

# Mobile data networks

# Impact on Higher-Layer Protocols

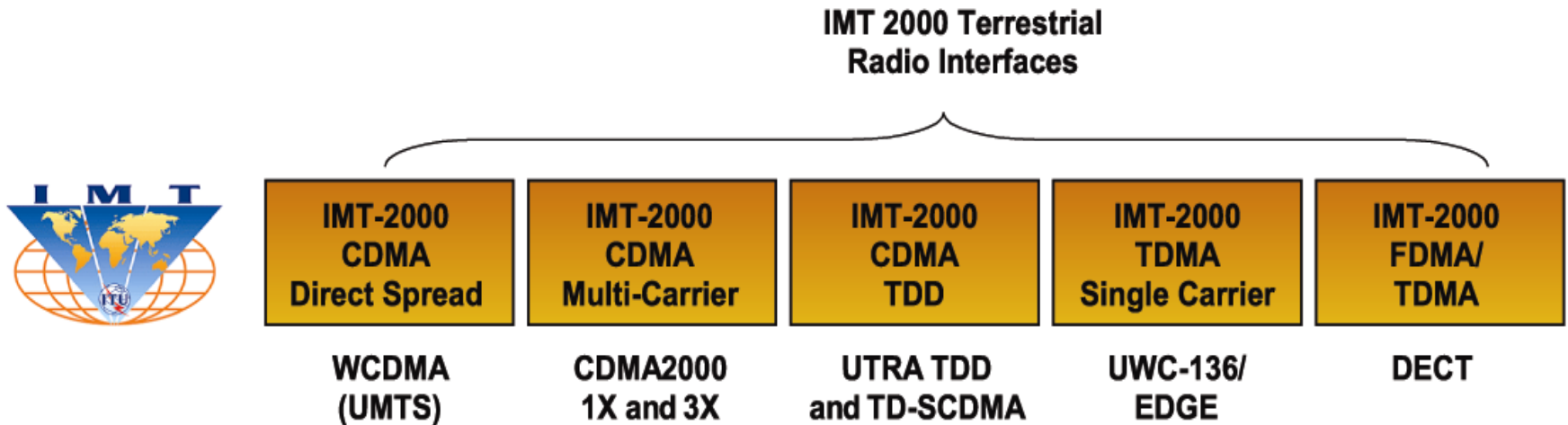
- Wireless and mobility change path properties
  - Wireless: higher packet loss, not from congestion
  - Mobility: transient disruptions, and changes in RTT
- Logically, impact should be minimal ...
  - Best-effort service model remains unchanged
  - TCP and UDP can (and do) run over wireless, mobile
- But, performance definitely *is* affected
  - TCP treats packet loss as a sign of congestion
  - TCP tries to estimate the RTT to drive retransmissions
  - TCP does not perform well under out-of-order packets
- Internet not designed with these issues in mind

# Conclusions

- Wireless
  - Already a major way people connect to the Internet
  - Gradually becoming more than just an access network
- Mobility
  - Today's users tolerate disruptions as they move
  - Tomorrow's users expect seamless mobility
- Challenges the design of network protocols
  - Wireless breaks the abstraction of a link
  - Mobility breaks association of address and location
  - Higher-layer protocols don't perform as well
- Next time: review of the course for last lecture

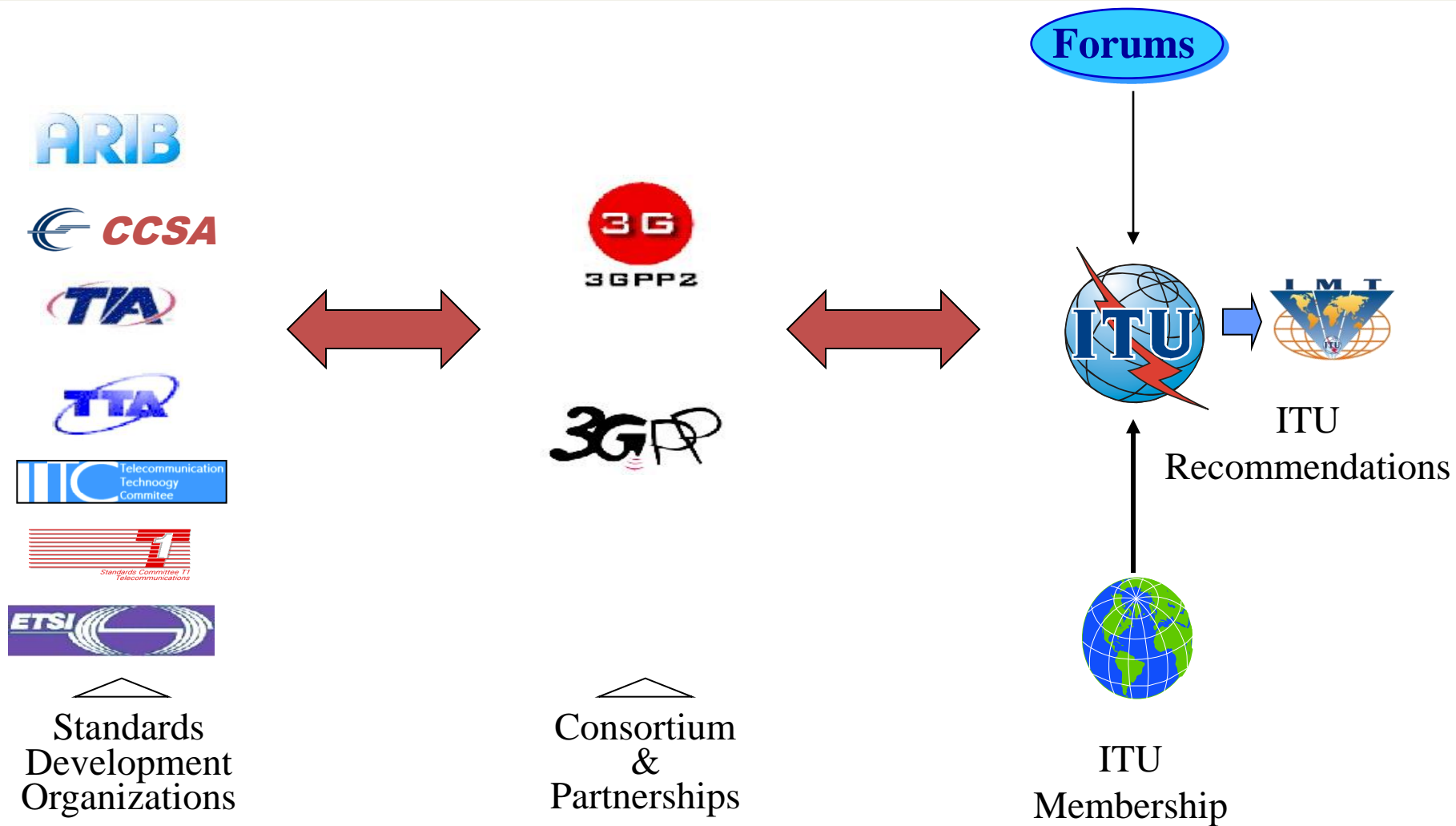
# IMT-2000 Radio Access Standards

- A reminder .....



- Standards driven by market, technology & regulatory opportunities & segments
- Extensive use of references to detailed information held by “external Recognized Organizations”
- Many of these standards are already being enhanced

# IMT-2000 Standards Development



# Goal

- **Goal: anytime, anywhere, anyone – the deployment of IMT-2000 systems started in year 2000**
- **Systems Beyond IMT-2000 capabilities, which extend and enhance IMT-2000, are expected to include:**
  - **Higher data rates**
  - **Improved roaming**
  - **True inter-system mobility management**
- **Greater flexibility to support many different types of services simultaneously (example: symmetrical, asymmetrical & unidirectional services)**

# Evolving Capabilities

- **IMT-2000 original minimum requirements for radio technology evaluation:**
  - 144 kbit/s for vehicular high speed
  - 384 kbit/s for medium speed, and
  - 2048 kbit/s for indoor and low speed
- **Currently the standard supports up to 10 Mbit/s, and further enhancements are being developed, possibly up to 30 Mbit/s by 2005**
- **Research targets for systems beyond IMT-2000 for deployment after 2010:**
  - 100 Mbit/s for high mobility
  - 1Gbit/s for low mobility

# Evolving Relationships

- Along with the future development of IMT-2000 and systems beyond IMT-2000, relationships will continue to develop between different communications and radio access systems. Ex:
  - Wireless personal area networks (WPANs)
  - Local area networks (LANs and WLANs)
  - Digital broadcast
  - Fixed wireless access
- Systems will increasingly be designed as a combination of different access technologies
- Will provide a common and flexible service platform for different services and applications
- Key driver for this convergence is the increasing prevalence of IP-based applications



# Fusion

## Recommendation ITU-R M.1645

**"Systems beyond IMT-2000 should be realized by the functional fusion of existing, enhanced and newly developed elements of IMT-2000, nomadic wireless access systems and other wireless systems with high commonality and seamless interworking and interoperability"**

# Domains

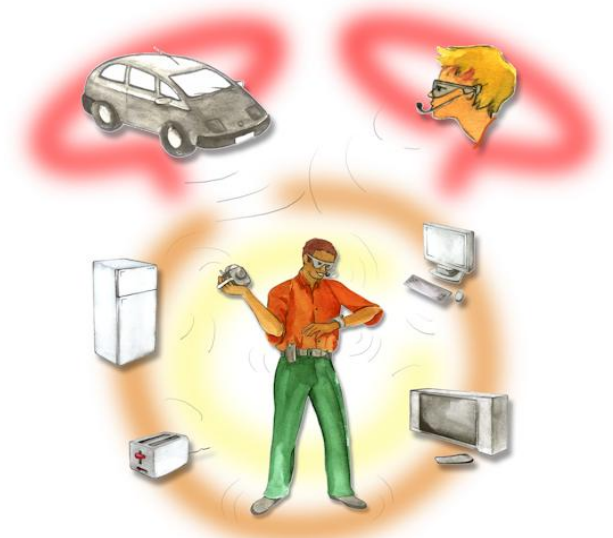
Personal Area



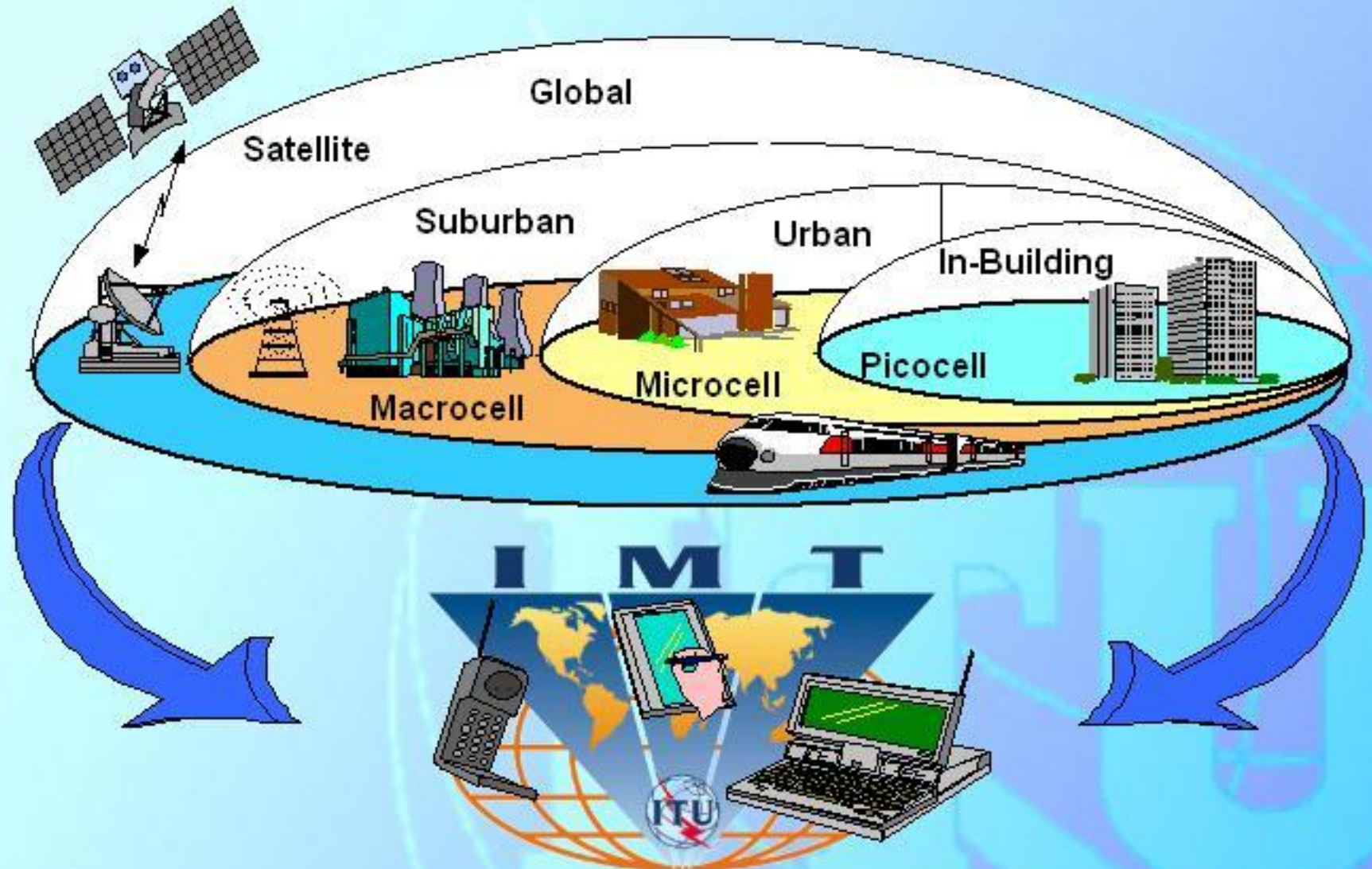
Immediate Area



Wide Area



# IMT-2000 Coverage Environments



# Variety of Access Networks for Systems Beyond IMT-2000

