Third Generation Mobile Systems: Around the World with IMT-2000

FCC/OET Tutorial
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Third Generation Mobile Systems: Around the World with IMT-2000

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- Radio Interface Evaluation Process
- U.S. Regulatory and Market Environment
- U.S. Goals for Third Generation Mobile Systems
- U.S. Deployment Scenarios
  - Licensing
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  - Timing
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- 1999 World Radio Conference: More Spectrum?

What is Third Generation Mobile?

First Generation - The analog mobile systems (such as AMPS) that were first adopted for cellular use in the 1980's.

Second Generation - The first digital mobile systems (such as GSM, CDMA, US TDMA/D-AMPS) that began to be implemented in the 1990's.

Third Generation - The next generation of digital mobile systems, forecast to provide greater ability to handle high speed data (for internet access, multimedia transfer, etc.); anticipated to be available in the early 2000's.

IMT-2000 Overview

- 1865 - International Telegraph Union (ITU) founded by twenty States
- 1927 - Creation of CCIR (International Radio Consultative Committee)
- 1932 - ITU changes name to International Telecommunication Union
- 1947 - ITU becomes specialized agency of UN

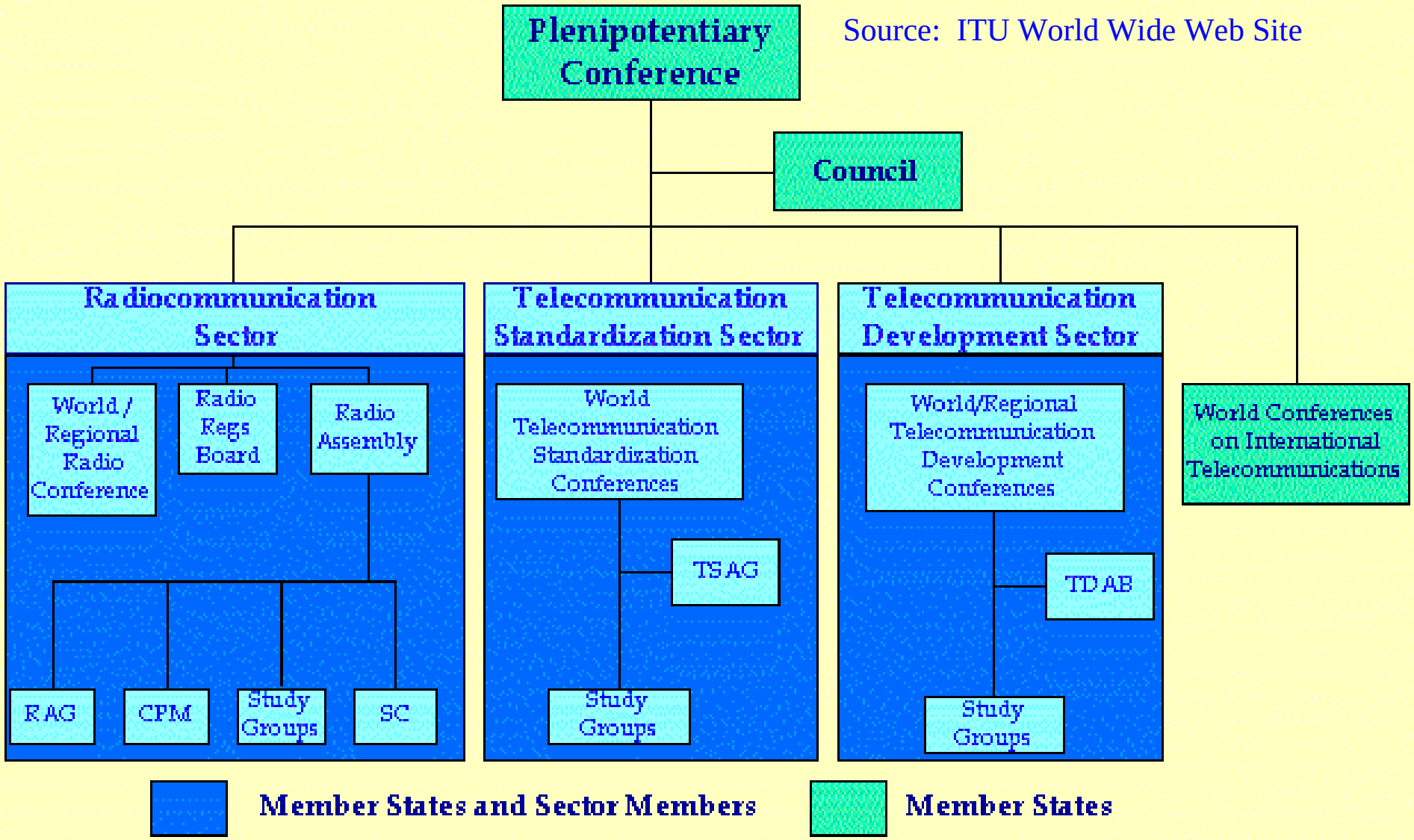
Source: ITU World Wide Web Site

IMT-2000 Overview

"The ITU is an intergovernmental organization, within which the public and private sectors cooperate for the development of telecommunications."

- Consists of:
  - 187 Member States (including Canada and US)
  - over 350 Sector Members

IMT-2000 Overview



Source: ITU World Wide Web Site

IMT-2000 Overview

Radiocommunication Study Groups:

SG 1 - Spectrum management

SG 3 - Radiowave propagation

SG 4 - Fixed-satellite service

SG 7 - Science services

SG 8 - Mobile, radiodetermination, amateur & related satellite services

SG 9 - Fixed service

SG 10 - Broadcasting service (sound)

SG 11 - Broadcasting service (television)

IMT-2000 Overview

Telecommunication Standardization Study Groups:

SG 2 – Network and service operation
SG 3 – Tariff and accounting principles including related telecommunications economic and policy issues
SG 4 – TMN and network maintenance
SG 5 – Protection against electromagnetic environment effects
SG 6 – Outside plant
SG 7 – Data networks and open system communications

IMT-2000 Overview

Telecommunication Standardization Study Groups:

SG 8 – Characteristics of telematic systems
SG 9 – Television and sound transmission
SG 10 – Languages and general software aspects for telecommunication systems
SG 11 – Signalling requirements and protocols
SG 12 – End-to-end transmission performance of networks and terminals
SG 13 – General network aspects
SG 15 – Transport networks, systems and equipment
SG 16 – Multimedia services and systems

IMT-2000 Overview

Structure for Addressing IMT-2000

- ITU-R TG 8/1 (IMT-2000)
  - ITU-R WP 8D (Mobile and Radiodetermination Satellite services)
- ITU-T SG 11 (Signalling requirements & protocols)
  - most ITU-T Study Groups
- Intersector Coordination Group on IMT-2000

IMT-2000 Overview

1985 - ITU Dec. 69 set up IWG 8/13 to determine:

- the overall objectives for future public land mobile telecommunication systems (FPLMTS)
- the frequency band or bands which would be suitable for FPLMTS
- the degree of compatibility or commonality desirable or achievable and the essential characteristics needed for this purpose.

1986 - First meeting of IWG 8/13 held

1991 - IWG 8/1 replaced by TG 8/1

IMT-2000 Overview

- 1992 - World Radio Conference identified 1885-2025 MHz and 2110-2200 MHz as intended for use, on a worldwide basis, by administrations wishing to implement FPLMTS. The bands 1980-2010 MHz and 2170-2200 MHz were allocated for mobile satellite service, potentially as the satellite component of FPLMTS.
- 1994 - International Mobile Telecommunications-2000 (IMT-2000) identified as replacement name for FPLMTS.

IMT-2000 Overview

- 1997
  - ITU-R adopts Recommendation on guidelines for evaluating radio transmission technologies
  - Circular Letter issued requesting candidate radio transmission technologies proposals (8/LCCE/47, 4 April 1997)

IMT-2000 Overview

Basic Requirements and Features:

- Contained in 17 adopted Recommendations
- Summarized in Circular Letter requesting submission of candidate radio transmission technologies for IMT-2000 radio interface

IMT-2000 Overview

Basic Requirements and Features:

"IMT-2000 defines third generation mobile systems which are scheduled to start service around the year 2000 … These systems will provide access by means of one or more radio links to a wide range of telecommunications services supported by the fixed and mobile telecommunications networks (e.g. PSTN/ISDN/PLMN), and to other services which may be unique to IMT-2000. A range of mobile terminal types designed for mobile and fixed use, is envisaged linking to terrestrial and/or satellite-based networks."

1997 Circular Letter

IMT-2000 Overview

Basic Requirements and Features:

"A goal for third generation mobile systems is to provide universal coverage and to enable terminals to be capable of seamless roaming between multiple networks … It is a design objective of IMT-2000 that the number of radio interfaces should be minimal and, if more than one interface is required, that there should be a high degree of commonality between them."

1997 Circular Letter

IMT-2000 Overview

Radio Recommendations:

- M.687-2 Future Public Land Mobile Telecommunication Systems (FPLMTS/IMT-2000)
- M.816-1 Framework for services supported on FPLMTS
- M.817 FPLMTS Network Architectures
- M.818-1 Satellite operations within FPLMTS
- M.819-2 FPLTMS for developing countries
- M.1034-1 Requirements for the radio interface(s)
- M.1035 Framework for the radio interface(s) and radio sub-system functionality

IMT-2000 Overview

Radio Recommendations:

- M.1036 Spectrum considerations for implementation of FPLMTS
- M.1078 Security principles
- M.1079 Speech and voice band data performance requirements
- M.1167 Framework for satellite component of FPLMTS
- M.1168 Framework of FPLMTS Management
- M.1223 Evaluation of security mechanisms
- M.1224 Vocabulary of terms

IMT-2000 Overview

Radio Recommendations:

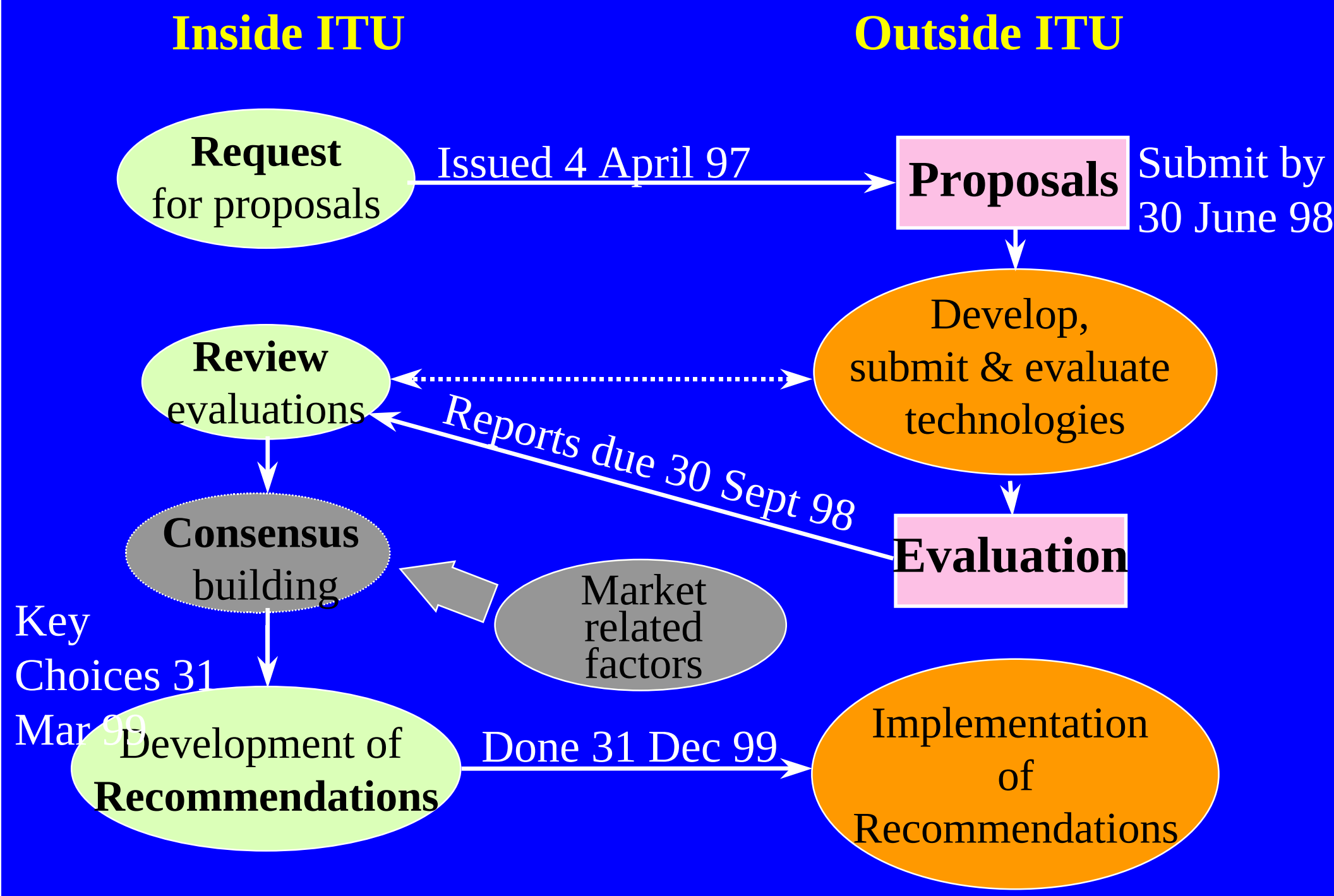
- M.1225 Guidelines for evaluation of radio transmission technologies for IMT-2000(FPLMTS)
- M.1308 Evolution of Land Mobile Systems towards IMT-2000
- M.1311 Framework for Modularity and Radio Commonality within IMT-2000

Land Mobile Handbook - Volume II: Principles and Approaches on Evolution to IMT-2000

Radio Interface Evaluation Process

Described in Circular Letter:

- Attachment 1 - Outline and Time Schedule of the IMT-2000 radio interface development process
- Attachment 4 - Summary of IMT-2000 Requirements and Objectives and Compliance Template
  - Also contains “global vision” for key features and objectives as compared to pre-IMT-2000 systems
- Attachment 6 - Table of Minimum Performance Capabilities


Inside ITU
Outside ITU
Request for proposals
Issued 4 April 97
Proposals
Submit by 30 June 98
Develop, submit & evaluate technologies
Review evaluations
Reports due 30 Sept 98
Evaluation
Consensus building
Market related factors
Key Choices 31 Mar 99
Development of Recommendations
Done 31 Dec 99
Implementation of Recommendations

Radio Interface Evaluation Process

IMT-2000 Radio Technology Evaluation Groups:

- Canadian Evaluation Group
- Telecom Engineering Center (India)
- China Evaluation Group
- T1P1/TR46 International Standards Ad-Hoc (USA)
- TIA/TR-45 Ad-Hoc International Standards Development Group (USA)
- Association of Radio Industries and Businesses (ARIB, Japan)
- ETSI SMG2 (Europe)
- ITU Malaysia
- TTA Evaluation Ad-Hoc (Korea)

Radio Interface Evaluation Process

Summary of Minimum Performance Capabilities:

Test environment	Indoor Office	Outdoor to Indoor and Pedestrian	Vehicular	Satellite
Data services capabilities – circuit switched and packet	At least 2 048 kbit/s	At least 384 kbit/s	At least 144 kbit/s	At least 9.6 kbit/s

See Circular Letter Attachment 4 for details

Radio Interface Evaluation Process

- For documentation and on-going activities, visit ITU IMT-2000 web site at:

  http://www.itu.int/imt

U.S. Regulatory and Market Environment

FCC Principles

William E. Kennard, Chairman, FCC, 1 October 1997

"I will be guided by three fundamental principles: competition, community, and common sense.

"The first principle is competition…the FCC must continue to promote competition in every sector of the communications marketplace…

"But competition must not be the goal itself. It is the FCC's job to work with the Congress to make sure that competition services

U.S. Regulatory and Market Environment

FCC Principles

"The second principle that will guide me is community…the American people want and expect communications policy to promote competition, but they want more. They want communications to serve communities-- all of our communities, and everyone within these communities.

"I will work hard to ensure that the communications revolution is inclusive -- not exclusive -- and that small businesses, women, and minorities are not left on the sidelines…"

U.S. Regulatory and Market Environment

FCC Principles

"The third principle is common sense. The FCC should always act with common sense.

"The Commission's rules should be clear and easy to understand. They should be practical, and reflect an understanding of the markets and businesses they affect. And they should be in touch with people's real needs and daily demands.

"Common sense means regulating only when necessary, and writing rules that are narrowly tailored and don't impose unnecessary burdens."

U.S. Regulatory and Market Environment

Key Regulatory/Spectrum Management Objectives

- Promote increased competition
- Enable flexibility to respond to the marketplace
- Establish clear guidelines for ensuring that public benefits are achieved
- Award licenses quickly and efficiently, using competitive bidding when appropriate
- Create administrative certainty through clear and firm ground rules
- Develop policies consistent with global marketplace needs

"Using Market-Based Spectrum Policy to Promote the Public Interest", January 1997

U.S. Regulatory and Market Environment

Key Regulatory/Spectrum Management Objectives

Corollaries relevant to Third Generation Mobile Systems:

- Continue to encourage competition
- Provide maximum flexibility to meet future marketplace needs
- Avoid mandating specific services or technologies
  - Encourage marketplace decisions and voluntary standards
- Address global marketplace needs
  - Pursue global spectrum harmonization opportunities

U.S. Regulatory and Market Environment

Current Competitive Mobile Radio Services

- Over 56,000,000 wireless subscribers in U.S.
  - Adding over 10,000,000 per year
- Cellular Radio Service
  - Two licenses per market
- Personal Communications Service (PCS)
  - Six licenses per market
- Enhanced Specialized Mobile Radio Service (ESMR)
  - Number of licenses per market varies

U.S. Regulatory and Market Environment

Current Competitive Mobile Radio Services

Service (Spectrum)	# Markets	Bandwidth	Technologies
Cellular (800 MHz)	734 Total (306 Metro; 428 Rural)	25 MHz	AMPS backbone; deploying IS-95 CDMA and US TDMA (D-AMPS)
PCS (2 GHz)	51 MTAs 493 BTAs	30 MHz 10 MHz	Deploying IS-95 CDMA, GSM (PCS-1900), and US TDMA (D-AMPS)
ESMR (800 MHz; 900 MHz)	175 EAs 51 MTAs	varies	Varies; generally can offer interconnection similar to cellular/PCS

U.S. Goals for Third Generation Mobile Systems

"As we consider the current and future uses of wireless customers in the U.S. it becomes very apparent that the existing wireless systems will not meet their future demands. With the fragmentation of capabilities across multiple networks, customers are likely to become increasingly frustrated and confused.

"Clearly, a next generation of wireless communications technology will be needed. One that converges the many different wireless technologies across multiple networks and is flexible enough to handle the wide range of demands of the customers."

U.S. Vision for IMT-2000/FPLMTS
20 September 1996

U.S. Goals for Third Generation Mobile Systems

Future Wireless Service Expectations

- Superior voice quality
- Ubiquitous, seamless coverage
- Enhanced messaging
  - including voice mail, e-mail, paging, fax, and caller identification
- Significantly higher data rates
  - necessary for advanced mobile computing including internet access, database access, image retrieval, video services, and multimedia communications
- Reasonable cost

U.S. Vision for IMT-2000/FPLMTS
20 September 1996

U.S. Goals for Third Generation Mobile Systems

Key Characteristics

- Flexibility
  - Multi-funtionality/multi-environment
  - Multi-mode operation
  - Multi-band operation/“frequency independence”
  - Flexible architecture
- Evolution and Migration
- Operations and Maintenance
  - Network management/dynamic network optimization
  - Service management
  - Advanced billing capabilities

U.S. Vision for IMT-2000/FPLMTS
20 September 1996

U.S. Goals for Third Generation Mobile Systems

- U.S. Goals for Third Generation Mobile Systems are reflected in ITU Recommendations on IMT-2000
- U.S. working through ITU to obtain global consensus on standards for Third Generation Mobile Systems

U.S. Goals for Third Generation Mobile Systems

U.S. IMT-2000 Policy Development Process:

- US Ad Hoc on TG 8/1
- US National Committee for ITU-R

To participate, or for more information, contact:

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U.S. Deployment Scenarios
Licensing

- U.S. Commercial Mobile Radio Service operators have regulatory flexibility to permit installation of third generation technologies

✓ U.S. has already licensed Third Generation Mobile Service providers

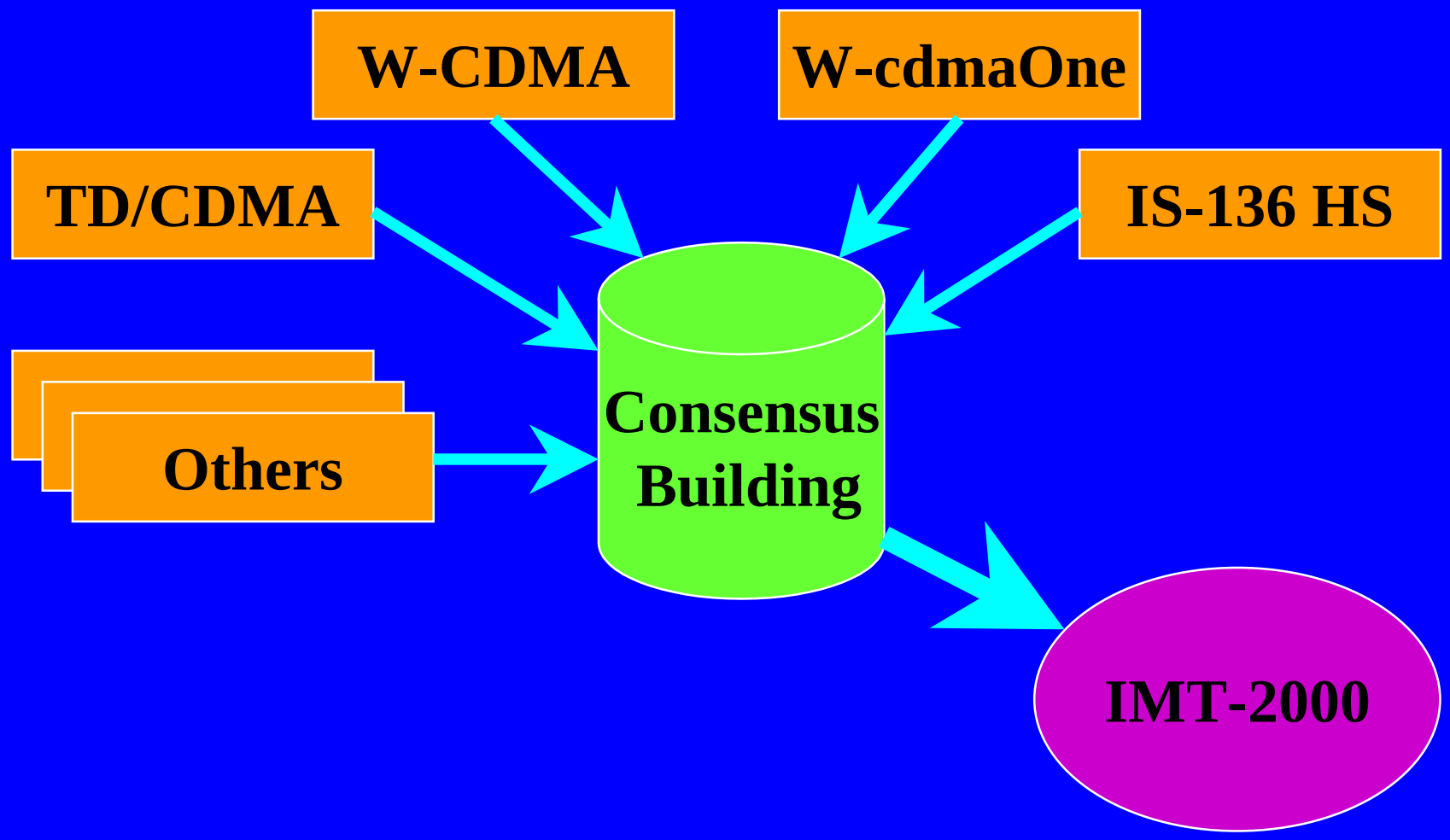
U.S. Deployment Scenarios
Timing

- Existing operators (cellular, PCS, etc.) will want to install third generation technologies if:
  - there is an evolution path from today's technologies
  - marketplace needs can be satisfied at reasonable cost
- Estimated time frame: 2003-2005

U.S. Deployment Scenarios
Technologies

- Europe (UMTS)
  - UTRA: W-CDMA; TD/CDMA
- U.S.
  - W-cdmaOne; W-CDMA
  - IS-136 HS (derived from US TDMA; D-AMPS)
  - others???
- Japan / Korea
  - W-CDMA; W-cdmaOne
- Other countries
  - ???

U.S. Deployment Scenarios
Technologies



U.S. Deployment Scenarios

Technologies

How many third generation technologies will emerge in the U.S.?

- Marketplace (<u>not government regulators</u>) will determine how many and which third generation technologies are developed
  - Flexibility to meet differing marketplace needs
  - High degree of competition facilities roaming
- Existing mobile systems use variety of standards
  - Different starting points may dictate different ending points

U.S. Deployment Scenarios
Technologies

How many third generation technologies will emerge in the U.S.?

- Likely no more than three or four
- Many players in U.S. marketplace would like to see a global technology emerge

This may depend largely on the ability of new mobile technologies to provide an evolution path for existing mobile systems!!!

U.S. Deployment Scenarios
Technologies

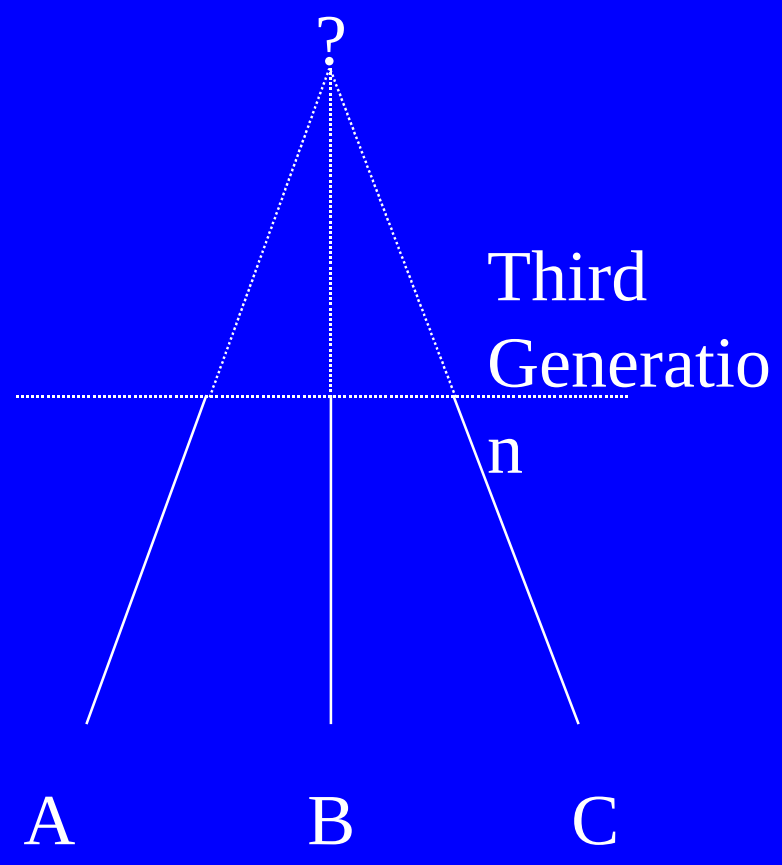
How many third generation technologies will emerge in other countries?

- In many cases, the government regulators (and to some extent the marketplace) will require a single technology
  - National/Regional roaming seems of paramount importance
  - Lack of adequate competition may not yield National/Regional roaming otherwise

U.S. Deployment Scenarios
Technologies

What if more than one third generation technology emerges?

- "Family of systems" approach
  - Members must meet minimum requirements
  - Members must provide interoperability/interworking
  - Provides a path for possible future convergence
  - Additional detail work needed

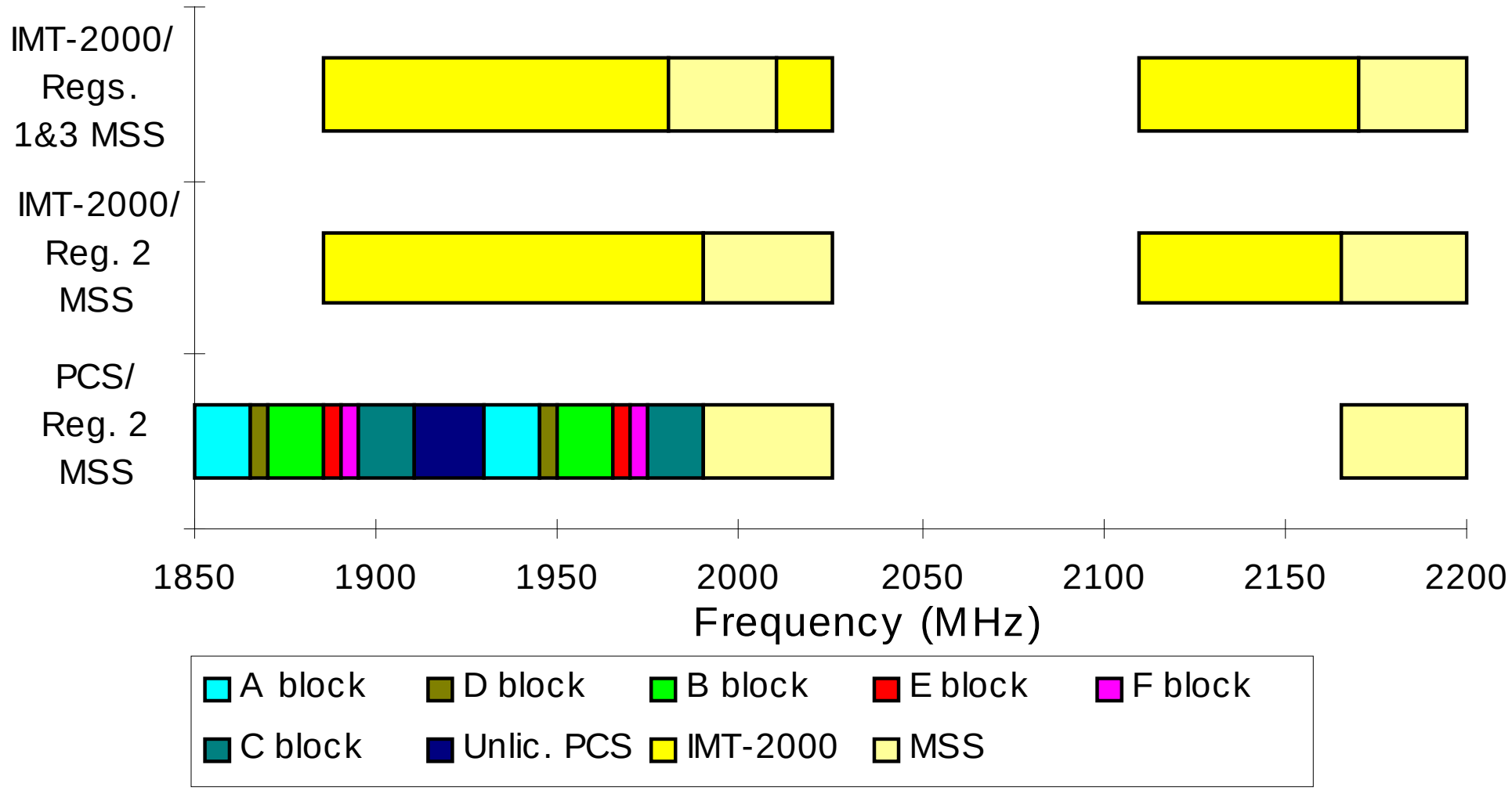


U.S. Deployment Scenarios
Frequency Bands

- Spectrum identified for IMT-2000 at WRC-92 (1885-2025 MHz and 2110-2200 MHz) not fully available for use in Europe, Japan, or North America
- U.S. and several other countries have installed PCS in spectrum identified for IMT-2000 in order to meet immediate needs
  - less flexibility in how IMT-2000 can be implemented

U.S. Deployment Scenarios

Frequency Bands - Mobile Services at 2 GHz



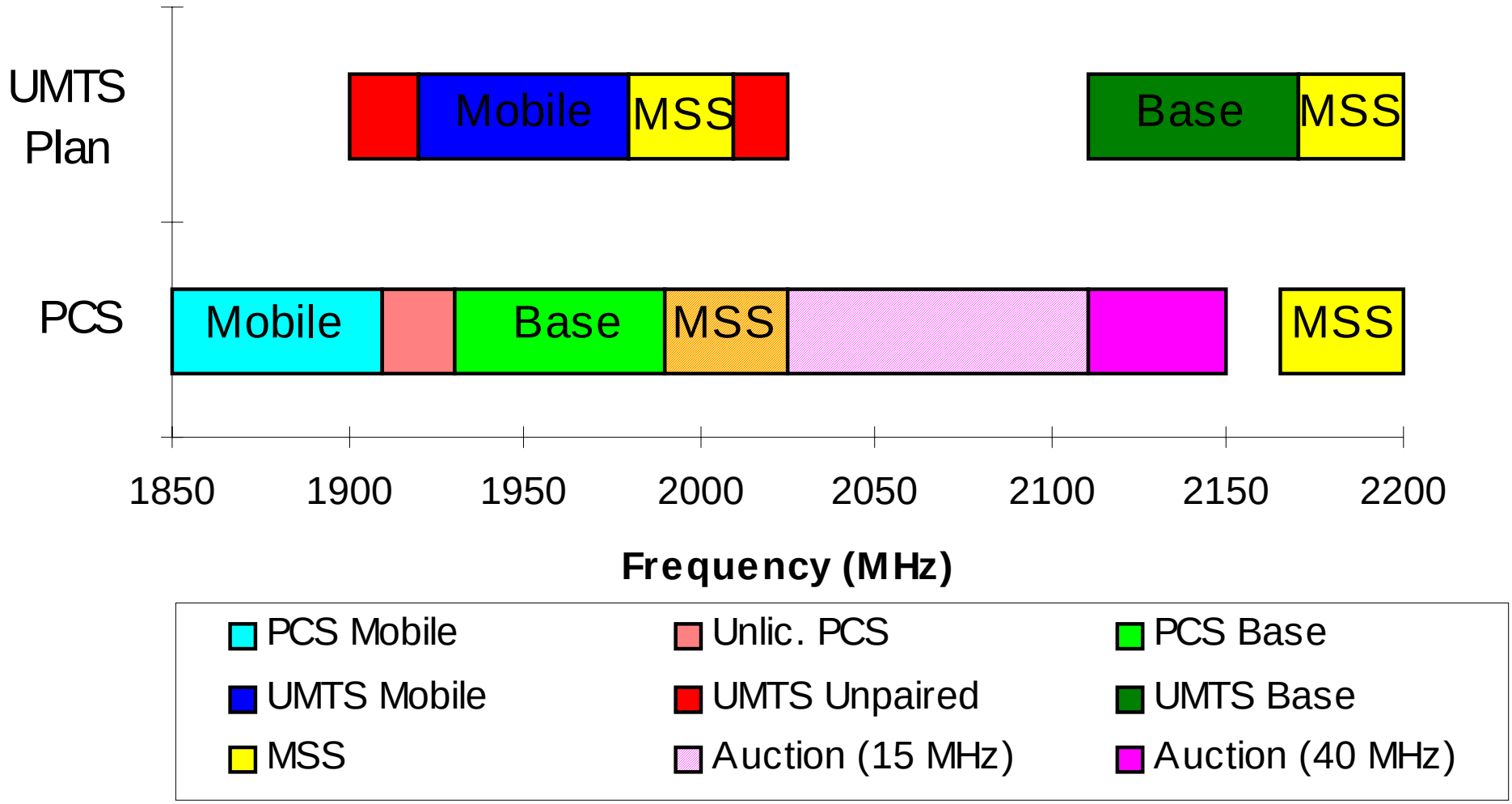
Simplified for illustration purposes

U.S. Deployment Scenarios
Frequency Bands

- IMT-2000 must be essentially frequency independent
  - U.S. operators will deploy third generation technologies in existing spectrum, just as they are deploying second generation technologies today
- Depending on marketplace needs and technology requirements, additional spectrum may be needed (or helpful) to implement third generation mobile
  - PCIA conducting spectrum study
  - Spectrum requirements to be reviewed at WRC-99
  - Balanced Budget Act of 1997

U.S. Deployment Scenarios

Frequency Bands - Mobile Services at 2 GHz



1999 World Radio Conference: More Spectrum?

IMT-2000 Agenda

WRC-97 recommended that WRC-99 consider and take appropriate action on issues related to IMT-2000:

- "review of spectrum and regulatory issues for advanced mobile applications in the context of IMT-2000, noting that there is an urgent need to provide more spectrum for the terrestrial component of such applications and that priority should be given to terrestrial mobile spectrum needs, and adjustments to the Table of Frequency Allocations as necessary." (1.6.1)

1999 World Radio Conference: More Spectrum? IMT-2000 Agenda

WRC-97 recommended that WRC-99 consider and take appropriate action on issues related to IMT-2000:

- "identification of a global radio control channel to facilitate multimode terminal operation and worldwide roaming of IMT-2000." (1.6.2)

1999 World Radio Conference: IMT-2000 Agenda

FCC WRC-99 Advisory Committee, IWG-1
(Mobile Service Matters including IMT-2000)

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The views expressed are those of the author and do not necessarily reflect the views of the Federal Communications Commission.