
CCNA Exploration

Network Fundamentals

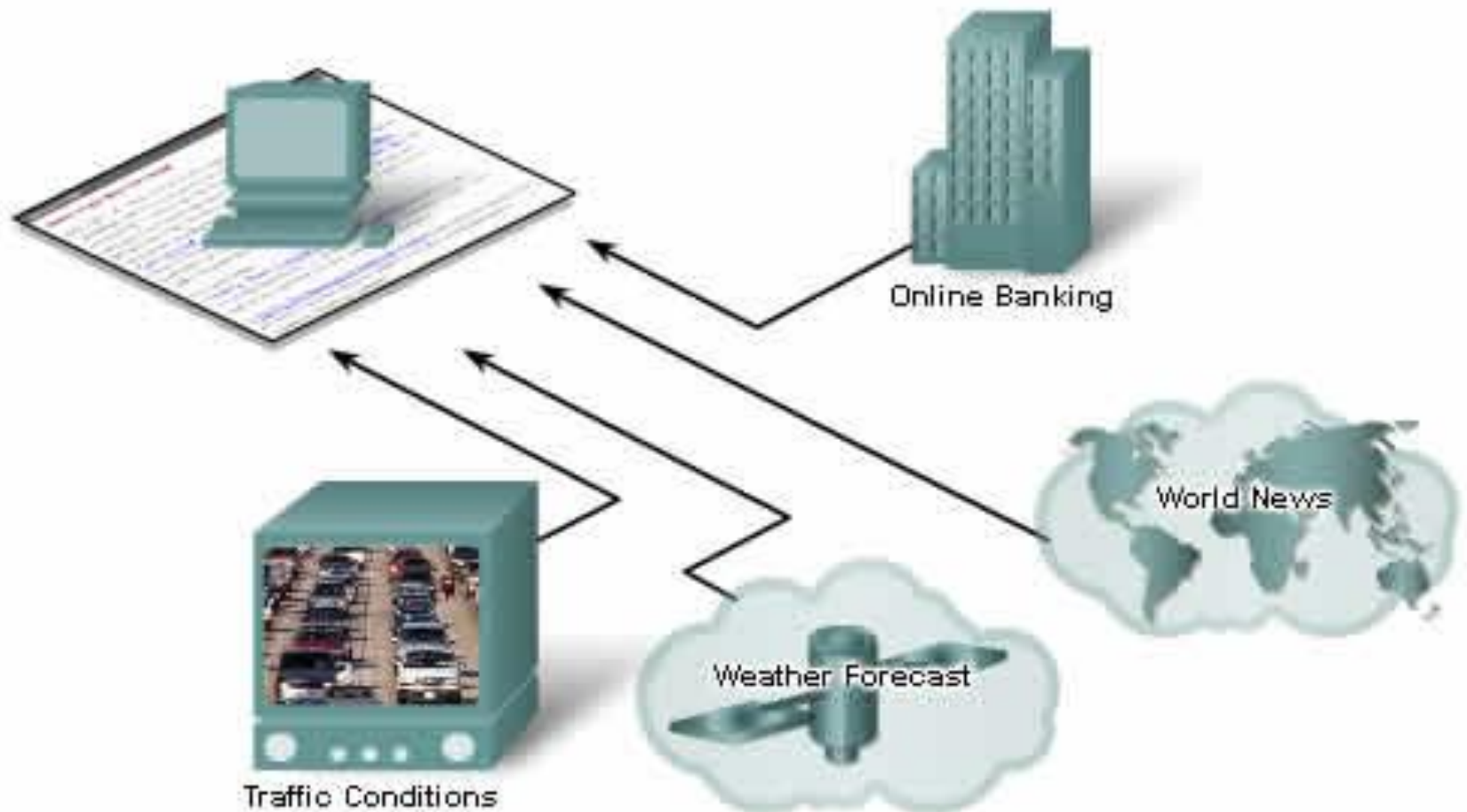
Chapter 01

Living in the Network-Centric World

Networks Supporting The Way We Live

- Among all of the essentials for human existence, the need to interact with others ranks just below our need to sustain life.
- Early communication relies on face-to-face conversations. Media breakthroughs continue to extend the reach of our communications. From the printing press to television, each new development has improved and enhanced our communication.
- Early data networks were limited to exchanging character-based information between connected computer systems.
- Current networks have evolved to carry voice, video streams, text, and graphics between many different types of devices

- Internet became an integral part of our daily routines
- In the course of a day, resources available through the Internet can help you:



Examples of Today's Popular Communication Tools

- Instant messaging
- Weblogs (blogs)
- Wikis
- Podcasting (iPods by Apple)
- Collaboration Tools - give people the opportunity to work together on shared documents

Networks Supporting the Way We Learn

- Courses delivered using network or Internet resources are often called online learning experiences, or e-learning.
- Online courseware and delivery offer many benefits to businesses. Among the benefits are:
 - Current and accurate training materials.
 - Availability of training to a wide audience.
 - Consistent quality of instruction
 - Cost reduction

Networks Supporting the Way We Works



- Business networks evolved to enable the transmission of many different types of information services, including e-mail, video, messaging, and telephony

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- Intranets, private networks in use by just one company, enable businesses to communicate and perform transactions among global employee and branch locations.
 - Companies develop extranets, or extended internetworks, to provide suppliers, vendors, and customers limited access to corporate data to check order status, inventory, and parts lists.

Networks Supporting the Way We Play

- The widespread adoption of the Internet by the entertainment and travel industries enhances the ability to enjoy and share many forms of recreation, regardless of location.



Online Interest Groups



Online Games



Online Entertainment



Instant Messaging



Online Travel



The onboard data network provides a range of services to airline personal seatback video systems.

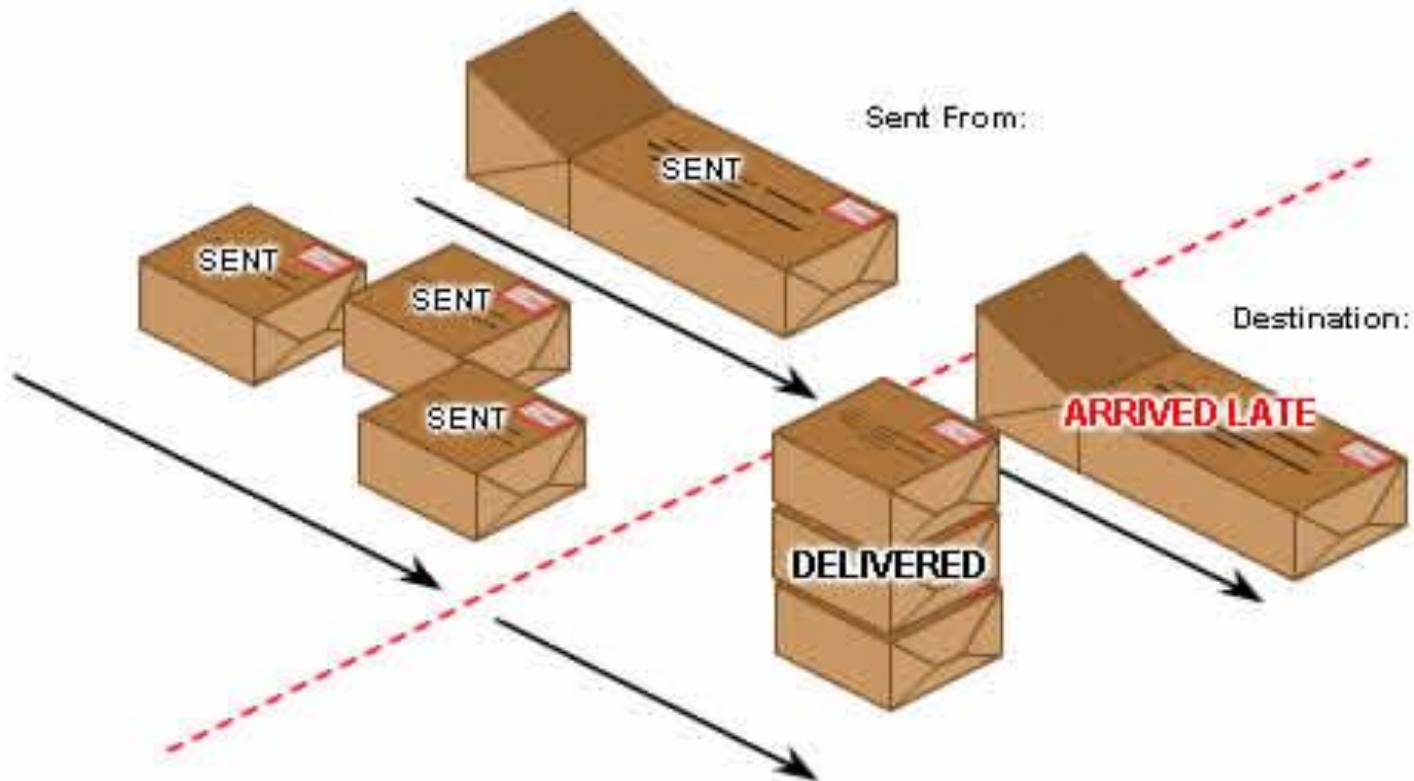
What is Communication?

- It can be in many forms and occurs in many environments
 - Before beginning to communicate with each other, we establish rules or agreements to govern the conversation. (**Protocols**)
 - Among the protocols that govern successful human communication are:
 - - An identified sender and receiver
 - - Agreed upon method of communicating (face-to-face, telephone, letter, photograph)
 - - Common language and grammar
 - - Speed and timing of delivery
 - - Confirmation or acknowledgement requirements
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Quality of Communication

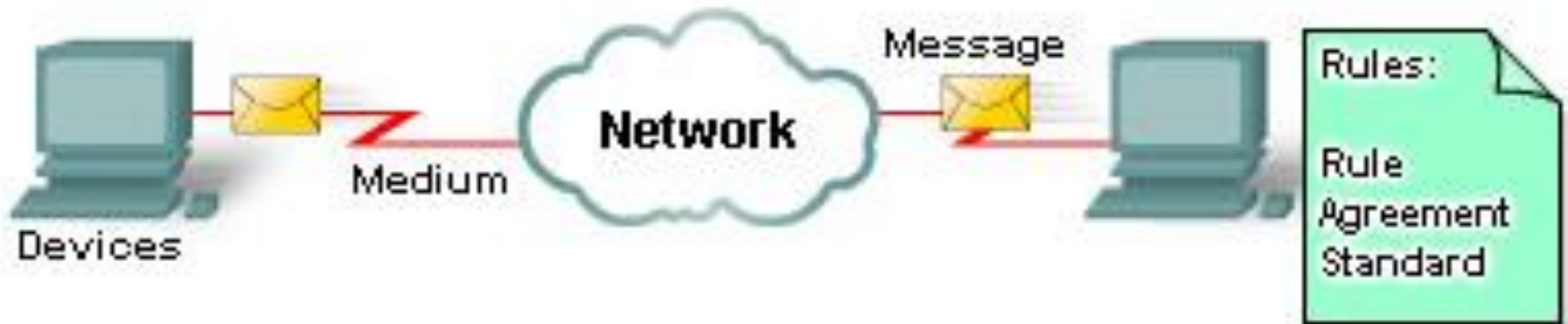
- Communication between individuals is determined to be successful when the meaning of the message understood by the recipient matches the meaning intended by the sender.
- For data networks, we use the same basic criteria to judge success. However, some **external factors** may affect the communication:
 - The quality of the pathway between the sender and the recipient
 - The number of times the message has to change form
 - The number of times the message has to be redirected or readressed
 - The number of other messages being transmitted simultaneously on the communication network
 - - The amount of time allotted for successful communication

- **Internal factors** affecting the successful communication across the network include:
 - The size of the message
 - The complexity of the message
 - The importance of the message

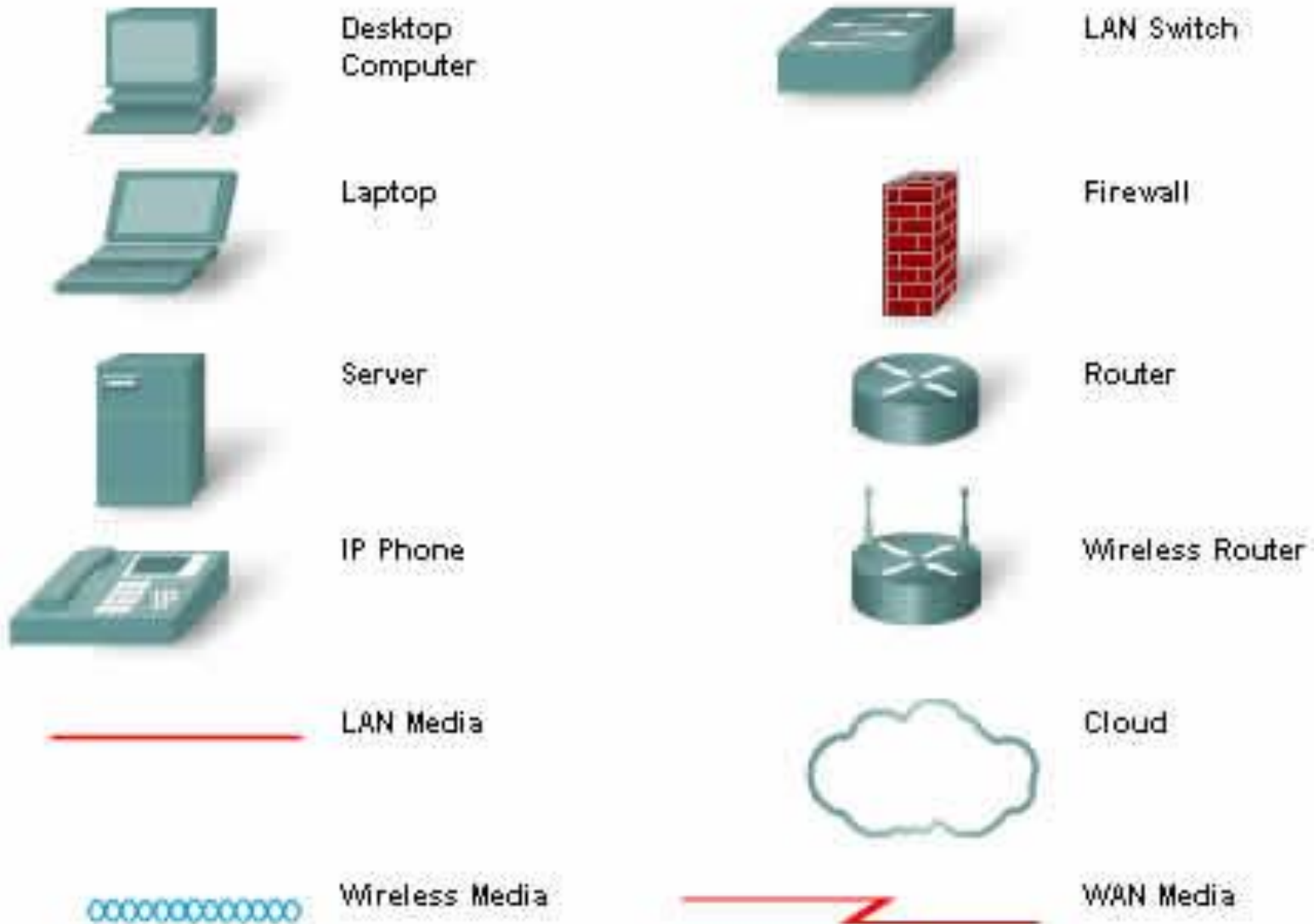


Communicating Over Networks

- All networks have **4** basic elements in common:
 - **Rules or agreements** to govern how the messages are sent, directed, received and interpreted.
 - The **messages** or units of information that travel from one device to another
 - A means of interconnecting these devices - a **medium** that can transport the messages from one device to another
 - **Devices** on the network that exchange messages with each other

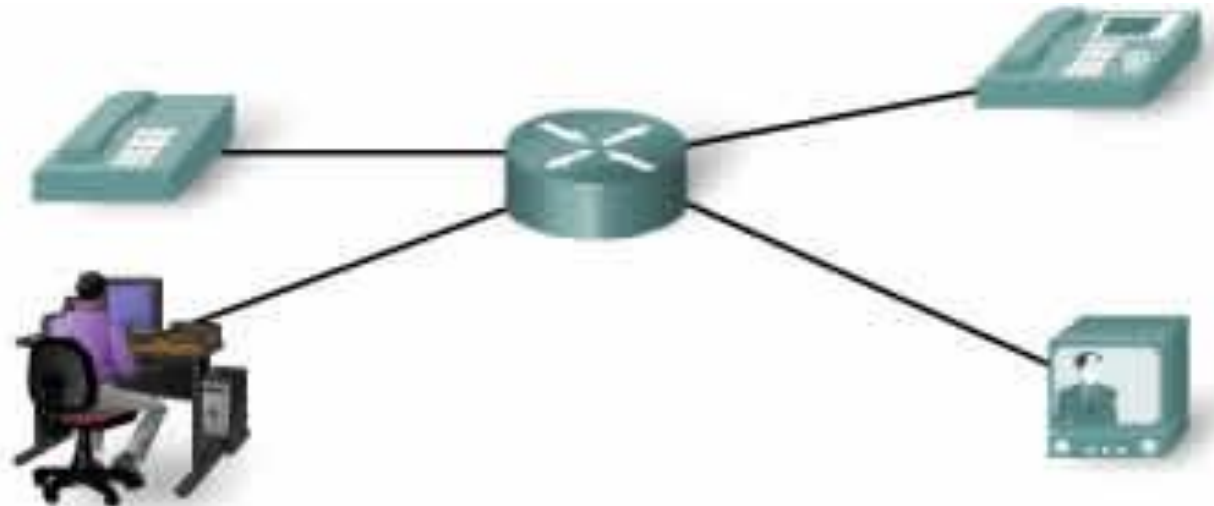


The Elements of a Network

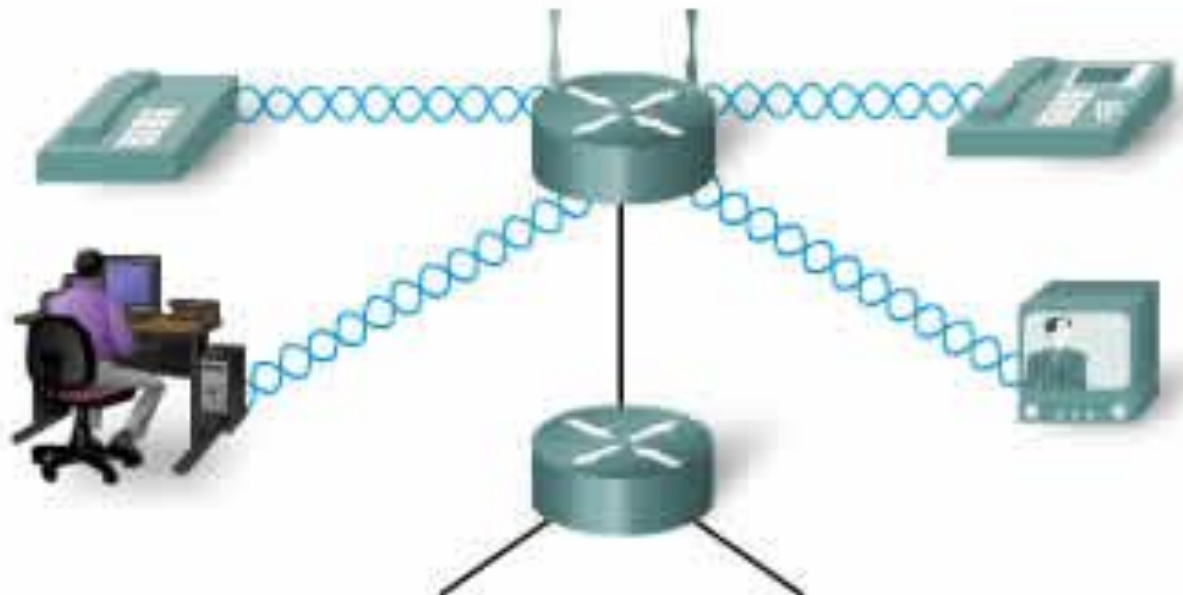


- Network connections can be wired or wireless.
 - In wired connections, the medium is either copper, which carries electrical signals, or optical fiber, which carries light signals.
 - In wireless connections, the medium is the Earth's atmosphere, or space, and the signals are microwaves.
 - Copper medium includes cables, such as twisted pair telephone wire, coaxial cable, or most commonly, what is known as Category 5 Unshielded Twisted Pair (UTP) cable.
 - Optical fibers, thin strands of glass or plastic that carry light signals, are another form of networking media.
 - Wireless media may include the home wireless connection between a wireless router and a computer with a wireless network card, the terrestrial wireless connection between two ground stations, or the communication between devices on earth and satellites.
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- In a typical journey across the Internet, a message may travel across a variety of media.

Wired networks used physical cables to connect devices.



Wireless networks use radio waves to communicate between devices.



Wireless networks are also connected to wired networks, at some point.

- Protocols are the rules that the networked devices use to communicate with each other. The industry standard in networking today is a set of protocols called TCP/IP (Transmission Control Protocol/Internet Protocol).

Service	Protocol ("Rule")
World Wide Web (WWW)	HTTP (Hypertext Transport Protocol)
E-mail	SMTP (Simple Mail Transport Protocol) POP (Post Office Protocol)
Instant Message (Jabber; AIM)	XMPP (Extensible Messaging and Presence Protocol) OSCAR (Open System for Communication in Realtime)
IP Telephony	SIP (Session Initiation Protocol)

Converged Networks

- Multiple services-multiple networks
 - Traditional telephone, radio, television, and computer data networks each have their own individual versions of the four basic network elements.
 - **Converged Networks**
 - Technology advances are enabling us to consolidate these disparate networks onto one platform - a platform defined as a converged network.
 - The flow of voice, video, and data traveling over the same network eliminates the need to create and maintain separate networks
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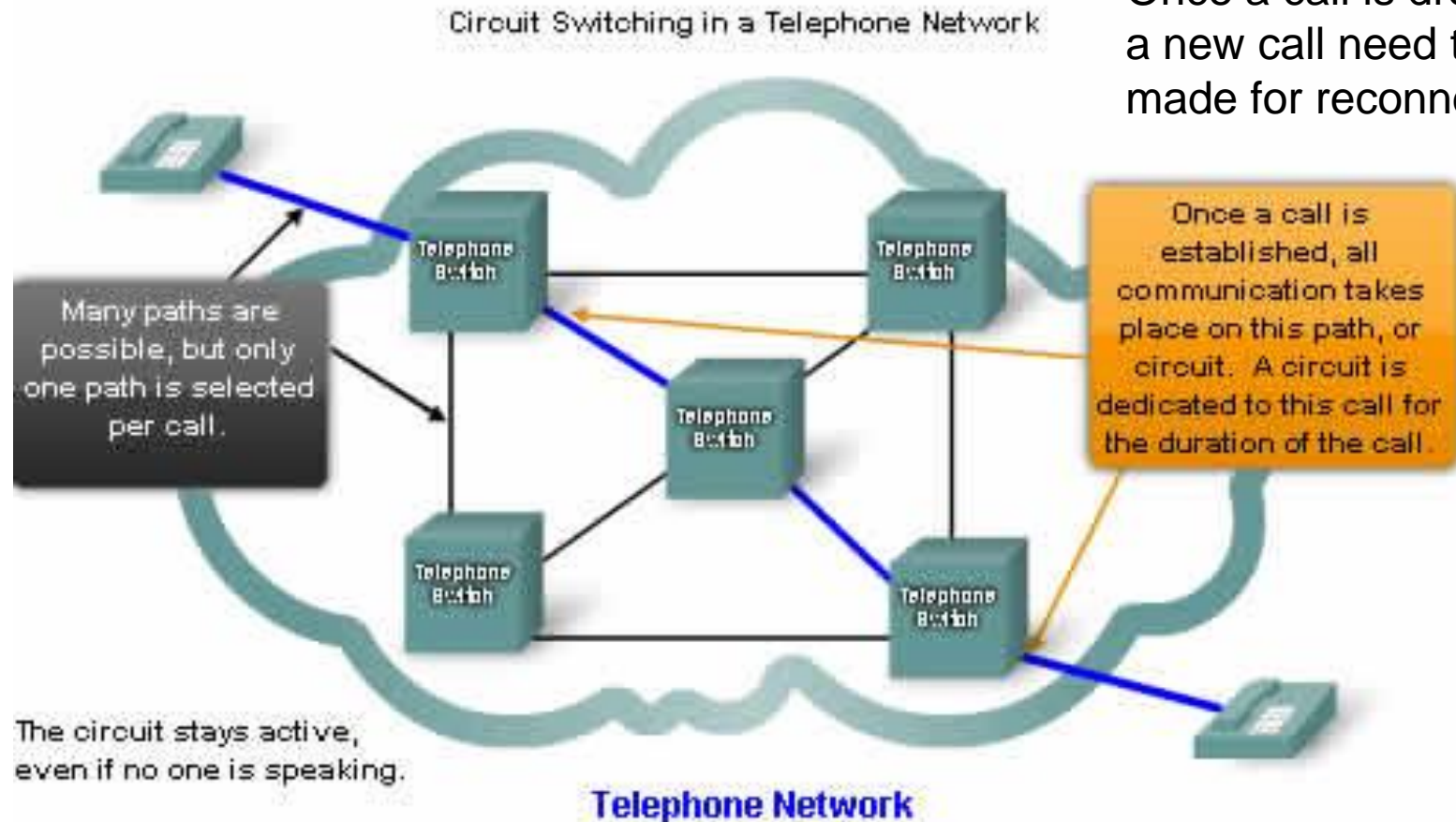
Network Architecture

- The term network architecture, refers to both the technologies that support the **infrastructure** and the **programmed services and protocols** that move the messages across that infrastructure
- There are **4** basic characteristics for networks in general to meet **user expectations**:
 - Fault tolerance,
 - Scalability,
 - Quality of service (QoS)
of video
 - Security

A Fault Tolerant Network Architecture

- Early network type: **Circuit switched connection-oriented network**

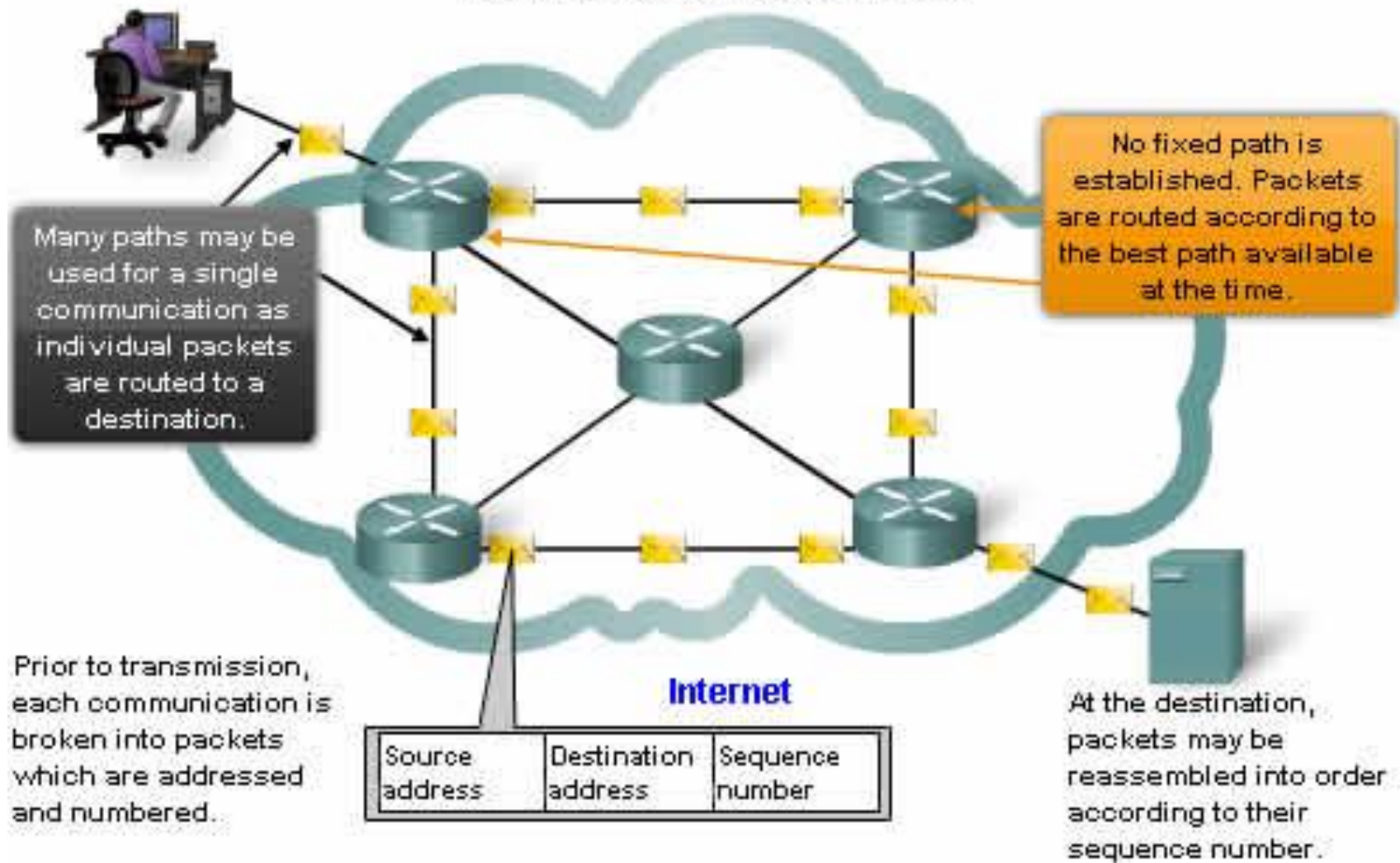
Once a call is dropped, a new call need to be made for reconnection



There are many, many circuits, but a finite number. During peak periods, some calls may be denied.

- Consider **Packet Switched Connectionless Network**

Packet Switching in a Data Network



Prior to transmission, each communication is broken into packets which are addressed and numbered.

During peak periods, communication may be delayed, but not denied.

Packet Switched Connectionless Network

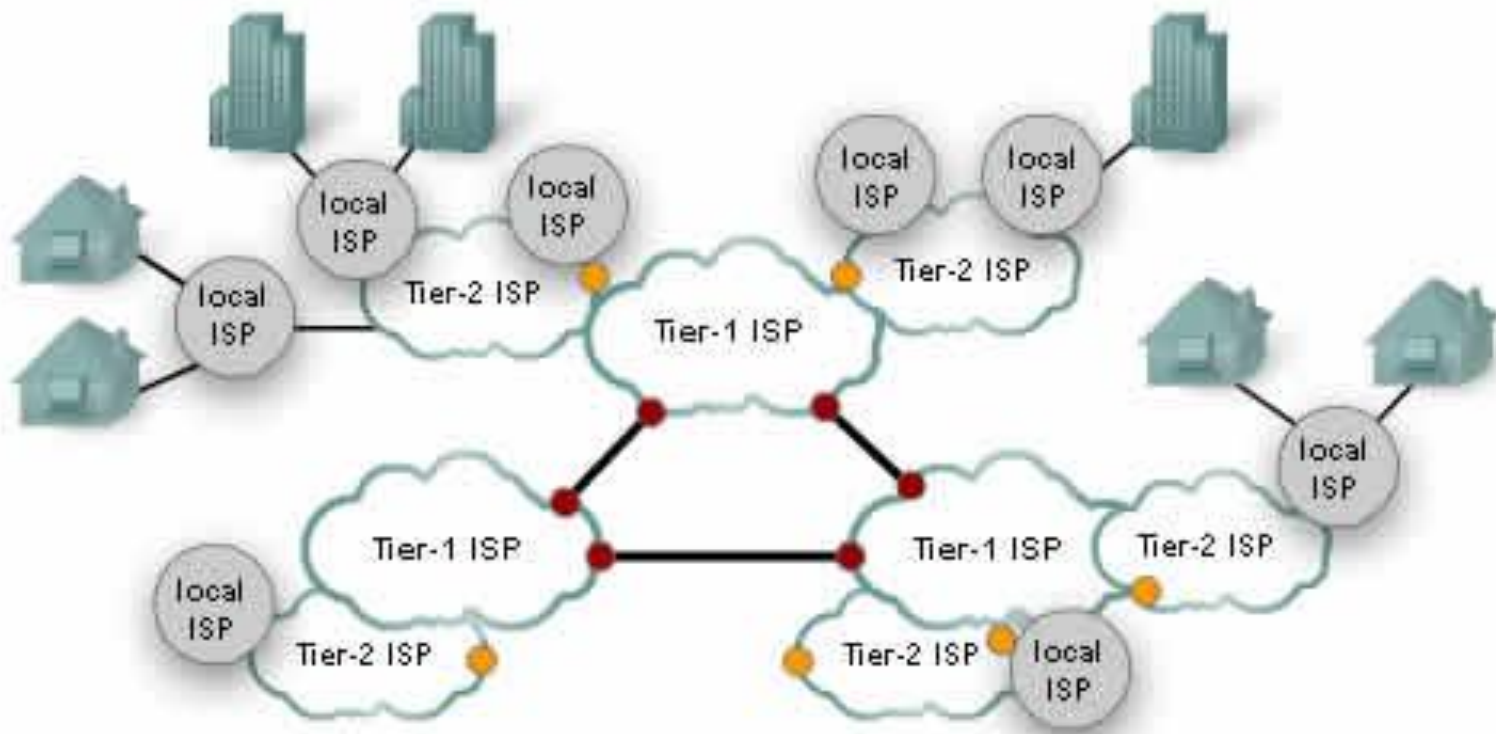
- A packet switched connectionless network had the features necessary to support a resilient, fault tolerant network architecture
 - The need for a single, reserved circuit from end-to-end does not exist
 - Any piece of a message can be sent through the network using any available path
 - Packets containing pieces of messages from different sources can travel the network at the same time
- By providing a method to dynamically use redundant paths, without intervention by the user, the Internet has become a fault tolerant, scalable method of communications.

Advantages of using Circuit Switched Connection-Oriented Network

- Nevertheless, there are some advantages of using Circuit Switched Connection-Oriented Network
 - Resources at the various switching locations are dedicated to providing a finite number of circuits, the **quality and consistency** of messages transmitted across a connection-oriented network can be guaranteed
 - The provider of the service can **charge** the users of the network for the period of time that the connection is active

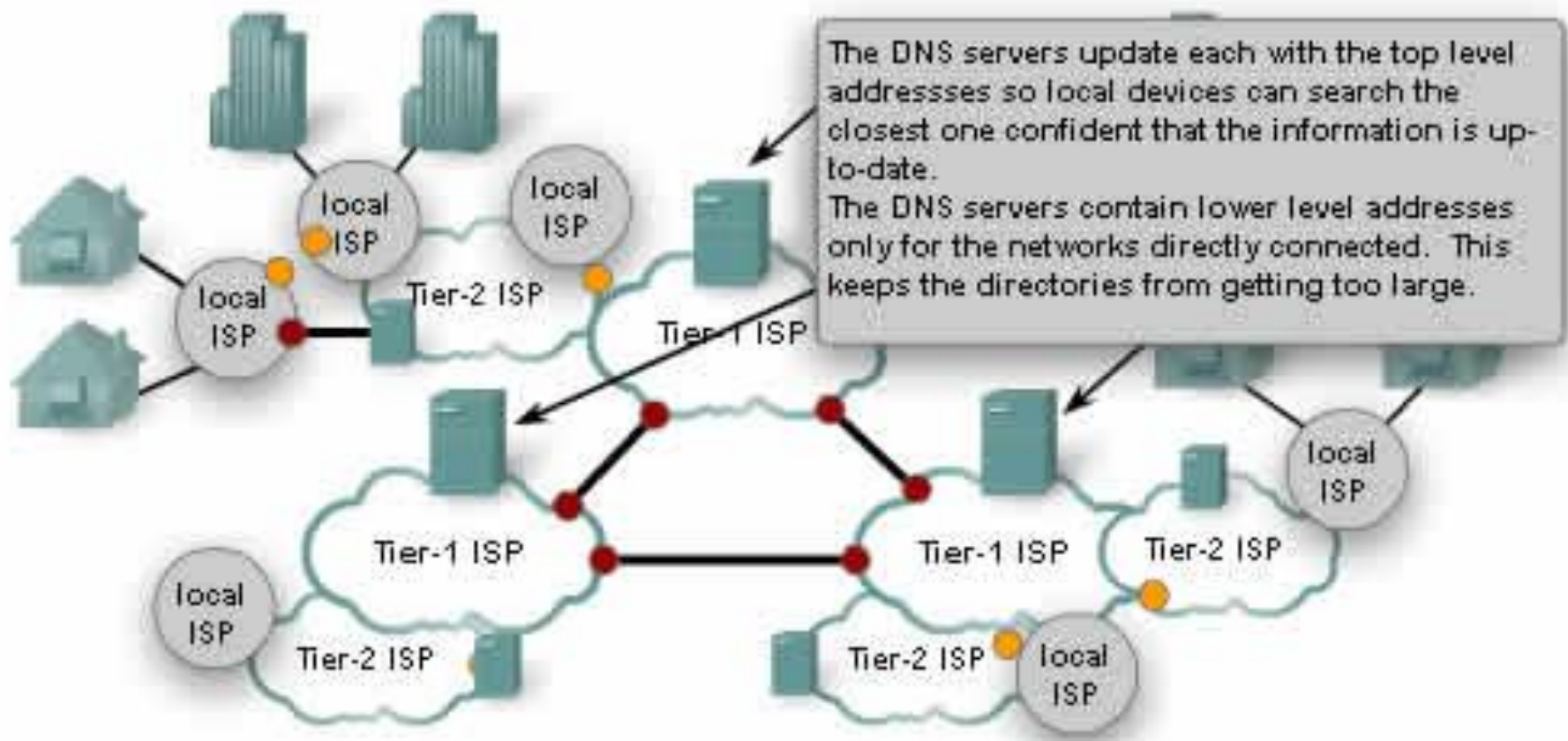
A Scalable Network Architecture

- Understand the Internet Architecture
 - **Tier-1 ISPs** are in the center of Internet, providing national and international connections
 - **Tier-2 ISPs** provide regional service. They pay Tier-1 ISPs
 - **Tier-3 ISPs** are local providers offer service to end-users. They pay Tier-2 ISPs.

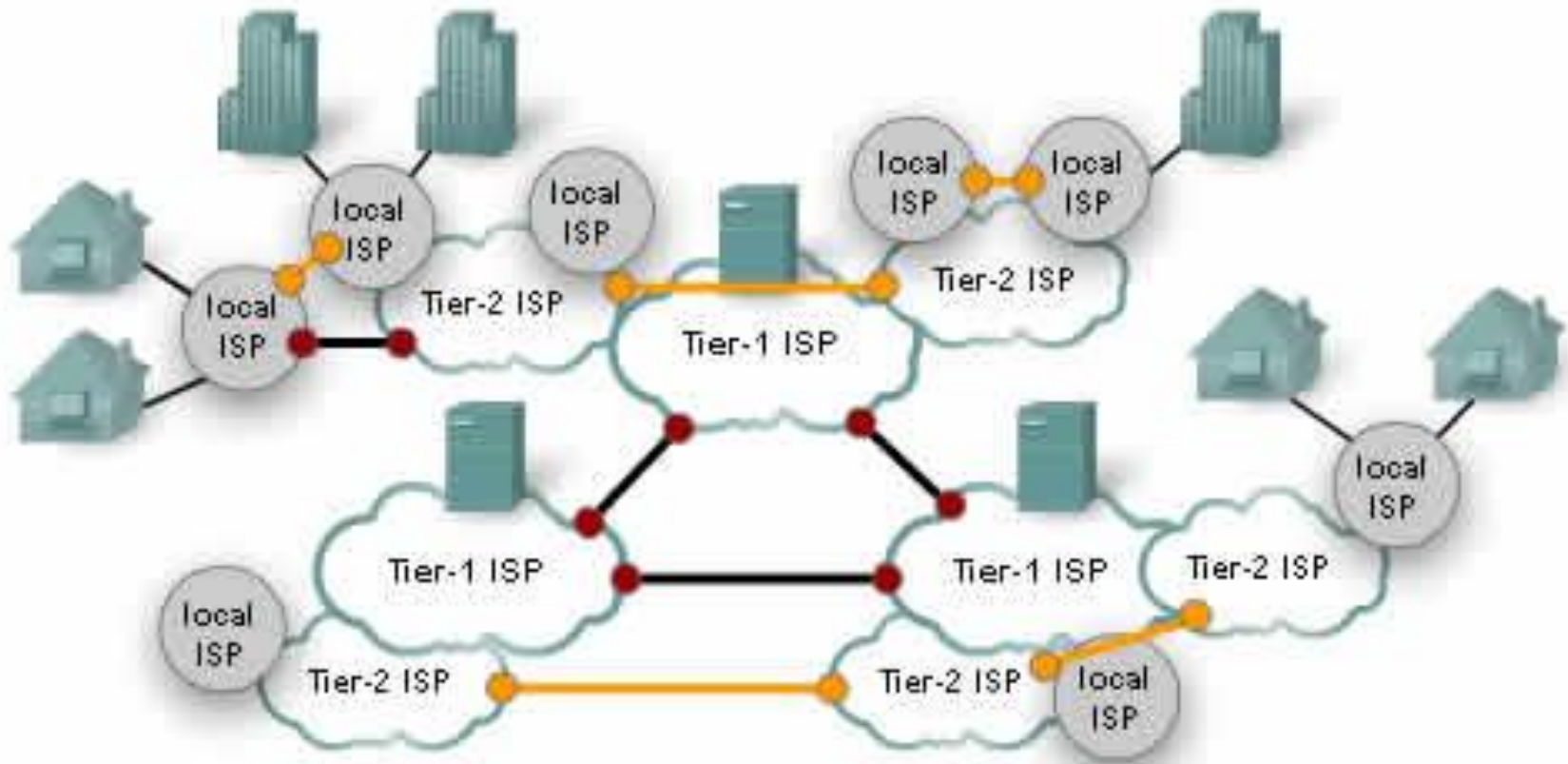


- The Internet - a collection of interconnected private and public networks, has a hierarchical layered structure for addressing, naming and connectivity services.

The Domain Name System (DNS) provides a hierarchical directory of addresses--one server doesn't have to hold the entire list of millions of addresses..



- At each level or layer of the hierarchy, individual network operators maintain peering relationships with other operators at the same level.
- As a result, network traffic that is destined for local or regional services does not need to traverse to a central point for distribution.

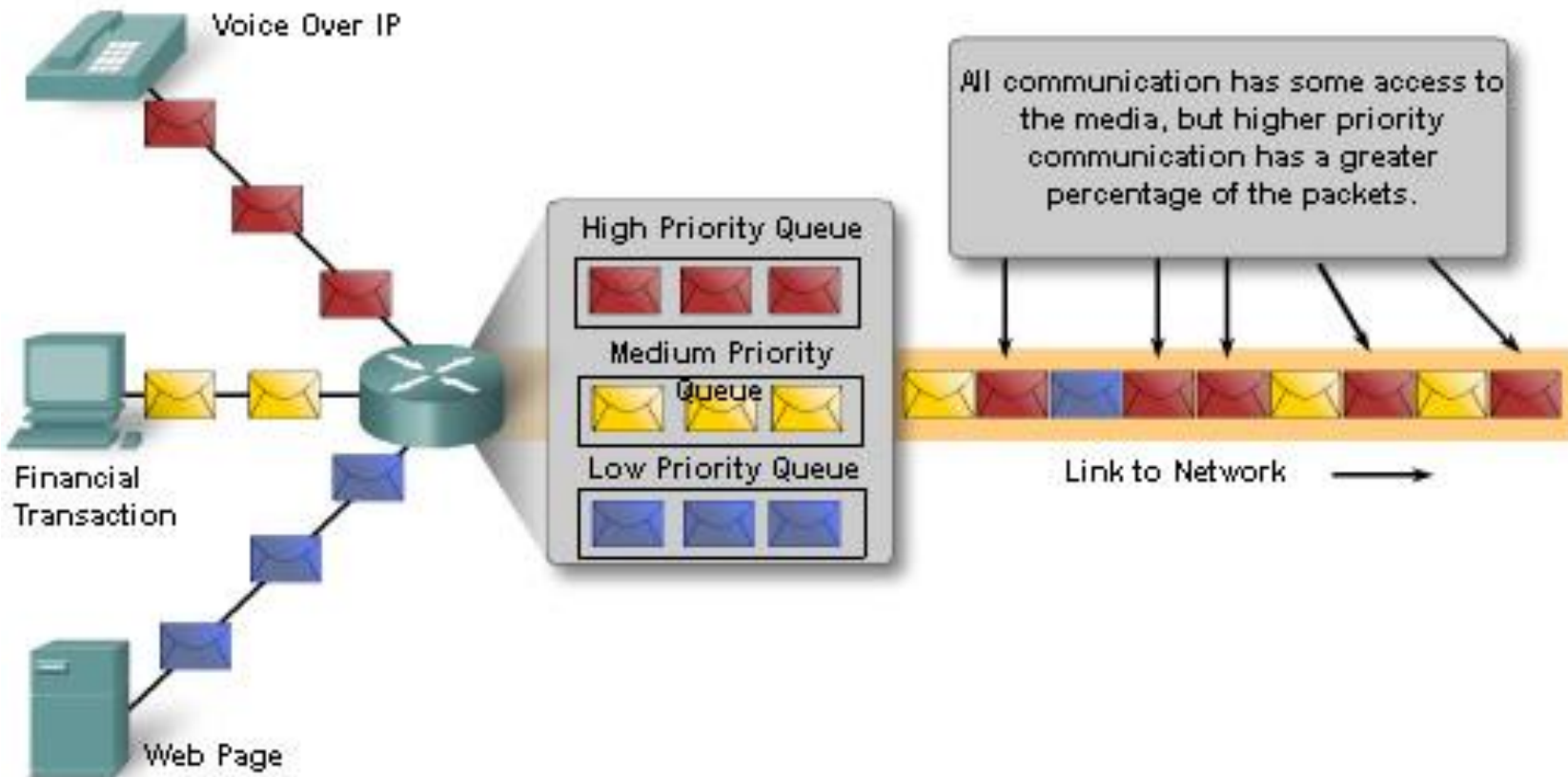


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- There is **no single organization** that regulates the Internet, the operators of the many individual networks that provide Internet connectivity cooperate to follow accepted standards and protocols
 - The adherence to standards enables the manufacturers of hardware and software to concentrate on product improvements in the areas of performance and capacity, knowing that the new products can integrate with and enhance the existing infrastructure

Providing Quality of Service (QoS)

- The packet-switched network architecture does not guarantee that all packets that comprise a particular message will **arrive on time**, in their **correct in order**, or even that they **will arrive** at all.
- Networks also need mechanisms to manage **congested network traffic**.
- Networks does not have infinite resources, therefore QoS is necessary.
- Constraints on network resources:
 - Technology limitations
 - Costs,
 - The local availability of high-bandwidth service

- Ensuring QoS requires a set of techniques to manage the utilization of network resources.
- In order to maintain a high quality of service for applications that require it, it is necessary to prioritize which types of data packets must be delivered at the expense of other types of packets that can be delayed or dropped.



- QoS

Classification:

- Classify data using combination of communication characteristics and the relative importance assigned to application. Treat all data within the same classification according to the same rules.
- Communication that is time-sensitive or important would be classified differently from communication that is of lesser importance.

Assigning Priorities:

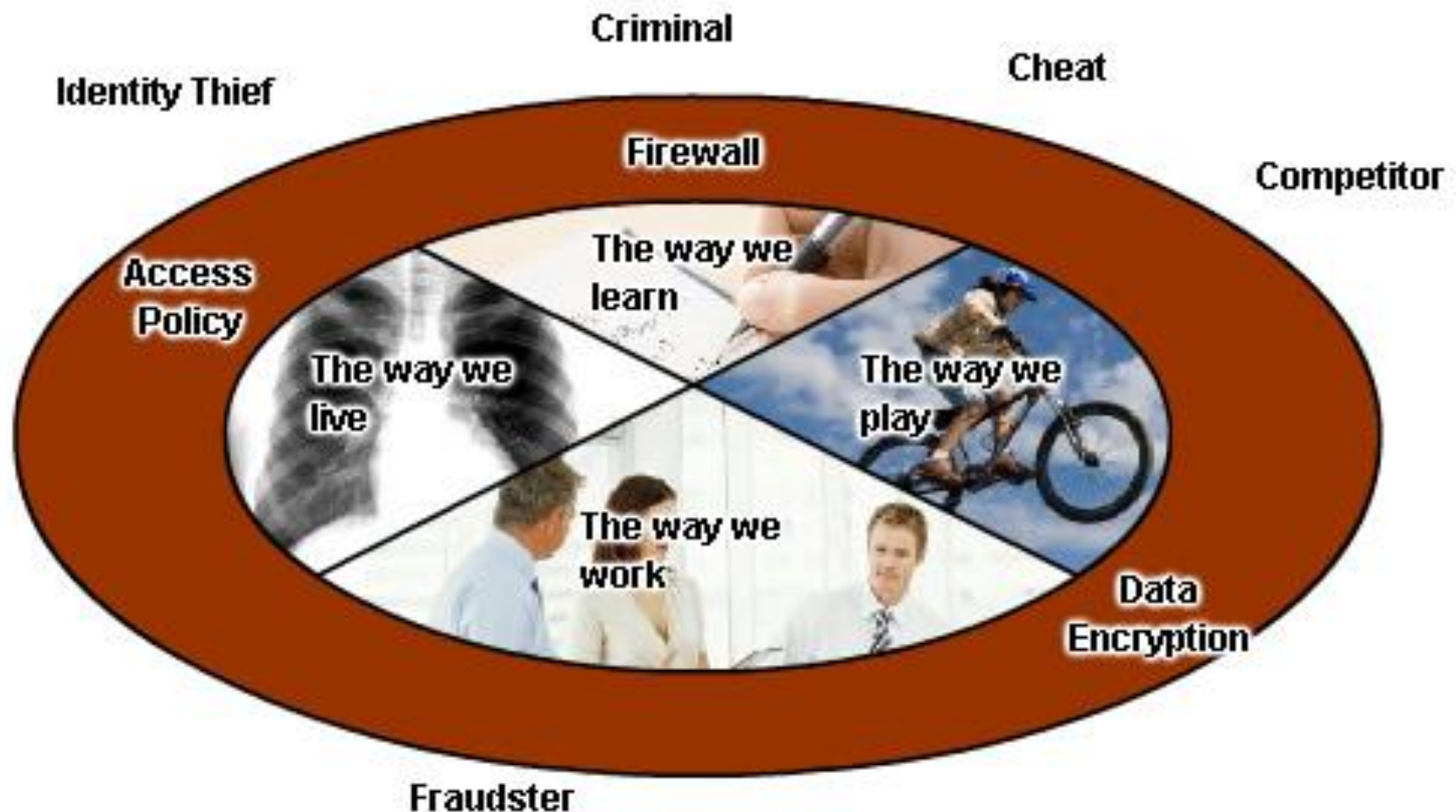
- Based on the **characteristics** of the information being communicated. The quality of a video stream is not as important as critical process control information that operates the manufacturing machinery..

Providing Network Security

- Unauthorized use of communication data might have serious consequences
- 2 types of network security concerns that must be addressed to prevent serious consequences:
 - **Network Infrastructure Security** - physical securing of devices that provide network connectivity and preventing unauthorized access to the management software that resides on them
 - **Content Security** - protecting the information contained within the packets being transmitted over the network and the information stored on network attached devices

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- Security measures taken in a network should:
 - Prevent unauthorized disclosure or theft of information
 - Prevent unauthorized modification of information
 - Prevent Denial of Service

 - Means to achieve these goals include:
 - Ensuring confidentiality
 - Maintaining communication integrity
 - Ensuring availability
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The communication and information that we would like to be private is protected from those who would make unauthorized use of it.

Trends in Networking

- **3** major trends that are contributing to the future shape of complex information networks:
 - - Increasing number of mobile users
 - - Proliferation of network capable devices
 - - Expanding range of services
- As networks increase in sophistication, the demand for people with networking skills will continue to grow.
- Even non-IT jobs, like manufacturing management or medical equipment design, now require a significant amount of knowledge about network operation in order to be successful.