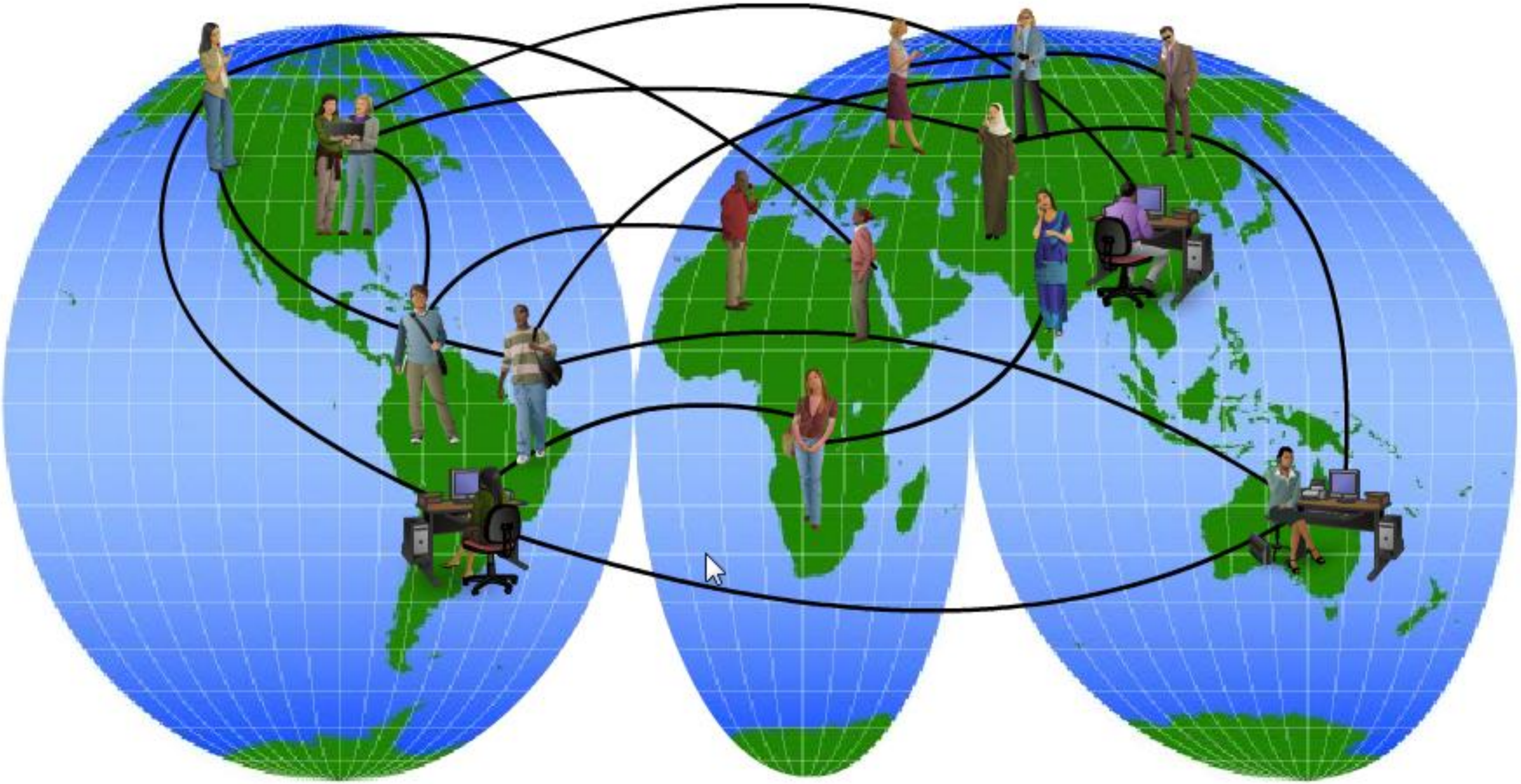
Chapter 1

Ch 1 Goals

In this chapter, you will learn to:

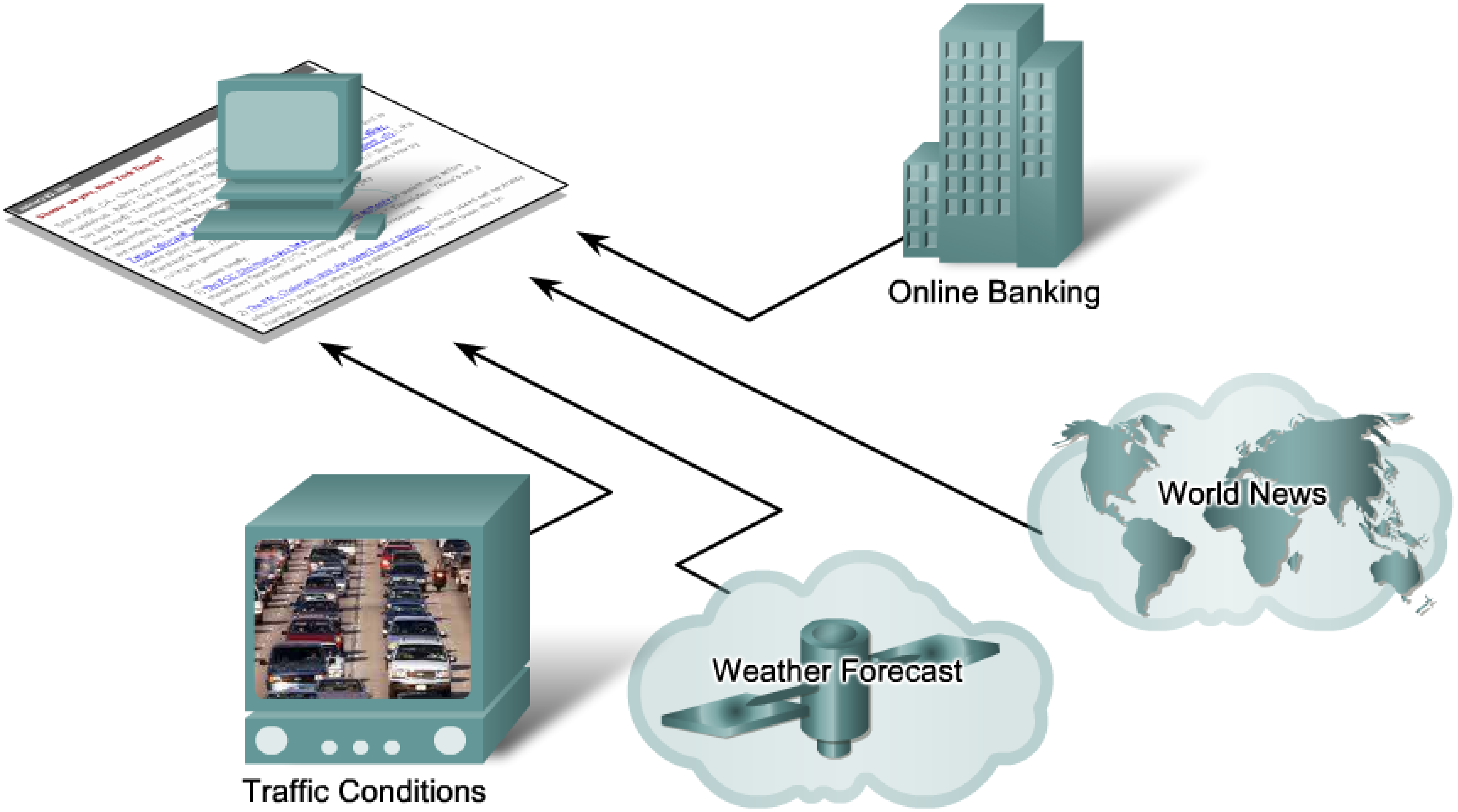
- **Describe how networks impact our daily lives.**
- **Describe the role of data networking in the human network.**
- **Identify the key components of any data network.**
- **Identify the opportunities and challenges posed by converged networks.**
- **Describe the characteristics of network architectures: fault tolerance, scalability, quality of service and security.**
- **Install and use IRC clients and a Wiki server.**

1.1.1 Networks Support the Way We Live



Imagine a world without networks

1.1.1 Networks Support the Way We Live



The way we live is supported by services delivered by the data network.

1.1.1 Networks Support the Way We Live

Hands-on Lab:

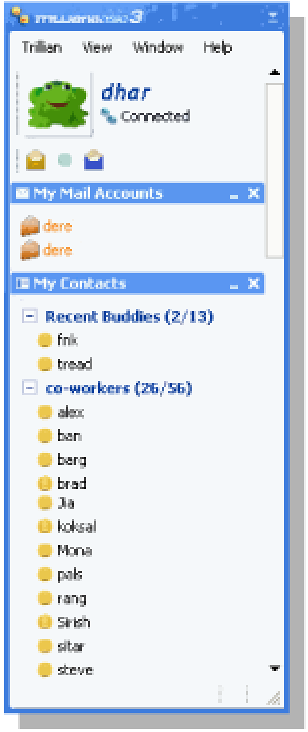
Using Google Earth™ to View the World

1.1.2 Examples – Today's Communication Tools

Podcasting

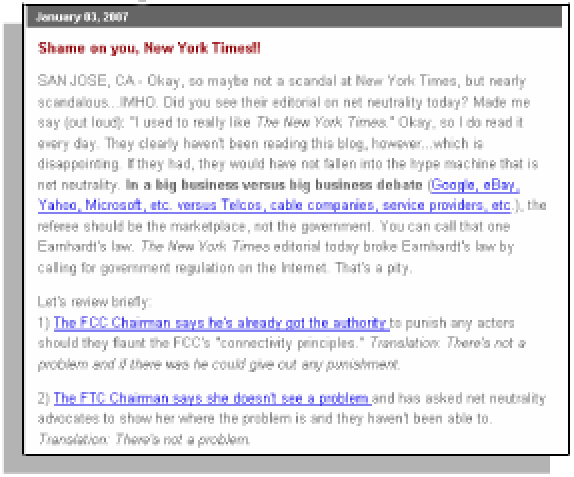
You can listen to your favorite radio show on your portable audio player whenever you have the time and wherever you are. Every time a new show becomes available, it can be automatically downloaded.

Instant Messaging



Instant messaging is everywhere and can include audio and video conversations. IM can send text messages to mobile phones.

Weblog



January 03, 2007

Shame on you, New York Times!!

SAN JOSE, CA - Okay, so maybe not a scandal at New York Times, but nearly scandalous...IMHO. Did you see their editorial on net neutrality today? Made me say (out loud): "I used to really like *The New York Times.*" Okay, so I do read it every day. They clearly haven't been reading this blog, however...which is disappointing. If they had, they would have not fallen into the hype machine that is net neutrality. **In a big business versus big business debate** (Google, eBay, Yahoo, Microsoft, etc. versus Telcos, cable companies, service providers, etc.), the referee should be the marketplace, not the government. You can call that one Earnhardt's law. *The New York Times* editorial today broke Earnhardt's law by calling for government regulation on the Internet. That's a pity.

Let's review briefly:

1) The FCC Chairman says he's already got the authority to punish any actors should they flaunt the FCC's "connectivity principles." *Translation: There's not a problem and if there was he could give out any punishment.*

2) The FTC Chairman says she doesn't see a problem and has asked net neutrality advocates to show her where the problem is and they haven't been able to. *Translation: There's not a problem.*

You can express your thoughts online, share your photos, and join a community of fellow thinkers.

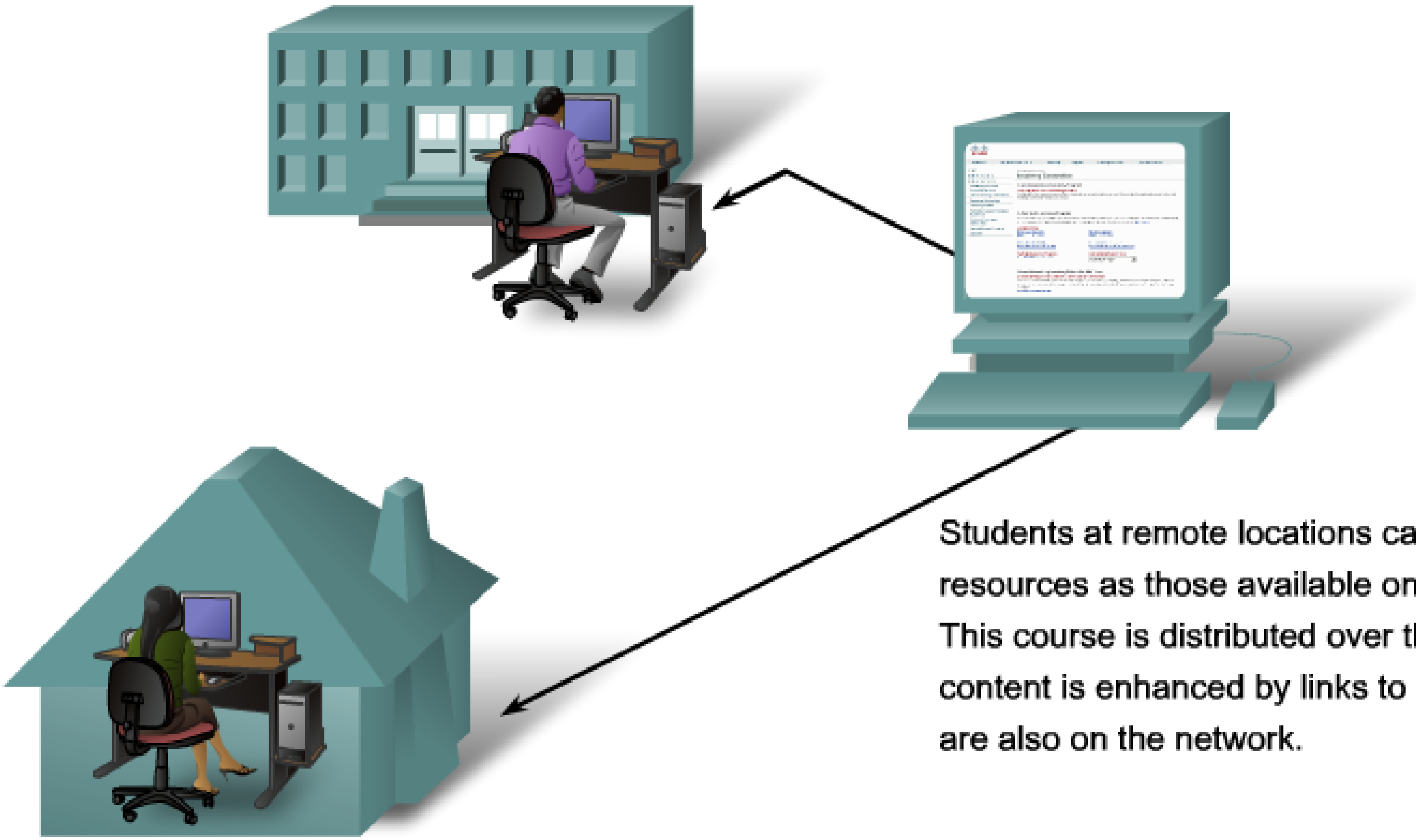
Overview of ‘wiki’

- Wiki: a website you can edit
- Invented in 1995 - Ward Cunningham
- Many uses - business, politics, education
- Many types - TWiki, MoinMoin, MediaWiki
- Hit mainstream with rise of Wikipedia (Jan. 2001)

WIKIPEDIA
The Free Encyclopedia

1.1.3 Networks in Learning

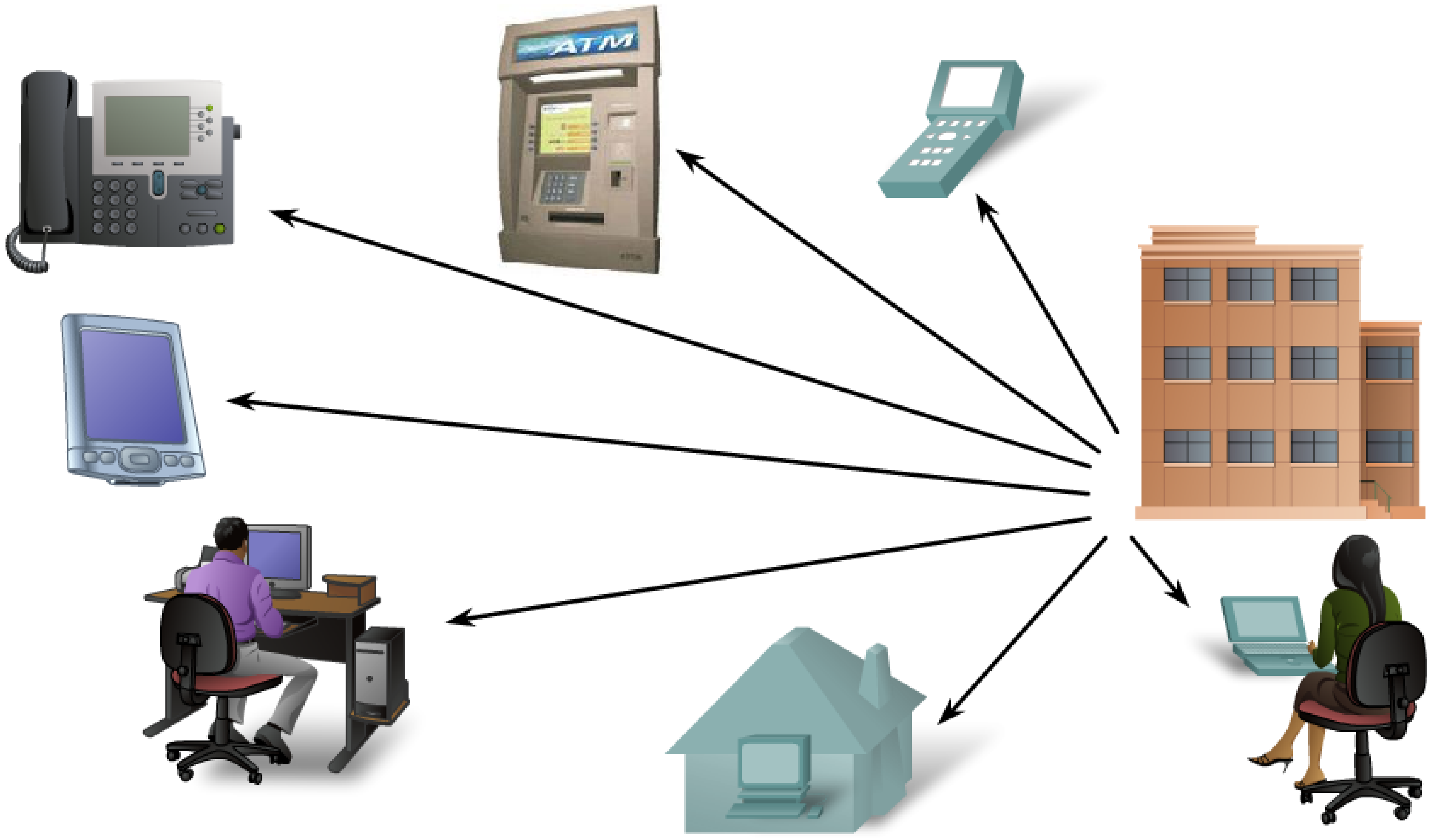
1.1.3 Networks in Learning



Students at remote locations can access the same resources as those available on campus.
This course is distributed over the network and the content is enhanced by links to other resources, which are also on the network.

The way we learn is supported by courseware delivered over the data network.

1.1.4 Networks at work



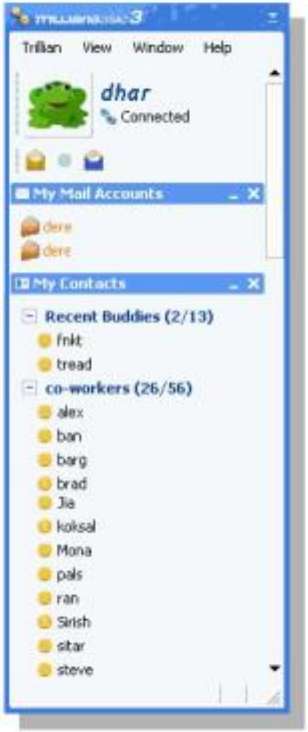
Business applications can be accessed remotely as if employees were on site.

1.1.5 Networks and Work

Online Interest Groups

Online Entertainment

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



Instant Messaging

The way we play is supported by services delivered by the data network.

1.2.1 What is Communiction?

Among the protocols that govern successful human communication are:

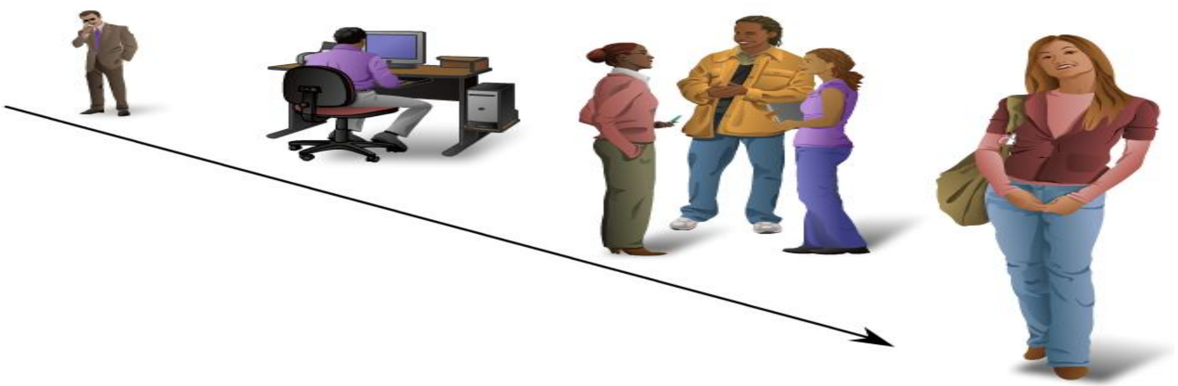
- **An identified sender and receiver**
- **Agreed upon method of communicating (face-to-face, telephone, letter, photograph)**
- **Common language and grammar**
- **Speed and timing of delivery**
- **Confirmation or acknowledgement requirements**

Communication is successful when the intended message has been received and confirmed.

1.2.2 Quality of Communications

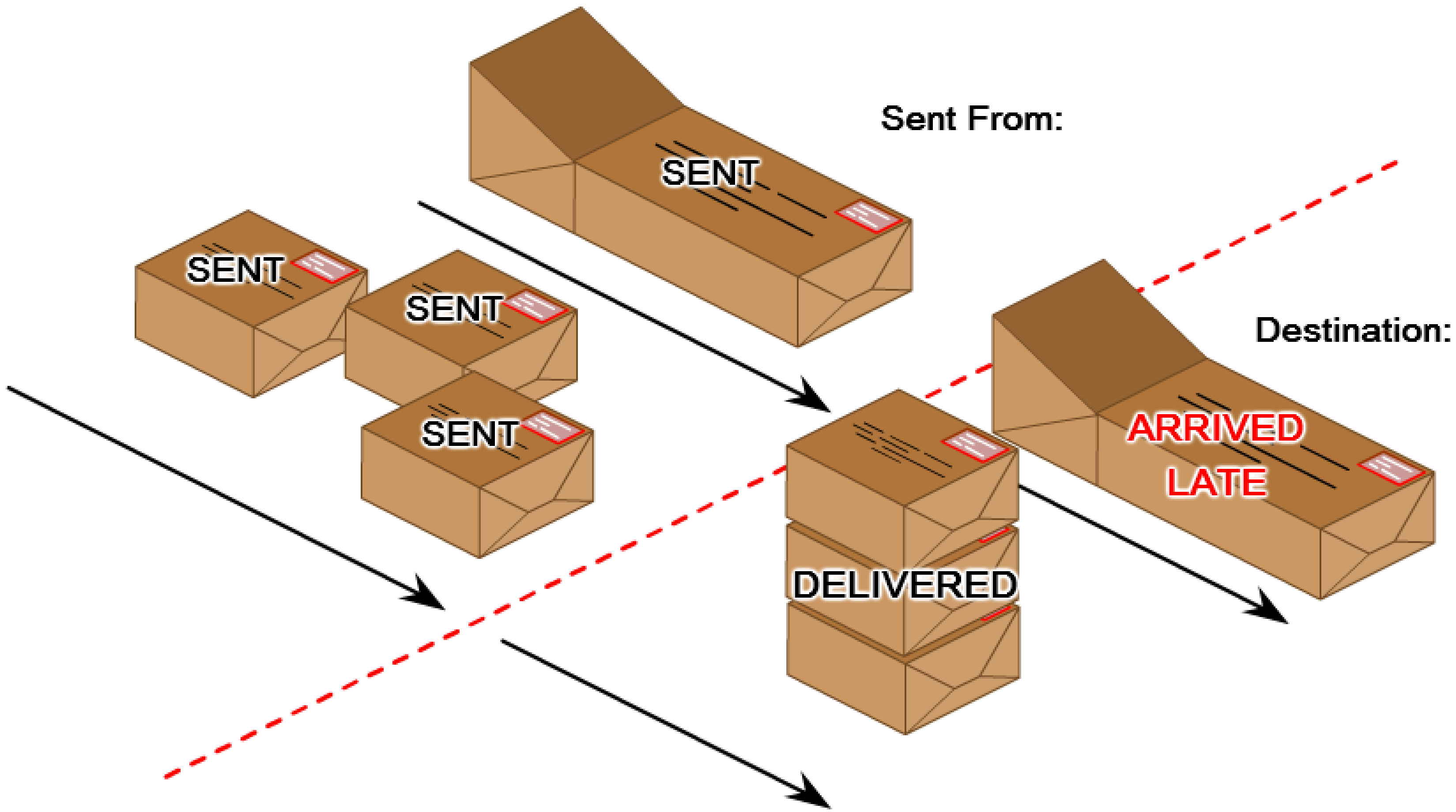
External factors affecting the success of communication include:

- **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 readdressed**
- **The number of other messages being transmitted simultaneously on the communication network**
- **The amount of time allotted for successful communication**



External factors will affect communication.

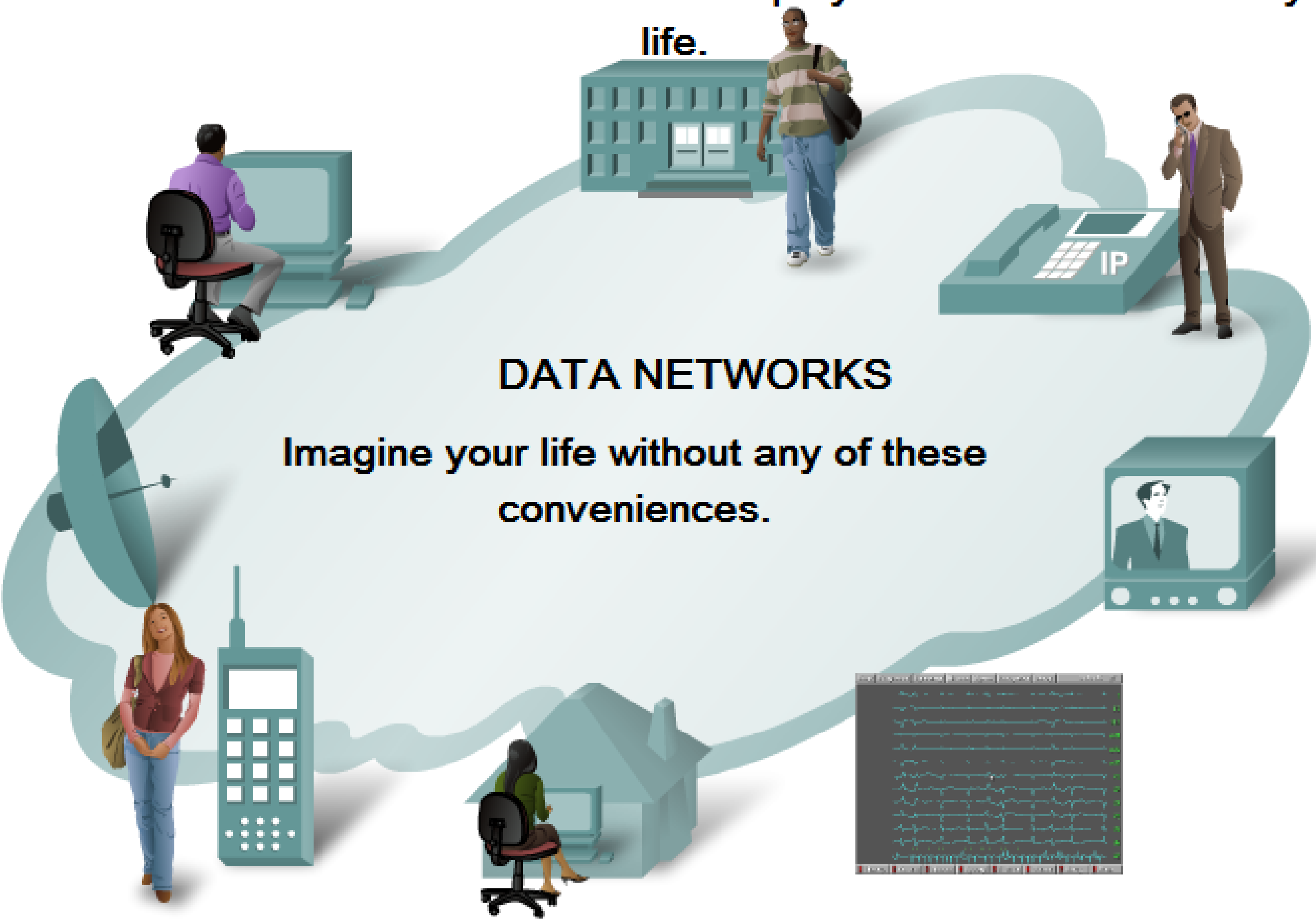
1.2.2 Quality of Communications



It is more difficult to deliver a large bulky package, quickly and without damage, than it is to deliver a number of smaller, less complex packages.

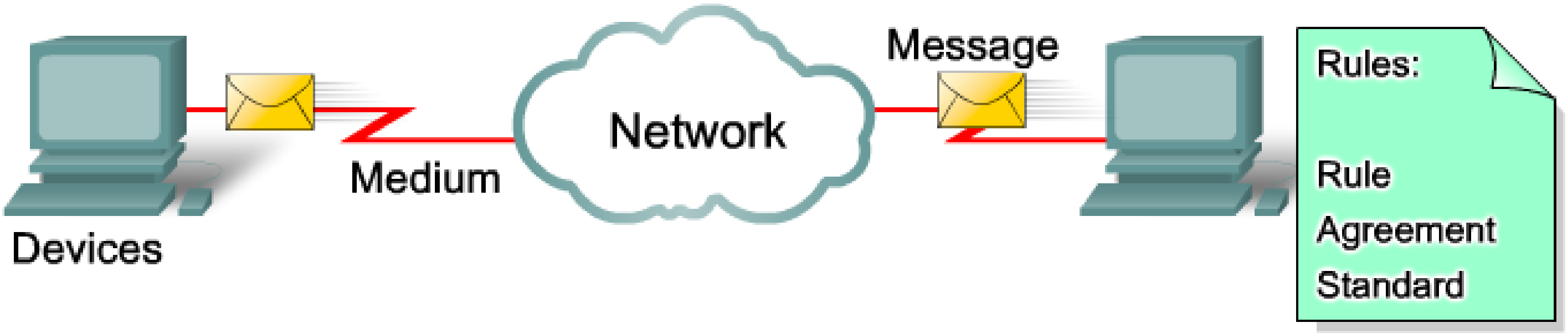
1.3.1 Communicating over networks

Communication across data networks plays a vital role in our daily life.



This course covers how data networks support the human network.

1.3.2 Elements of a Network

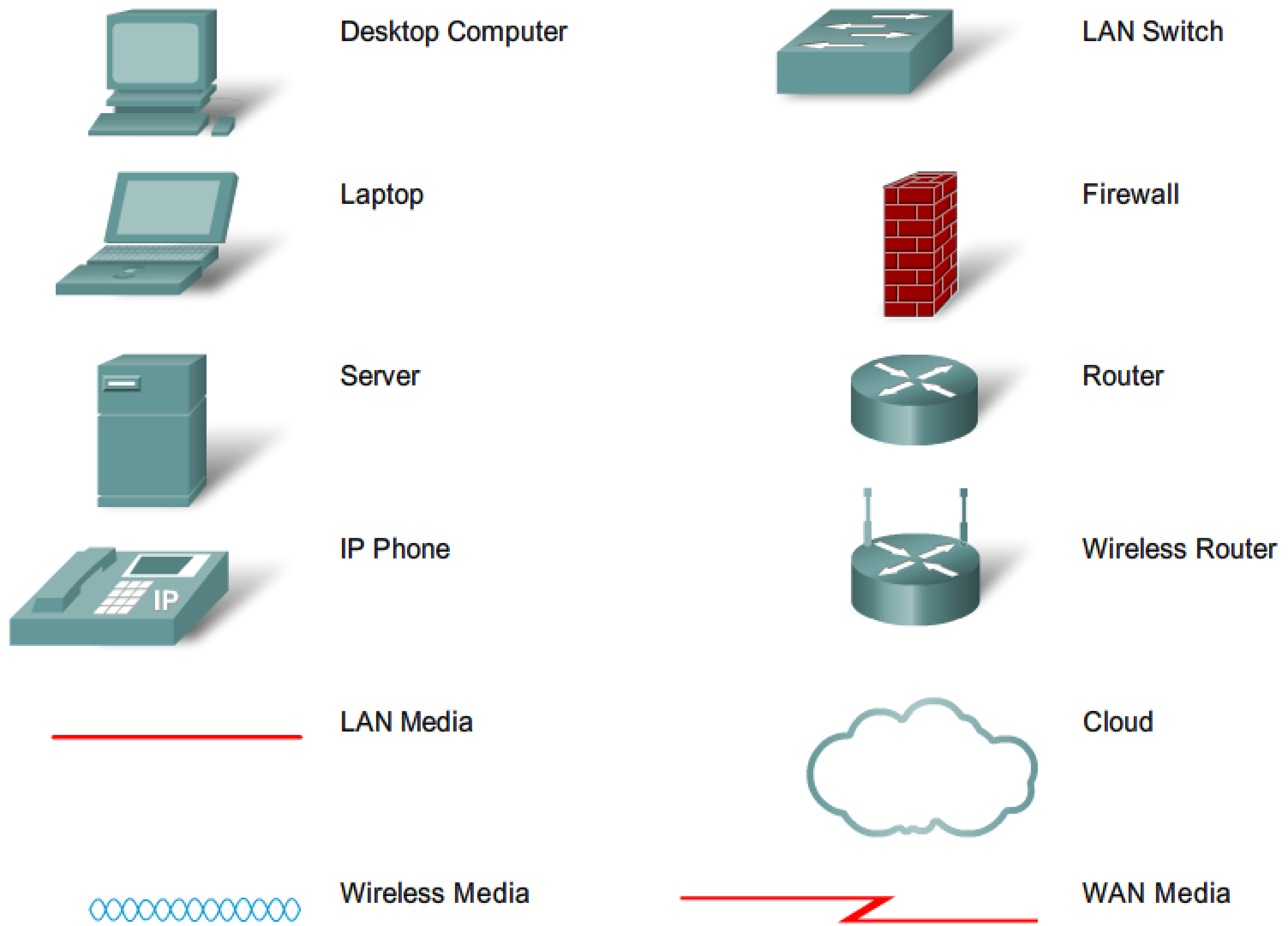


Four elements of a network:

- Rules
- Medium
- Messages
- Devices

1.3.2 Elements of a Network

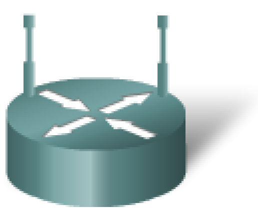
Common Data Network Symbols



1.3.2 Elements of a Network

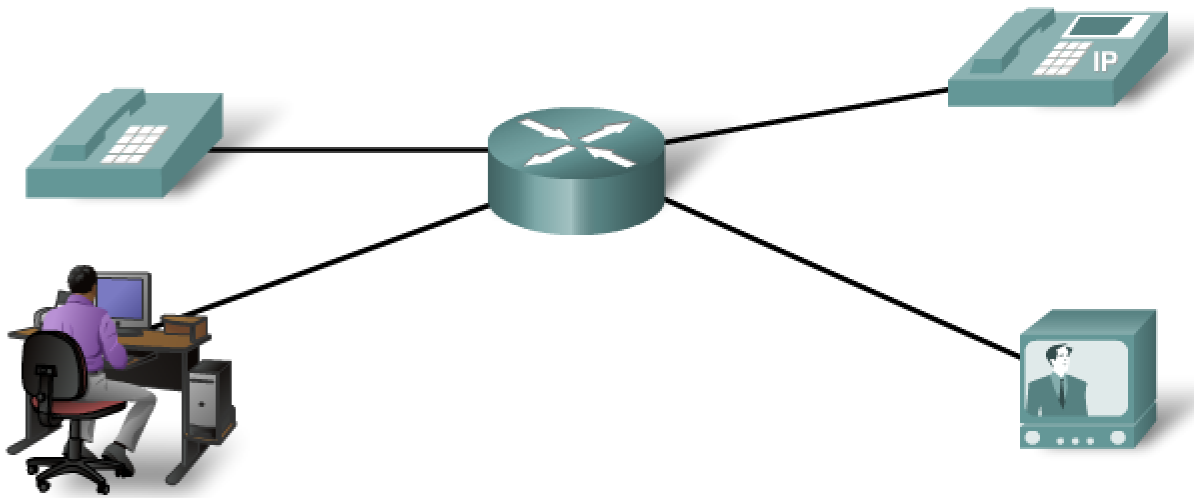
Wired networks used physical cables to connect devices.

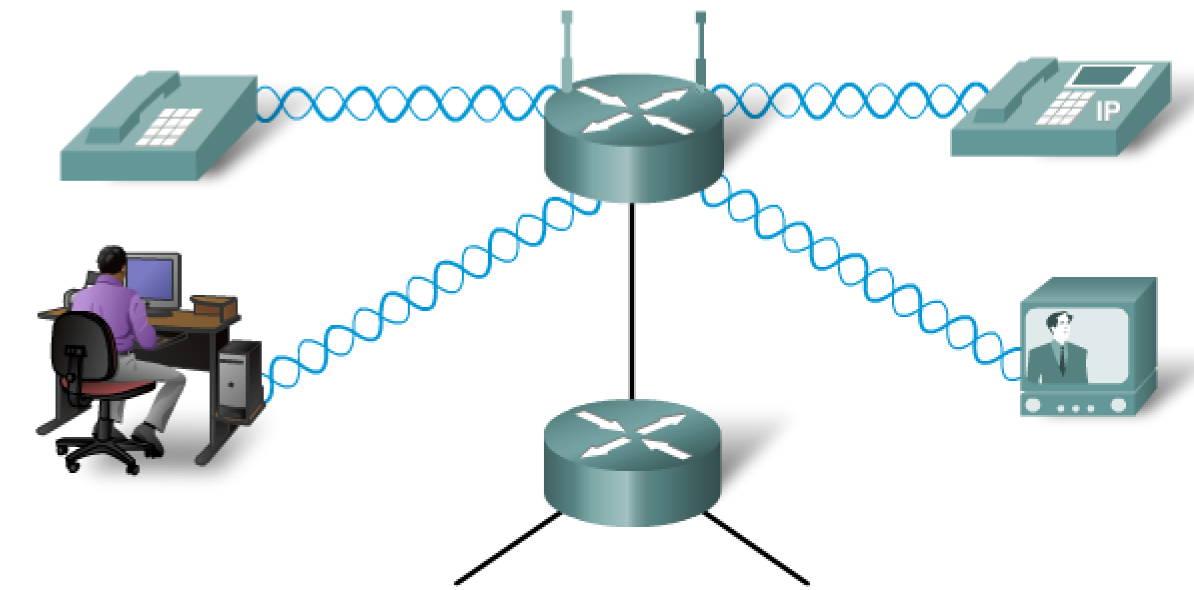
Wireless networks use radio waves to communicate between devices.



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

Network Connections

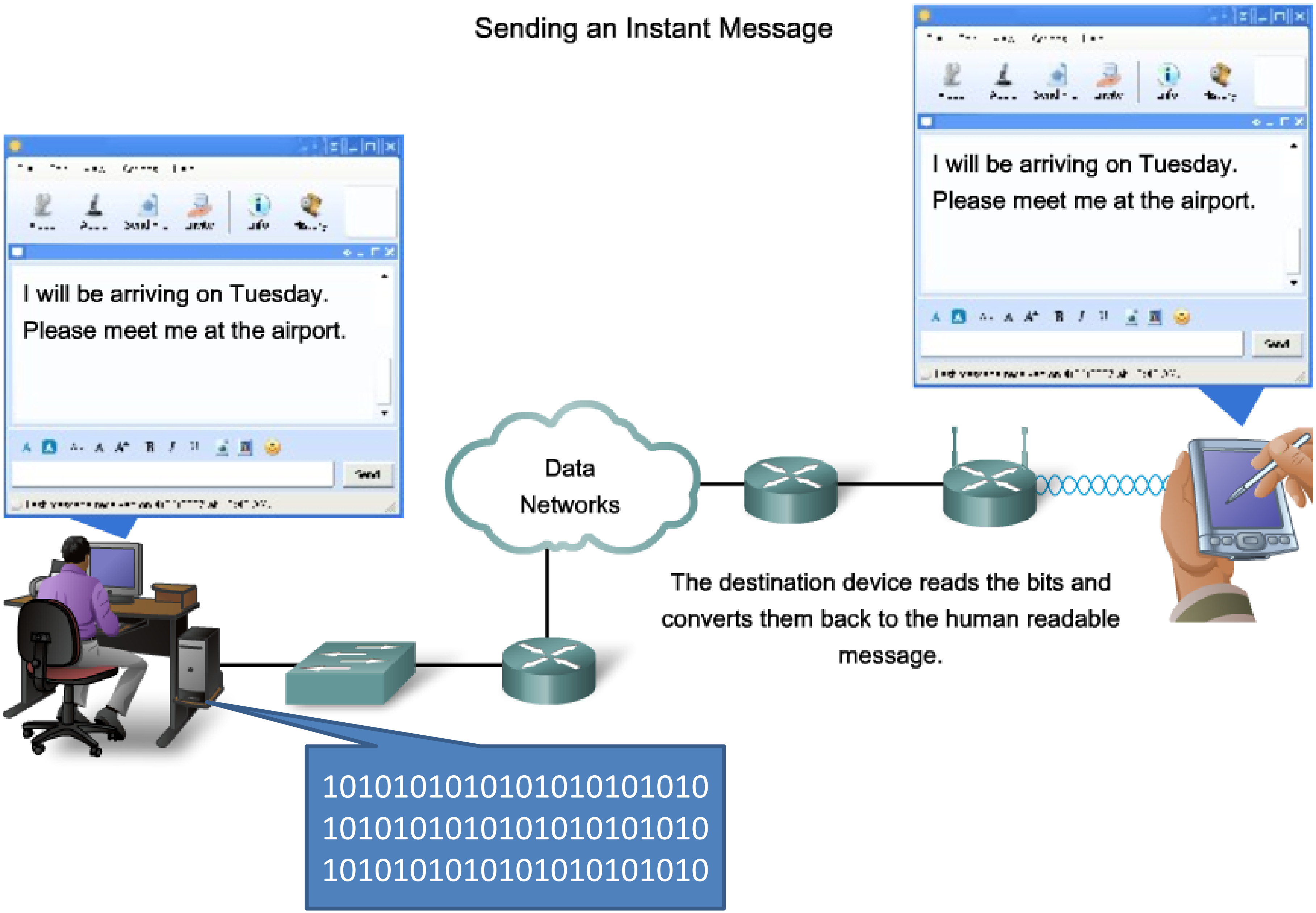




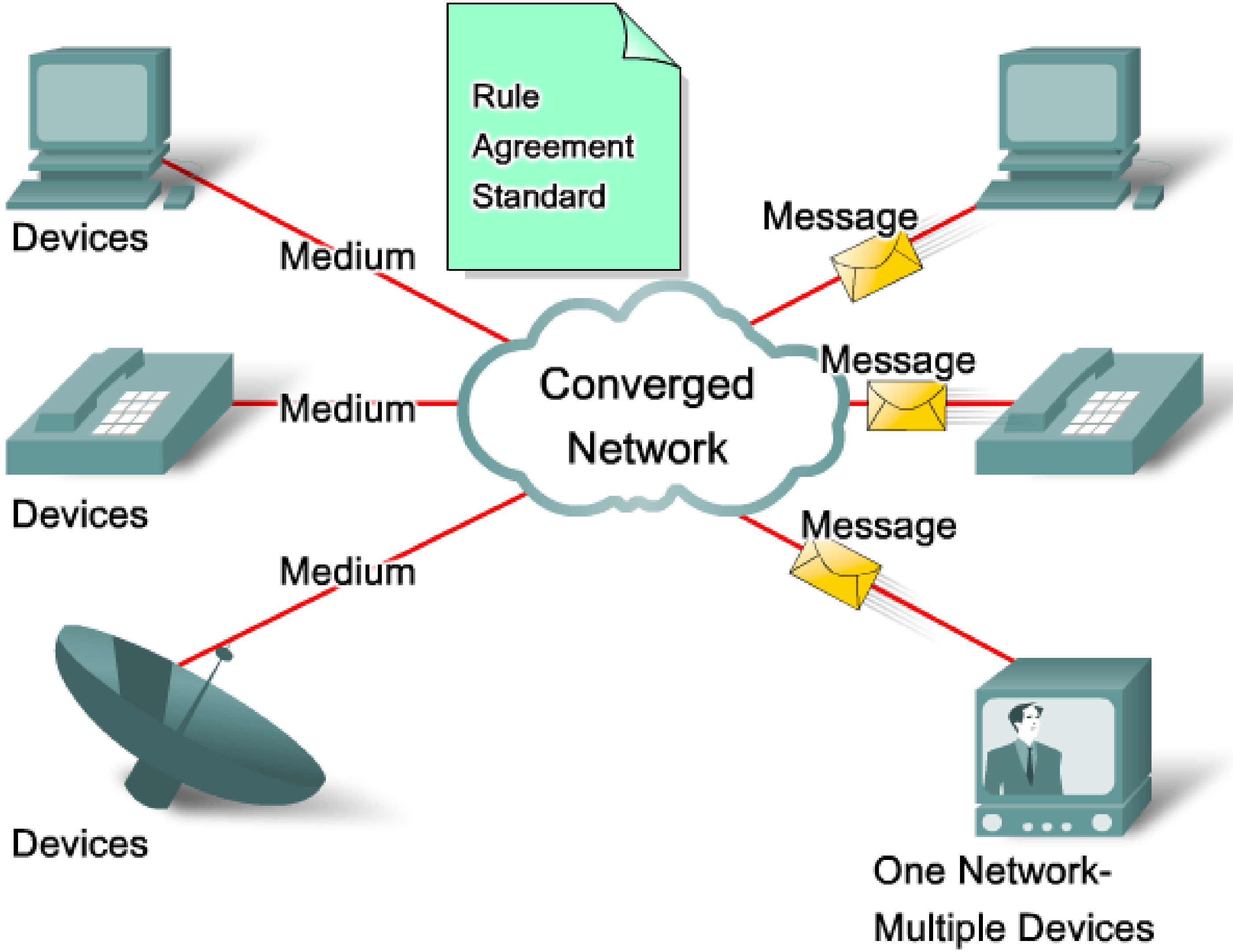
1.3.2 Elements of a Network

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)

1.3.2 Elements of a Network

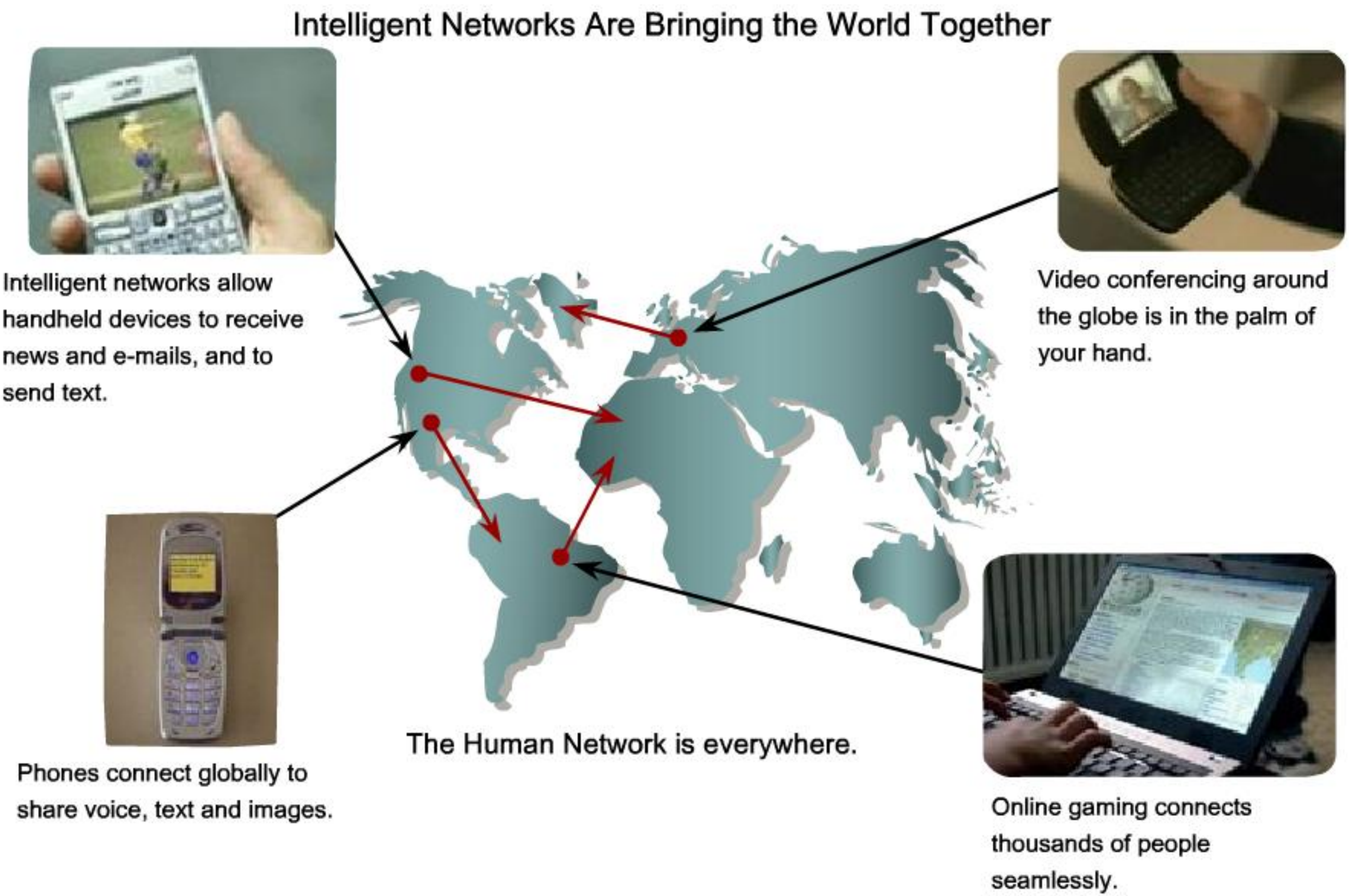


1.3.3 Converged Networks

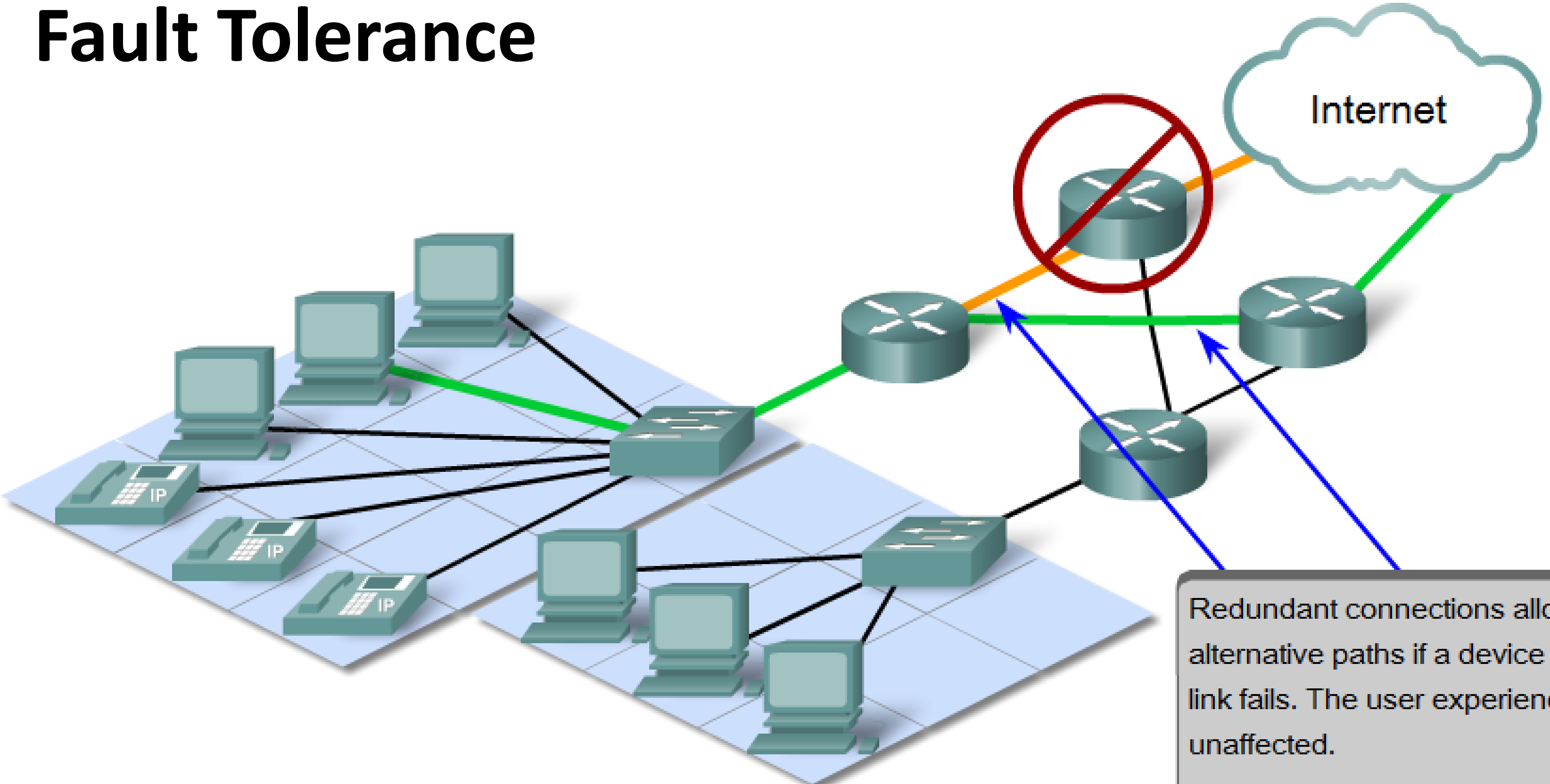


Converged data networks carry multiple services on one network.

1.3.3 Converged Networks



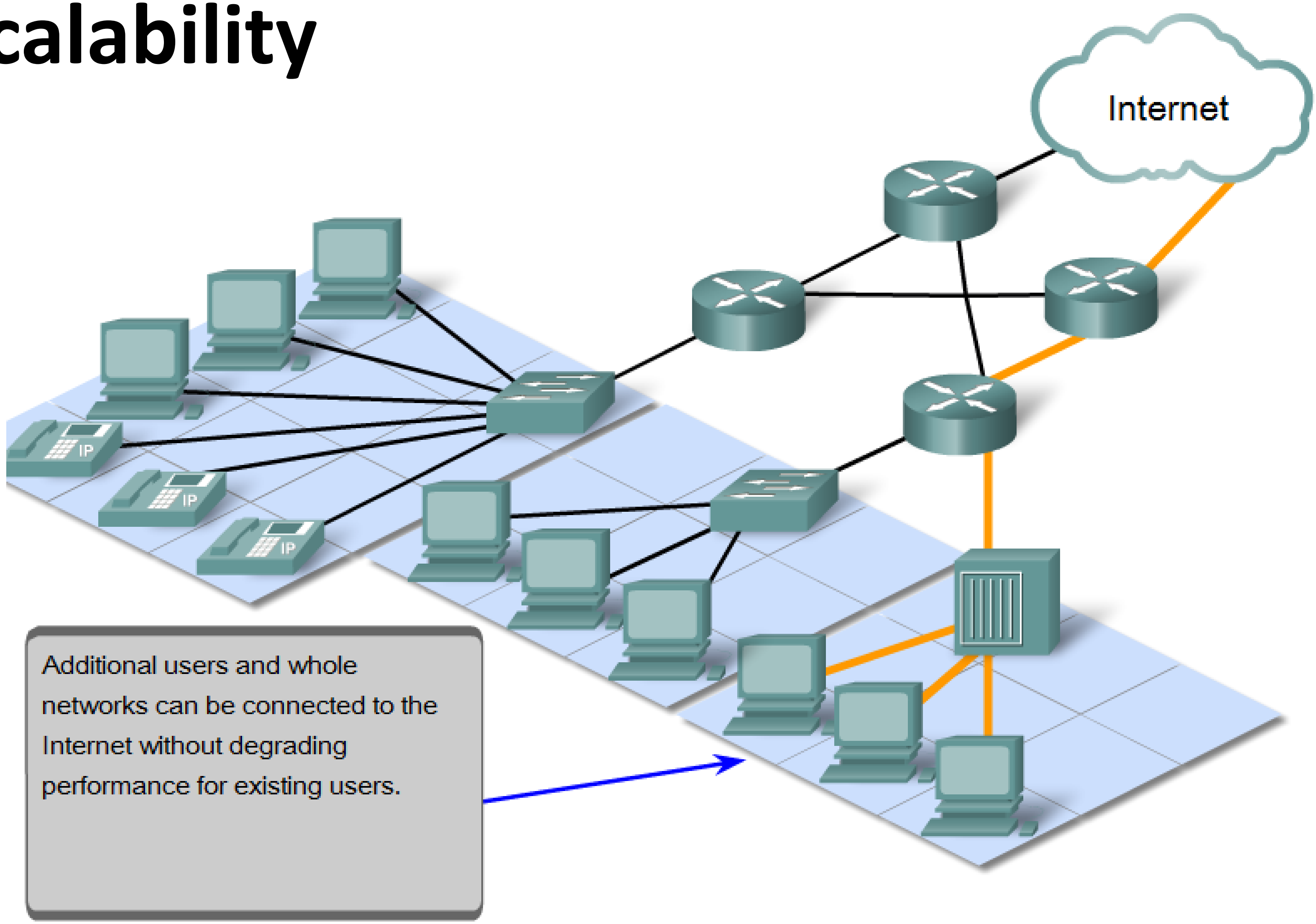
Fault Tolerance



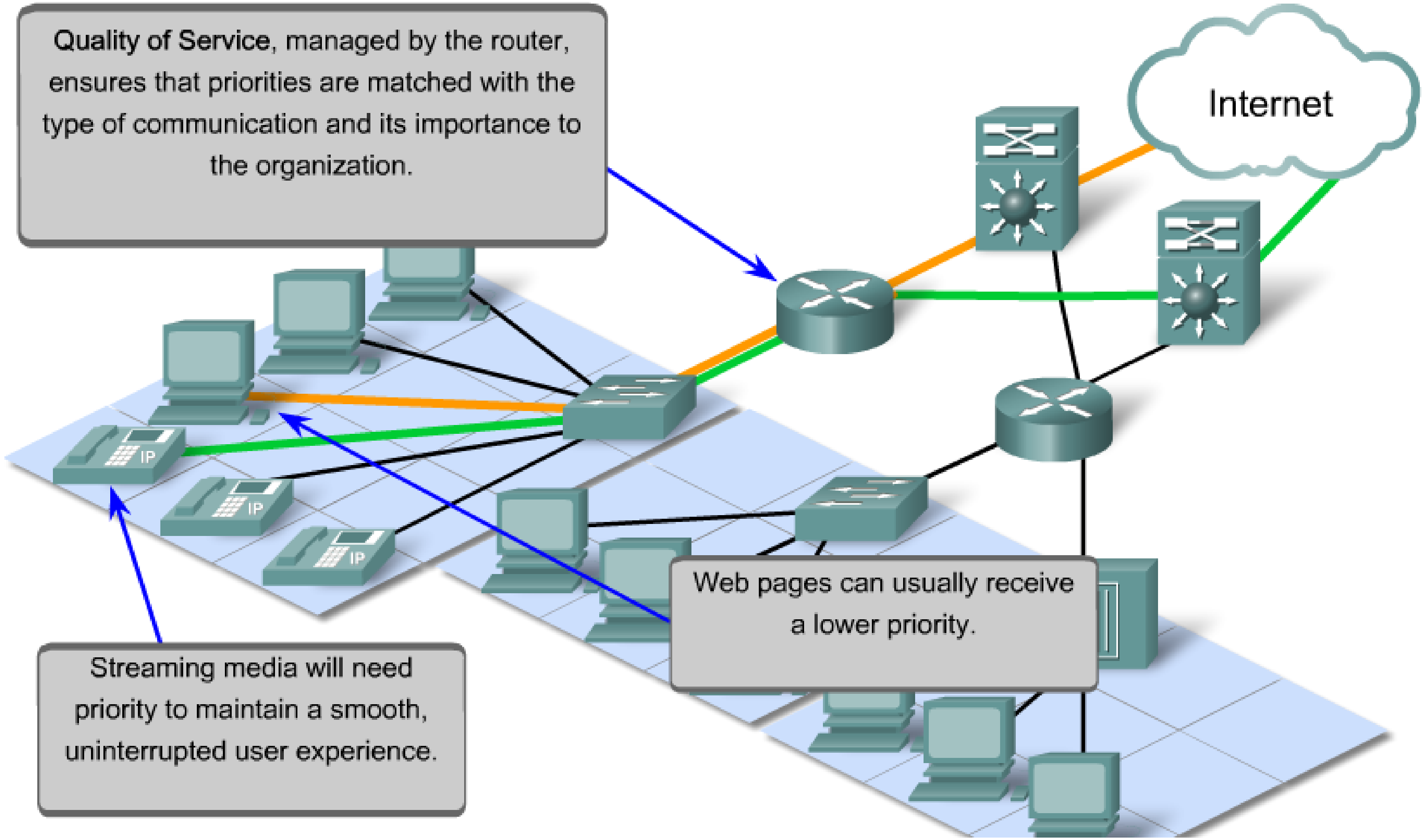
Redundant connections allow for alternative paths if a device or a link fails. The user experience is unaffected.

1.4.1 Network Architecture

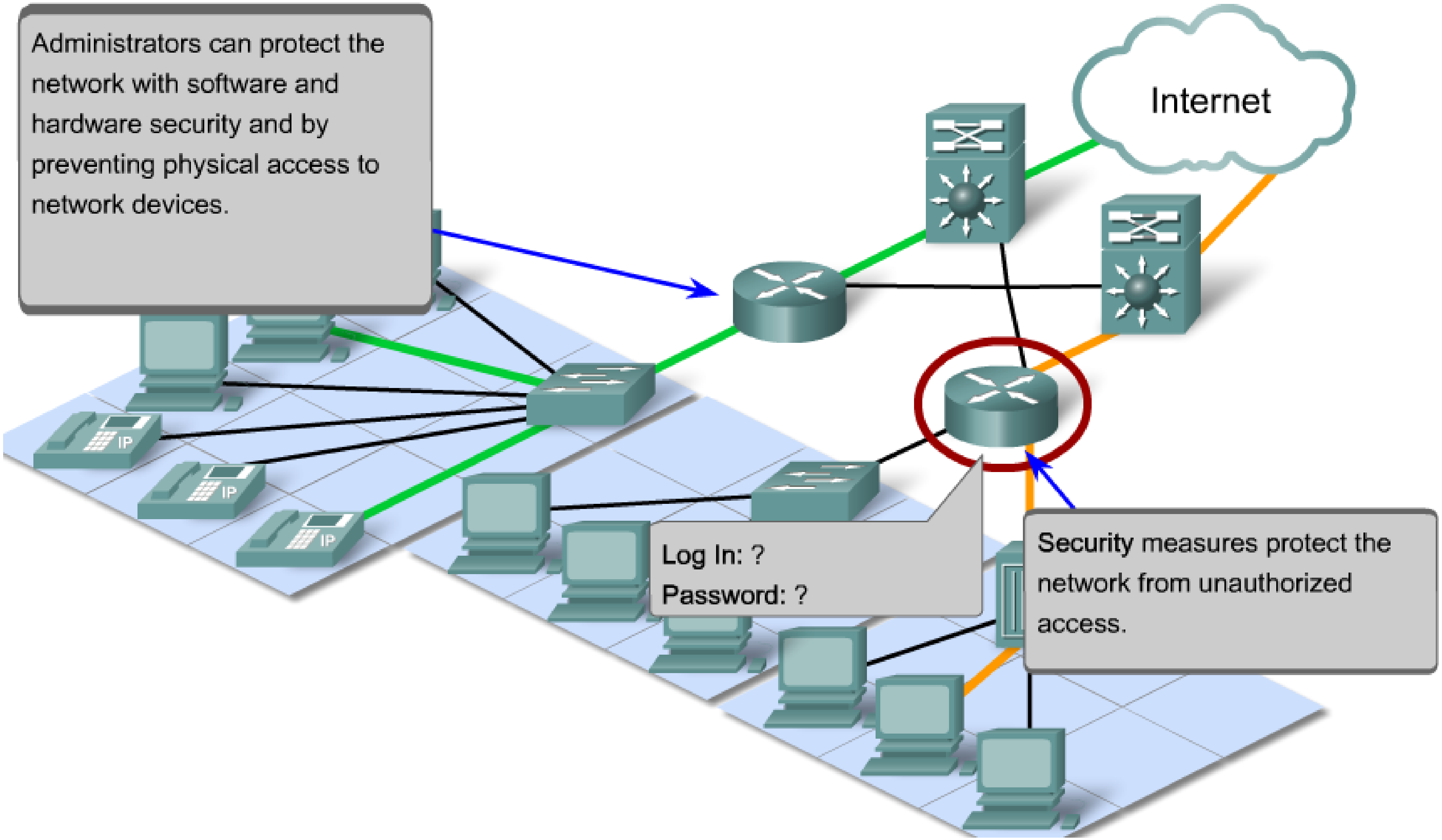
Scalability



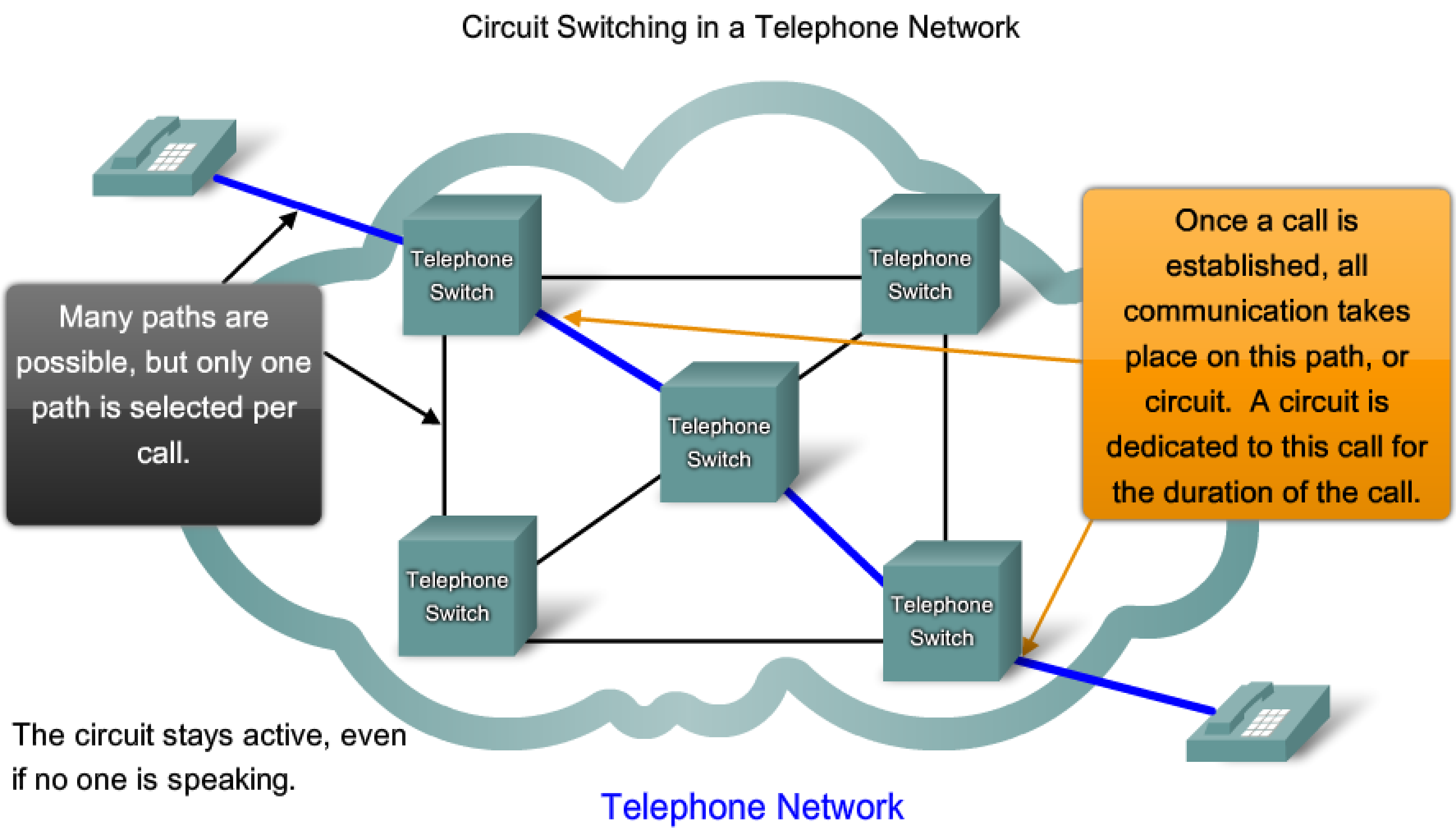
1.4.1 Network Architecture



1.4.1 Network Architecture

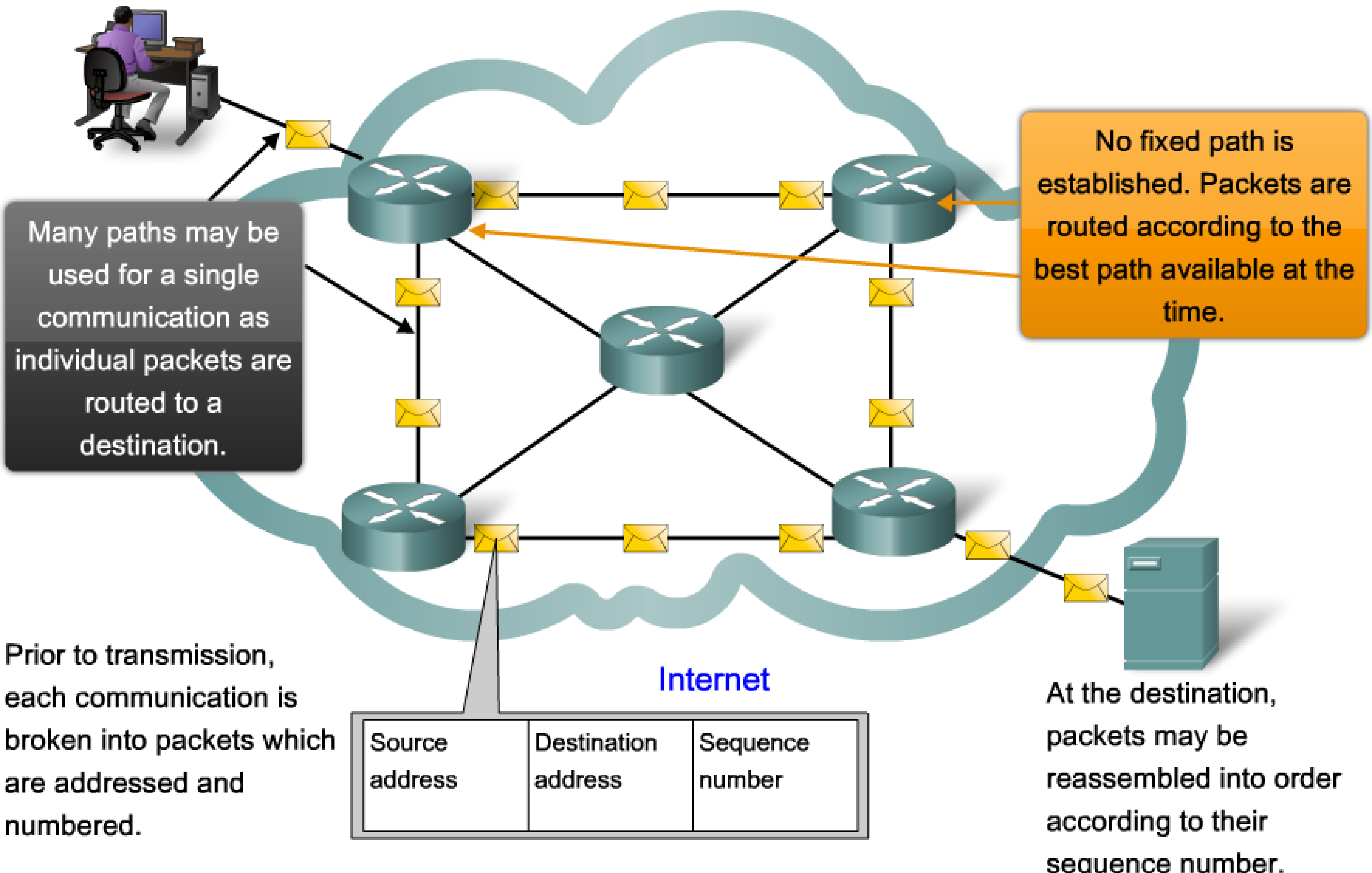


1.4.2 Fault Tolerant Network Architecture



1.4.2 Fault Tolerant Network Architecture

Packet Switching in a Data Network



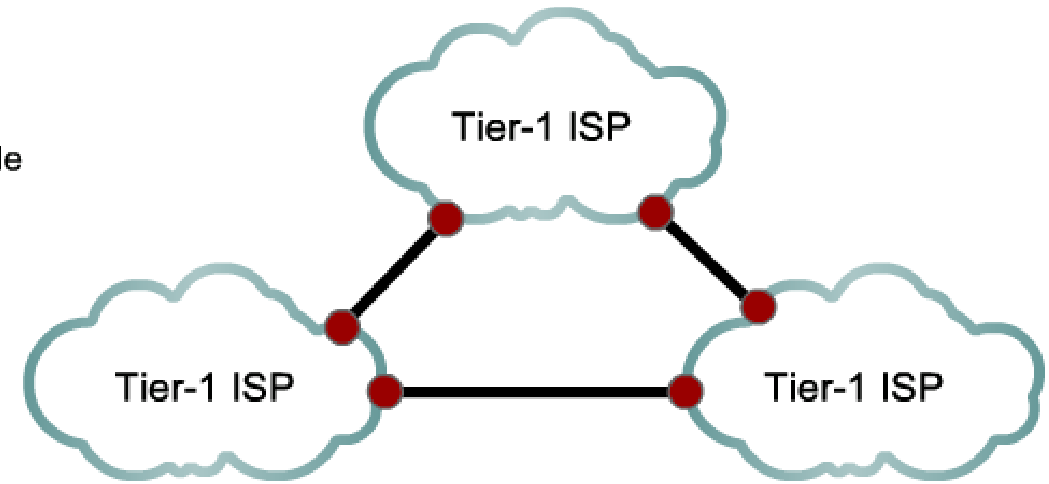
During peak periods, communication may be delayed, but not denied.

1.4.3 Scalable Network Architecture

Internet Structure - A Network of Networks

At the center of the Internet, “tier-1” ISPs provide national and international connections. These ISPs treat each other as equals.

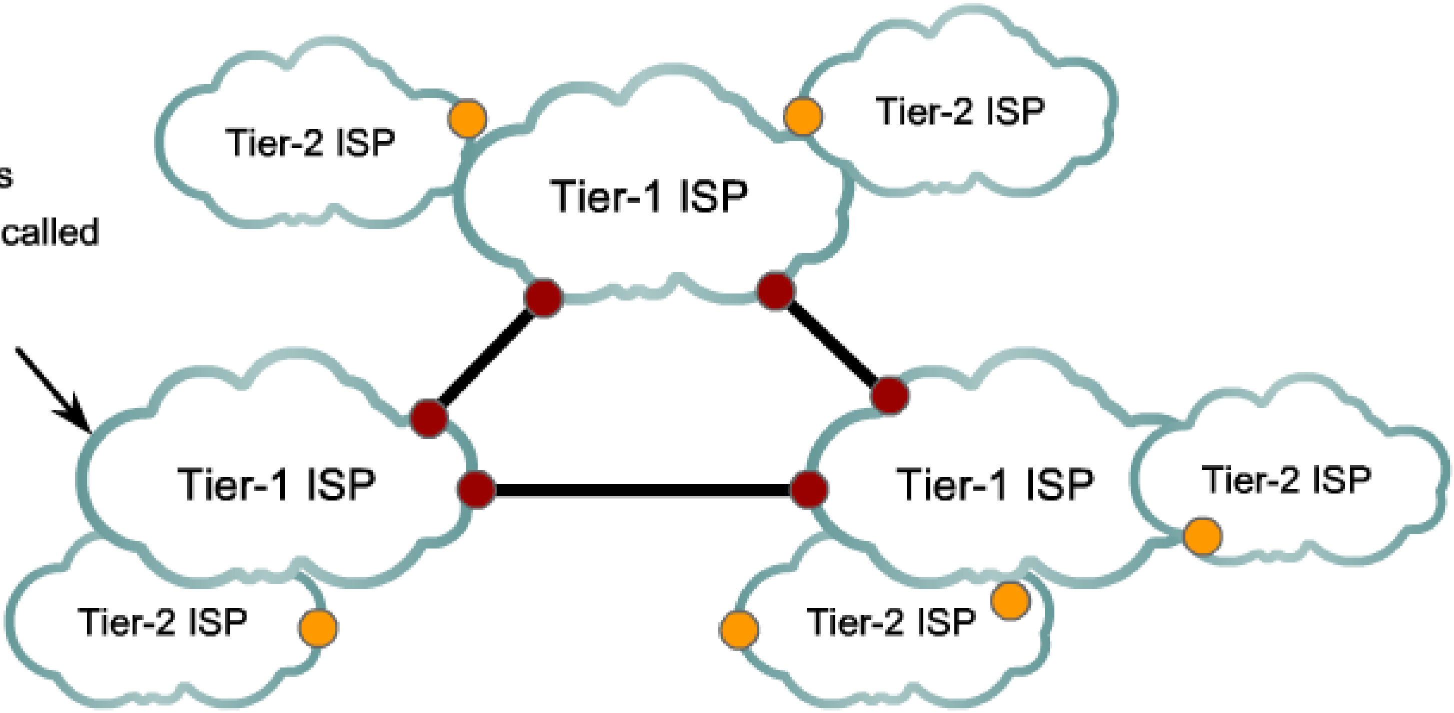
Examples are: Verizon, Sprint, AT&T, NTT, cable systems and wide area wireless networks.



This is the “backbone” of the Internet.

1.4.3 Scalable Network Architecture

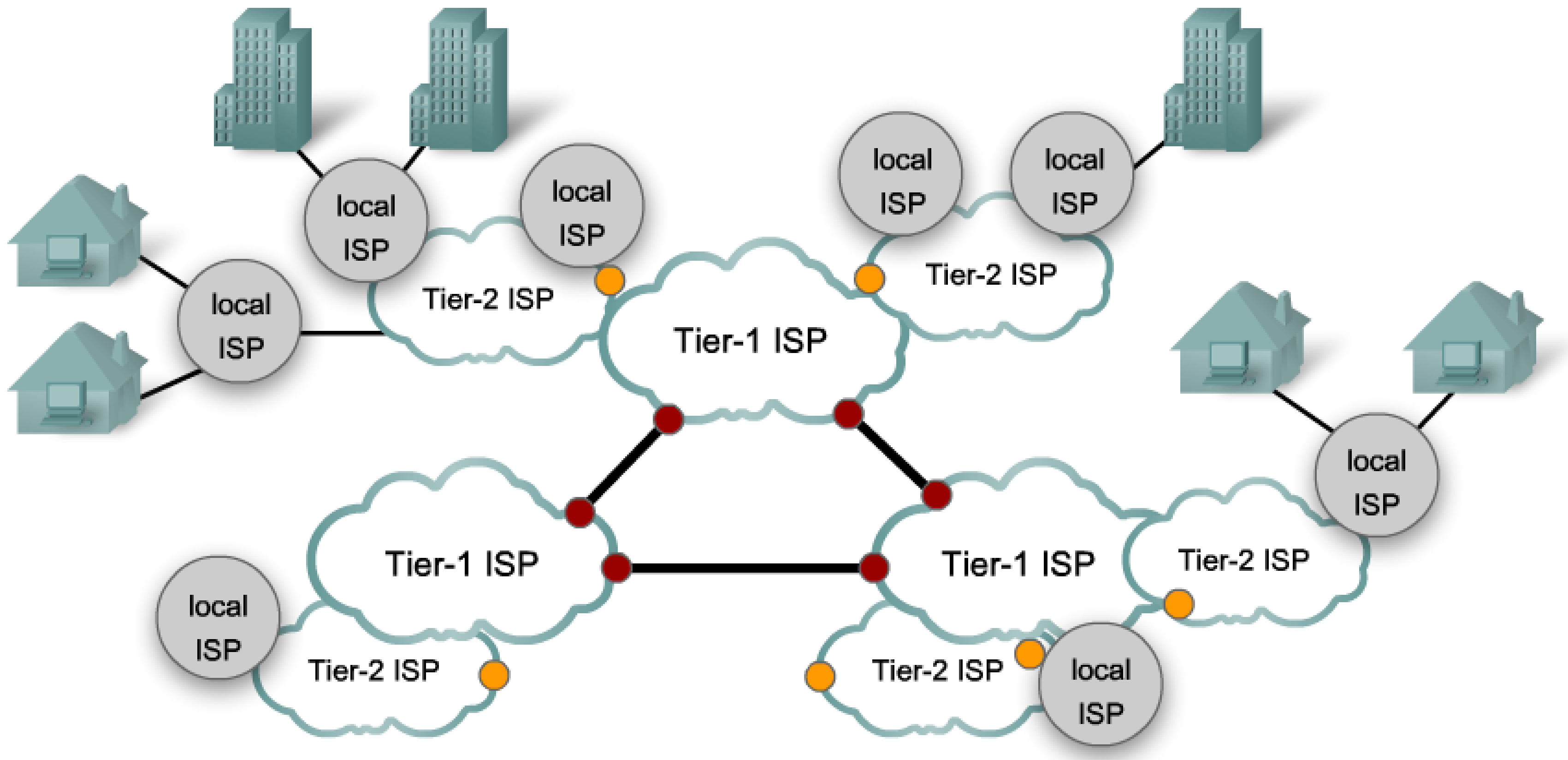
The point where ISPs interconnect is often called a "border."



1.4.3 Scalable Network Architecture

Internet Structure - A Network of Networks

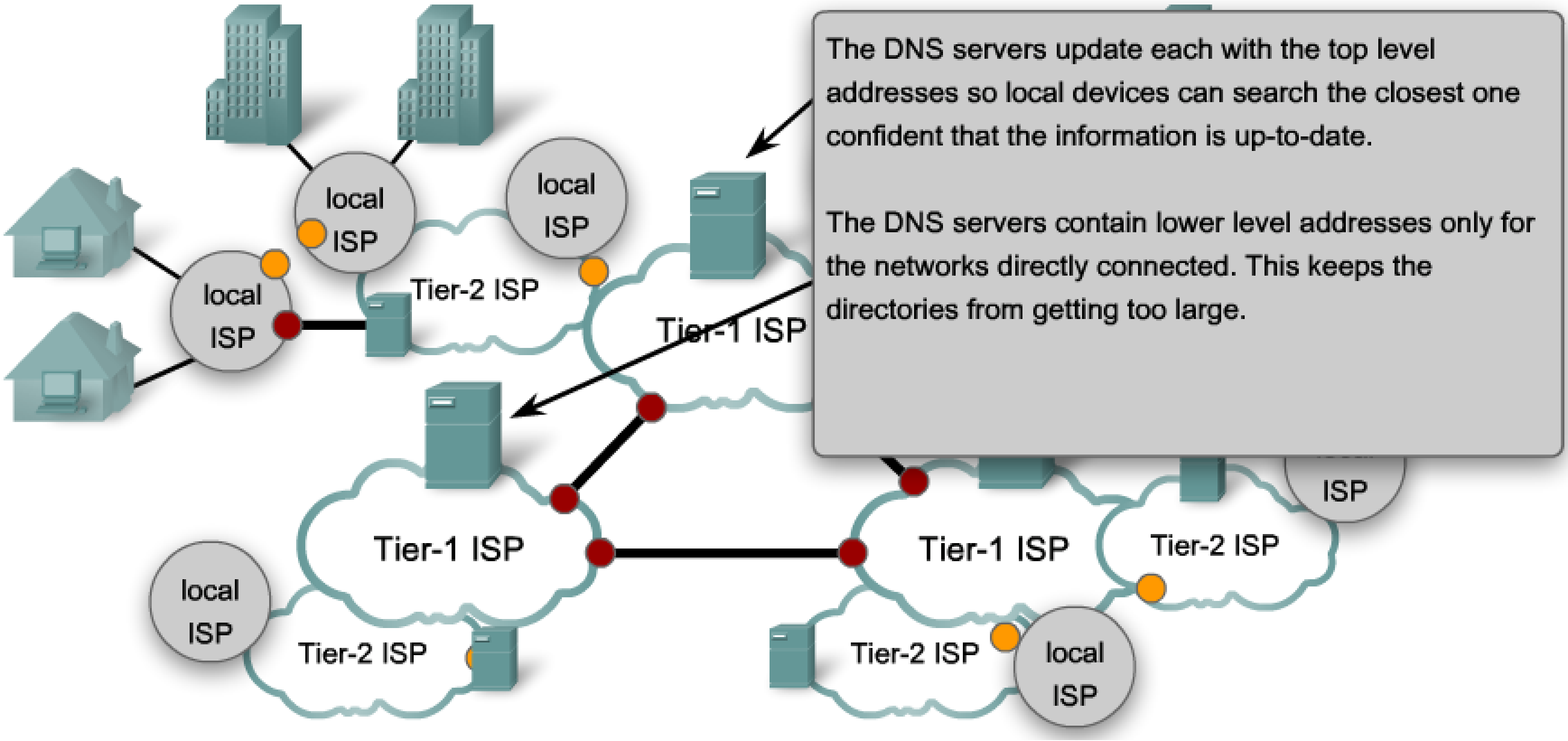
"Tier-3" ISPs are the local providers of service directly to end users. Tier-3 ISPs are usually connected to Tier 2 ISPs and pay Tier 2 providers for Internet access.



1.4.3 Scalable Network Architecture

Internet Structure - A Network of Networks

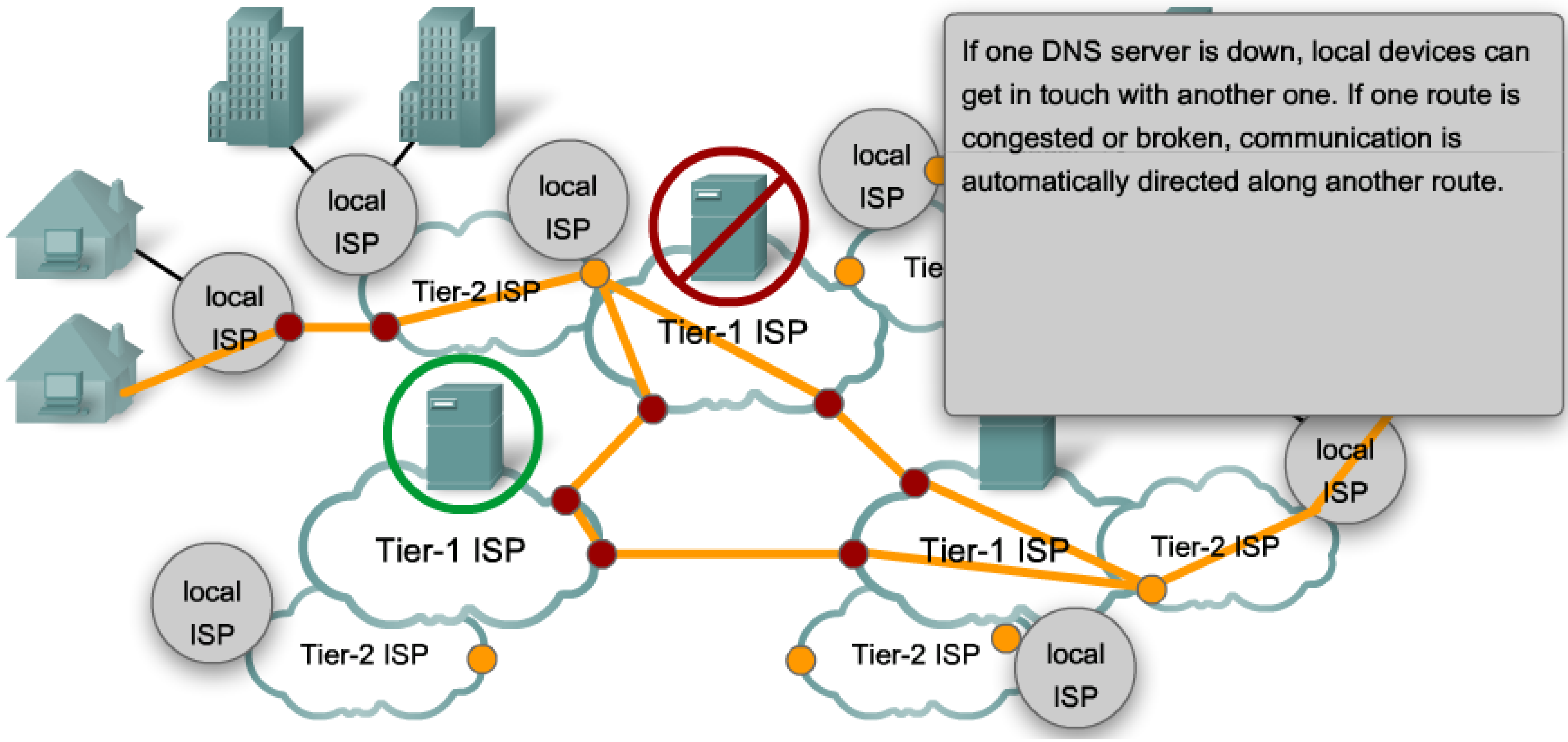
The Domain Name System (DNS) provides a hierarchical directory of addresses--one server doesn't have to hold the entire list of millions of addresses.



1.4.3 Scalable Network Architecture

Internet Structure - A Network of Networks

The distributed nature of connections and directories means that communication can bypass bottlenecks and outages. Originally designed to protect against military attack, the system has also proved the best way to offer a scalable, reliable civilian network.



1.4.4 Providing Quality of Service

Converged Networks

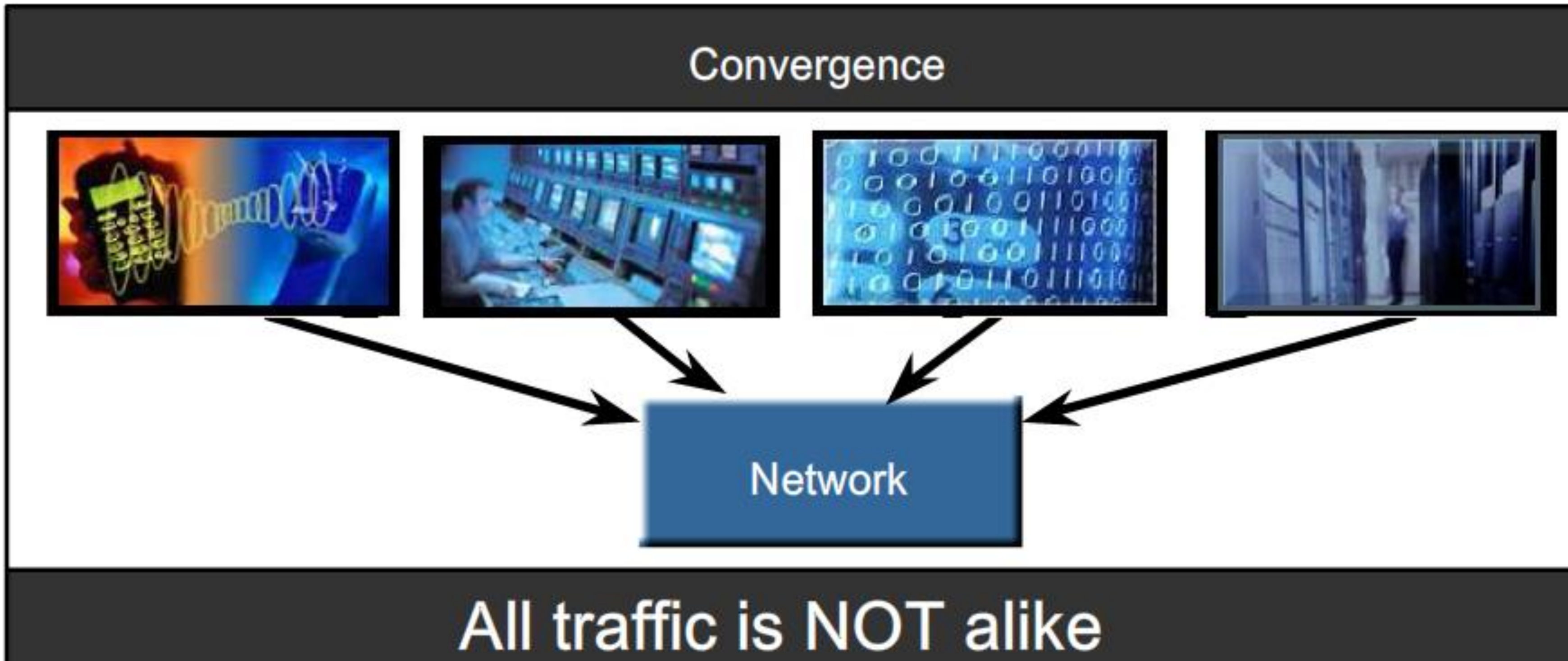
Real-time traffic
- Voice over IP (VoIP)
- Videoconferencing

Transactional traffic
- Order processing & billing
- Inventory & reporting
- Accounting & reporting

Streaming traffic
- Video on Demand (VoD)
- Movies

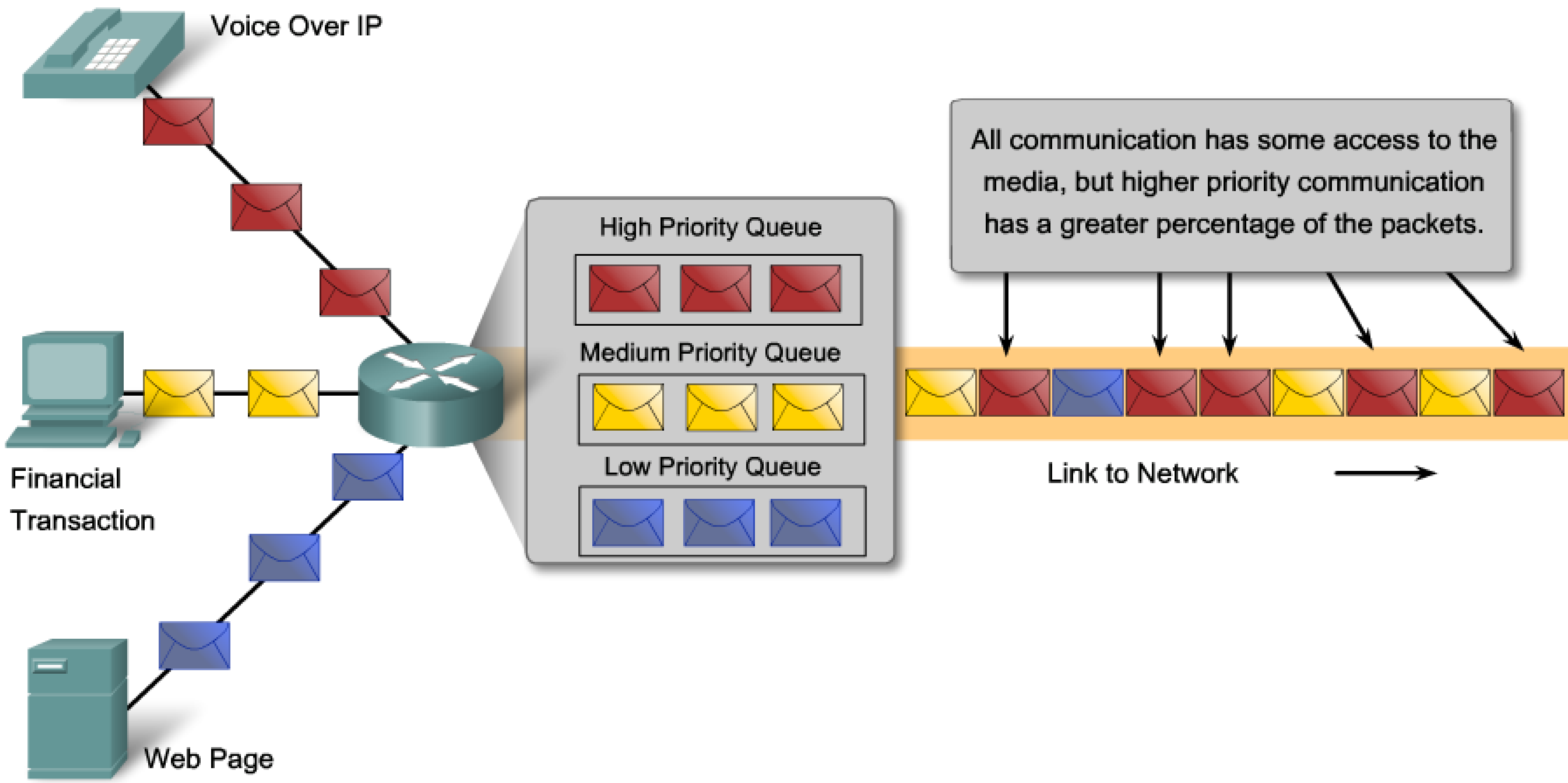
Web content
- Browsing
- Shopping

Bulk traffic
- E-mail
- Data backups
- Print files



1.4.4 Providing Quality of Service

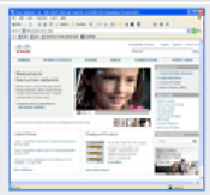
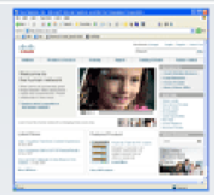
Using Queues to Prioritize Communication



Queuing according to data type enables voice data to have priority over transaction data, which has priority over web data.

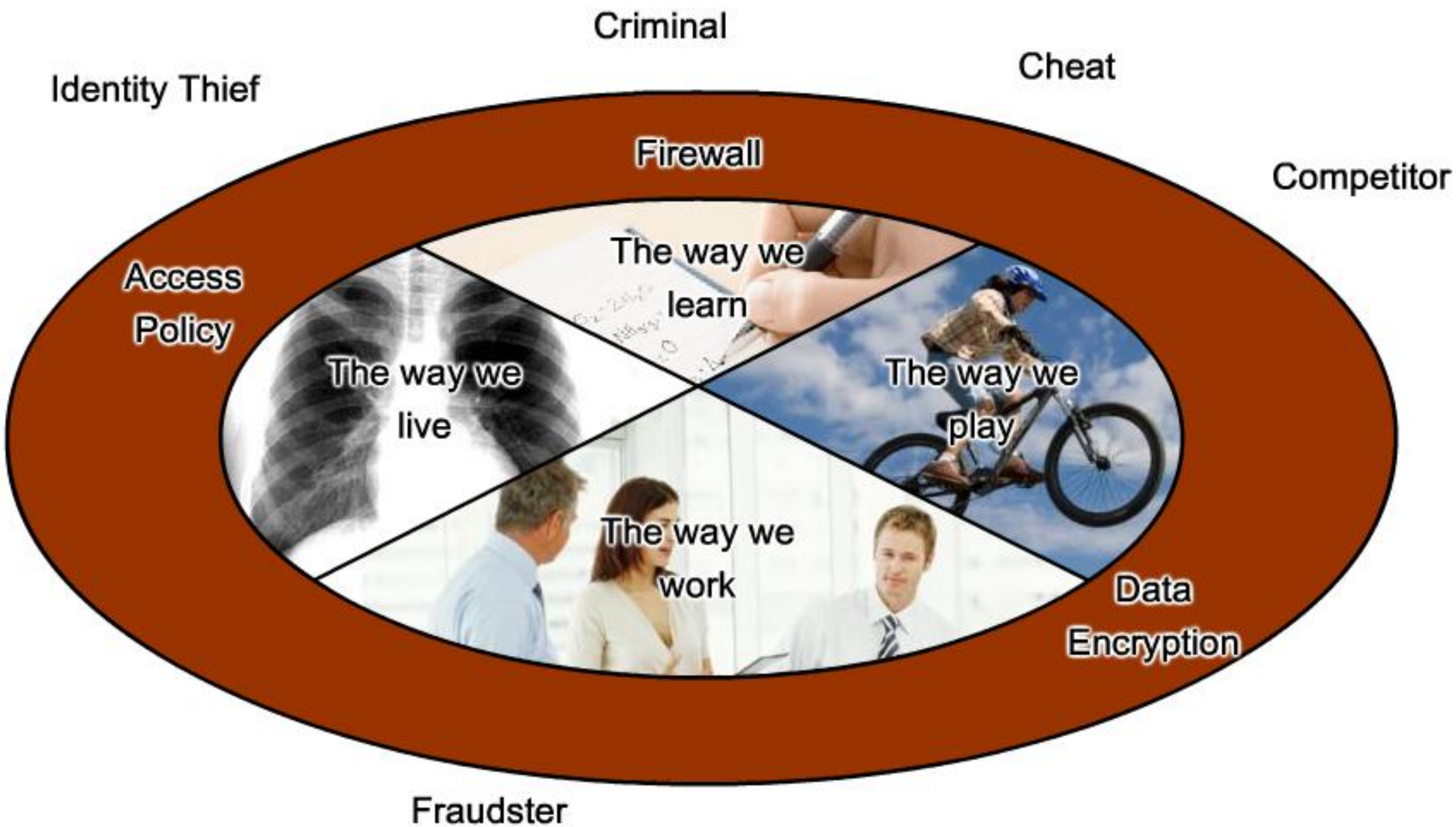
1.4.4 Providing Quality of Service

Quality of Service Matters

Communication Type	Without QoS	With QoS
Streaming video or audio	 Choppy picture starts and stops.	 Clear, continuous service.
Vital Transactions	Time : Price 02:14:05 $1.54 Just one second earlier...	Time : Price 02:14:04 $1.52 The price may be better.
Downloading web pages (often lower priority)	 Web pages arrive a bit later...	 But the end result is identical.

QoS mechanisms enable the establishment of queue management strategies that enforce priorities for different classifications of application data. Without properly designed and implemented QoS mechanisms, data packets will be dropped without consideration of the application characteristics or priority.

1.4.5 Providing Network Security



The communication and information that we would like to be private is protected from those who would make unauthorized use of it.

1.4.5 Providing Network Security

Top Ten Cyber Security Menaces for 2008

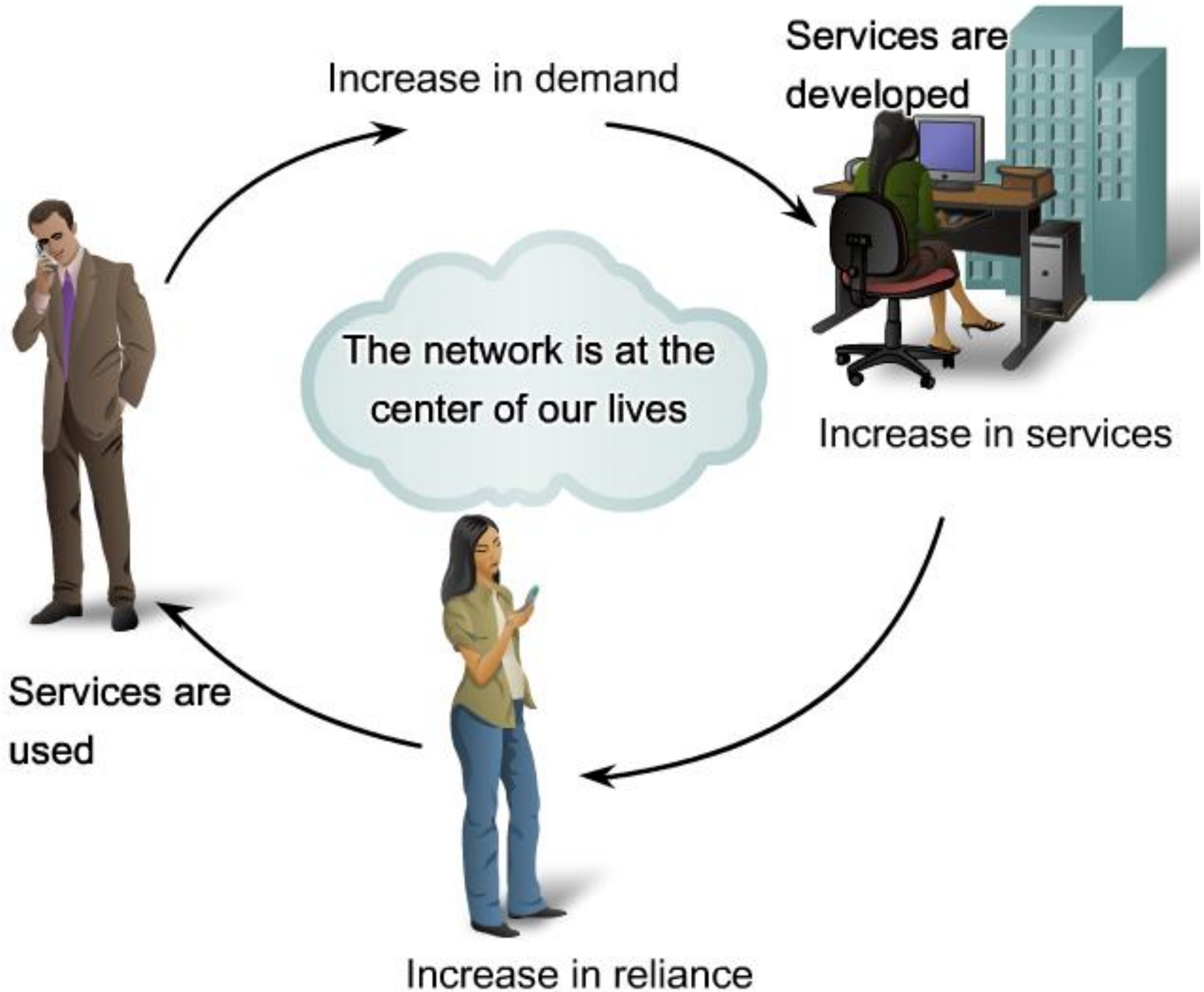
Twelve cyber security veterans, with significant knowledge about emerging attack patterns, worked together to compile a list of the attacks most likely to cause substantial damage during 2008.

Participants included Stephen Northcutt, Ed Skoudis, Marc Sachs, Johannes Ullrich, Tom Liston, Eric Cole, Eugene Schultz, Rohit Dhamankar, Amit Yoran, Howard Schmidt, Will Pelgrin, and Alan Paller.

Here's their consensus list in ranked order:

1. **Increasingly Sophisticated Web Site Attacks That Exploit Browser Vulnerabilities - Especially On Trusted Web Sites**
   Web site attacks on browsers are increasingly targeting components, such as Flash and QuickTime, that are not automatically patched when the browser is patched. At the same time, web site attacks have migrated from simple ones based one or two exploits posted on a web site to more sophisticated attacks based on scripts that cycle through multiple exploits to even more sophisticated attacks that increasingly utilize packaged modules that can effectively disguise their payloads. One of the latest such modules, mpack, produces a claimed 10-25% success rate in exploiting browsers that visit sites infected with the module. While all this is happening, attackers are actively placing exploit code on popular, trusted web sites where users have an expectation of effective security. Placing better attack tools on trusted sites is giving attackers a huge advantage over the unwary public.

1.5.1 Where is it all going?



Mobile users will rely increasingly on data networks and use a variety of devices.

1.5.2 Network Careers

A broad range of careers will use networking skills and knowledge.

1.6.1 Using Collaboration Tools

Hands-on Lab:

Using Collaboration Tools - IRC and IM

1.6.2 Using Collaboration Tools

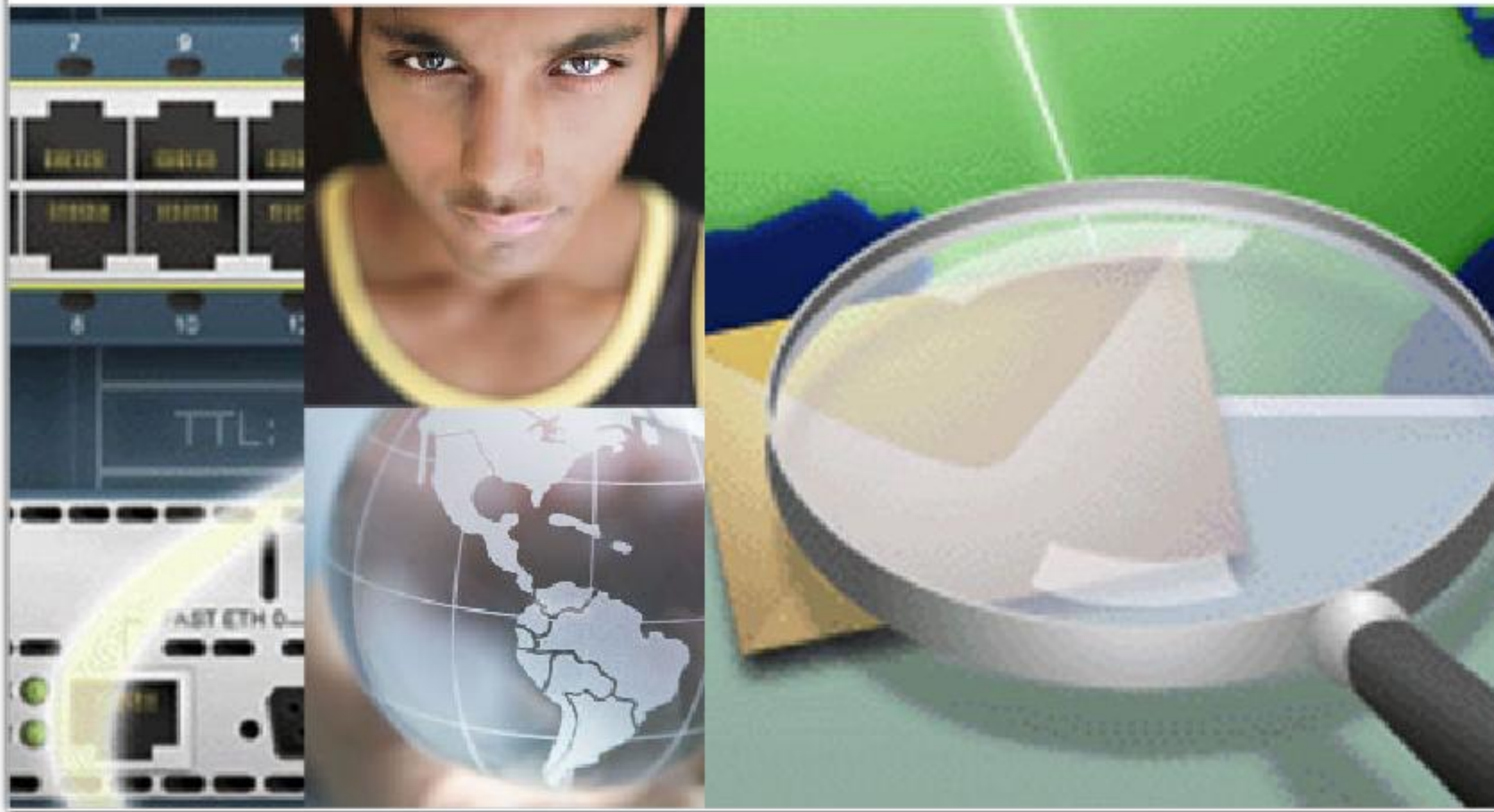
In this lab, you will define the terms wiki and blog. You will also explain the purpose of a wiki and blog and how these technologies are used for collaboration.

1.7.1 Summary

In this chapter, you learned to:

- Describe how networks impact our daily lives.
- Describe the role of data networking in the human network.
- Identify the key components of any data network.
- Identify the opportunities and challenges posed by converged networks.
- Describe the characteristics of network architectures: fault tolerance, scalability, quality of service and security.
- Install and use IRC clients and a Wiki server.

Skills Integration Challenge:
Introduction to Packet Tracer



Base 10 Numbering System

Place Value	___ ___ ___ ___ 1000 100 10 1
$Base^{Exponent}$	$10^3 = 1000$ $10^2 = 100$ $10^1 = 10$ $10^0 = 1$
Number of Symbols	10
Symbols	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Rationale	Typical number of fingers equals ten

Base 2 Numbering System

Place Value	128 64 32 16 8 4 2 1
Base^{Exponent}	$2^7 = 128$ $2^3 = 8$ $2^6 = 64$ $2^2 = 4$ $2^5 = 32$ $2^1 = 2$ $2^4 = 16$ $2^0 = 1$
Number of Symbols	2
Symbols	0, 1
Rationale	Two-state (discrete binary) voltage systems made from transistors can be diverse, powerful, inexpensive, tiny and relatively immune to noise.

ASCII Code

Keyboard	Binary Codes
A	01000001
B	01000010
C	01000011
D	01000100
E	01000101
F	01000110
G	01000111
H	01001000

128	64	32	16	8	4	2	1

The Letter A

0	1	0	0	0	0	0	1

Binary to Decimal Conversion

128	64	32	16	8	4	2	1

1	1	0	0	0	0	0	0

1	0	0	1	1	0	0	1

1	1	1	1	1	1	1	1

Decimal to Binary Conversion

128	64	32	16	8	4	2	1

Number	Divide	Result	Remainder
192	**/ 2 =**	96	0
96	**/ 2 =**	48	0
48	**/ 2 =**	24	0
24	**/ 2 =**	12	0
12	**/ 2 =**	6	0
6	**/ 2 =**	3	0
3	**/ 2 =**	1	1
1	**/ 2 =**	0	1

Decimal - Binary - Hexadecimal Table

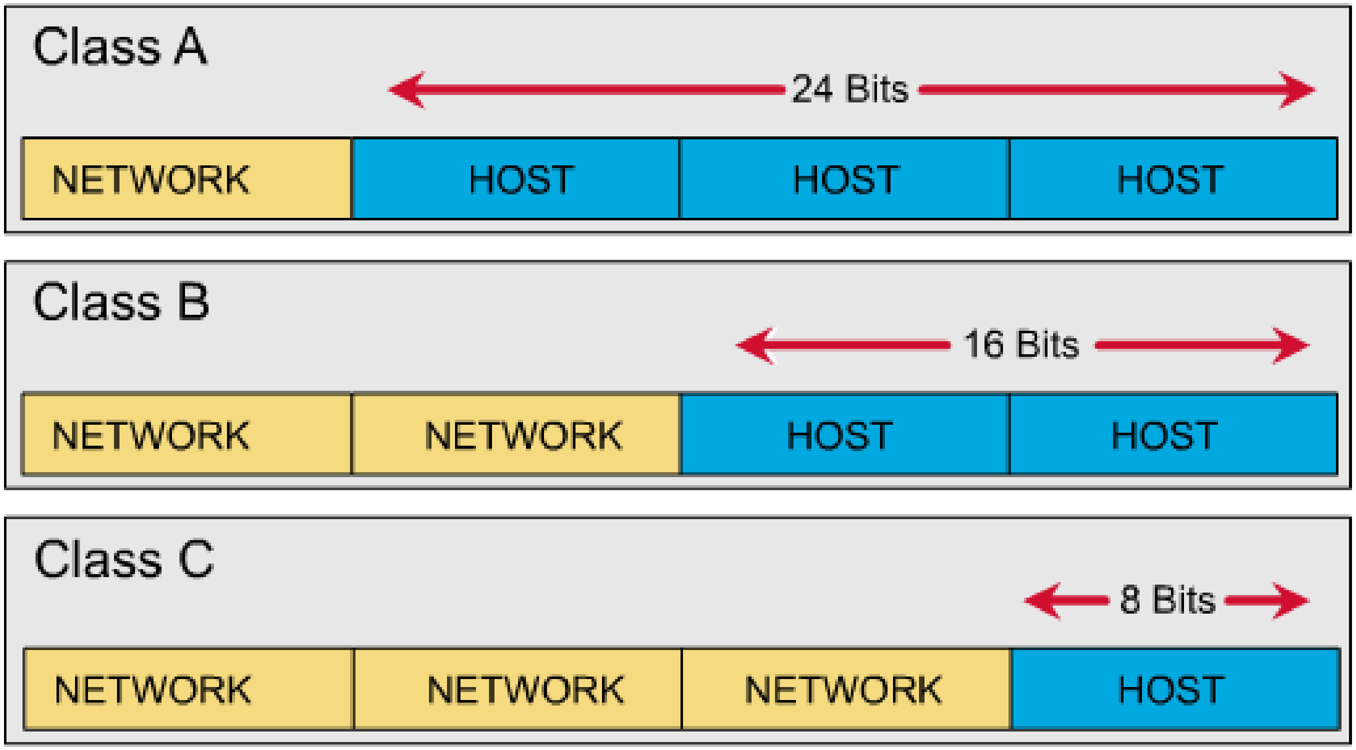
Decimal	Binary	Hexadecimal
0	00000000	00
1	00000001	01
2	00000010	02
3	00000011	03
4	00000100	04
5	00000101	05
6	00000110	06
7	00000111	07
8	00001000	08
9	00001001	09
10	00001010	0A
11	00001011	0B
12	00001100	0C
13	00001101	0D
14	00001110	0E
15	00001111	0F
16	00010000	10
32	00100000	20
64	01000000	40
128	10000000	80
255	11111111	FF

Dotted Decimal Notation

Binary	11001000		01110010		00000110		00110011
Decimal	200	.	114	.	6	.	51
	number	dot	number	dot	number	dot	number

IP Address Classes

IP Address Classes



Class "C" is the final commercial class of addresses. With eight bits for the host address, only two hundred fifty four hosts are allowed. Most smaller organizations use a class "C" or several class "C" addresses. As you'll see later, two addresses are always reserved: one for the network, and one for the broadcast address.

Address Classes

Cls	1st Octet Decimal Range	1st Octet High Order Bits	Network / Host ID (N=Network, H=Host)	Default Subnet Mask	Number of Networks	Hosts per Network (usable addresses)
A	1 – 126*	0	N.H.H.H	255.0.0.0	126 ($2^7 - 2$)	16,777,214 ($2^{24} - 2$)
B	128 – 191	1 0	N.N.H.H	255.255.0.0	16,382 ($2^{14} - 2$)	65,534 ($2^{16} - 2$)
C	192 – 223	1 1 0	N.N.N.H	255.255.255.0	2,097,150 ($2^{21} - 2$)	254 ($2^8 - 2$)
D	224 – 239	1 1 1 0	Reserved for Multicasting			
E	240 – 254	1 1 1 1 0	Experimental, used for research			

IP First Octet Address Ranges

High Order Bits	Octet in Decimal	Address Class
0	0 - 127	A
10	128 - 191	B
110	192 - 223	C