



Chapter 1

Living in a Network-Centric World

Communicating in a Network-Centric World



Global Access



- The globalization of the Internet has succeeded faster than anyone could have imagined.
- The manner in which social, commercial, political and personal interactions occur is rapidly changing to keep up with the evolution of this global network.

Networks – Behind the Scenes

- Networks are more than just connecting cables.
- They are a complex and sophisticated combination of protocols, software and hardware.

- Security and Privacy
- 24 x 7 availability
- Quality of Service
- Video on Demand
- Voice over IP
- Redundancy and backup
- Mission critical applications and user expectations
- Wireless

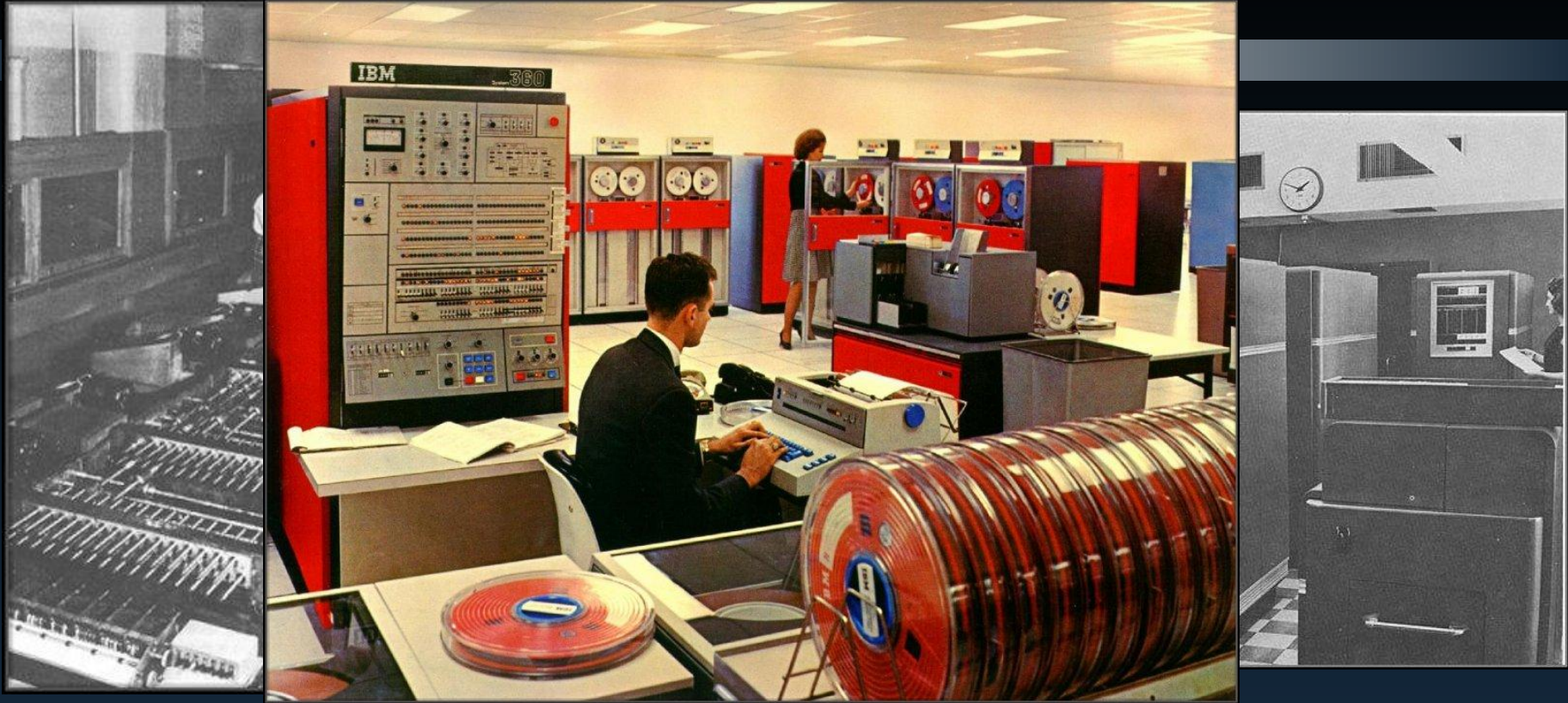


Networks – The Early Days



- Early communication relied on face-to-face conversations.
- The telephone was used for voice and the post office delivered most of the written communications.
- Video communication was one-way using the television.

Networks – The Early Days



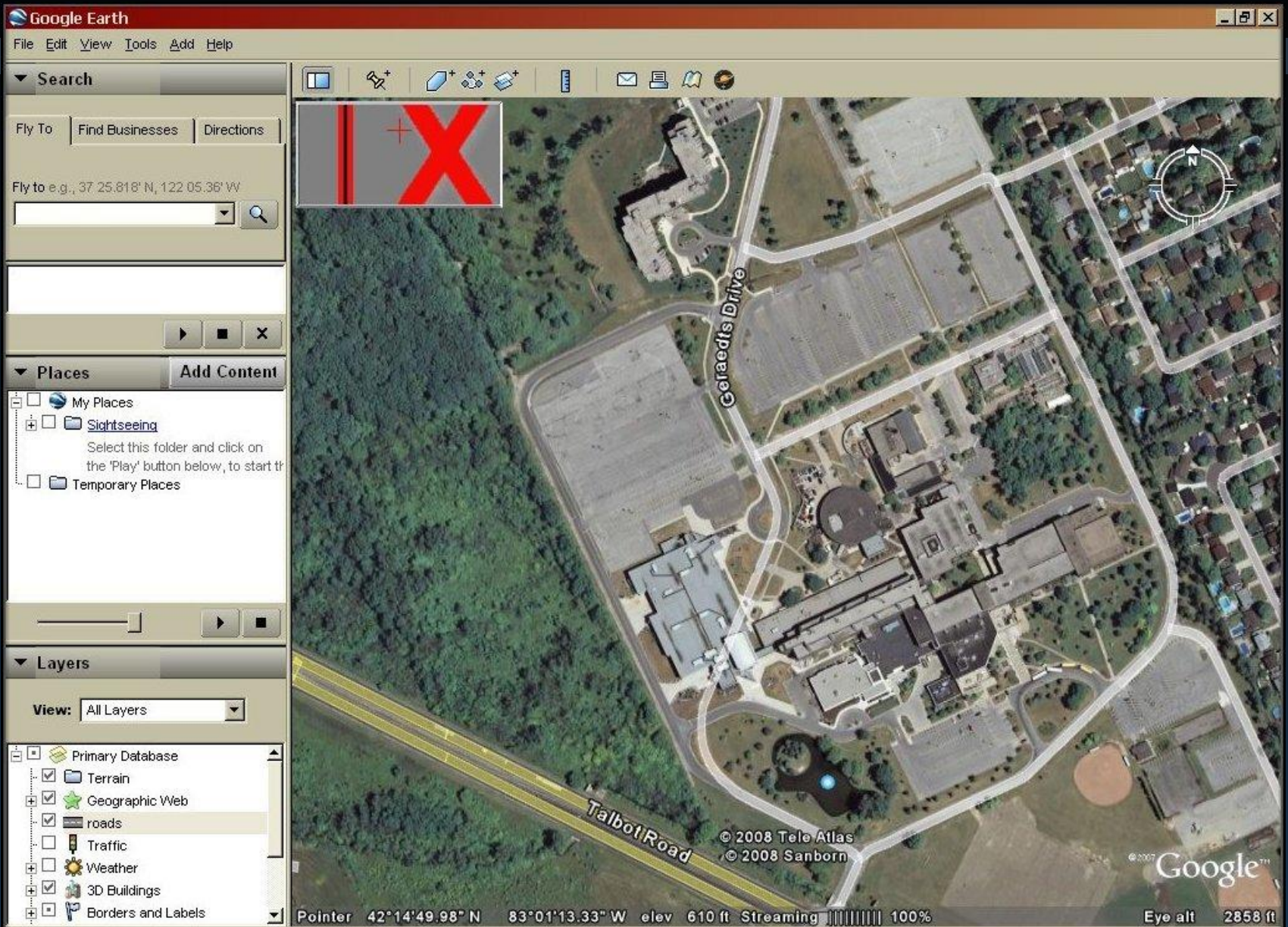
- Early networks were limited to character based information.
- Communications between computers was not easy and required a host (no pun intended) of resources to accomplish the simplest data transfer.



Wind Energy Cell Phone Charger

- Today's many types of devices - **SIMULTANEOUSLY**.
 - Voice, Video, Audio, Text, graphics

Networks – Today – A Global Community



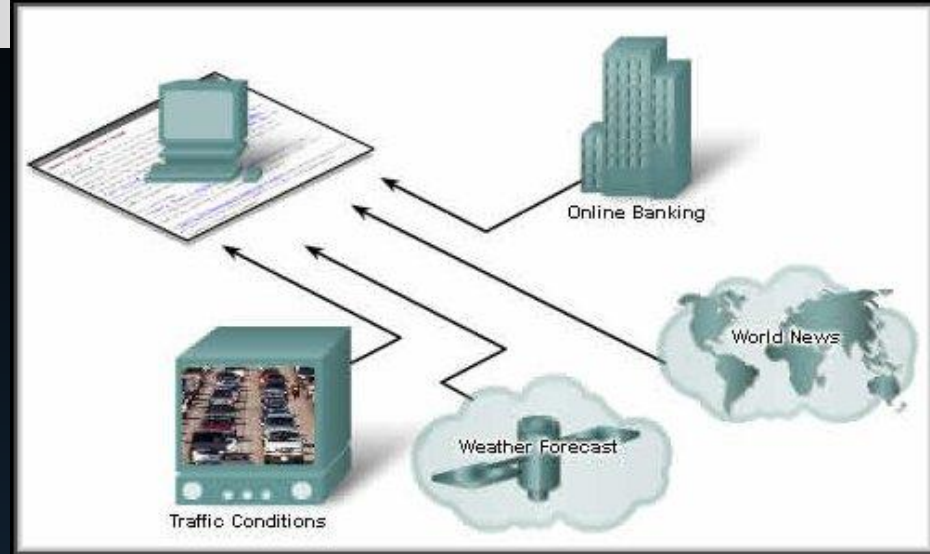
Networks Supporting The Way We Live



- The Internet has quickly become an integral part of our daily routines.
- Data networks that were once only used to transport business information are now used to improve our quality of life no matter where we live.

Networks Supporting The Way We Live

- In the course of the day, Internet resources can help you.
- **IM** - Instant Messaging:
 - Internet Relay Chat (IRC)
- **Blogs** (Weblogs):
 - Personal opinions on any conceivable subject.
- **Podcasting**:
Sharing recordings with a wide audience (Apple iPods)
- **Wikis**:
 - A collaboration tool. Gives people the opportunity to work together on shared documents.



Networks Supporting The Way We Learn

- E-Learning



Networks Supporting The Way We Learn

- Online discussions and access to resources.

The screenshot shows a Blackboard Learning System interface. The main content area is titled "1.1.1 Networks Supporting the Way We Live" and contains several paragraphs of text. The first paragraph discusses the need to interact with others. The second paragraph discusses the evolution of communication methods. The third paragraph discusses the impact of communication technology. The fourth paragraph discusses early data networks. A large graphic of a globe with people and network lines is positioned to the right of the text. The interface includes a navigation menu on the left, a search bar on the right, and a footer with copyright information.

1 Living in a Network-Centric World
1.1 Communicating in a Network-Centric World
1.1.1 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. 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.

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.

CCNA Exploration
Network Fundamentals

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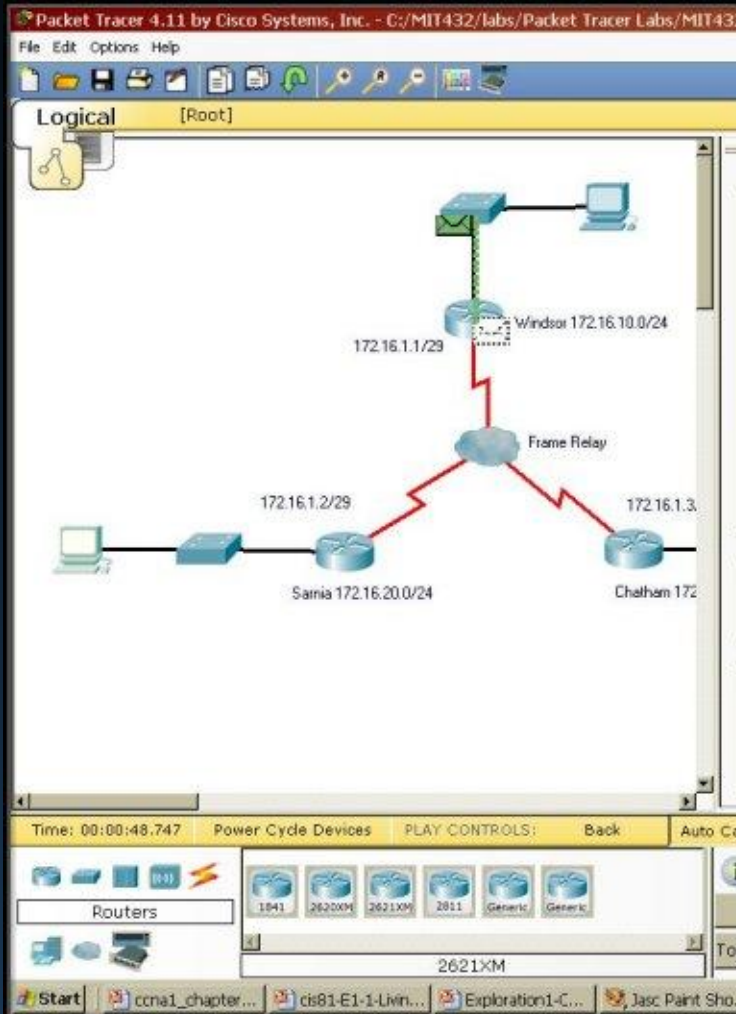
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Looking up ...

Start ccna1_chapter... cis81-E1-1-Livin... Exploration1-C... Jasc Paint Sho... Exploration Ind... file:// - Mozill... 7:59 AM

Networks Supporting The Way We Learn

- Tools - Packet Tracer



PDU Information at Device: Windsor

OSI Model | Inbound PDU Details | Outbound PDU Details

At Device: Windsor
Source: Sarnia PC
Destination: 172.16.10.2

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer 3: IP Header Src. IP: 172.16.20.2, Dest. IP: 172.16.10.2 ICMP Message Type: 8	Layer 3: IP Header Src. IP: 172.16.20.2, Dest. IP: 172.16.10.2 ICMP Message Type: 8
Layer 2: Frame Relay FRAME RELAY	Layer 2: Ethernet II Header 0000.0C37.CB01 >> 0001.9650.D11E
Layer 1: Port Serial0/2/0	Layer 1: Port(s): FastEthernet0/0

1. The routing table finds a routing entry to the destination IP address.
2. The destination network is directly connected. The router sets destination as the next-hop.
3. The router decrements the TTL on the packet.

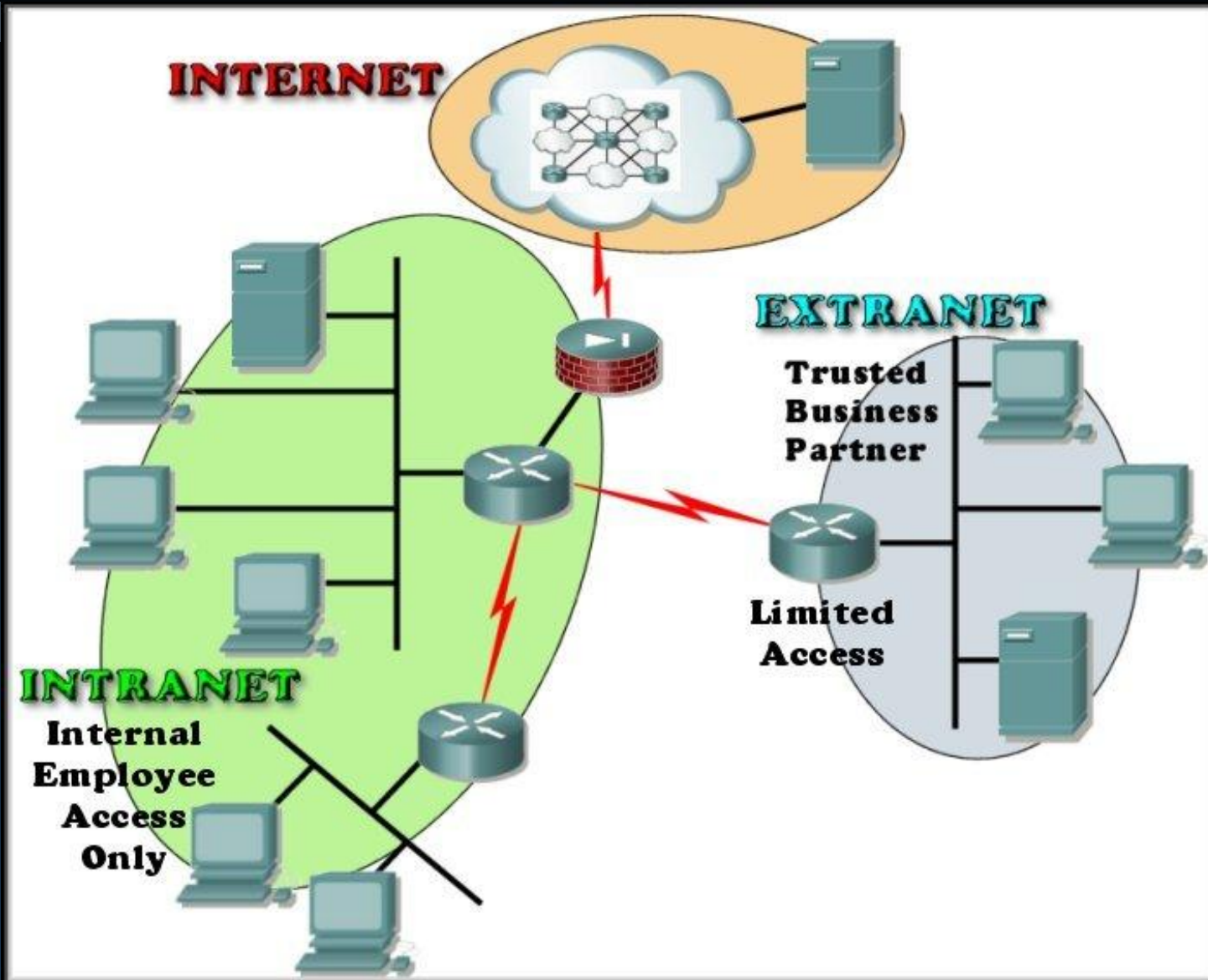
Challenge Me << Previous Layer Next Layer >>

Networks Supporting The Way We Work



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

Networks Supporting The Way We Work



Networks Supporting The Way We Work

The screenshot shows a Mozilla Firefox browser window displaying the St. Clair College Intranet. The browser's address bar shows the URL <http://intranet.stclaircollege.ca/intranet/>. The page features the St. Clair College logo and the word "INTRANET" in large, bold letters. Below the logo, there is a navigation bar with buttons for "Home", "Previous Page", "Internet", and "Search", followed by a search input field. The main content area includes links for "Internal Telephone Directory" and "IT Systems Status". A list of various resources is displayed in two columns, including links to "Academic Interface Users Group", "Material and Safety Data Sheets", "Accessibility Plan", "Information Services", "Audio Visual & Media", "Library", "Blackboard Course Management", "Marketing", "Chrysler Theatre", "Official Logos", "College Committees", "People Directory", "College Policy and Procedures", "Professional Development", "Community & Corporate Training", "Registrar's Office", "Division: Business Plan 2001-2004", "Scheduling", "Continuing Education", "ScotiaMcLeod's St. Clair Group RRSP", "Convocation", "Staff Personal Web Pages", "Curriculum & Program Design", "Student Administration - Entering Grades", "Mydocs (H drive) Password Change", "Student Success and Retention Information", "Employee Assistance Program (EAP)", "Telephone Instructions", "Facilities Management", "Union Locals", "Financial Services", "Windows XP Roll Over Instructions - Updated", "Gartner Research intraWeb", and "Human Resources". The browser's status bar at the bottom shows the system tray with the time 9:58 AM and several open applications.

Networks Supporting The Way We Play

Online Games

Online Entertainment

Online Interest Groups

Online Travel

Instant Messaging

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

- The entertainment and travel industries have made use of the Internet to provide online gaming, music and movie downloads, online travel bookings, hotel and car reservations and much, much more.

Networks Supporting The Way We Play



- Some of the most innovative developments in network technology have come from the increasing demand for entertainment.

Communications – What is it?

- Communications can take many forms and occurs in many different environments.
- We establish rules, **or protocols**, for communicating with each other:
 - Identify the sender and receiver.
 - Agree on the method.
 - Common language.
 - Speed and delivery of the message.
 - Confirmation that the message was received.
- Communications between individuals is successful if the meaning of the received message is the same as the meaning of the message that was sent.

Communications - Quality

- For data networks, we use the same basic criteria to judge successful communication.
- However, there are **external factors** that can affect the message.
 - The **quality of the pathway** between the sender and the recipient.
 - The number of times the message has to **change form** or be **redirected** or **re-addressed**.
 - The number of **other messages** being transmitted simultaneously on the communication network.
 - The **amount of time** allotted for successful communication.

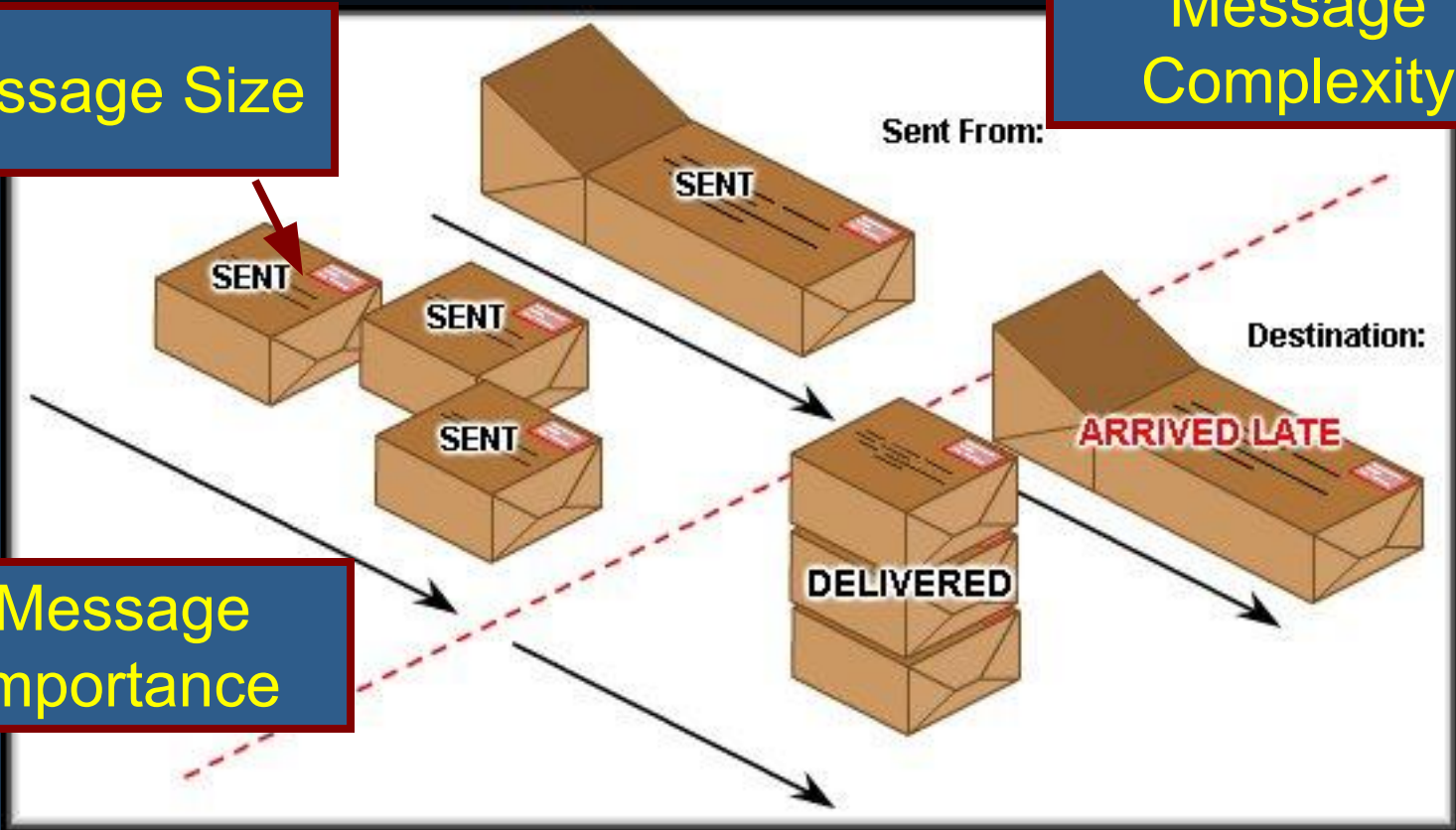
Communications - Quality

- There are also **internal factors** that can affect successful communication.

Message Size

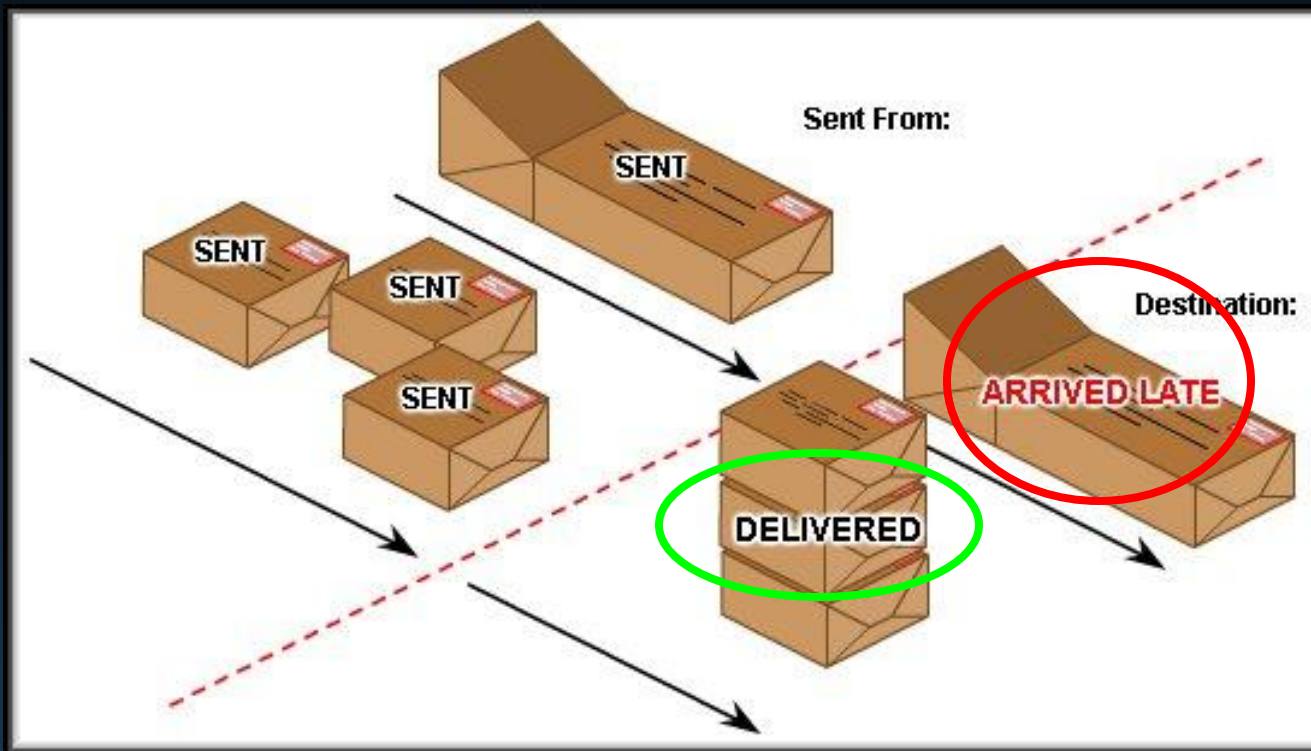
Message Complexity

Message Importance



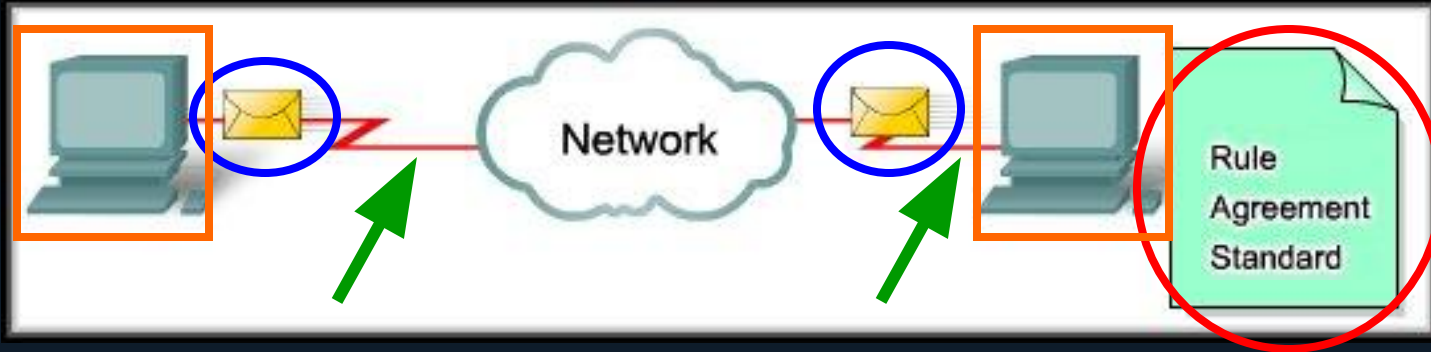
Communications - Quality

- It is also more difficult to deliver a large, bulky package successfully and without damage than it is to deliver several smaller packages.



Network As A Platform

- All networks have 4 basic elements in common:



Rules (protocols) to govern the handling of the message.

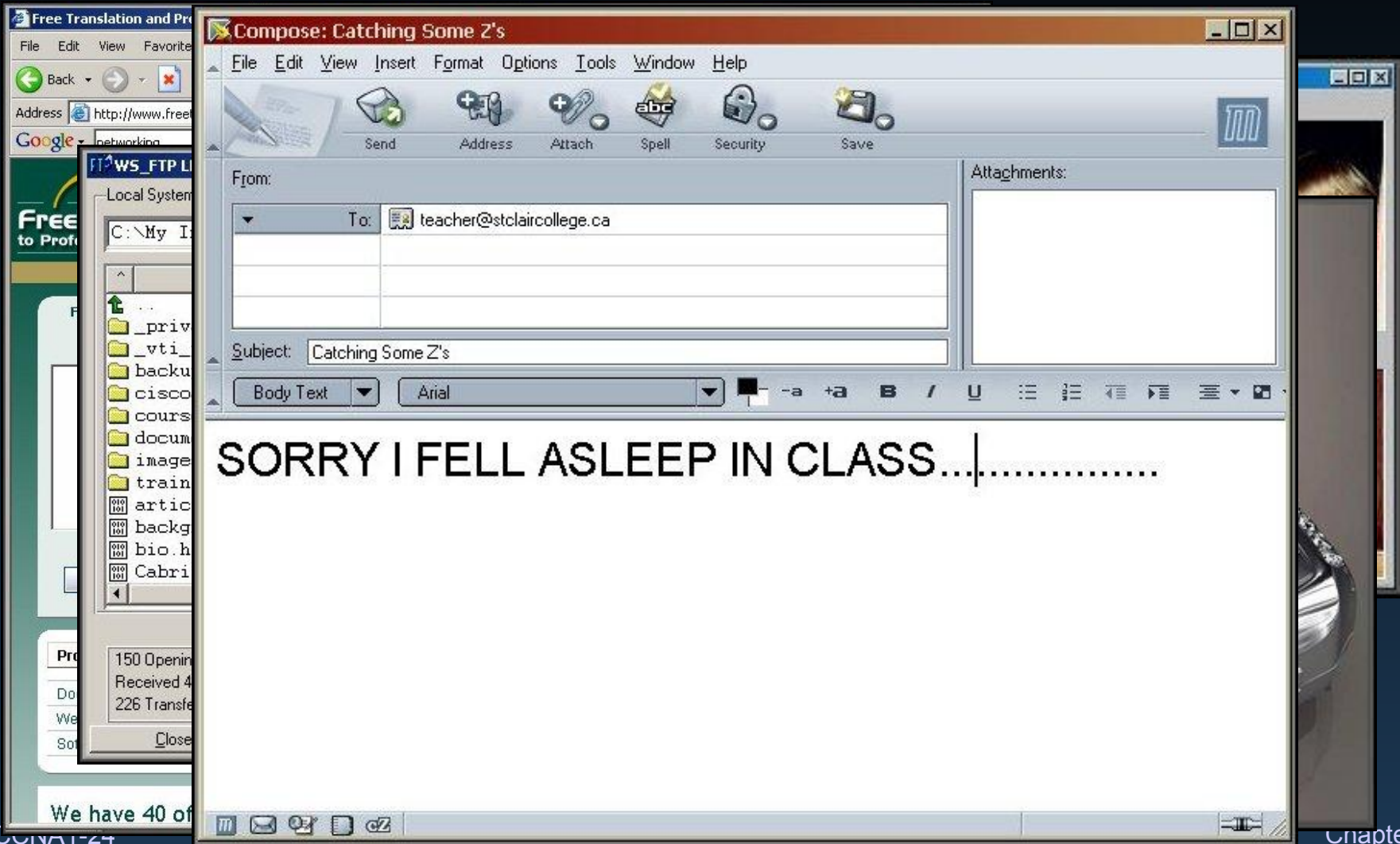
Messages that travel from one device to another.

Medium that is used to interconnect devices and can transport the messages from one device to another.

Devices on the network that exchange messages.

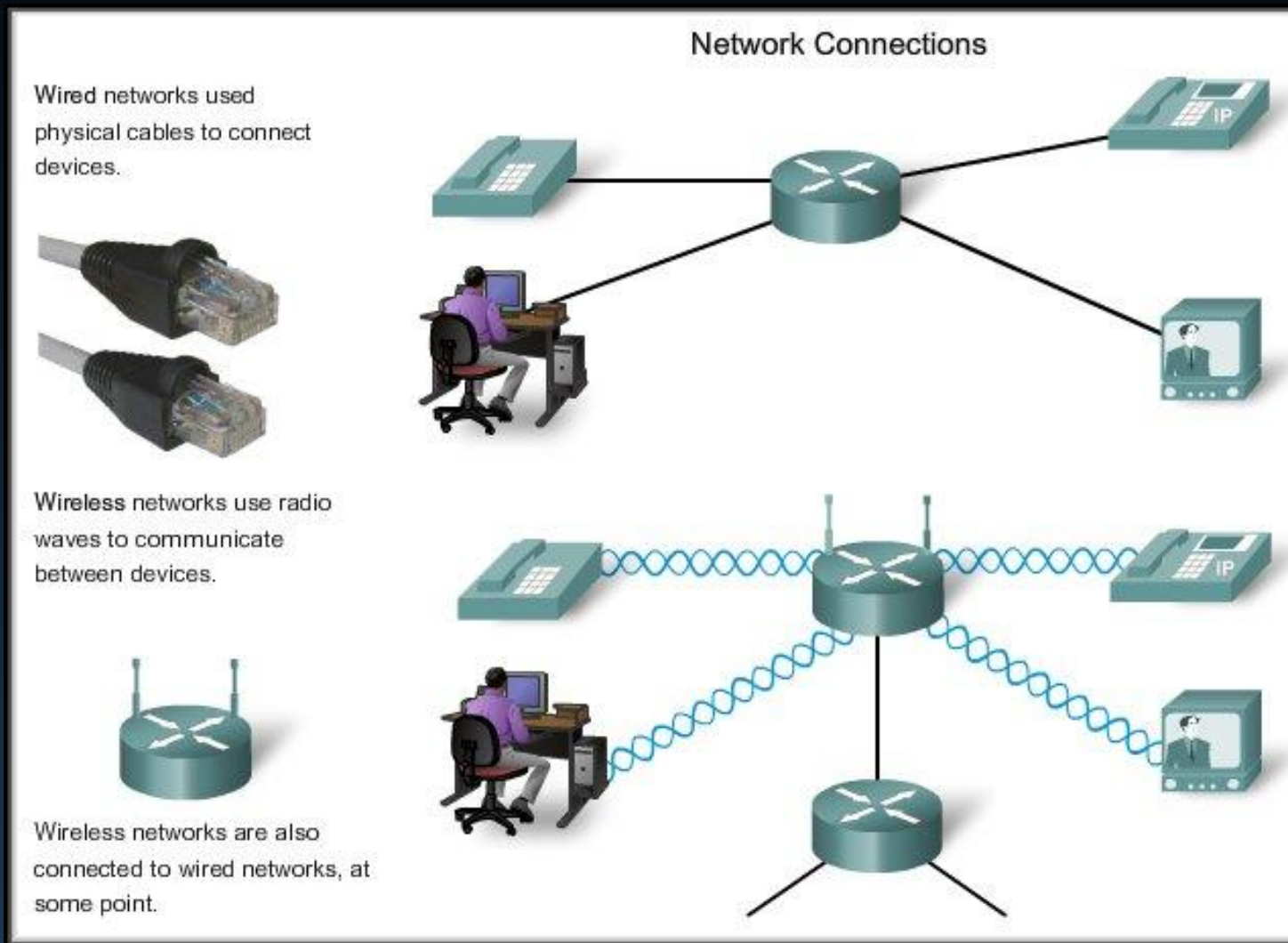
Network As A Platform

Messages take many forms.



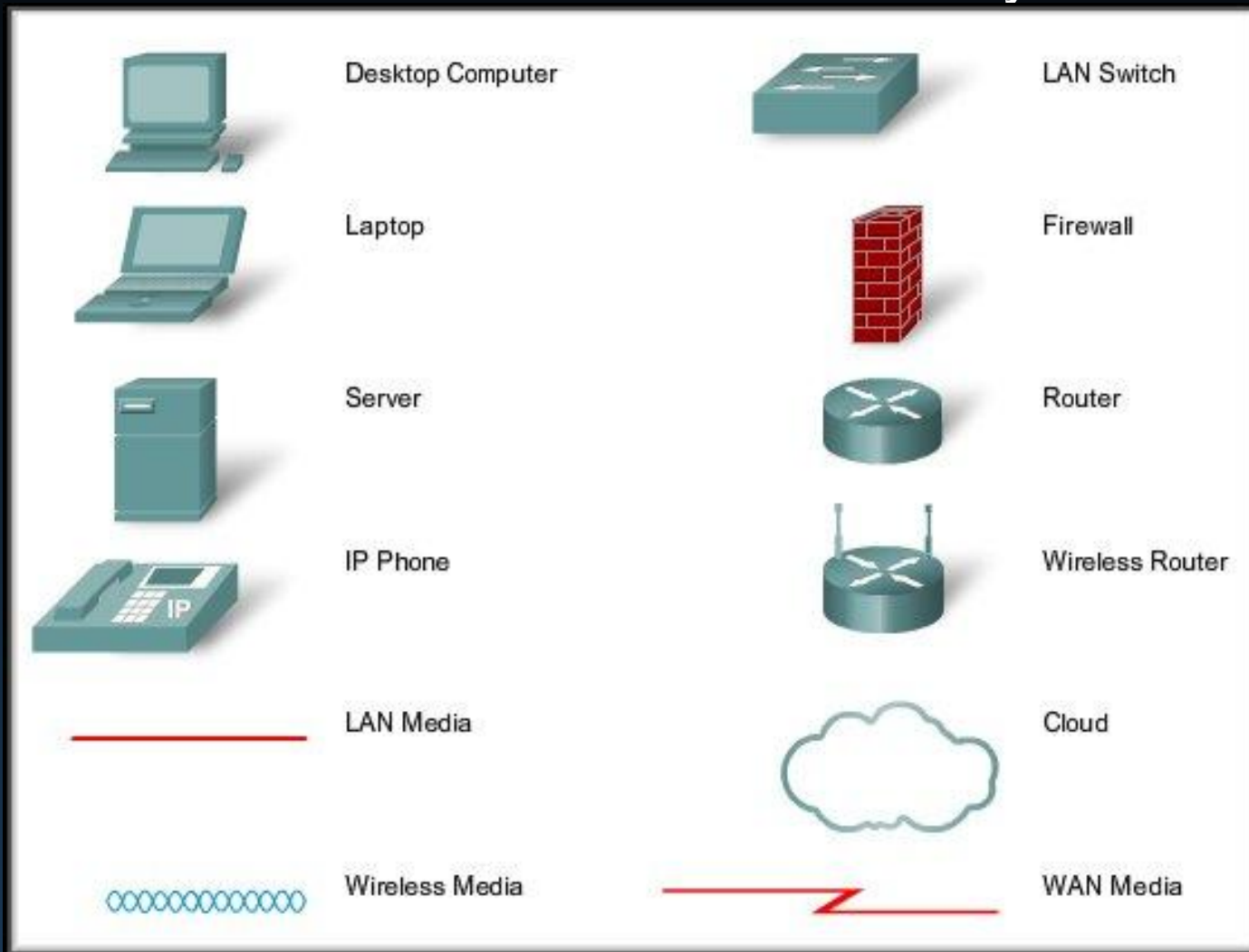
Network As A Platform

Media on a network can be varied.



Network As A Platform

Devices on a network – Common Symbols



Network As A Platform

Rules on a network seem almost endless – but they're not.

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)

- **Other Application Protocols:**
 - DNS, DHCP, FTP
- **Some Other Protocols:**
 - TCP/IP Protocol Suite, Ethernet, Routing Protocols

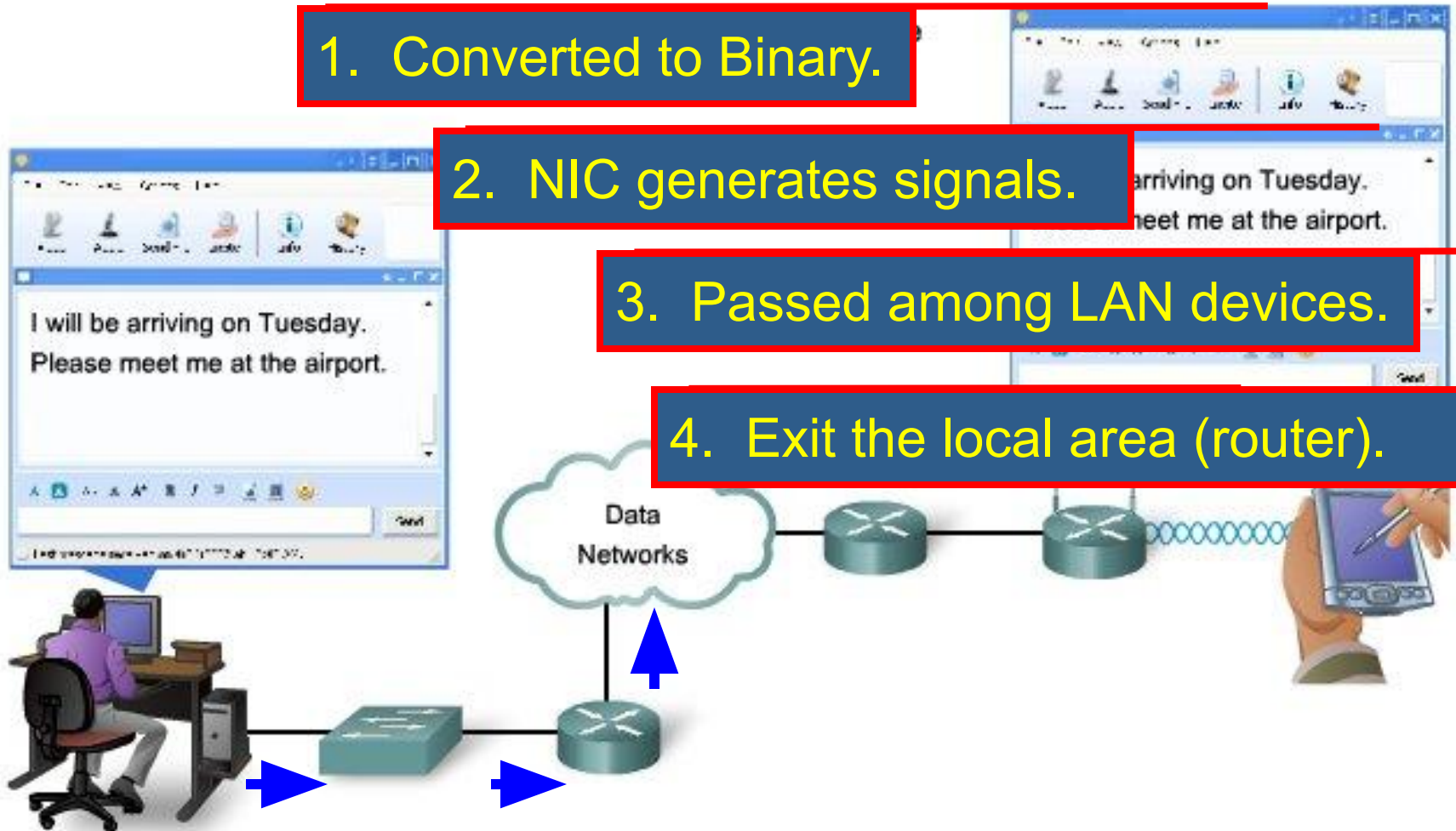
Putting It all Together

1. Converted to Binary.

2. NIC generates signals.

3. Passed among LAN devices.

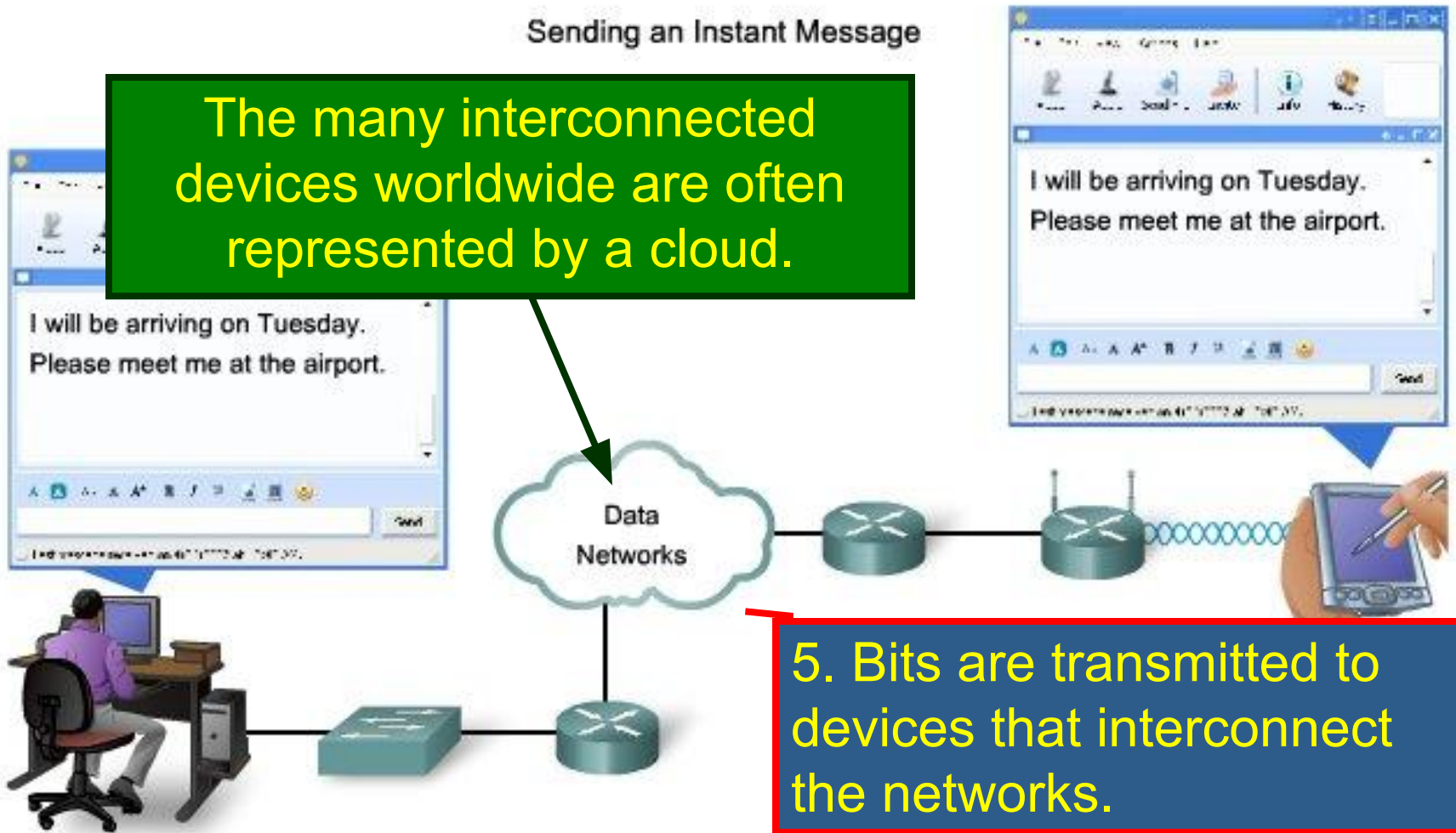
4. Exit the local area (router).



Putting It all Together

Sending an Instant Message

The many interconnected devices worldwide are often represented by a cloud.

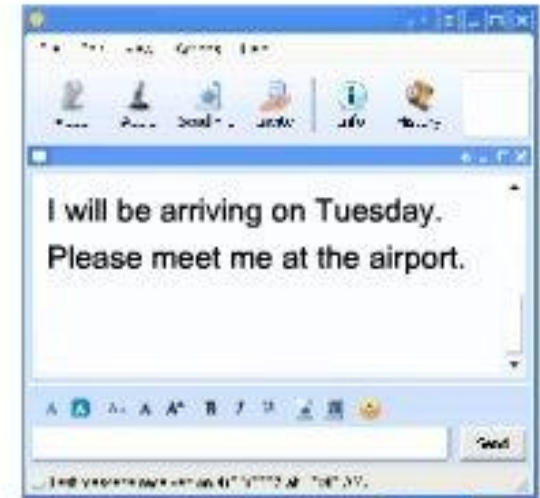


5. Bits are transmitted to devices that interconnect the networks.

Putting It all Together

Sending an Instant Message

6. Passed among local devices at the destination.



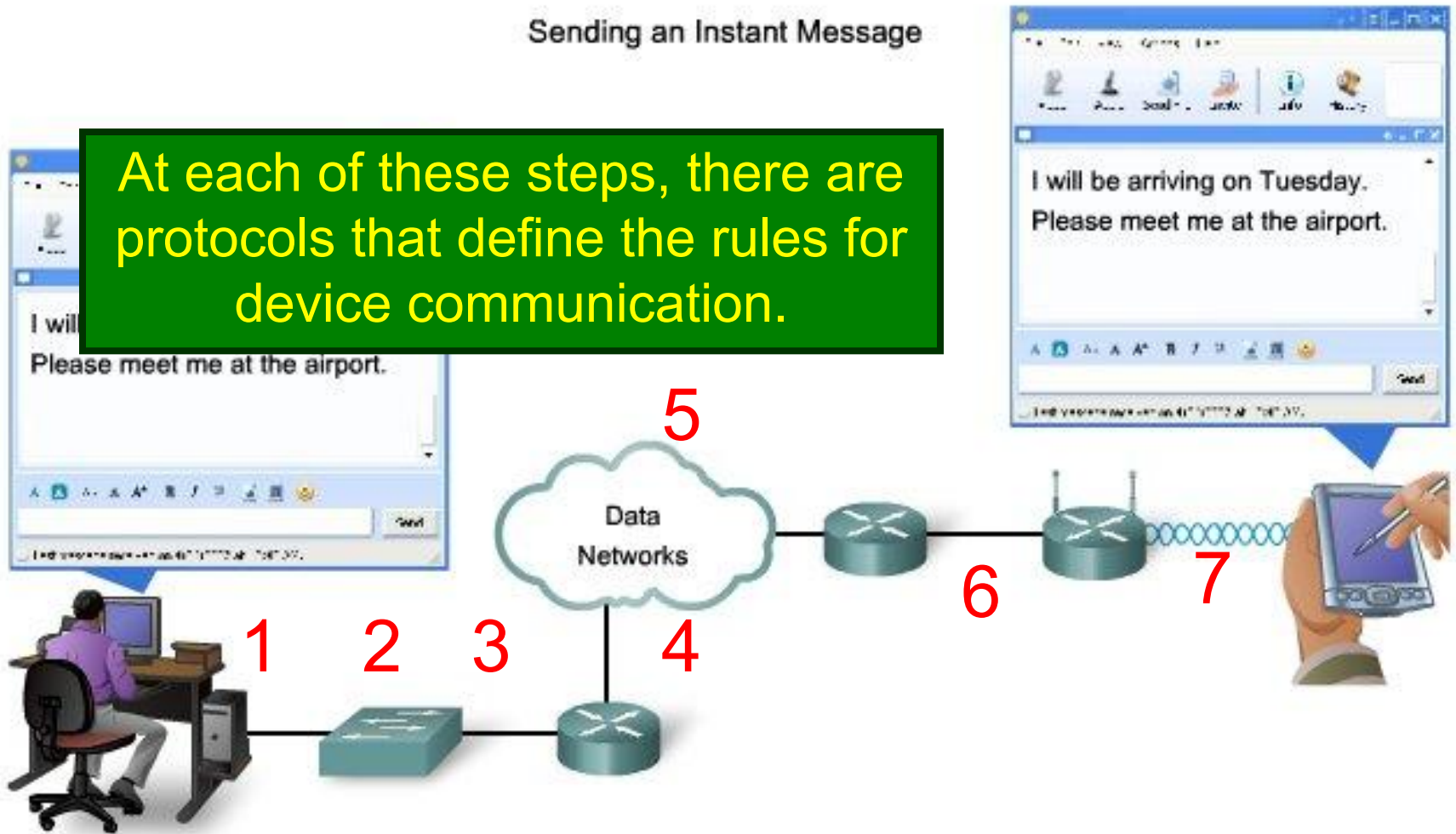
7. The destination device converts the bits into human readable form.



Putting It all Together

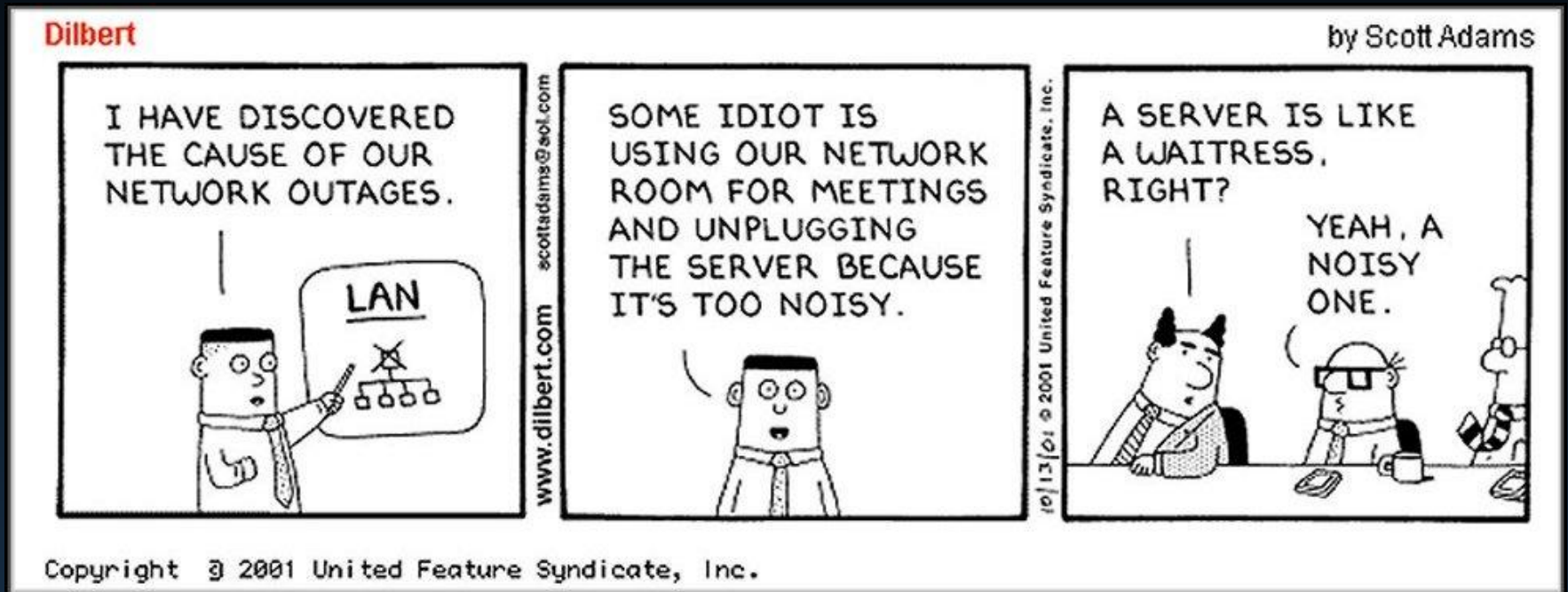
Sending an Instant Message

At each of these steps, there are protocols that define the rules for device communication.



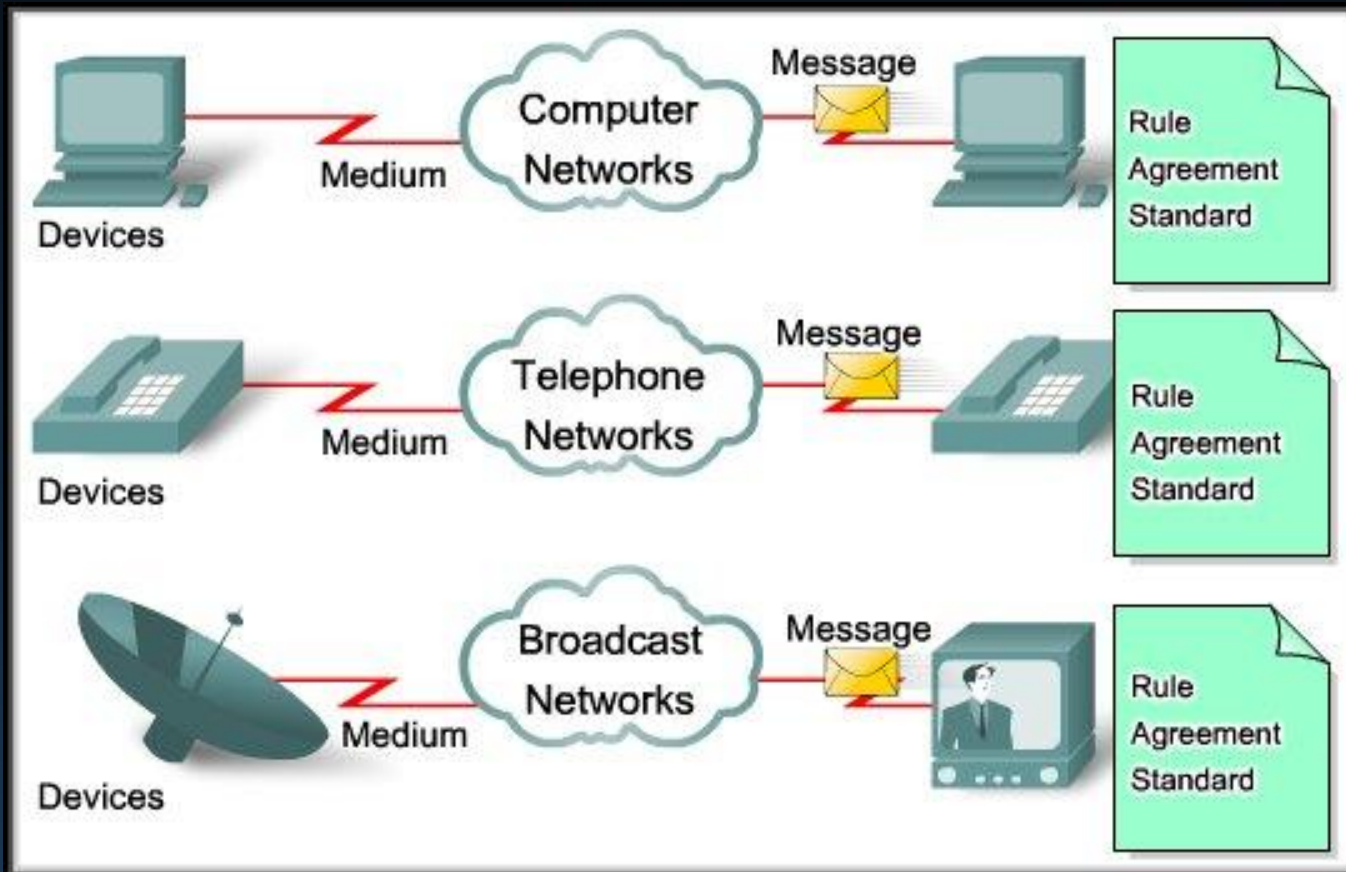
Putting It All Together

- Of course, it always helps to know what you're doing.



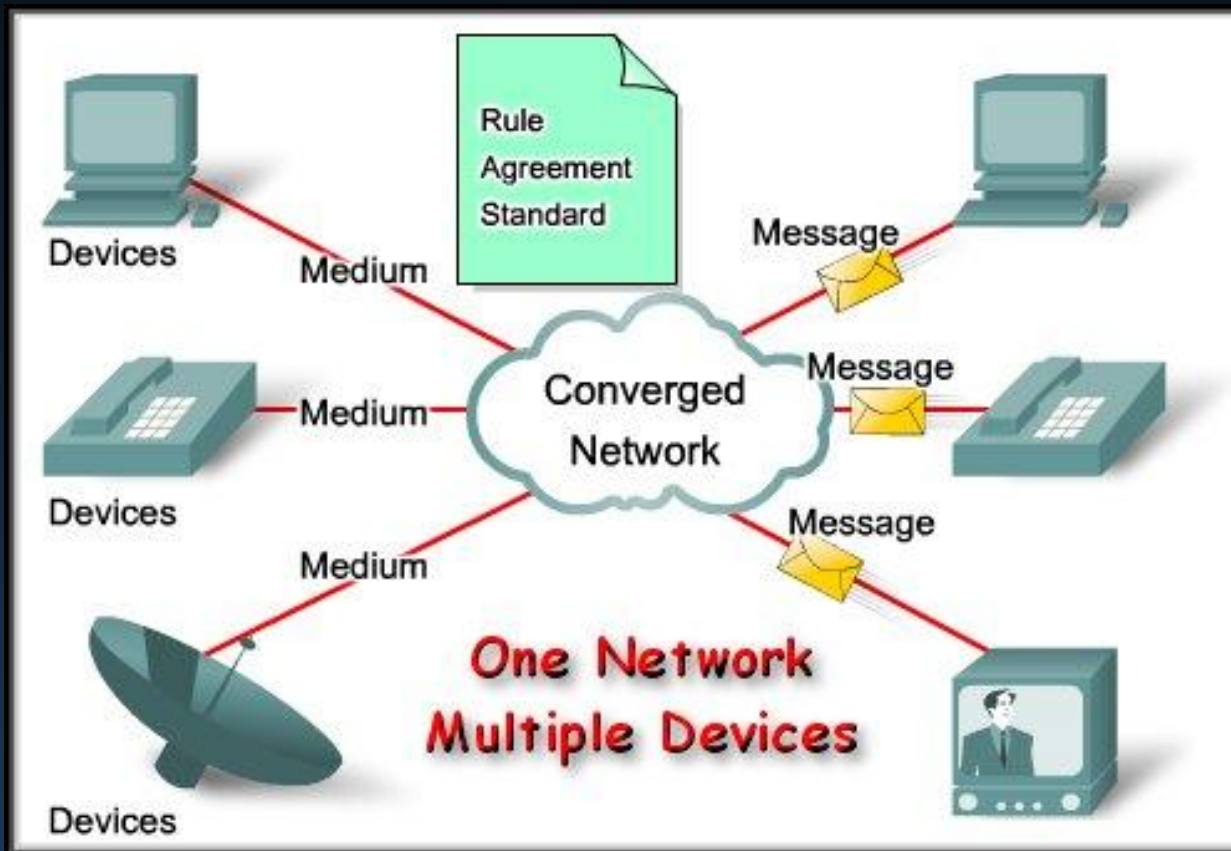
Converged Networks

- 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**.



Converged Networks

Intelligent Networks Are Bringing the World Together



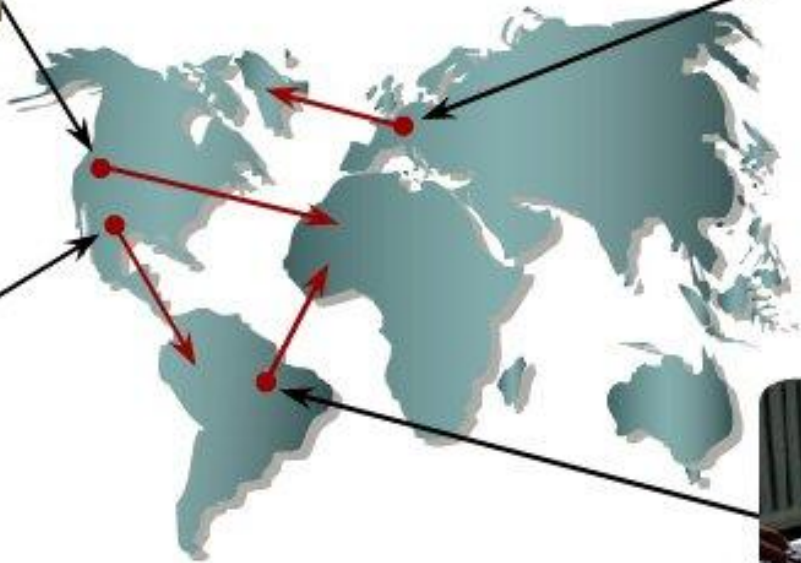
Intelligent networks allow handheld devices to receive news and e-mails, and to send text.



Video conferencing around the globe is in the palm of your hand.



Phones connect globally to share voice, text and images.



The Human Network is everywhere.



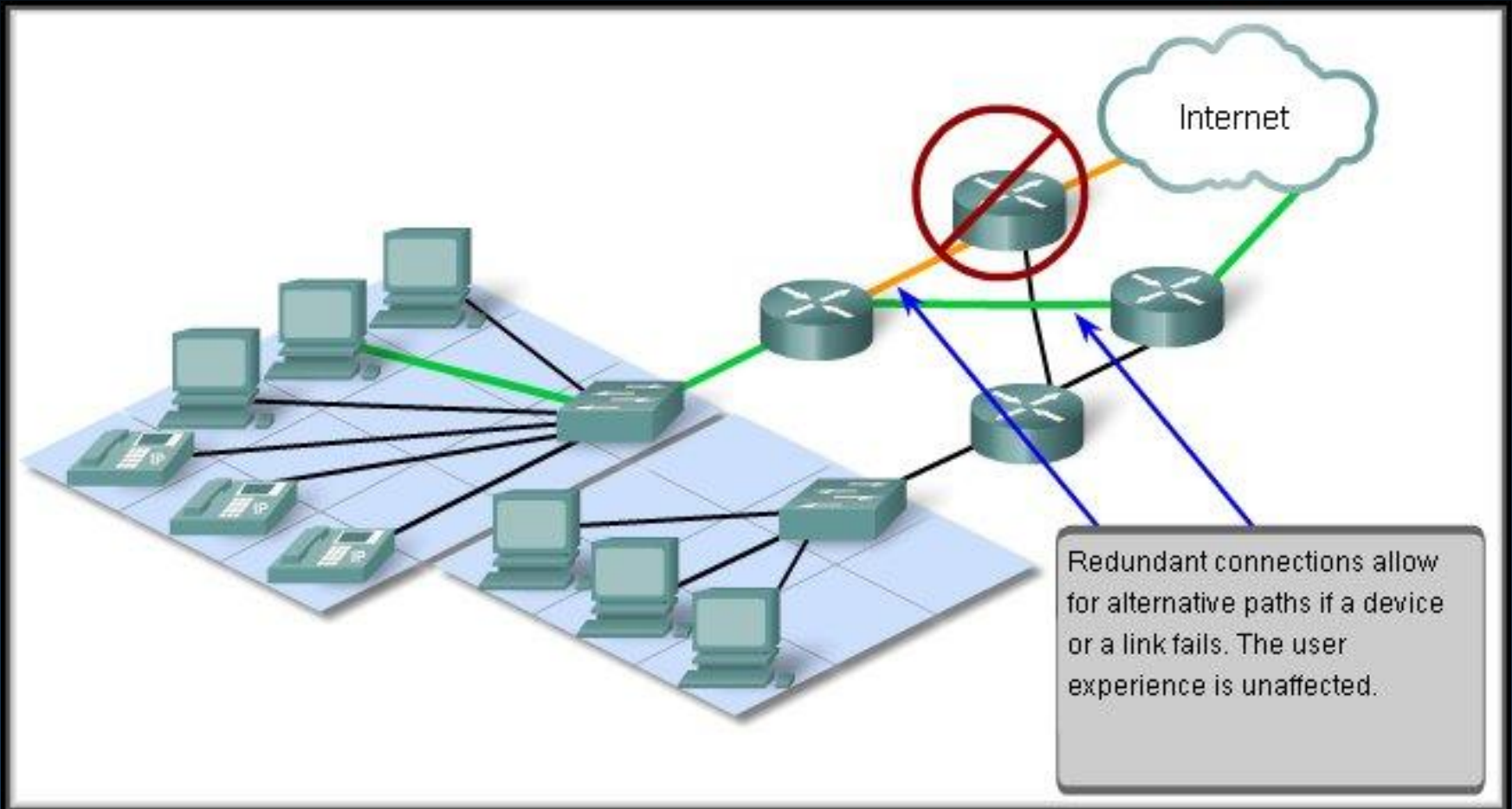
Online gaming connects thousands of people seamlessly.

The Architecture of the Internet

- The term **Network Architecture**:
 - Technologies that support the **infrastructure**
 - **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)
 - Security

The Architecture of the Internet

Fault Tolerance



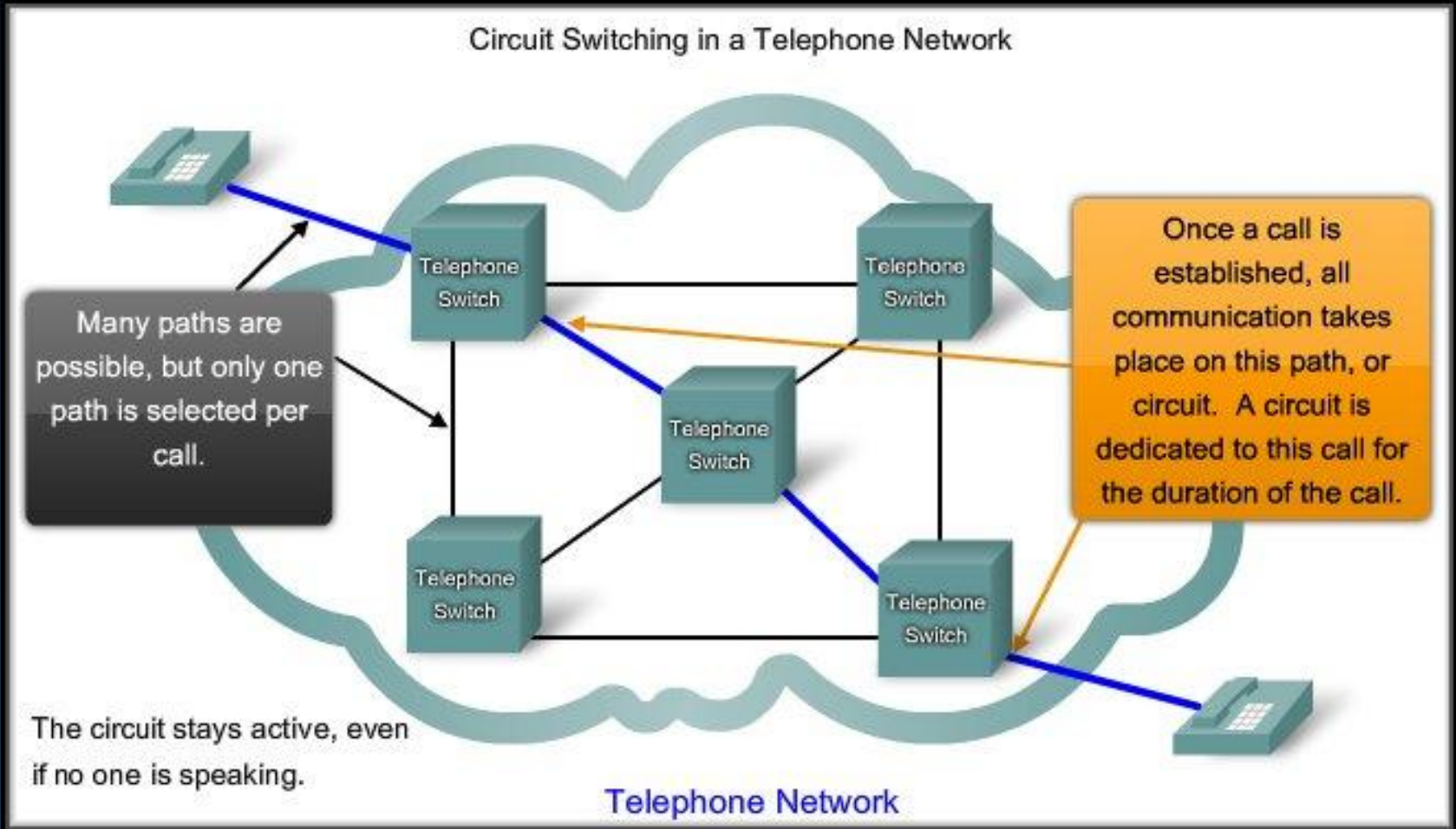
The Architecture of the Internet

- **Fault Tolerance:**

- The Internet, in its early inception, was the result of research funded by the United States Department of Defense (DoD).
- **Fault tolerance** was the focus of the initial internetwork design.
- Early network researchers looked at the existing communication networks, which were primarily for the transmission of voice traffic, to determine what could be done to improve the fault tolerance level.

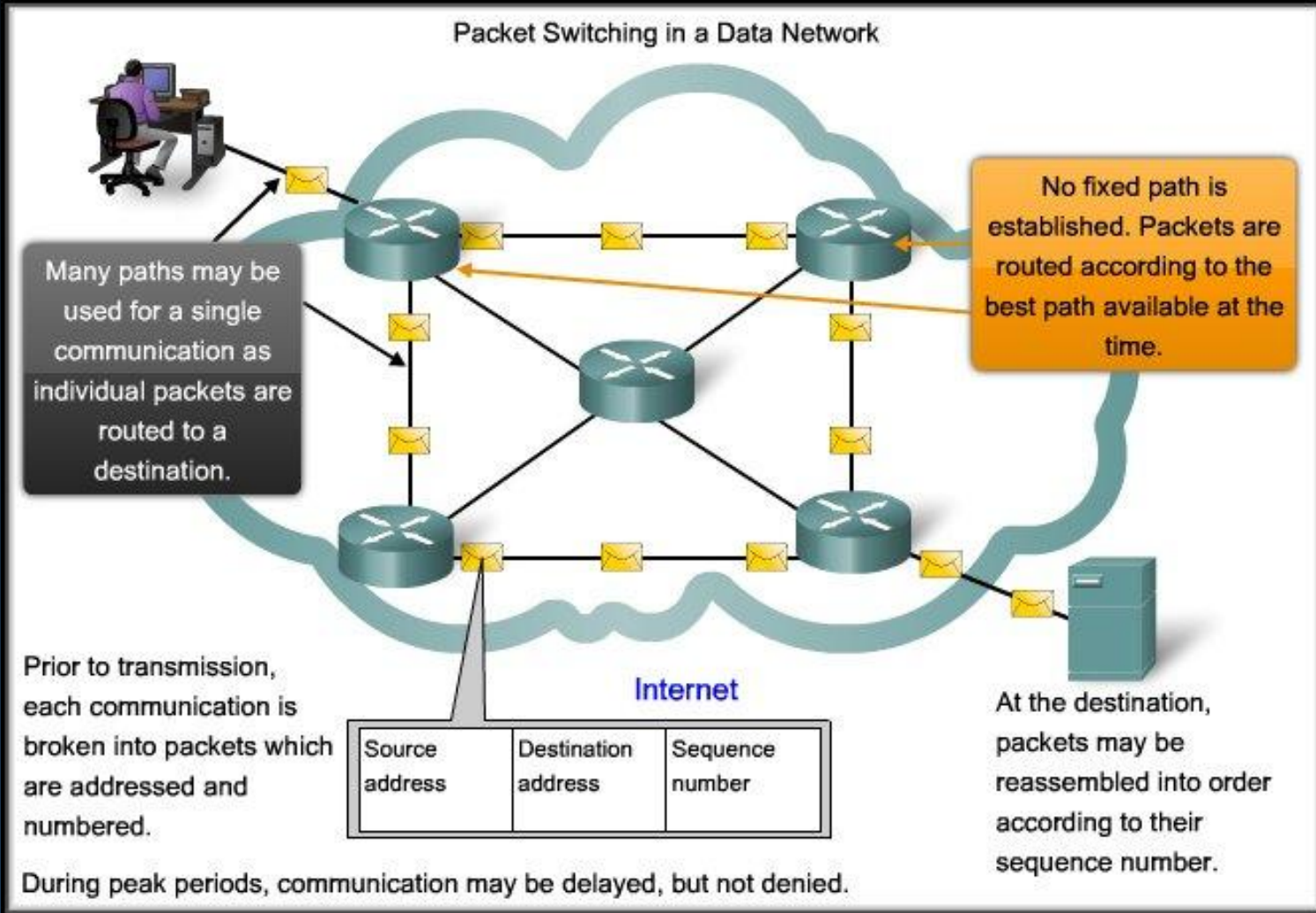
The Architecture of the Internet

Circuit Switched – Connection-Oriented Networks



The Architecture of the Internet

Packet Switched – Connectionless Networks

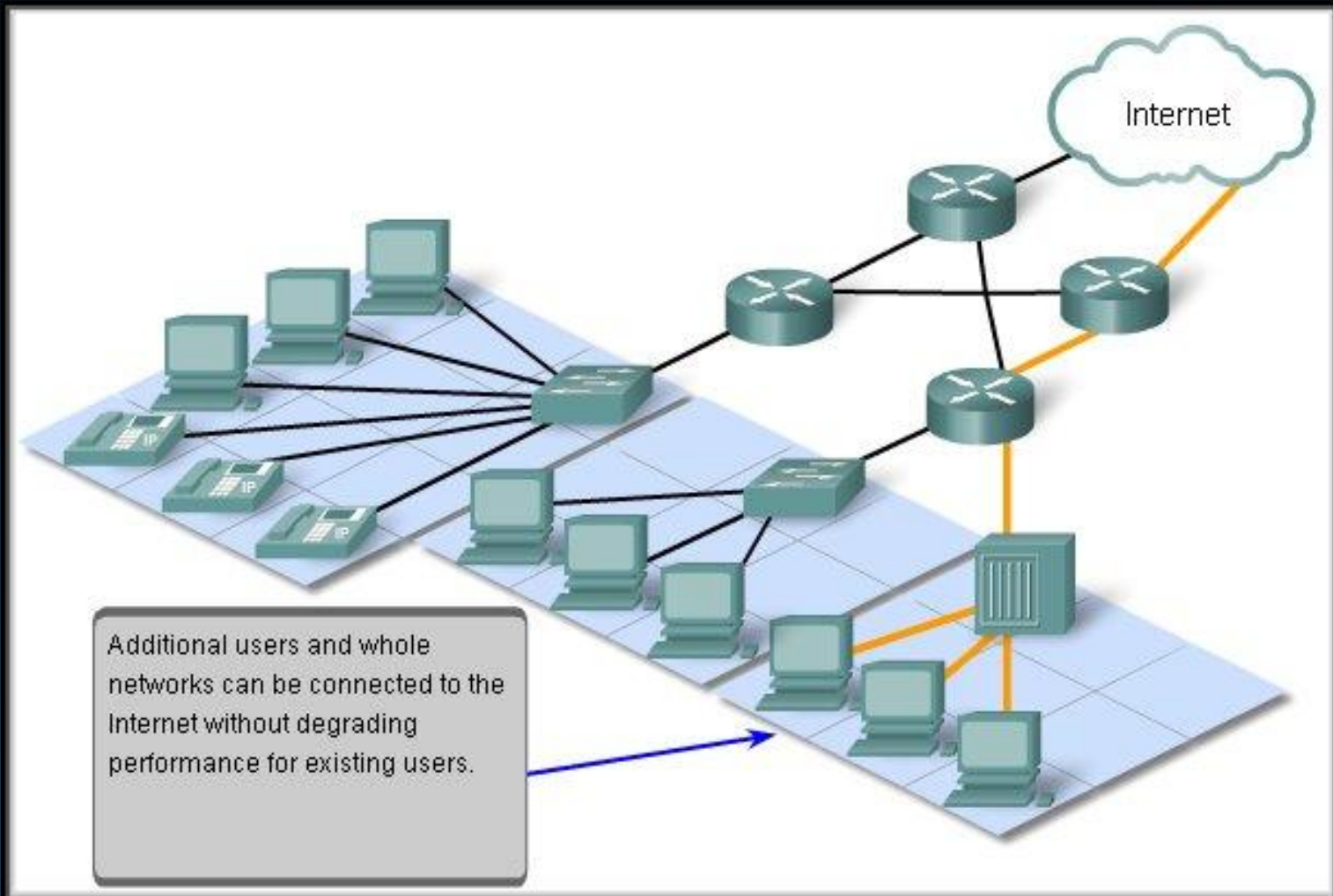


The Architecture of the Internet

Circuit Switched	Packet Switched
Connection-oriented	Connectionless
Dedicated Circuit	Shared Circuit
Guaranteed level of service (Bandwidth, QoS)	Messages divided into packets
Inefficient use of Medium	Efficient use of Medium
Single path, no redundancy	Fault Tolerant , multiple possible paths

The Architecture of the Internet

Scalability

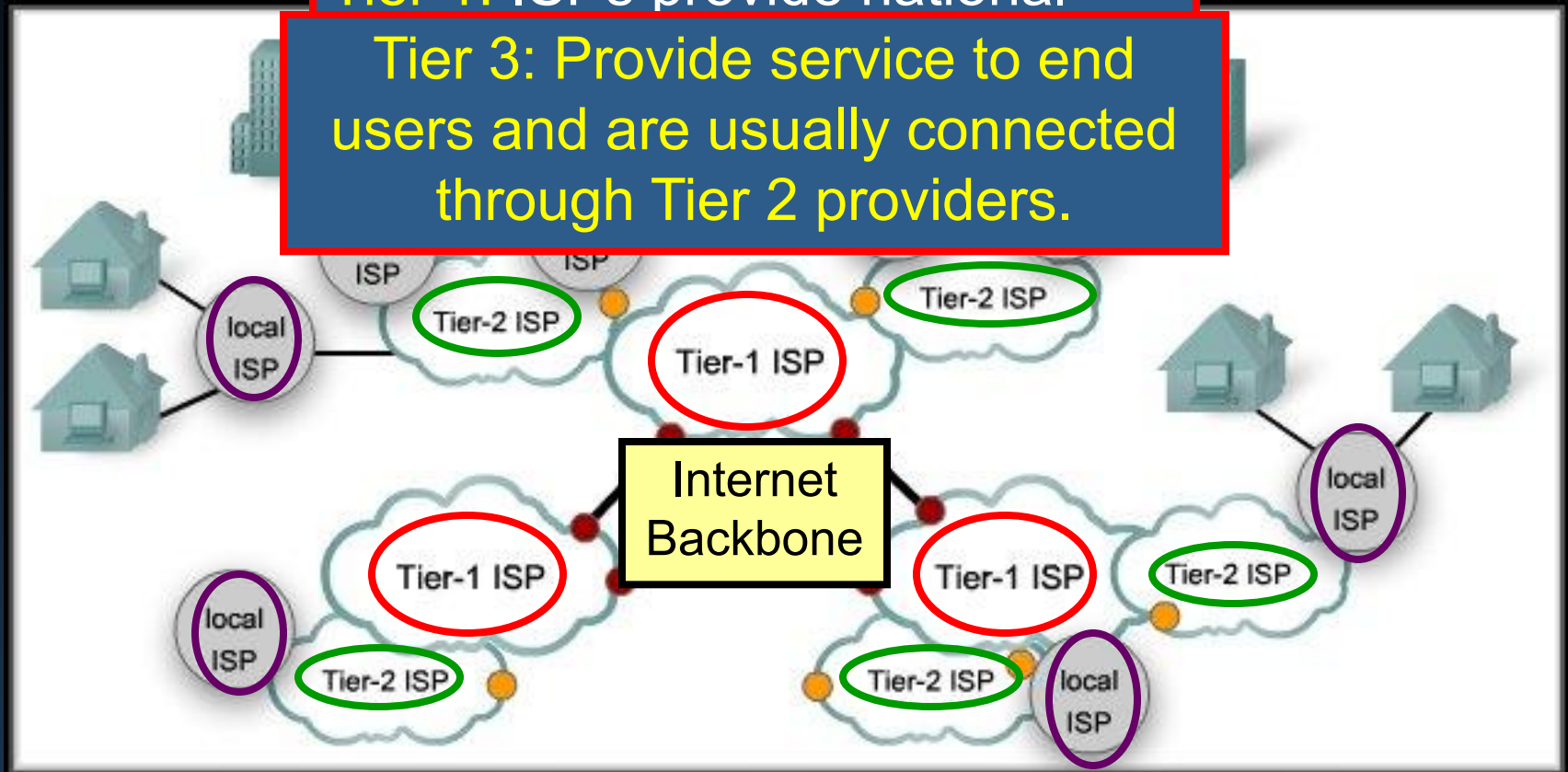


The Architecture of the Internet

- A good example of **scalability** is the Tier architecture of the Internet.

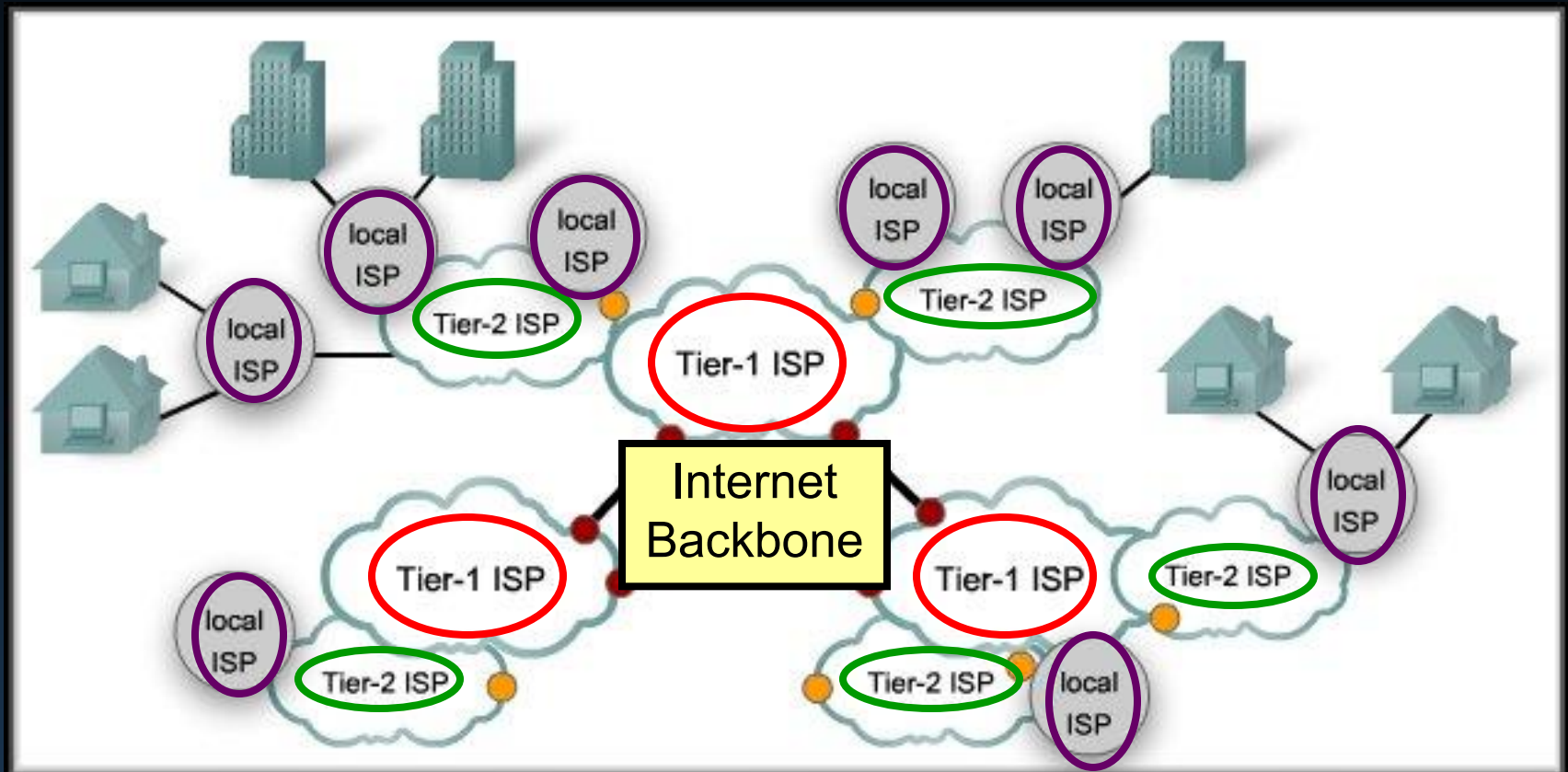
Tier 1: ISPs provide national

Tier 3: Provide service to end users and are usually connected through Tier 2 providers.



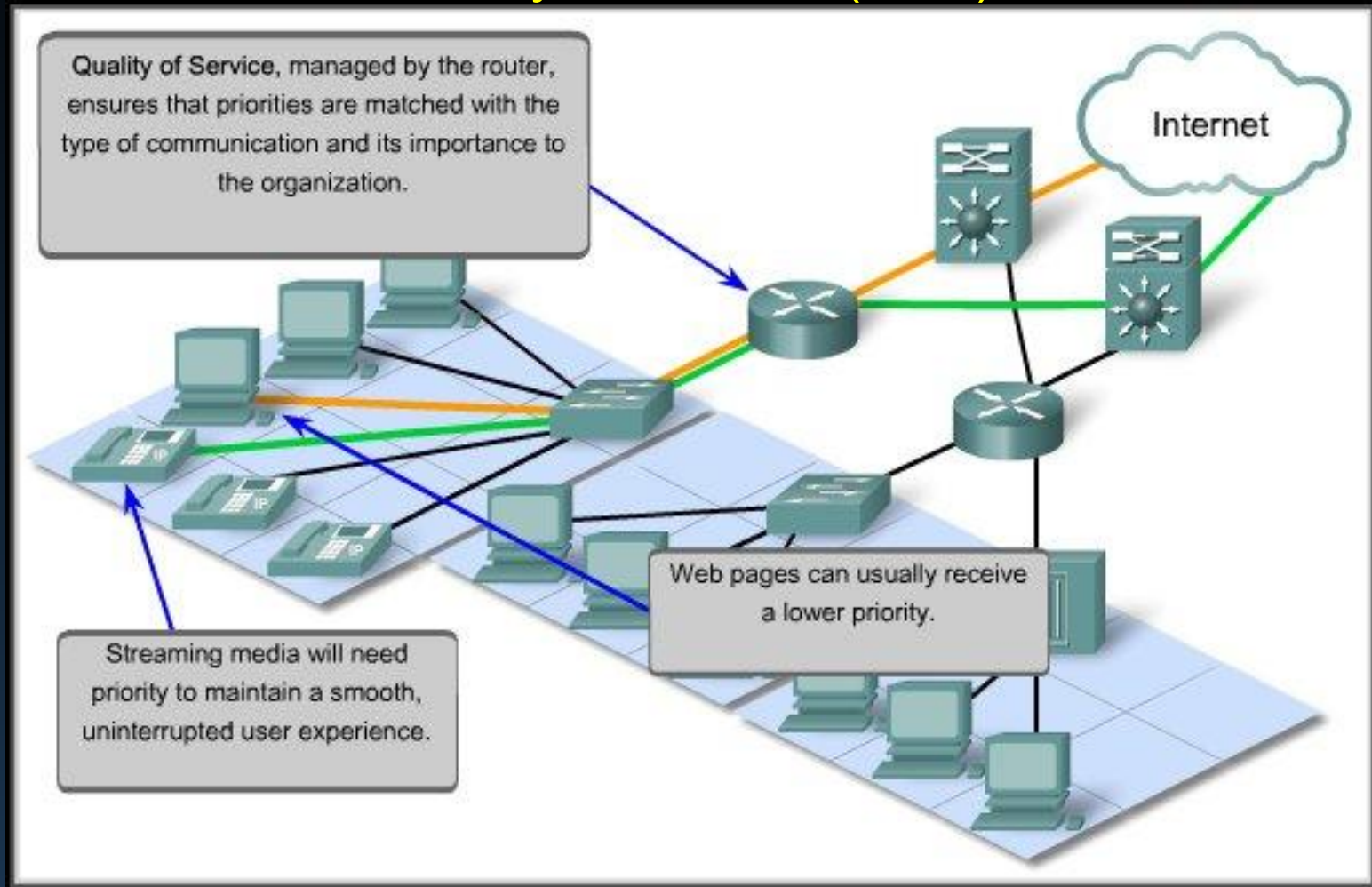
The Architecture of the Internet

- Additional providers can be added relatively easily with no disruption of current services. *THAT is scalability!*



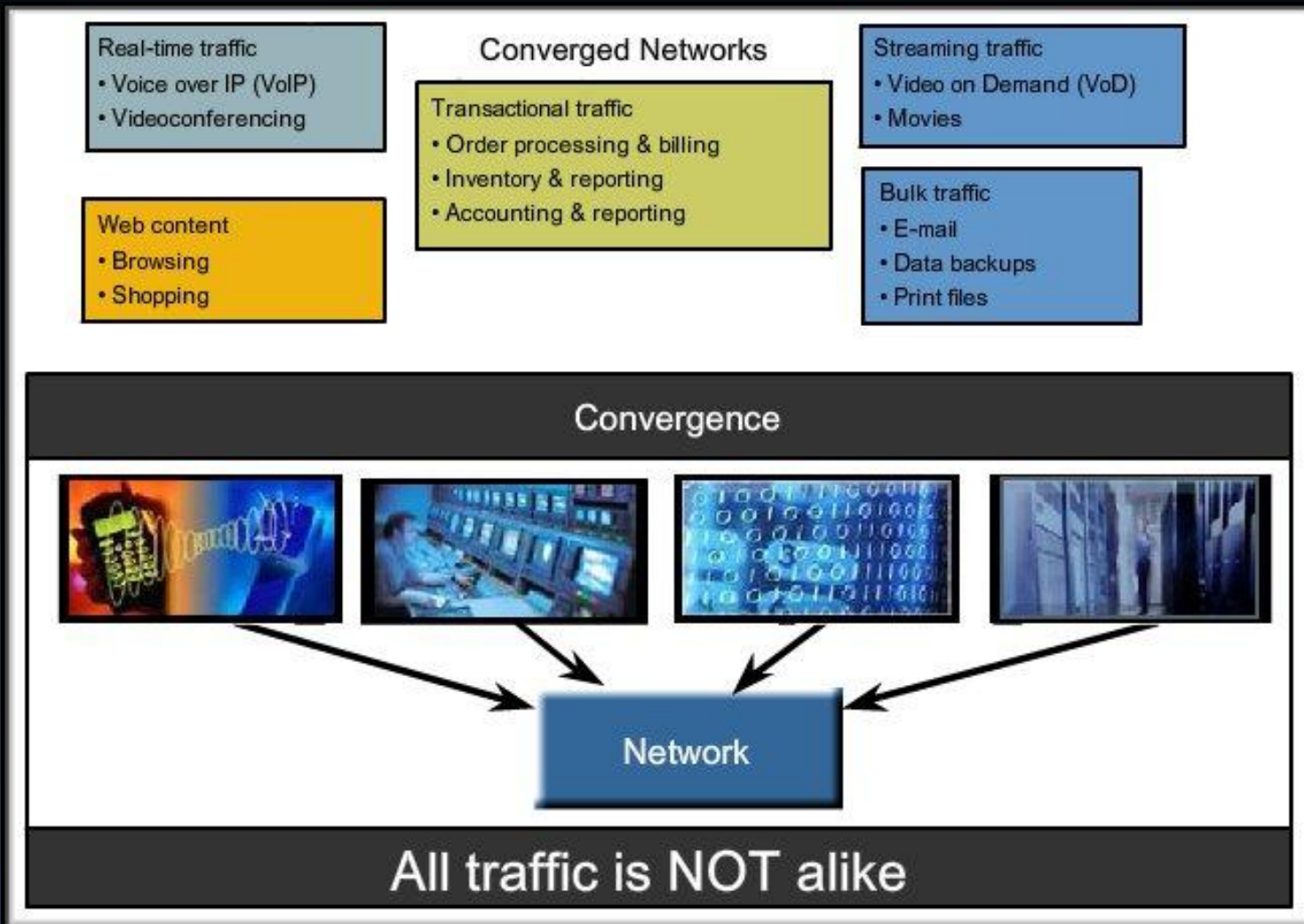
The Architecture of the Internet

Quality of Service (QoS)



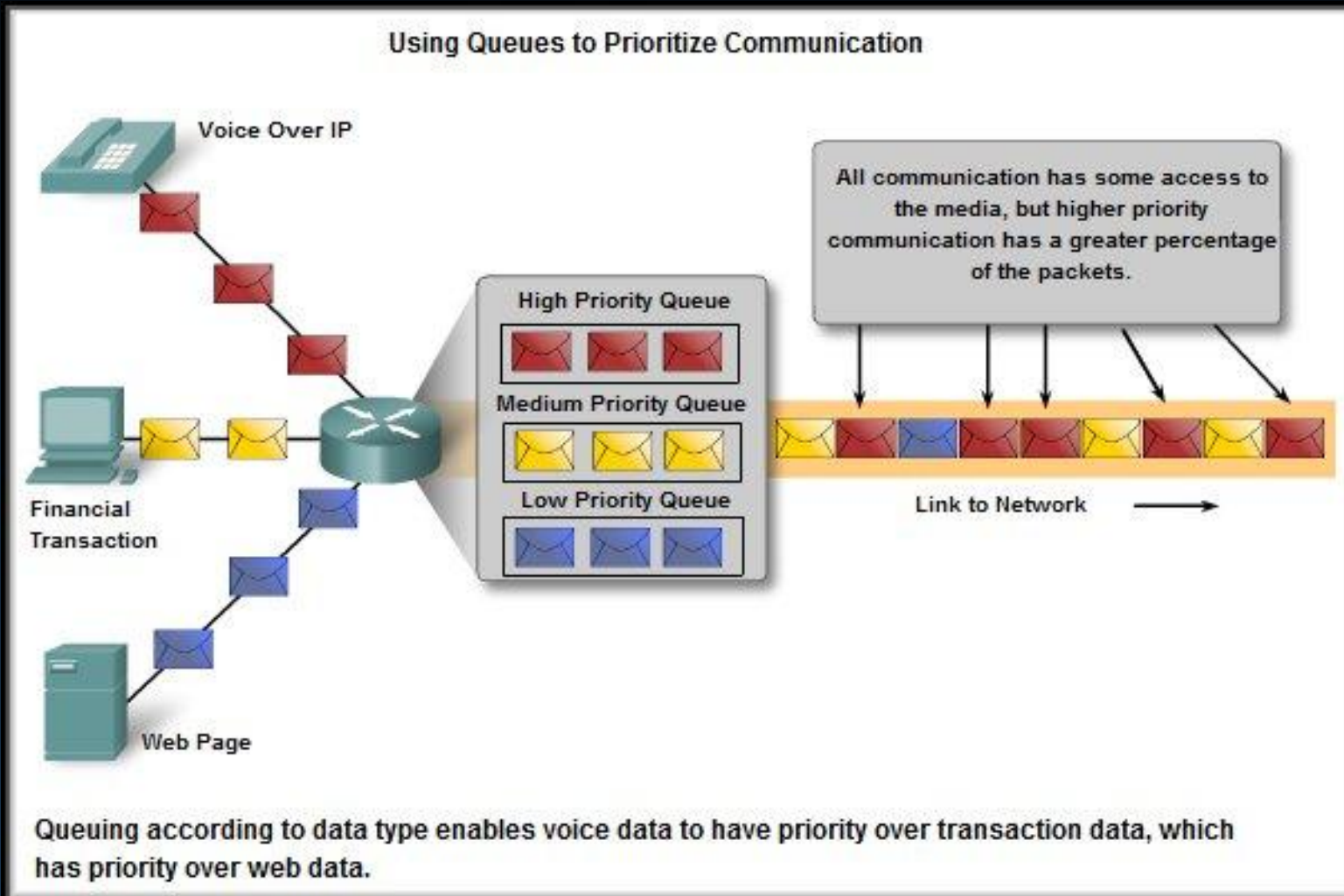
The Architecture of the Internet

Quality of Service (QoS)



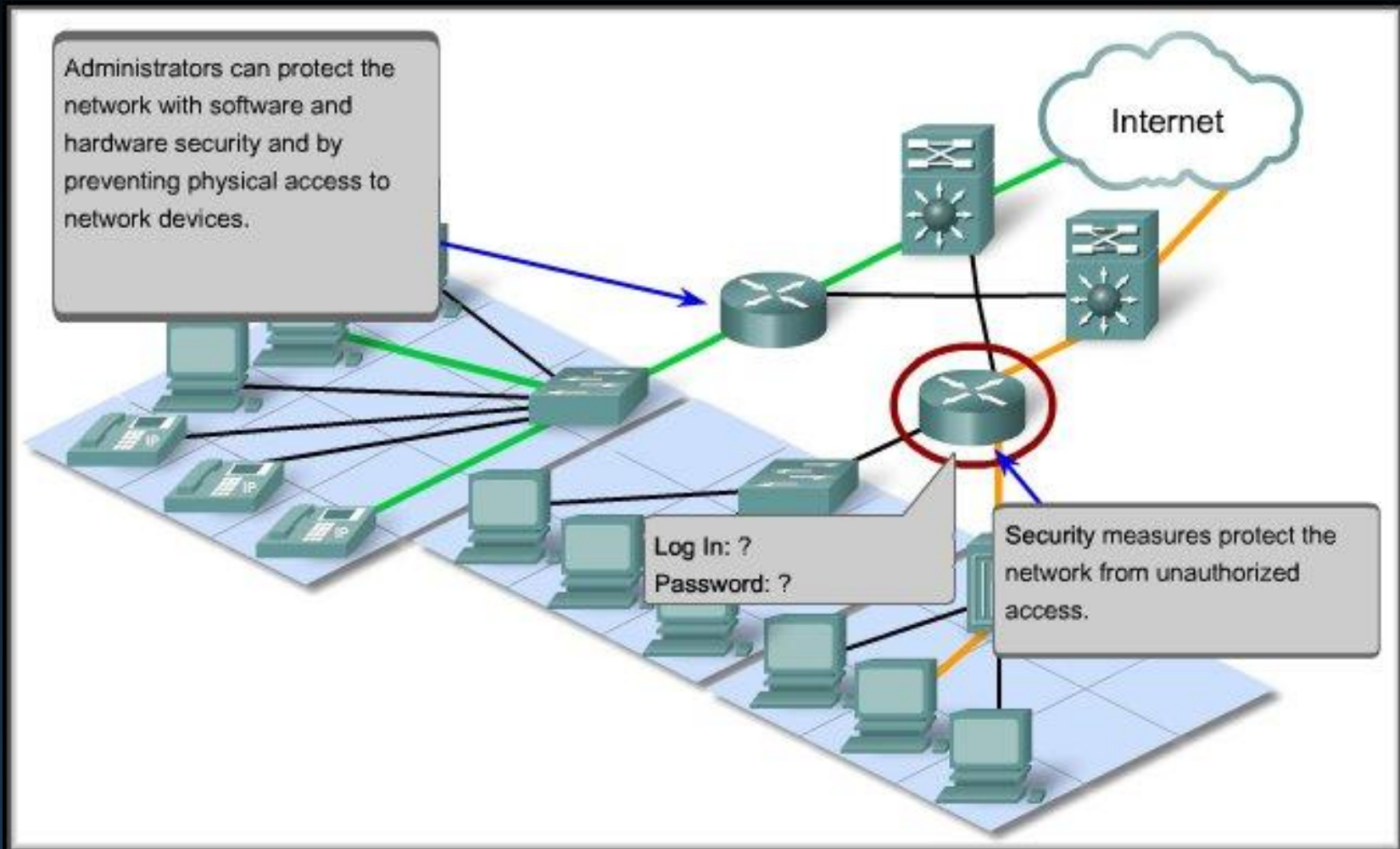
The Architecture of the Internet

Quality of Service (QoS)



The Architecture of the Internet

Security



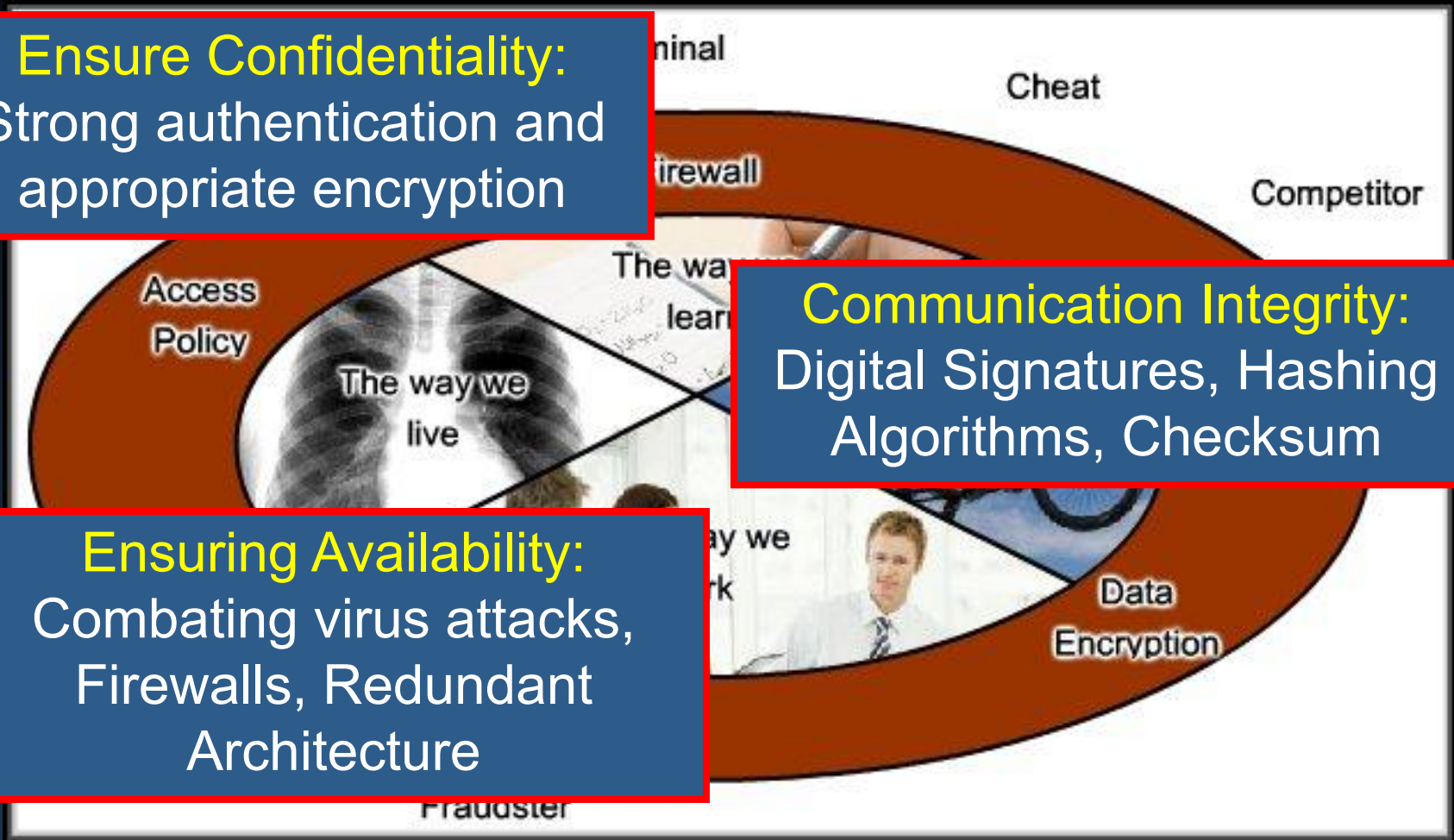
The Architecture of the Internet

Security

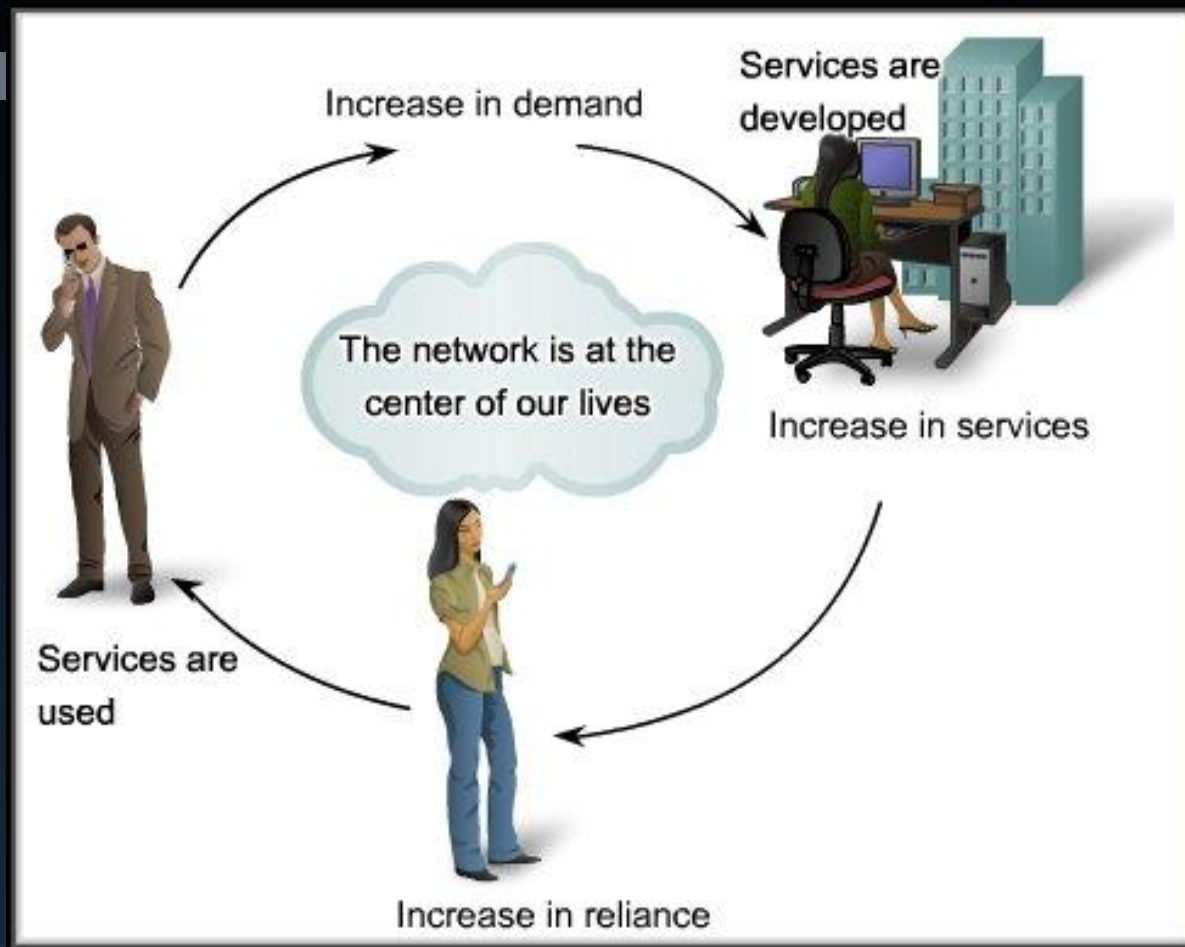
Ensure Confidentiality:
Strong authentication and appropriate encryption

Communication Integrity:
Digital Signatures, Hashing Algorithms, Checksum

Ensuring Availability:
Combating virus attacks, Firewalls, Redundant Architecture



Trends in Networking



- Increasing number of mobile users
- Proliferation of network capable devices
- Expanding range of services

Careers



- Information Technology and networking careers are growing and evolving as fast as the underlying technologies and services. As networks increase in sophistication, the demand for people with networking skills will continue to grow.

“IT” is not the Network – it IS the users.

- The IT (Information Technology) department is not the network.
- The network is the users and their:
 - Needs
 - Expectations
 - Requirements
 - Uses



If IT doesn't find a way, the users will!



A Shift in Attitude

- Old school IT doesn't work any more.
 - We don't support MACs.
 - We can't allow that application on our network.
 - We can't give them access on our network.
 - We have too much to do already.
 - We don't support that.
 - You don't know about networks, so we can't do that.
 - That would breach our security



Technical and Soft Skills

- Networking professionals need more knowledge and skills today than ever before.
- Tomorrow's IT professionals will need even more.
- Just as important, and sometimes even more important, are the soft skills:
 - Attitude
 - Enthusiasm
 - Communications skills
 - Professionalism and Ethics

