



Jaringan Komunikasi Data

Communication and Converged Networks

How Networks Impact Our Daily Life

Online Interest Groups



Online Gaming



Online Entertainment



Virtual Classrooms



Collaborative Learning Spaces



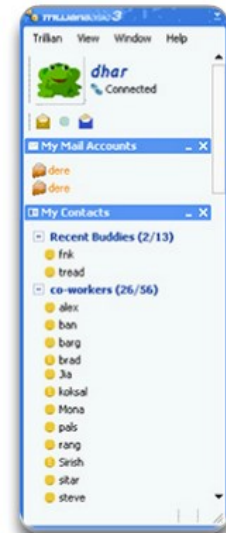
Online Shopping



Onboard Data Networks



Instant Messaging



Networks support the way we learn ...



On-demand Video



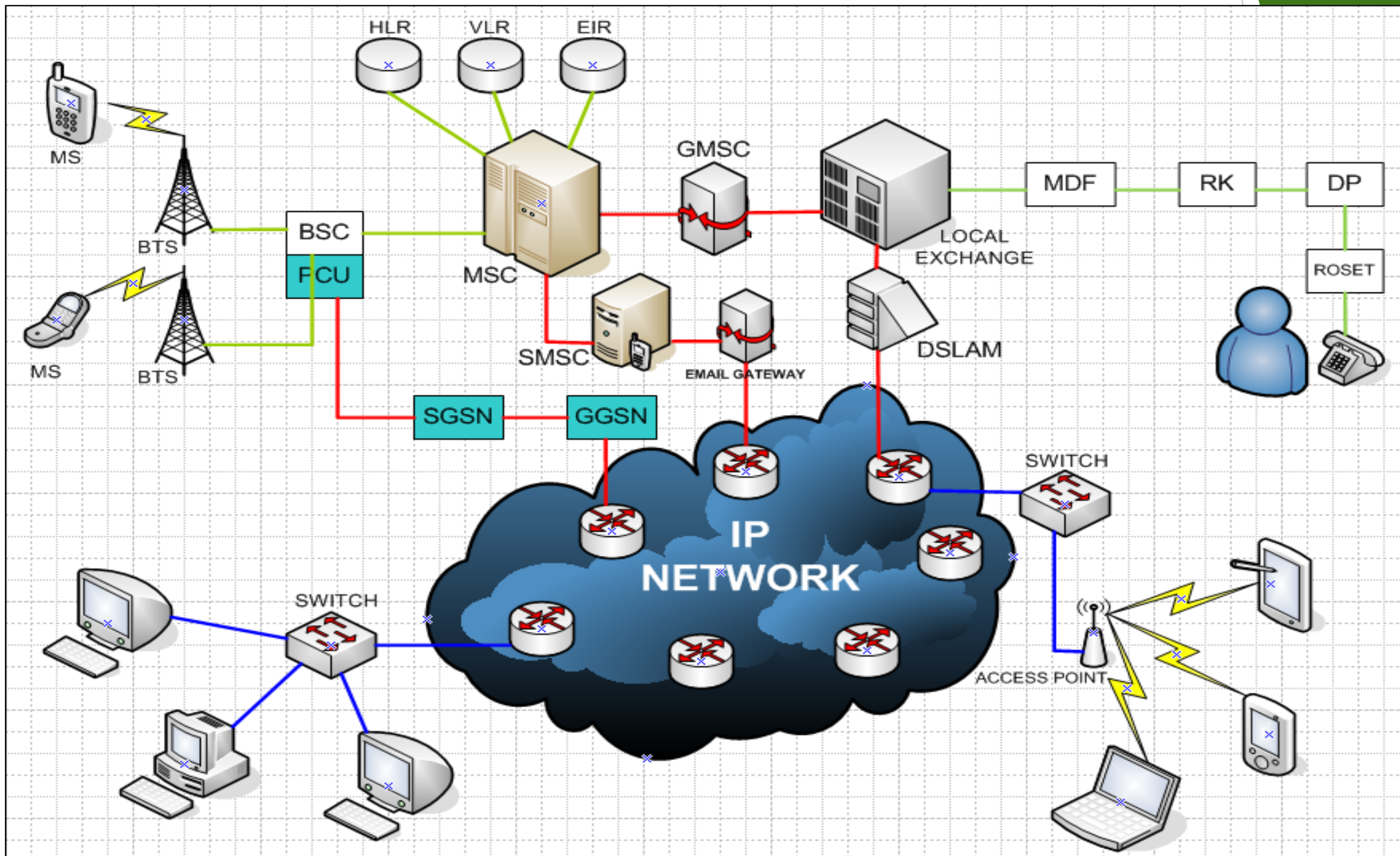
Mobile Learning

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

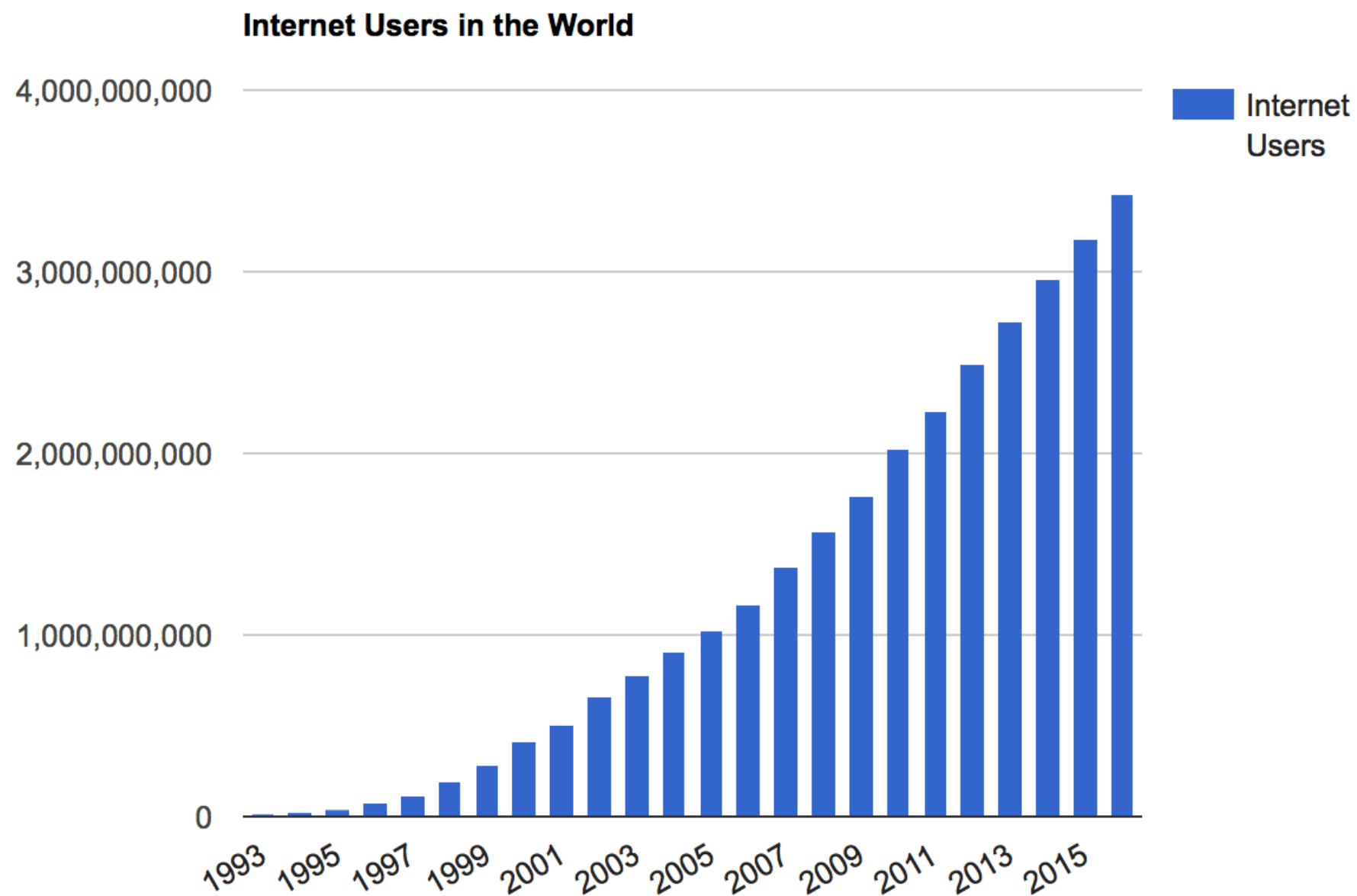
Video Conference



Network Growth



Internet Users Growth in The World



Source: www.internetlivestats.com

Internet Users by Country

Internet Users by Country (2016)

See also: [2015 Estimate](#) and [2014 Finalized](#)

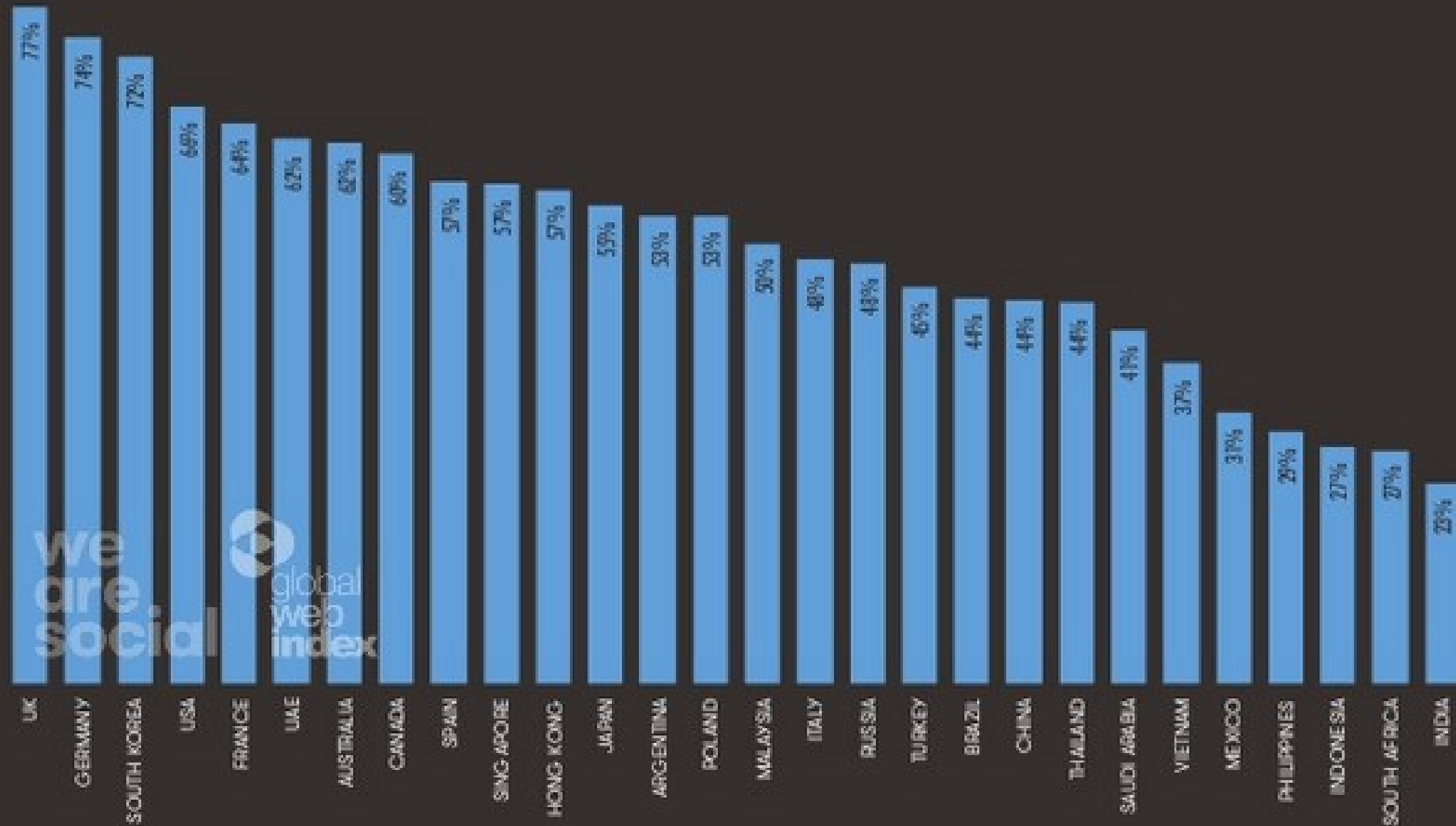
#	Country	Internet Users (2016)	Penetration (% of Pop)	Population (2016)	Non-Users (internetless)	Users 1 Year Change (%)	Internet Users 1 Year Change	Population 1 Y Change
1	China	721,434,547	52.2 %	1,382,323,332	660,888,785	2.2 %	15,520,515	0.46 %
2	India	462,124,989	34.8 %	1,326,801,576	864,676,587	30.5 %	108,010,242	1.2 %
3	U.S.	286,942,362	88.5 %	324,118,787	37,176,425	1.1 %	3,229,955	0.73 %
4	Brazil	139,111,185	66.4 %	209,567,920	70,456,735	5.1 %	6,753,879	0.83 %
5	Japan	115,111,595	91.1 %	126,323,715	11,212,120	0.1 %	117,385	-0.2 %
6	Russia	102,258,256	71.3 %	143,439,832	41,181,576	0.3 %	330,067	-0.01 %
7	Nigeria	86,219,965	46.1 %	186,987,563	100,767,598	5 %	4,124,967	2.63 %
8	Germany	71,016,605	88 %	80,682,351	9,665,746	0.6 %	447,557	-0.01 %
9	U.K.	60,273,385	92.6 %	65,111,143	4,837,758	0.9 %	555,411	0.61 %
10	Mexico	58,016,997	45.1 %	128,632,004	70,615,007	2.1 %	1,182,988	1.27 %
11	France	55,860,330	86.4 %	64,668,129	8,807,799	1.4 %	758,852	0.42 %
12	Indonesia	53,236,719	20.4 %	260,581,100	207,344,381	6.5 %	3,232,544	1.17 %
13	Viet Nam	49,063,762	52 %	94,444,200	45,380,438	3.3 %	1,564,346	1.07 %
14	Turkey	46,196,720	58 %	79,622,062	33,425,342	5.1 %	2,242,750	1.22 %
15	Philippines	44,478,808	43.5 %	102,250,133	57,771,325	4.4 %	1,855,574	1.54 %

Source: www.internetlivestats.com

JAN
2016

ACTIVE E-COMMERCE SHOPPERS

PERCENTAGE OF THE NATIONAL POPULATION WHO BOUGHT SOMETHING ONLINE IN THE PAST MONTH [SURVEY-BASED]



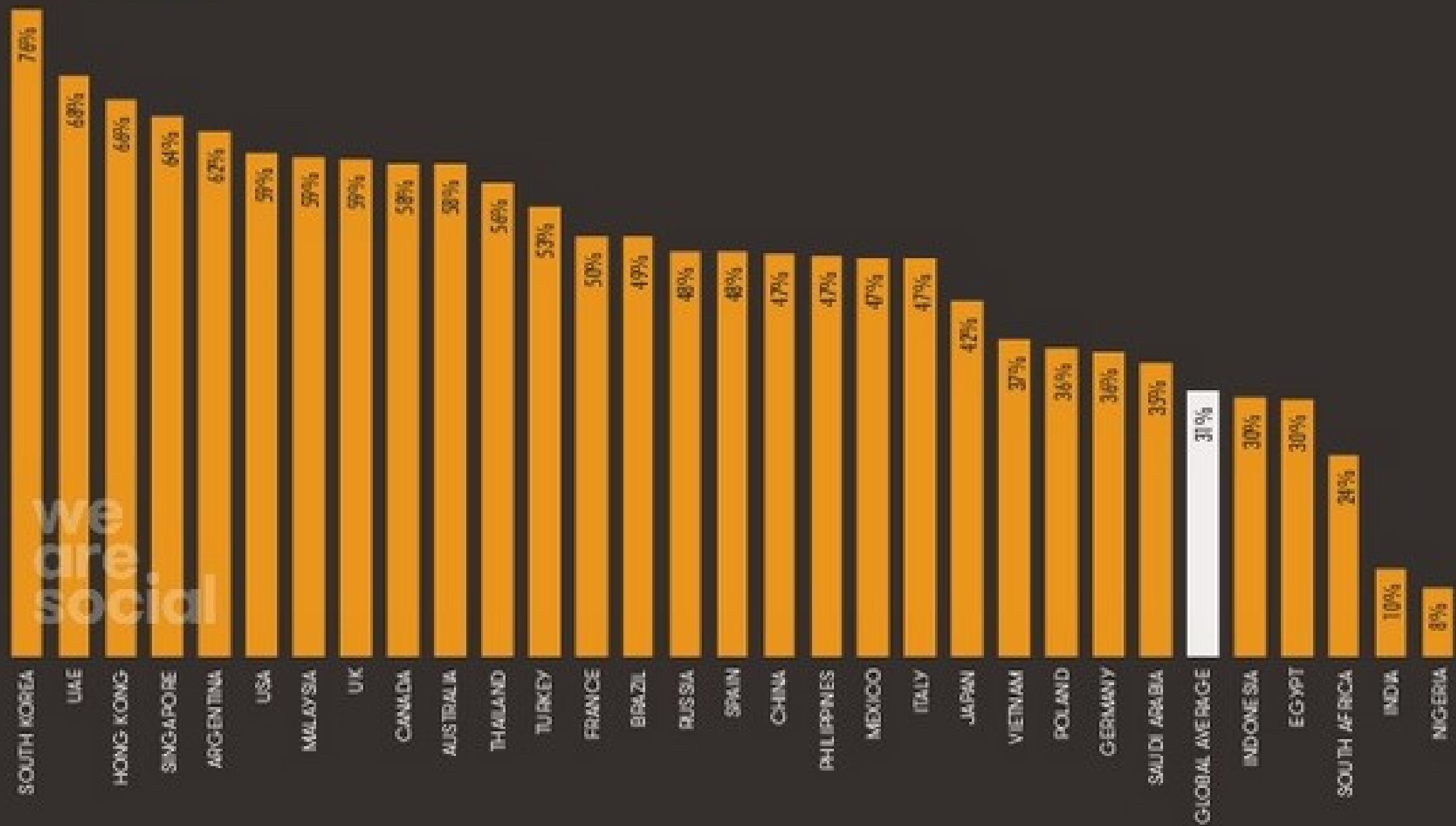
we
are
social

global
web
index

JAN
2016

SOCIAL MEDIA USE BY COUNTRY

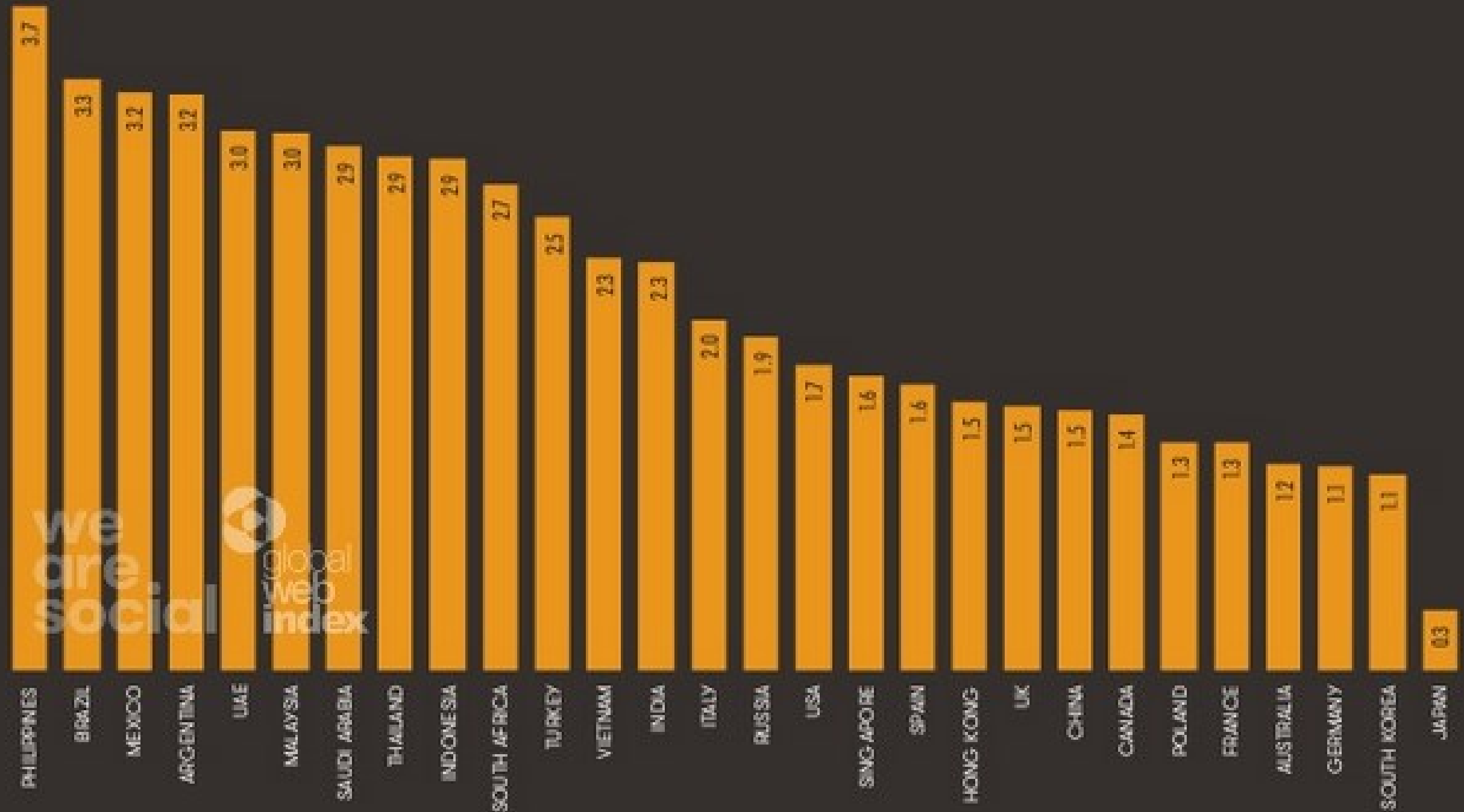
ACTIVE ACCOUNTS ON THE TOP SOCIAL NETWORK IN EACH COUNTRY, COMPARED TO POPULATION



**JAN
2016**

TIME SPENT ON SOCIAL MEDIA

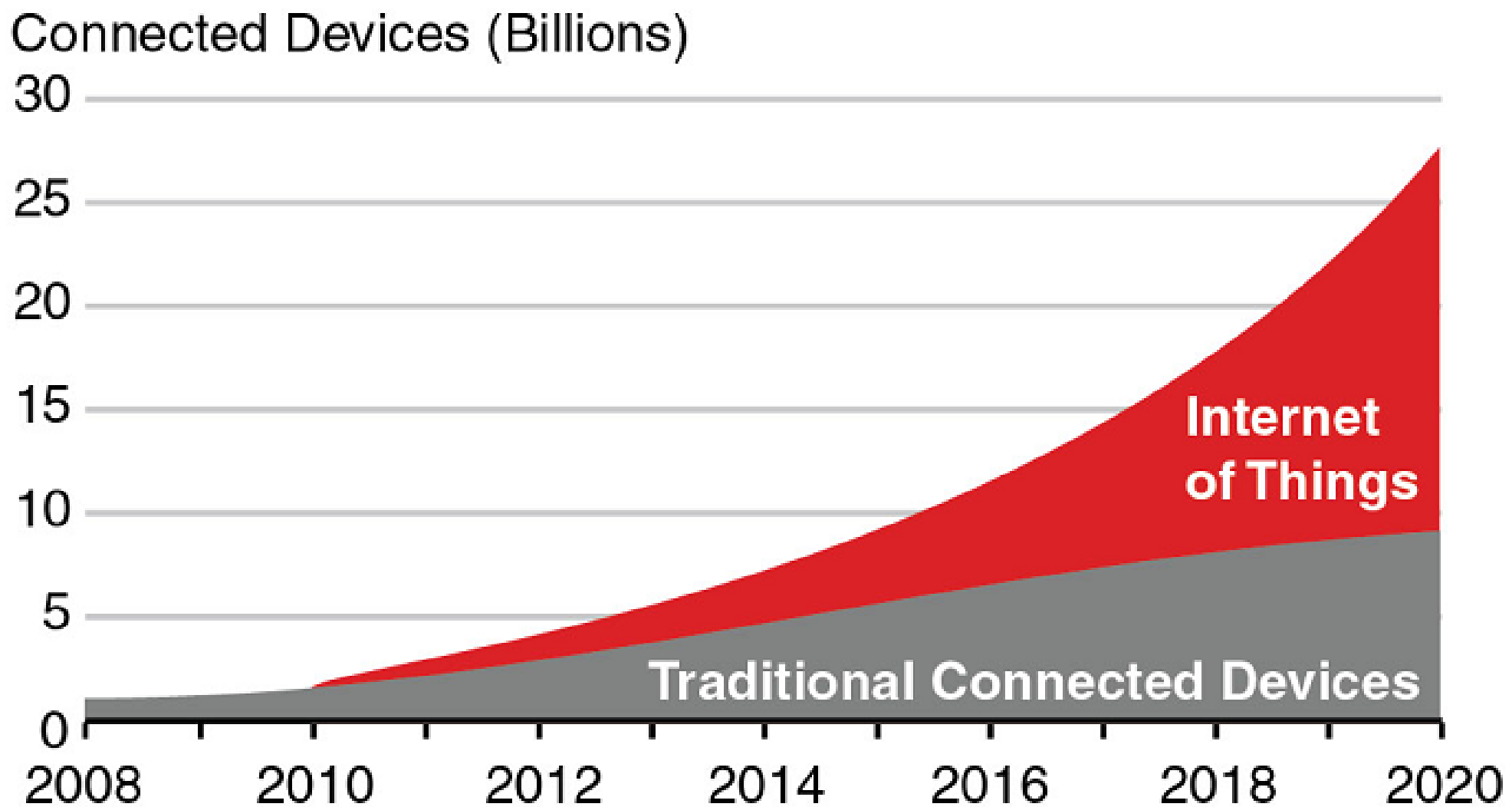
AVERAGE NUMBER OF HOURS THAT SOCIAL MEDIA USERS SPEND USING SOCIAL MEDIA EACH DAY



we
are
social

global
web
index

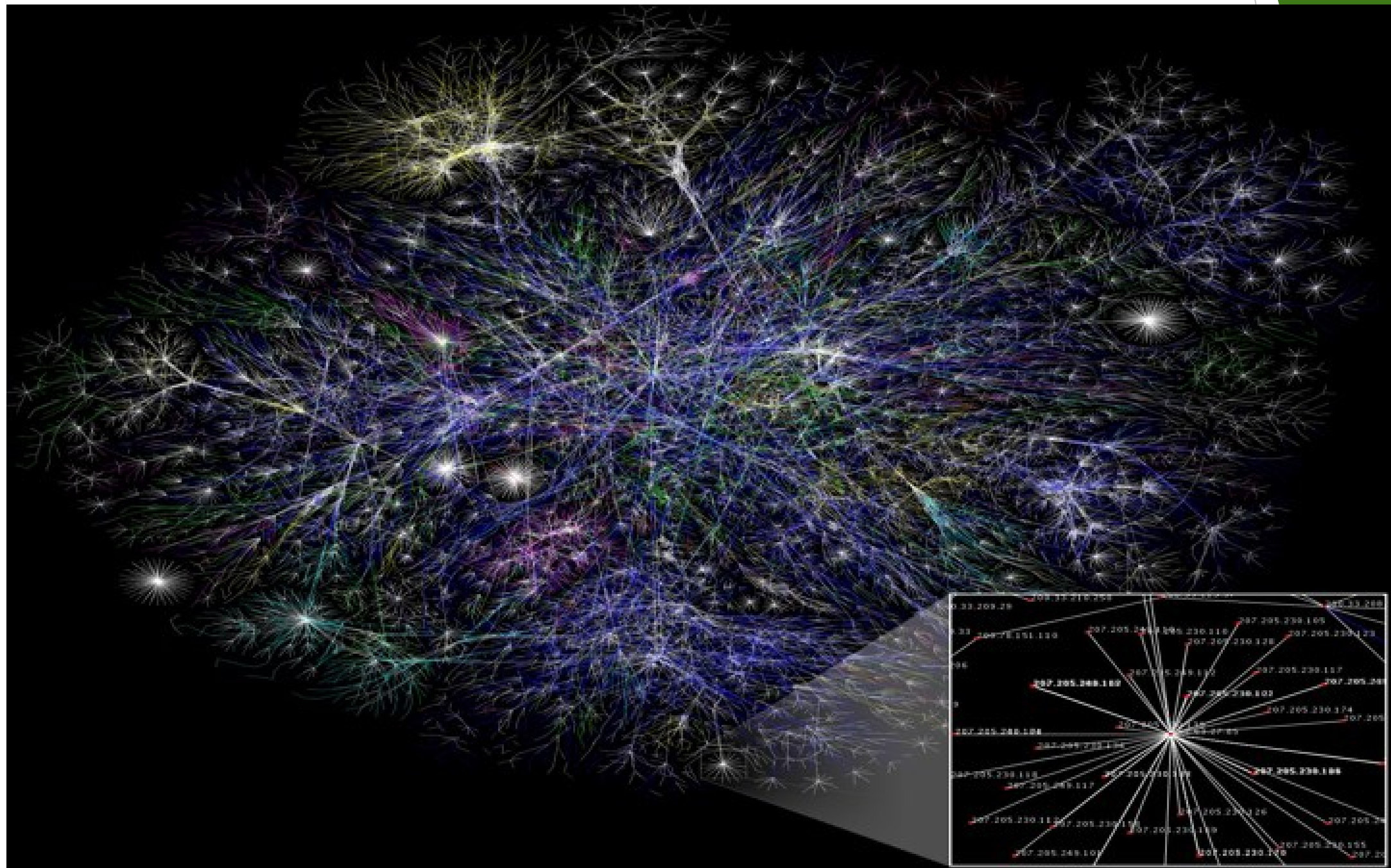
Estimated Worldwide Growth of Traditional Connected Devices and IoT



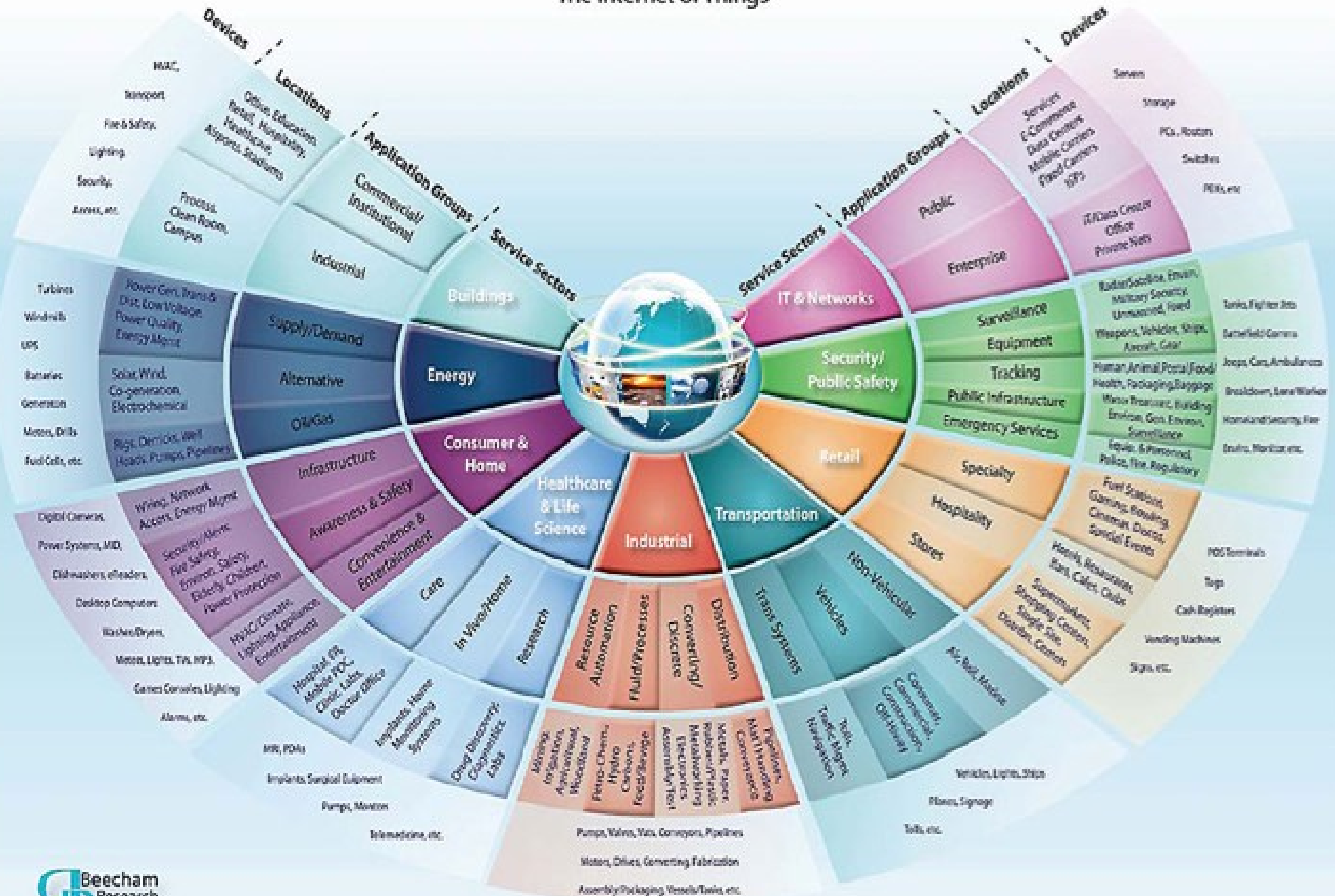
Source: A.T. Kearney

IoT ripples through advanced industries.

Data Growth

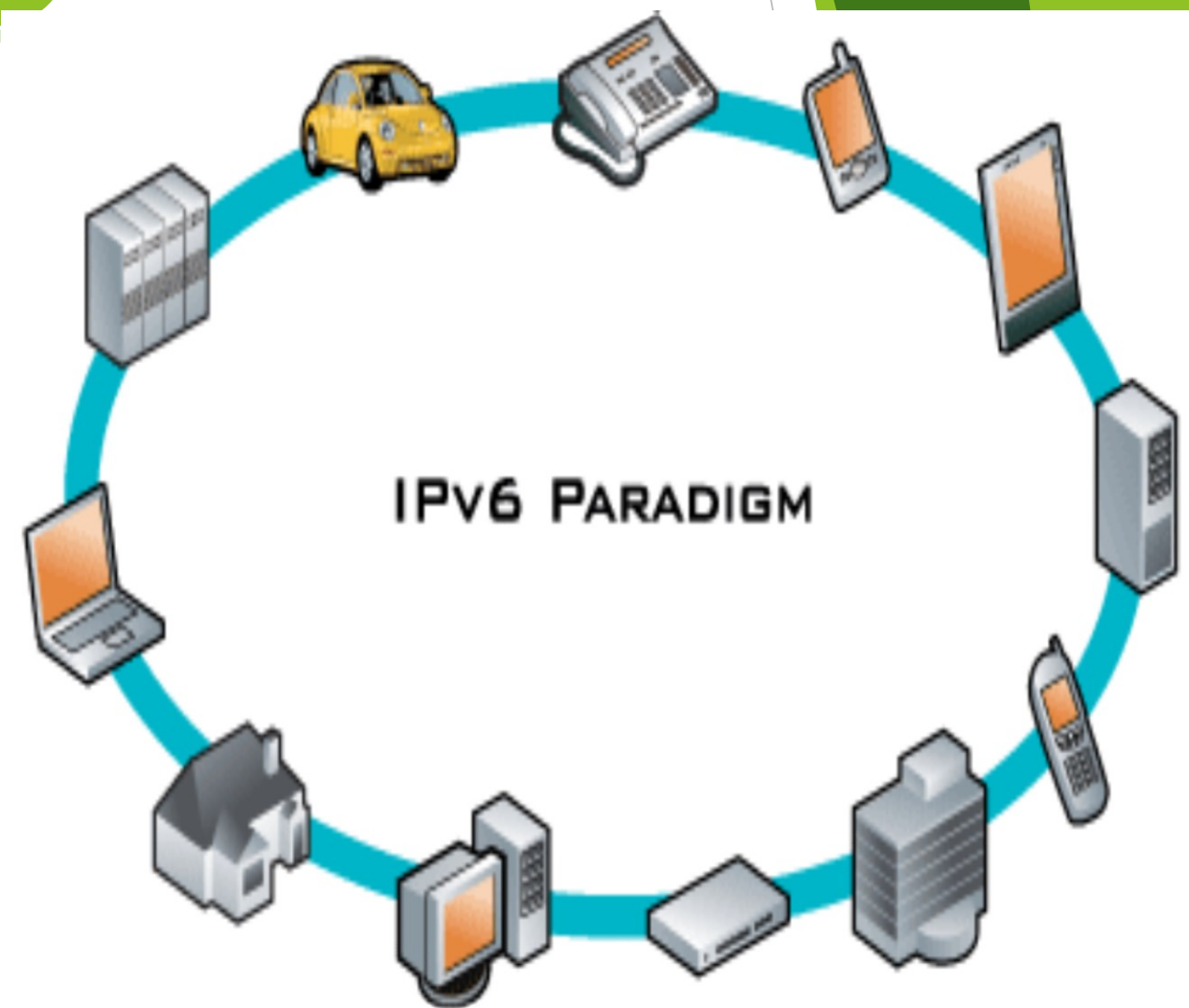


The Internet of Things

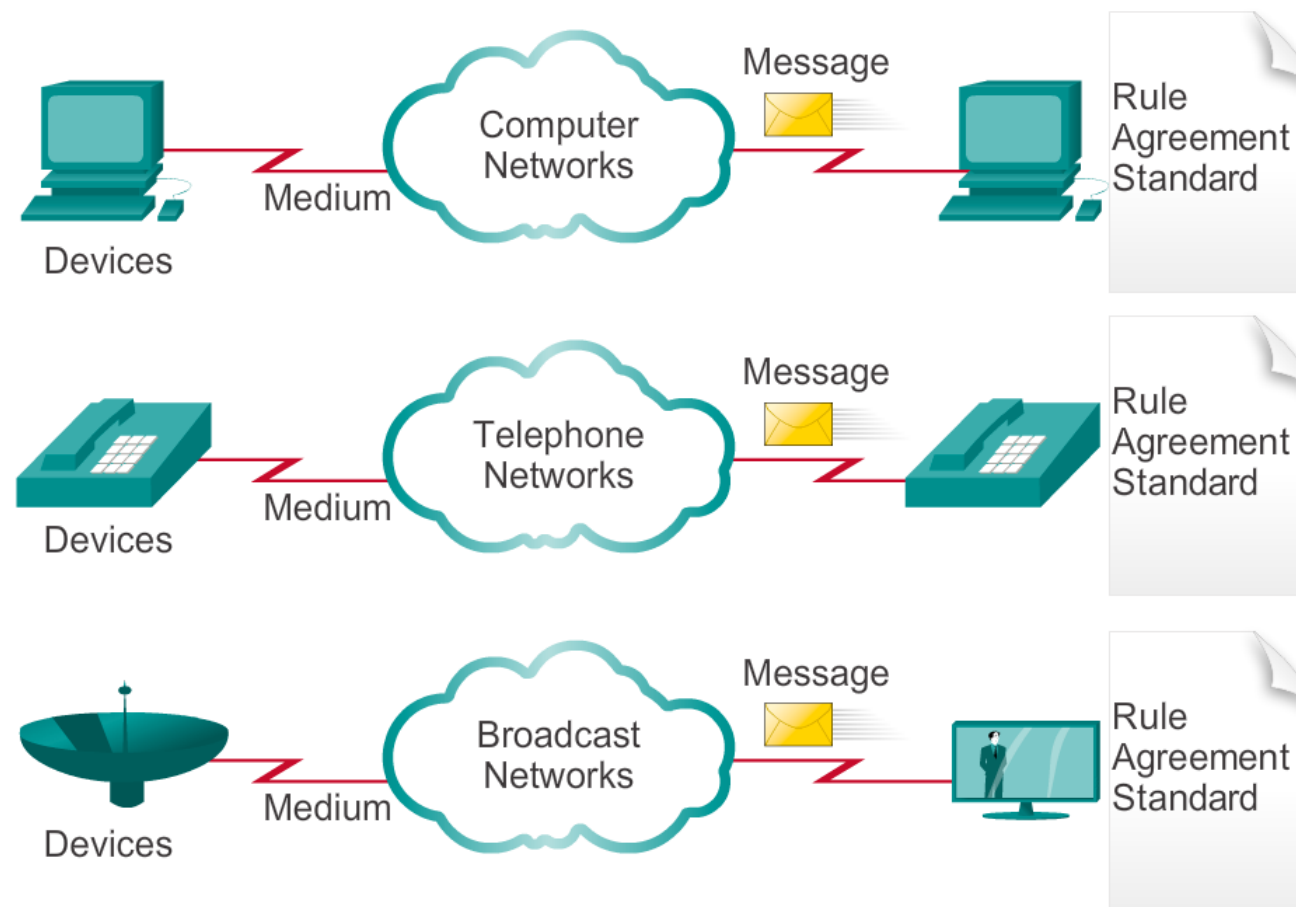


IPv4

IPv6



Data Networking Role, Components, and Challenges



Various elements make up a network :

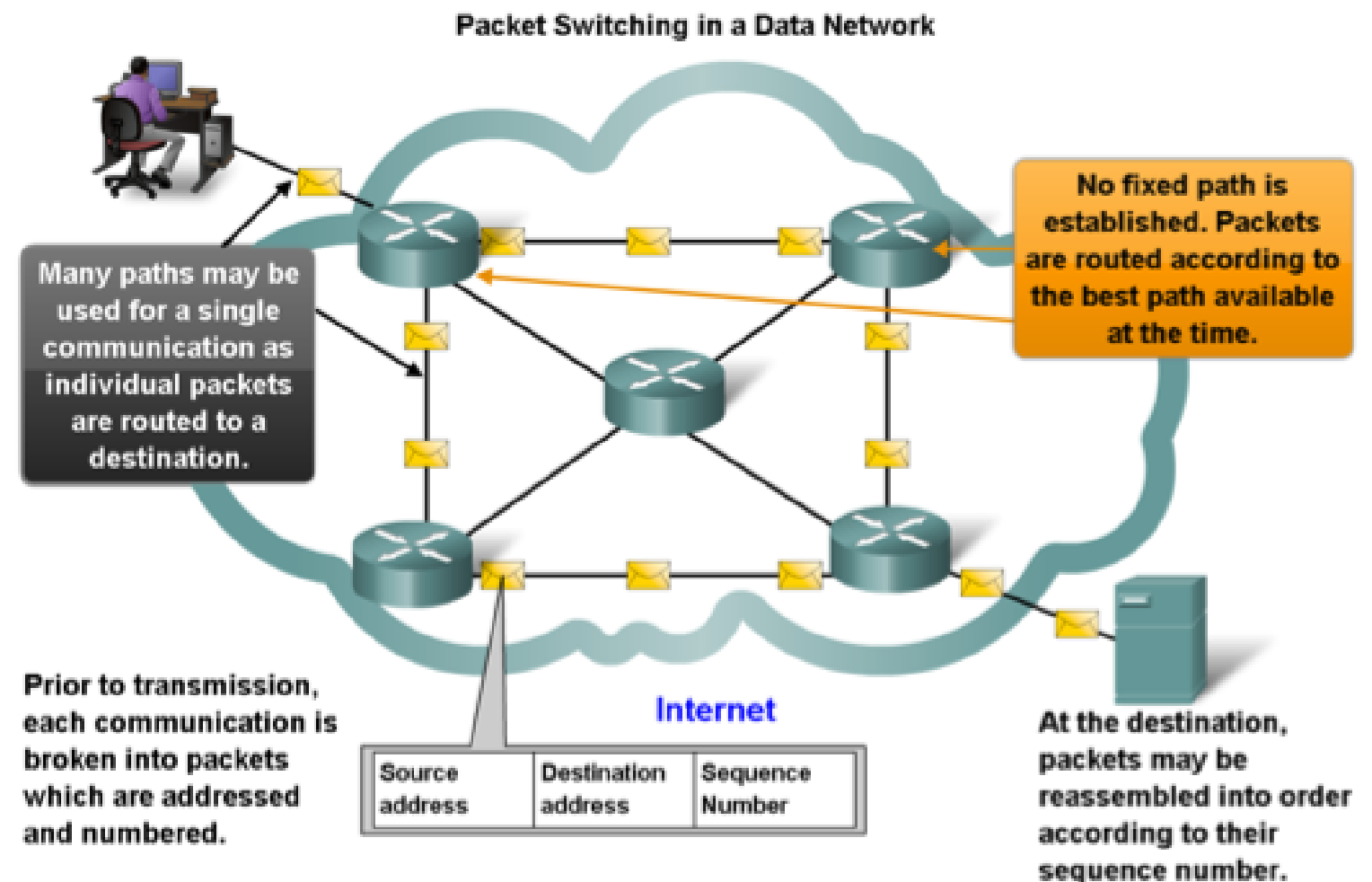
- **Devices:** These are used to communicate with one another
- **Medium:** This is how the devices are connected together
- **Messages:** Information that travels over the medium
- **Rules:** Governs how messages flow across network

Network Architecture - Reliable Networks

- ▶ There are four basic characteristics that the underlying architectures need to address in order to meet user expectations:
 - ▶ ***Fault Tolerance***
 - ▶ ***Scalability***
 - ▶ ***Quality of Service (QoS)***
 - ▶ ***Security***

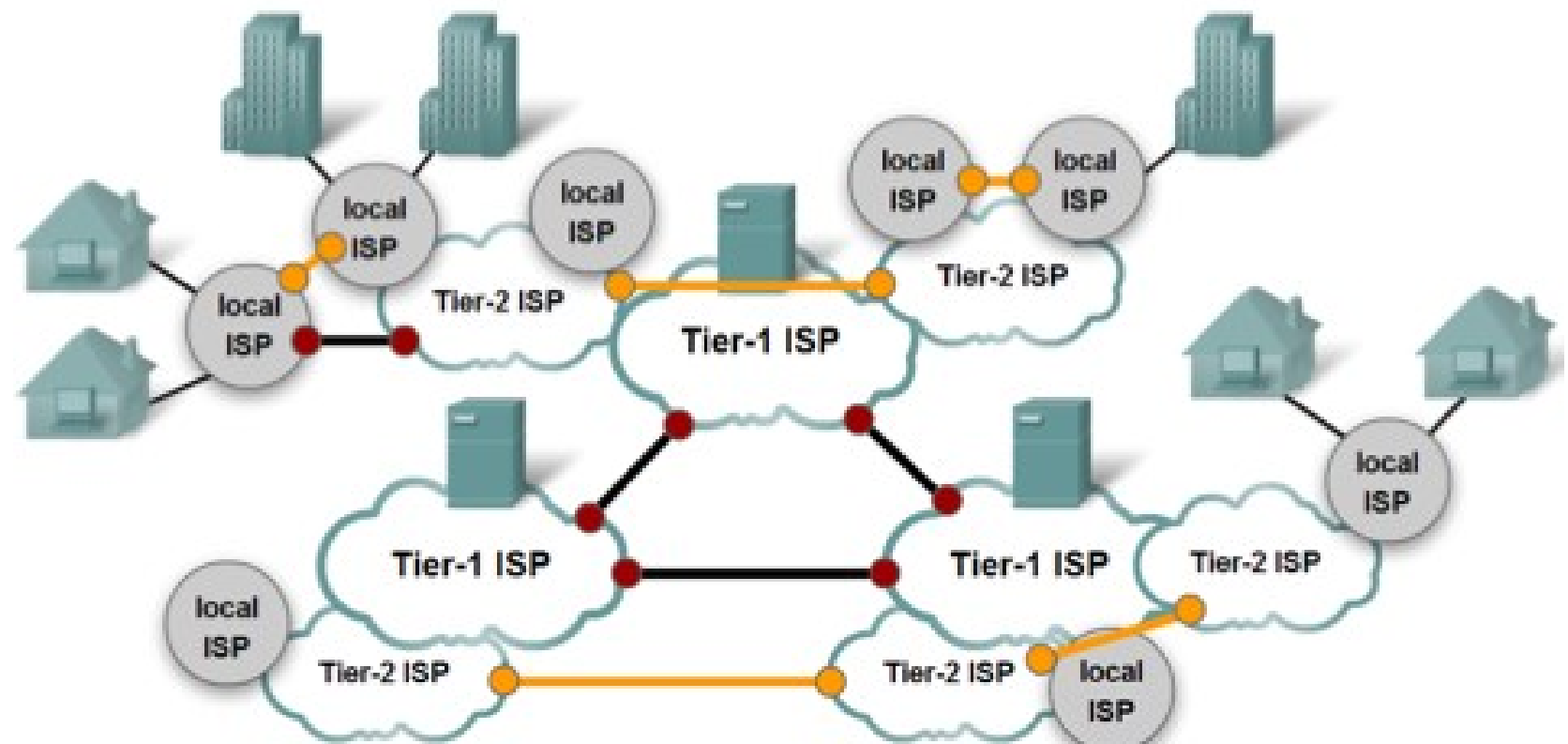
Fault Tolerance

- Packet switching helps improve the resiliency and fault tolerance of the Internet architecture



Scalability

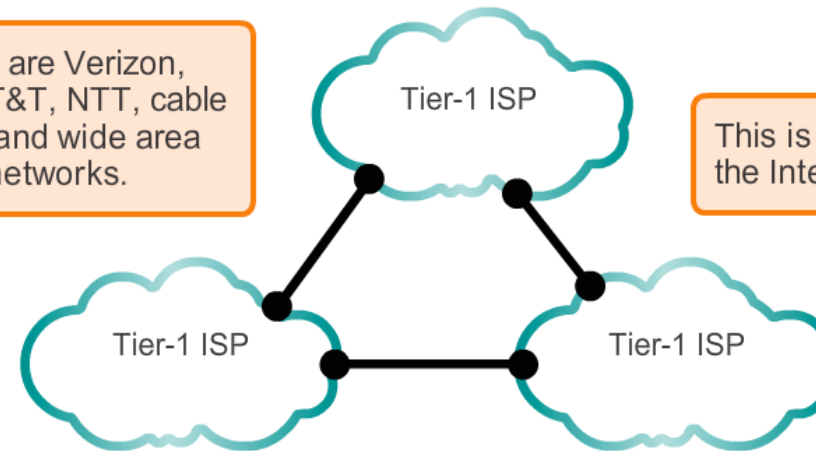
- ▶ Characteristics of the Internet that help it scale to meet user demand
 - ▶ Hierarchical
 - ▶ Common standards
 - ▶ Common protocols



Tier 1

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

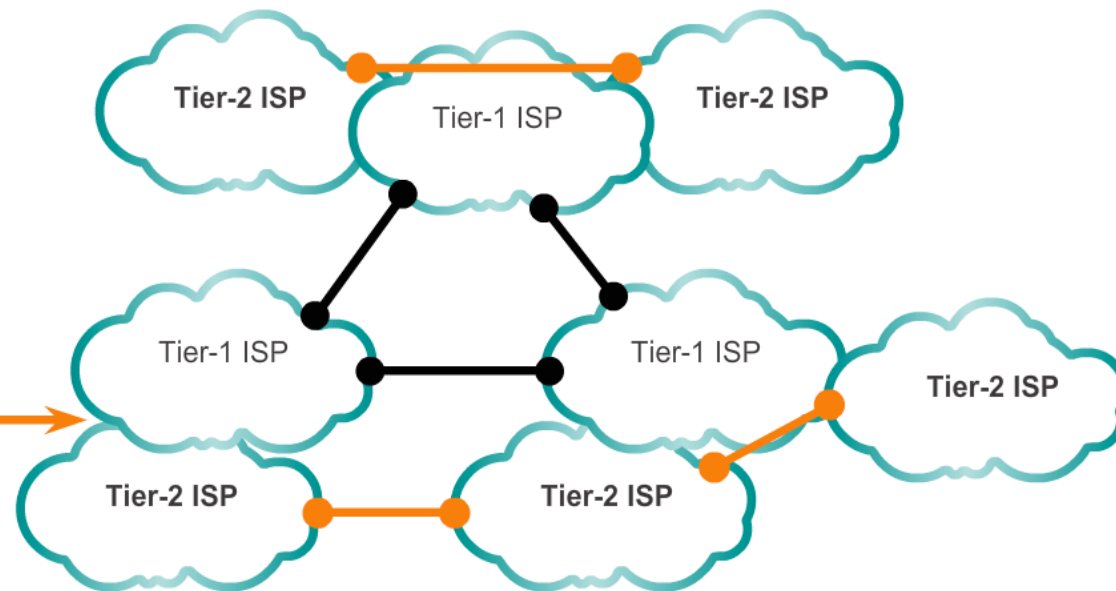
This is the backbone of the Internet.



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

The point where ISPs interconnect is often called a border.

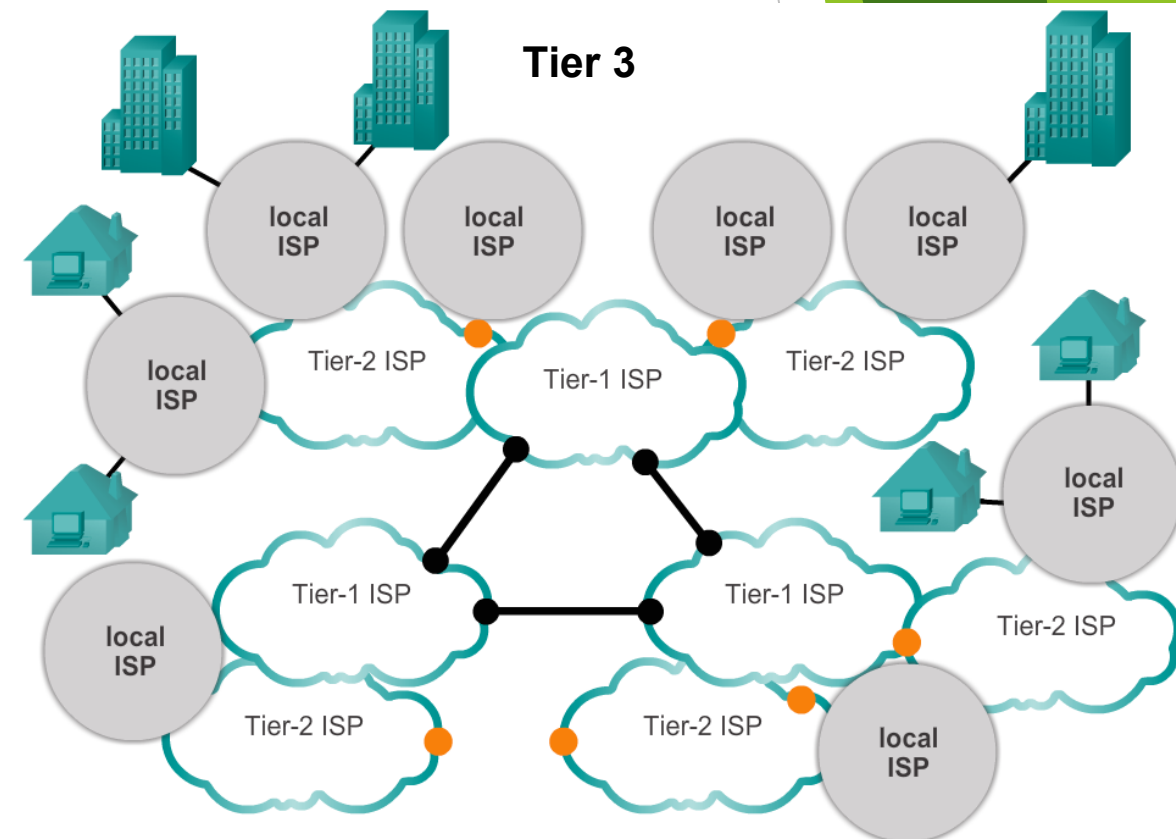
Tier 2



Tier-2 ISPs are smaller and often provide regional service. Tier-2 ISPs usually pay Tier-1 ISPs for connectivity to rest of the Internet.

Peer connections between networks at the same level provide direct connections, bypassing longer routes and preventing congestion on the backbone.

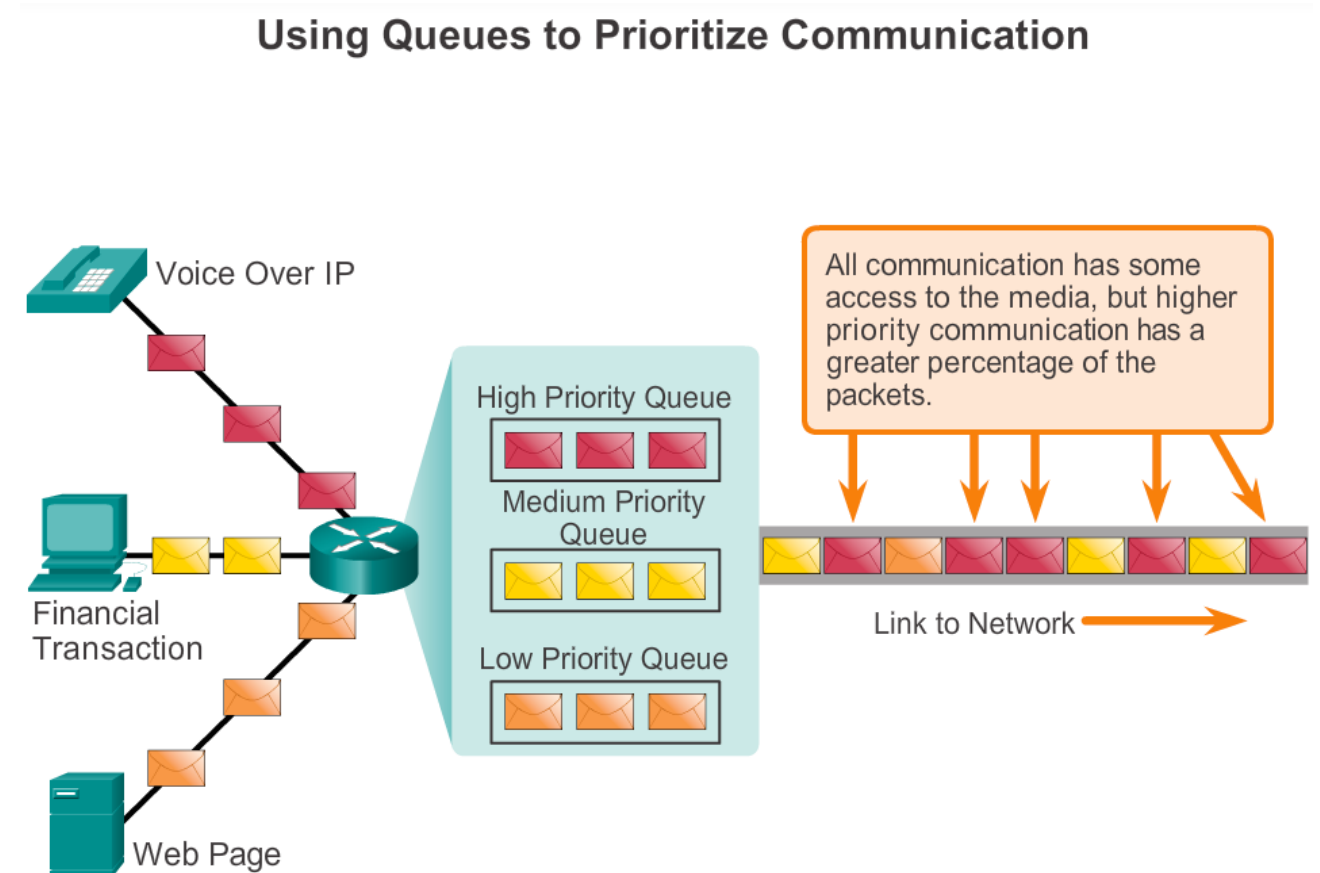
Tier 3



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.

Quality of Services (QoS)

- ▶ Networks also need mechanisms to manage congested network traffic.
- ▶ Network bandwidth is the measure of the data carrying capacity of the network. In other words, how much information can be transmitted within a specific amount of time? Network bandwidth is measured in the number of bits that can be transmitted in a single second, or bits per second (bps).
- ▶ When simultaneous communications are attempted across the network, the demand for network bandwidth can exceed its availability, creating network congestion.



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

Security

- ▶ There are two types of network security concerns that must be addressed: **network infrastructure security** and **information security**.
- ▶ Basic measures to secure data networks
 - ▶ Ensure confidentiality through use of
 - ▶ User authentication
 - ▶ Data encryption
 - ▶ Maintain communication integrity through use of
 - ▶ Digital signatures
 - ▶ Ensure availability through use of
 - ▶ Firewalls
 - ▶ Redundant network architecture
 - ▶ Network and hardware without a single point of failure

Security is Important for How We Use a Network

Unauthorized Transactions

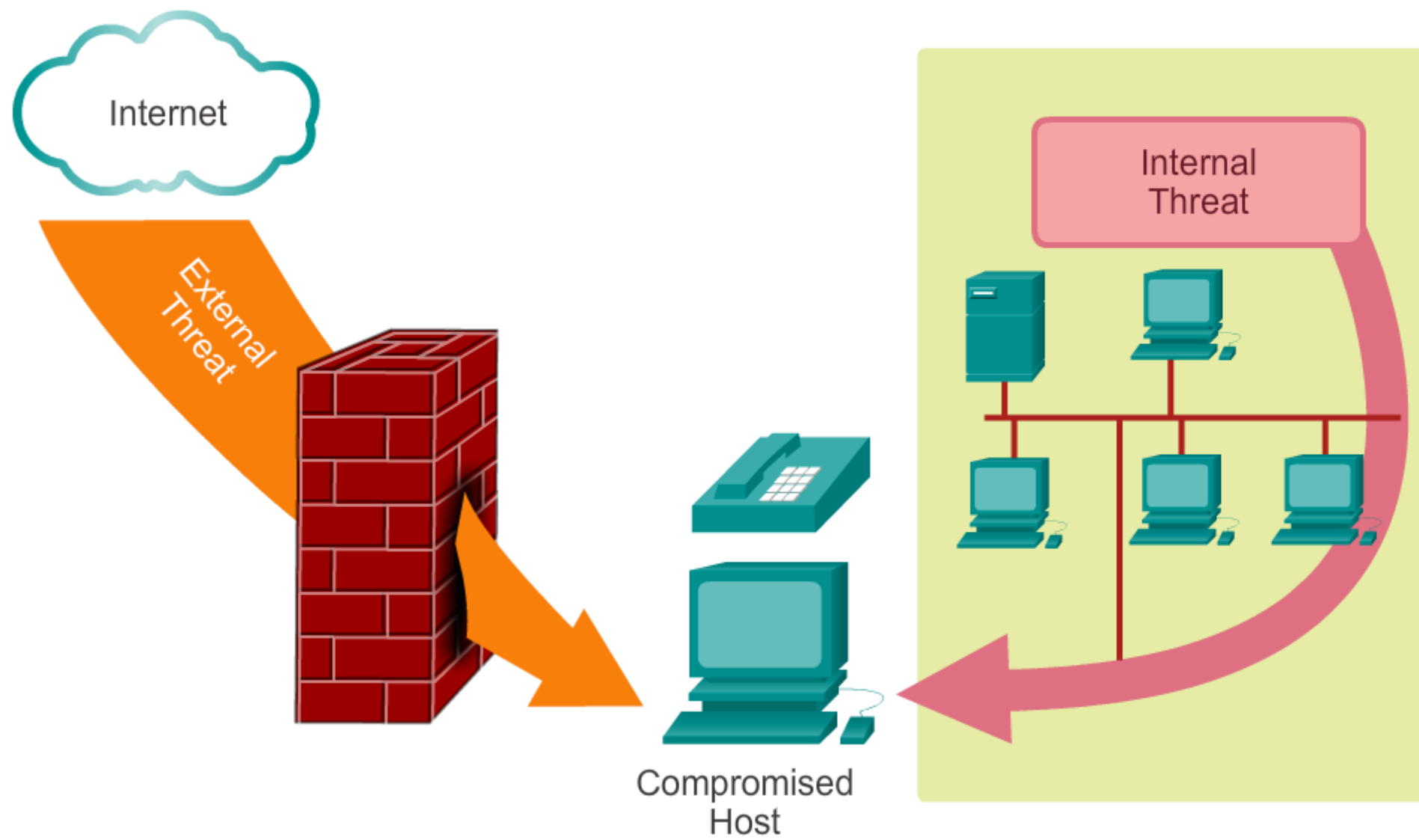
REFERENCE	SOLD	POSTED	ACTIVITY SINCE LAST STATEMENT	AMOUNT
483087382		1/25	PAYMENT THANK YOU	-168.80
32F149ER3	1/12	1/15	RECORD RECYCLER ANYTOWN USA	14.83
89102DI82	1/13	1/15	BEERPARA REST ANYTOWN USA	30.55
XX14PUD32	1/18	1/18	GREAT EXPECTATIONS BIG CITY USA	27.50
84XT3293A	1/20	1/21	DINO-CEL PETROLEUM ANYTOWN USA	12.76
873DM5321	2/09	2/09	SHIRTS 'N SUCH TIERVILLEUSA	40.10

Out of Business

Unauthorized use of our communications data can have severe consequences.

- ▶ No single solution can protect the network from the variety of threats that exist. For this reason, security should be implemented in multiple layers, using more than one security solution. If one security component fails to identify and protect the network, others still stand.
- ▶ Network security components for a home or small office network should include, at a minimum:
 - ▶ **Antivirus and antispyware** - to protect user devices from malicious software
 - ▶ **Firewall filtering** - to block unauthorized access to the network. This may include a host-based firewall system that is implemented to prevent unauthorized access to the host device, or a basic filtering service on the home router to prevent unauthorized access from the outside world into the network.
- ▶ In addition to the above, larger networks and corporate networks often have other security requirements:
 - ▶ **Dedicated firewall systems** - to provide more advanced firewall capability that can filter large amounts of traffic with more granularity
 - ▶ **Access control lists (ACL)** - to further filter access and traffic forwarding
 - ▶ **Intrusion prevention systems (IPS)** - to identify fast-spreading threats, such as zero-day or zero-hour attacks
 - ▶ **Virtual private networks (VPN)** - to provide secure access to remote workers

Firewall



Data Networking Role, Components, and Challenges

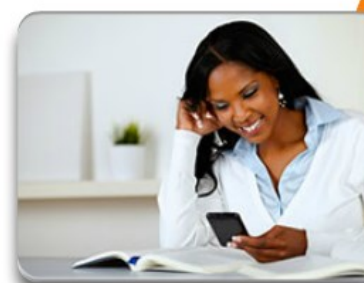
- ▶ The role of converged networks in communications
- ▶ Converged network
 - ▶ A type of network that can carry voice, video & data over the same network



Intelligent networks allow handheld devices to receive news and emails, 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.



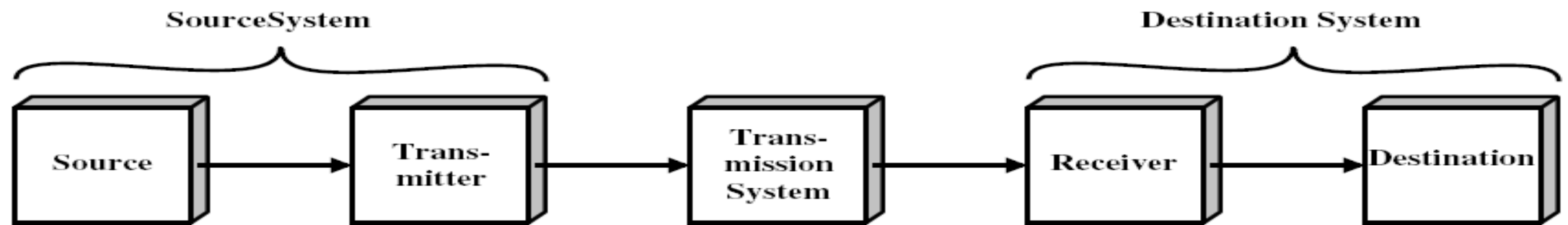
The Human Network is everywhere.



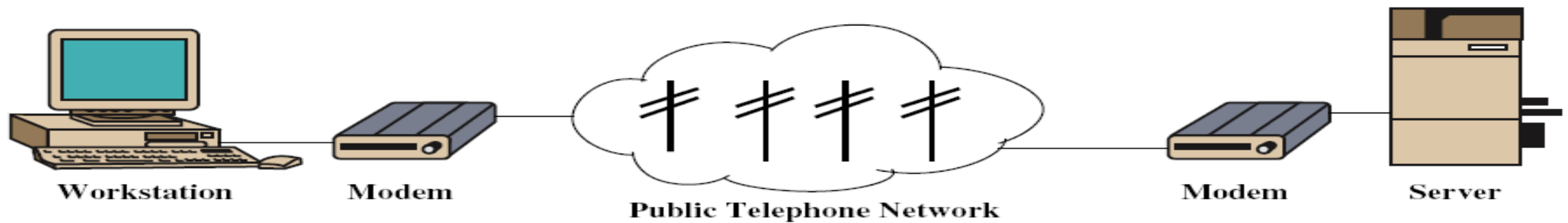
Online gaming connects thousands of people seamlessly.

Communicating Over The Networks

Model Komunikasi



(a) General block diagram

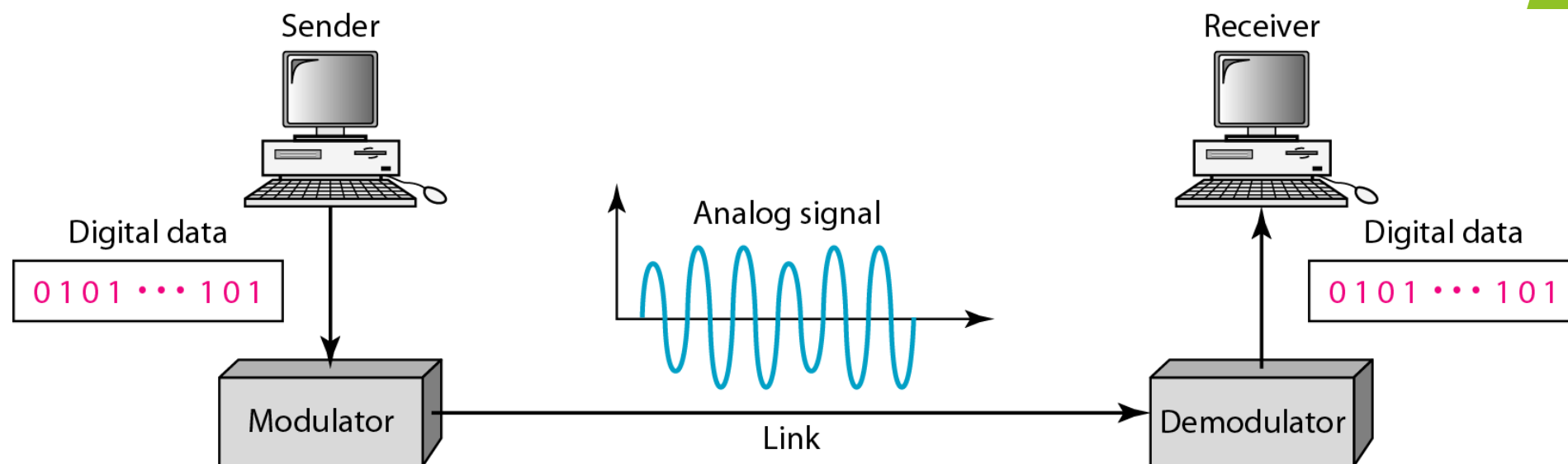
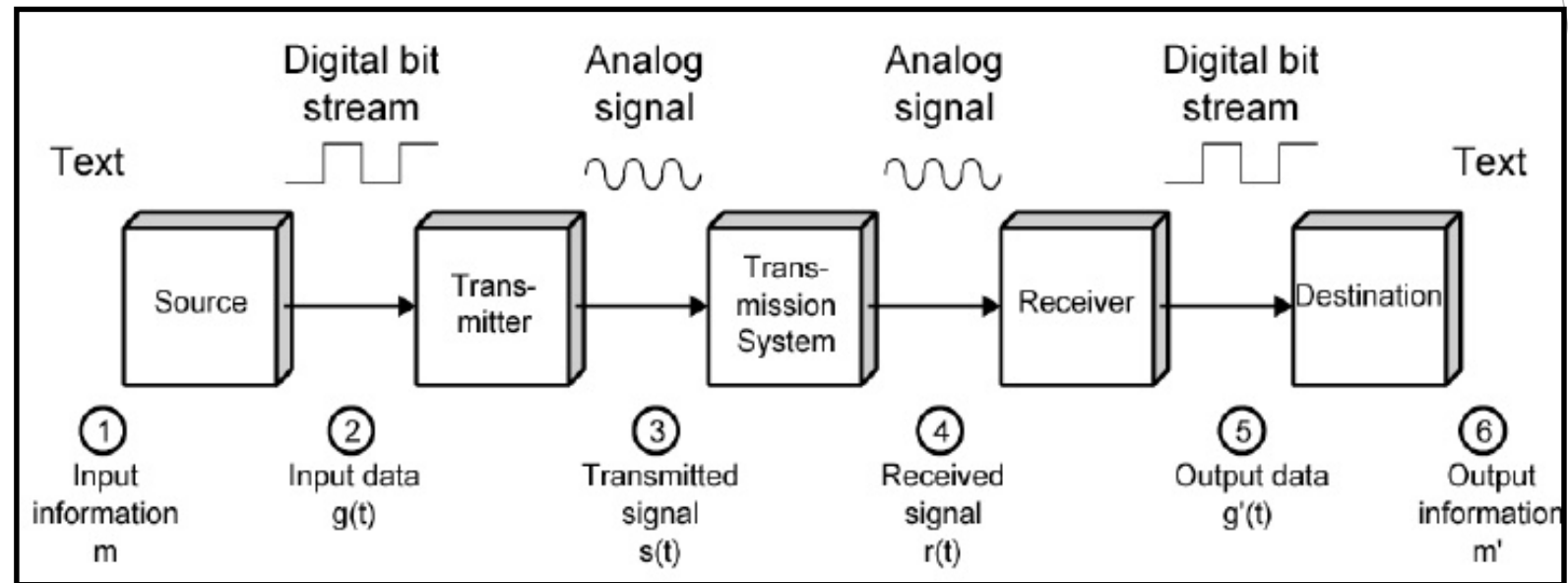


(b) Example

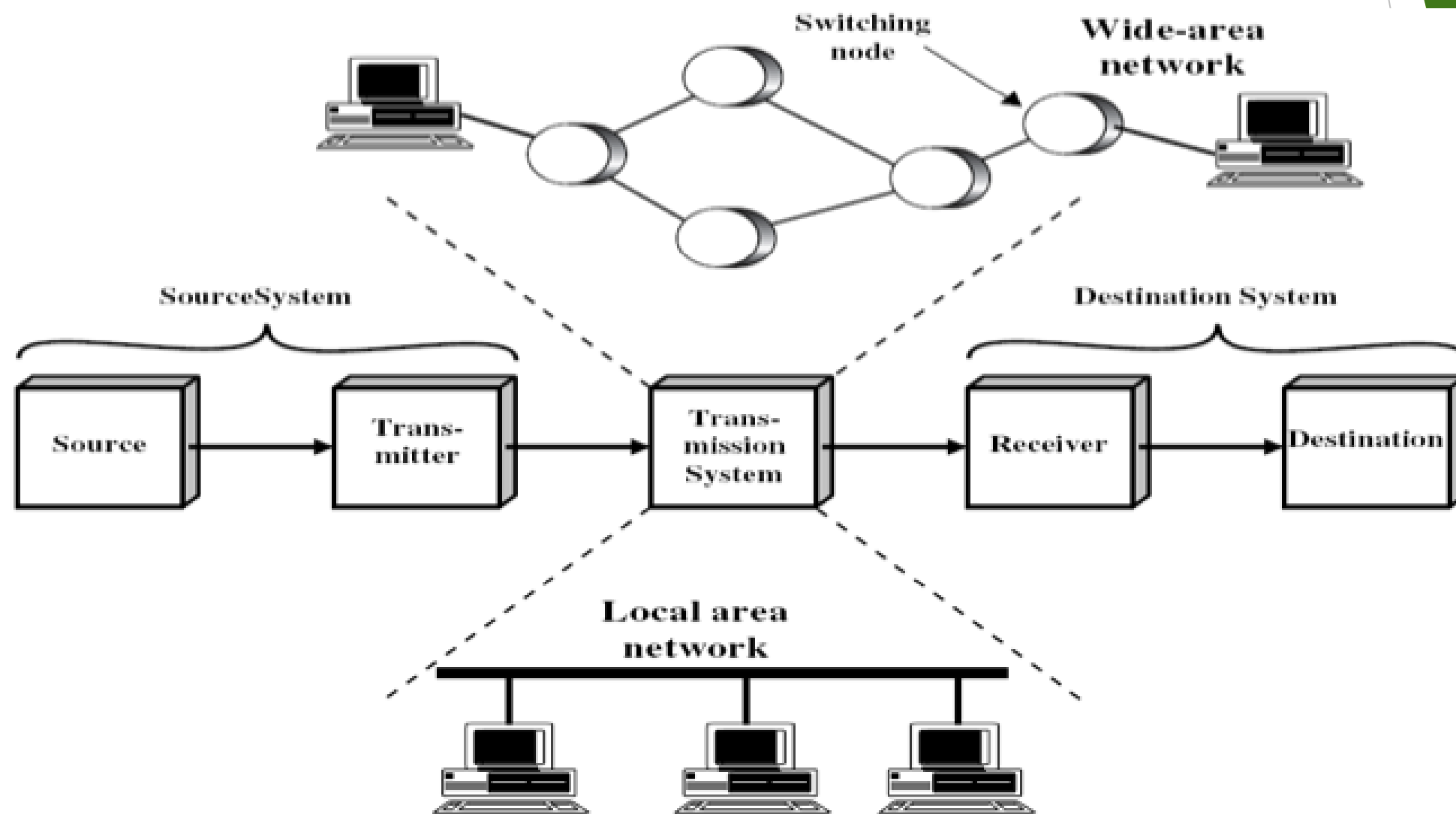
Elemen Sistem Komunikasi

1. Source (Sumber)
2. Transmitter (Pengirim)
3. Transmission System (Sistem Transmisi)
4. Receiver (Penerima)
5. Destination (Tujuan)

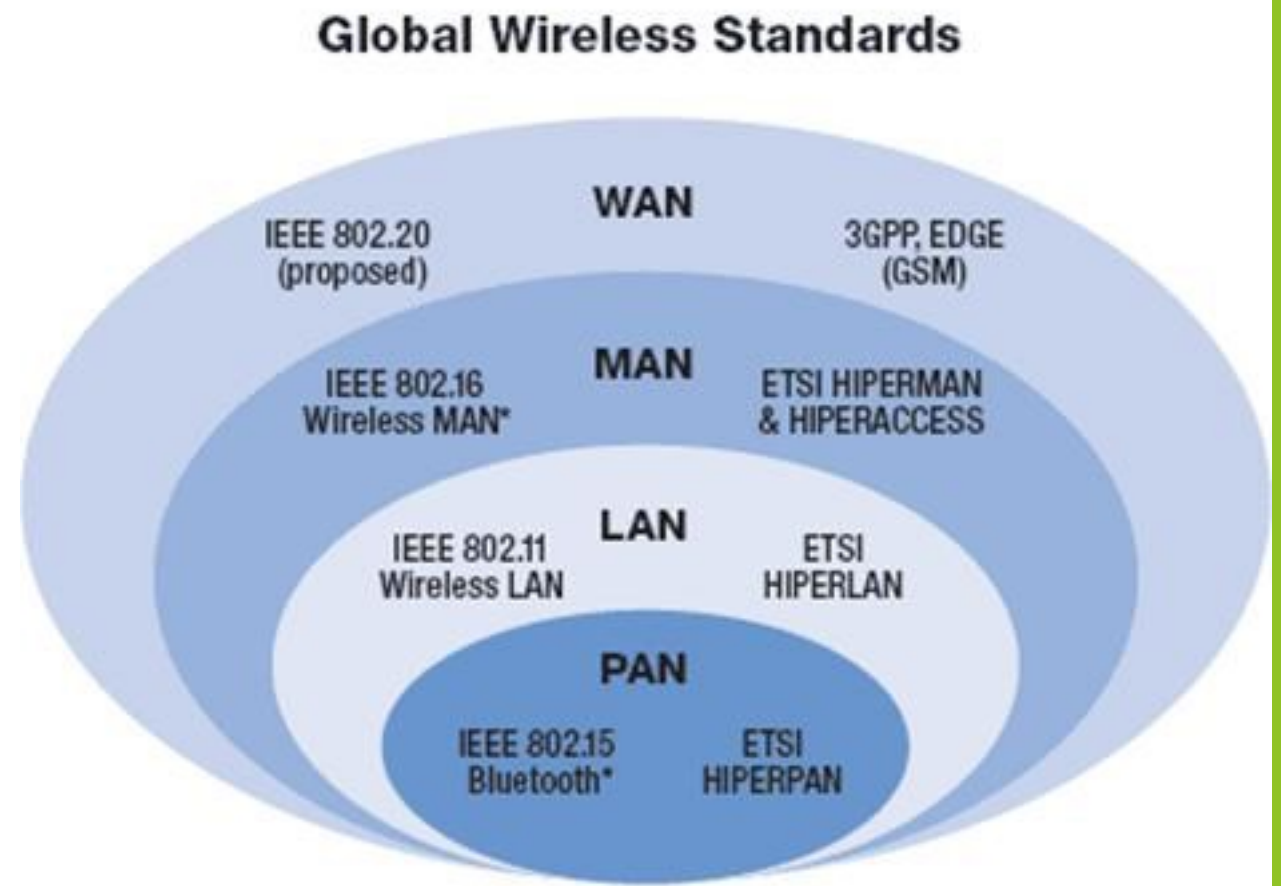
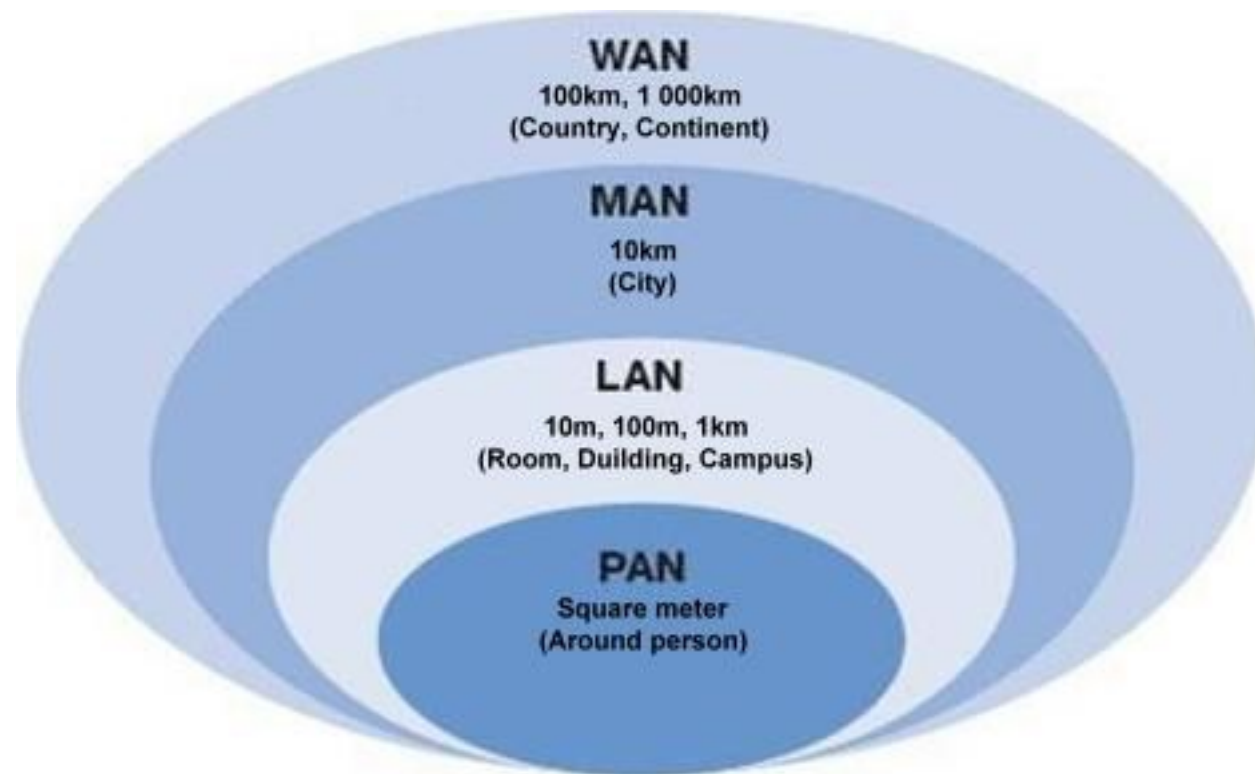
Komunikasi Data



Jaringan Komunikasi Data



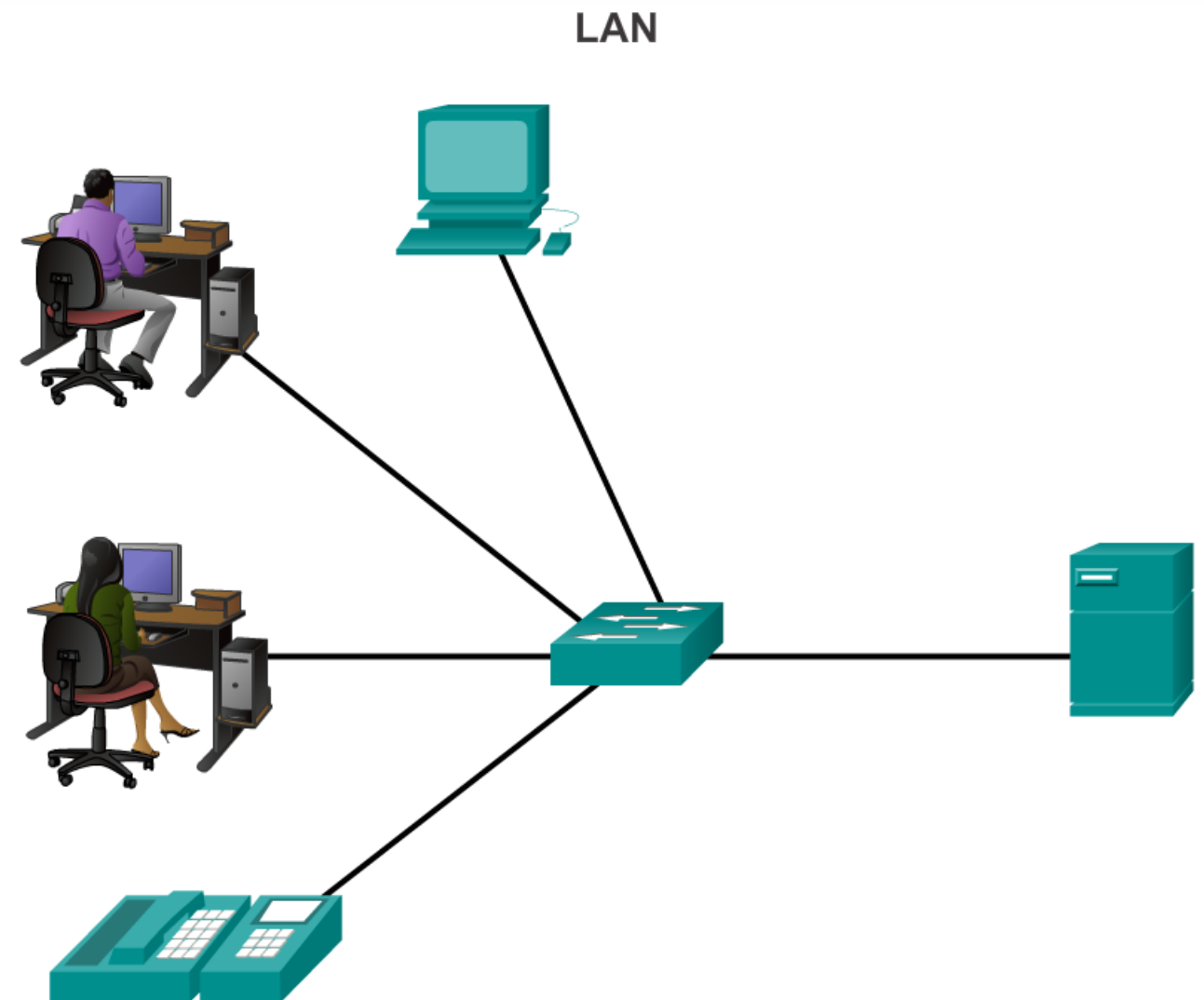
Types of Networks



CRITERIA	LAN	MAN	WAN
Cost	Low	High	Higher
Network Size	Small	Larger	Largest
Speed	Fastest	Slower	Slowest
Transmission media type	Twisted-pair	Twisted-pair and fibre-optic cables	Fiber optic, radio wave and satellite
Number of computers	Smallest	Large	Largest

Local Area Network (LAN)

- ▶ **Local Area Networks (LANs)** are a network infrastructure that spans a small geographical area. Specific features of LANs include:
 - ▶ LANs interconnect end devices in a limited area such as a home, school, office building, or campus.
 - ▶ A LAN is usually administered by a single organization or individual. The administrative control that governs the security and access control policies are enforced on the network level.
 - ▶ LANs provide high speed bandwidth to internal end devices and intermediary devices.



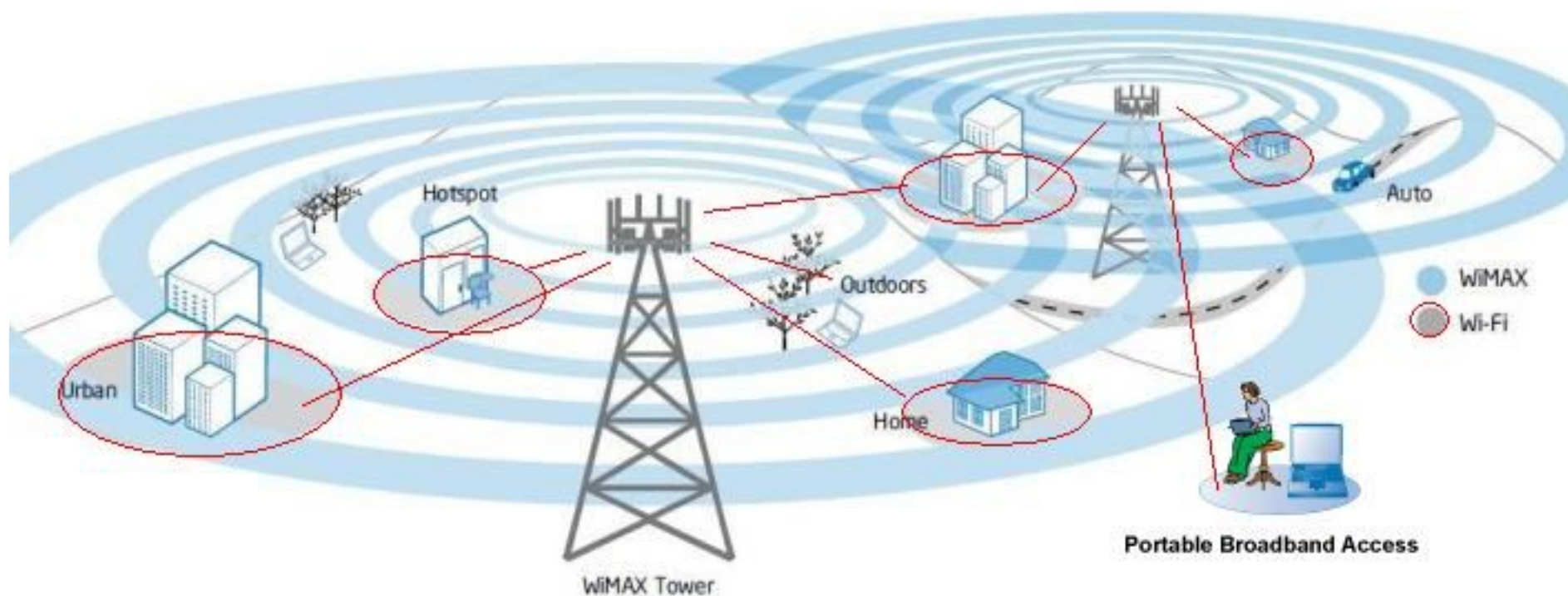
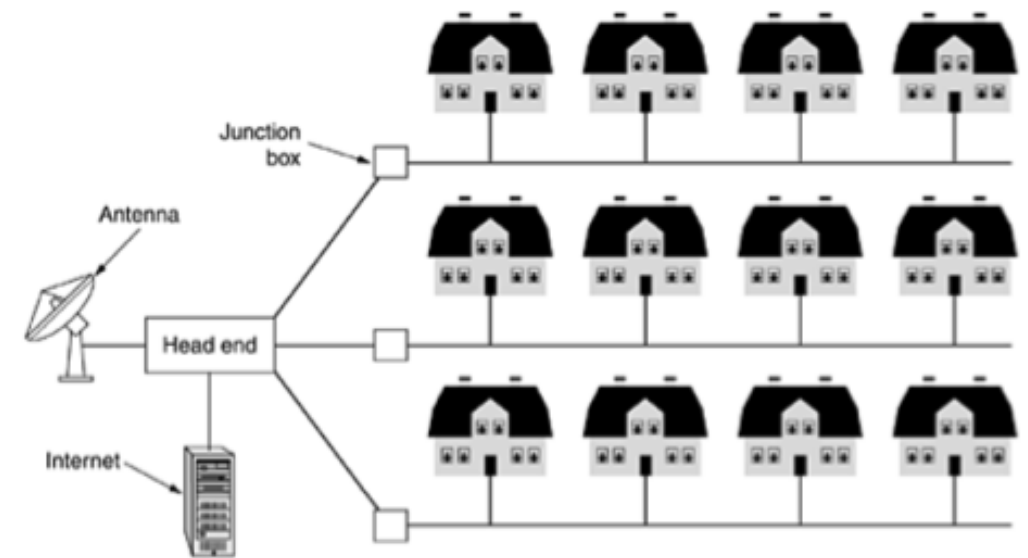
A network serving a home, building, or campus is considered a LAN.

Metropolitan Area Network (MAN)

► Metropolitan Area Network (MAN) -

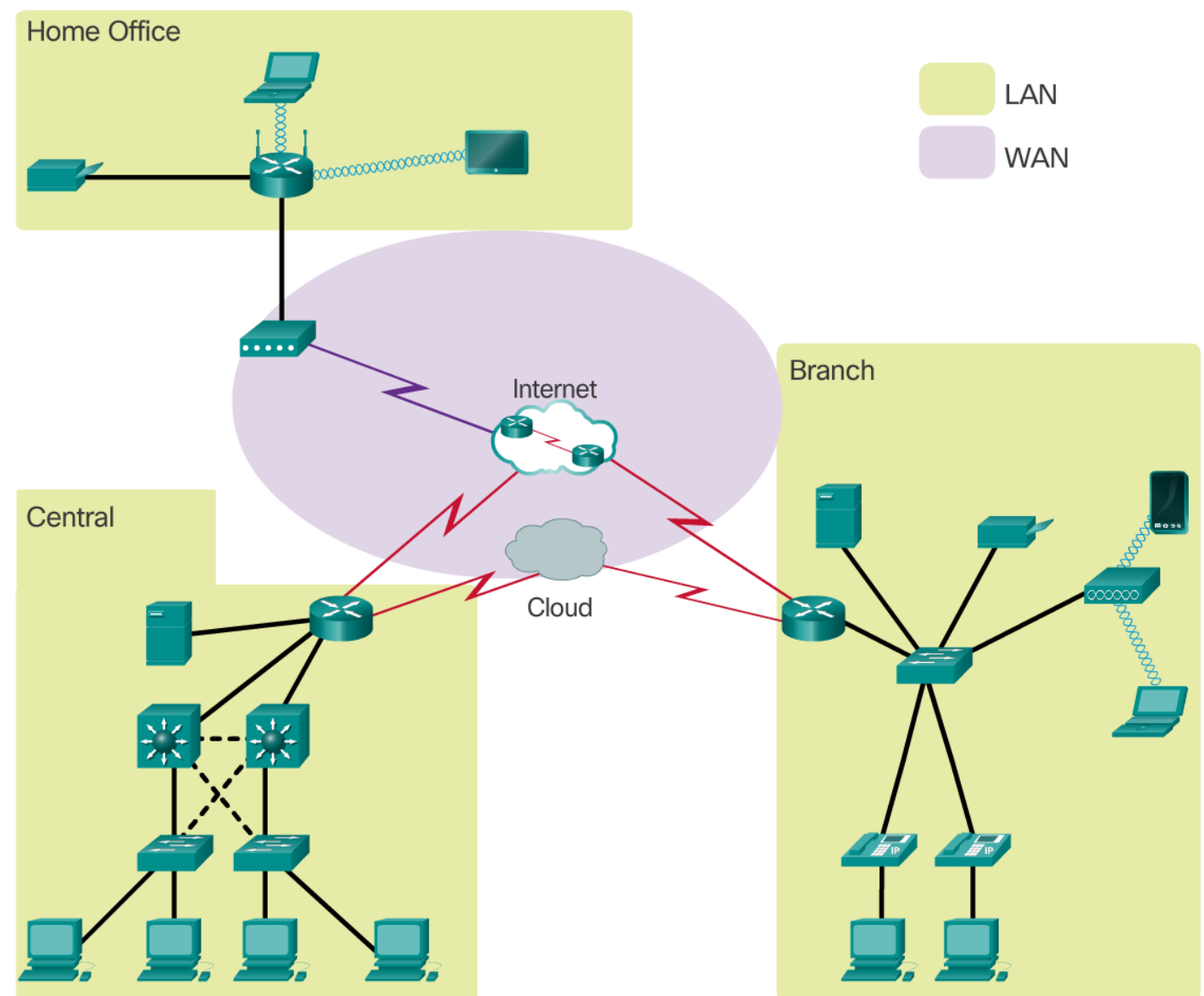
A network infrastructure that spans a physical area larger than a LAN but smaller than a WAN (e.g., a city). MANs are typically operated by a single entity such as a large organization.

Figure 1-8. A metropolitan area network based on cable TV.



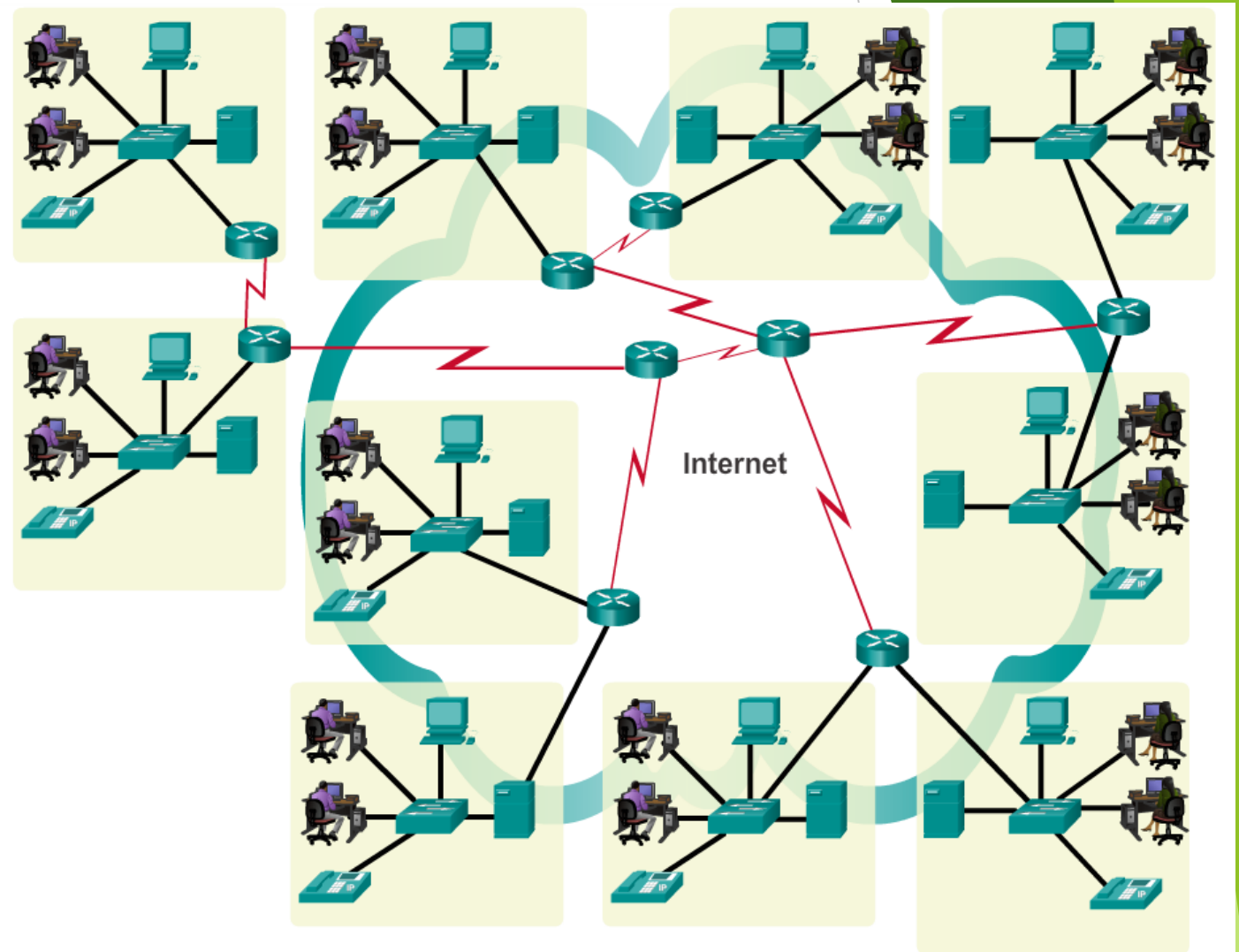
Wide Area Network (WAN)

- ▶ **Wide Area Networks (WANs)** are a network infrastructure that spans a wide geographical area. WANs are typically managed by service providers (SP) or Internet Service Providers (ISP).
- ▶ Specific features of WANs include:
 - ▶ WANs interconnect LANs over wide geographical areas such as between cities, states, provinces, countries, or continents.
 - ▶ WANs are usually administered by multiple service providers.
 - ▶ WANs typically provide slower speed links between LANs.



Internet

► The Internet is a worldwide collection of interconnected networks (internetworks or internet for short), cooperating with each other to exchange information using common standards. Through telephone wires, fiber optic cables, wireless transmissions, and satellite links, Internet users can exchange information in a variety of forms.



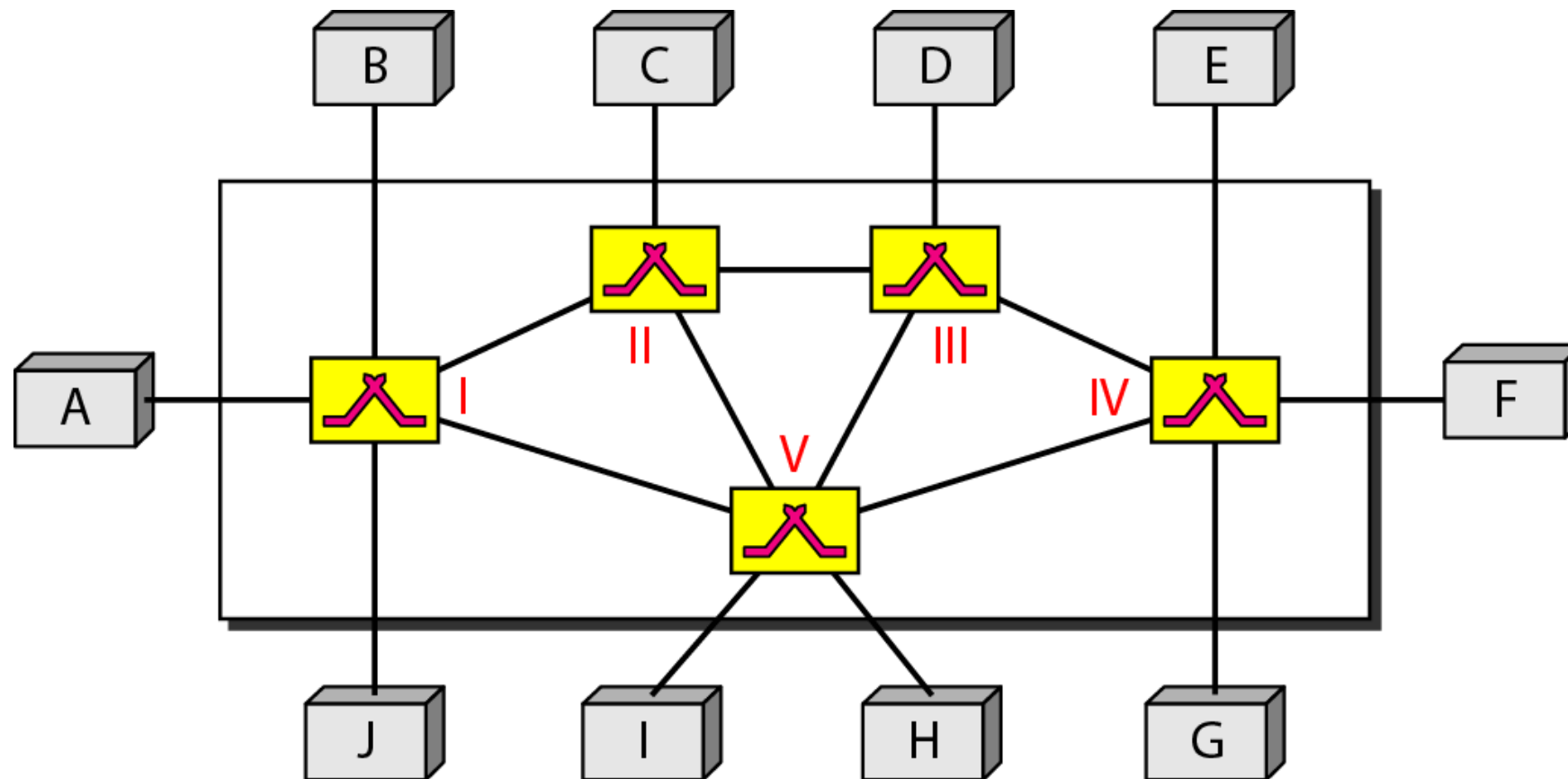
LANs and WANs may be connected into internetworks.

Switching

- ▶ Permasalahan yang timbul jika jaringan memiliki banyak perangkat:
 - ▶ Boros
 - ▶ semakin banyak perangkat akan makin banyak dan makin panjang link tidak efisien dalam cost
 - ▶ Mayoritas link akan idle dalam suatu waktu
- ▶ Solusi: **SWITCHING**

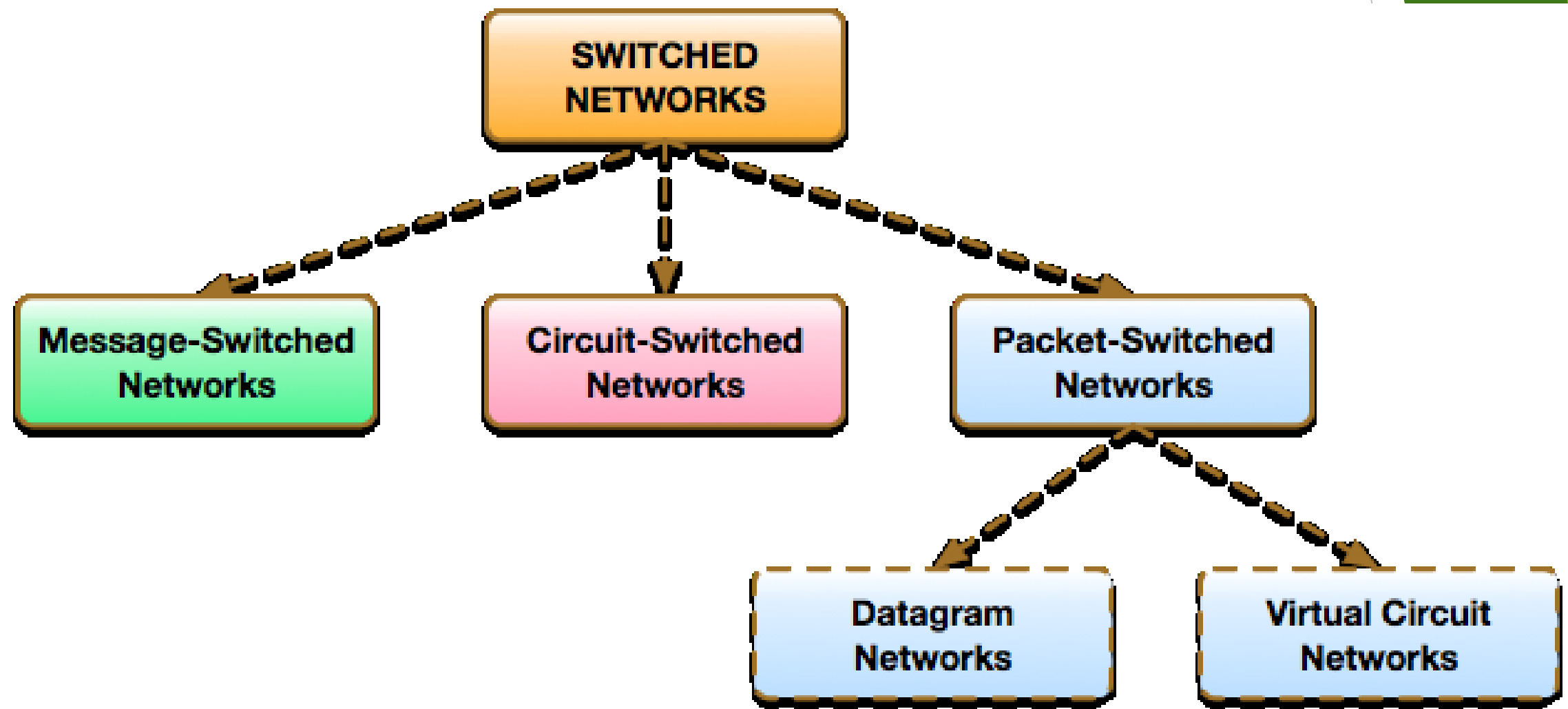


Switched Network



- Sebuah jaringan switching (Switched Network) akan terdiri dari satu set node interlink yang disebut **switch**.
- Switch merupakan perangkat yang mampu menciptakan koneksi sementara (temporary connection) antara 2 atau lebih perangkat yang terhubung ke switch.

Taxonomy Jaringan Switching



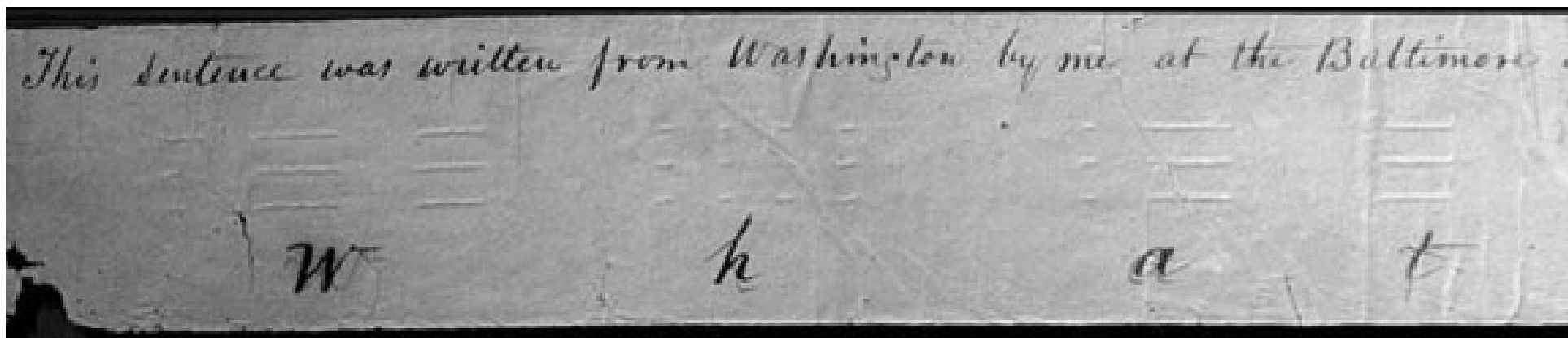
Message Switching

Message-Switched Networks

- Digunakan pada jaringan **telegraph**
 - Telegraphy : writing in distance
- Sinyal-sinyal morse dari suatu stasiun telegraph ditransfer ke stasiun yang lain (bisa jadi melalui beberapa perantara)



Penemu Telegraph:
Samuel F.B Morse
1791- 1872



"WHAT HATH GOD WROUGHT" The first telegraph message sent by Morse from Baltimore to Washington
About.com

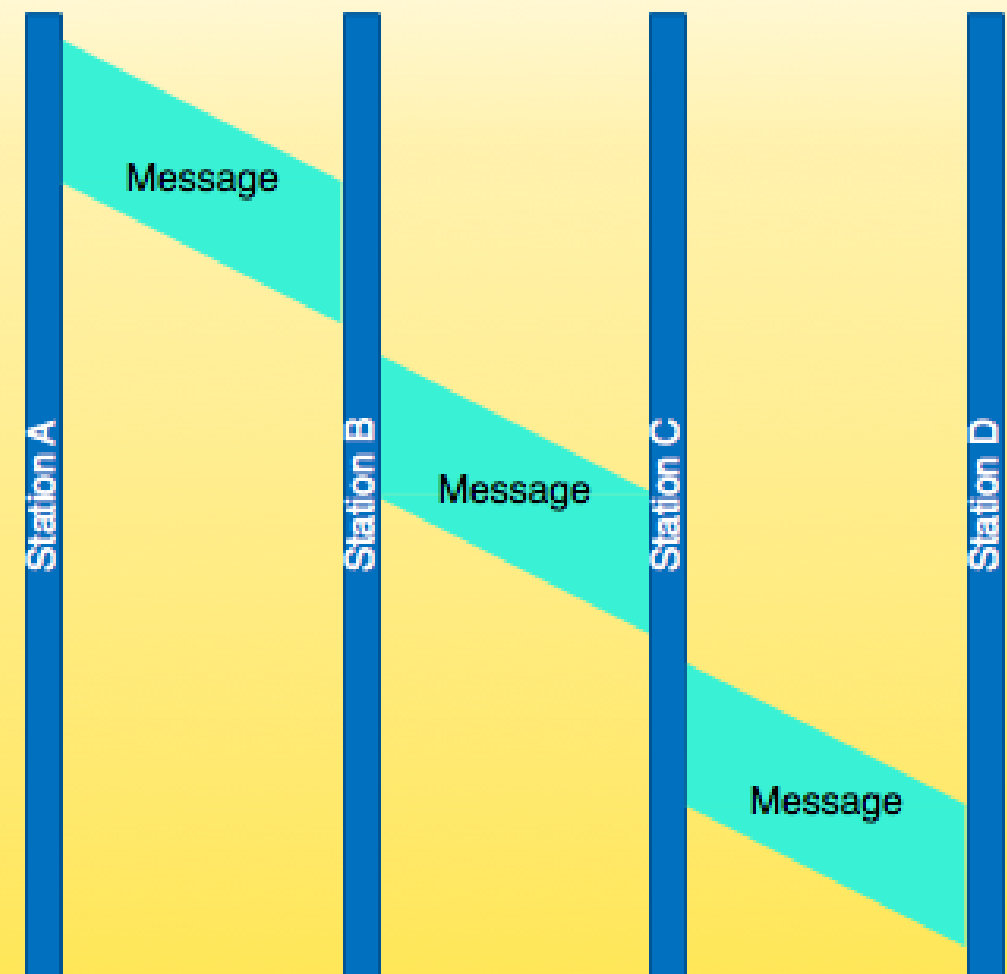


Cara Kerja Message Switching

Cara Kerja Message-Switching

- Stasiun perantara akan menerima keseluruhan message lalu memeriksa stasiun berikutnya yang harus dituju (this is routing process), kemudian mem-forward message ke stasiun berikutnya tersebut → Ini merupakan proses **store-and-forward**
- Proses store-and-forward ini diulangi sampai message tiba di tujuan
- Tidak ada proses pembentukan dan pemutusan koneksi

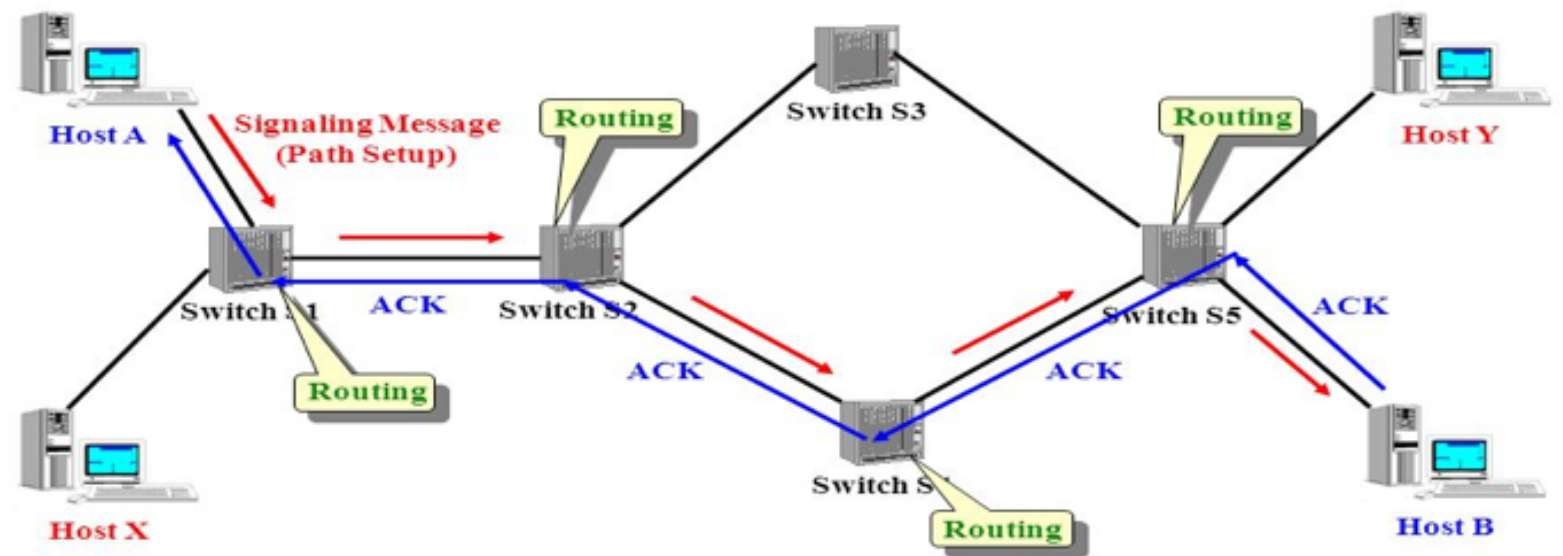
Timing Diagram



Circuit Switching

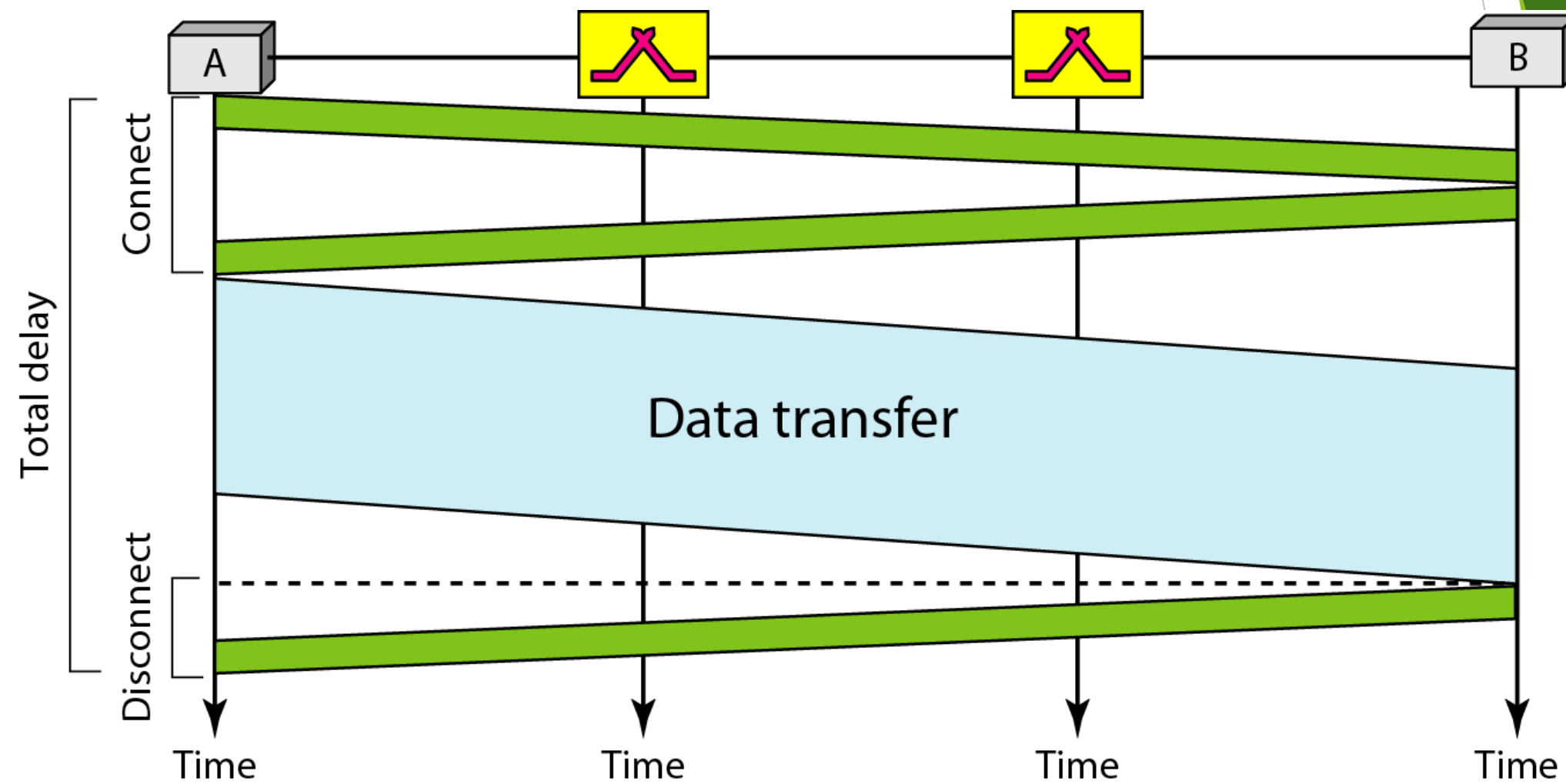
Circuit-Switched Networks

- Digunakan pada jaringan telepon
- Komunikasi berlangsung di dalam tiga tahap:
 1. **Pembentukan koneksi** antara dua pihak yang berkomunikasi
 - Proses ini ditujukan untuk mendefinisikan jalur yang harus ditempuh oleh informasi yang akan dikirimkan
 - Koneksi yang dibentuk (resource jaringan yang sudah dialokasikan bagi suatu panggilan) bersifat dedicated (tidak di-share bersama panggilan lain)
 - Baik ada maupun tidak ada informasi yang ditransfer, koneksi terhubung terus
 2. **Transfer informasi**
 3. **Pemutusan koneksi**

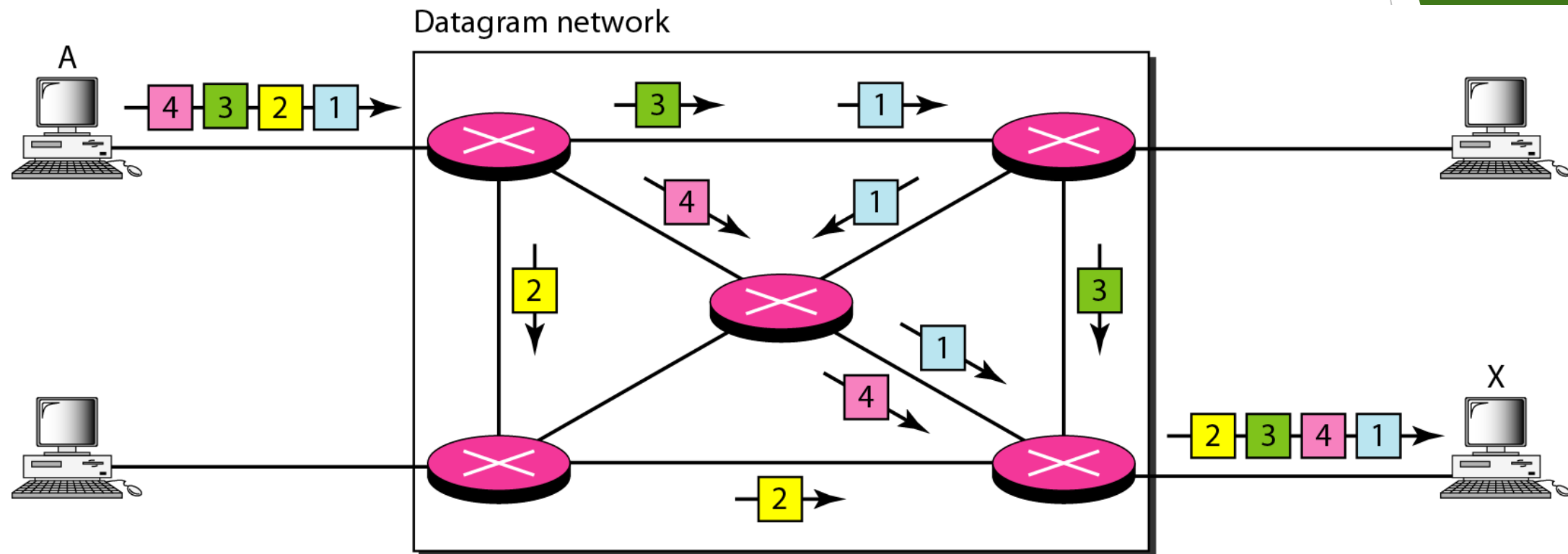


- Berdasarkan adanya keharusan pembentukan koneksi sebelum transfer informasi berlangsung maka teknik circuit switching disebut bersifat **connection oriented**
- Teknik circuit switching cocok untuk mentransfer voice
- Sifat koneksi yang dedicated dapat menjamin delay dan jitter yang disyaratkan untuk transfer voice

Delay in a Circuit-switched Network



Packet Switching

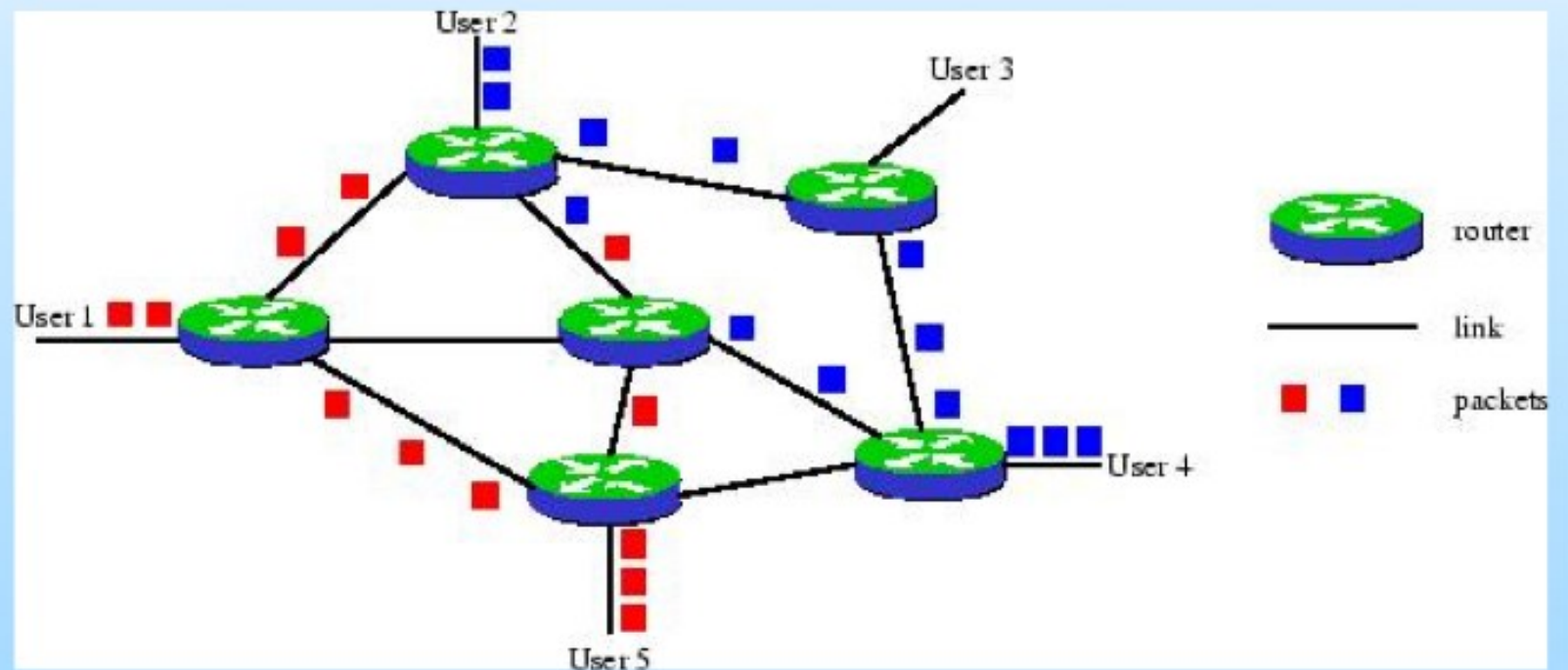


- Digunakan pada jaringan untuk mentransfer informasi data
- Sebelum dikirimkan ke jaringan, message dipecah ke dalam beberapa message yang ukurannya lebih pendek
- Message-message yang ukurannya pendek ini disebut paket
- Di penerima, paket-paket itu akan disusun kembali membentuk message semula

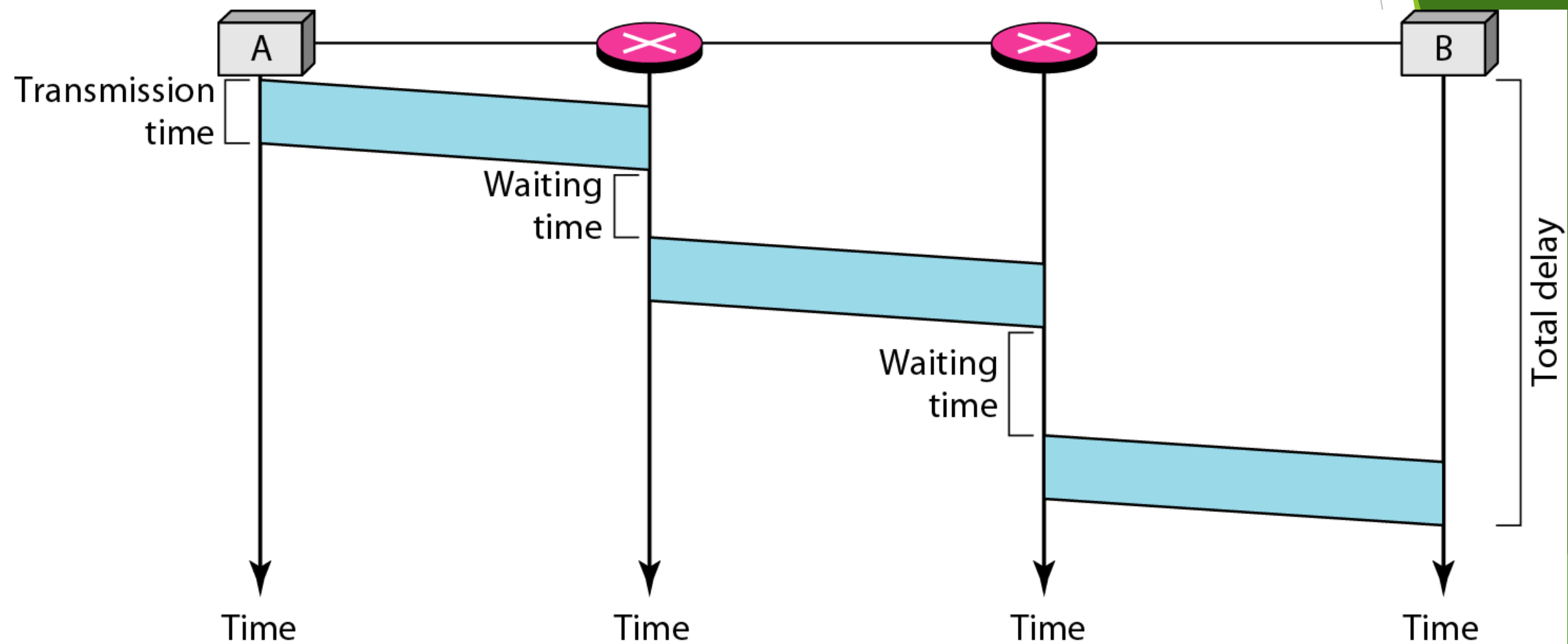
Datagram Packet Switching

- **Connectionless** → Tidak ada pembentukan koneksi dahulu
- Paket-paket yang dikirimkan diberi identifier node pengirim dan tujuan
- Paket yang sampai di intermediate node akan diforward ke node berikutnya (bila memungkinkan)
 - Intermediate node tidak perlu menunggu sampainya semua paket yang berasal dari suatu message
- This is store-and-forward process (just like in message switching)

Ilustrasi Datagram Packet Switching



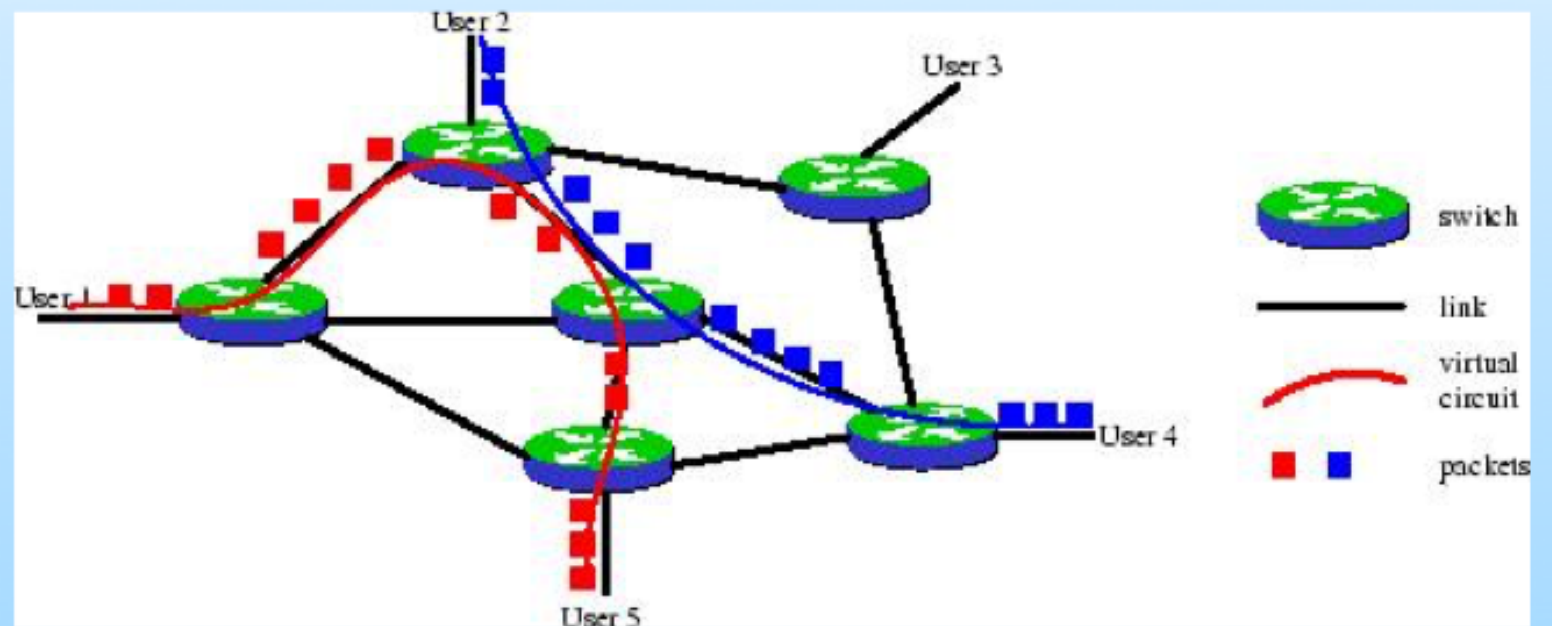
Delay in a Datagram Network



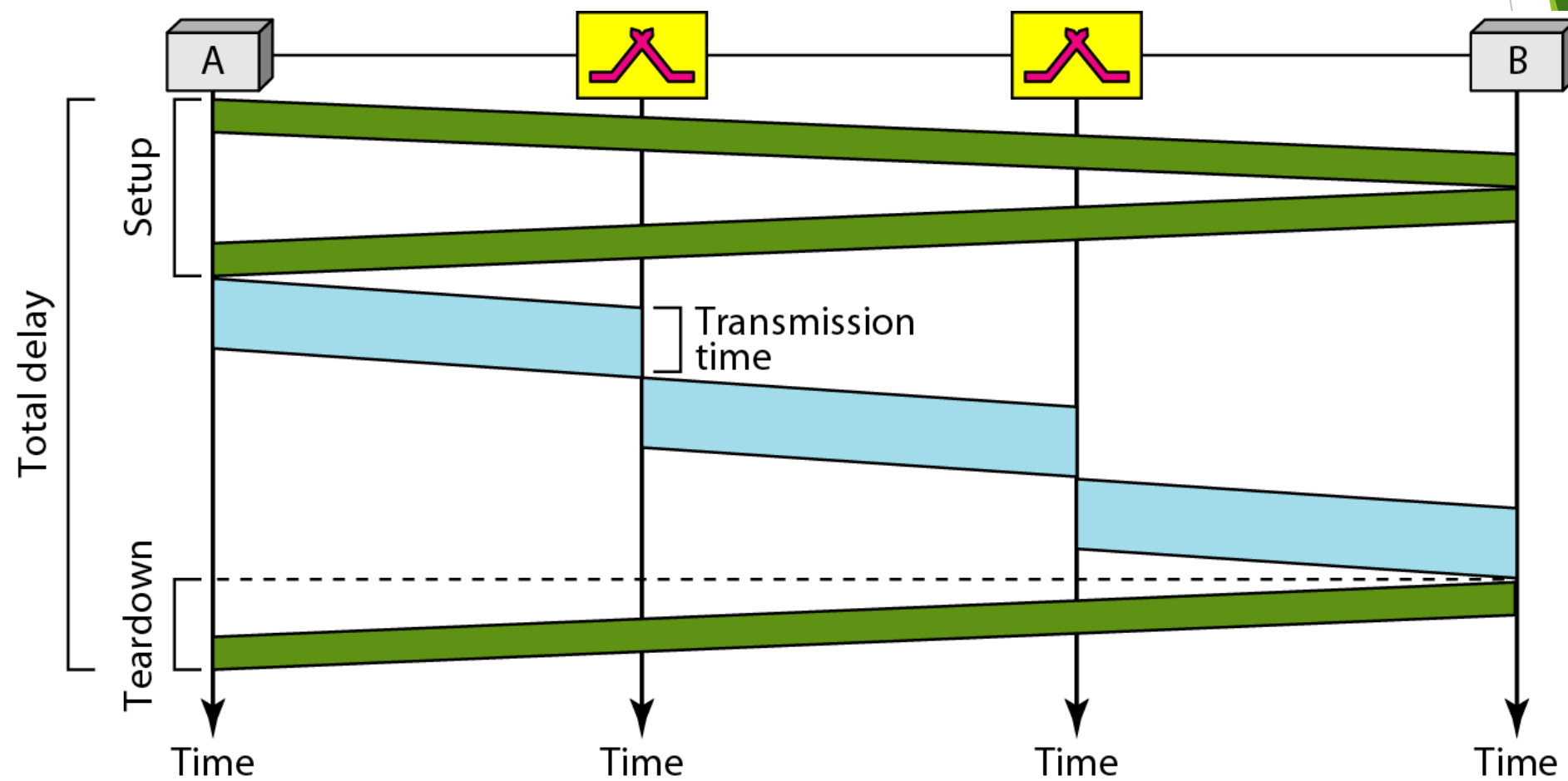
Virtual Circuit Packet Switching

- Memadukan keunggulan circuit switching dan datagram packet switching
 - **Connection oriented;** komunikasi berlangsung di dalam tiga tahap seperti pada circuit switching
 - Pemakaian resource jaringan tidak dedicated
 - Store-and-forward process masih berlangsung
- Setelah koneksi terbentuk, paket-paket yang berasal dari suatu message yang sama akan dikirimkan melalui jalur yang sudah ditentukan ketika pembentukan koneksi
 - Paket-paket tiba di tujuan secara teratur

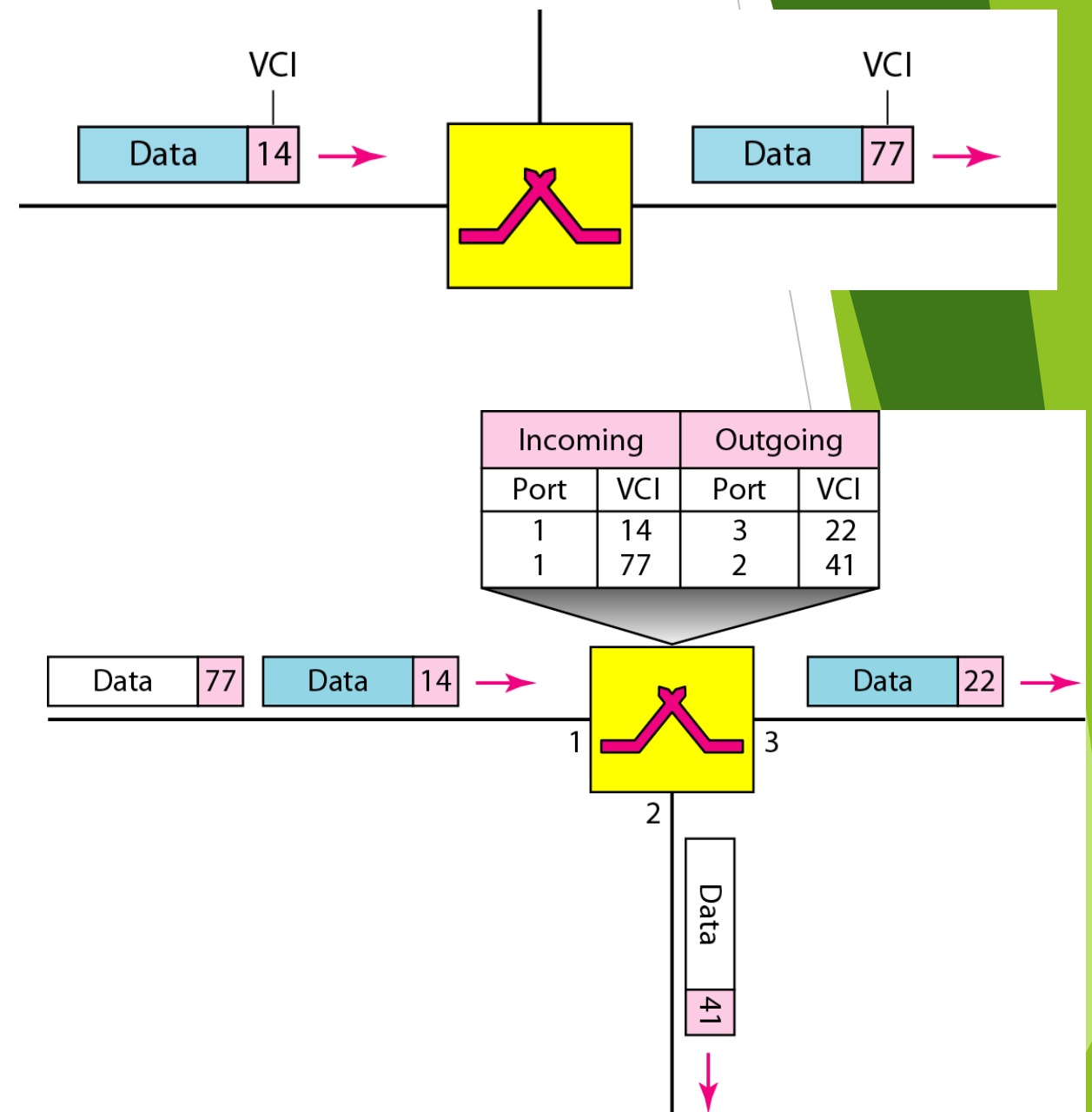
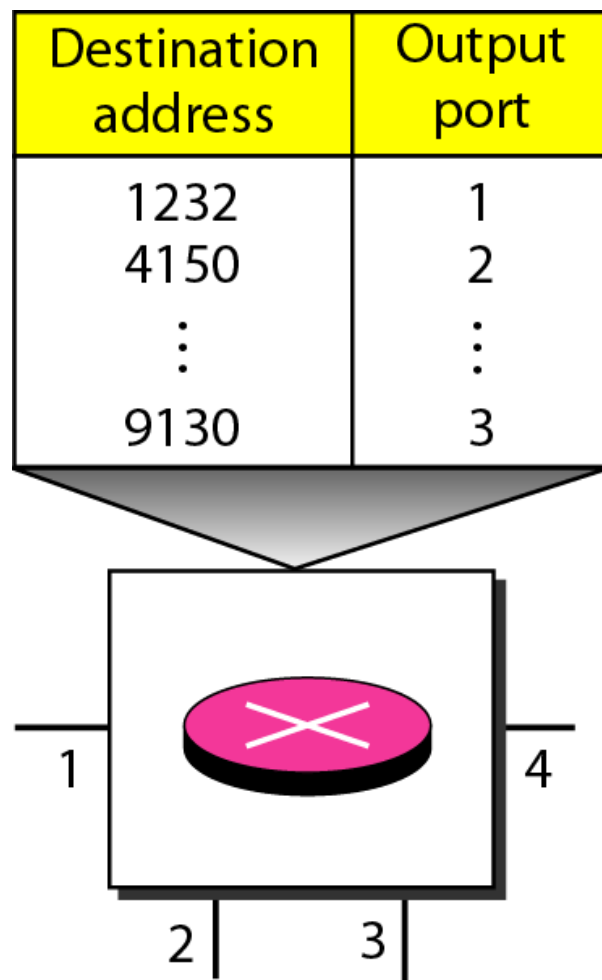
Ilustrasi Virtual Circuit Packet Switching



Delay in a Virtual-circuit Networks

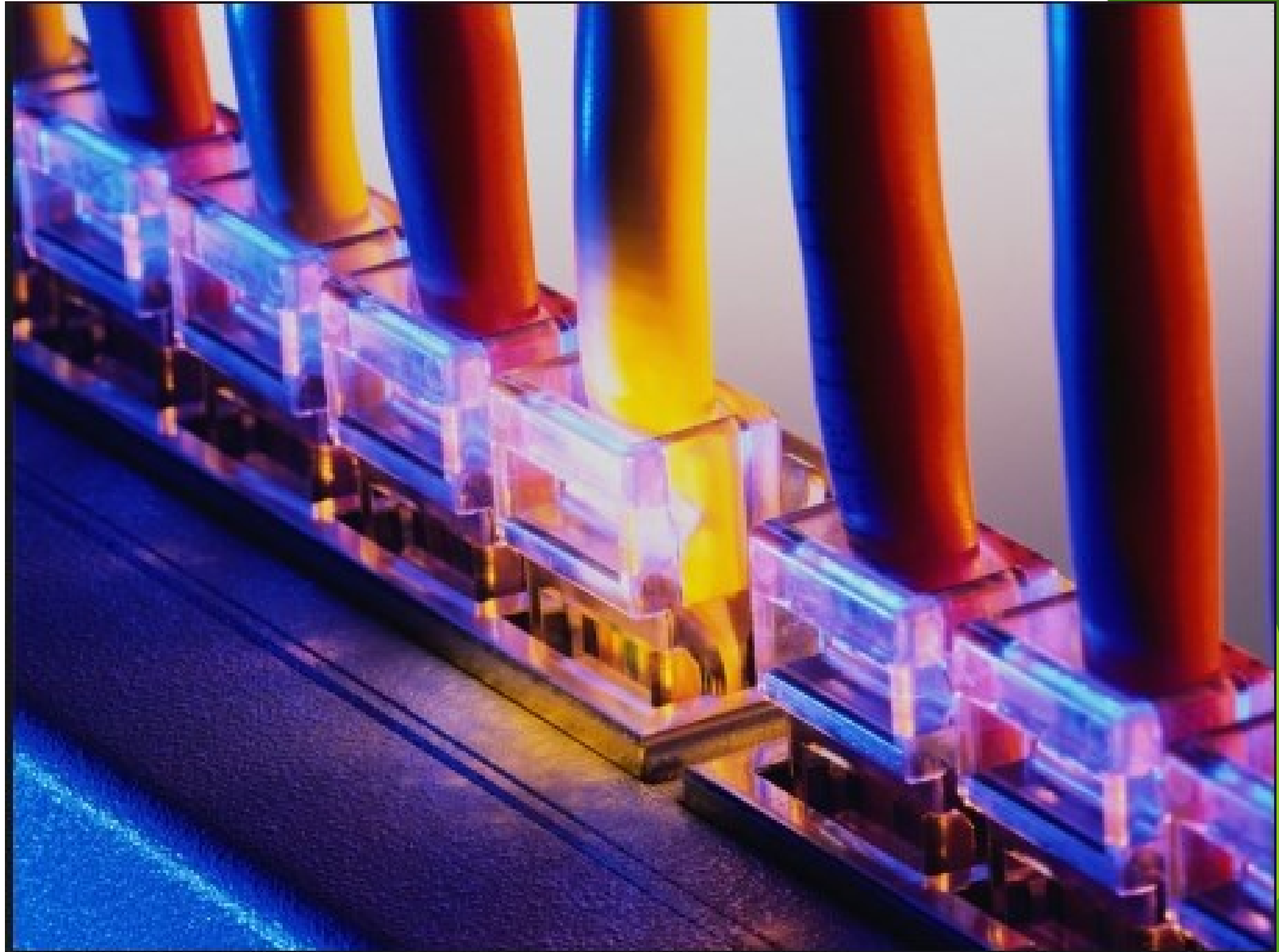


Datagram vs Virtual Circuit



Comparison between Datagram and Virtual Circuit

Issue	Datagram	Virtual Circuit
Circuit Setup	Not needed	Required
Addressing	Each packet contains the full source and destination address	Each packet contains a short VC number
State information	Routers do not hold state information about connections	Each VC require router table space per connection
Routing	Each packet is routed independently	Route chosen when VC is set up; all packets follow it
Effect of router failures	None, except for packet lost during the crash	All VCs that passed through the failed router are terminatd
Quality of Service	Difficult	Easy if enough resource can be allocated for each VC
Congestion control	Difficult	Easy if enough resource can be allocated for each VC



Happy Learning....