SNS COLLEGE OF TECHNOLOGY

Coimbatore – 35

An Autonomous Institution

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19ECT311 / Wireless Communication

III ECE/ VI SEMESTER
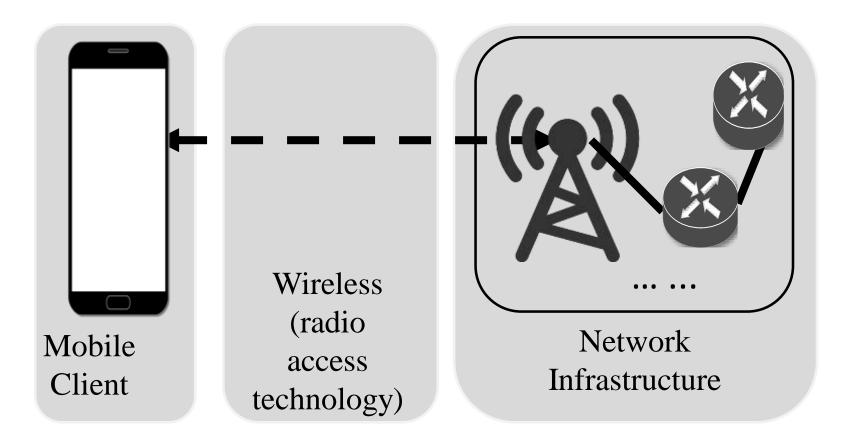
Unit I -**FUNDAMENTALS OF WIRELESS COMMUNICATION**

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
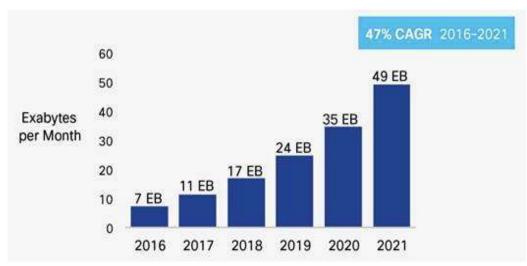

Outdoor

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
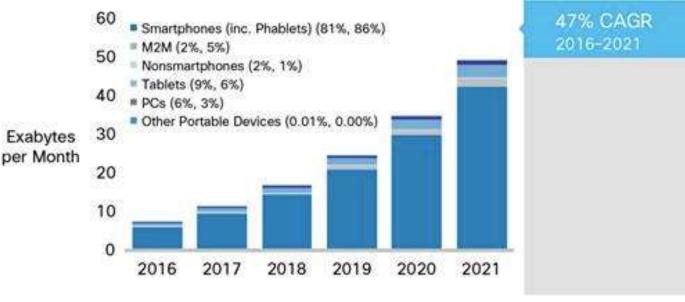 - 7 fold growth by 2021 (49 exabytes/month)

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

Chart: Exabytes per Month (2016–2021)
- Smartphones (inc. Phablets) (81%, 86%)
- M2M (2%, 5%)
- Nonsmartphones (2%, 1%)
- Tablets (9%, 6%)
- PCs (6%, 3%)
- Other Portable Devices (0.01%, 0.00%)

47% CAGR 2016-2021

Mobile Network Evolution

1G	**2G**	**3G**	**4G**
AMPS,	GSM/GPRS/	WCDMA/HSPA	LTE
NMT	EDGE	+	LTE-A
TACS	cdmaOne	CDMA2000/EV	
		DO	
		TD-SCDMA	

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

Cellular Networks: From 1G to 4G

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)
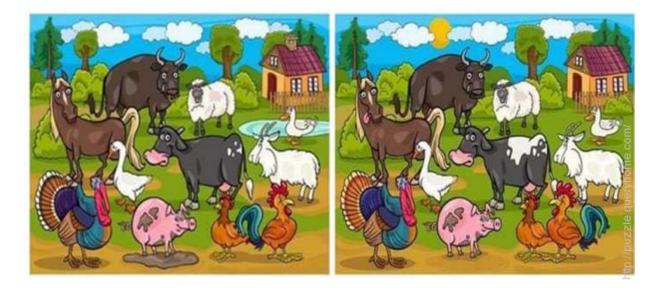
Inter-Generation Technologies

- 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"
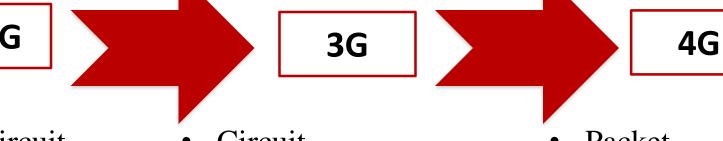
Find the difference between two images

Network Architecture Evolution

2G		3G		4G

- Circuit-switching for voice

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

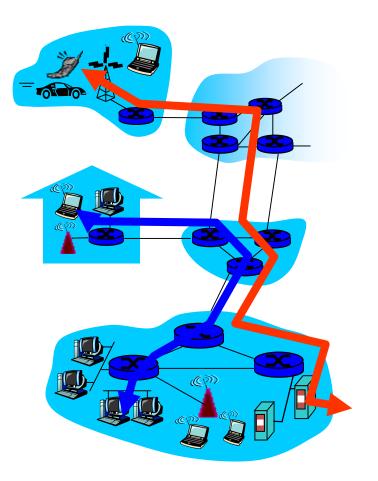- Packet-switching for everything
- IP-based

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
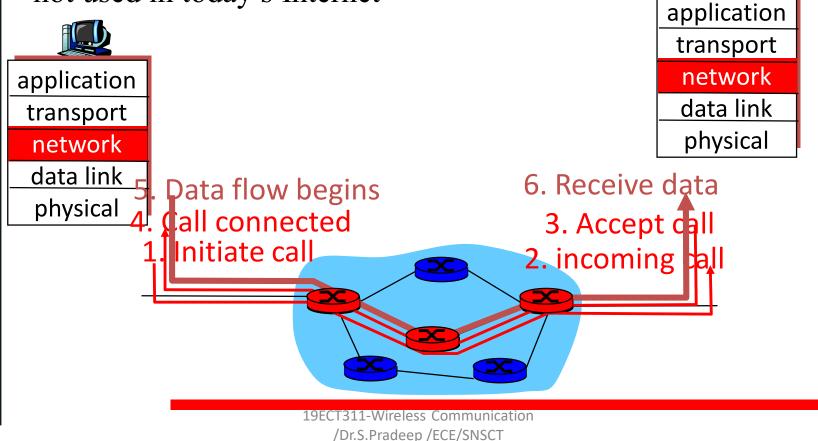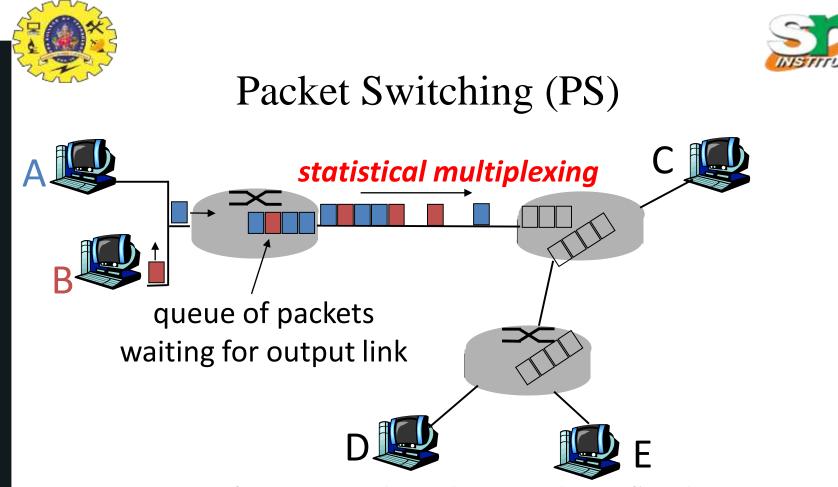
- call setup required

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

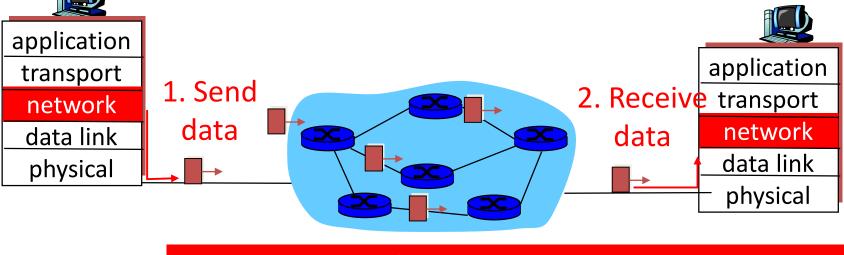queue of packets
waiting for output link

- 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
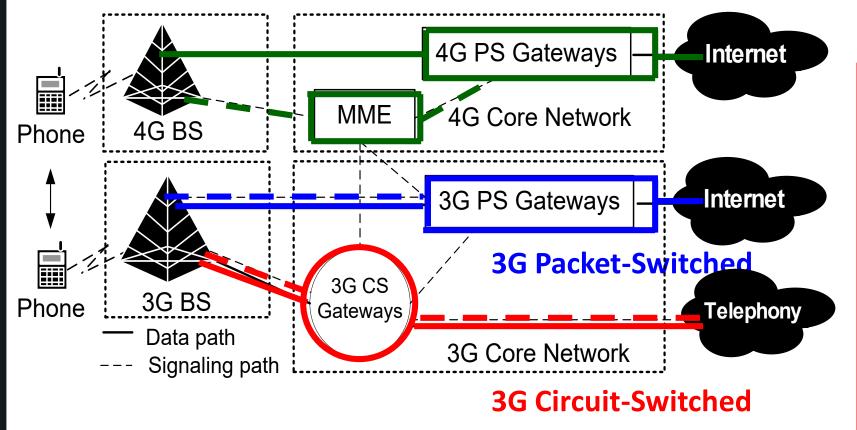 - packets btw same source-dest pair may take different paths

1. Send data

2. Receive data

3G/4G Network Architecture

4G Packet-Switched

4G PS Gateways — Internet

MME | 4G Core Network

Phone | 4G BS

3G PS Gateways — Internet

3G Packet-Switched

Phone | 3G BS

3G CS Gateways

Telephony

— Data path
--- Signaling path

3G Core Network

3G Circuit-Switched

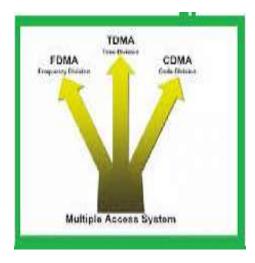# Issues Vital to cellular

- 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