

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.

* 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.

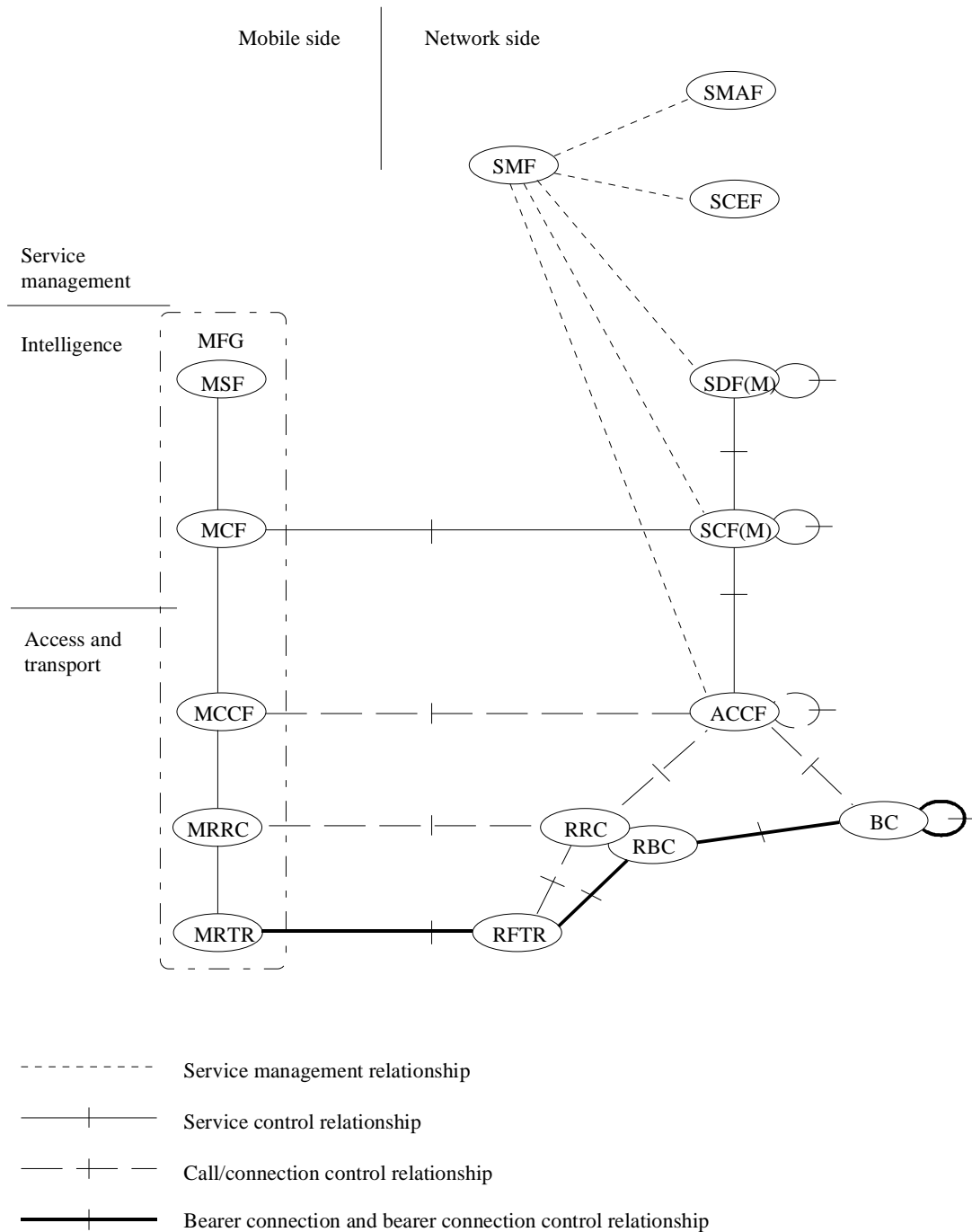
4.2 Basic functional model

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.

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.

In the model, the call control logic is separated from the physical bearer control itself. At the fixed network side, this is not significant, i.e. CCF and BC functionalities could well be combined. However, at the radio side there has to be a physical distribution of at least the radio emission and reception functionalities due to the necessary physical distribution of cells. Therefore, the model has been fitted to support such a physical distribution of functionalities.

4.3.3.1 Access and call control function (ACCF)

The basic task of the ACCF is to establish (based on instructions from SCF(M)) a call to the distant end of a network and to associate radio and network node resources to the call.

In general the ACCF includes the following functionalities:

- analyse and process mobile service requests;
- establish, manage and release a call;
- call control adaptation between IMT-2000 and PSTN/ISDN;
- maintain network call states;
- invoke service logic (e.g. request for routing information);
- provide special resources;
- request for allocation of radio resources;
- request for allocation of network resources;
- inter-RRC hand-over execution (inter- and intra-ACCF);
- perform charging operation.

4.3.3.2 Bearer control (BC)

This function controls the bearer connection elements in order to provide the bearer service requested by the ACCF. In general it includes the following functionalities:

- select and create/delete bearer resources;
- connect, maintain and disconnect bearer connections;
- perform routing for network side bearer connections;
- provide information relevant for charging.

4.3.3.3 Radio resource control (RRC)

This function handles the overall control of the radio resources and radio connections within a given area (typically many cells).

In general the RRC includes the following functionalities:

- radio channel management (including access control);
- radio channel supervision (including assessment of radio channel measurement results from RFTR);
- radio channel power control;
- analysis of mobile radio environment reports;
- hand-over initiation due to changes in radio environment (inter- and intra-RRC);
- intra-RRC hand-over execution;
- system information broadcast management (radio access information and network information);
- paging execution.

Note 1 – It may be appropriate to define a paging execution functional entity separate from RRC, specifically in a scenario with paging via a separate radio access system.

4.3.3.4 Radio bearer control (RBC)

This function is closely related to the RRC. It connects, maintains and disconnects radio bearer connections and interconnects them with the fixed network bearer resources.

4.3.3.5 Radio frequency transmission and reception (RFTR)

Typically, this function will manage the radio resources available within a single cell. It includes the following functionalities:

- RF generation, emission and reception including:
 - source (e.g. speech) coding and decoding;
 - error protection coding and decoding;
 - ciphering and deciphering;
 - baseband channel multiplexing and demultiplexing;
 - modulation and demodulation;
 - RF carrier multiplexing and demultiplexing;
 - RF amplification;
- initial (random) access detection;
- radio and network channel interworking;
- radio channel measuring and reporting;
- power control execution.

4.3.3.6 Mobile call control function (MCCF)

This function will handle the mobile side of access control and call control and is responsible for initiating functional requests based on requests from the user or other functional entities. In general the MCCF includes the following functionalities:

- maintain mobile side call states;
- formulate service requests;
- call control adaptation between IMT-2000 and PSTN/ISDN.

4.3.3.7 Mobile radio resource control (MRRC)

This function handles the mobile side of the radio connection. In general it includes the following functionalities:

- radio channel supervision;
- local radio environment reporting (if mobile assisted or mobile controlled handover);
- handover initiation (if mobile controlled handover);
- radio access information monitoring and analysis.

4.3.3.8 Mobile radio transmission and reception (MRTR)

This function handles the radio transmission and reception on the mobile side. It includes the following functionalities:

- RF generation, emission and reception including:
 - source (e.g. speech) coding and decoding;
 - error protection coding and decoding;
 - ciphering and deciphering;
 - baseband channel multiplexing and demultiplexing;
 - modulation and demodulation;

- RF carrier multiplexing and demultiplexing;
- RF amplification;
- radio channel measurements;
- power level adjustment.

4.3.3.9 Mobile functions group (MFG)

The combined functionalities of the functional entities on the mobile side.

4.4 Network functional reference model and network interconnection

In Fig. 2, a network functional reference model is shown including the interconnection of five different networks. The five networks have different significance:

- *originating network*: this is the serving network as seen for a mobile originated call. The service control parts of that network are shown with subscript “o”, i.e. SDF(M)o and SCF(M)o;
- *originating home network*: this is the master network for mobile subscriber and location data related to a call originating mobile subscriber. The service control parts of that network are shown with the subscript “oh”, i.e. SDF(M)oh and SCF(M)oh;
- *terminating network*: this is the serving network as seen for a mobile terminated call. The service control parts of that network are shown with the subscript “t”, i.e. SDF(M)t and SCF(M)t;
- *terminating home network*: this is the master network for mobile subscriber and location data related to a call terminating (receiving) mobile subscriber. The service control parts of that network are shown with the subscript “th”, i.e. SDF(M)th and SCF(M)th;
- *intermediate network*: this is a possible intermediate network used only for routing and establishment of the bearer connection between the originating and the destination networks. In this network, the combination of CCF and BC merely indicate the capability of this network to route and switch a bearer connection and has no significance on the functional architecture of that network (PSTN, ISDN, etc.).

Note 1 – Although shown as belonging to different networks, the functional entities belonging to the originating network, the home networks and the terminating network could as well be seen as functional entities located in different parts of the same network, i.e. as visited originating control point, home control points and visited terminating control point.

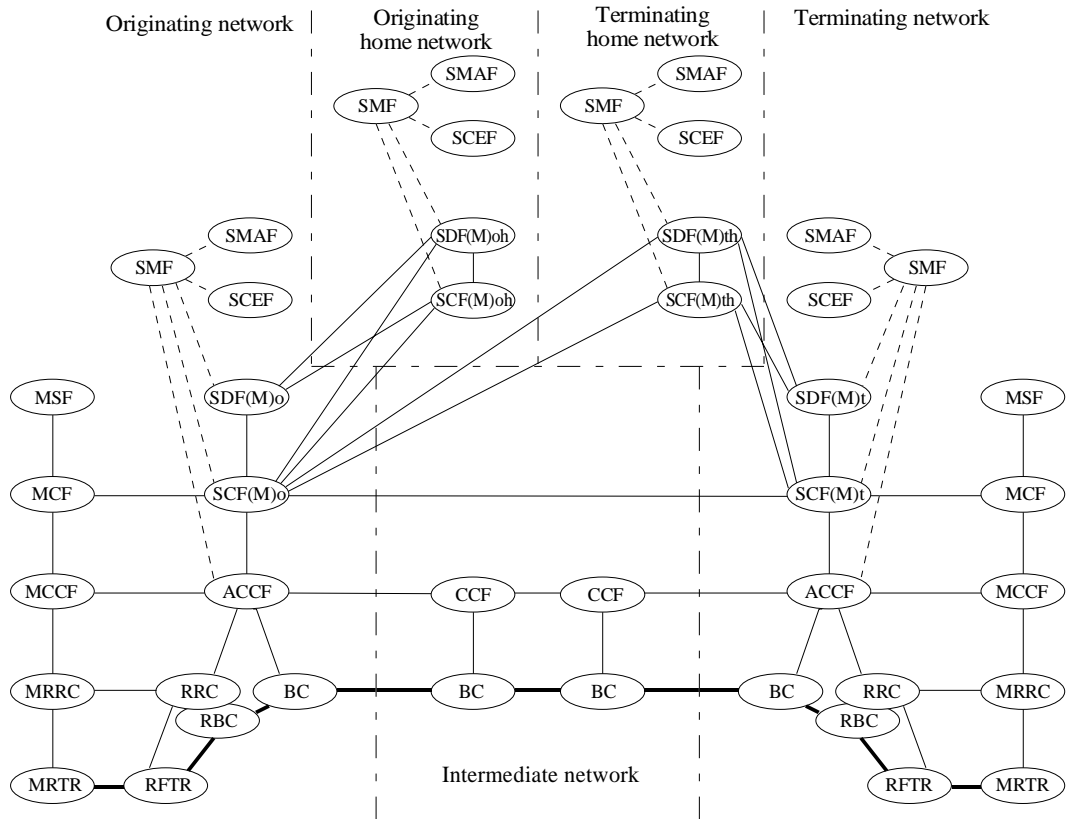
It should be noted that the subscripts “o”, “oh”, “th” and “t” only indicate the roles of the respective FEs in this model and do not imply any difference in functionalities between the four sets of SDF(M)/SCF(M).

The direct relationships and the interconnection of the four sets of SDF(M)/SCF(M) include a number of options (all combined in Fig. 2), resulting in different requirements on the split of service logic between SDF(M) and SCF(M).

Direct connection SDF(M)-SDF(M) (Fig. 3) gives the advantage that service and mobility data can be managed completely at the SDF(M) level in a modular way with no impact on other functional entities. The SCF(M) can always interrogate its own SDF(M), irrespective of where data is stored. However, SDF(M) will require functionalities for complete data management including access security procedures (e.g. SDF(M)h must initiate updating of visited SDF(M) in case service data is changed).

Direct connection SCF(M)-remote SDF(M) (Fig. 4) gives SCF(M)o the possibility to directly enquire the SDF(M)th of the destination subscriber for subscriber data (e.g. for compatibility checking) and routing information. Also in this case SDF(M)h will require functionalities for remote data access and access security. Updating of visited SDF(M) has to be performed via SCF(M)h.

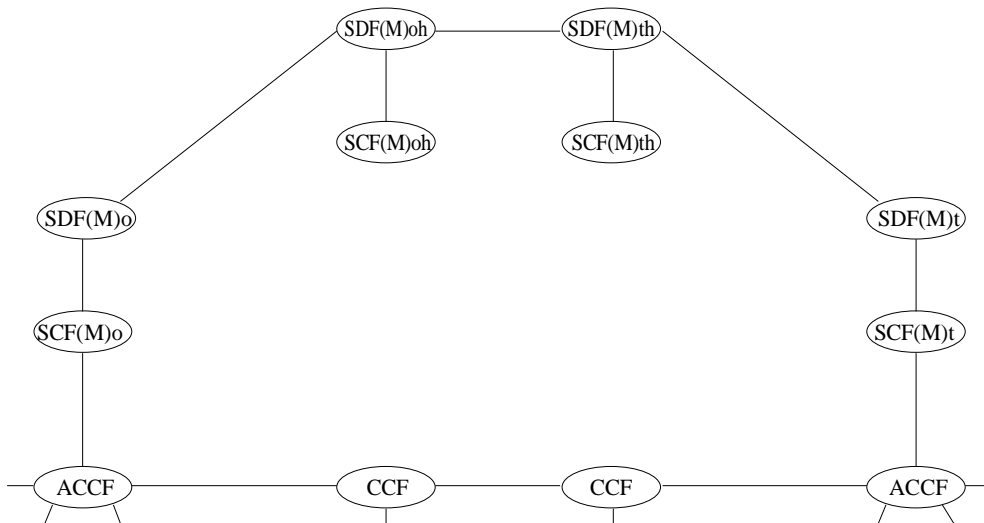
FIGURE 2
Network functional reference model



Note 1 – See § 4.3 and 4.4 for details of acronyms.

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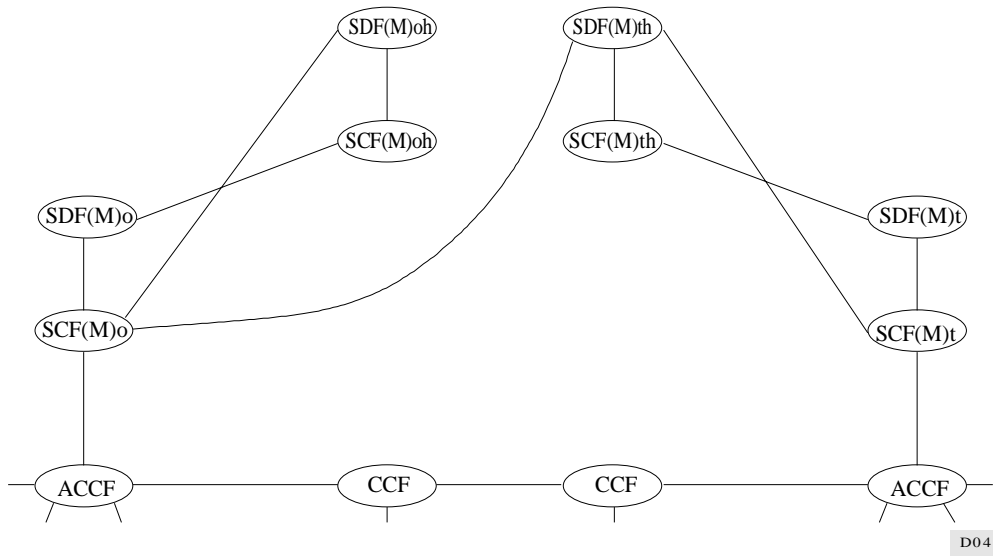
FIGURE 3
Direct interconnection SDF(M)-SDF(M)



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FIGURE 4

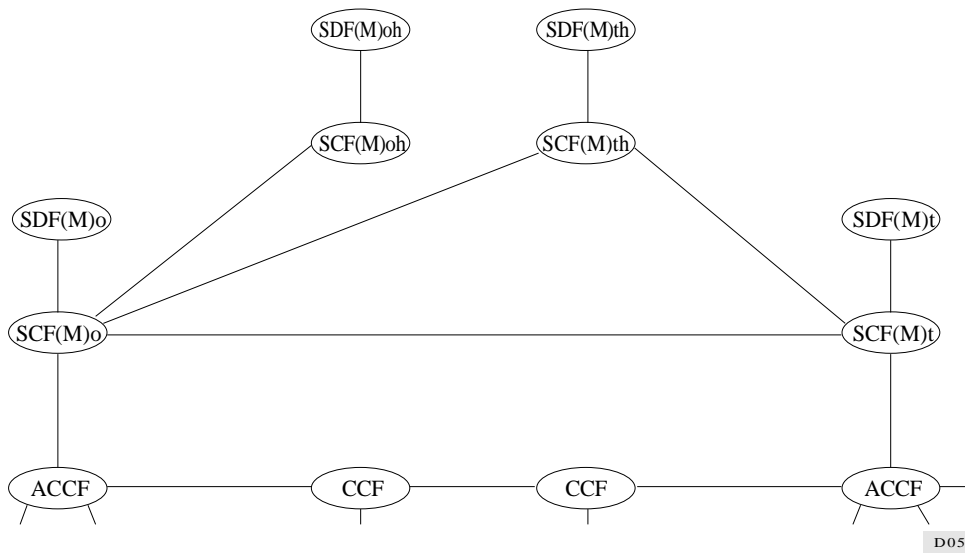
Direct interconnection SCF(M)-remote SDF(M)



Direct connection SCF(M)-SCF(M) (Fig. 5) assumes that all data access, including access security procedures, is controlled by SCF(M). SDF(M) can be regarded as a simple data storage function. However, the updating of visited SDF(M)s is more complex as it involves more entities. The SCF(M) must also be informed or detect by itself when data in the associated SDF(M) is changed.

FIGURE 5

Direct interconnection SCF(M)-SCF(M)



A flexible functional architecture would include all these possibilities as in Fig. 2. However, the direct connection alternatives are the same as for UPT and therefore the preferred solution will be the one that is chosen for UPT.

4.5 Short description of dynamic relationships

In this section some examples of the dynamic relationships between the identified functional entities are shown. Reference is made to Fig. 2.

4.5.1 Location updating

The MCF functional entity (FE) of the mobile station (MS) is continuously monitoring and analysing network information as broadcast by the network and its RRC functional entity. In addition, the MRRC functional entity of the MS provides the MCF with information regarding the radio environment (e.g. best received cell). As the MCF recognizes that a cell in a new location/paging area is better than the current cell and that the new cell is a permitted cell (e.g. according to data stored in the MSF functional entity), the MCF will request MCCF/MRRC to access the new cell for location updating.

After a successful random (initial) access, which is performed by the MRRC functional entity based on access information as broadcast by the network, a suitable radio resource is allocated by the RRC functional entity. The location update request is then forwarded to the visited SCF(M), assumed as SCF(M)_o in Fig. 2. Depending on the interconnection possibility used, SDF(M)_{oh} of the MS is informed either directly from SCF(M)_o or via SDF(M)_o or SCF(M)_{oh}. If relevant data is not available in SDF(M)_o/SCF(M)_o it is downloaded from SDF(M)_{oh} either directly or via SCF(M)_{oh}.

Before the location updating is accepted, the authentication procedure is performed between the SCF(M)_o and the MCF functional entities using authentication parameters downloaded from SDF(M)_{oh}. Note that authentication may take place in both directions (i.e. the MS may also request the network to authenticate itself). Possible ciphering control and possible temporary identity exchange is also performed between the SCF(M)_o and the MCF functional entities.

When the location updating has been accepted, the SDF(M)_{oh} has the responsibility to inform the possible previous visited SDF(M) that the mobile station has now moved to an area controlled by another SDF(M). This information can be sent either directly or via SCF(M)_{oh} or via the previous visited SCF(M) depending on SDF(M)/SCF(M) interconnections.

4.5.2 Mobile originated call setup

The user request for a call is initially processed by the MCCF. After some initial service control by the MCF/MSF and after a successful initial (random) access performed by MRRC/MRTR-RFTR/RRC, the call setup request is forwarded to the ACCF. After some initial analysis, the ACCF will invoke the service logic in the SCF(M)_o required for outgoing call setup.

By accessing data in SDF(M)_o (and possibly also SDF(M)_{oh}), the SCF(M)_o will perform the authentication procedure towards the MCF and service feature analysis and compatibility checking against the requested service. Note that for an outgoing UPT call, a UPT database may also be consulted.

If required, SCF(M)_o will also provide additional routing information regarding the destination address, e.g. after accessing SDF(M)_{th}.

After a successful response from the SCF(M)_o, the ACCF will initiate routing of the call towards the network side (via CCF/BC) and allocate a suitable radio resource via RRC/RBC/RFTR/MRTR/MRRC.

Note that the model also supports the possibility to delay the allocation of network and radio resources until the addressed user has responded. This can be done by the SCF(M)_o requesting the SCF(M)_t to alert the user and have the user respond before any resources are allocated.

At the end of the call, ACCF will release the resources and provide the SCF(M)_o with charging information. This information is then forwarded to an appropriate entity (e.g. SDF(M)_{oh}) for later processing.

4.5.3 Mobile terminated call setup

The originator of the call may be using either a mobile terminal or a terminal in the fixed network. Some node in the network used will have the capability to detect that the requested call is to terminate in a mobile terminal, i.e. that an SCF(M) has to be requested for routing information. In the fixed network, this analysis and detection capability may be included in any suitable exchange (local exchange, trunk exchange, special gateway, etc.). For simplicity reasons, the example covered by Fig. 2 is assumed, i.e. the originator is using an IMT-2000 mobile terminal.

After detecting that the destination address is a mobile terminal, the originating ACCF will request the SCF(M)o for routing information. The SCF(M)o will forward the request to SDF(M)th of the addressed terminal either directly or via SCF(M)th depending on the SDF(M)/SCF(M) interconnection used. (In case the call is to a UPT user, a UPT database may also have to be involved.)

After receiving the routing information the SCF(M)o may either request the SCF(M)t to locate the terminal before any resources are allocated to the call or it may route the call directly to the destination ACCF which will then request SCF(M)t to locate the terminal for an incoming call.

The SCF(M)t will then initiate the paging procedure in the RRCs supporting the paging area in which the mobile station is currently registered. The paging is detected by the MCF functional entity in the mobile station and after a successful access to an appropriate RFTR/RRC, the paging response is forwarded to the SCF(M)t.

After successful authentication, which is performed between the SCF(M)t and the MCF of the addressed mobile station using parameters received from SDF(M)th/SCF(M)th (either downloaded previously in connection with location updating or on request), and after successful service feature analysis, the SCF(M)t will acknowledge the through-connection of the call.

If the SCF(M)o was requesting the locating, additional routing information is sent to SCF(M)o which can then instruct its ACCF to route the call to the destination ACCF/BC/RBC/RRC.

4.5.4 Handover

Handover, or changing the radio communication path during a communication transaction to maintain the service quality, is a key function in mobile systems. Different strategies for recognition, initiation and execution exist. Generally it is possible to place the responsibility for the different steps of the handover process on the mobile side, the network side or to use a combination of both mobile and network initiatives.

A key element in the handover recognition process is the quality of the current channel used and the assessment of possible candidate target cells (or channels) for a necessary handover. In the mobile station, the MRRC functional entity controls these measurements of current channel quality and detection of possible handover candidate cells (radio environment). In the mobile assisted handover case, the measurement results are reported to the RRC functional entity of the network to assist the network controlled handover.

The corresponding measurements on the network side are performed by the RFTR functional entity and reported to RRC.

When the need for handover is detected, either by the MRRC functional entity (mobile controlled handover) or by the RRC functional entity (network controlled handover, possibly mobile assisted), a request for handover is generated. This is processed by the RRC and if the target cell is controlled by the same RRC, the allocation of the new channel and the switching over to it is controlled by the RRC itself.

If the target cell does not belong to the RRC, the ACCF is requested to perform the handover process in the network.

For mobile controlled handover where the request for handover is sent to the new cell (forward handover), the RFTR/RRC and possibly also the ACCF must have the capability to identify the currently used connection and to switch it to the new RFTR/channel.

5. Functional interfaces

Figures 1 and 2 identify the functional relationships between the different functional entities. For a number of these relationships, dynamic control capabilities are required in order to support IMT-2000 services. These control capabilities can be referred to as functional interfaces.

For the mobile side of the functional model it is recognized that the different functional entities shown will normally reside in the same physical entity. Therefore, they are referred to as a single functional entity, the mobile functions group (MFG).

Note 1 – The possible use of a specific user/subscription device (e.g. “smart card”) in the mobile station is outside the scope of this Recommendation.

The following functional interfaces can be identified:

A) MFG-RFTR	E) RRC-RFTR	I) ACCF-RRC
B) MFG-RRC	F) RRC-RBC*	J) ACCF-BC
C) MFG-ACCF	G) RBC-RFTR	K) ACCF- SCF(M)
D) MFG- SCF(M)	H) RBC-BC	L) SCF(M)-SDF(M)

In addition, the following functional interfaces are of special importance for network interworking:

M) SDF(M)-SDF(M)	O) SCF(M)-SCF(M)	Q) ACCF-CCF
N) SCF(M)-SDF(M)	P) ACCF-ACCF	R) BC-BC

Within the mobile functions group (MFG), the following functional interfaces can be identified:

S) MRTR-MRRC	U) MCCF-MCF
T) MRRC-MCCF	V) MCF-MSF

6. Configuration examples

This section serves to demonstrate the mapping of the functional entities of the functional model onto physical entities. These specific configuration examples are not necessarily the only configurations possible. They are split into a subsection for the network side and another subsection for the mobile side.

6.1 Configuration examples for the network side

This subsection shows examples of distribution of functional entities for some possible network configurations that may be realized for IMT-2000. It is not intended that this subsection contains an exhaustive list of configurations, but configurations that assist in identifying the possible network interface points.

It should be noted that the configuration examples may also apply to public mobile satellite networks (PMSN), e.g. reference to base station (BS) or cell station (CS) can be replaced by reference to land earth station (LES).

6.1.1 Stand alone IMT-2000 network

In the example of Fig. 6, the IMT-2000 services are provided by a stand alone IMT-2000 network. Interworking between the IMT-2000 network and other networks (e.g. PSTN, ISDN, PLMN) is taken care of by the mobile control nodes (MCN), either via special gateway MCNs or via each individual MCN.

The scenario shows how the functionalities can be distributed differently in the network in order to optimize the configuration for different requirements. For example, MCN-A contains RRC/RBC functionalities to support direct connection of simple cell stations (CS, supporting a single cell/sector). This could be advantageous in cases where the cell sites are relatively close to the MCN.

* Because of the close relationship between RRC and RBV, the F functional interface is now shown explicitly in the diagrams.

In other cases, the MCN is placed relatively far from a traffic source, e.g. another part of the city. Then a cell station controller (CSC) with RRC/RBC functionality is placed close to the traffic source area. It then controls the local cell stations which cover the area and it also controls the local handovers within that area.

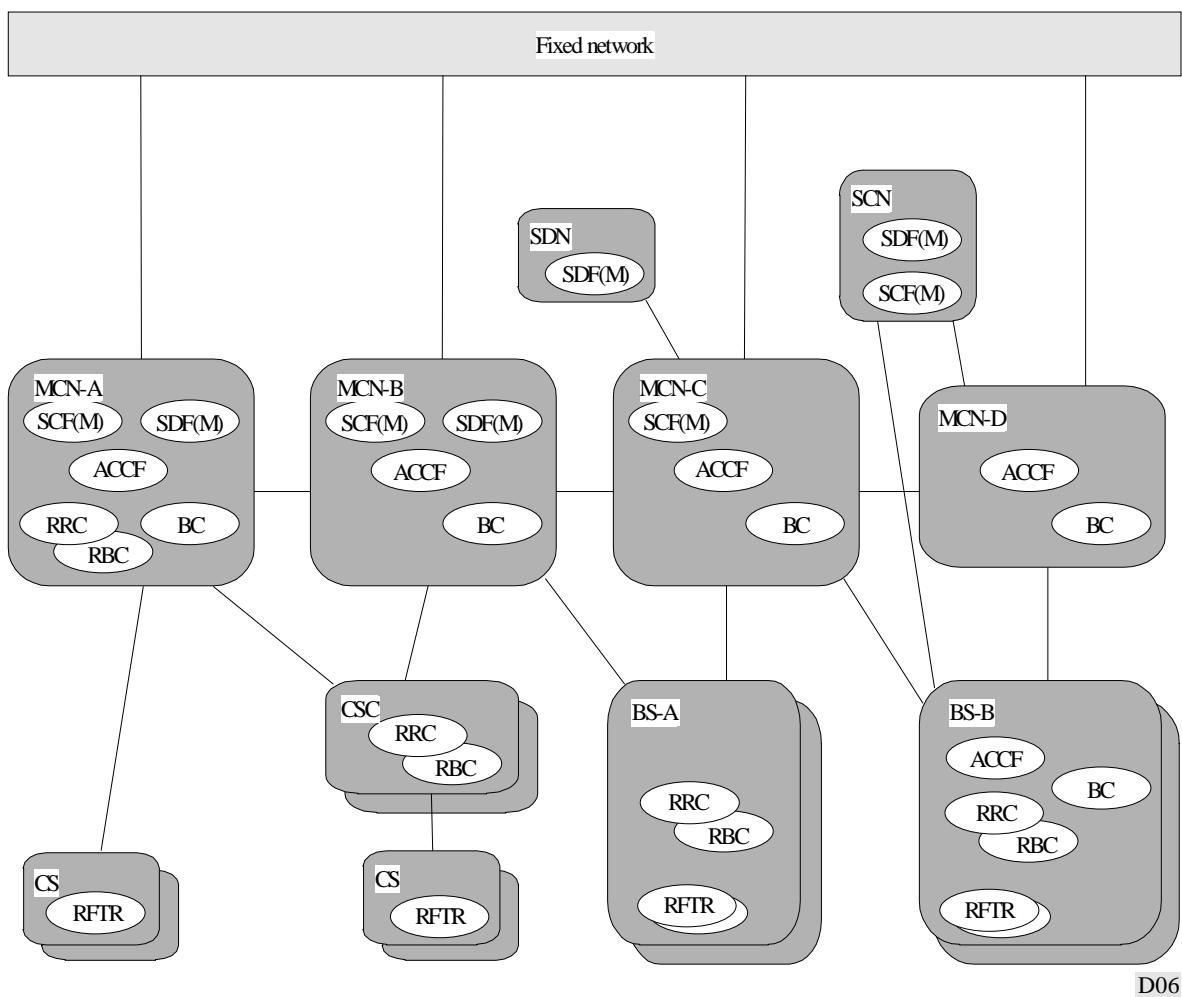
For a sectorized cell site, it may be efficient to control the cells (sectors) locally by RRC/RBC functionality on the site as in BS-A. Each sector will have its own RFTR functionality.

The scenario also includes a “smart” base station, BS-B, which contains ACCF functionality which may be partly or wholly similar to the ACCF of an MCN. This enables local call control within the BS itself.

The example also shows the use of stand alone databases (service data nodes, SDN), and stand alone service control nodes (SCN).

FIGURE 6

Stand alone IMT-2000 network



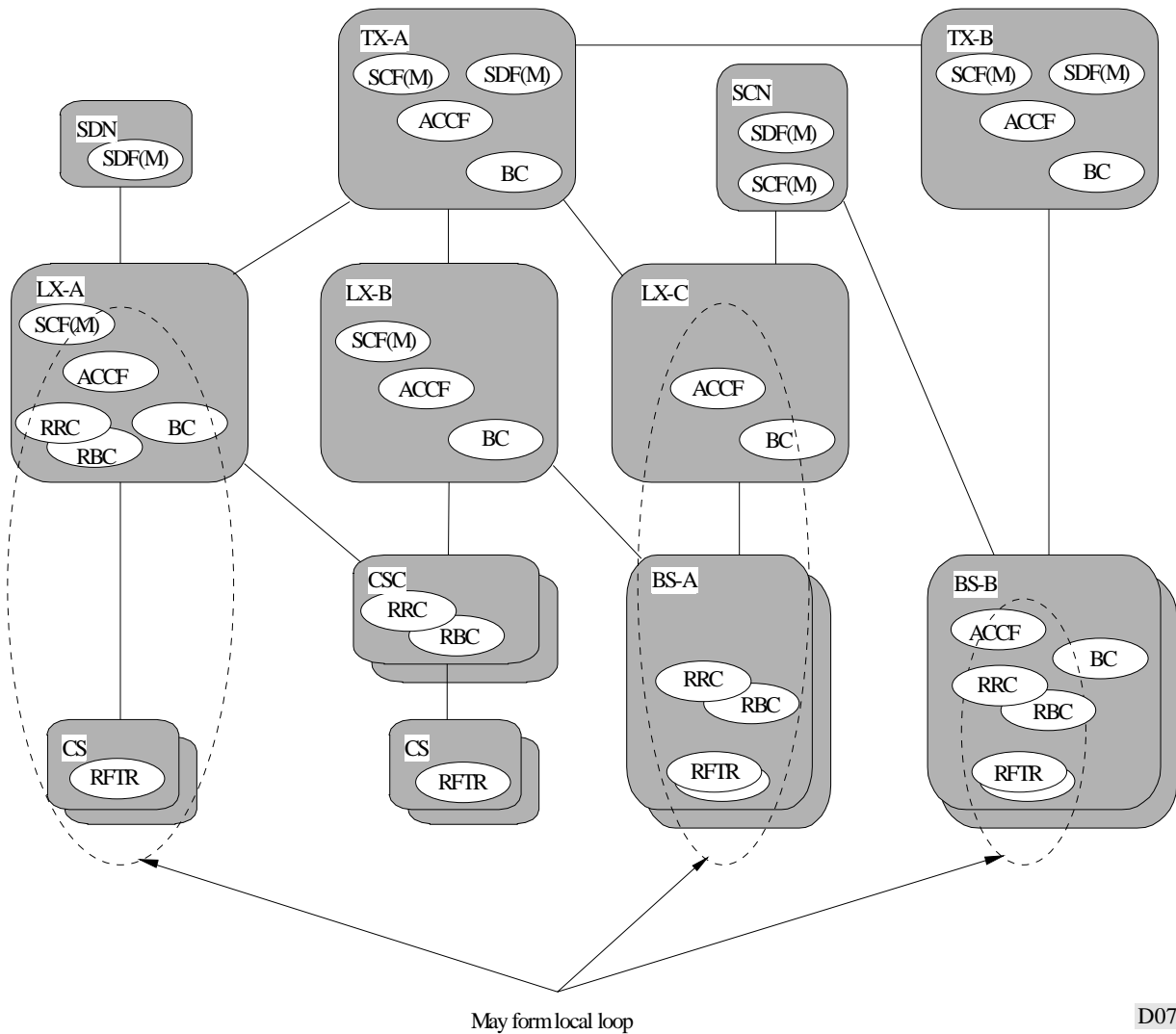
6.1.2 IMT-2000 integrated with the fixed network

In Fig. 7 the IMT-2000 services are provided by integrating the IMT-2000 functionalities into the nodes of the fixed network. A specific example of integration that may apply to developing countries is where the fixed network supports both wireline and wireless user access sub-systems.

The figure shows how the IMT-2000 functionalities can be distributed between local exchanges (LX) and trunk exchanges (TX). As indicated for the stand alone IMT-2000 network, the distribution of functions depends on how the network or parts of the network are optimized.

FIGURE 7

IMT-2000 integrated with the fixed network



Of special interest is replacing the local loop by radio access. If no terminal mobility support is required in this case, a minimum functionality could be covered by the combination ACCF/RRC/RBC/RFIR. A couple of such combinations are encircled in Fig. 7. However, to handle some security mechanisms, SCF functionality should also be included in LX (like LX-A and LX-B).

6.2 Configuration examples for the mobile side

This subsection contains some examples of configurations for the mobile side of the radio interface. Four different configurations are considered:

- personal station (PS),
- mobile station (MS) with standard ISDN terminal interface,
- a PS in tandem with a MS,
- a mobile exchange (MX) with wireless access.

It should be noted that the configuration examples may also apply to the mobile end of satellite links, e.g. reference to mobile station (MS) can be replaced by reference to mobile earth station (MES).

Figure 8 shows the personal station (PS). In this case only the man machine interface (MMI) towards the user and the radio interface towards the network are required.

FIGURE 8
Personal station (PS)

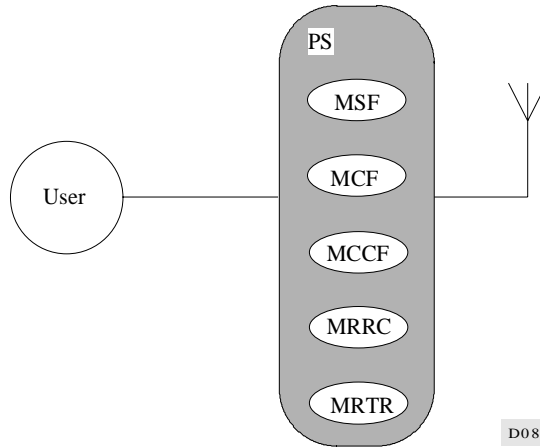


Figure 9 shows a mobile station where a standard ISDN terminal interface has been implemented at reference point R or S. A standard ISDN terminal equipment (TE) can be connected at this interface. The IMT-2000 functionality of the mobile station is contained in the mobile termination entity (MT).

In case the mobile termination entity is to be used only for local loop replacement, the MCF and MSF functionalities may be deleted or limited to security functions.

FIGURE 9
Mobile station with standard ISDN terminal interface

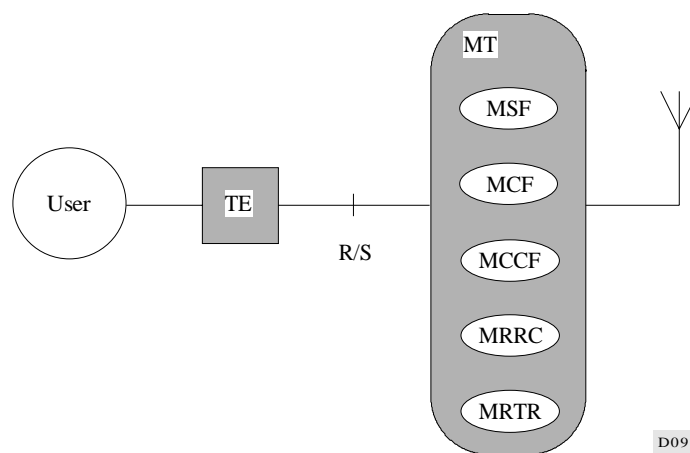


Figure 10 outlines the functional composition of a personal station (PS) in tandem with a mobile station (MS). In this case the mobile station is supporting a separate radio interface towards the personal station (RRC/RBC/RFTR functionalities). This radio interface requires only limited functionality if only one personal station may be connected at any time and terminal mobility is not supported.

FIGURE 10

Personal station in tandem with mobile station

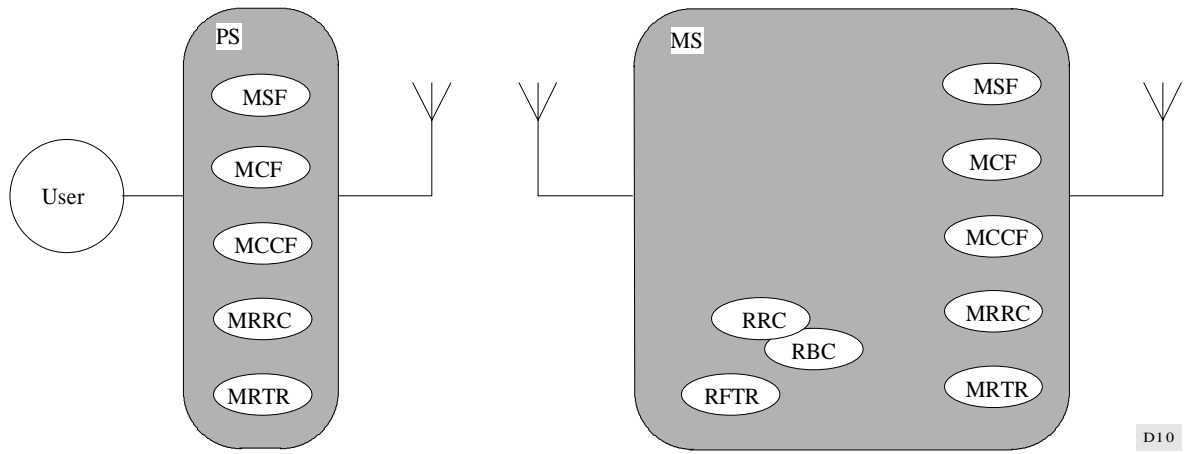


Figure 11 shows the most advanced mobile configuration, that of a mobile exchange (MX) with wireless access. The configuration shows the case of hierarchical cells (tandem radio access), i.e. the mobile exchange must include some of the network functionalities such as ACCF, SCF(M) and SDF(M) to support mobility within the mobile exchange itself.

Note 1 – The operational aspects (e.g. location management, paging, etc.) of the tandem and exchange type of mobile station need further study.

FIGURE 11

Mobile exchange with wireless access

