Role of Standards in Advancing the Technologies for Wireless Access

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8 September 2000

Outline

- **General standards requirements**

- **Some trends in wireless access**

- **Standardization efforts encourage the use of advanced technologies; Two examples: IMT-2000, BWA**

- **A view towards the future**

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What is a standard?

- "a document <u>established by consensus</u> and <u>approved by a recognized body</u>, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context."

  Ref.: ISO/IEC Guide 2, 1996

- **Example: ITU-T and ITU-R Recommendations are non-binding international standards.**

Some Famous Quotes About Standards

- **Standards are boring …**

- **Standards stifle innovation …**

- **Standardization is the enemy of creativity …**

- **Standards are industry's way of codifying obsolescence …**

- **The nice thing about standards is that there are so many to choose from …**

- **Standards are like sausages …**

The other side of the coin

Standards . . .

- **Set higher goals ("raise the bar")**

- **Create momentum ("band wagon effect")**

- **Develop mass markets**
  - Avoid user confusion
  - Lower the costs of equipment
  - Increase interconnectivity and availability of services

- **Provide a framework for orderly growth of capabilities and features**

- **Encourage healthy competition**

Standards Requirements

- **Market Driven**

- **Timely**

- **Quality**

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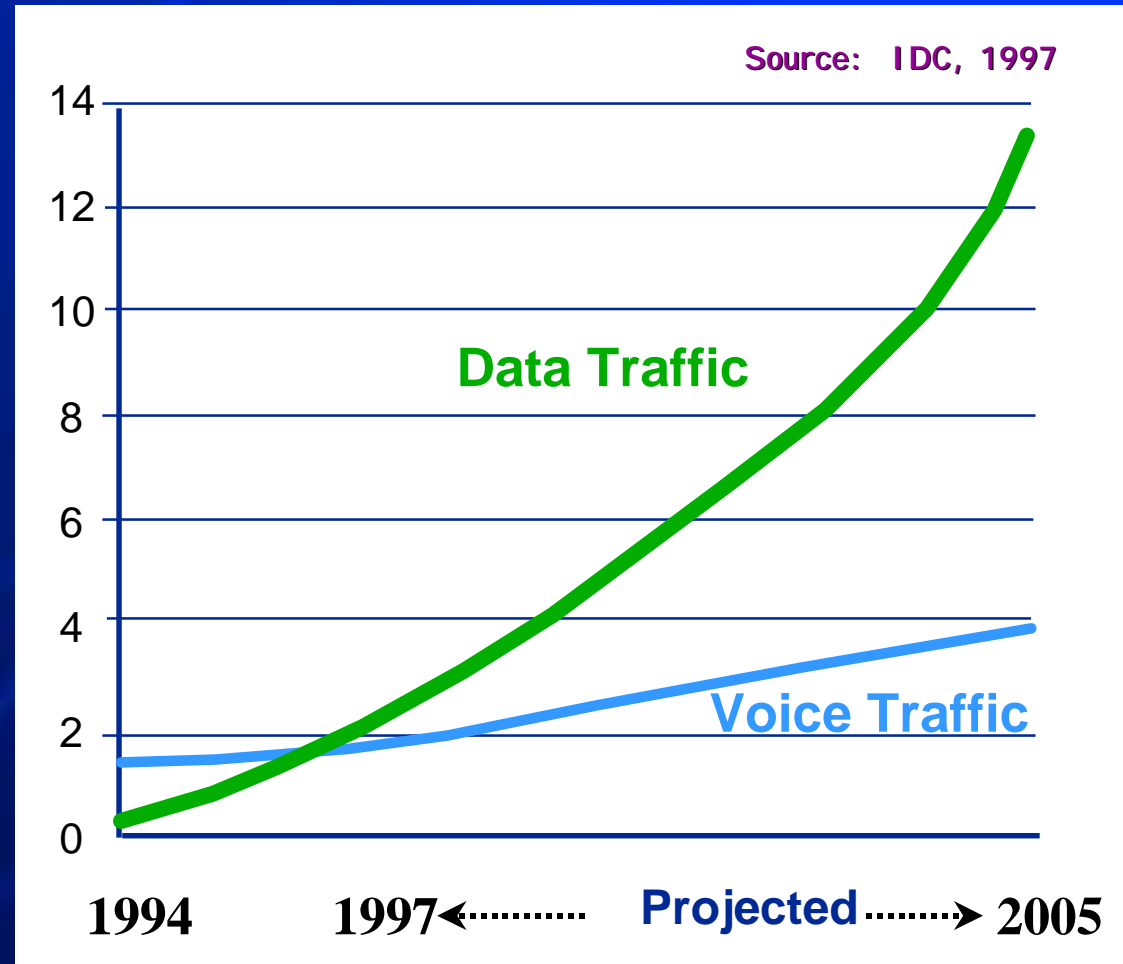
- **A view towards the future**

Prime Drivers of Multimedia Mobility

- **Growth of Multimedia on the Fixed Network**

  — remote computing, infotainment and electronic commerce (e-commerce)

- **Demand for Rapid and Remote Access to Information**

  — "mobile office" applications are just the tip of the iceberg

  — banks, retailers and content providers looking for new delivery channels for mobile commerce and transaction-based applications

- **Convergence**

  — fixed-mobile convergence, as well as convergence of communications, information, entertainment, commerce and computing

Wireless Access will be at the centre of the future information society

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Growth of Multimedia Traffic on the Fixed Network

U.S. long-distance traffic in billions of gigabits per year

Source: IDC, 1997

Data Traffic

Voice Traffic

14
12
10
8
6
4
2
0

1994   1997 ◄·········· Projected ········► 2005

A new industry challenge created by the explosion of the Internet and WWW ...

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Wireless Industry Dynamics

Prices

- **End user**
- **Infrastructure**

Subscribers

- **High growth**

Usage

- **Increasing minutes of use**
- **Creative marketing focus**

Emerging Technology Discontinuity: IP

**Wireless networks must become
more cost effective to own, operate and grow**

Challenges in wireless access standardization

- **Strong consumer demand for advanced capabilities**

- **Need to lower the cost of equipment**

- **Globalization**

- **Increasing competition / deregulation**

- **Time to market and greater speed of development**

- **Need for evolution and flexibility**

- **More efficient use of the spectrum**

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International Standardization: The Work of the ITU Study Groups

Administrations
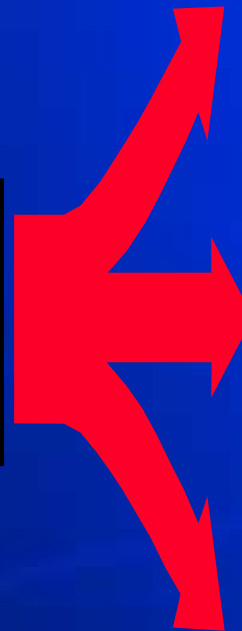
Organizations

Sector Members

Questions
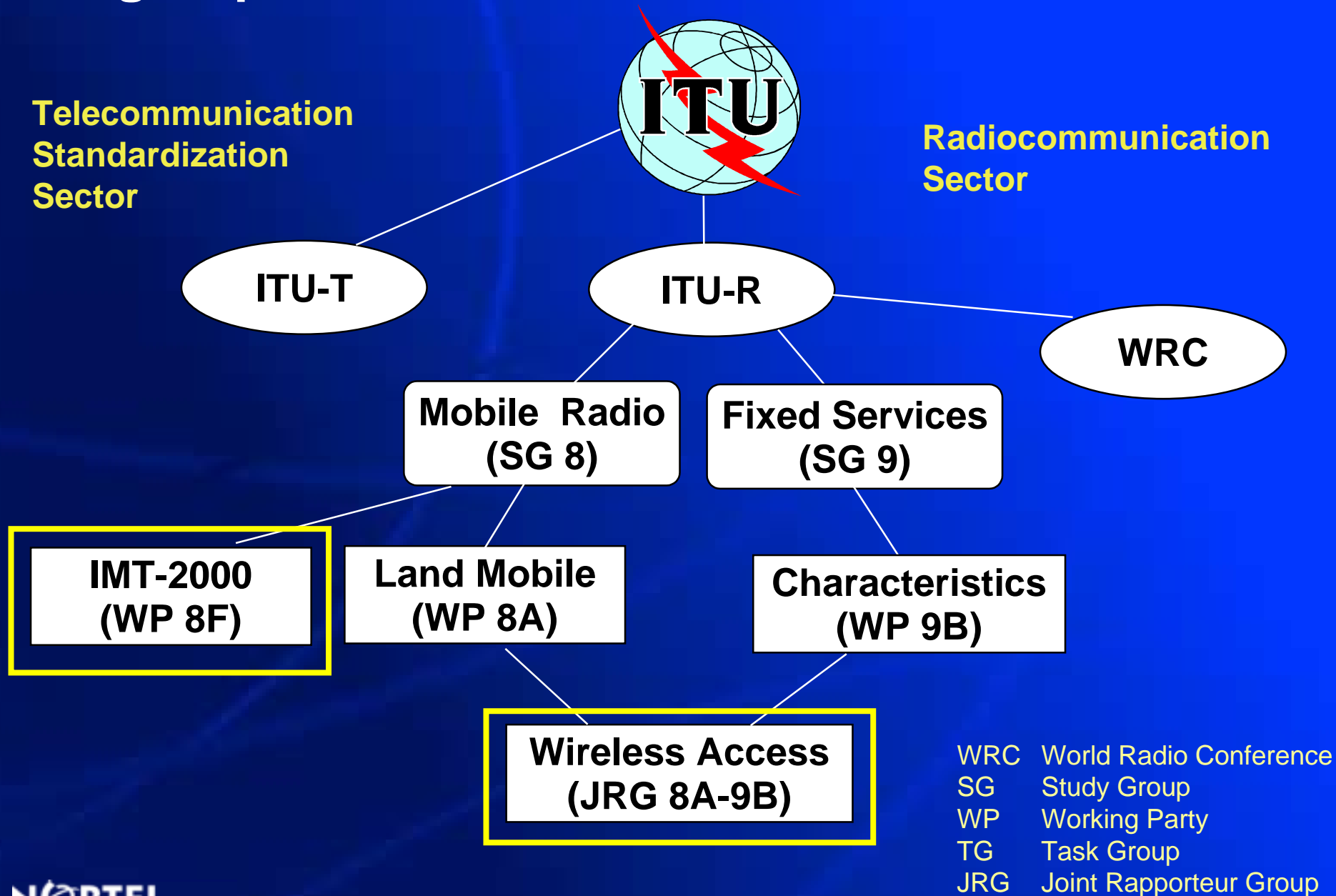
STUDY GROUPs
- Working Parties
- Task Groups
- Rapporteur Groups

Handbooks

Reports

Recommendations (standards)

IMT-2000

- Mobile Telecommunications - Anywhere - Anytime

- Deployment around year 2000 subject to market considerations

- Support evolution of second-generation systems

- Frequency band around 2 GHz

- Wide range of services with high quality and integrity, comparable to the fixed network

- Provision of these services over a wide range of user densities and coverage areas

- Integration of satellite and terrestrial systems

- Standards in ITU-T (network) and ITU-R (radio)

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IMT-2000 Standards Developement

- **Started in 1985**

- **Recommendation M.687-2 IMT-2000 (Concepts and Objectives)**
  - 20 Mbit/s target bit rate capacity

- **Spectrum requirements were secured (WARC-92 and WRC-00)**

- **Initial framework Recommendations produced by ITU-R**
  - Triggered the required research (e.g., European research programmes such as RACE and ACTS, university research)
  - Triggered the development of detailed standards in other standards development organizations

- **ITU-R Task Group 8/1 put in place a thorough standards development process**

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IMT-2000 Standards Development in Europe

- **First UMTS project in 1989 as part of RACE I**

- **RACE II Air Interface projects CODIT and ATDMA**

- **RACE II Network project MONET**

- **ACTS air interface projects:**
    - FRAMES – terrestrial radio interface,
    - SINUS – satellite radio interface, and
    - RAINBOW – General Radio Access Network – GRAN – concept separating radio dependent and radio independent functions.

- **IST advanced technologies projects**

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Basic IMT-2000 System Model for Modularity and Commonality
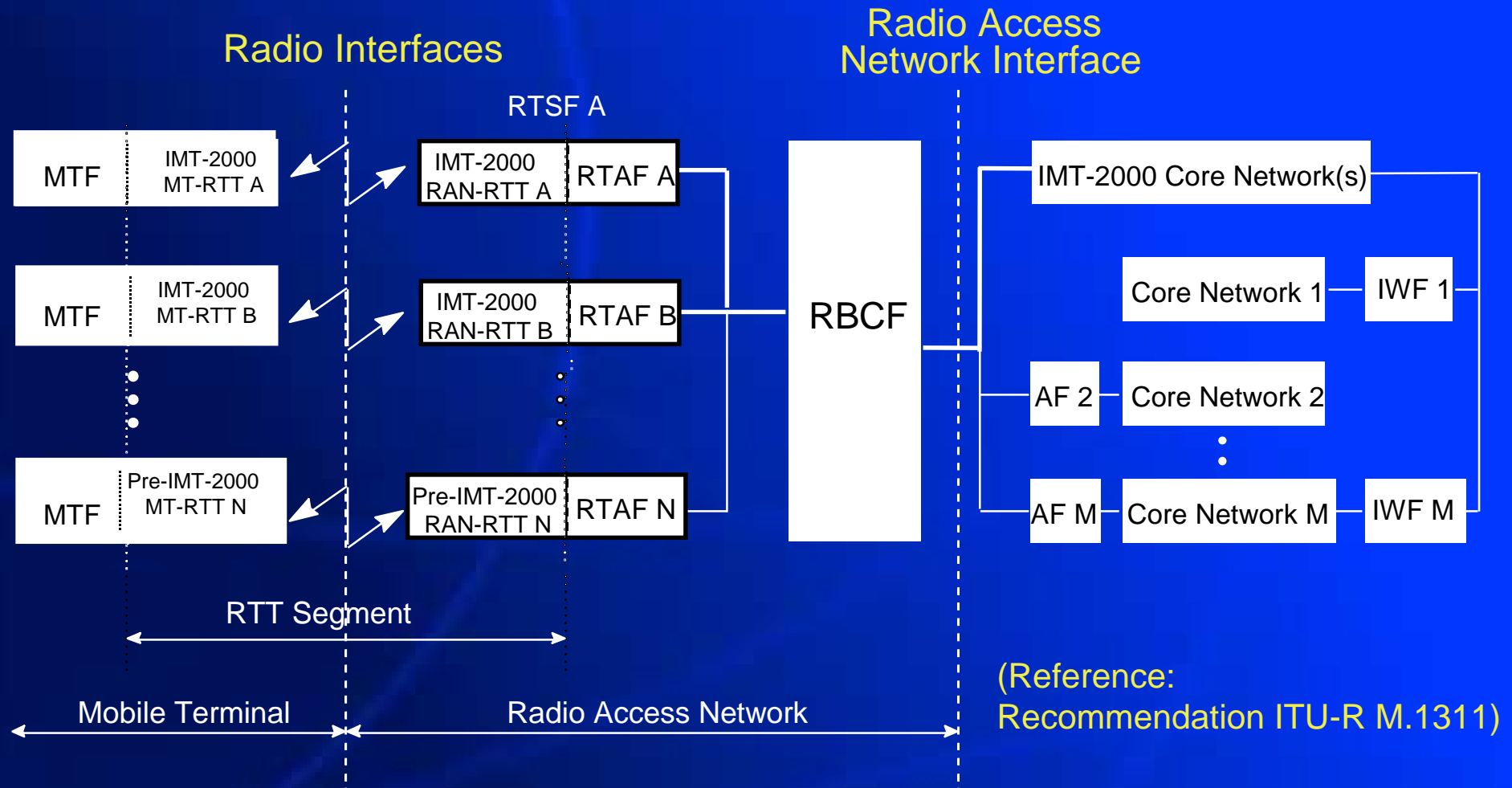
MT — Mobile Terminal Functions
RTT — Radio Transmission Technology
RTAF — Radio Transmission Adaptation Functions
RBCF — Radio Bearer Common Functions

MTF — Mobile Terminal
RAN — Radio Access Network
AF — Adaptation Functions
IWF — Interworking Functions

General block diagram of an IMT-2000 device: RF and Baseband Groupings
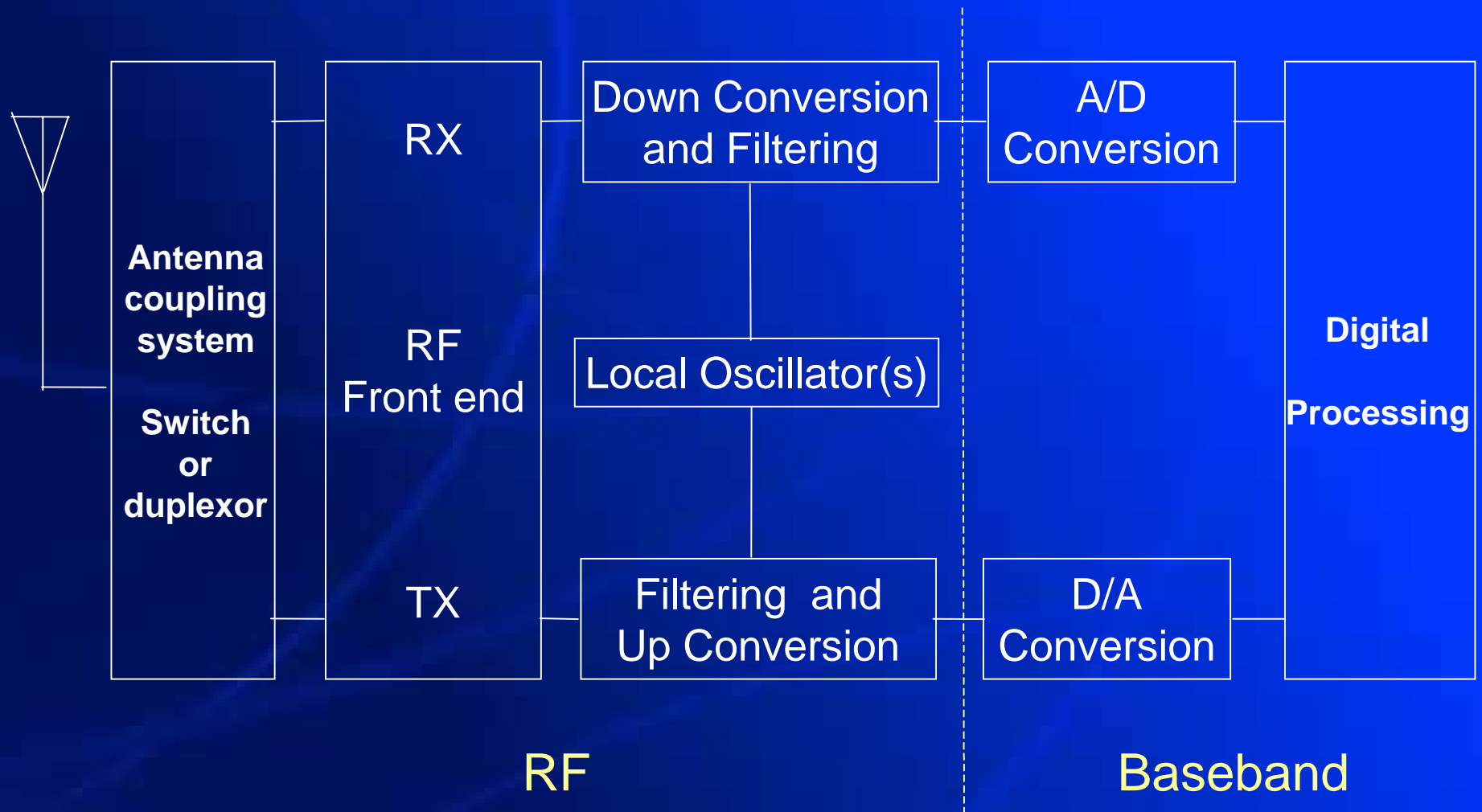
RF Key Characteristics

Transmitter characteristics:

Transmit power
- Power classes
- Dynamic range
- Power control steps
- Frequency stability

Output RF spectrum emissions
- 3 dB Bandwidth
- Adjacent channel leakage power ratio
- Out of band and spurious emissions
- Transmit linearity requirements
- Standby RF output power

Receiver characteristics:
- Receiver sensitivity
- Receiver dynamic range
- Intermodulation sensitivity
- Spurious response and blocking
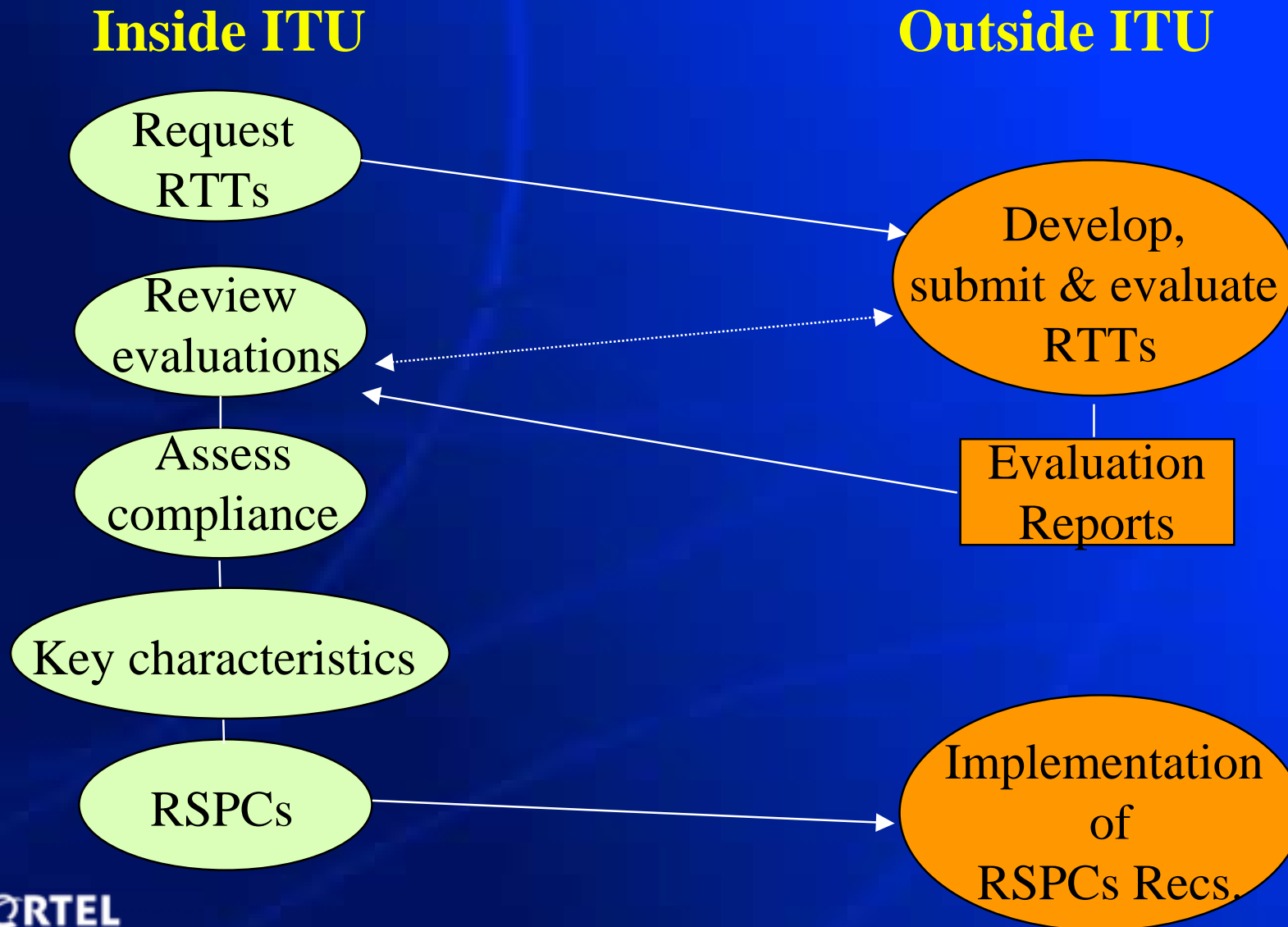- Adjacent channel selectivity

Other characteristics:
- Diversity techniques
- Smart antennas
- Minimum operating bandwidth

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Baseband Key Characteristics

- Multiple access technique
- Multi-carrier
- Duplexing scheme
- Modulation
- Channelization code
- Scrambling code
- Pilot structure
- Detection
- Channel coding and interleaving
- Variable data rate
- Chip rate
- Frame structure

- Variable length spreading factor
- Random access
- Inter base station asynchronous/ synchronous operation
- Absolute up-link chip code synchronization
- Handover
- Power control
- Diversity
- Adaptive equalizer
- Dynamic Channel Allocation

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IMT-2000 RADIO INTERFACE DEVELOPMENT PROCESS

Inside ITU

Outside ITU

Request RTTs

Review evaluations

Assess compliance

Key characteristics

RSPCs

Develop, submit & evaluate RTTs

Evaluation Reports

Implementation of RSPCs Recs.

IMT 2000 Candidate Radio Technologies Requirements

Environment	Indoor Office	Outdoor-to-Indoor and Pedestrian	Vehicular
Mobility	Low	Medium	High
Handover	Required	Required	Required
Circuit Switched	2048 kb/s @10^{-6} BER	384 kb/s @10^{-6} BER	144 kb/s @10^{-6} BER
Packet Switched	2048 kb/s @10^{-6} BER	384 kb/s @10^{-6} BER	144 kb/s @10^{-6} BER

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Worldwide 3G Standards Bodies

GSM- based UMTS

IMT-2000

Third Generation Partnership Project

3GPP

ITU

T1P1

ETSI

ARIB /TTC

TTA

TIA

IETF

O H G

UWCC

3GPP 2

Mobile IP

ANSI-41 + CDMA2000 + M-IP Architecture
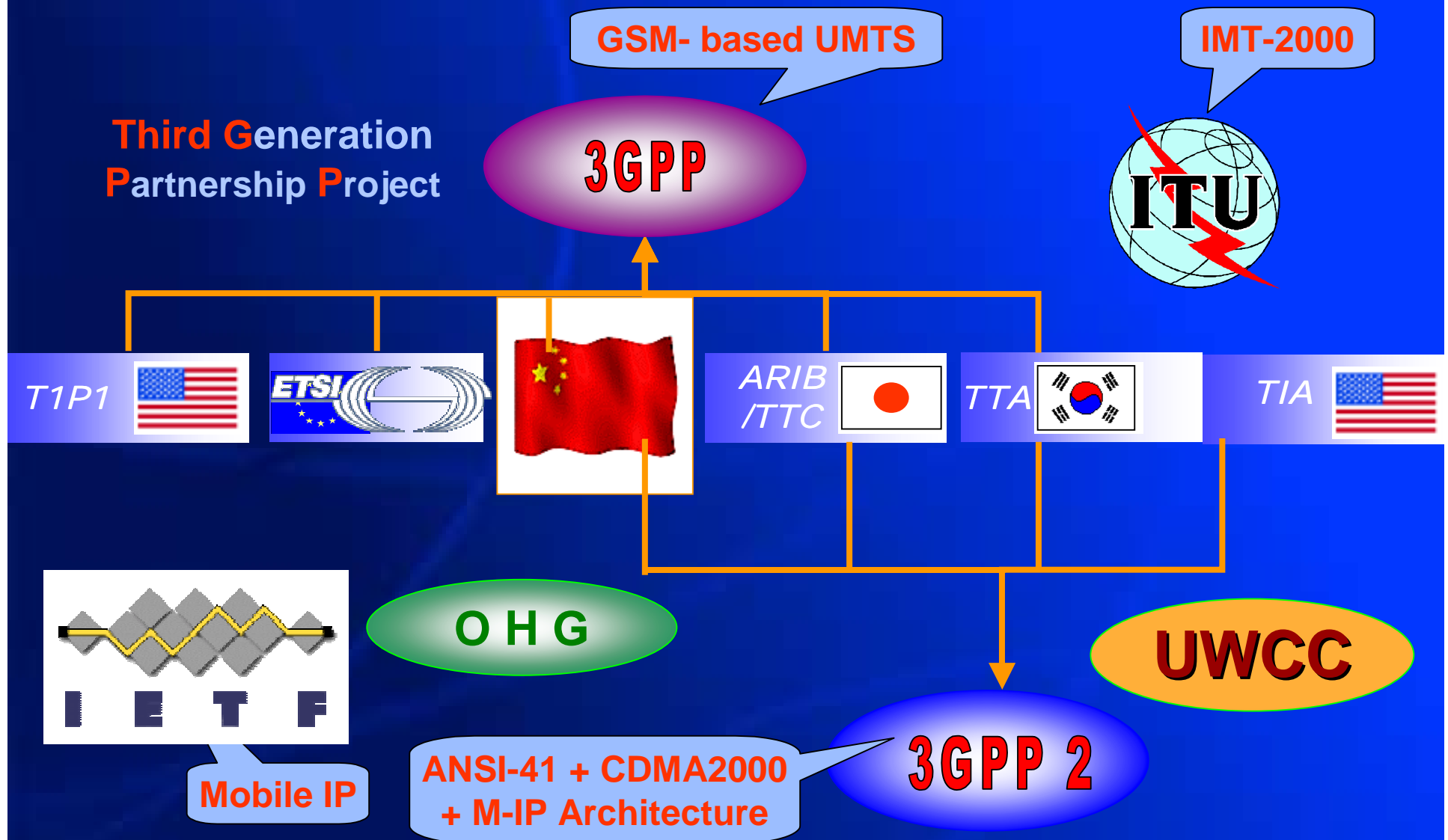
TIME SCHEDULE
FOR ITU-R IMT-2000 RADIO INTERFACE STANDARD DEVELOPMENT ACTIVITIES

1997	1998	1999	2000

PROPOSALS

EVALUATION

CONSENSUS BUILDING

DETAILED STANDARDS
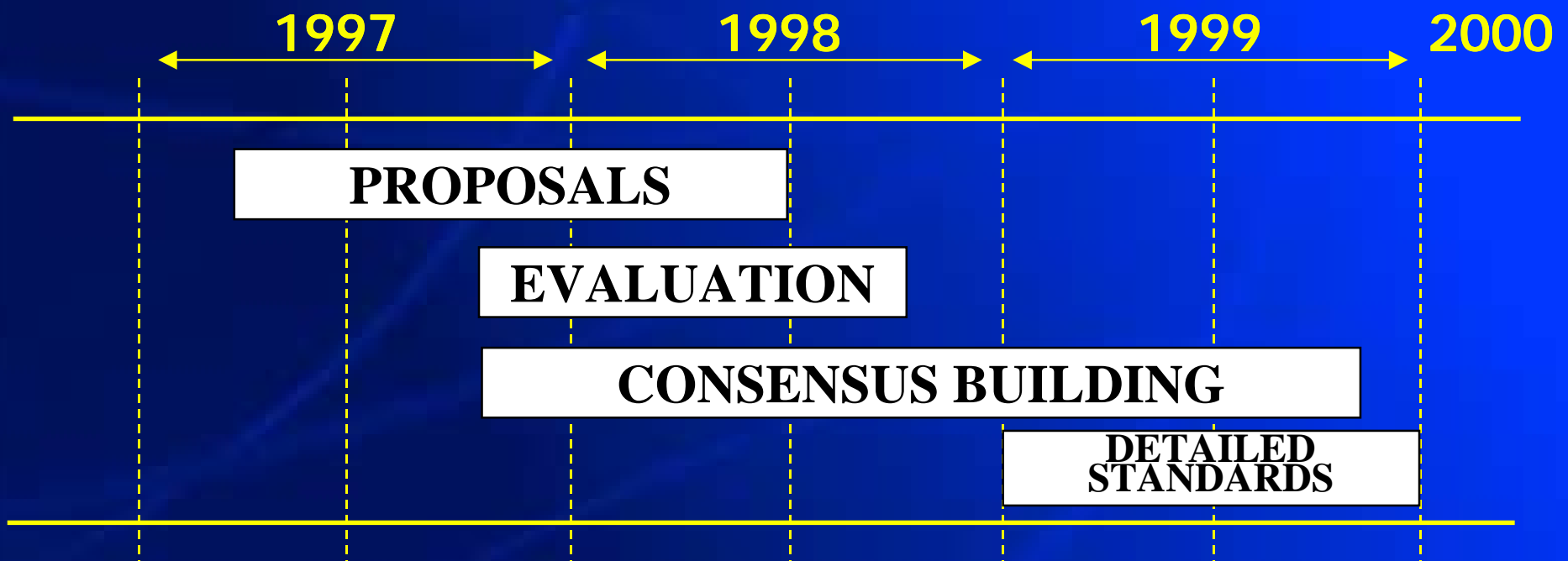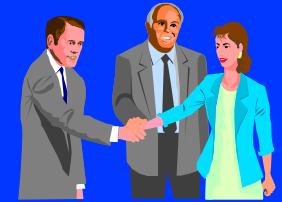
May 2000: Recommendation ITU-R M.1457
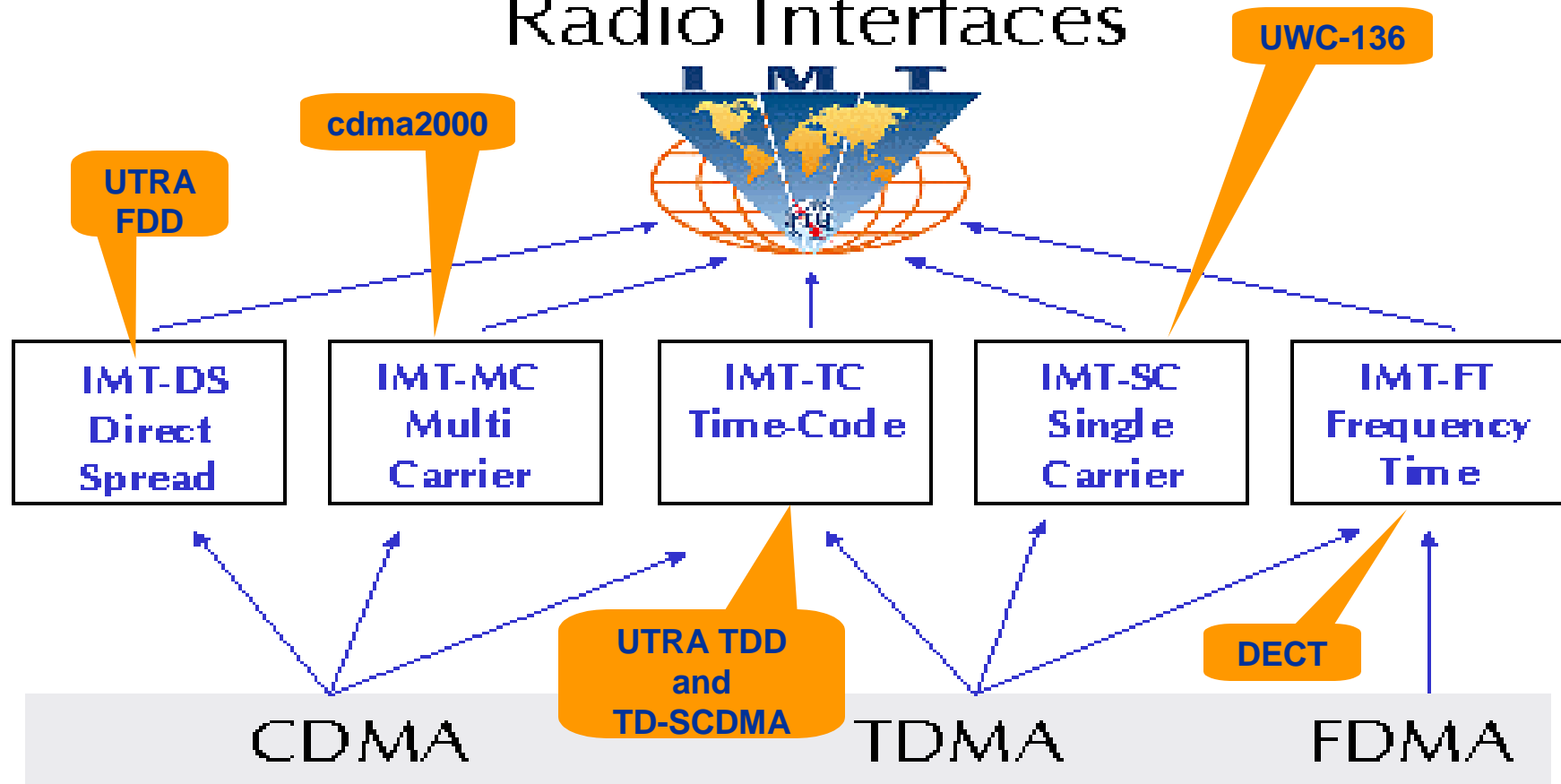
FDD: Harmonization of the Protocol Layers

GSM MAP

ANSI 41

GSM MAP

ANSI 41

L3, MM, CC (WCDMA)

L3, MM, CC (cdma2000)

L3, MM, CC (WCDMA)

L3, MM, CC (cdma2000)

L3 RRC (WCDMA) | HOOKS | EXTENSION

EXTENSION | HOOKS | L3 (cdma2000)

L2 (WCDMA) | HOOKS | EXTENSION

EXTENSION | HOOKS | L2 (cdma2000)

L1 (WCDMA) | HOOKS | EXTENSION ???

EXTENSION ??? | HOOKS | L1 (cdma2000)

DIRECT SPREAD

MULTI-CARRIER

any functionality that is specified for the initial release of the standards to permit extensions (backwards compatibility)

"Extensions" – are any additional functionality which needs to be specified in detail to meet the harmonization requirements

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IMT-2000 and FWA

- IMT-2000 is a system

- ITU-R WP 8F
  IMT-2000

- IMT-2000 standards for
  both mobile and fixed
  applications

- FWA is an application

- ITU-R JRG 8A-9B
  Wireless Access

- FWA standards, not
  necessarily IMT-2000,
  e.g., spectrum,
  performance, etc.

IMT-2000   FWA

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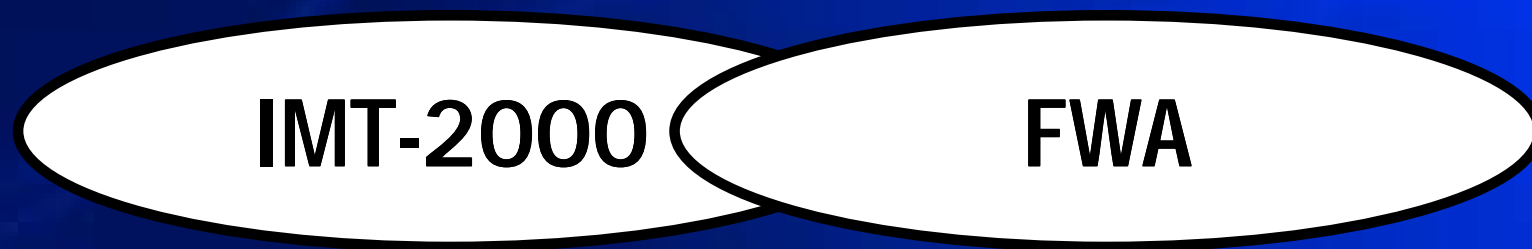
FWA in ITU-R

- **The ITU-R Joint Rapporteur Group 8A-9B on Wireless Access was formed by Working Parties 8A and 9B to resolve an important area of overlap between Study Groups 8 and 9 in the work on wireless access using both fixed and mobile technologies**

- **The arrangement has been very satisfactory for all the parties involved and has led to good results as demonstrated by the following outputs to-date in seven meetings:**

    — 10 ITU-R Recommendations/Standards
      (8 in the F-series and 2 in the M-series)

    — 1 draft Recommendation

    — 9 working documents towards draft Recommendations

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Fixed Wireless Access (including BWA)

- **Speed is of the essence to meet time to market requirements**

- **Example: Recommendation ITU-R F.1599 ("Radio transmission systems for fixed broadband wireless access (BWA) based on cable modem standards") was developed in just three months (Feb – Apr 1999) taking advantage of previous developments for cable modems.**

- **In the meantime more advanced techniques are being developed and standardized by IEEE 802.16**

  — First priority: Meet market needs in a timely manner

  — Second priority: Evolve and advance the systems

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Standards and IPR

- **There is a desire to include IPR in standards**
  - —Standardization ensures use of the IPR which is included in the standard in most cases
  - —Most standardization bodies require non-discriminatory and reasonable terms and conditions for IPR in standards

- **Only the most advanced techniques get included in standards (this is ensured by peer review)**

- **This promotes enhanced capabilities and better solutions**

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A view towards the future

PowerPC
Faster devices
Pentium II and III

marímba

get PointCast free

Push Technologies

Microsoft Internet Explorer

N

More Users
NCs   Smart
HPCs Phones

More Applications

Explosive Traffic Growth

Internet Telephony

VPNs

WCDMA
Faster Access
CDMA2000   EDGE

Firewalls

Extranets

Search Engines

Protocols & Standards

JAVA

YAHOO!

AltaVista
Search Network

excite

Richer Content

CNNin interactive CNN.com

Multicast

MPEG

VXTREME
real-time web video

Streaming Video

Solution: Unified Networks

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Unified Networks
…are essential for delivering integrated multimedia mobility…

Service and Application Layer

Circuit Switched Telephony Gateway

Provisioning of Services

PBX, Centrex VoIP Services

Value Added Services

Billing and Settlements

Services Creation and Packaging Environment

Online Content

and E-Commerce

Transport and Connectivity Layer

Managed IP WAN (EXTRANet)

Network Management

The Internet

Access Layer and User Domains

Mobility Management

BTS BTS BTS

Macrocells

BTS BTS BTS

Microcells and Picocells

BTS

Data/Voice

Mobile / Fixed Public / Private

Corporate Intranets

Wide Area and High Density   *Campus and In-Building*

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Unified Networks Packet Architecture

Services & Applications Servers

Management Servers

Access Net. Servers
- Mobility Management
- IP Management
- Authentication
- Subscriber Database

Application Servers
- Voice Telephony App.
- SMS Messaging Apps.
- Web & Email Apps.

Network Mgmt
- Subnet & Element Mgrs
- QoS Policy Mgmt
- Centralized Net. Mgmt

Back Office
- Billing
- Customer Service

Routers
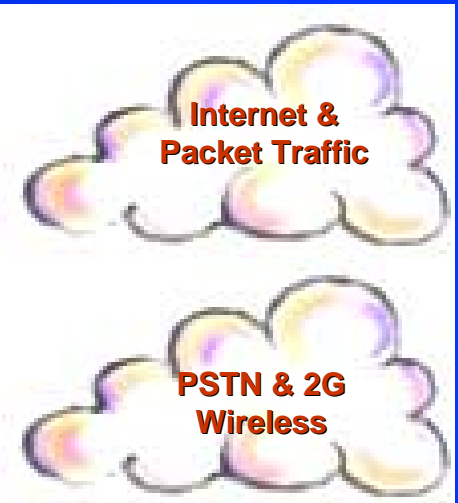- IP and ATM
- Centralized or Distributed

Managed Packet WAN

Wireless Gateway
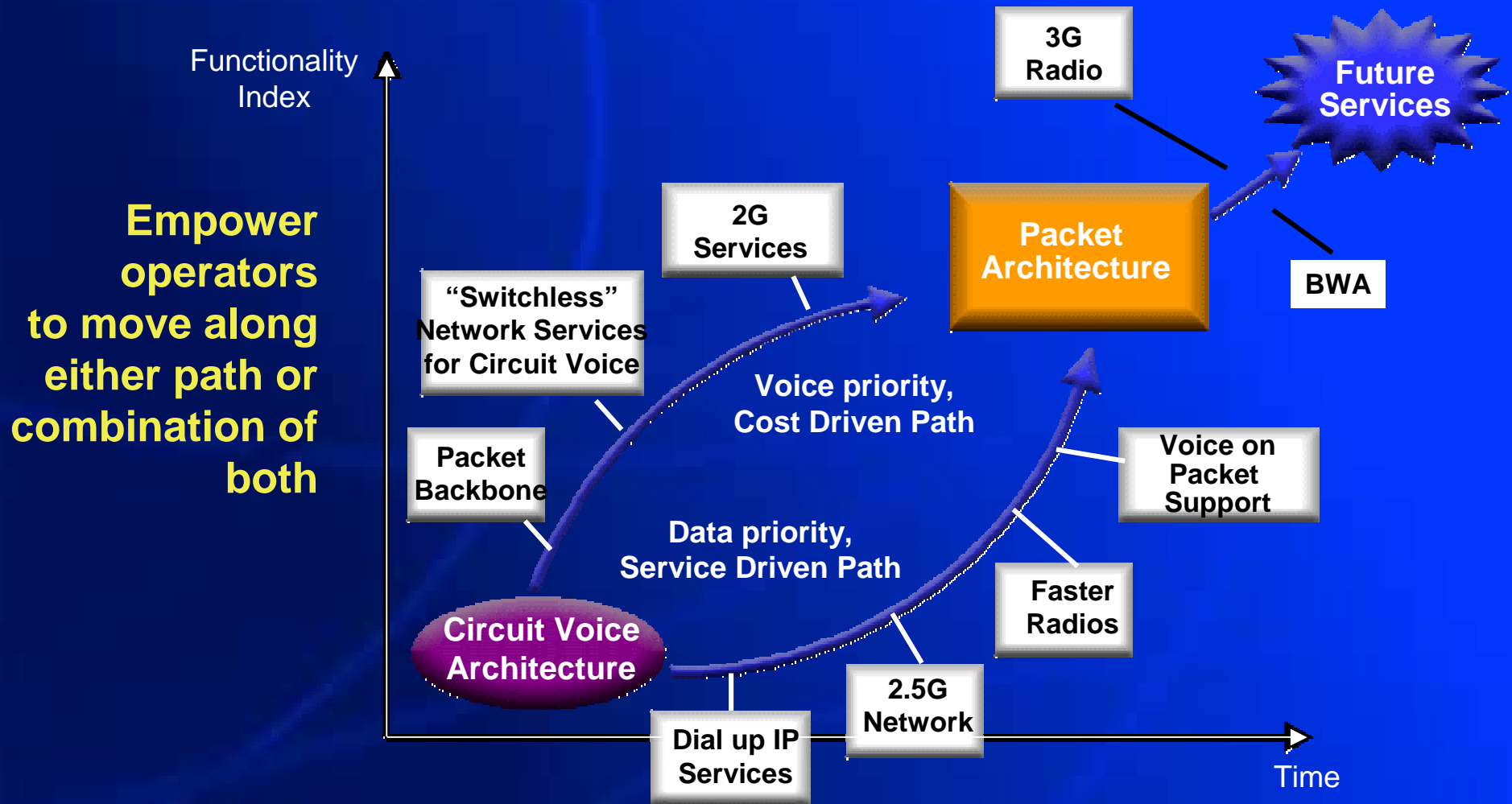- Packet Enh. BSC
- Local Mobility Mgmt
- RF Resource Mgmt

Circuit Gateway
- Wireless vocoders conversion to PCM

Internet & Packet Traffic

PSTN & 2G Wireless

Distributed architecture, Server Based Accelerated Service Innovation in IP Environment

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Summary and Conclusions

- **We have discussed the other side of the coin about standards**

  — Strong consumer demand for advanced capabilities at low costs, particularly driven by Internet applications, put pressure into timely standards development.

- **We have shown examples based on standardization of IMT-2000 and FWA/BWA in the ITU**

  — Standards development provide frameworks for evolutionary growth.

  — More advanced capabilities are introduced in an orderly manner.

- **We have shown some views about the evolution towards the future**

  — Explosive growth of wireless services and applications

  — Role of Unified Networks

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