Course Overview

- Introduction and History
- Regulatory Issues
- Fundamentals of Cellular Systems
- 1st Generation: AMPS and CDPD
- 2nd Generation: GSM
- 3rd Generation: IMT-2000
- Mobile IP
- TCP over Wireless Link

European R&D Programs

- 1985-1995: RACE (Research into Advanced Communications in Europe)
  - Phase I: concentrated on system engineering, outlining specifications and key technologies
  - Phase II: concentrated on systems integration, prototyping of new services and applications
- since 1995: ACTS (Advanced Communications Technologies and Services):
  - integrate the building blocks identified during RACE into one single system
  - major research effort into following three network platforms:
    - UMTS (Universal Mobile Telecommunications Systems)
    - MBS (Mobile Broadband Systems)
    - WLAN (Wireless Local Area Networks)

3rd Generation Cellular Systems

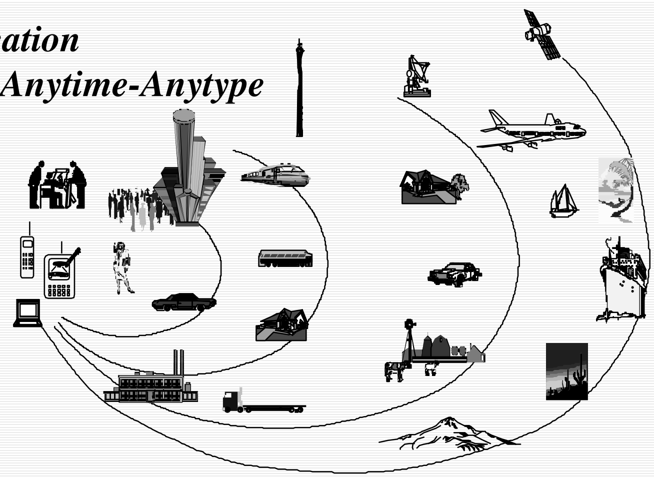
- next generation mobile communication systems under development at ITU and ETSI (one of GSM study groups)
- European project is Universal Mobile Telecommunication System (UMTS), while ITU project is called International Mobile Telecommunications 2000 (IMT-2000), formerly known as Future Public Land Mobile Telecommunication System (FPLMTS)
- time horizon: basic standards by 2000, commercialization by 2005, “life” expectancy beyond 2025
- mobile access part of future Broadband ISDN network
- service objectives
  - broad range of customizable telecommunication services up to 2 Mbps, subset of B-ISDN
  - support Universal Personal Telecommunications (UPT), fixed network service for personal mobility, allowing registration and deregistration at any terminal
  - support wide range of terminal types

3rd Generation Cellular Systems

- support public and private environments
- operation in, and roaming between, different operating environments
  - sparse, rural, suburban, urban
  - indoor/outdoor
  - residential/business
  - pedestrian/vehicular
- provide integrated satellite component
- combine range of existing wireless systems (cellular, cordless, mobile data, paging) to share infrastructure costs and harmonize services
- allow flexible and rapid creation of new services
- efficient usage of spectrum resources
- enable provision of wireless local loop

What is IMT-2000?

Communication
Anywhere-Anytime-Anytype



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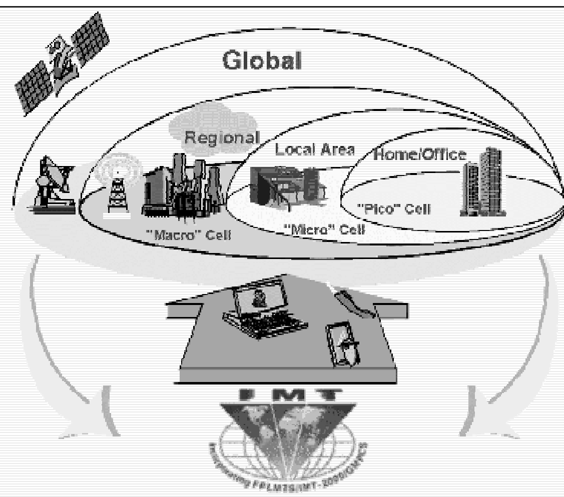
IMT-2000 Vision



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Cellular/PCS Data Speed Evolution (to IMT-2000)

Low Speed Data	Medium Speed Data	High Speed Data
8Kbps ~ 14.4Kbps	32Kbps ~ 64Kbps	144Kbps ~ 384Kbps
Text data, Graphic	Graphic, Image	Image,Video
Remote Login, E-mail, Text mode Internet	Internet, Internet VOD	Multimedia, VOD,
Now	~ 1999	~2000 (IMT-2000)

- ➨ **Data Speed Performance will reach to the IMT-2000 grade,**
- ➨ **Data Service Applications will be completely matured before the Commercial Deployment of the IMT-2000 system.**

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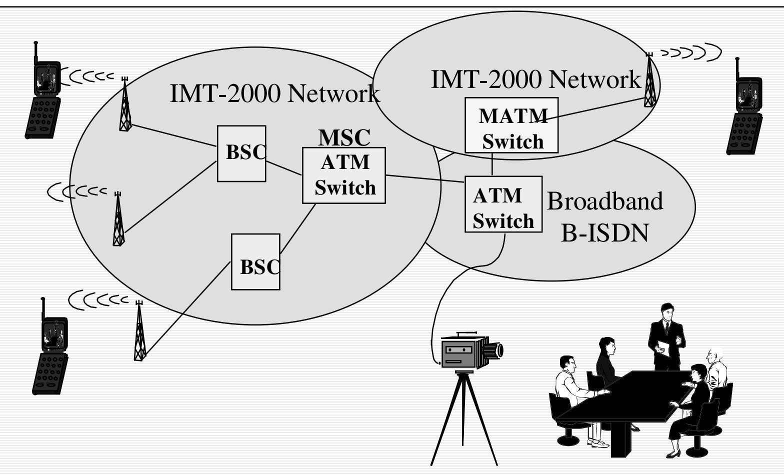
Broadband Network and Services



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IMT-2000 Minimum Performance Capabilities

- Vehicular:
  - Bandwidth ≥ 144 kbps,
  - error rate ≤ 10^{-6}
- Outdoor to Indoor and Pedestrian:
  - Bandwidth ≥ 384 kbps,
  - error rate ≤ 10^{-6}
- Indoor Office:
  - Bandwidth ≥ 2 Mbps,
  - error rate ≤ 10^{-6}

IMT-2000 within ITU

- ITU-R TG 8/1: Radio
  - spectrum allocation: at WARC-92, set aside 1885-2025 and 2110-2220 MHz bands worldwide for terrestrial & satellite, lower band pretty much free in Europe and Japan, used in China for CDMA and WLL, used in North America for PCS ......
  - satellite component
  - technology evaluation & choice
  - interface specification
- ITU-T SG 11 (lead), 2, 7, 13, 16: Network
  - services, numbering, charging
  - switching, signaling, protocols
  - security
  - operation & management
  - performance

IMT-2000 Development

- Regional activities (North America, Europe, and Asia/Pacific), submit standard proposals
- Each region has own unique history, existing systems, etc., so likely outcome of IMT-2000 activities is a "family of standards", assuring air-interface and network standards interoperability
- Time schedule for radio specifications:
  - February 1997: request for candidate radio transmission technologies
  - April 1998: cut-off for submissions to U.S. TG 8/1
  - July 1998: cut-off for submissions of candidate proposal to ITU-R
  - March 1999: TG 8/1 determines key characteristics of IMT-2000 radio interface
  - December 1999: TG 8/1 completes development of radio interface specifications

IMT-2000 Status

- Current proposals:
  - North America: wideband cdmaONE/WIN
  - Europe: UMTS (CDMA with FDD for paired spectrum, TDD for unpaired spectrum)
  - Asia/Pacific: J-IMT-2000 & wideband cdmaOne
- cdmaOne: DS-CDMA/FDD, chip rates of 1.2288/3.6864/7.3728 Mcps, frame length of 20 msec, QPSK/BPSK modulation, convolutional coding, synchronous base stations, ...
- UMTS W-CDMA: DS-CDMA/FDD or TDD, chip rates of 4.096/8.192/16.384 Mcps, frame length of 10 msec, QPSK modulation, convolutional and Reed-Solomon coding, asynchronous base stations, ...

Other Critical Activities

- Spectrum Estimation
  - Methodologies for Terrestrial and Satellite
  - Amount of spectrum for Terrestrial and Satellite (apparently there is an urgent need for more spectrum being assigned to the terrestrial component)
  - Spectrum Harmonization for IMT-2000 deployment, for example: identification of global radio control channel to facilitate multimedia terminal operation and worldwide roaming
- Regulatory Issues: Completing the work on recommendations specifying technical, operational, and administrative requirements necessary to facilitate orderly deployment of IMT-2000 systems and the global circulation of IMT-2000 terminals