

## RECOMMENDATION 817\*

## INTERNATIONAL MOBILE TELECOMMUNICATIONS-2000 (IMT-2000)

## Network architectures

(Question 39/8)

(1992)

The CCIR,

*considering*

- a) CCIR Recommendation 687;
- b) that the cost of radio and very large scale integration (VLSI) technology is continually decreasing, thus making, in a number of cases, the radio approach a competitive alternative access option to the voice and non-voice telecommunication services;
- c) that different systems are under study within various research and standards bodies;
- d) the need for a flexible system structure able to match network investment to revenue growth, to adapt readily to environmental factors and to respond to new developments without restricting innovation;
- e) that there is a need for mobile terminals to roam between public land mobile telecommunication networks in different countries;
- f) that users may want to be able to use the same terminal equipment and procedures as in the fixed networks to access similar telecommunication services in IMT-2000;
- g) that IMT-2000 will be implemented in network environments utilizing the concepts of intelligent networks (IN) and Universal Personal Telecommunication (UPT);
- h) that IMT-2000 will support Universal Personal Telecommunication;
- j) the functional modelling and functional architectures of intelligent networks and UPT as defined by the CCITT,

*recommends*

that International Mobile Telecommunications-2000 intended for regional and/or worldwide use should be structured functionally according to Annex 1.

## ANNEX 1

## International Mobile Telecommunications-2000

## Network architectures

## 1. Scope

The purpose of this Annex is to present the functional network architectures and some of the resulting network configurations which are possible for IMT-2000. The Annex should form the basis for defining the information flows within IMT-2000.

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\* This Recommendation should be brought to the attention of the CCITT.

In § 2, some consideration is given to some aspects of IMT-2000 which have implications on the architecture model of IMT-2000. General definitions are included in § 3.

In § 4 and 5, the basic functional model of IMT-2000 is described together with a network functional architecture including network interconnections. In § 6 some examples are given of possible mappings of the functional model onto different physical configurations.

*Note 1* – Throughout this Annex, the term ISDN should be understood to include also broadband ISDN (B-ISDN) unless otherwise stated or implicit from context.

## 2. General architectural aspects

IMT-2000 is intended to provide telecommunication services to mobile and fixed users via a wireless link, covering a wide range of user sectors (e.g. public, private, business, residential, etc.) and accommodating a wide range of user equipment (e.g. personal pocket terminals, vehicle mounted terminals, special mobile terminals, standard PSTN/ISDN terminal equipment connected to the mobile station, etc.). The network architecture model developed for IMT-2000 must therefore be flexible enough to cover all these application scenarios. In light of this, some general considerations are given in the following sub-sections.

### 2.1 Provision of IMT-2000 services

In Recommendation 687, Figs. 1 and 2 outline some scenarios for provision of IMT-2000 services. Recommendation 816 discusses the services in more detail. In Recommendation 819 the adaptation of IMT-2000 to meet the needs of developing countries is discussed.

Although IMT-2000 is intended primarily for public access, provision of IMT-2000 services in connection with private networks must be foreseen, e.g. the connection of a mobile PBX or LAN (e.g. on board a ship or train) to the public networks or the use of personal pocket stations as extensions to a PBX. Public radio access to a PBX can also be envisaged (e.g. hotels, hospitals, etc.).

It should also be possible to use an IMT-2000 radio connection for a residential cordless telephone application or as a replacement for the local loop wiring.

In the case of developing countries, an objective is to allow for small and simple start-up systems, that can be readily expanded in capacity and can evolve in functionality as required. In a more general way, IMT-2000 radio interfaces will be applied to fixed services in all types of environment, i.e. urban, rural and remote as represented in Fig. 1 of Recommendation 819.

In the architecture model for IMT-2000 it shall be possible to identify the relevant reference points for these applications.

### 2.2 User/service access

In addition to the specific IMT-2000 terminals (e.g. personal pocket terminal), it is required that IMT-2000 support standard terminal interfaces as defined for ISDN/PSTN, etc. Relevant reference points for these interfaces must be identified.

### 2.3 Radio access technology

IMT-2000 will be used in different environments including high traffic density business areas, rural areas, indoor use, outdoor use, via personal pocket terminals, vehicle mounted terminals, etc. Taking into account that it should be possible to optimize the system structure for the different environments, the architecture model must take into account the possibility that different radio access technologies may be used, i.e. the radio interface may be different in different parts of a network.

This means that functions which are dependant on radio access technology should be identified and separated from functions which are not dependant on radio access technology so that as much as possible of the network can be defined independently from the radio access technology.

## 2.4 IMT-2000 in relation to other telecommunications networks

IMT-2000 may be implemented as a stand alone network with gateways and interworking units connecting it to the supporting networks, in particular PSTN, ISDN and B-ISDN (broadband ISDN). This is comparable to the current implementations of public land mobile networks and it is also a solution in cases where the fixed network and the radio network are operated by different operators.

However, IMT-2000 may also be integrated with the fixed networks. In this case the functionality required to support specific radio network requirements, e.g. location registration, paging and handover, is an integral part of the fixed network. Such integration will be more and more feasible with the development of intelligent networks and exchanges for ISDN and B-ISDN.

In such an integrated case, the base stations may be connected directly to a local exchange which can support IMT-2000 traffic by locally integrated functions and by accessing functions in remote service control points.

## 2.5 IMT-2000 in relation to UPT

Universal Personal Telecommunication (UPT) provides personal mobility between terminals and networks. Personal mobility is a feature by which the telecommunications services, the routing and the charging can be related to a personal identity/subscription which can be moved freely between terminals and networks.

IMT-2000 will support UPT as it is defined by the CCITT. However, from a logical point of view the personal mobility provided by UPT is functionally separate from the terminal mobility inherent in the radio access. Therefore, the two types of mobility should be logically separated in the network models. Thus, UPT support will not appear explicitly in the IMT-2000 network models.

## 3. General definitions

The definition of the following terms, used in this Annex, can be found in CCITT Recommendation Q.1001:

- public land mobile network (PLMN),
- mobile services switching centre (MSC),
- base station (BS),
- mobile station (MS),
- cell.

For the satellite part, the following corresponding terms are used:

- public mobile satellite network (PMSN) corresponds to PLMN,
- land earth station (LES) corresponds to base station (BS),
- mobile earth station (MES) corresponds to mobile station (MS),
- satellite coverage or spot corresponds to cell.

## 4. IMT-2000 functional model

### 4.1 General

The following model has been developed to be non-service specific as well as non-environment specific.

The model is strictly functional and does not imply any limitations regarding implementation or distribution of functions onto physical configurations.

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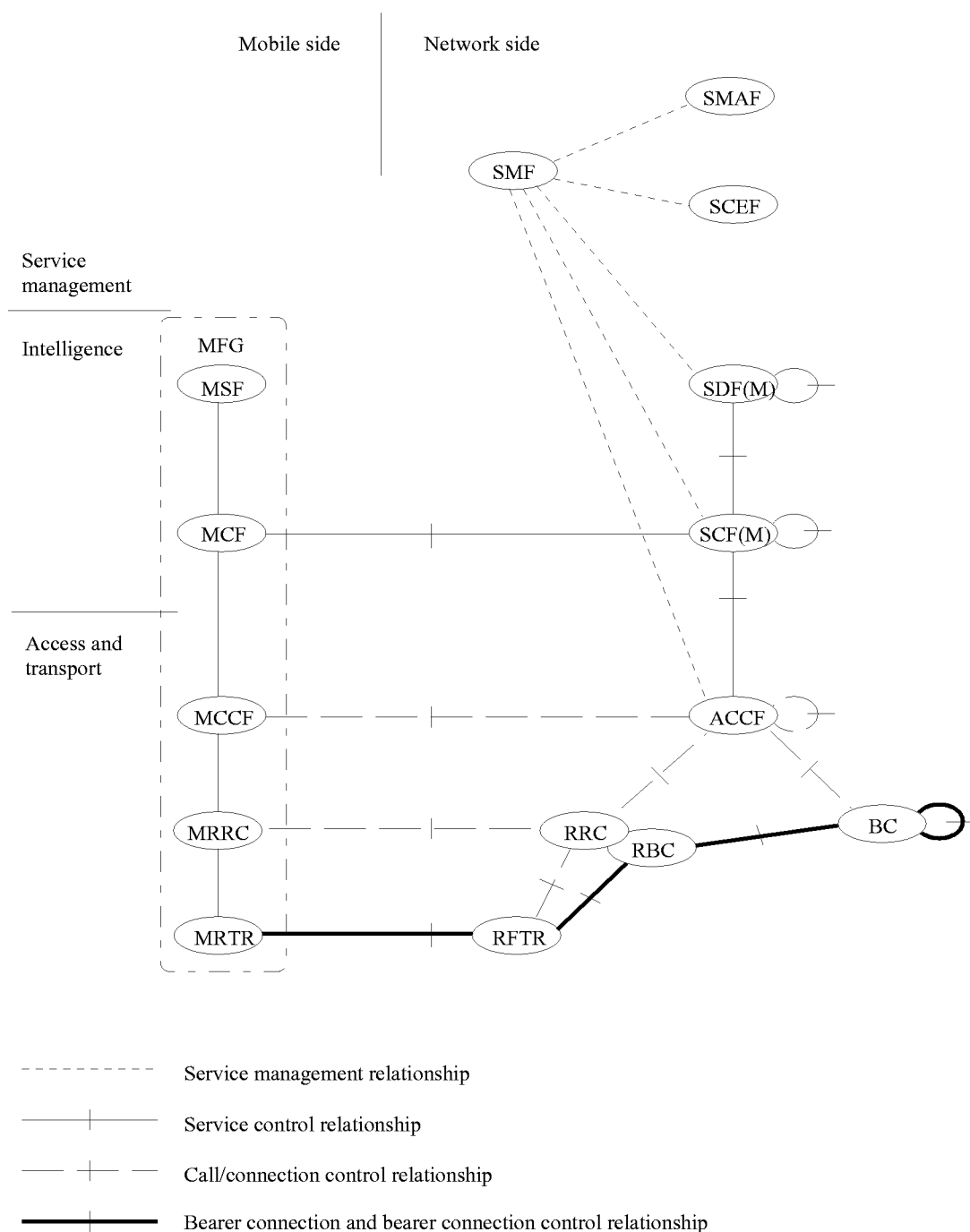
## 4.2 Basic functional model

The basic functional model in Fig. 1 outlines the types of functional entities required to provide IMT-2000 services irrespective of environment (microcells, macrocells, satellite spots, etc.). The model also shows the functional relationships between these functional entities.

In a specific network, several functional entities of the same type may exist. However, in the basic functional model, each functional entity type is shown only once. A relationship between two functional entities of the same type is shown as a “relation loop” starting and ending in the same functional entity.

FIGURE 1

Basic functional model for IMT-2000



Note 1 – See § 4.3 for details of acronyms.

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The functional entities are grouped into three classes:

- *service management*: includes functions related to service creation, service provision, customer control capabilities, and support for the administration, coordination and control of a data base;
- *intelligence*: includes functions related to service logic and service control (e.g. mobility management functions);
- *access and transport*: includes functions related to access, call and bearer control (e.g. radio resource management).

In the model, a distinction has also been made between functions residing at the mobile side of the radio interface and the functions residing at the network side of the radio interface. The functions at the mobile side together form the functionalities required at the access (mobile) side of the concentrator formed by the radio interface (e.g. paging response, initial access, authentication, channel coding, ciphering, etc.).

### 4.3 Description of functional entities

#### 4.3.1 Functions related to service management

These functions support service creation, service provision, customer control capabilities, and support for the administration, coordination and control of a database.

##### 4.3.1.1 Service management function (SMF)

This function involves service management control, service provision control and service deployment control.

##### 4.3.1.2 Service management access function (SMAF)

This function provides an interface (e.g. screen presentation) to the SMF.

##### 4.3.1.3 Service creation environment function (SCEF)

This function allows a service to be defined, developed, tested and input to the SMF. The output of this function involves service logic and service data templates.

#### 4.3.2 Functions related to service logic and service control

These functions provide the control of the supported services and capabilities. Together they form what could be regarded as the “intelligent” part of a network. Specifically, the mobile environment and mobility services are supported by these functions.

##### 4.3.2.1 Service data function (mobile) (SDF(M))

This function handles storage and access to service related data and network data and provides consistency checks on data. It hides from the SCF the real data implementation and provides a logical data view to the service control function (SCF).

The suffix (M) is included to indicate that this is a mobile related functionality which may differ from the SDF associated with fixed network developments.

In general the SDF(M) includes functionalities to:

- store service and mobility related data, e.g.:
  - location information;
  - service profile;
  - security related parameters;
- check data consistency;
- initiate data up-dating (e.g. security parameter download).

As indicated, the SDF(M) will contain more functionalities than pure data storage. It must also contain functions for some data management, e.g. to request for more data from another SDF, an SCF or an SMF in case it is running out of data (e.g. security parameter sets) or to update dependent SDFs in case some basic data is changed (e.g. to update a visited SDF(M) in case the service profile is changed in the home SDF(M)).

*Note 1* – In a mobile network consisting of several IMT-2000, it may be necessary to differentiate between home and visited SDF(M)s. However, in the basic functional model, no such distinction is made.

#### 4.3.2.2 Service control function (mobile) (SCF(M))

This function contains the overall service logic and handles service related processing activity. It supports all mobile specific functions and provides overall service control. Service logic is invoked by service requests from other functionalities to support location management, mobility management, identity management and services as defined.

The suffix (M) is included to indicate that this is a mobile related functionality which may differ from the SCF associated with fixed network developments.

In general the SCF(M) includes the following functionalities:

- paging control (e.g. initiate paging, process paging response);
- service feature analysis (e.g. compatibility checking);
- provide routing information;
- perform location management;
- perform identity management;
- subscriber verification;
- subscriber authentication;
- authentication processing;
- confidentiality control (e.g. ciphering management).

*Note 1* – The need to define a paging control functional entity separate from SCF(M), specifically in a scenario with paging via a separate radio access system, is for further study.

#### 4.3.2.3 Mobile storage function (MSF)

This is a pure data storage function at the mobile side of the radio interface. In addition to subscription or service related parameters it stores:

- location information, and
- identity and security related parameters.

#### 4.3.2.4 Mobile control function (MCF)

This function contains the service logic and service related processing required at the mobile side of the radio interface. It supports all mobile specific functions (e.g. location management, mobility management, identity management) and provides local service control.

In general the MCF includes the following functionalities:

- network information monitoring and analysis;
- location up-date initiation;
- authentication processing;
- confidentiality control (e.g. ciphering management);
- paging recognition and response.

### 4.3.3 Functions related to access, call and bearer control

This group of functions encompasses all handling of the physical communication resources. This includes both the radio resources used between the mobile stations and the network, and the fixed network resources used for mobile related transactions.