

# CHAPTER ONE

## INTRODUCTION

# 1.1 History and Overview of Networks

- ❑ Each of the past three centuries has been dominated by a single technology.
- ❑ The 18<sup>th</sup> century was the era of great mechanical system accompanying the industrial revolution
- ❑ The 19<sup>th</sup> century was the age of the steam engine
- ❑ During the 20<sup>th</sup> century the key technology was information gathering, processing and distribution.
- ❑ In the 20<sup>th</sup> century, we saw
  - the installation of worldwide telephone networks,
  - the invention of radio and television,
  - the birth and unprecedented growth of the computer industry and
  - the launching of communication satellites

# Cont...

- ❑ As the ability to **gather ,process** and **distribute information** grows, the demand for **even more sophisticated information** processing grows even faster.
- ❑ This demand creates a **rapid technology progress** which allows companies to have branches in different part of the world and see and control their current status at the push of the button.
- ❑ **Computer network** is a **collection of autonomous computers interconnected by a single technology**.
- ❑ Computer networks emerge relatively in the **late 1960s**.
- ❑ They have inherited many **useful properties from their predecessors namely older and more widely used telephone networks**.
- ❑ However, computer networks have brought something new in to the world of communication, namely the **practical inexhaustible store of information** accumulated by human existence during the several thousand years of its existence.

# 1.2 The Impact of Network on Daily Life

- ❑ Among all of the essentials for human existence, **the need to interact** with others ranks just below our need to sustain life.
- ❑ Communication is almost **as important to us as our reliance on air, water, food, and shelter**.
- ❑ The methods that we use to **share ideas and information are constantly changing and evolving**.
- ❑ Whereas the human network was once limited to 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.
- ❑ As with every advance in communication technology, the creation and interconnection of **robust data networks** is having a profound effect.

# Cont...

- 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.
- Previously separate and distinct communication forms have converged onto **a common platform**.
- This platform provides access to a wide range of alternative and new communication methods that enable people to interact directly with each other almost instantaneously.
- The immediate nature of communications over the Internet encourages the **formation of global communities**.
- These communities **foster social interaction** that is independent of location or time zone.
- In general computer network is changing our day to day life whether knowingly or unknowingly.

# Cont...

- ❑ It is incredible how quickly the Internet became an integral part of our daily routines.
- ❑ The complex interconnection of electronic devices and media that comprise the network is transparent to the millions of users who make it a valued and personal part of their lives.
- ❑ Data networks that were once the transport of information from business to business have been repurposed to improve the quality of life for people everywhere.
- ❑ In the course of a day, resources available through the Internet can help you:
  - Decide what to wear using online current weather conditions.
  - Find the least congested route to your destination, displaying weather and traffic video from webcams.
  - Check your bank balance and pay bills electronically.

# Cont...

- ❑ Receive and send e-mail, or make an Internet phone call, at an Internet cafe over lunch.
- ❑ Obtain health information and nutritional advice from experts all over the world, and post to a forum to share related health or treatment information.
- ❑ Download new recipes and cooking techniques to create a spectacular dinner.
- ❑ Post and share your photographs, home videos, and experiences with friends or with the world.

## 1.3 The network as a platform

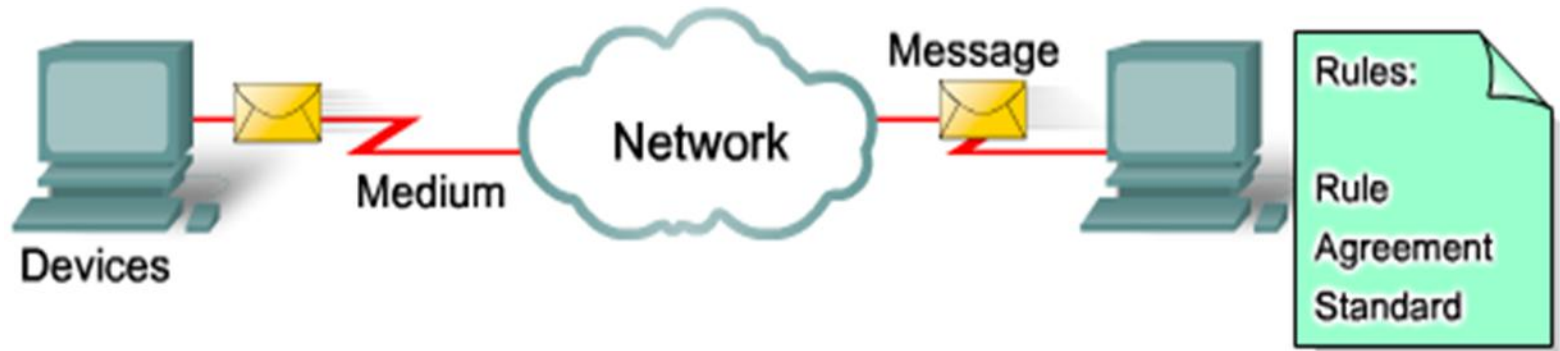
- ❑ Being able to reliably communicate to anyone, anywhere, is becoming increasingly important **to our personal and business lives**.
- ❑ In order to support the immediate delivery of **the millions of messages being exchanged between people all over the world**, we rely on a web of interconnected networks.
- ❑ These data or information networks vary in size and capabilities, but all networks have four 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



# Cont..

- ❑ The **standardization of the various elements** of the network enables equipment and devices created by different companies to work together.
- ❑ Experts in various technologies can contribute their best ideas on how to develop an **efficient network, without regard to the brand or manufacturer of the equipment.**

# 1.4 Network Role and Elements



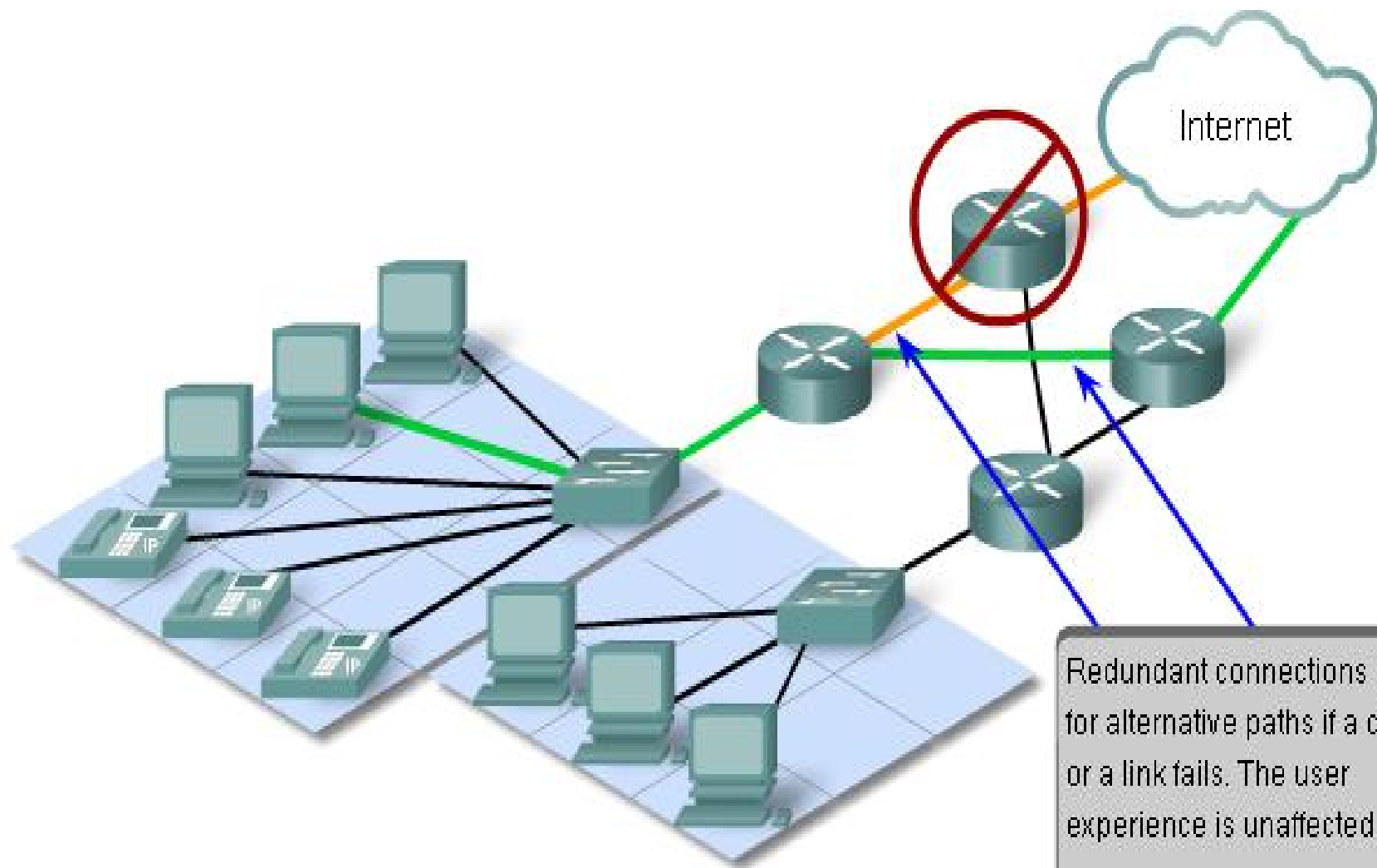
- ❑ The diagram shows elements of a typical network, including devices, media, and services, tied together by rules, that work together to send messages.
- ❑ We use the word messages as a term that encompasses **web pages, e-mail, instant messages, telephone calls, and other forms of communication** enabled by the Internet.

## 1.5 Network Architecture and characteristics

- ❑ Networks must support a wide range of *applications* and *services*, as well as operate over many different types of *physical infrastructures*.
- ❑ The **term network architecture**, in this context, refers to **both the technologies that support the infrastructure and the programmed services and protocols that move the messages across that infrastructure.**
- ❑ As the internet, and networks in general, evolve, we are discovering that there are **four basic characteristics that the underlying architectures need to address in order to meet user expectations:**
  - ✓ **fault tolerance,**
  - ✓ **Scalability,**
  - ✓ **Quality of service, and**
  - ✓ **Security.**

# Fault Tolerance

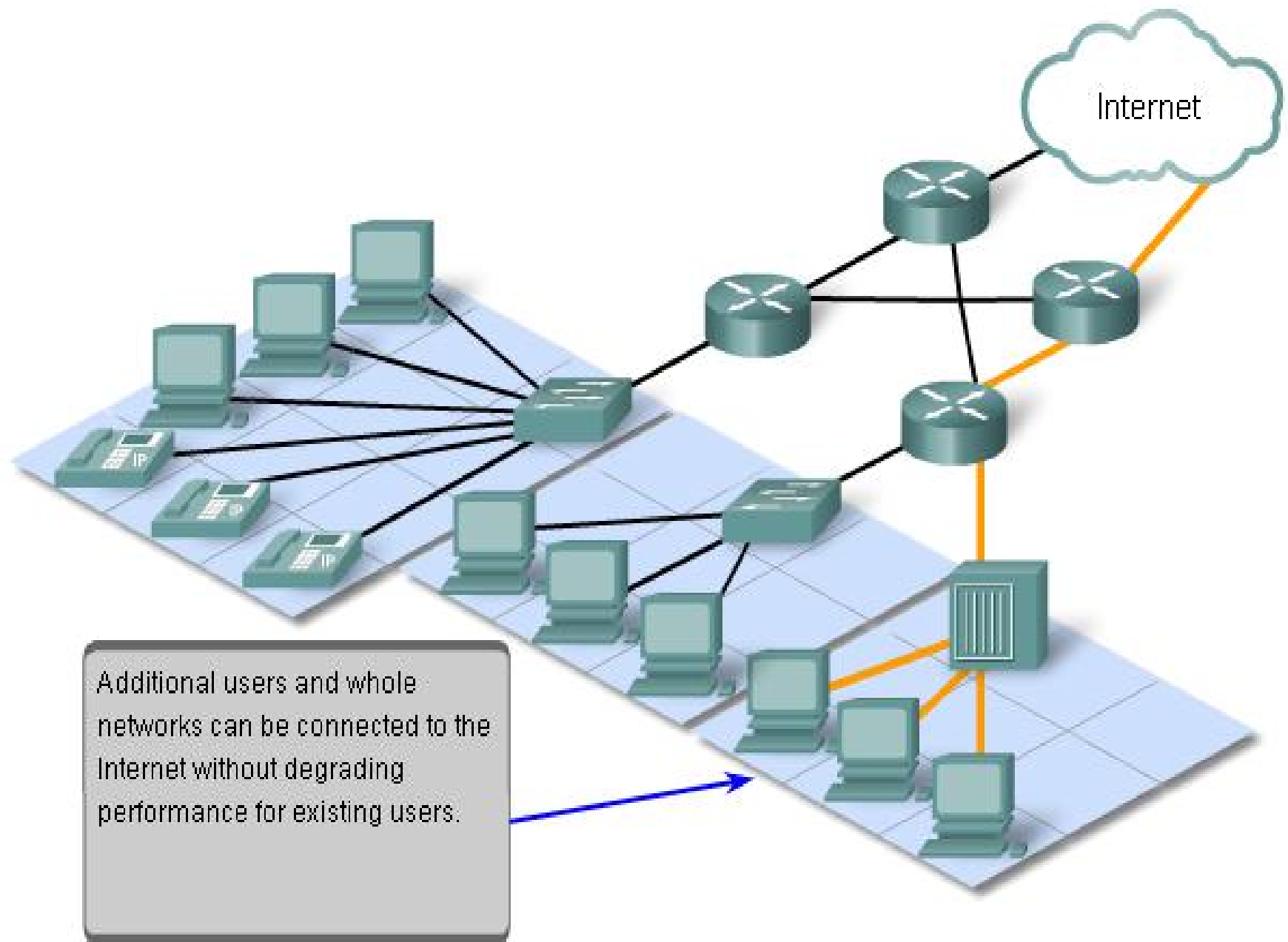
- ❑ The expectation that the Internet is always available to the millions of users who rely on it requires a network architecture that is designed and built to be fault tolerant.
- ❑ A fault tolerant network is one that limits the impact of a hardware or software failure and can recover quickly when such a failure occurs.
- ❑ These networks depend on redundant links, or paths, between the source and destination of a message.
- ❑ If one link or path fails, processes ensure that messages can be instantly routed over a different link transparent to the users on either end.
- ❑ Both the physical infrastructures and the logical processes that direct the messages through the network are designed to accommodate this redundancy.
- ❑ This is a basic premise of the architecture of current networks.



Redundant connections allow for alternative paths if a device or a link fails. The user experience is unaffected.

# Scalability

- A scalable network can **expand quickly to support new users and applications** without impacting the performance of the service being **delivered to existing users**.
- **Thousands of new users and service providers** connect to the Internet each week.
- The ability of the network to support these new interconnections depends on a **hierarchical layered design** for the **underlying physical infrastructure and logical architecture**.
- The operation at each layer enables users or service providers to be **inserted without causing disruption to the entire network**.
- Technology developments are constantly increasing the message carrying capabilities and performance of the physical infrastructure components at every layer.
- These developments, along with new methods to identify and locate individual users within an internetwork, are enabling the Internet to keep pace with user demand.



# Quality of Service (QoS)

- The Internet is currently providing an acceptable level of fault tolerance and scalability for its users.
- But new applications available to users over internetworks create higher expectations for the quality of the delivered services.
- Voice and live video transmissions require a level of consistent quality and uninterrupted delivery that was not necessary for traditional computer applications.
- Quality of these services is measured against the quality of experiencing the same audio or video presentation in person.



# Quality of Service (QoS)...

- Traditional voice and video networks are designed to support a single type of transmission, and are therefore able to produce an acceptable level of quality.
- New requirements to support this quality of service over a converged network are changing the way network architectures are designed and implemented.

# Security

- ❑ The Internet has evolved from a **tightly controlled internetwork of educational and government organizations** to a **widely accessible means for transmission of business and personal communications**.
- ❑ As a result, the **security requirements of the network have changed**.
- ❑ The security and privacy expectations that result from the use of internetworks to exchange confidential and business critical information exceed what the current architecture can deliver.
- ❑ Rapid expansion in communication areas that were not served by traditional data networks is increasing the need to embed security into the network architecture.

# Security...

- ❑ As a result, much effort is being devoted to this area of research and development.
- ❑ In the meantime, many tools and procedures are being implemented to combat inherent security flaws in the network architecture.

# 1.6 Computer Network Vs Human Network

## Human Networks

Generally regarded as a social structure composed of individuals, business partners, friends or other organizations connected through technology, using devices such as PCs, cell phones, PDAs and digital TV

- ❑ Evidence can be found in the rapid rise of social networking
- ❑ people are now more than ever inextricably linked through e-mail, photographs, wikis, blogs, podcasts, instant messaging and more
- ❑ Societal shifts that the human network has yielded are:
  - ✓ added transparency to organizations,
  - ✓ the decentralization of power from traditional institutions
  - ✓ The democratization of established social structures

# Computer Networks

- ❑ A system in which a number of independent computers are linked together to share data and peripherals, such as hard disks and printers
- ❑ The term network can also be defined as a set of different types , terminals, telephones and other communication equipments , connected by data communication links, which allow the network components to work together
- ❑ The network components may be located within a small area or spread over many remote location hold the network hold together

# Why Computer Networks

- Sharing information/data
- Sharing hardware and software
- Centralizing administration and support

# Why Computer Networks

More specifically, computers that are part of a network can share:

- ✓ Documents (memo, spreadsheets, invoices, and so on)
- ✓ E-mail messages
- ✓ Word-processing software
- ✓ Project-tracking software
- ✓ Illustrations, photographs, videos, and audio files
- ✓ Live audio and video broadcasts
- ✓ Printers.
- ✓ Fax machines
- ✓ Modems
- ✓ CD-ROM drives and other removable drives, such as Zip drives
- ✓ Hard drives
- ✓ So many more...