



INTERNATIONAL TELECOMMUNICATION UNION

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**Q.1701**

(03/99)

SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for IMT-2000

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**Framework for IMT-2000 networks**

ITU-T Recommendation Q.1701

(Previously CCITT Recommendation)

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*For further details, please refer to ITU-T List of Recommendations.*

# **ITU-T RECOMMENDATION Q.1701**

## **FRAMEWORK FOR IMT-2000 NETWORKS**

### **Summary**

This Recommendation sets out the "family of systems" concept which provides the basis for the development of IMT-2000 standards including the set of signalling requirements for IMT-2000. It also contains a description of the interfaces in the system which may need to be standardized by the ITU. It has been agreed that the development of IMT-2000 requirements will be performed in Capability Sets and this Recommendation sets out the contents of Capability Set 1 and the vision for subsequent Capability Sets.

### **Source**

ITU-T Recommendation Q.1701 was prepared by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 15th of March 1999.

### **Keywords**

FPLMTS, Family concept, IMT-2000, IMT-2000 Capability Sets, Third generation systems.

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## Recommendation Q.1701

### FRAMEWORK FOR IMT-2000 NETWORKS

(Geneva, 1999)

#### 1 Scope

The scope of this Recommendation is to provide an overall framework for the development of ITU-T IMT-2000 signalling requirements. This Recommendation is a guideline document for the other IMT-2000 Recommendations: Recommendations to be developed for the network functional model, information flows, the UIM-MT interface, the radio interface, the access interface, and the network interface. Specifically, this Recommendation provides:

- 1) a description of the IMT-2000 "family of systems" concept and what constitutes a family member;
- 2) identification of IMT-2000 service and network capabilities for IMT-2000 Capability Set 1 (and beyond);
- 3) a description of the approach to providing ITU-T IMT-2000 requirements in Capability Sets;
- 4) identification and description of the IMT-2000 interfaces necessary to be standardized to support Capability Set 1; and
- 5) a description of the structure of IMT-2000 Recommendations.

#### 2 References

The following ITU Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU Recommendations is regularly published.

- [1] ITU-T Recommendation A.3 (1996), *Elaboration and presentation of texts and development of terminology and other means of expression for Recommendations of the ITU Telecommunications Standardization Sector*.
- [2] ITU-T Recommendation M.3100 (1995), *Generic network information model*.
- [3] ITU-R Recommendation M.687-2 (1997), *International Mobile Telecommunications (IMT-2000)*.
- [4] ITU-R Recommendation M.816-1 (1997), *Framework for services supported on International Mobile Telecommunications-2000 (IMT-2000)*.
- [5] CCIR Recommendation M.817 (1992), *International Mobile Telecommunications-2000 (IMT-2000). Network architectures*.
- [6] ITU-R Recommendation M.818-1 (1993), *Satellite operation within International Mobile Telecommunications-2000 (IMT-2000)*.
- [7] ITU-R Recommendation M.819-2 (1997), *International Mobile Telecommunications-2000 (IMT-2000) for developing countries*.
- [8] ITU-R Recommendation M.1034-1 (1997), *Requirements for the radio interface(s) for International Mobile Telecommunications-2000 (IMT-2000)*.

- [9] ITU-R Recommendation M.1035 (1993), *Framework for the radio interface(s) and radio sub-system functionality for International Mobile Telecommunications-2000 (IMT-2000)*.
- [10] ITU-R Recommendation M.1078 (1993), *Security principles for International Mobile Telecommunications-2000 (IMT-2000)*.
- [11] ITU-R Recommendation M.1167 (1995), *Framework for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)*.
- [12] ITU-R Recommendation M.1168 (1995), *Framework of International Mobile Telecommunications-2000 (IMT-2000)*.
- [13] ITU-R Recommendation M.1223 (1995), *Evaluation of security mechanisms for IMT-2000*.
- [14] ITU-R Recommendation M.1224 (1997), *Vocabulary of terms for International Mobile Telecommunications-2000 (IMT-2000)*.
- [15] ITU-T Recommendation F.115 (1995), *Service objectives and principles for future public land mobile telecommunication systems*.
- [16] ITU-T Recommendation F.700 (1996), *Framework Recommendation for audiovisual/multimedia services*.
- [17] ITU-T Recommendation I.211 (1993), *B-ISDN service aspects*.
- [18] ITU-T Recommendations I.375.x series (1998), *Network capabilities to support multimedia services*.
- [19] CCITT Recommendation Q.1001 (1988), *General aspects of public land mobile networks*.
- [20] ITU-T Recommendation Q.1290 (1998), *Glossary of terms used in the definition of intelligent networks*.
- [21] ITU-T Recommendation E.164 (1997), *The international public telecommunication numbering plan*.
- [22] ITU-T Recommendation E.212 (1998), *The international identification plan for mobile terminals and mobile users*.
- [23] CCITT Recommendation E.213 (1988), *Telephone and ISDN numbering plan for land mobile stations in public land mobile networks (PLMN)*.
- [24] ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks*.
- [25] CCITT Recommendation E.214 (1988), *Structure of the land mobile global title for the signalling connection control part (SCCP)*.
- [26] ITU-R Recommendation M.1311 (1997), *Framework for modularity and commonality within IMT-2000*.

### 3 Definitions

This Recommendation makes use of the terms defined for cellular radio technologies in Recommendation Q.1001, with the following definitions from Recommendation Q.1290.

**3.1 bearer control:** The set of functions used to direct the low layer (common) means of transmission in a node.

NOTE – The underlined part is an addition to the Q.1290 definition.

**3.2 call:** An end-to-end logical relationship between two or more parties, established on behalf of an initiating party, associated with a service invocation.



**3.3 call control:** The set of functions used to progress a call, i.e. service negotiation, set-up modification and release of single or multiple calls, used in conjunction with the service request from the user. There may be zero, one, or several connections established for one call.

**3.4 connection:** An association of transmission channels or circuits, switching and other functional units set up to provide a means for a transfer of information between two or more points in a telecommunications network. A connection is composed of several connection links. There are one or more connections for each media component of a call.

**3.5 connection control:** The set of functions used for setting up, maintaining and releasing a communications path between two or more users and a network entity, e.g. a dual-tone multifrequency receiver.

**3.6 Home CN:** The Home CN is the IMT-2000 network which is related by subscription to the subscriber. The Home CN permanently contains user-specific data including location, authentication, and service profile information related to the IMT-2000 user.

**3.7 IMT-2000 network capabilities:** A capability of an IMT-2000 network which is utilized to support service capabilities but which is not itself a service capability.

**3.8 IMT-2000 service capabilities:** A capability of an IMT-2000 network to offer a service or service feature to subscribers. A service capability becomes visible to a user or subscriber as part of a service or service feature provided by a network operator. Service capabilities depend on network capabilities.

**3.9 Serving CN:** The serving CN is the IMT-2000 network where a registered IMT-2000 user is being served.

**3.10 Transit CN:** A CN located on the communication path between the serving CN and the remote end party.

**3.11 Virtual Home Environment (VHE):** This is a capability whereby a user is offered the same service experience in a visited network as in his home network.

NOTE – The degree to which the VHE matches the actual home environment may be subject to, for example, the degree of cooperation between the visited and home networks, their relative technical capabilities, and the compatibility of the user terminal.

#### **4 Abbreviations and acronyms**

This Recommendation uses the following abbreviations.

ATM	Asynchronous Transfer Mode
BCSM	Basic Call State Model
BER	Bit Error Rate
BS	Base Station
CLNS	Connectionless Network Service
CN	Core Network
CONS	Connection Oriented Network Service
CS	Capability Set
FE	Functional Entity
FT	Fixed Terminal

FWA	Fixed Wireless Access
IC	Integrated Circuit
IE	Information Element
IF	Information Flow
IMT-2000	International Mobile Telecommunications-2000
IN	Intelligent Network
IP	Internet Protocol
ISDN	Integrated Services Digital Network
IWF	Interworking Function
kbit/s	Kilobits per second
Mbit/s	Megabits per second
MMI	Man-Machine Interface
MT	Mobile Terminal
NNI	Network-to-Network Interface
NSAP	Network Service Access Point
PDH	Plesiochronous Digital Hierarchy
PDN	Packet Data Network
PIN	Personal Identification Number
PN	Private Network
PSDN	Public Switched Data Network
PSTN	Public Switched Telephone Network
PTM	Point-to-Multipoint
PTP	Point-to-Point
QoS	Quality of Service
RAN	Radio Access Network
RF	Radio Frequency
(R)NC	(Radio) Network Controller
SDH	Synchronous Digital Hierarchy
SDL	Specification and Description Language
SDR	Software-defined radio
UIM	User Identity Module
UPT	Universal Personal Telecommunications
VHE	Virtual Home Environment

## 5 Introduction

This clause provides a high-level overview of an IMT-2000 System, its functional subsystems, functional communication, and physical interfaces.

### 5.1 IMT-2000 System

An IMT-2000 System can be described by a set of high-level functional subsystems, functional entities, and functional communication between subsystems. Functional entities are described in the Network Functional Model for IMT-2000. The interfaces and high-level functional communication across the interfaces between the functional subsystems are described in clause 8. An IMT-2000 System is characterized by its ability to provide IMT-2000 capabilities to its users as identified in the IMT-2000 Capability Sets.

### 5.2 Functional subsystems

At the highest level, an IMT-2000 System can be described by a set of functional subsystems which perform actions and interact among themselves to support IMT-2000 wireless users. An IMT-2000 System consists of the following functional subsystems (see Figure 1):

**User Identity Module (UIM) functional subsystem:** The UIM functions support user security and services. The functions may reside in either a removable physical card for a MT or it may be integrated into the physical mobile terminal.

**Mobile Terminal (MT) functional subsystem:** The MT functions provide the ability to communicate with the UIM and radio access network and support user services and mobility.

**Radio Access Network (RAN) functional subsystem:** The RAN functions provide the ability to communicate with the MT and core network. The functions in the RAN act as a bridge, router, and gateway as necessary for exchanging information between the core network and mobile terminal.

**Core Network (CN) functional subsystem:** The CN functions provides the ability to communicate with the RAN and other CNs as well as the functions necessary to support user services and user mobility.

These functional subsystems are presented for modelling purposes and may be implemented as one or more physical platforms in a number of arrangements. The functional subsystems are further decomposed into more granular functional elements which are described in the Network Functional Model for IMT-2000.

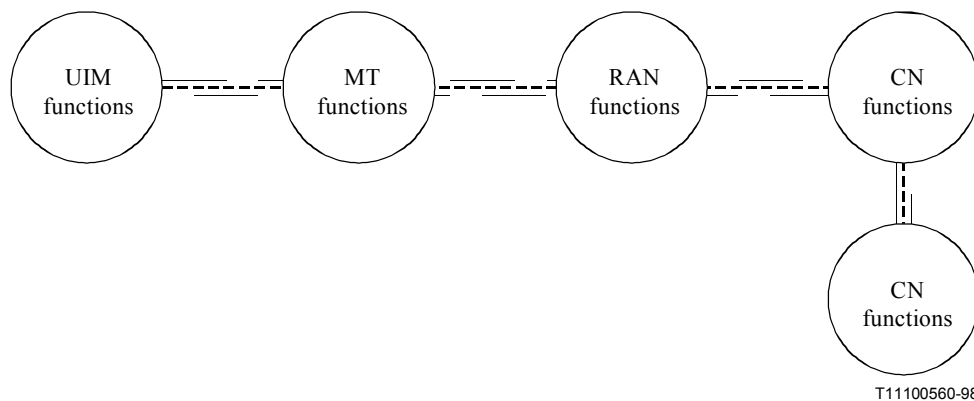


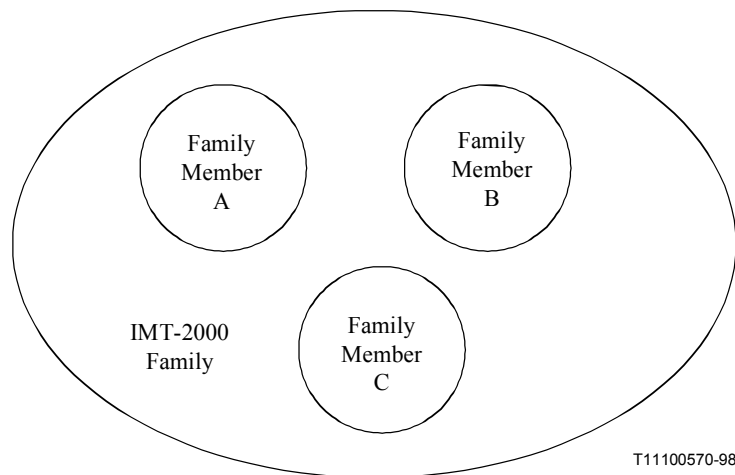
Figure 1/Q.1701 – IMT-2000 Functional subsystems

## 6 IMT-2000 Family concept

The IMT-2000 Family concept is used to realise a global service offering among IMT-2000 systems.

### 6.1 IMT-2000 Family

The IMT-2000 Family (see Figure 2) is a federation of IMT-2000 Systems providing IMT-2000 capabilities to its users as identified in IMT-2000 Capability Sets. The family is characterized by the ability of its member systems to provide service to the subscribers of other family members in a roaming service offering. However, individual family members may have different intra-system specifications (e.g. functionalities in physical entities, signalling protocols, etc.)



**Figure 2/Q.1701 – IMT-2000 Family**

### 6.2 An IMT-2000 Family Member

An IMT-2000 Family Member is an IMT-2000 System. A Family Member integrates and incorporates the IMT-2000 functions into physical entities and associated interfaces as necessary to provide IMT-2000 capabilities. The UIM, MT, RAN, and CN functional subsystems may be specific to each Family Member along with the associated internal processes, internal interactions, and internal communication between functional entities. Support for IMT-2000 capabilities and interfaces will facilitate roaming between family members. The family members' networks interoperate as necessary to accomplish the roaming objectives.

Family members have the option to selectively deploy only those capabilities and interfaces of IMT-2000 Family member networks which are needed to support the services they choose to offer. Individual Family Member systems are characterized by their support of service and network capabilities defined within the IMT-2000 Capability Sets.

### 6.3 Key features of IMT-2000 Family members

The key features of IMT-2000 family members are:

- support of users of other family members in a roaming service offering; and
- provisioning of a consistent set of service offerings based on the IMT-2000 capability sets and interfaces (given technical constraints and market requirements).

ITU has available a set of interface specifications to achieve the above key features.

## 7 Service concepts and network capabilities

### 7.1 Capability Set concept

IMT-2000 functionality will be defined in Capability Sets. The requirements Recommendations will follow such an approach.

### 7.2 Capability Set 1

The first IMT-2000 Capability Set (Capability Set 1) is intended to show a significant improvement over second generation system capabilities in order to make the change worthwhile in terms of customer perception. Therefore, IMT-2000 Capability Set 1 is intended to provide more service and network capabilities than are available in existing second generation systems.

IMT-2000 Capability Set 1 contents are those capabilities, and the interfaces functionality to support those capabilities which are to be included in the Network Functional Model for IMT-2000, etc.

Table 1 shows the capabilities to be supported by IMT-2000 Capability Set 1. It is anticipated that additional Capability Sets for IMT-2000 systems will continue to accumulate capabilities.

NOTE – In the following table, the term "network" refers to the access and/or the core network, if not otherwise stated.

**Table 1/Q.1701 – Capability Set 1 for IMT-2000**

Category	Capabilities
A) Existing Capability	1 Widely used existing second generation core fixed and mobile services and capabilities, possibly enhanced
B) Long-Term Objectives	1 Support network capabilities that are a distinct improvement over widely used 2G (second generation) wireless networks system capabilities in the areas of voice, data, messaging, image and multimedia, including: <ul style="list-style-type: none"> <li>1.1 Enhanced roaming</li> <li>1.2 Increased data rates</li> <li>1.3 Multimedia and Internet wireless services</li> </ul>
C) Bearer Capability	1 For terrestrial access: <ul style="list-style-type: none"> <li>1.1 At least 144 kbit/s in vehicular radio environment, BER <math>\leq 10^{-6}</math>, both for circuit and packet services</li> <li>1.2 At least 384 kbit/s in outdoor to indoor and pedestrian radio environments, BER <math>\leq 10^{-6}</math>, both for circuit and packet services</li> <li>1.3 At least 2048 kbit/s in indoor office radio environment, BER <math>\leq 10^{-6}</math>, both for circuit and packet services</li> </ul> 2 Range of QoS with independent negotiation: <ul style="list-style-type: none"> <li>2.1 Real time/non-real time</li> <li>2.2 Delay characteristics</li> <li>2.3 Maximum acceptable Bit Error Rate</li> <li>2.4 Bit rate/throughput</li> </ul> 3 Support of packet services (both on the radio interface and on the fixed interfaces)

**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (continued)**

Category	Capabilities
<p>C) Bearer Capability (continued)</p>	<p>4 For the satellite access interface:</p> <p>4.1 The data rates from any one user of the satellite component of IMT-2000 may be expected to range from 9.6 kbit/s up to 144 kbit/s, depending on operating environment and type of terminal.</p> <p>5 Communication configurations:</p> <p>5.1 PTP: Point-to-point service bidirectional (Connection Type 1)</p> <p>5.2 PTM: Point-to-multipoint service (Connection Type 2)</p> <p>5.2.1 Broadcast</p> <p>5.2.2 Multicast Capabilities</p> <p>5.2.2.1 Pre-assigned, i.e. root selected at call set-up</p> <p>6 Communication types:</p> <p>6.1 CLNS: Connectionless network service</p> <p>6.2 CONS: Connection oriented network service</p> <p>7 Symmetry of access links:</p> <p>7.1 Symmetric (equal bit rates upstream and downstream)</p> <p>7.2 Asymmetric (unequal bit rates upstream and downstream)</p> <p>8 Fixed and variable bit rate traffic</p> <p>9 Bearer interworking procedures:</p> <p>9.1 Bearer connection adaptation/conversion</p> <p>9.2 Bearer, Service component and Teleservice</p> <p>9.2.1 Mapping</p> <p>9.2.2 Negotiation</p> <p>9.2.3 Fallback procedures</p>
<p>D) Access Network Capability – General</p>	<p>1 Support for packet services including:</p> <p>1.1 Negotiable bit rate of delivery (peak and mean throughput)</p> <p>1.2 Negotiable delay tolerance</p> <p>1.3 Negotiable reliability classes (determines the probability of data loss, out of sequence delivery, duplicate delivery and corrupted data)</p> <p>2 Support of:</p> <p>2.1 Constant bit rate with timing: connection-oriented</p> <p>2.2 Variable bit rate with timing: connection-oriented</p> <p>2.3 Variable bit rate without timing: connectionless</p> <p>2.4 Variable bit rate without timing: connection-oriented</p> <p>2.5 Efficient link layer recovery</p>

**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (continued)**

Category	Capabilities
D) Access Network Capability – General <i>(continued)</i>	3 Radio Resource Control Capabilities: 3.1 Radio channel and Radio environment monitoring and supervision 3.1.1 Radio channel quality monitoring 3.1.2 Macro diversity monitoring 3.2 Radio resources allocation, deallocation 3.3 Radio-frequency power Control and setting 4 Support of FWA applications with ISDN-like functionality
E) Core Network Capability – General	1 Support of: 1.1 Constant bit rate with timing: connection-oriented 1.2 Variable bit rate with timing: connection-oriented 1.3 Variable bit rate without timing: connectionless 1.4 Variable bit rate without timing: connection-oriented 2 Support of both circuit and packet communications for handling voice, data and video simultaneously 3 Interworking: 3.1 with ISDN: support of ISDN "like" services at 56 kbit/s, 64 kbit/s, 128 kbit/s, and 144 kbit/s (including D-channel) 3.2 with B-ISDN CS 2.1 3.3 with X.25 PDN: support PAD access bearer at rates of 300, 1200, 2400, 4800, and 9600 bit/s. Support X.25 packet mode bearer at rates of 2400, 4800, and 9600 bit/s 3.4 with IP networks for user-initiated and network-initiated contexts 3.5 with PSTN (voice, fax, and data via modem) 4 Mobility: 4.1 Terminal Mobility 4.2 Personal Mobility 4.3 Service Mobility (e.g. Virtual Home Environment) 5 Internet and Data Applications: 5.1 IMT-2000 shall provide interworking with IP networks (including intranet, IPv4 and IPv6) 5.2 IMT-2000 may provide stand-alone Internet-type services 6 Global (worldwide) roaming and service interoperability between IMT-2000 Family Members 7 Core Network Transport Capabilities: 7.1 Support of packet-switched and circuit-switched operation 7.2 Support of evolved family member network architecture (PDH/SDH/ATM) 7.3 Support of open interfaces to IN Servers, Dedicated Service Providers Servers

**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (continued)**

Category	Capabilities
<p>F) Network Capabilities – Call Control</p>	<ol style="list-style-type: none"> <li>1 Separation of call and bearer channel/connection control</li> <li>2 Single address/name/directory for a user, to facilitate service transportability. This does not preclude multiple subscriber numbers</li> <li>3 Support of IN CS-1/2 to enable access to IN-based services</li> <li>4 Provision of mobility-enhanced BCSM functionality</li> <li>5 Multiple simultaneous calls per terminal or directory number</li> <li>6 Multimedia mail store and forward</li> <li>7 Multimedia Calls (see Broadband Signalling Capability Sets 1 and 2.1, including add/drop connection for point-to-point communication configurations, and add/drop party)</li> <li>8 Call internetworking procedures:               <ol style="list-style-type: none"> <li>8.1 Belonging to different IMT-2000 Networks (IMT-2000 Family Members internetworking)</li> <li>8.2 Belonging to IMT-2000 Networks and to Fixed Networks [PSTN, PSDN, (IP)INTERNET, (B)ISDN]</li> </ol> </li> <li>9 Emergency Call:               <ol style="list-style-type: none"> <li>9.1 Identification of emergency call</li> <li>9.2 Emergency call handling</li> <li>9.3 Emergency caller location</li> </ol> </li> <li>10 Priority Call:               <ol style="list-style-type: none"> <li>10.1 Identification of priority call</li> <li>10.2 Priority call handling</li> </ol> </li> <li>11 Geographic positioning of a terminal/user:               <ol style="list-style-type: none"> <li>11.1 Geographic position determination</li> <li>11.2 Geographic position notification</li> <li>11.3 User control over subscribed location service information, including the capability to prevent inadvertent disabling of mandatory service location functionality</li> </ol> </li> <li>12 Independence of connection characteristics for multi-connection calls</li> </ol>
<p>G) Network Capabilities – Security Procedures</p>	<ol style="list-style-type: none"> <li>1 User authentication and ciphering for both circuit and packet modes</li> <li>2 Terminal identification including the ability to detect stolen and non-type approved terminals</li> <li>3 User-network mutual authentication</li> <li>4 Support of service-dependent authentication and ciphering mechanisms</li> <li>5 Control of misuse of a network, i.e. prevent fraudulent use by an unauthorized user or by an authorized user exceeding his authority</li> <li>6 Ciphering on the radio interface (user and control information)</li> </ol>



**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (continued)**

Category	Capabilities
G) Network Capabilities – Security Procedures <i>(continued)</i>	<ul style="list-style-type: none"> <li>7 Lawful interception (as applicable per national regulatory requirements)</li> <li>8 Privacy of user and subscriber-related data (including user identity)</li> <li>9 Privacy of billing data</li> <li>10 Privacy of user messages</li> <li>11 Authentication mechanism negotiation between user, serving and home networks</li> <li>12 Event reporting and event limitation to support fraud prevention</li> </ul>
H) Network Capabilities – Resource allocation	<ul style="list-style-type: none"> <li>1 Allocation based on negotiated QoS</li> <li>2 Overload controls</li> <li>3 Spectrum-efficient support for mixed services configurations (e.g. low bit rate/high bit rate, real-time/non-real-time services)</li> <li>4 Route optimization at call set-up and during a call</li> </ul>
I) Network Capabilities – Numbering and Addressing	<ul style="list-style-type: none"> <li>1 Support of numbering and addressing portability</li> <li>2 Identification, Addressing and Numbering Plan: <ul style="list-style-type: none"> <li>2.1 Identity Management <ul style="list-style-type: none"> <li>2.1.1 Terminal</li> <li>2.1.2 International Mobile User</li> <li>2.1.3 Subscriber ISDN</li> <li>2.1.4 Multicast Group</li> </ul> </li> <li>2.2 Support of existing and advanced Addressing and Numbering Plans, including: <ul style="list-style-type: none"> <li>2.2.1 Recommendation E.164,</li> <li>2.2.2 Recommendation E.212,</li> <li>2.2.3 Recommendation E.213,</li> <li>2.2.4 Recommendation X.121,</li> <li>2.2.5 NSAP (Network Service Access Point),</li> <li>2.2.6 IPv4/v6,</li> <li>2.2.7 email and Internet type addresses</li> <li>2.2.8 other mechanisms, e.g. calling by name</li> </ul> </li> <li>2.3 Address encapsulation and mapping</li> <li>2.4 Support of Recommendation E.214 (Land Mobile Global Title) addressing</li> </ul> </li> </ul>

**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (continued)**

Category	Capabilities
<p>J) Network Capabilities – Charging and Accounting</p>	<p>These items reflect the choices identified for IMT-2000 charging and accounting.</p> <ol style="list-style-type: none"> <li>1 Standardized billing and charging user profiles</li> <li>2 Standardized event reporting and usage detail recording               <ol style="list-style-type: none"> <li>2.1 Call detail recording</li> <li>2.2 Charging information generation for                   <ol style="list-style-type: none"> <li>2.2.1 Circuit-switched calls</li> <li>2.2.2 Packet data transmission sessions</li> <li>2.2.3 Services realized exclusively by exchanging signalling information</li> <li>2.2.4 Data transmission on the transparent UIM-Home Network channel</li> </ol> </li> </ol> </li> <li>3 New charging mechanisms [e.g. volume (number of packets or bytes including by source/destination address pair), QoS, time, etc.]</li> <li>4 Real-time charging</li> <li>5 Flexible charging/billing mechanisms:               <ol style="list-style-type: none"> <li>5.1 User notification of charges before, during, and after significant events</li> <li>5.2 Quasi-real time transmission of usage data records</li> </ol> </li> <li>6 Third party charging (e.g. charging to other parties during multiparty calls)</li> <li>7 Prepaid billing</li> <li>8 Location-dependent billing and charging</li> <li>9 Real-time access to billing information</li> </ol>
<p>K) Network Capabilities – Roaming</p>	<ol style="list-style-type: none"> <li>1 Interoperability and roaming among IMT-2000 family of systems using a single subscription</li> <li>2 Ability to supplement mobility management with IN-type service logic</li> <li>3 Ability to supplement authentication control with IN-type service logic. This capability does not include generation of authentication parameters (e.g. triplets)</li> <li>4 Mobility and global roaming:               <ol style="list-style-type: none"> <li>4.1 Location management, including automatic update</li> <li>4.2 User Registration, Update and Cancellation</li> <li>4.3 Service Monitoring Registration, Update, Activation, Deactivation and Cancellation</li> <li>4.4 User Profile Database management and control</li> <li>4.5 Security and Authentication Database management and control</li> </ol> </li> </ol>

**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (continued)**

Category	Capabilities
L) Network Capabilities – Service Portability	<ol style="list-style-type: none"> <li>1 The serving system should be able to enable support of a roaming user's services based on the user profile information.</li> <li>2 Seamless (i.e. transparent to users) service portability with other IMT-2000 networks independent of environment technologies (e.g. cellular, cordless, satellite).</li> <li>3 Support of Virtual Home Environment to enable a user to be offered the same service experience when roaming as when in the home network, for operator-specific services               <ol style="list-style-type: none"> <li>3.1 Direct home command</li> <li>3.2 Relay service control</li> </ol> </li> <li>4 Support of UPT</li> <li>5 Support of Service profile management</li> <li>6 Support of standardized supplementary services</li> </ol>
M) Network Services/Features – Handover	<ol style="list-style-type: none"> <li>1 Intra-Family Member handover is supported               <ol style="list-style-type: none"> <li>1.1 Support for Hierarchical Cell Structure                   <ol style="list-style-type: none"> <li>1.1.1 Call transfer and handover across cell layers</li> <li>1.1.2 Location management within multiple cell layers</li> </ol> </li> </ol> </li> </ol>
N) Network Services/Feature – Service Provisioning	<ol style="list-style-type: none"> <li>1 Over-the-air service provisioning               <ol style="list-style-type: none"> <li>1.1 Support for both voice and data services</li> <li>1.2 Uploadable and downloadable (e.g. service parameters)</li> <li>1.3 Support for security and authentication</li> </ol> </li> </ol>
O) Network Services/Features – Quality of Service	<ol style="list-style-type: none"> <li>1 Based on subscription</li> <li>2 QoS negotiation during service invocation</li> <li>3 QoS re-negotiation during a service session (e.g. call)</li> <li>4 QoS of multimedia services as good as on wired access (depending on bearer service classes)</li> <li>5 Speech quality equivalent to wireline</li> <li>6 Meet minimum delay requirements (affects signalling timers, etc.)</li> </ol>
P) Network Services/Features – Supplemental Support	<ol style="list-style-type: none"> <li>1 Cordless Telephone Access</li> <li>2 Virtual private networks</li> <li>3 Operator support services</li> <li>4 IP-based services</li> <li>5 Satellite access: considerations for long link delay, limited power, and bandwidth management</li> <li>6 Media transparency (i.e. user data delivered unchanged)</li> </ol>

**Table 1/Q.1701 – Capability Set 1 for IMT-2000 (concluded)**

Category	Capabilities
<p>Q) Network Services/Features – Terminals &amp; User Interface Modules (UIM)</p>	<ol style="list-style-type: none"> <li>1 Network model to support:               <ol style="list-style-type: none"> <li>1.1 Network with uploading and downloading of user profiles, data information, etc., to support UIM functionality via functional communication channels</li> <li>1.2 Software configurable terminals, for operational flexibility (e.g. to support pro-active applications)</li> <li>1.3 Flexible enough to support future enhancements in software-defined radios, for operational flexibility</li> </ol> </li> <li>2 Mobiles and UIM with downloading capabilities over the air for data and applications. Appropriate procedures should set in place to protect sensitive and confidential information transferred over the air</li> <li>3 Multiple calls on a single terminal</li> <li>4 Support terminal roaming with removable or integrated UIM and provide information needed from UIM to associate a subscriber with the MT and to personalize the MT</li> <li>5 Personal mobility based on a UIM separate from the terminal (IC card)</li> <li>6 Multiple registration of one user on several terminals for different services</li> </ol>
<p>R) Network Capabilities – Packet Transfer Control</p>	<ol style="list-style-type: none"> <li>1 Registration/Authentication</li> <li>2 Address Assignment:               <ol style="list-style-type: none"> <li>2.1 Static</li> <li>2.2 Dynamic</li> </ol> </li> <li>3 Sleep mode to support battery power conservation</li> <li>4 Optimal packet routing</li> <li>5 Multi-protocol support</li> <li>6 Data compression</li> <li>7 Internetworking (e.g. tunnelling, mobile-IP support)</li> <li>8 Location Identification</li> <li>9 Load Balancing across RF channels</li> <li>10 Multiple simultaneous address registrations (e.g. IP addresses) on a single terminal</li> <li>11 Priority access (for registration and data transfer)</li> <li>12 Multimedia sessions</li> </ol>

### 7.3 Future capabilities for IMT-2000

Development of future IMT-2000 Capability Sets should take account of the following principles:

- Future Capability Sets should consist of previous Capability Sets augmented with enhanced and new capabilities; and
- there should be forward and backward compatibility between Capability Sets.

## 8 Interfaces for study

### 8.1 List of interfaces

The following list of interfaces has been developed which need to be identified and are for standardization in ITU (see Figure 3):

- The Network-to-Network Interface (NNI)  
This interface is realized by an ITU-T specified NNI protocol. The ITU-T's protocol work will be on the ITU-T specified NNI protocol. The CN-CN interworking can also be realized by specifying an interworking function (IWF) for protocol (and billing) information conversion between different family members. But the detailed specification of this interworking function is outside the scope of ITU.
- The Mobile Terminal to Radio Access Network (MT-RAN) interface.
- The User Identity Module to Mobile Terminal (UIM-MT) interface.
- The Radio Access network to Core network (RAN-CN).

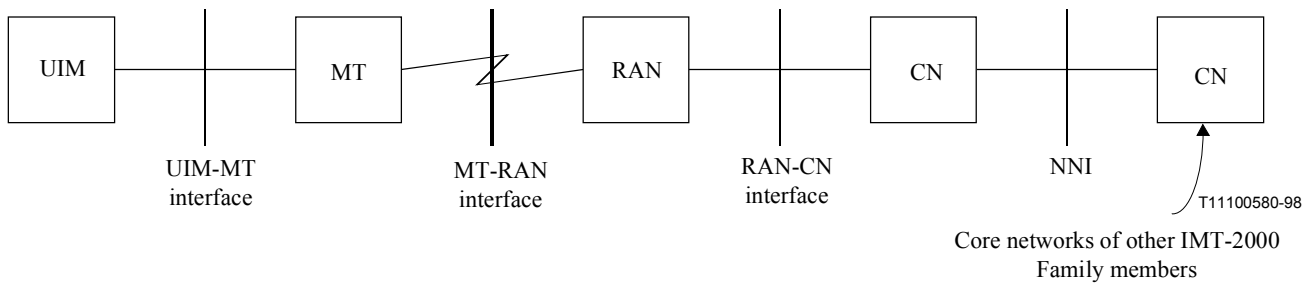
Initial aspects of Stage 2 specification for the RAN-CN interface (identification of FEs and relationships, including preliminary allocation of FEs to RAN and CN functional subsystems) will be addressed as part of ITU-T IMT-2000 CS-1, and the full Stage 2 (IFs, IEs and SDL diagrams) and Stage 3 (protocols) may be addressed as part of later IMT-2000 Capability Sets.

Two complementary pictures are produced, one in Figure 3 showing the physical viewpoint and the other in Figure 4 showing the functional viewpoint. This is done so that the radio independent protocols such as call control, application and service control and location management are carried transparently from the user agent in the terminal to the core network. (Other cases for further study.)

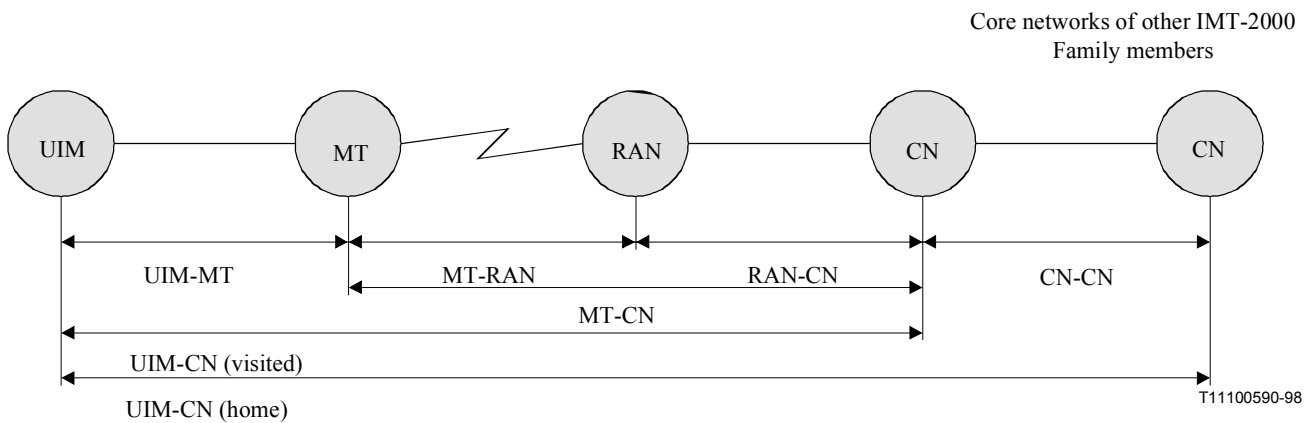
NOTE 1 – a) Functional requirements/objectives will be common among family members.

b) Functional elements and information flows may be different among family members.

NOTE 2 – There may be intra-family member communication which perform similar functionality to the NNI but this is outside the scope of ITU.

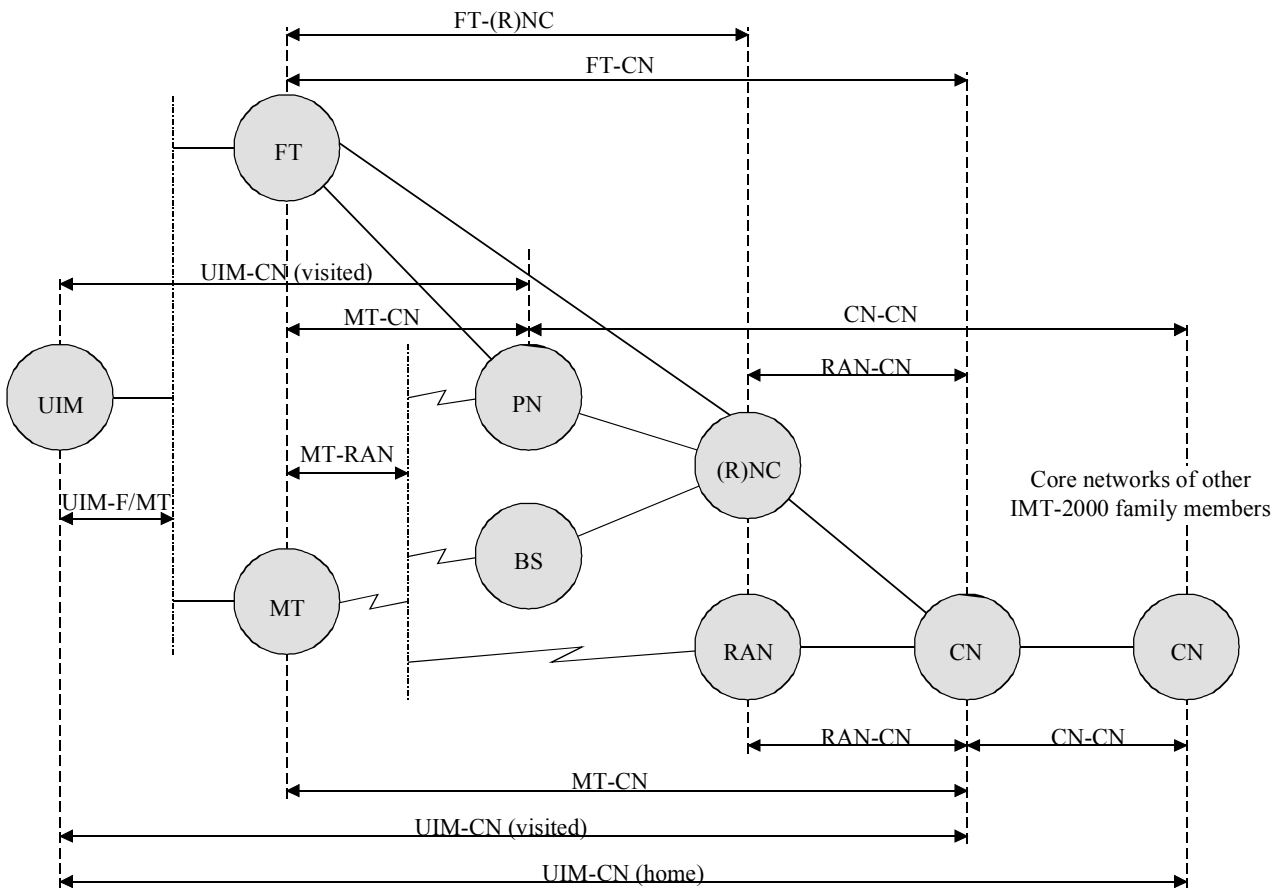


**Figure 3/Q.1701 – Physical interfaces of an individual IMT-2000 family member**



**Figure 4/Q.1701 – Functional communications of an individual IMT-2000 family member**

It is shown in Figure 5 that the interfaces listed in clause 8 are sufficient to support all the required scenarios in Recommendation F.116, i.e. FT-(R)NC, FT-CN and UIM-FT functional communications are equivalent to MT-RAN, MT-CN and UIM-MT functional communications respectively. The protocols developed for one scenario may be more generally applied to the other scenarios.



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Scenario where the private network supports the core networks capabilities of an IMT-2000 family member.  
 A user of one IMT-2000 core network roams into an IMT-2000 private network attached to another IMT-2000 core network.

- BS Residential Cordless Base Station
- FT Fixed Termination
- PN Private Network
- (R)NC (Radio) Network Controller  
 Equals ISDN-NT access network concentrator for fixed terminations

NOTE – All interfaces shown are functional and may be carried transparently over lower layer physical interfaces.

### Figure 5/Q.1701 – Composite functional interface model

The support of personal mobility, and terminal mobility between the cordless and cellular accesses is required. In the case of the public residential environment, it is assumed that personal mobility is also supported on the Fixed Terminal (FT). The details of the physical implementations are outside the scope of this Recommendation.

IMT-2000 interfaces for study should also consider the satellite component of IMT-2000 consistent with Figures 3 and 4.

The FT-CN functional communication is the Access interface from a fixed terminal to the Core Network supporting Call Control functionality, extended with Mobility Management procedures to support Personal Mobility via UIM functionality.

The FT-(R)NC functional communication may support the attachment of an IMT-2000 Mobile Terminal to interconnect with the network via a fixed line interface. This may allow the User to access dedicated resources where a port may be available. It also provides an access path for the UIM and the network to support personal Mobility on the UIM where the UIM may be integrated.

The (R)NC may support an IMT-2000 Radio Interface for cordless or small cell sites including the (R) Radio functionality. For residential cordless phone applications, the R(NC) may be a null function. Without the Radio functionality it may be used to interconnect with ports to provide fixed line access. For wireline PSTN access, the R(NC) may also be a null function.

RAN-CN functional communication can also include BS-CN communication.

## **8.2 Network-to-Network Interface (NNI)**

This is the interface between different core networks of IMT-2000 Systems.

For a given user in a roaming situation, and for a typical call, Figure 3 shows two CNs: the CN on the left is the Serving CN, the CN on the right represents both the home CN and the Transit CN. This introduces the need to distinguish between different information flows on the CN-CN interface, as shown in the following subclauses.

### **8.2.1 Serving CN to Home CN functional communication**

The NNI supports information exchange between the serving and the home core network of a subscriber for authentication control and subscriber-specific service control, especially related to the support of the Virtual Home Environment, as well as provision of location information.

### **8.2.2 Serving CN to Transit CN functional communication**

This functional communication supports:

- information exchange between the originating serving core network and the terminating home core network to enable establishment of mobile-terminated calls in case of a roaming user;
- information exchange between an originating and terminating serving core network for call and service control purposes (including call set-up, negotiation of service capabilities, etc.).

This functional communication path provides for end-to-end calls between Core Networks and can be provided only if the serving CN and the Transit CNs implement suitable interoperable or common specifications.

### **8.2.3 CN-CN functional communication for Packet Data**

The NNI supports:

- information exchange between serving and home CN for mobility management data and possible delivery of bearer packet data; and
- information exchange between the serving or home and a transit CN for possible delivery of bearer packet data.

## **8.3 MT-RAN interface**

The MT-RAN interface is the radio interface between the MT and RAN. This interface supports functional communication between the MT-RAN and MT-CN.

### **8.3.1 MT-RAN functional communication**

This is the functional communication between the MT and the RAN. The information carried is in support of data protection and resource management.

An IMT-2000 network may support multiple dissimilar access techniques (e.g. fixed radio, cellular, cordless, satellite, wireline, etc.). In addition, for the radio cellular access using the IMT-2000 cellular bandwidth, the set of specifications may be different among family members.



### **8.3.2 MT-CN functional communication**

This is the functional communication between the MT and the CN. The information carried on this functional communication path, such as call control and mobility management, is carried transparently through the RAN.

## **8.4 The UIM-to-MT interface**

This is the physical interface between the user-removable UIM and the Mobile Terminal and is a single, clearly defined interface. The definition of this interface includes a secure physical (ISO compliant) specification (e.g. size, contacts, electrical specification, voltage, basic information exchange protocols).

The UIM may be physically removable from the MT or it may be integrated into the MT (non-removable). A non-removable UIM is functionally equivalent to a removable UIM. Standards for UIM physical interconnection to the MT do not apply to a non-removable UIM. Some UIM functionalities may be uploadable and downloadable.

### **8.4.1 UIM-MT and UIM-CN functional communications**

Information is passed from the UIM to the MT for processing in the MT or for transfer to the CN. The MT may use the information in subsequent communication with the CN in the MT-CN functional communication. Information such as the following non-exhaustive examples may be exchanged:

- UIM access control (e.g. PIN transfer to authenticate the user to the UIM);
- identity management (e.g. transfer of internationally unique subscriber or user identity);
- authentication control (e.g. transfer of challenges and responses for authentication);
- service control (e.g. transfer of user service profiles or user service logic); and
- man-machine interface control (e.g. transfer of user-specific MMI configuration).

The UIM-MT functional communication will allow for the establishment of family-specific information exchange between the UIM and the MT.

The UIM-CN functional communication is used to support services where software objects in the UIM relates to Software in the Network. These may be, e.g. profile services and data services. This may be used for downloading software tools or objects over a pseudo-transparent (connection) data path established across the network.

The UIM-CN functional communication will allow for the establishment of family-specific information exchange between the UIM and the (home) CN.

## **8.5 The RAN-to-CN interface**

This is the interface between the RAN and the CN. A RAN may be connected to different CNs and a CN may be connected to different RANs. This interface may also support fixed radio, cordless terminal mobility, satellite, wireline, etc.

### **8.5.1 RAN-CN functional communication**

The purpose of the RAN to CN interface is to facilitate the exchange of:

- bearer traffic (such as voice, data, etc.);
- control information (such as call, mobility, etc.); and
- data security and resource management information.



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