Lecture 25: Cellular Networks

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Contents of Chapter 7

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- WiFi: 802.11 wireless LANS
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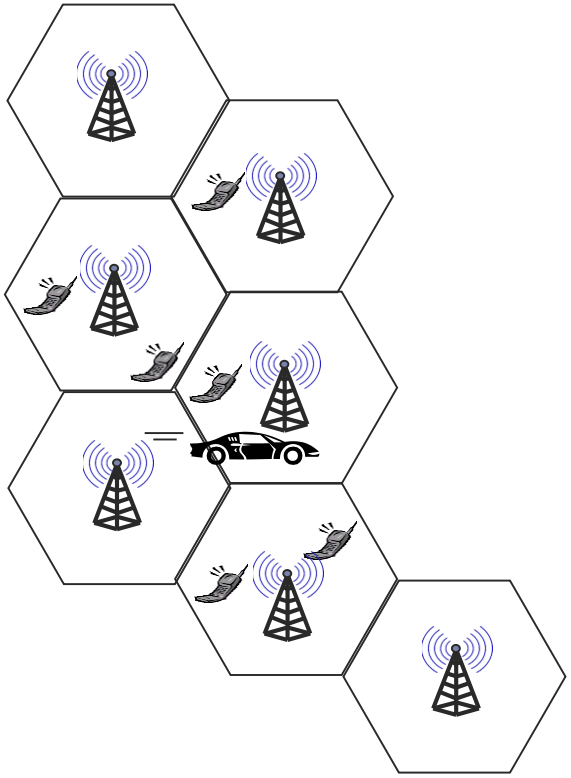
- Wireless and mobility: Impact on higher-layer protocols **(skipped)**

Introduction

- **Cellular communications**
  - *a.k.a.* mobile communications
  - The service region is partitioned into a number of geographic coverage areas, known as cells.
  - Each cell contains a base transceiver station (BTS) that transmits signals to and receives signals from the mobile stations (MSs) in its cell.



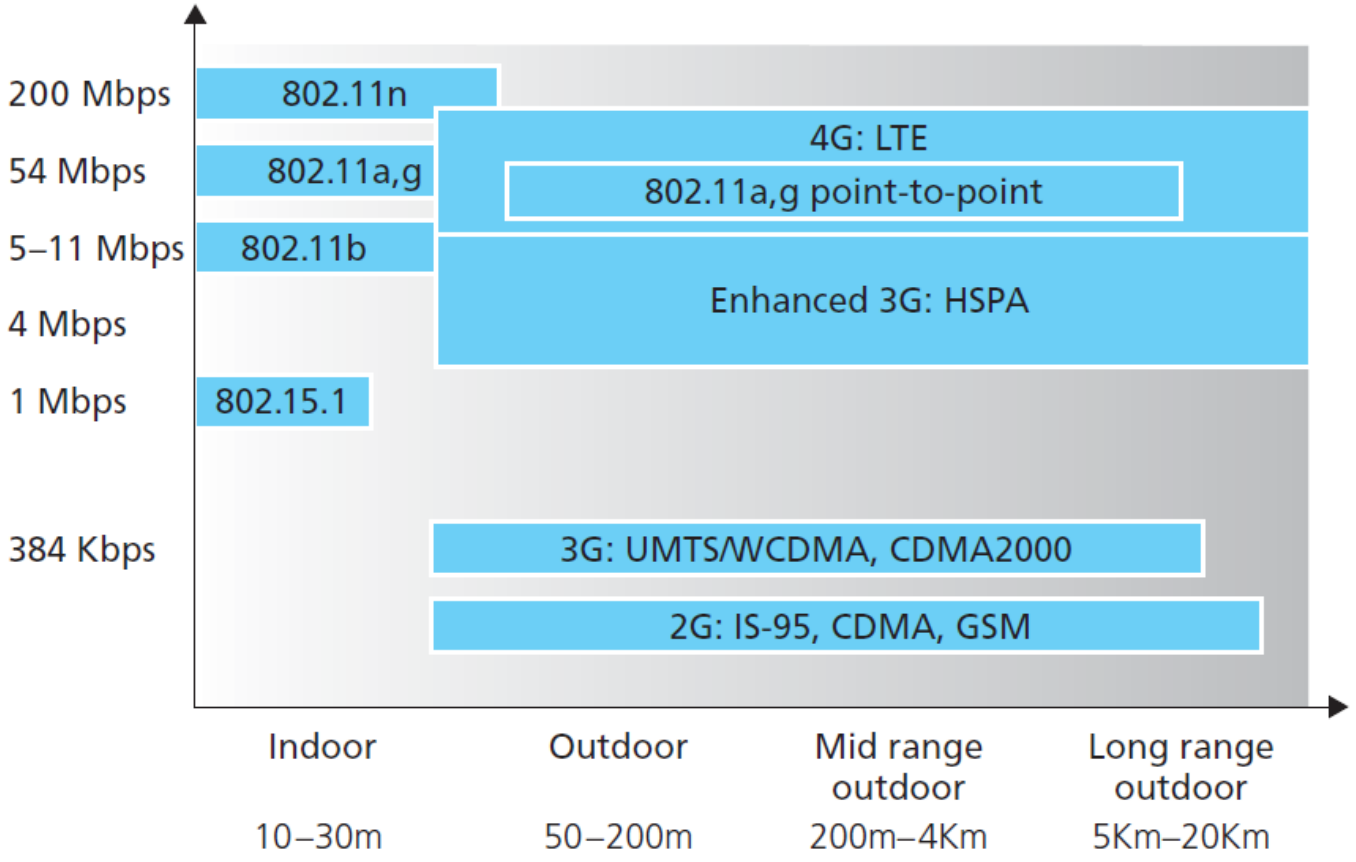
Generations of Cellular Communication

- **1G (around 1980~)**
  - Voice-only, analog FDMA system
- **2G (early 1990s~)**
  - Voice and limited data service (e.g., SMS), digital communications
  - Standards: GSM, IS-95
- **2.5G (second half of the 1990s~)**
  - Voice and packet data service
  - Standard: GPRS
- **3G (early 2000~)**
  - Improved data rate, WCDMA
  - Standard: HSPA (~14 Mbps for data service)
- **4G (2011~)**
  - Integrated voice and data over all-IP core network
  - Standard: LTE-Advanced

GPRS: General packet radio services
GSM: Global system for mobile communications
HSPA: High speed packet access, SMS: Short message service

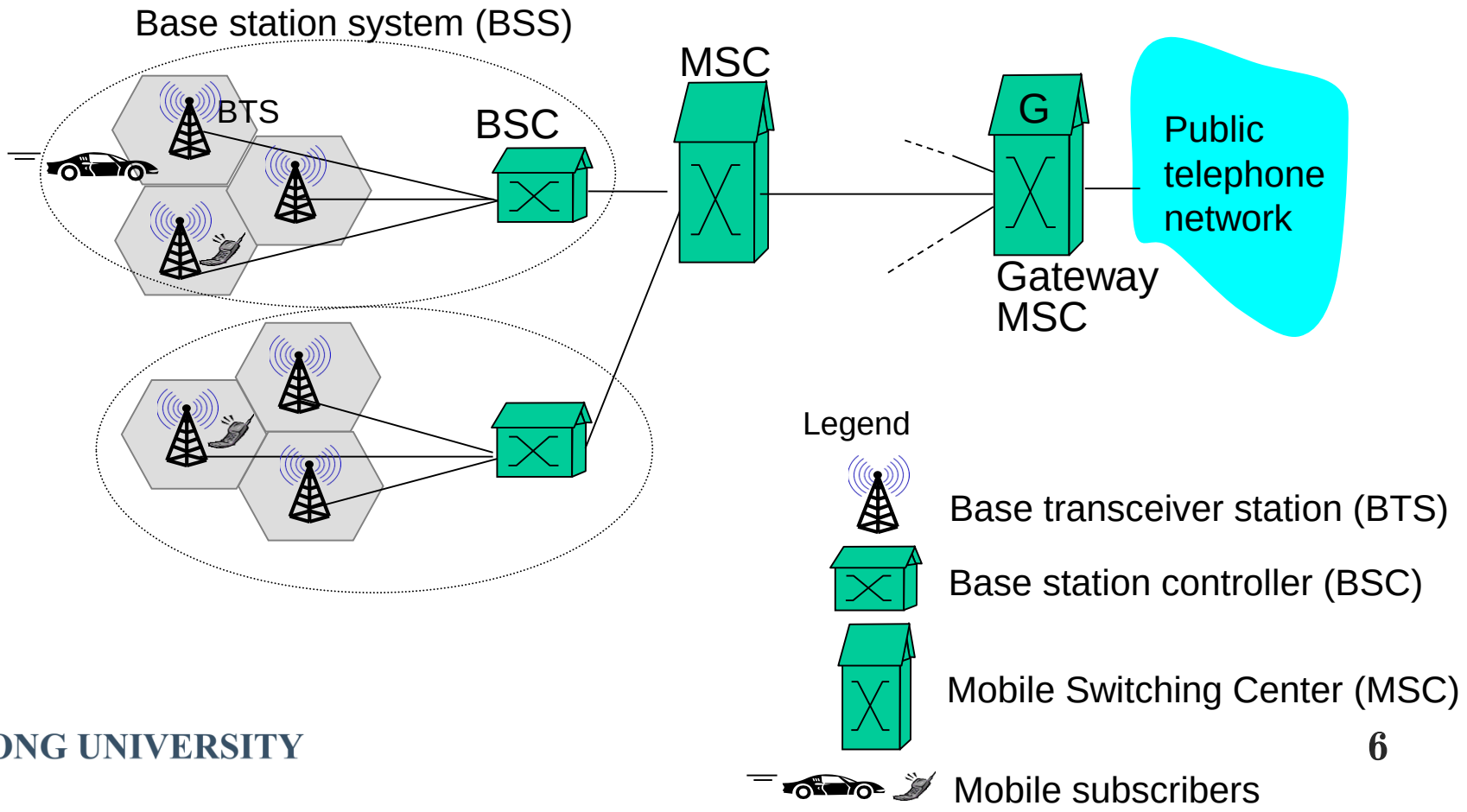
Generations of Cellular Communication

- Link characteristics of wireless network standards



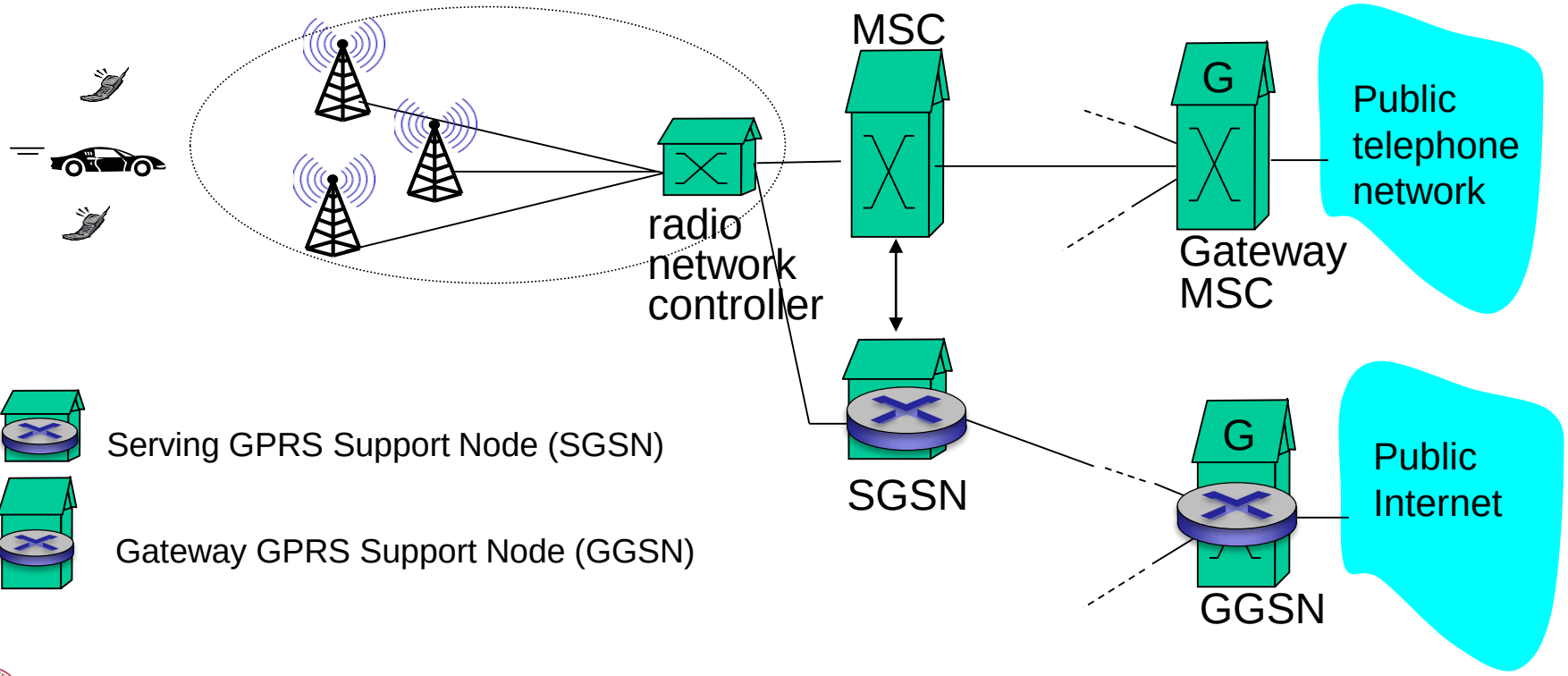
Cellular Network Architecture

- **2G network architecture**
  - MSC: User authorization and accounting, call establishment



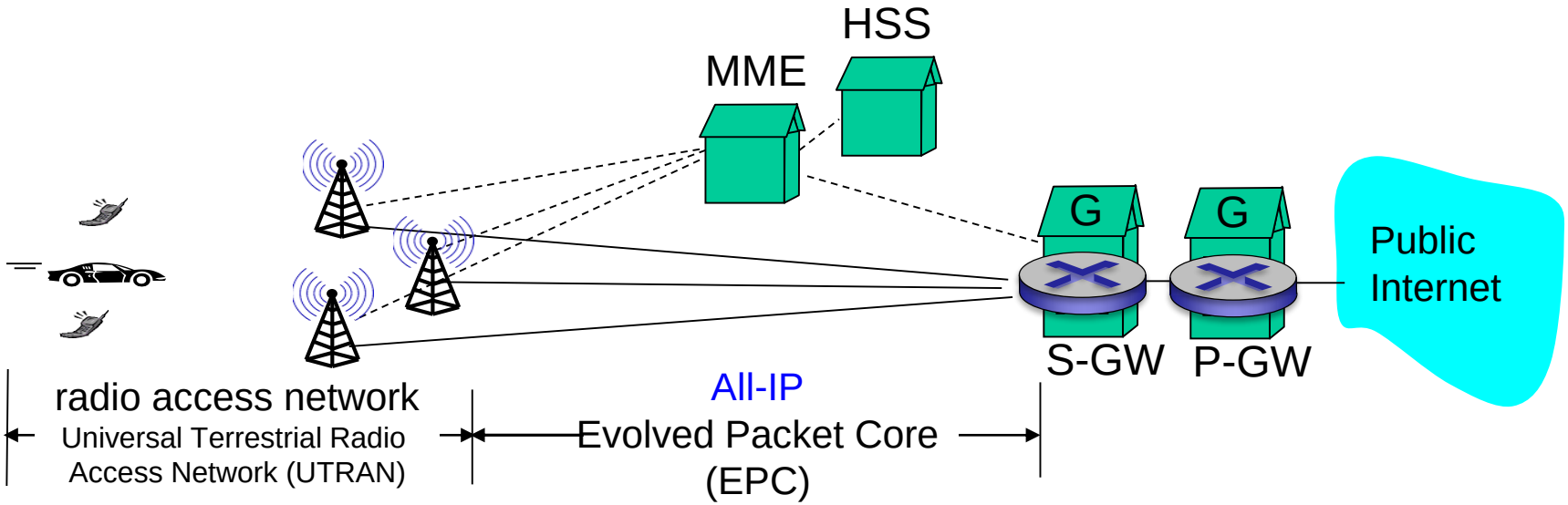
Cellular Network Architecture

- **3G network architecture**
  - SGSN: Delivering datagrams to/from the mobile nodes
  - GGSN: Connecting multiple SGSNs into the larger Internet



Cellular Network Architecture

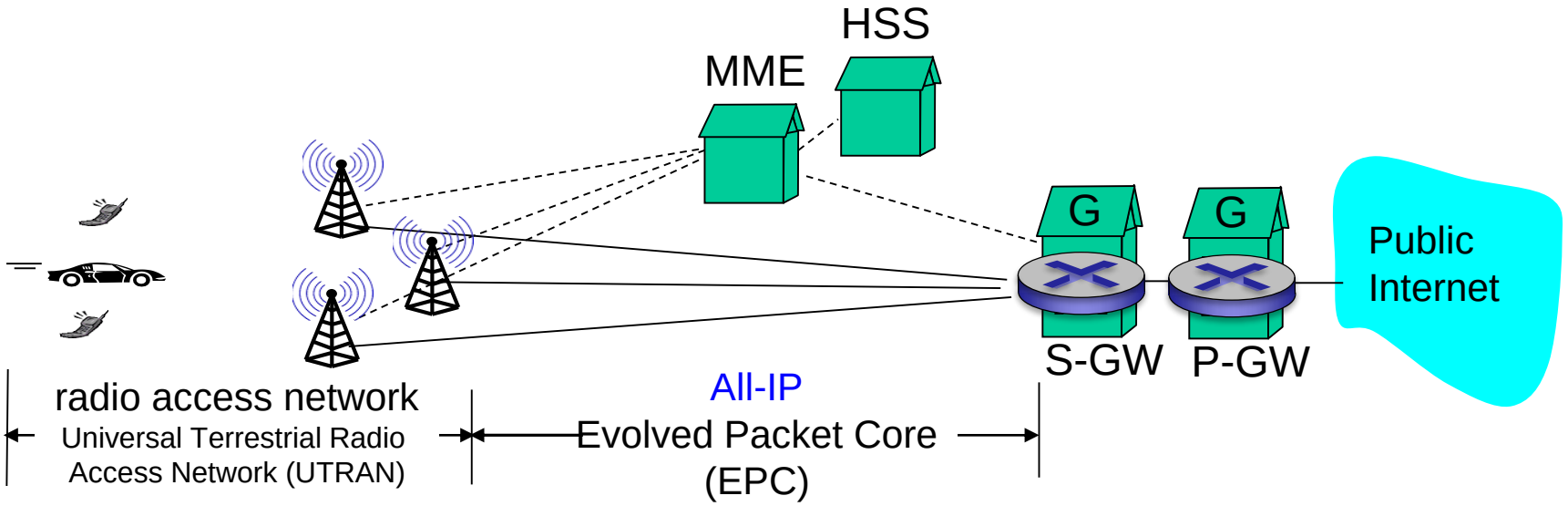
- **4G network architecture**



  - eNodeB
    - Forward datagrams between UE and the P-GW
    - Registration and mobility signaling traffic

Cellular Network Architecture

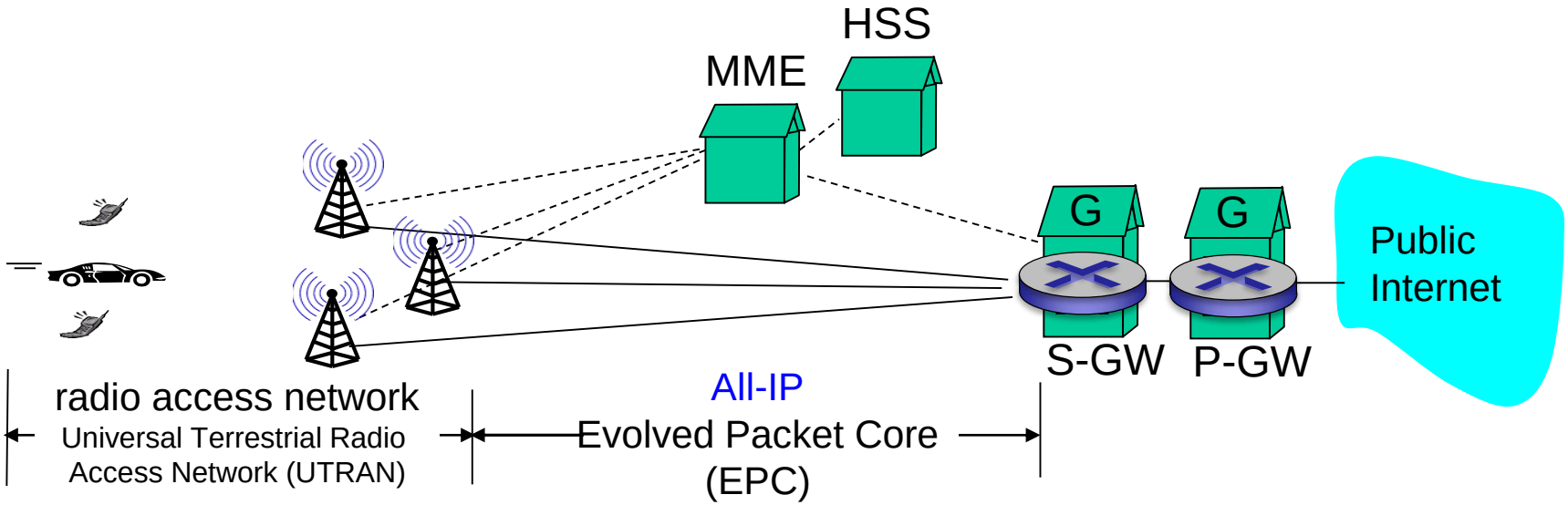
4G network architecture (cont'd)



- Mobility management entity (MME)
  - Connection and mobility management
- Home subscriber server (HSS)
  - Contain UE information including roaming access capabilities, QoS profiles, and authentication information

Cellular Network Architecture

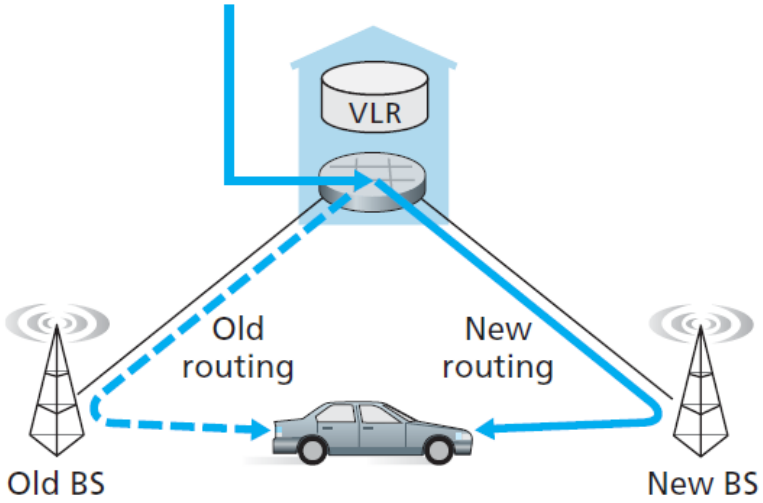
4G network architecture (cont'd)



- Packet data network gateway (P-GW)
  - IP address allocation to the UEs, QoS enforcement
- Serving gateway (S-GW)
  - Data-plane mobility anchor point (all UE traffic will pass through the S-GW)
  - Charging/billing functions

Handoffs in GSM

- **Handoff**
  - Occur when a mobile station changes its association from one base station to another during a call.
  - Scenario
    - Poor signal quality from a base station
    - Congestion at the base station



VLR: Visitor location register

Handoffs in GSM

- **Steps in accomplishing a handoff between base stations with a common MSC**
  - 1) Inform that a handoff is to be performed
  - 2) MSC initiates path setup to the new BS
  - 3) New BS allocates resources for the MS
  - 4) Provide information that the MS will need
  - 5) MS is informed that it should perform a handoff
  - 6) MS establish a connection to new BS
  - 7) MS sends a handoff complete message
  - 8) The resources are released