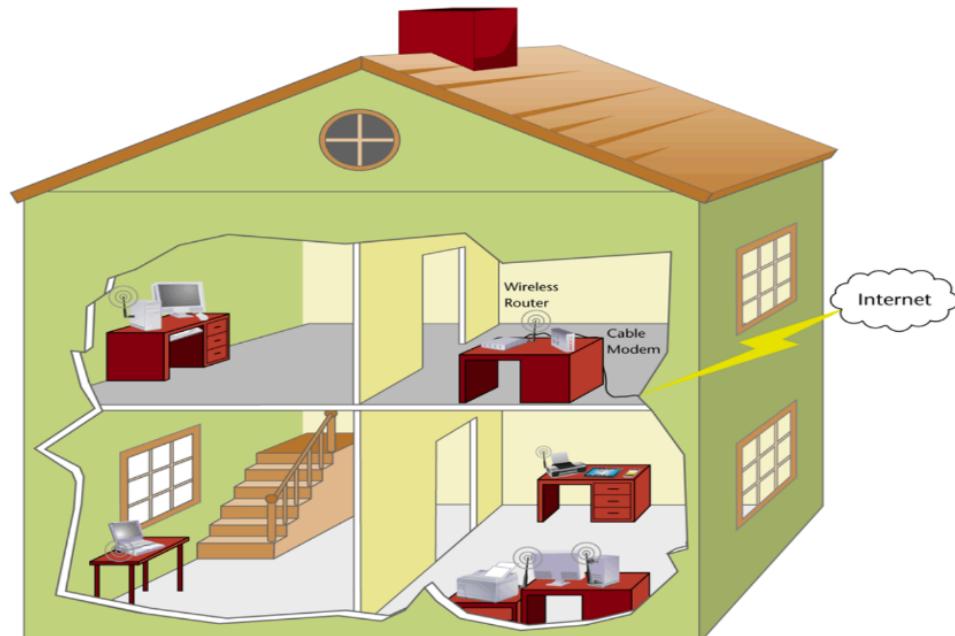
## Wireless Protocols

- **IEEE 802.11:** a family of wireless protocols known as **Wi-Fi** (Wireless Fidelity)
  - Supports wireless communication within 100 meters of router
  - 802.11 subtypes support various distances and speeds up to 248 Mbps
- **Access point (AP):** connection between wireless device and a wired network
  - **Hotspot** allows Internet access within range of equipment

This slide discusses Wi-Fi technology:

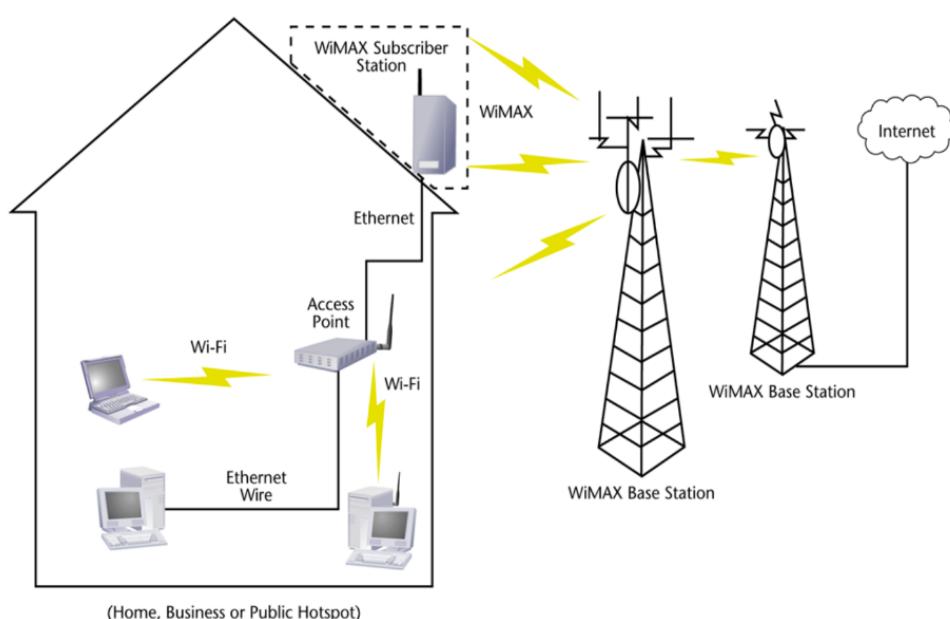
- IEEE 802.11, commonly known as Wi-Fi, is a set of wireless protocols enabling wireless communication within a range of approximately 100 meters of a router. For example, Australians use Wi-Fi extensively in homes, offices, cafes, and public spaces for internet access.
- Access points (APs) act as intermediaries between wireless devices and wired networks, facilitating wireless connectivity. In Australia, you'll find APs in various public places offering Wi-Fi hotspots, such as airports, libraries, and coffee shops, providing internet access to users within their range.

An example of a home using a wireless network



- **Encryption:** function of protocols that scrambles and encodes messages
  - Encryption keys are shared only between sender and receiver
- **Bluetooth** allows devices to communicate within 10 meters
  - Transmits voice and data
  - Considered a PAN technology

- **Worldwide Interoperability for Microwave Access (WiMAX)** increases the range and speed of wireless communication
  - Works with metropolitan area networks (MANs)
  - Would enable Internet connection while in a moving vehicle
- **Long-Term Evolution (LTE)**: a standard method of wireless communications, specifically for high-speed data transmission for mobile phones
  - Also known as 4G LTE



Protocol	Max. Range	Max. Speed	Main Use
802.11a	75 meters (250 feet)	54 Mbps	LAN
802.11b	100 meters (330 feet)	11 Mbps	LAN
802.11g	100 meters (330 feet)	54 Mbps	LAN
802.11n	160 meters (530 feet)	248 Mbps	LAN
802.15 Bluetooth	10 meters (33 feet)	1 Mbps	PAN
802.16 WiMax	50 km (31 miles)	100 Mbps	MAN
802.11ac	90 meters (300 feet)	349 Mbps	LAN

Wireless networking protocols

- Networking professionals refer to generations of mobile communication technologies
  - First generation (1G): analog
  - Second generation (2G): provided digital voice encoding
  - Third generation (3G): increased speeds that support video, videoconferencing, and full Internet access
  - Fourth Generation (4G): digital only, with packet switching and tighter security

- Variety of options when subscribing to network services
- **Downstream:** speed of receiving from network
- **Upstream:** speed of transmitting to network
- Services with lower rates for upstream than downstream are suitable for most individuals and businesses

Service	Downstream Speed	Availability	Monthly Fee
Dial-up	56 Kbps	Universal	\$9–11
BPL	0.25–3 Mbps	Limited availability	\$20–40
Cable	0.5–3 Mbps	Widespread; available nearly everywhere where cable TV service is offered	\$30–50
DSL	0.25–1.5 Mbps	More limited than cable, but spreading faster; speed depends on distance from telco office	\$30–50
T1	1.544 Mbps	Widespread	\$250–500
T3	45 Mbps	Widespread	\$4,000–16,000
Satellite	0.5–10 Mbps	Widespread; practical only with view to the southern sky	\$50–70

Typical features and costs of Internet services

Service	Downstream Speed	Availability	Monthly Fee
Fixed Wireless	100 Mbps	Limited, but spreading	\$30–50
Fiber to the Premises	5–30 Mbps	Limited, but spreading	\$350
OC-3	155.52 Mbps	Limited availability	\$20,000–45,000K \$10,000–30,000K
OC-12	622.08 Mbps	Limited availability	Several hundred thousand dollars
OC-48	2.488 Gbps	Limited availability	Several hundred thousand dollars
OC-192	9.952 Gbps	Limited availability	Several hundred thousand dollars
OC-255	13.21 Gbps	Limited availability	Several hundred thousand dollars

Typical features and costs of Internet services

## Cable

- Internet links provided by television cable firms
- Cable connected to Internet server
- At residence, cable is split into TV set and computer via a bridge called a cable modem
- Cable shared by all subscribers connected to the node
  - Communication speeds may slow during peak times and as more subscribers join the service

## Digital Subscriber Line (DSL)

- **Digital subscriber line (DSL):** data remains digital through entire transmission
- Uses telephone lines connected to DSL bridge (DSL modem)
- Transmission bit rates
  - Closely related to distance from telephone company's central office

- **T1 and T3 lines:** point-to-point dedicated digital circuits provided by telephone companies
  - T1 line is made up of 24 channels of 64 Kbps each
  - T3 line is made up of 672 channels of 64 Kbps each
- T1 and T3 service is expensive
- Used by universities and large companies for backbone and Internet connections



- Satellite services use microwave radio transmission
- Service provider installs dish antenna that is tuned to a communications satellite
- Speeds up to 45 Mbps
- Used for private homes and for mobile uses such as shipping and trucking
- Global positioning system (GPS): a free satellite service that provides location information

- **Voice over Internet Protocol (VoIP)**: uses Internet connection to conduct telephone conversations
- Examples of companies offering IP telephony
  - Vonage and Comcast
- Free services offered by Skype or iCall
- Cost effective for businesses and homes
- Experts predict convergence of cell phone and VoIP phone

- RFID tags are tiny and need little power
- Objects are embedded with tags that contain a transponder (a radio transceiver activated by a signal transmitted to it)
- Tags are encoded with **electronic product code (EPC)**
- Readers decode data stored in tag's memory and pass the data to a host computer
- Efficient for large companies, but expensive for smaller companies

Use	Example
Access Control	 Cards used to replace door keys.
People Tracking	 Keep children within school. Track prisoners on probation and prevent fleeing.
Animal Tracking	 Track pets.
Livestock Management	 Track life cycle of farm animals (e.g., feeding and immunization). Equip each cow with a unique ID to track diseases.
Antitheft Measures	 Transponders integrated into car keys. Only a legal key can start the engine.

Transportation		At airport, safety inspection of tagged luggage.
Retail		Tracking products in pallets and on shelves. Contactless payment.
Pharmaceuticals		Reduce drug counterfeiting.
Health Care		Tag people who enter and leave an epidemic zone.

- Convergence occurs in networking technology
- Cell phones can act as Web phones using VoIP
- New television sets will connect to Internet, cable, and satellites concurrently
- Single device to connect to any type of network
- “Smart appliances” interact with their owners
- Opportunities for businesses to provide new information services and better manage the salesforce

- Portable music/video players communicate with PCs via Wi-Fi to download files and transmit to wireless earphones
- Cell phones read RFID tags on products
  - Compare prices and make purchases

This slide illustrates the use of technology in consumer devices:

Portable music and video players in Australia often use Wi-Fi to download media files from PCs and transmit them to wireless earphones, allowing users to enjoy content without physical connections.

Cell phones equipped with RFID technology can read tags on products, enabling consumers to compare prices and make purchases conveniently. In Australia, this technology is employed in retail settings to enhance the shopping experience.