CIS 585 Communication and Information Services

Fourth-generation Mobile Technology

4G

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Introduction

- What is 4G
- Objectives of 4G
- Compare 4G with 3G
- 4G Key Components
- International Initiatives

What is 4G?

- **Wireless World Research Forum defines 4G as:**

  A network that operates on Internet technology, combines it with other applications and technologies such as Wi-Fi, and runs at speeds ranging from 100 Mbps (in cell-phone networks) to 1 Gbps (in local WI-FI networks).

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What is 4G?

- **Other descriptions:**
  - Fourth-generation cellular communication system.
  - Fourth-generation mobile technology
  - Fully IP-based wireless internet
  - 100 Mbps (outdoor) and 1Gbps (indoor)
  - End-to-end QoS (Quality of service)
  - High security
  - Any services, anytime, anywhere, at affordable cost
  - A collection of technologies and protocols
  - A Single standard
  - Developing time line from 2000 to 2010
  - 4G will make us as a part of the Internet.

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Objectives of 4G

- Efficient and High network capacity
- Nominal date rate: 100 Mbps-1 Gbps
- Smooth handoff across heterogeneous network
- Seamless connectivity
- Global roaming across multiple networks
- High quality of service for multimedia support

  (real time audio, high speed data, HDTV video content, mobile TV, etc)
- Interoperationable with the existing wireless standards
- All IP system, packet switched network

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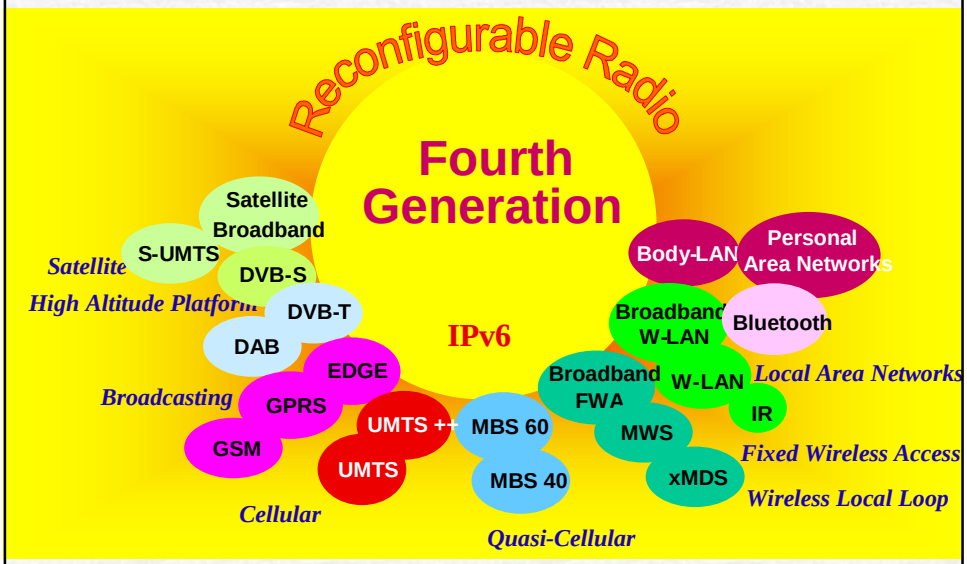
Reference Model of 4G System



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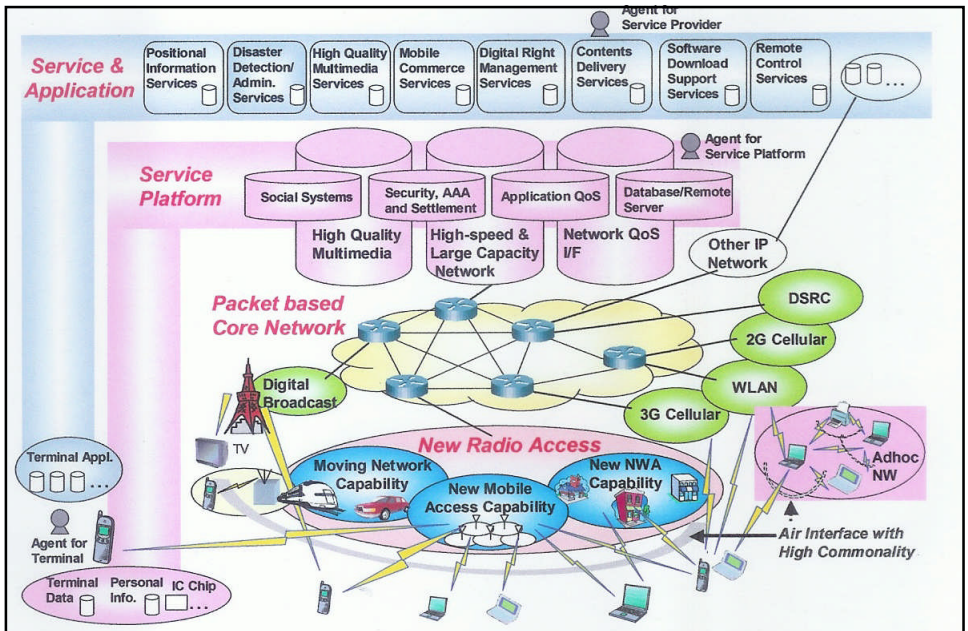
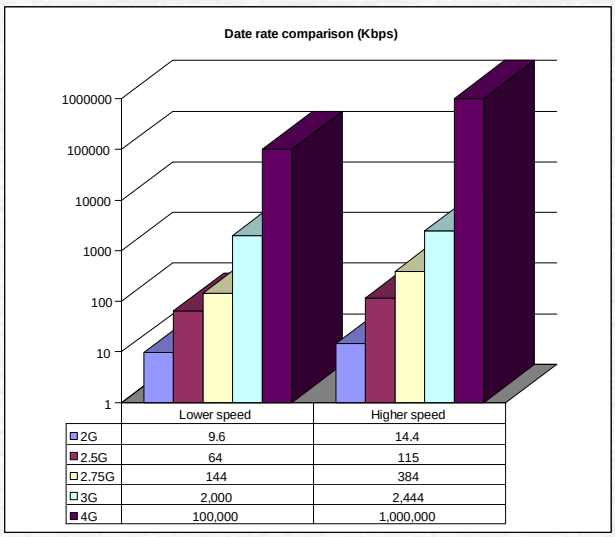


Fig. 1: Reference model of 4G mobile systems



	Lower speed	Higher speed
2G	9.6	14.4
2.5G	64	115
2.75G	144	384
3G	2,000	2,444
4G	100,000	1,000,000

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Compare 4G with 3G

	3G (including 2.5G, sub3G)	4G
Major Requirement Driving Architecture	Predominantly voice driven - data was always add on	Converged data and voice over IP
Network Architecture	Wide area cell-based	Hybrid - Integration of Wireless LAN (Wi-Fi, Bluetooth) and wide area
Speeds	384 Kbps to 2 Mbps	20 to 100 Mbps in mobile mode
Frequency Band	Dependent on country or continent (1800-2400 MHz)	Higher frequency bands (2-8 GHz)
Bandwidth	5-20 MHz	100 MHz (or more)
Switching Design Basis	Circuit and Packet	All digital with packet voice
Access Technologies	W-CDMA, 1xRTT, Edge	OFDMA and MC-CDMA (Multi Carrier CDMA)
Forward Error Correction	Convolutional rate 1/2, 1/3	Concatenated coding scheme
Component Design	Optimized antenna design, multi-band adapters	Smarter Antennas, software multi-band and wideband radios Software-Defined Radio
IP	A number of air link protocols, including IP 5.0	All IP (IP6.0)

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4G Key Components – (1)

- **Access Schemes**

  ❖To add advantages in scalability new access schemes like OFDMA, Single carrier FDMA, and MC-CDMA have been proposed as part of the next generation UMTS, 802.16e and 802.20 standards.

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4G Key Components – (2)

- **IPv6**

❖ Remove the need for Network Address Translation (NAT)

❖ Enables a number of applications with better multi-cast, security and route optimization capabilities.

❖ Support a great number of wireless enabled devices.

❖ Provide more available address space and number of addressing bits

❖ Enables 4G coding schemes innovation

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4G Key Components – (3)

- **Multi-Antenna Systems**

❖ MIMO (Multiple-input and multiple-output) multiplexing

❖ Is used to send data via various routes across a network in order to increase date capacity.

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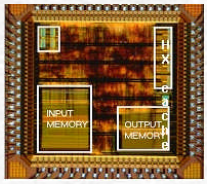
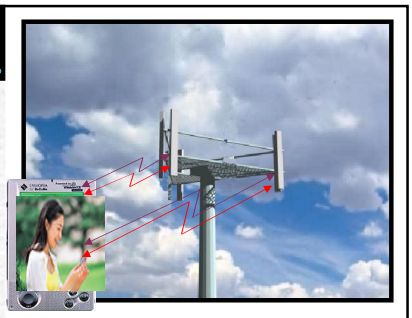
Example: MIMO





- MIMO increases the peak data rates and average throughput of data systems.
- Comparison between conventional (1,1) system and (4,4) system:
  - Increase peak data rate by up to a factor of 3
  - Increase average throughput by a factor of 2.2.

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4G Key Components – (4)

- **Software-Defined Radio (SDR)**

❖ 4G devices will constitute all collection of wireless standards. This can be realized by using SDR technology.

❖SDR is one form of open wireless architecture (OWA). .

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International Initiatives (1)

- **WWRF (Wireless World Research Forum)**

❖ In 2001, Alcatel, Ericsson, Motorola, Nokia and Siments formed the WWRF to explore 4G

❖ Provides a global platform for discussion of results, exchange of views to initiate global cooperation toward 4G

❖ Work with the ITU, UMTS Forum, ETSI, 3GPP, 3GPP2, IETF, and other relevant bodies regarding commercial and standardisation issues

❖In 2003, WWRF announced an effort to establish linkages and discuss common goals with Japan's mobile TT forum.

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International Initiatives (2)

- **ITU (International Telecommunication Union)**

❖ **ITU** is the leading United Nations agency for information and communication technology

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International Initiatives (3)

- **Japan and China signed a memorandum in 2005 to work together on 4G.**
- **Japan NTT DoCoMo has tested the 4G in 2005 and hopes to launch a commercial 4G Network by 2010**

Reference:

- http://www.itu.int/net/home/index.aspx
- http://www.wireless-world-research.org/
- http://en.wikipedia.org/wiki/
- http://newscientist.com