SNS COLLEGE OF TECHNOLOGY

Coimbatore – 35

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
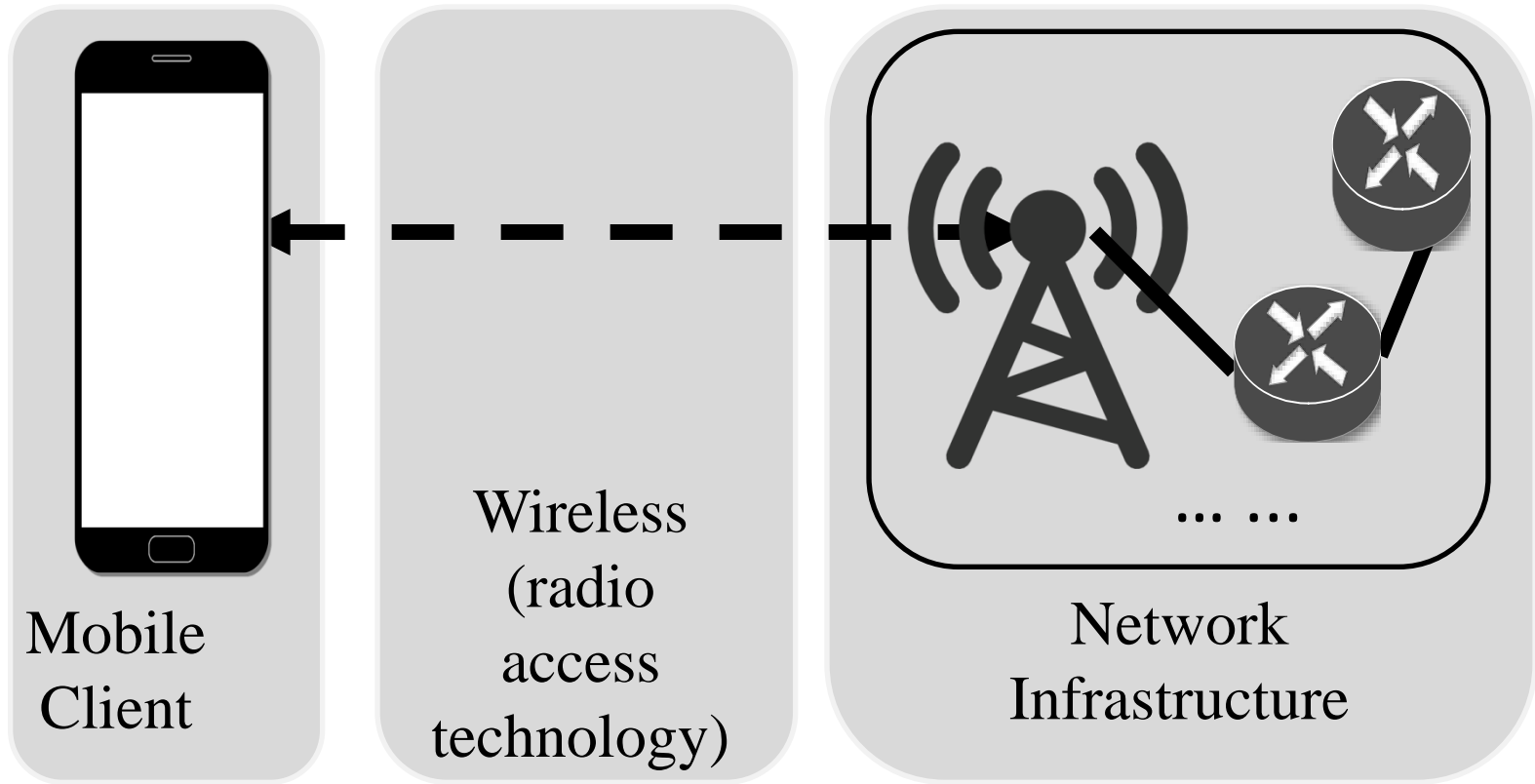
19ECT311 / Wireless Communication

III ECE/ VI SEMESTER

Unit I -**FUNDAMENTALS OF WIRELESS COMMUNICATION**

Topic 1 : Evolution of cellular systems: 2G - 3G- 4G cellular networks

Wireless Communication

Mobile Client

Wireless (radio access technology)

Network Infrastructure

... ...

Wireless Communication

- Wireless communication is the transfer of information over a distance without the use of electrical conductors or "wires".

- The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometers for radio communications).

- When the context is clear, the term is often shortened to "wireless".

- Wireless communication is generally considered to be a branch of telecommunications.

Ubiquitous Mobile Network Services

In-building
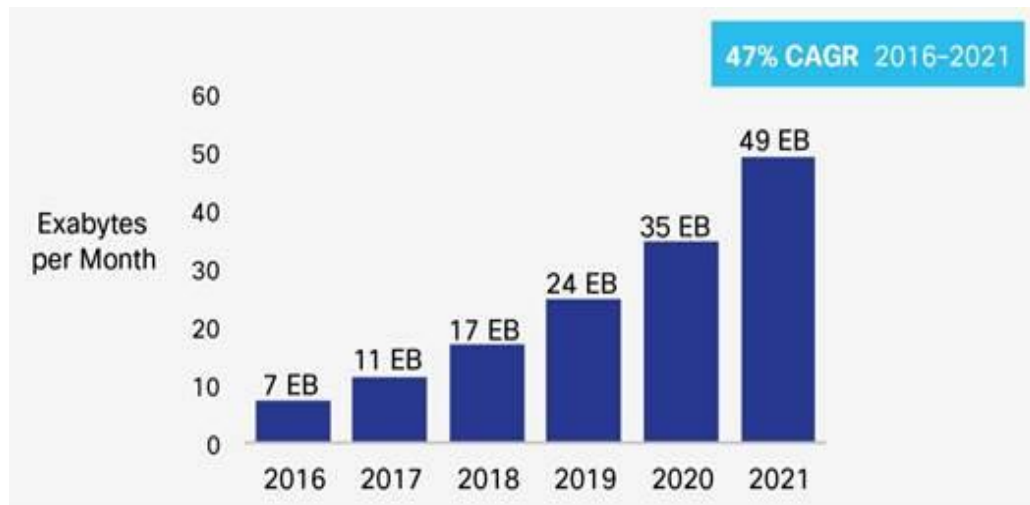

Outdoor

Walking

Driving

Subway

High-speed train

Ubiquitous Mobile Network Services

- Global Mobile Data Traffic
  - 7.2 exabytes/month in 2016 (63% growth)
  - 18 fold growth in the past five years
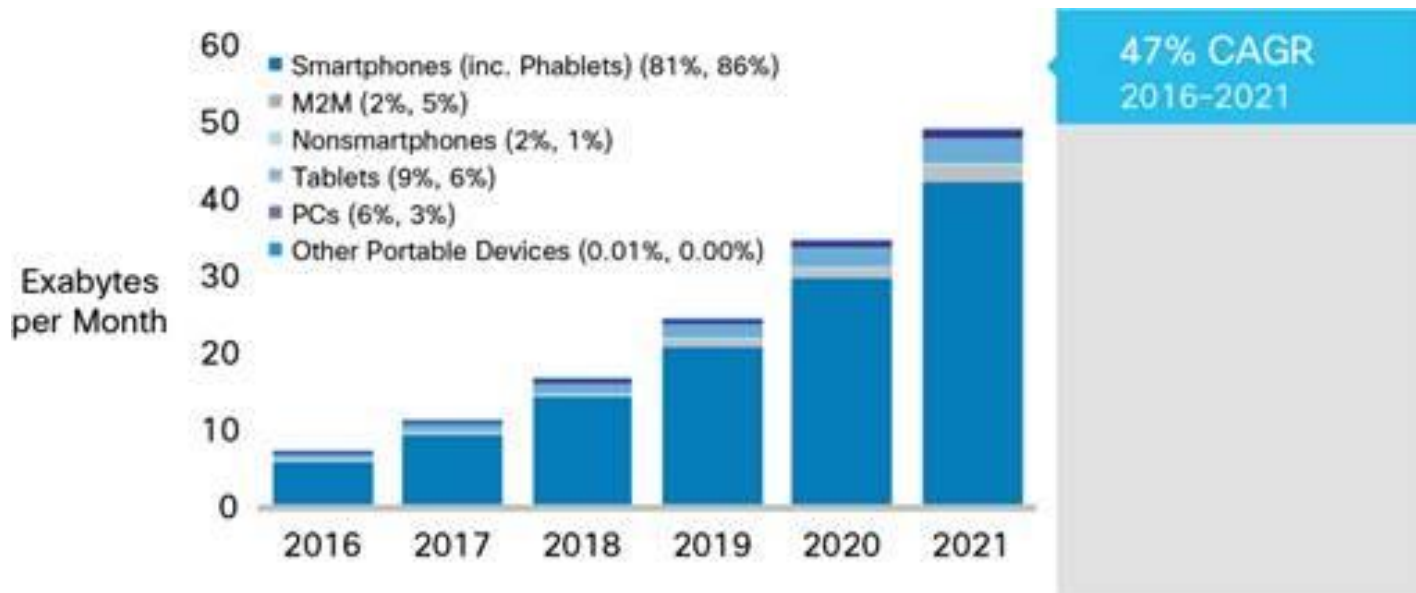 - 7 fold growth by 2021 (49 exabytes/month)

Source: Cisco Visual Networking Index, 2017: Global Mobile Data Traffic Forecast Update, 2016–2021 White Paper
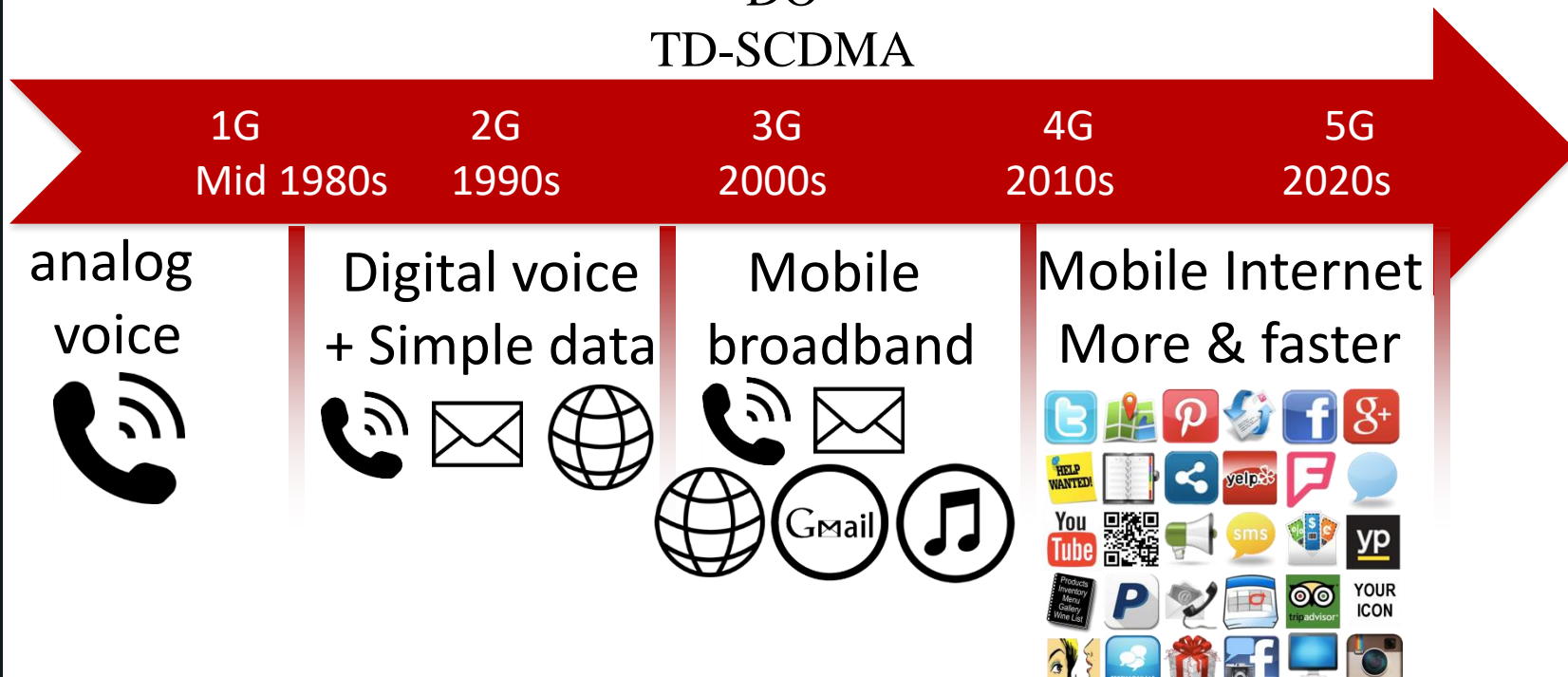
Ubiquitous Mobile Network Services

- Smartphones: primary internet access points
  - By 2021, 98% traffic and 75% connections from "smart" devices
  - 4G: 75% traffic and 53% connections
  - 5G: 1.5% traffic and 0.2% connections

Mobile Network Evolution

1G
AMPS,
NMT
TACS

2G
GSM/GPRS/
EDGE
cdmaOne

3G
WCDMA/HSPA
+
CDMA2000/EV
DO
TD-SCDMA

4G
LTE
LTE-A

1G	2G	3G	4G	5G
Mid 1980s	1990s	2000s	2010s	2020s

analog
voice

Digital voice
+ Simple data

Mobile
broadband

Mobile Internet
More & faster

Standards Body: 3GPP

- An international standards body
- Evolves and standardizes GSM, UMTS, LTE among others

The 3rd Generation Partnership Project (3GPP) unites [Six] telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TTA, TTC), known as "Organizational Partners" and provides their members with a stable environment to produce the highly successful Reports and Specifications that define 3GPP technologies

- 3GPP standards

Cellular Network Standards

Generation	3GPP Circuit Switched	3GPP Packet Switched	3GPP2	Wimax Forum
2G	GSM		cdmaOne	
2.5G 2.75G		GPRS EDGE		
3G	UMTS		CDMA2000	
3.5G		HSPA/+	CDMA EV-DO	
4G		**LTE**		WiMAX

1G: First generation wireless cellular: Early 1980s

– Analog transmission, primarily speech: AMPS (Advanced Mobile Phone Systems) and others

2G: Second generation wireless cellular: Late 1980s

– Digital transmission

– Primarily speech and low bit-rate data (9.6 Kbps)

2.5G: 2G evolved to medium rate (< 100kbps) data

Cellular networks: From 3G to 4G

- 3G: future Broadband multimedia

  – 144 kbps - 384 kbps for high-mobility, high coverage

  – 2 Mbps for low-mobility and low coverage

4G :Mobile broadband Internet access

  – Mobile web access, IP telephony, gaming services, high-definition mobile TV

  – Video conferencing, 3D television, and cloud computing

What is LTE?

- LTE is always evolving and 3GPP often has new "releases"
  - First release: Rel-8
  - Current: Rel-11, Rel-12
  - Toward LTE-Advanced (4.5G)

Cellular Networks/ 19EC302-Wireless
Communication /Dr.A.Karthikeyan
/ECE/SNSCT

Inter-Generation Technologies

- CS networks need to be able to connect with PS networks and other distinct cellular networks
  - The internet is a good example of PS network
- GPRS (General packet radio service)
  - 2.5G packet switched technology
- EDGE (Enhanced Data Rates for GSM Evolution)
  - 2.75G packet switched technology
- HSPA (High Speed Packet Access)
  - 3.5/3.75 packet switched data technology
  - There were a few quick iterations on this technology, thus "variants"

Find the difference between two images

Network Architecture Evolution

2G ➡ **3G** ➡ **4G**

- Circuit-switching for voice

- Circuit-switching for voice
- Packet-switching for data

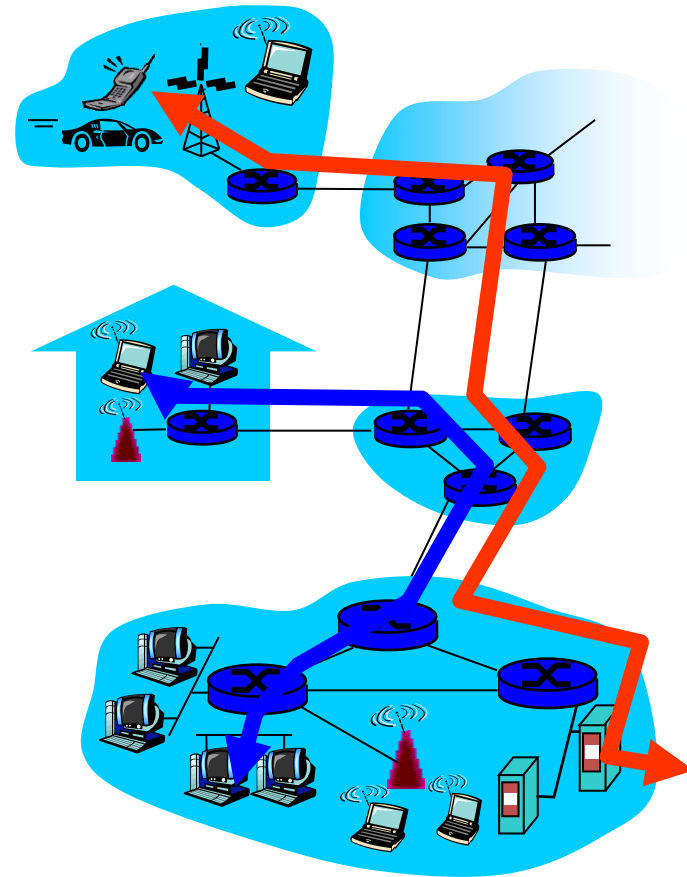- Packet-switching for everything
- IP-based

Telecomm Infrastructure ➡ **IP-based Internet**

2G Based on Circuit Switching (CS)

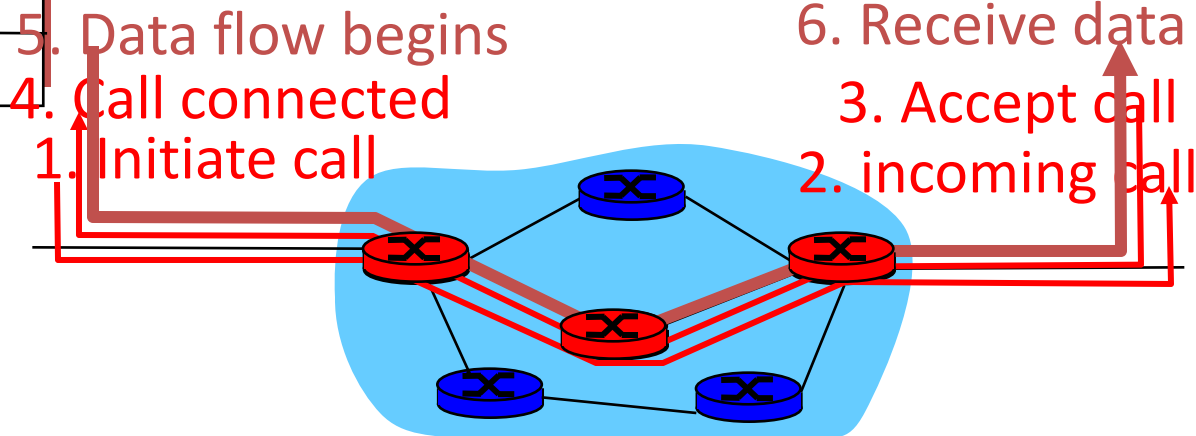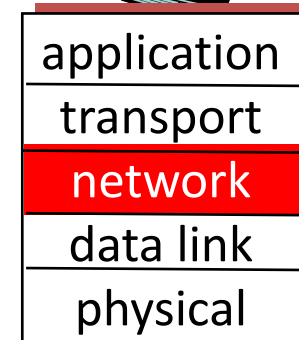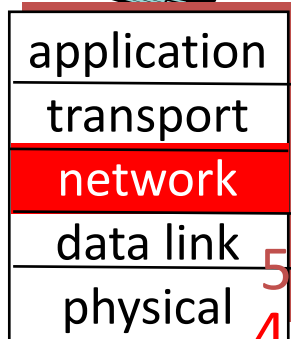**End-end resources reserved for "call"**

- link bandwidth, switch capacity

- dedicated resources: no sharing

- circuit-like (guaranteed) performance

- call setup required

CS Signaling
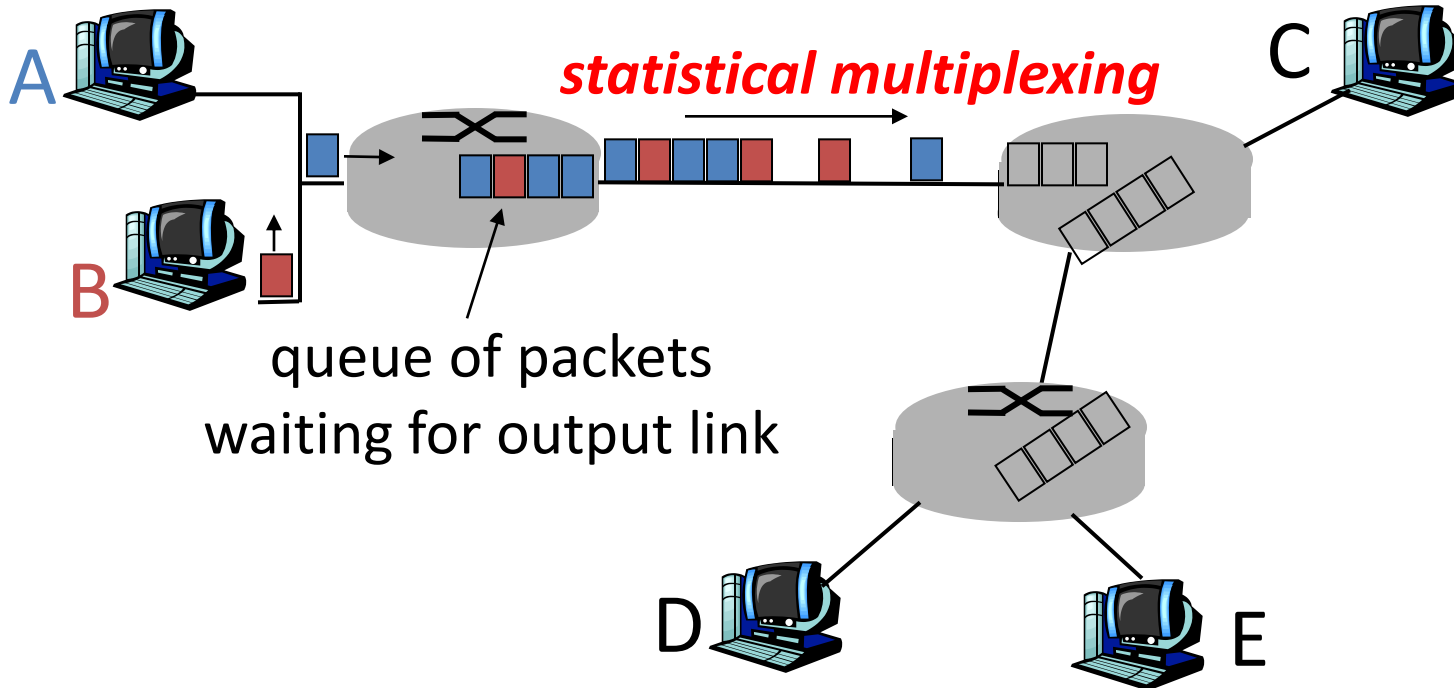
- used to setup, maintain teardown VC

- used in 2G, as well as in 3G

- not used in today's Internet

application
transport
network
data link
physical

application
transport
network
data link
physical

5. Data flow begins

6. Receive data

4. Call connected

3. Accept call

1. Initiate call

2. incoming call

Packet Switching (PS)
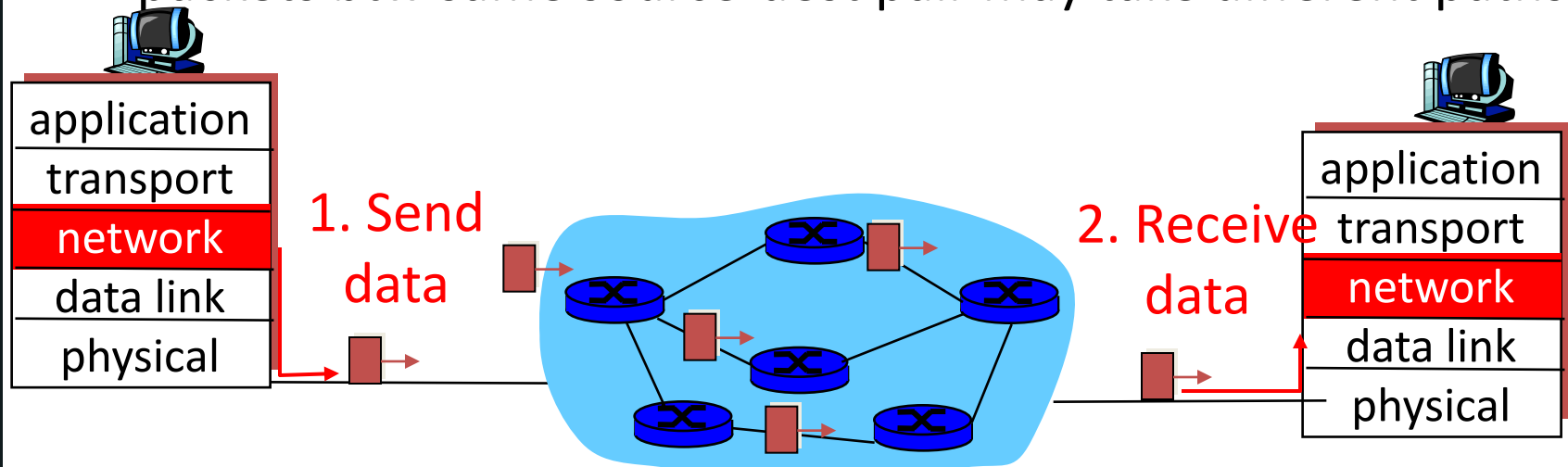

statistical multiplexing

A

B

C

D

E

queue of packets
waiting for output link

- Sequence of A & B packets does not have fixed pattern, bandwidth shared on demand → statistical multiplexing

- Store-and-forward at intermediate routers
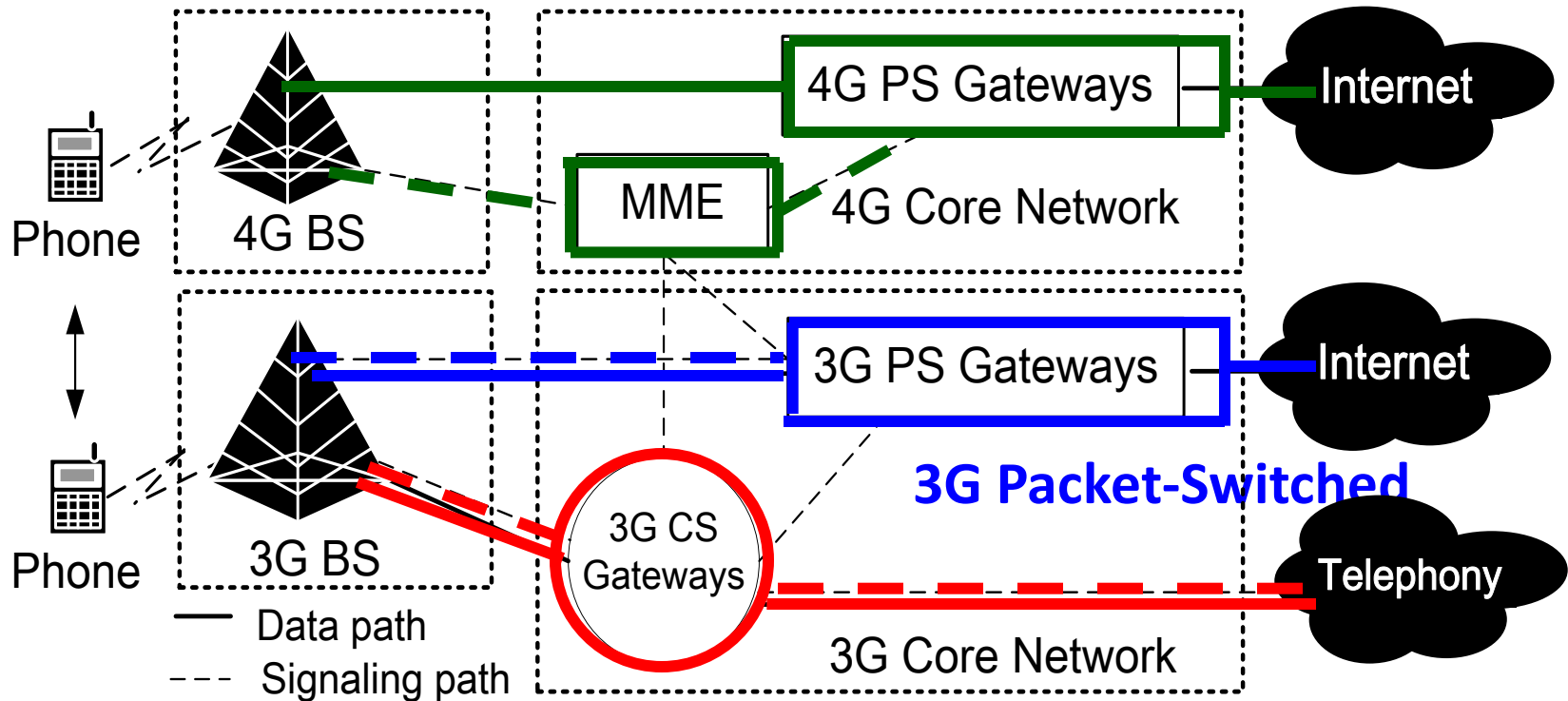
- Used by the Internet

PS Signaling

- no call setup at network layer

- routers: no state about end-to-end connections
  - no network-level concept of "connection"

- packets forwarded using destination host address
  - packets btw same source-dest pair may take different paths

1. Send data

2. Receive data

application
transport
network
data link
physical

application
transport
network
data link
physical

3G/4G Network Architecture

4G Packet-Switched

Phone — 4G BS — MME — 4G Core Network — 4G PS Gateways — Internet

Phone — 3G BS — 3G CS Gateways — 3G PS Gateways — Internet

3G Packet-Switched

3G Core Network — Telephony
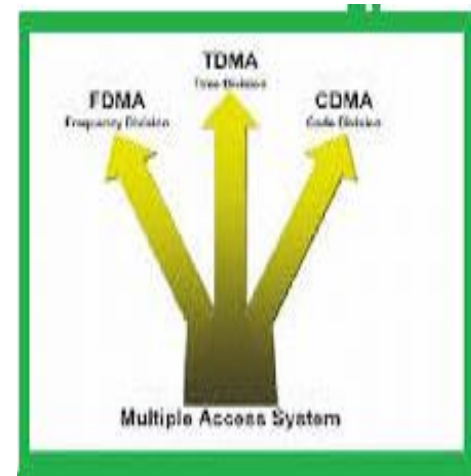
— Data path
--- Signaling path

3G Circuit-Switched

Issues Vital to cellular

- Frequency allocation
  - Licensed
  - Many providers
- Multiple Access
  - Many users
  - Wide area of coverage
  - Traffic management

- Location management
  - High mobility (in cars, trains)
  - Multiple suppliers
  - Handoff management, roaming
- Handled differently by different generations

Assessment

1.Differntiate 3G from 4G.

2.What is packet switching?

3.Discuss about 3GPP