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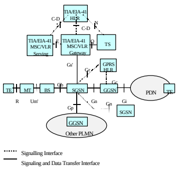

INTERNATIONAL TELECOMMUNICATION UNION

RADIOCOMMUNICATION STUDY GROUPS

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PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R M.[IMT.RSPC]1

DETAILED SPECIFICATIONS OF THE RADIO INTERFACES OF IMT-2000

1 Introduction

International Mobile Telecommunications-2000 (IMT-2000) are third generation mobile systems which are scheduled to start service around the year 2000 subject to market considerations. They will provide access, by means of one or more radio links, to a wide range of telecommunications services supported by the fixed telecommunication networks (e.g. PSTN/ISDN/IP), and to other services which are specific to mobile users.

A range of mobile terminal types is encompassed, linking to terrestrial and/or satellite based networks, and the terminals may be designed for mobile or fixed use.

Key features of IMT-2000 are:

– high degree of commonality of design worldwide;
– compatibility of services within IMT-2000 and with the fixed networks;
– high quality;
– small terminal for worldwide use;
– worldwide roaming capability;
– capability for multimedia applications, and a wide range of services and terminals.

IMT-2000 are defined by a set of interdependent ITU Recommendations of which this one is a member.

[Draft New Recommendation ITU-R M.IMT.RKEY] defines the key characteristics of the IMT-2000 radio interfaces, and represents the results of the evaluation process by the ITU-R on IMT-2000 radio interface proposals submitted to the ITU to a set of defined requirements.

This Recommendation forms the final part of the process of specifying the radio interfaces of IMT-2000, as defined in Recommendation ITU-R M.1225. It identifies the detailed specifications for the IMT-2000 radio interfaces.

[1] Any reference to an external document in this Recommendation means that the external document is considered to be part of this Recommendation. However, such a reference does not give the external document the status, as a stand-alone document, of an ITU Recommendation. Any reference to an external document is accurate at the time of approval of this Recommendation. Since the external document may be revised, users of this Recommendation are advised to contact the source of the external document to determine whether the reference is still current. The references were valid at the time of publication.

This Recommendation has been developed based on consideration of the evaluation results and consensus building, continuing from the IMT-2000 key characteristics defined in Recommendation ITU-R M.[IMT.RKEY] and recognising the need to minimise the number of different radio interfaces and maximise their commonality, while incorporating the best possible performance capabilities in the various IMT-2000 radio operating environments.

[Editor’s Note: For satellite component, some text will be developed if necessary].

2 Scope

This Recommendation identifies the IMT-2000 terrestrial and satellite radio interface specifications, based on the key characteristics identified in Recommendation ITU-R M.[IMT.RKEY] and output of activities outside ITU.

These radio interfaces support the features and design parameters of IMT-2000, including the capability to ensure worldwide compatibility and international roaming.

[Editor’s Note: For satellite component, some additional text will be developed if necessary].

3 Related Recommendations

The existing IMT-2000 Recommendations that are considered to be of importance in the development of this particular Recommendation are as follows:

ITU-R M.687-2 – International Mobile Telecommunications 2000 (IMT-2000)

ITU-R M.816-1 – Framework for services supported on IMT-2000

ITU-R M.817 – IMT-2000 Network architectures

ITU-R M.818-1 – Satellite operations within IMT-2000

ITU-R M.819-2 – IMT-2000 for developing countries

ITU-R M.1034-1 – Requirements for the radio interface(s) for IMT-2000

ITU-R M.1035 – Framework for the radio interface(s) and radio sub-system functionality for IMT-2000

ITU-R M.1036-1 – Spectrum considerations for implementation of IMT-2000 in the bands 1 885–2 025 MHz and 2 110–2 200 MHz

ITU-R M.1167 – Framework for the satellite component of IMT-2000

ITU-R M.1224 – Vocabulary of Terms for IMT-2000

ITU-R M.1225 – Guidelines for evaluation of radio transmission technologies for IMT-2000

ITU-R M.1308 – Evolution of land mobile systems towards IMT-2000

ITU-R M.1311 – Framework for modularity and radio commonality within IMT-2000

ITU-R M.1343 – Essential Technical Requirements of mobile earth stations for global non-geostationary mobile-satellite service systems in the bands 1-3 GHz.

ITU-R M.[IMT.RKEY] - Key characteristics for the IMT-2000 radio interfaces

ITU-R SM.329 – Spurious emissions

ITU-T Q.1701 – Framework for IMT-2000 Networks

ITU-T Q.1711 – Functional Network Architecture for IMT-2000

ITU-T Q.1721 – Information flows for IMT-2000

ITU-T Q.1731 – Functional Specifications and requirements for IMT-2000 radio interface

Handbook on Principles and Approaches on Evolution to IMT-2000 – Volume 2 of Handbook on Land Mobile (including Wireless Access)

[Editor' Note: Additional Recommendations may be added to the exiting list for satellite component if necessary].

4 Considerations

4.1 Radio Interfaces for IMT-2000

4.1.1 Introduction

[Editor's note: This section should contains general introduction to the "Radio Interfaces of IMT-2000", to be developed by TG 8/1].

Recommendation ITU-R M.[IMT.RKEY] indicates that the IMT-2000 radio interface development process should comprise a single terrestrial standard encompassing two high level groupings; CDMA, TDMA, or a combination thereof. The CDMA grouping accommodates FDD direct sequence, FDD multi-carrier and TDD. The TDMA grouping accommodates FDD single carrier, FDD multi-carrier and TDD. These groupings satisfy the needs expressed by the global community.

Additionally, consistent with ITU-T Recommendation Q.1701, the IMT-2000 Recommendations should include the capability of operating with both of the major third generation core networks.

In line with this, the terrestrial IMT-2000 radio interfaces comprise two high level groupings, with a small number of discrete variants representing the various combinations thereof:

[EDITOR'S NOTE: THE LIST BELOW IS AN EXAMPLE AT THIS STAGE - THE FINAL VERSION WILL REFLECT ANY AGREED INCORPORATION OF OTHER TECHNOLOGIES, E.G. TD-SCDMA, AND DISCUSSIONS WITHIN OHG.]

Radio interface #1 (title of section 5.1)

Radio interface #2 (title of section 5.2)

Radio interface #3 (title of section 5.3)

Radio interface #x (title of section 5.x)

The terrestrial radio interfaces are described in detail in Section 5.

Recommendation ITU-R M.[RKEY] lists the key characteristics of six radio interfaces for the satellite component of IMT-2000. As highlighted in that Recommendation, due to the constraints on satellite system design and deployment, several satellite radio interfaces will be required for IMT-2000 (see Recommendation ITU-R M.1167 for further considerations).

A satellite system is severely resource limited (e.g., power and spectrum limited), its radio interfaces are therefore specified primarily based on a whole system optimisation process, driven by the market needs and business objectives. It is generally not technically feasible or viable from a business point-of-view to have a radio interface common to satellite and terrestrial IMT-2000 components. Nevertheless, it is desirable to achieve as much commonality as possible with the terrestrial component when designing and developing a satellite system.

The strong dependency between technical design and business objectives of an IMT-2000 satellite system requires a large scope of flexibility in the satellite radio interface specifications. Future modifications and updates of these specifications may nevertheless be needed in order to adapt to changes in market demands, business objectives, technology developments, and operational needs, as well as to maximise the commonality with IMT-2000 terrestrial systems as appropriate.

The satellite radio interfaces are described in detail in Section 6.

4.1.2 Terrestrial component

[Editor's note: this section should contained general introduction to the terrestrial part, to be developed by TG 8/1: considerations related to terrestrial component, RKEY related introduction].

4.1.3 Satellite component

The terrestrial and satellite components are complementary, with the terrestrial component providing coverage over areas of land mass with population density considered to be large enough for economic provision of terrestrially based systems, and the satellite component providing service elsewhere by a virtually global coverage. The ubiquitous coverage of IMT-2000 can only therefore be realised using a combination of satellite and terrestrial radio interfaces. Since a satellite radio interface will provide this global coverage, international use is ensured, subject of course, to various regulatory processes in each country.

To fulfil the scope given in Section 2, this Recommendation describes those elements needed for worldwide compatibility of operation noting that international use is inherently ensured through the global coverage of a satellite system. This description includes consideration of all the satellite component interfaces.

Figure 4.1, which has been developed from Figure 1 of Recommendation ITU-R M.818, shows the various interfaces in the IMT-2000 satellite component here.

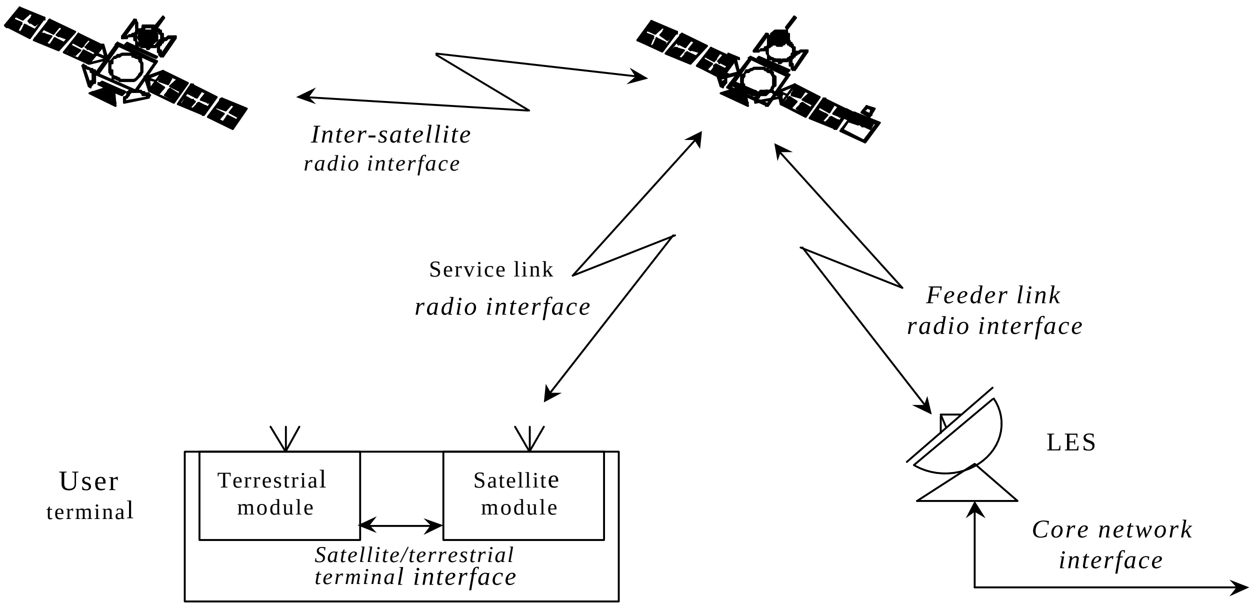

FIGURE 4.1

Interfaces in the satellite component of IMT-2000
N.B. This figure is based on Figure 1 of Recommendation ITU-R M.818

4.1.3.1 Radio Interfaces

4.1.3.1.1 Service link interface

The service link interface is the radio interface between mobile earth stations and satellite stations.

4.1.3.1.2 Feeder link interface

The feeder link interface is the radio interface between satellite stations and land earth stations. Feeder links are analogous to the radio interfaces used on “back-haul” fixed links to carry traffic to/from terrestrial base stations. When designing a satellite system, system specific implementations for feeder links result since:

i) feeder links will operate in a number of frequency bands which are outside the bands identified for IMT-2000;

ii) each individual feeder link presents its own issues, some of which are related to satellite system parameters, while others are related to frequency bands of operations.

The feeder link radio interface is therefore largely an intra-system specification, and can be viewed as an implementation issue, which has been addressed in Recommendation ITU-R M.1167 stating that “the radio interfaces between the satellites and the LESs (i.e. the feeder links) are not subject to IMT-2000 standardisation”.

4.1.3.1.3 Inter-satellite link interface

The inter-satellite link interface is the interface between different satellite stations of the same system, noting that some systems may not implement this interface. The issues discussed above under feeder link interface are also applicable here, and the specification of this interface is therefore outside the scope of this Recommendation.

4.1.3.2 Other Interfaces

It is recognised that the core network and satellite/terrestrial terminal interfaces described below are not radio interfaces. However, it is also recognised that they have a direct impact on the design and specification of satellite radio interfaces and on the worldwide compatibility of operation. Other IMT-2000 Recommendations also make reference to these interfaces.

4.1.3.2.1 Core Network Interface

The core network interface is the interface between land earth stations and terrestrial networks. Recommendation ITU-R M.1167 indicates that “the IMT-2000 satellite component interfaces with other networks in the same way as the IMT-2000 terrestrial component”.

4.1.3.2.2 Satellite/Terrestrial Terminal Interface

The satellite/terrestrial terminal interface is the interface between the satellite and terrestrial modules within a user terminal. For terminals incorporating both the satellite and terrestrial components of IMT-2000, there is a requirement to identify both how the two components operate together and any interfacing necessary between them.

For example, Recommendation ITU-R M.818 highlights “that a protocol be developed to establish whether a terrestrial or satellite component should be used for a given call”. Recommendation ITU-R M.1167 also recognises that “an IMT-2000 user should not necessarily need to request the terminal to access the satellite or the terrestrial component” and also that “in order to facilitate roaming, it is important that the user can be reached by dialling a single number, regardless of whether the mobile terminal is accessing the terrestrial or the satellite component at the time”.

4.2 Incorporation of Externally Developed Material

[Editor’s Note: this section contains information on the development process of IMT.RSPC. The inclusion of this section in IMT.RSPC is considered relevant since it will inform the reader on the issues discussed during the development of the Recommendation; therefore it will provide a rationale for the overall IMT.RSPC structure. This section is considered relevant for any reader; also SG 8 will benefit from this section. If felt appropriate, this section can be removed from the Recommendation]

[Editor’s Note: the text in italic in the following may be revisited based on the responses from SDOs and PPs to the liaison statement from TG8/1 on the issues addressed in this section]

[Editor’s Note: For satellite component, some text will be developed if necessary].

4.2.1 Description of the approach used for the development of IMT.RSPC

[Editor’s Note: the content of this section was agreed but the text could be editorially reworded in a form more suitable for a Recommendation]

USE OF REFERENCES

It was decided in ITU-R [TG8/1] that neither the extreme of “all references” nor the extreme of “100% new or incorporated text” is an appropriate approach to complete RPSC within the established deadline. It has also been decided that significant use of references of externally developed specifications is the most appropriate solution.

The following conditions apply with respect to the inclusion of references to documents of other organizations in this Recommendation:

a) the other organization owner of the document:
   - is a recognized and qualified body (e.g., accredited standardization organization);
   - agreed to the use of the reference and to make the document and its revisions available to ITU membership[2] (a written statement should be obtained by the BR Secretariat in this regard before the Recommendation is formally approved);

b) the document referred to in the Recommendation:
   - is a finalized and approved document by the owner organization;
   - is clearly identified (type, title, number, version, date, degree of stability, etc.);
   - has any IPR issue related to it clearly identified.

RADIO INTERFACE SPECIFICATION SECTIONS OF RSPC (SECTIONS 5.X)

TG 8/1 has decided that having the Radio Interface Sections as complete individual sections is the most appropriate presentation of the radio interface specification to ensure completeness.

RELATIONSHIP OF MATERIAL DEVELOPED BY ITU-R [TG8/1] AND EXTERNAL ORGANISATIONS

It has been decided [by TG 8/1] that the information contained in the radio interface section of RSPC (Sections 5.X) will have three parts: “Reference From External Material” part, “Extract From External Material” part and “ITU Created Material” part.

For the “Reference From External Material” portion of Section 5.X, using material included by referencing, it has been decided [within TG 8/1] that ITU-R [TG 8/1] should adopt the structure of the detailed specifications coming from external Standards Development Organisations (SDOs) and 3rd Generation Partnership Projects (3GPPs) and should not attempt to unilaterally edit this material.

For the “Extract From External Material” portion of Section 5.X, using extracted or incorporated material, it has been concluded that specifying the format and structure of this portion is appropriate and does not present a burden on the responding organizations to supply their inputs in accord with the [TG8/1] established criteria.

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[2] A full copy of the document and its revisions is to be made available to the ITU-R Secretariat.

The issues addressed include:

4.2.2 Approval of IMT.RSPC

The RSPC Recommendation is an ITU Recommendation even though the content of RSPC includes material that has been developed external to the ITU and included into RSPC either by direct incorporation or through the use of referencing of content. The approval of the “complete” Recommendation (incorporating ITU-R created material, incorporation of externally developed material, and the content included by use of external references) will follow the usual course of ITU-R Recommendation procedure. Change authority is addressed in Section 4.2.5.

4.2.3 Overview of Copyright and Licensing Aspects, including ownership

Copyright and licensing procedures have been established as follows:

– *The “Complete” RSPC Recommendation Itself*

The ITU has a combination of owned and assigned rights to copy, distribute, and sell to its members in the usual way. SDOs etc have assigned appropriate rights (not necessarily exclusive) to the ITU-R to copy, distribute and sell. The “complete” RSPC Recommendation (incorporating ITU-R-created material, incorporation of externally developed material, and the content included by use of external referencing) is made available to ITU members through the ITU itself.

– *The “ITU-R Created Material” Part*

The document contains ITU-R created material of which the ITU-R therefore owns the copyright. ITU-R can copy, distribute or sell as it may wish, and can if necessary assign similar rights to other entities.

– *The “Extract From External Material” Part*

The document contains directly incorporated externally generated material, for which the source SDO owns the copyright, and has assigned appropriate rights to the ITU-R to copy, distribute and sell.

– *The “Reference From External Material” Part*

The document contains some reference from external material for which the source SDO owns the copyright, and has assigned appropriate rights to the ITU-R to copy, distribute and sell; and which the SDO have agreed to make available to ITU members who are purchasing the Recommendation.

4.2.4 Maintenance of the RSPC Recommendation, including frequency of updates, version control and approval procedures

The ITU-R is responsible for maintenance of its Recommendations including all of RSPC. Relevant external organisations are requested to provide the ITU with periodic updates of their radio interface specifications as they relate to RSPC. The process for maintaining the RSPC after approval by ITU-R is dependent upon communication between the ITU-R and the appropriate 3GPPs and SDOs. It is recommended that the external organisations notify the ITU of updates to their specifications in a timely manner. Conversely the ITU should notify the external organisations of pertinent schedules within the ITU to ensure co-ordination with approval cycles of the ITU-R parties having ongoing responsibility for IMT-2000 Recommendations.

Initially, it is believed that annual maintenance update interval should be followed for RSPC. It is recognised that updates to each radio interface specification will be occurring independently, however updates of RSPC should be done as a single combined update by the ITU-R endeavouring *to accommodate as well as possible the varying schedules among the external organisations. It is suggested that co-ordination by the external organisations among themselves on this issue be done to ensure uniformity of updates.*

Timing of the first update release of RSPC should be negotiated between the ITU and the external organisations. It is suggested that the first update be released by the ITU-R no later than January 2001. Development of an on-going update schedule and procedure should ideally be worked out prior to final approval of RSPC within ITU-R. The lack of such a process on maintenance in place prior to final approvals of RSPC within the ITU-R should not delay such approval or release of RSPC, however it is urged that the maintenance process negotiations be addressed as a matter of urgency and concluded prior to the final approval timeline within the ITU-R.

4.2.5 Change authority

It should be noted that the content of RSPC being included in the "extract from external material" part and the "reference from external material" part is essentially "controlled" by the relevant external organisations but is an essential part of RSPC which is "controlled" by the ITU-R. A mechanism was defined, whereby through mutual agreement, certain portions of these two parts are edited and/or modified under request of the ITU-R (particularly during the completion and approval portion of the process) or by request by the relevant external organisations. Such a mechanism is appropriate for management of on going change authority for RSPC.

4.2.6 Publication and Distribution Aspects

Consistent with the outcomes of copyright, ownership, licensing, change authority and the maintenance process, the ITU and relevant external organization should mutually develop processes and mechanisms to ensure that publication and distribution of RSPC, and the related external materials is flexible enough to support a range of purchasing option. This range may include just the purchase of RSPC text (without the referenced material) or may extend through to a "one stop shopping" concept for purchase of not only RSPC text but also the materials that are incorporated equivalently by reference. Further purchase options may be to obtain either a particular "radio interface section" or getting all included "radio interface sections"

Investigation of electronic means such as "hyperlinks" may help ensure that references to external material are current and may be useful in the maintenance/update process and should be investigated.

4.2.7 Other comments relevant to the development of IMT.RSPC

[Editor's Note: this section is a place-holder for additional issues to be addressed here]

[Editor's Note: in the following, two separate sections are foreseen for the recommendations of the terrestrial and the satellite component respectively; this may be revisited when the material from SWG 5-4 will be available]

5 Recommendations (Terrestrial Component)[3]

The ITU Radio communication Assembly recommends that the radio interfaces given in Sections 5.1 to 5.[N] should be those of the terrestrial component of IMT-2000. The description given in sections 5.1.3, 5.2.3, , , , and 5.N.3 is recommended as the complete definition of the radio interfaces of the terrestrial component of IMT-2000.

Unwanted emission limits are identified in Section 7. These may be generic or specific to particular technologies. (See Documents 8-1/347, 8-1/348.)

[Editor’s Note: the sections below are examples at this stage - the final version will reflect any agreed incorporation of other technologies.]

5.1 Radio Interface No-1

5.1.1 Introduction

[Editor’s Note:

– *This section corresponds to the “Original part (10%)”.*

– *This subsection 5.1 corresponds to materials supplied by CWTS, i.e. Doc. 8-1/407 for TD-SCDMA.*

– *TG 8/1 will develop this part based on future contributions.*

– *Terminology : ITU-R M.1224]*

The TD-SCDMA radio interface is defined by a set of CWTS standards, the following sub-section list only those TD-SCDMA standards, dealing with lower layers of the IMT-2000 air interface.

5.1.2 Overview of the Radio Interface

[Editor’s Note:

This section gives summary information of the radio interface. The complete definition of the radio interface is given in Section 5.1.3.

– *This section corresponds to the “Extracted part (20%)”.*

– *This section should have the structure and style defined by Annex-1 of Doc. 8-1/TEMP/213.*

– *This section should include the Summary of Major Technical Parameters Table shown in the format defined by Annex-1 of Doc. 8-1/TEMP/213.*

– *TG 8/1 requests SDOs to develop this part using the style guide defined above.*

– *Terminology : SDO’s terminology*

– *Input material : 8-1/407]*

Based on smart antenna, synchronous CDMA and other new technologies, the TD-SCDMA technology is one of the most advanced Radio Transmission Technology (RTT). This section will describe the main features of TD-SCDMA, and the RTT of TD-SCDMA.

[3] ***Editor’s Note: The current version intends to show the base line structure of this section. Each sub-section for detailed specification shall be revised further.***

SYNCHRONOUS CDMA:

The spreading sequences of multiple EUs CDMA signals are synchronized at the Node B. This feature is important in a CDMA system to guarantee the orthogonality property of the spreading codes and to virtually remove the co-channel interference from other code channels.

SMART ANTENNA SYSTEM:

A smart antenna system is formed by an array of multiple antennas and cohenrate transceivers and advanced digital signal processing algorithms. Instead of having a single fixed beam pattern from a traditional antenna, the smart antenna can effectively generate multiple beam patterns, each of which is pointed toward a particular EU. Such beam patterns can also adapt to follow any mobile EU. On the receive side, such a feature, i.e., spatially selective receive, can greatly increase the receive sensitivity, minimize the co-channel interference from co-channel EUs at different locations leading to higher capacity. It can also effectively incorporate multipath components to combat multipath fading. On the transmit side, intelligent spatial selective beamforming transmit can reduce the interference to other co-channel EUs and leading to higher capacity and dramatically reduce the output power requirement.

SOFTWARE RADIO:

Software radio is a technology of realizing radio functions by digital signal processing (DSP) software. In the TD-SCDMA system, many functions traditionally implemented by RF or baseband analog circuits or ASICs are realized by state-of-the-art DSP algorithms. These functions include intelligent RF beamforming, on-board RF calibration, carrier recovery, and timing adjustment. The main advantages of the software radio include but not limited to: (1) it is flexible and programmable instead of hard wired; (2) it is repeatable and precise; (3) it never ages nor is it sensitive to environments; (4) it can implements sophisticated functions without requiring expensive hardware; (5) it can be low cost following the trend of forthcoming inexpensive powerful digital signal processors (DSPs).

BATON HANDOVER:

Based on the position information of all active UE, which is obtained by smart antenna and uplink synchronization technology, the handover procedure will be much precise and efficiency. The baton handover may combined with hard- and soft-handover, and operate between the Node B in the same system or between systems.

5.1.2.1 General description of Layer 1

5.1.2.1.1 Multiple Access

The access scheme is Direct-Sequence Code Division Multiple Access (DS-CDMA) with information spread over approximately 1.6 MHz bandwidth in TDD (Time Division Duplex) for operating with unpaired bands respectively. TDD mode is defined as follows:

TDD:A duplex method whereby forward link and reverse link transmissions are carried over same radio frequency by using synchronised time intervals. In the TDD, time slots in a physical channel are divided into transmission and reception part. Information on forward link and reverse link are transmitted reciprocally.

In TD-SCDMA, there is TDMA component in the multiple access in addition to DS-CDMA. Thus the multiple access has been also often denoted as TDMA/CDMA due added TDMA nature.

The carrier separation is 1.6 MHz depending on the deployment scenario with 200 kHz carrier raster. A 10 ms radio frame is divided into 2*10 0.472 ms time slots. A physical channel is therefore defined as a code (or number of codes) and additionally in TDD mode the sequence of 0.472 ms time slots completes the definition of a physical channel. TD-SCDMA uses the 72-frame superframe structure. The resulting longer frame duration is under discussion (hyperframe, etc.)

The information rate of the channel varies with the symbol rate being derived from the 1.3542 Mchips/s chiprate and the spreading factor is from 1 to 16 for TDD uplink and downlink. Thus the respective modulation symbol rates vary from 1.3542 Msymbols/s to 422 symbols/s for TDD.

Furthermore, relaying between nodes can be used by means of Opportunity Driven Multiple Access (ODMA) in TDD mode.

5.1.2.1.2 Coding and interleaving

For the channel coding in TD-SCDMA two options are supported:

- Convolutional coding, either 1/2 rate or 1/3 rate for packet data and services requiring quality level 10-3 or lower over the physical layer with forward error correction (FEC).
- Turbo coding, for the services requiring higher than 10-3 quality level.

<Editor’s note: Turbo coding method is under refinement >

5.1.2.1.3 Modulation and spreading

The modulation scheme is QPSK with root raised cosine pulse shaping with roll-of factor 0.22.

With CDMA nature the spreading (& scrambling) process is closely associated with modulation. In TD-SCDMA, different families of spreading codes are used to spread the signal:

- For separating channels from same source, channelisation codes are used.
- For separating different base station the following solutions are supported:
  - a) Gold codes in downlink Pilot, or
  - b) Scrambling codes with the length 16 used as defined in 105.
- For separating different mobiles the following code families are defined:
  - a) Codes with period of 16 chips and midamble sequences of 144 chips length.
  - b) Gold codes in uplink pilot.

5.1.2.1.4 Transmission and reception

The TD-SCDMA frequency bands assumed for operation are:

1) Unpaired spectrum at 1 900-1 920 MHz and at 2 010-2 025 MHz
for TDD mode operation, and used for both Node B and UE transmission;
(1 895-1 918.1 MHz band is occupied by PHS in Japan. 1 850-1 990 MHz band is occupied by PCS 1900 in U.S. 1 900-1 920 MHz band is occupied by PHS and DECT in China.)

2) Another proposed unpaired spectrum at 1 785-1 805 MHz for TDD mode operation.

Several power classes are being defined currently.

5.1.2.1.5 Physical layer procedures

There are several physical layer procedures involved in TD-SCDMA operation. Such a procedures covered by physical layer description are:

1) The power control, with both closed loop and open loop power control;
2) Handover measurements for handover within TD-SCDMA mode;
3) The measurement procedures for preparation for handover to GSM900/GSM1800;
4) The measurement procedures for preparation for handover to other TDD/FDD mode;
5) Random access processing;
6) Dynamic Channel Allocation (DCA) with TDD mode operation;
7) ODMA specific procedures such as probing;
8) Uplink synchronization;
9) Beamforming for both uplink and downlink (Smart antenna).

TABLE 5.1.2-1

Summary of Major Technical Parameters (RF Front-end)

The definition of the parameter is identical to “Description” of the key characteristic listed in the Draft New Recommendation ITU-R M.[IMT.RKEY].

Name of Parameter		**List of proposed values**	
		Mobile Station Value	**Base Station Value**
	Transmitter characteristics		
	Transmit power		
1.1	Power classes	The maximum power levels are expected to be (1.9GHz Band): Class I: 28dBm <EIRP < 33dBm Class II: 23dBm <EIRP < 30dBm Class III: 18dBm <EIRP < 27dBm Class IV: 13dBm <EIRP < 24dBm Class V: 8dBm <EIRP < 21dBm	The maximum power level is subject to constraints from regulatory agencies and based on the product design.
1.2	Dynamic range	The value depends on terminal power class and may be up to 80 dB.	30 dB

Name of Parameter		List of proposed values	
		Mobile Station Value	**Base Station Value**
	Transmitter characteristics		
	Transmit power		
1.3	Power Control Steps	1.0 dB nominal	3.0 dB nominal
1.4	Frequency stability	0.1 ppm (locked to the system)	0.05 ppm
	Output RF spectrum emissions		
1.5	3 dB Bandwidth	1.36MHz	1.36MHz
1.6	Adjacent Channel Leakage power ratio	ACPR=30dBc Next ACPR=40dBc	ACPR=35dBc Next ACPR=45dBc
1.7	Out of band and Spurious emissions	Requirements will be based on applicable tables from ITU-R Recommendations SM.329 and from the ERC Recommendations that are currently under progress. Other regulatory bodies will also have recommendations to this requirement. 30 dBc in adjacent channel 40 dBc in alternate channel 50 dBc in second alternate channel -36 dBm in 30 kHz offset 1.8MHz -36dBm /1kHz (9kHz<f<150kHz) -36dBm /10kHz (150kHz<f<30MHz) -36dBm/100kHz (30MHz<f<1GHz) -30dBm/1MHz (1GHz<f<(fc-20)MHz) -30dBm/1MHz ((fc+20)MHz <f<11GHz) Notes NB: Necessary Bandwidth (1.6MHz) Fc: Center frequency of carrier	Requirements will be based on applicable tables from ITU-R Recommendations SM.329 and from the ERC Recommendations that are currently under progress. Other regulatory bodies will also have recommendations to this requirement. 35 dBc in adjacent channel 45 dBc in alternate channel 55 dBc in second alternate channel -36 dBm in 30 kHz offset 1.8MHz -36dBm /1kHz (9kHz<f<150kHz) -36dBm /10kHz (150kHz<f<30MHz) -36dBm/100kHz (30MHz<f<1GHz) -30dBm/1MHz (1GHz<f<(fc-20)MHz) -30dBm/1MHz ((fc+20)MHz <f<11GHz) Notes NB: Necessary Bandwidth (1.6MHz) Fc: Center frequency of carrier
1.8	Transmit linearity requirements	Linear transmitters required Linearity: 3 dB backoff with QPSK	Linear transmitters required Linearity: 5 dB backoff with QPSK
1.9	Standby RF output power	-47 dBm /1MHz in frequency band (f<1GHz) -40 dBm/1MHz in frequency band (f>1GHz)	-47 dBm /1MHz in frequency band (f<1GHz) -40 dBm/1MHz in frequency band (f>1GHz)
	Receiver characteristics		
2.1	Reference sensitivity	Based on NF ≤ 7dB -105dBm for 9.6kbps measurement channel	Based on NF ≤ 6dB -110dBm for 9.6kbps measurement channel.
2.2	Receiver dynamic range	The maximum value 80 dB	≥30dB

Name of Parameter		List of proposed values	
		Mobile Station Value	**Base Station Value**
	Transmitter characteristics		
	Transmit power		
2.3	Intermodulation sensitivity	Linear receivers required; the 3 rd Order intercept point will be specified between -10 dBm and -15 dBm.	Linear receivers required; the 3 rd Order intercept point will be specified between 5 dBm and 10 dBm.
2.4	Spurious response and Blocking	In-band: -44dBm (over 15MHz offset) Out of band:-30dBm (2025-2070MHz and 2210-2225MHz)-15dBm (other frequency)	In-band: -40dBm (over 15MHz offset) Out of band:-30dBm (2025-2070MHz and 2210-2225MHz)-15dBm (other frequency)
2.5	Adjacent channel selectivity	The exact specifications are yet to be defined.	The exact specifications are yet to be defined.
	Other characteristics		
3.1	Diversity techniques	Time diversity: symbol interleaving, error coding and correction and multiple time slots receiver. Space diversity (optional MS antenna diversity) Code diversity Frequency diversity	Time diversity: symbol interleaving, error coding and correction and multiple time slots receiver. Space diversity (smart antenna) Code diversity Frequency diversity (Multi-carrier for 1.36Mcps)
3.2	Smart antennas	Not required, but accommodated	Supported both in the up- and down link beamforming through pilots.
3.3	Minimum operating bandwidth	TDD: 1900-1920, 2010-2025 MHz. Deployment of TDD in the 1920-1980 MHz band is an open item. Operating bandwidth: 1.6 MHz . 5 MHz	TDD: 1900-1920, 2010-2025 MHz. Deployment of TDD in the 1920-1980 MHz band is an open item. Operating bandwidth: 1.6 MHz . 5 MHz

TABLE 5.1.2-2

Summary of Major Technical Parameters (Baseband)

The definition of the parameter is identical to “Description” of the key characteristic listed in the Draft New Recommendation ITU-R M.[IMT.RKEY].

#	Names of the Parameter	Values
1	**Multiple access technique**	TD/CD/SDMA
2	**Chip rate**	1.3542 Mcps
3	**Frame structure**	*Number of time slots in a frame:* 10/ subframe subframe length: 5ms Frame Length:10 ms
4	**Variable length spreading factor**	1-16

#	Names of the Parameter	Values
5	**Inter base station asynchronous/ synchronous operation**	synchronous
6	**Inter-user synchronization**	used
7	**Handover**	· Hard handover · Inter- and intra-system handover (including between 2G and 3G) · Baton handover
8	**Channel coding and interleaving**	**Coding**: Convolutional code Turbo code **Interleaving**: Intra-frame MIL (10 ms) Inter-frame interleaving (20/40/80 ms)
9	**Random access**	· Packet Random Access channel · Preamble + Message
10	**Modulation (up-link and down-link)**	**Data modulation** UL and DL - QPSK, **Spreading modulation** UL and DL - QPSK,
11	**Channelization code (up-link and down-link)**	· Walsh code · Type of code: Real OVSF Code length: 1-16 chips (1 symbol)
12	**Scrambling code (up-link and down-link)**	Tbd
13	**Pilot structure**	· Time-multiplex dedicated pilot time slot
14	**Detection (up-link and down-link)**	· Detection: Coherent · Joint detection
15	**Power control (up-link and down-link)**	· Closed loop (dedicated channels) · Open loop (random-access channel)
16	**Variable data rate (up-link and down-link)**	Supported
17	**Diversity**	· Time diversity · Frequency diversity · Space diversity (smart antenna) · Code diversity · Antenna diversity with MRC · Multi-carrier transmission diversity (optional) · Selective transmit diversity or parallel trasnmit diversity for TDD mode · Handover diversity
18	**Adaptive equalizer**	Used
19	**Dynamic Channel Allocation**	Supported
20	**Duplexing Scheme**	TDD
21	**Multicarrier**	Not required but can be used in BS

5.1.3 Detail Specification of the Radio Interface

[Editor’s note:

– *This section corresponds to the “Reference part (70%)”.*

– *This section should include all references to ensure worldwide compatibility.*

– *Description style of this section should be based on Annex-1 of Doc. 8-1/TEMP/213.*

– *TG 8/1 requests SDOs to review and update this part.*

– *Terminology : SDO's terminology which should also be referenced in this part*

– *Input material : 8-1/406 (CWTS)*

]

5.1.3.1 Detailed Specifications

The most recent versions of the TD-SCDMA series of draft specifications as developed within the CWTS WG1. Some of them were approved or endorsed during the WG1#2 meeting.

Detailed specifications can be found at *http://www.CWTS.org*.

The specification for a TD-SCDMA mobile system shall be organized as 6 series as follows:

00x series: General description of the radio interface protocol architecture and the functions;

10x series: Physical layer specifications;

20x series: Layer 2 signaling;

30x series: Layer 3 signaling;

40x series: RF specifications for both BTS and UE;

50x series: Conformance testing.

5.1.3.2 Documentation list

001 RADIO INTERFACE PROTOCOL ARCHITECTURE

The present document shall provide an overview description of the TD-SCDMA radio interface protocol architecture.

002 SERVICES PROVIDED BY THE PHYSICAL LAYER

The present document is a technical specification of the services provided by the physical layer to upper layers.

003 UE FUNCTIONS AND INTERLAYER PROCEDURES IN CONNECTED MODE

This document defines the UE States and the principal tasks undertaken by the UE when in connected mode. It includes informative interlayer procedures for the UE to perform the required tasks.

This document attempts to provide a comprehensive overview of the different states and transitions within the connected mode of a TD-SCDMA terminal. The applicable set of states for a given service may be a subset of the total set of possible states.

In addition to describing the states and related transitions, this document describes all procedures that assign, reconfigure and release radio resources. Included are, e.g., procedures for transitions between different states and substates, handovers and measurement reports. The emphasis is on showing the combined usage of both peer-to-peer messages and interlayer primitives to illustrate the functional split between the layers, as well as the combination of elementary procedures for selected examples.

004 UE PROCEDURES IN IDLE MODE

The present document shall describe the overall idle mode processes for the UE and the functional division between the non-access stratum and access stratum in the UE. The UE is in idle mode when the connection of the UE is closed on all layers, e.g., there is neither a MM connection nor an RRC connection.

This document also presents examples of interlayer procedures related to the idle mode processes, and describes idle mode functionality of a dual mode TD-SCDMA/GSM UE.

101 PHYSICAL LAYER – GENERAL DESCRIPTION

This specification describes the documents being produced by CWTS and first complete versions expected to be available by end of 1999. This specification gives also general description of the physical layer of the TD-SCDMA air interface.

102 USER EQUIPMENT PHYSICAL LAYER CAPABILITIES

This specification describes the physical layer capabilities of the UE.

103 PHYSICAL CHANNELS AND MAPPING OF TRANSPORT CHANNELS ONTO PHYSICAL CHANNELS

This specification describes the characteristics of the Layer 1 transport channels and physical channels in the TD-SCDMA mode of CWTS. The main objectives of the document are to be a part of the full description of the TD-SCDMA Layer 1, and to serve as a basis for the drafting of the actual technical specification (TS).

104 MULTIPLEXING AND CHANNEL CODING

This specification describes the documents being produced by the CWTS and first complete versions expected to be available by end of 1999. This specification describes the characteristics of the Layer 1 multiplexing and channel coding in the TD-SCDMA mode of CWTS.

105 SPREADING AND MODULATION

The present document describes spreading and modulation for the TD-SCDMA mode of CWTS.

106 PHYSICAL LAYER PROCEDURES DESCRIPTION

This document specifies and establishes the characteristics of the physicals layer procedures in the TD-SCDMA mode of CWTS.

107 PHYSICAL LAYER - MEASUREMENTS

This document describes the measurements done at the UE and network in order to support operation in idle mode and connected mode.

As far as the measurements in idle mode are concerned, this TS described the following:

– measurements for the cell selection for a UE supporting TD-SCDMA;

– measurements for cell reselection for a UE camping on an TD-SCDMA cell.

As far as the measurements in connected mode are concerned, this TS describes measurements when the UE is connected to a TDD cell for the cell connected state. This TS provides the minimum requirements for the UE and networks. Some explanatory text is also contained in the TS but it is more of a descriptive nature than normative.

As far as the measurements for the handover preparation, this specification defines the requirements to the UE and network, as well as parametrisation rules for the compressed mode in order to accommodate idle periods.

201 MEDIUM ACCESS CONTROL (MAC) PROTOCOL SPECIFICATION

The scope of this description is the specification of the MAC protocol.

The following lists the contents for the specification of the MAC protocol:

1. list of procedures
2. logical flow diagrams for normal procedures
3. logical description of message
4. principles for error handling
5. some exceptional procedures which are felt criteria
6. It should, as far as possible, have the same format and outline as the final specification
7. exact message format
8. all scenarios

401 UE RADIO TRANSMISSION AND RECEPTION

This document establishes the minimum RF characteristics of the TD-SCDMA mode of CWTS for the User Equipment (UE).

402 BTS RADIO TRANSMISSION AND RECEPTION

This document establishes the minimum RF characteristics of TD-SCDMA mode of CWTS for the BTS.

403 RF PARAMETERS IN SUPPORT OF RADIO RESOURCE MANAGEMENT

This Technical Specification shall describe RF parameters and Requirements for the Radio Resource Management.

404 UE AND BTS EMC

This Technical Specification shall describe RF EMC parameters and Requirements for both UE and BTS in TD-SCDMA mode of CWTS.

501 BTS CONFORMANCE TESTING

502 UE CONFORMANCE TESTING

Both these specifications describe the documents being produced by the CWTS and first complete versions expected to be available by first half of 2000.

5.2 Radio Interface No 2

5.2.1 Introduction

[Editor's Note:

– *This section corresponds to the "Original part (10%)".*

– *This subsection 5.2 corresponds to materials supplied by ETSI, i.e. Docs. 8-1/341, 8-1/342, and 8-1/343 for EP DECT.*

– *TG 8/1 will develop this part based on future contributions.*

– *Terminology : ITU-R M.1224]*

[NOTE – General introduction to the DECT radio interface and its characteristics, to be developed by TG 8/1. Subsequent sub-sections to be developed by external SDOs and ETSI EP DECT.]

The Digital Enhanced Cordless Telecommunications (DECT) Radio Interface is defined by a set of ETSI standards. A high level description of the DECT features and how the ETSI standards for DECT interrelate to the different applications can be found in the ETSI Technical Report TR 101 178 “A high level guide to the DECT standardization”.

The following sub-sections list only those DECT standards, which are relevant for this ITU-R recommendation, dealing with the lower layers of the IMT-2000 air interface.

5.2.2 Overview of the Radio Interface

The Digital Enhanced Cordless Telecommunications (DECT) Radio Interface is defined by a set of ETSI standards. A high level description of the DECT features and how the ETSI standards for DECT interrelate to the different applications can be found in the ETSI Technical Report TR 101 178 “A high level guide to the DECT standardization”.

DECT is a general radio access technology for wireless telecommunications. It is a high capacity digital technology, for wide cell radii ranging from a few meters to several kilometres, depending on application and environment. It provides telephony quality voice services, and a broad range of data services, including Integrated Services Digital Network (ISDN) and packet data. It can be effectively implemented in a range from simple residential cordless telephones up to large systems providing a wide range of telecommunications services, including Fixed Wireless Access (FWA).

5.2.2.1 General access technology

DECT provides a comprehensive set of protocols which provide the flexibility to interwork between numerous different applications and networks. Thus a local and/or public network is not part of the DECT specification. Figure 1 illustrates this.

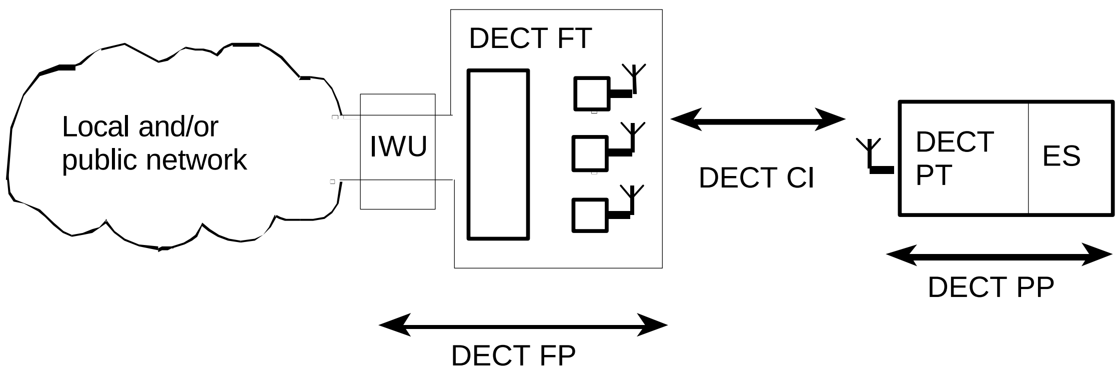


FIGURE 1

The DECT Common Interface (CI)

DECT covers, in principle, only the air interface between the DECT Fixed Part (FP) and Portable Part (PP). The Interworking Unit (IWU) between a network and the DECT Fixed radio Termination (FT) is network specific and is not part of the DECT CI specification. Similarly, the End System (ES), the application(s) in a DECT PP is also excluded. The IWU and end system are only specified as regards general end-to-end compatibility requirements e.g. on speech transmission. The IWU and ES are also subject to general attachment requirements for the relevant public network, e.g. the PSTN/ISDN.

NOTE – An ES depends on the application supported in a PP. For a speech telephony application the ES may be a microphone, speaker, keyboard and display. The ES could equally well be a serial computer port, a fax machine or whatever the application requires.

For each specific network, local or global, the specific services and features of that network are made available via the DECT air interface to the users of DECT PPs/handsets. Except for cordless capability and mobility, DECT does not offer a specific service; it is transparent to the services provided by the connected network. Thus the DECT CI standard is, and has to be, a tool box with protocols and messages from which a selection is made to access any specific network, and to provide means for market success for simple residential systems as well as for much more complex systems e.g. office ISDN services.

The detailed requirements that have governed the DECT standardisation efforts are provided by the ETR 043, “DECT Common Interface Services and Facilities Requirements Specification”, where one requirement is flexibility for additions and evolutionary applications. The DECT CI standard has a layered structure and is contained in EN 300 175, Parts 1 to 8. It contains a complete set of requirements, procedures and messages. The messages also contain codes that are reserved for evolutionary applications and proprietary extensions. The DECT authentication algorithm and the DECT encryption algorithm are not part of the CI standard, but are obtained from ETSI through a special legal procedure. The administration of global unique DECT identity codes for manufacturing, installation and public operation are also handled by ETSI.

5.2.2.2 Summary of the DECT physical layer

The tasks of the physical layer can be grouped into five categories:

a) to modulate and demodulate radio carriers with a bit stream of a defined rate to create a radio frequency channel;

b) to acquire and maintain bit and slot synchronization between transmitters and receivers;

c) to transmit or receive a defined number of bits at a requested time and on a particular frequency;

d) to add and remove the synchronization field and the Z-field used for rear end collision detection;

e) to observe the radio environment to report signal strengths.

5.2.2.2.1 The physical channels

For the radio access frequency channels as well as a time structure are defined. The carrier spacing is 1.728 MHz. To access the medium in time, a regular TDMA structure with a frame length of 10 ms is used. Within this frame 24 full-slots are created, each consisting of two half-slots. A double slot has a length of two full slots, and starts concurrently with an even numbered full slot.

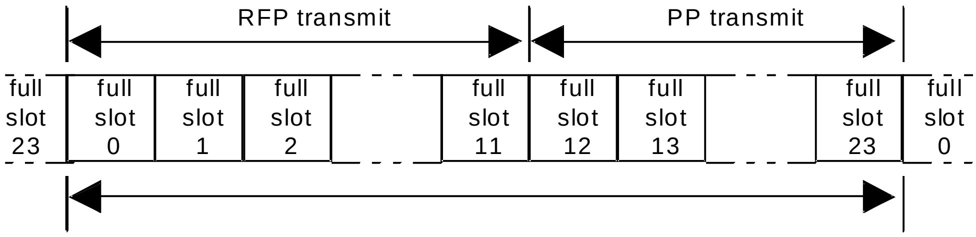


FIGURE 2

Full slot format

Data is transmitted within the frequency, time, and space dimensions using physical packets. Physical packets shall be of one of the following four types:

– short physical packet P00 (D-field contains 64 bits);

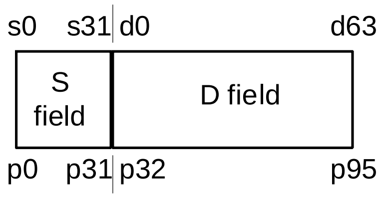


FIGURE 3

P00 packet

– basic physical packet P32 (the D-field contains 388 bits);

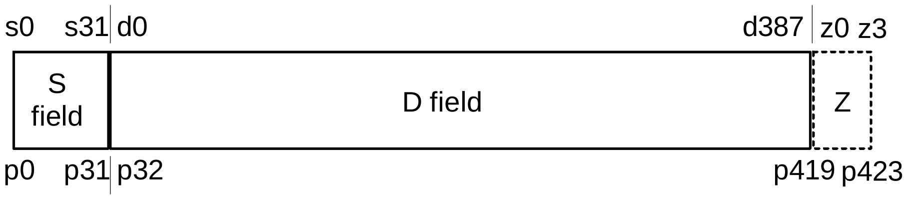


FIGURE 4

Packet P32

– low capacity physical packet P08 (the D-field contains 148 bits);

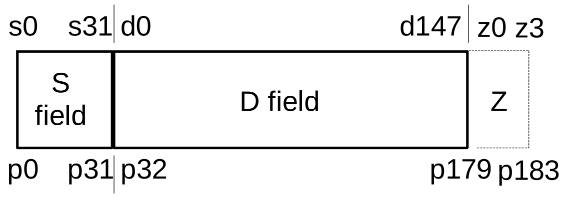


FIGURE 5

Packet P08

– high capacity physical packet P80 (the D-field contains 868 bits).

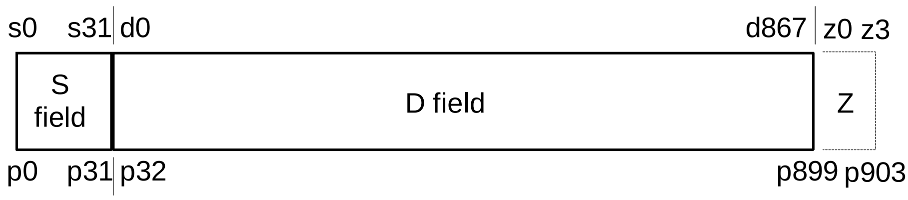


FIGURE 6

Packet P80

Each physical packet contains a synchronization field S and a data field D. The packets P80, P32 and P08 may contain an optional collision detection field, Z.

The synchronization field S may be used by the receiver for clock and packet synchronization of the radio link. The first 16 bits are a preamble, and the last 16 bits are the packet synchronization word. A prolonged preamble field which extends the preamble bit pattern by 16 bits is optional. This prolonged preamble field may be used by a receiver for implementation of an antenna selection diversity algorithm.

5.2.2.2.2 The RF carrier modulation

The modulation method is either Gaussian Frequency Shift Keying, (GFSK), with a bandwidth-bit period product of nominally 0,5 or 'Differential Phase Shift Keying' (DPSK). Equipment is allowed to use 4- level and/or 8- level modulation in addition to 2-level modulation. This will increase the bit rate of single radio DECT equipment by a factor 2 or 3, which allows for 2 Mbit/s services. For example, the asymmetric double-slot service with modulation configuration 3 will provide up to 2.640 Mbit/s B-field data rate. The 4-level modulation shall be π/4-DQPSK and the 8-level modulation π/8-D8PSK. It is only allowed to use 4-level and/or 8-level modulation in the B+Z or the A+B+Z fields, whereby the S+A or the S field respectively shall use the π/2-DBPSK 2-level modulation. The allowed combinations of modulation schemes are defined in the table below.

TABLE 1

Allowed combinations of modulation schemes

Configuration	S -field	A-field	B+Z-field
1a	GFSK	GFSK	GFSK
1b	π/2-DBPSK	π/2-DBPSK	π/2-DBPSK
2	π/2-DBPSK	π/2-DBPSK	π/4-DQPSK
3	π/2-DBPSK	π/2-DBPSK	π/8-D8PSK
4a	π/2-DBPSK	π/4-DQPSK	π/4-DQPSK
4b	π/2-DBPSK	π/8-D8PSK	π/8-D8PSK

Schemes 2 and 3 ensure that equipment with basic 2-level modulation, and equipment with a higher rate option, can efficiently share a common base station infrastructure. The GFSK modulation can be detected for instance in a non-coherent π/2-DPSK receiver, and the π/2-DPSK modulation can be detected in a GFSK receiver. Therefore all A-field information including broadcast system information, paging and call control can be received independently of whether configuration 1, 2 or 3 is used.

5.2.2.3 Summary of the DECT Medium Access Control (MAC) layer

The MAC layer offers three groups of services to the upper layers and to the management entity:

– broadcast message control (BMC);

– connectionless message control (CMC);

– multi-bearer control (MBC).

The BMC provides a set of continuous point-to-multipoint connectionless services. These are used to carry internal logical channels, and are also offered to the higher layers. These services operate in the direction FT to PT, and are available to all PTs within range.

The CMC provides connectionless point-to-point or point-to-multipoint services to the higher layers. These services may operate in both directions between one specific FT and one or more PTs.

Each instance of MBC provides one of a set of connection oriented point-to-point services to the higher layers. An MBC service may use more than one bearer to provide a single service.

Four types of MAC bearer are defined:

1) Simplex bearer: a simplex bearer is created by allocating one physical channel for transmissions in one direction.

2) Duplex bearer: a duplex bearer is created by a pair of simplex bearers, operating in opposite directions on two physical channels.

3) Double simplex: a double simplex bearer is created by a pair of long simplex bearers operating in the same direction on two physical channels.

4) Double duplex bearer: a double duplex bearer is composed by a pair of duplex bearers referring to the same MAC connection.

A bearer can exist in one of three operational states:

1) Dummy bearer: where there are normally continuous transmissions (i.e. one transmission in every frame).

2) Traffic bearer: where there are continuous point-to-point transmissions. A traffic bearer is a duplex bearer or a double simplex bearer or a double duplex bearer.

3) Connectionless bearer: where there are discontinuous transmissions. A connectionless bearer is either a simplex or a duplex bearer.

The MAC layer defines a logical structure for the physical channels. The user bit rate depends on the selected slot-type, modulation scheme, level of protection and number of slots. The table below gives the user bit-rates for unprotected single slot operation.

TABLE 2

Bit-rates for single slot operation

	2-level modulation	**4-level modulation**	**8-level modulation**
Half slot	8 kbit/s	16 kbit/s	24 kbit/s
Full slot	32 kbit/s	64 kbit/s	96 kbit/s
Double slot	80 kbit/s	160 kbit/s	240 kbit/s

5.2.2.4 Summary of the DECT data link control layer

The DLC layer contains two independent planes of protocol, the C-plane and the U-plane. The C-plane is the control plane of the DECT protocol stacks. The U-plane is the user plane of the DECT protocol stacks.

5.2.2.4.1 C-Plane services

The C-plane data link service is provided by two protocol entities called LAPC and Lc. These two protocol entities separate the link access protocol functions from the lower link control functions. The upper LAPC entity uses a protocol derived from the ISDN LAPD protocol. The lower Lc entity buffers and fragments complete LAPC frames (LAPC protocol data units) to/from the MAC layer.

The Lb entity provides a broadcast service in the direction FP to PP. It operates on simple fixed length frames and uses the dedicated MAC layer broadcast service.

5.2.2.4.2 U-Plane services

The U-plane services are all optional, in the sense that each service corresponds to a particular requirement, and for any given application only selected services may be implemented. Each U-plane service is divided into two entities, an upper (LUx) entity and a lower (FBx) entity. The upper (LUx) entity contains all of the service dependent functions, and therefore defines the majority of the procedures. The lower (FBx) entity buffers and fragments the complete U-plane frames (LUx protocol data units) to/from the MAC layer. The following family members have been defined:

LU1: Transparent Unprotected service (TRUP);

LU2: Frame Relay service (FREL);

LU3: Frame Switching service (FSWI);

LU4: Forward Error Correction service (FEC);

LU5: Basic Rate Adaption service (BRAT);

LU6: Secondary Rate adaption service (SRAT);

LU7: 64 kbit/s data bearer service with ARQ mechanism;

LU8: 64 kbit/s data bearer service without ARQ mechanism;

LU9: Unprotected Rate Adaption for V series Equipment (RAVE) service;

LU10: Enhanced Data service;

LU11: 64 kbit/s data bearer service when A and B field are both modulated at 4 level;

LU12 to LU15: Reserved for standard family member;

LU16: Escape for non-standard family (ESC).

5.2.2.5 Summary of the DECT network layer

The DECT NWK layer (layer 3) protocol contains the following groups of functions:

Link Control Entity (LCE): The establishment, operation and release of a C-plane link between the fixed termination and every active portable termination.

Call Control (CC) entity: The establishment, maintenance and release of circuit switched calls.

Call Independent Supplementary Services (CISS) entity: The support of call independent supplementary services.

Connection Oriented Message Service (COMS) entity: The support of connection-oriented messages.

Connectionless Message Service (CLMS) entity: The support of connectionless messages.

Mobility Management (MM) entity: The management of identities, authentication, location updating, on-air subscription and key allocation.

In addition all of these C-plane entities interface to the Lower Layer Management Entity (LLME). This provides co-ordination of the operations between different NWK layer entities and also between the NWK layer and the lower layers.

5.2.2.6 Summary of the DECT identities and addressing

FP identities are used to inform PPs about the identity of a DECT FP and the access rights to that DECT FP and thereby reduce the number of access attempts from unauthorized portables. A DECT FP broadcasts this information. A PP needs to be able to interpret necessary parts of this broadcast information to detect the access rights to a system or even access rights agreements between system operators, i.e. operators A and B have a bilateral agreement permitting their users to roam between their systems. These agreements can change and cannot therefore be stored in PPs without updating them frequently. Therefore the FP handles access rights information which is embedded in the identity structure. The DECT identity structure provides solutions for residential, public and private environments. This can also be extended to combinations between these environments, e.g. private groups of users within a public DECT network, and e.g. public users access to private DECT networks.

PP identities have two main purposes, first to enable a PP to select a valid DECT FP and second to uniquely identify the PP within that DECT FP. For these purposes there are two identities defined. These identities are the PARK, and the IPUI.

Connection related identities are associated with the peer-to-peer communication in DECT. That means that every layer-to-layer connection has an identity. These identities serve the purpose of hand shake, protection against co-channel interference, avoiding loss of a connection during bearer and connection handover, etc.

5.2.2.7 Summary of the DECT security features

Two basic security services are specified, which are authentication and encryption. The authentication is used to verify the provided identity. There are four forms defined, which are portable authentication, fixed part authentication, mutual authentication and user authentication. Encryption is used to obtain confidentiality of the data which is transmitted over the air.

5.2.2.8 Coexistence of uncoordinated installations on a common frequency band

The mandatory Instant Dynamic Channel Selection messages and procedures provide effective coexistence of uncoordinated private and public systems on the common designated DECT frequency band and avoids any need for traditional frequency planning. Each device has access to all channels (time/frequency combinations). When a connection is needed, the channel is selected, that at that instant and at that locality, is least interfered of all the common access channels. This avoids any need for traditional frequency planning, and greatly simplifies the installations. This procedure also provides higher and higher capacity by closer and closer base station installation, while maintaining a high radio link quality. Not needing to split the frequency resource between different services or users gives a very efficient use of the allocated spectrum. There is a large spectrum efficiency gain in sharing spectrum between applications and between operators.

Much unique knowledge and experience is available in the DECT community on the subject of sharing spectrum between uncoordinated installations. Information on this subject has been collected in an ETSI Technical Report, TR 101 310, which describes configurations for typical DECT applications and relevant mixes of these, including residential, office, public and RLL applications, and the traffic capacity is analysed, mainly by advanced simulations.

5.2.2.9 Access to different systems by the same PP

Each DECT system, FP, has a broadcasted globally unique Access Rights Identity, ARI. To each ARI are linked the available services, the related protocols and when required e.g. a cipher-key and/or authentication-key. For each service suitable protocols have been selected from the CI tool box to efficiently provide these services.

Similarly each DECT PP (handset) has one or more Portable Access Rights Keys, PARKs. One PARK relates to one FP or a group of FPs belonging to the same operator. To each PARK are linked the corresponding FP ARIs, related services and protocols, and when required e.g. a ciphering-key and/or authentication-key.

Thus the same PP will have access several different types of systems, if equipped with the relevant PARKs and associated protocols. Thus, it is basically not a common protocol for all systems that provide inter system roaming, but it is that the PP is equipped with access rights and related protocols to the wanted systems. A detailed description of the flexible and powerful DECT identity provisions are found in part 6 of the DECT CI standard.

5.2.2.10 Access to several applications through the same base station

DECT also provides the means for sharing base stations or systems between different operators or applications, e.g. hosting private user groups in a large public system, Providing public access through a privately owned system, or hosting public access to several service providers in one system owned by one of the service providers.

5.2.2.11 Summary of DECT technical parameters

TABLE 3

Summary of major technical parameters

Technical parameter	Value	Reference
Multiple access technique	TDMA	EN 300 175-2 4.2
Duplexing Scheme	TDD	EN 300 175-2 4.2
Frame Length	10 ms	EN 300 175-2 4.2
Number of time slots in a frame	12 double slots 24 full slots 48 half slots	EN 300 175-2 4.2
Modulation	GFSK, pi/2 DBPSK, pi/4 DQPSK, pi/8 D8PSK	EN 300 175-2 5.4, Annex D
RF bit rate	1 152 kbit/s for 2-level modulation 2 304 kbit/s for 4-level modulation 3 456 kbit/s for 8-level modulation	EN 300 175-2 4.2, Annex D
Channel spacing	1 728 kHz	EN 300 175-2 4.1
Transmit power	Peak power Level 1: 2,5 mW (4 dBm) Level 2: 250 mW (24 dBm)	EN 300 175-2 5.3
Frequency stability	For the portable part the centre frequency accuracy shall be within ± 50 kHz at extreme conditions either relative to an absolute frequency reference or relative to the received carrier, except during the first one second after the transition from the idle-locked state to the active-locked state the centre frequency accuracy shall be within ± 100 kHz at extreme conditions relative to the received carrier. At an RFP the transmitted RF carrier frequency corresponding to RF channel c shall be in the range Fc ± 50 kHz at extreme conditions. The maximum rate of change of the centre frequency at both the RFP and the PP while transmitting, shall not exceed 15 kHz per slot.	EN 300 175-2 4.1

Adjacent Channel Leakage power ratio	1. channel: 160 mW 2. channel: 1 mW 3. channel: 40 nW >3. channel: 20 nW	EN 300 175-2 5.5
Out of band and Spurious emissions	The peak power level of any RF emissions outside the radio frequency band allocated to DECT, when a radio end point has an allocated physical channel, shall not exceed 250 nW at frequencies below 1 GHz and 1 mW at frequencies above 1 GHz. The power shall be defined in the bandwidths given in the table below. If a radio end point has more than one transceiver, any out of band transmitter intermodulation products shall also be within these limits. Frequency offset, fo from edge of band — Measurement bandwidth 0 MHz £ fo < 2 MHz — 30 kHz 2 MHz £ fo < 5 MHz — 30 kHz 5 MHz £ fo < 10 MHz — 100 kHz 10 MHz £ fo < 20 MHz — 300 kHz 20 MHz £ fo < 30 MHz — 1 MHz 30 MHz £ fo < 12,75 GHz — 3 MHz	EN 300 175-2 5.5
Transmit linearity requirements	The power level of intermodulation products that are on any DECT physical channel when any combination of the transmitters at a radio end point are in calls on the same slot on different frequencies shall be less than 1 mW. The power level is defined by integration over the 1 MHz centred on the nominal centre frequency of the afflicted channel and averaged over the time period.	EN 300 175-2 5.5
Reference sensitivity	-86 dBm with 1.152 Mbit/s. Sensitivity is measured at 10E-3 raw BER.	EN 300 175-2 6.2
Intermodulation sensitivity	The level of the interfering signals is -47 dBm, wanted signal is -80 dBm and 10E-3 raw BER.	EN 300 175-2 6.6

Spurious response and Blocking	With the desired signal set at -80 dBm, the BER shall be maintained below 0,001 in the presence of any one of the signals shown in the table below. F_L and F_U are the lower and the upper edges of the allocated frequency band. Frequency — interferer level for radiated measure-ments (dBµV/m) — interferer level for conducted measure-ments (dBm) 25 MHz < f < F_L –100 MHz 120 -23 F_L -100 MHz <f<F_L -5 MHz 110 -33 /f-Fc/ > 6 MHz 100 -43 F_U +5 MHz <f<F_U +100 MHz 110 -33 F_U +100 MHz <f<12,75 GHz 120 -23	EN 300 175-2 6.5
Adjacent channel selectivity	With a received signal strength of -73 dBm (i.e. 70 dBµV/m) on RF channel M, the BER in the D-field shall be maintained better than 0,001 when a modulated, reference DECT interferer of the indicated strength is introduced on the DECT RF channels shown below Interferer on RF channel Y — Interferer signal strength dBµV/m — dBm Y=M 60 -83 Y=M±1 83 -60 Y=M±2 104 -39 Y=any other channel 110 -33	EN 300 175-2 6.4
Handover	Seamless handover, mobile controlled, triggered when an other base station becomes stronger.	EN 300 175-3, 7.2.5 & 10.6 EN 300 175-4, 9.2 & 10.5 EN 300 175-5, 15.7
Random access	Instant dynamic channel selection for every set-up using the least interfered channel measured at the mobile	EN 300 175-3, 11.4
Pilot structure	Broadcast system information available on each active down link, at least one down link is active on every base station.	EN 300 175-3, 7.2 & 11.1
Dynamic Channel Allocation	Supported	EN 300 175-3, 11.4

5.2.3 Detail Specification of the Radio Interface

[Editor's note:

- *This section corresponds to the "Reference part (70%)".*
- *This section should include all references to ensure worldwide compatibility.*
- *Description style of this section should be based on Annex-1 of Doc. 8-1/TEMP/213.*
- *TG 8/1 requests SDOs to review and update this part.*
- *Terminology : SDO's terminology which should also be referenced in this part*
- *Input material : 341, 342, 343 (DECT)]*

The following sub-sections list only those DECT standards, which are relevant for this ITU-R recommendation, dealing with the lower layers of the IMT-2000 air interface.

5.2.3.1 Physical Layer

The ETSI standard EN 300 175 - 2 "DECT Common Interface Part 2: Physical Layer" specifies the physical channel arrangements. DECT physical channels are radio communication paths between two radio end points. A radio end point is either part of the fixed infrastructure or a Portable Part (PP), typically a handset. The assignment of one or more particular physical channels to a call is the task of higher layers.

The Physical Layer (PHL) interfaces with the Medium Access Control (MAC) layer, and with the Lower Layer Management Entity (LLME). On the other side of the PHL is the radio transmission medium which has to be shared extensively with other DECT users and a wide variety of other radio services. The tasks of the PHL can be grouped into five categories:

a) to modulate and demodulate radio carriers with a bit stream of a defined rate to create a radio frequency channel;

b) to acquire and maintain bit and slot synchronization between transmitters and receivers;

c) to transmit or receive a defined number of bits at a requested time and on a particular frequency;

d) to add and remove the synchronization field and the Z-field used for rear end collision detection;

e) to observe the radio environment to report signal strengths.

5.2.3.2 MAC Layer

The ETSI standard EN 300 175 - 3 "DECT Common Interface Part 3: Medium Access Control Layer" specifies the layer 2a of the DECT protocol stack.

It specifies three groups of MAC services:

- the broadcast message control service;
- the connectionless message control service; and
- the multi-bearer control service.

It also specifies the logical channels that are used by the above mentioned services, and how they are multiplexed and mapped into the Service Data Units (SDUs) that are exchanged with the Physical Layer (PHL).

5.2.3.3 Conformance Requirements

The ETSI standard EN 300 176 - 1 “DECT Approval test specification, Part1: Radio” specifies radio tests for DECT equipment. It covers testing of radio frequency parameters, security elements and those DECT protocols that facilitate the radio frequency tests and efficient use of frequency spectrum. The aims of this document are to ensure efficient use of frequency spectrum, that no harm done to other radio networks and services and that no harm done to other DECT equipment or its services.

5.3 Radio interface No. 3

5.3.1 Introduction

[Editor’s Note:

– *This section corresponds to the “Original part (10%)”.*

– *This subsection 5-3 corresponds to materials supplied by TIA TR45.3, i.e. Docs. 8-1/376, and 8-1/414.*

– *TG 8/1 will develop this part based on future contributions.*

– *Terminology : ITU-R M.122]*

A complete set of specifications is being developed for the UWC-136 radio interface. This standards specification is to be contained in TIA/EIA-136.

[TIA TR-45.3 believes that the complete radio interface from L3 Radio Resource and Mobility Management to physical layer should be handled in TG8/1.]

5.3.2 Overview of the UWC-136 Radio Interface

The “Universal Wireless Communications 136” (UWC-136) Radio Interface was designed to provide a TIA/EIA-136 (designated as 136) based Radio Transmission Technology that meets ITU-R’s requirements for IMT-2000. UWC-136 maintains the TDMA community’s philosophy of evolution from 1st to 3rd generation systems while addressing the specific desires and goals of the TDMA community for a 3rd generation system.

UWC-136 is an attractive and powerful evolutionary step for 136. The technology presented provides for future IMTS services to existing operators, as well as providing new operators competitive features, services and technology. Additionally, the technology provides these same features and services in other bands around the world where regulatory approval has been granted to offer such services.

UWC-136 uses a three component strategy for evolving the 136 technology towards 3rd generation. The strategy consists of enhancing the voice and data capabilities of the 30 kHz channels (designated as 136+), adding a 200 kHz carrier component for high speed data (384 kbit/s) accommodating high mobility (designated as 136HS Outdoor), and adding a 1.6 MHz carrier component for very high speed data (2 Mbit/s) in low mobility applications (designated as 136HS Indoor). The combined result constitutes the IMT-2000 Radio Interface referred to as UWC-136.

The 136HS Outdoor and Indoor components were developed to satisfy the requirements for an IMT-2000 Radio Transmission Technology, with the additional requirement for the consideration of commercially effective evolution and deployment in current 136 networks. Such considerations include flexible spectrum allocation, spectrum efficiency, compatibility with 136 and 136+, and support of macrocellular performance at higher mobile speeds.

5.3.2.1 Services

UWC-136 builds on the mature and powerful TIA/EIA-136 standard, which has evolved over many years. Thus, all TIA/EIA-136 services are included, and UWC-136 adds the capabilities of 384 kbit/s, and 2 Mbit/s high speed data. UWC-136, through TIA/EIA-136, supports signalling for both full-rate (3 users/30 kHz) and half-rate (6 users/30 kHz) services.

Voice Services

Three full-rate voice coders are presently defined: VSELP, ACELP, and US1. Enhancements to voice services entail a more robust full-rate voice service using DQPSK modulation, and a low delay and improved tandeming codec for wireless office applications using 8-PSK modulation. An additional slot format for DQPSK results in a link budget improvement of 4 dB in robustness for ACELP.

For 8-PSK a new slot format was defined not only for US1, but also to prepare for 6 users per RF carrier. RF carriers support both DQPSK and 8-PSK modulation formats so that mobiles supporting either modulation can exist on the same carrier to maximize trunking efficiency.

Voice services are supported with robust error correction coding and link quality improvement techniques such as per slot power control. Enhanced reporting mechanisms for Frame Error Rate, real-time C/I, and BER are also defined to aid in RF system engineering.

Data Services

UWC-136 supports a scalable packet data service having data rates from 11.2 kbit/s to greater than 2 Mbit/s. This packet data service is referred to as GPRS-136 since it uses the higher layer protocols of GPRS. GPRS-136 provides GPRS upper layer support across all three bearers: 136+, 136HS Outdoor, and 136HS Indoor. GPRS-136 integrates packet switched services with existing circuit switched services while maintaining TIA/EIA-136 capabilities. A Mobile Station in operation on the packet network may automatically move to the circuit network to place and receive calls, then return to the packet network upon completion of a circuit call. Mobile Stations in operation on the packet network are also able to support services such as Short Message Service (SMS) and message waiting indications.

The user can access two forms of data network: X.25 and Internet Protocol (IP) based. For IP based networks the user may have dynamic or static IP allocation. Differing Quality of Service requirements are supported for any data session and multiple simultaneous data sessions are supported. Only the user’s subscription and system engineering limit the number of data sessions that are open for a user. The general approach of GPRS-136 data model is to overlay the circuit switched network nodes with packet data network nodes for service provisioning, registration, mobility management, and accounting. Interworking is provided between the circuit switched and packet data networks for mobiles capable of both services. GPRS-136 allows a user engaged in an active data transfer to suspend/resume operation should they wish to make or receive a circuit call.

Ancillary Services

UWC-136 offers a host of services some of which are: short messaging, message waiting indication, calling name indication, extended standby time via “sleep mode”, wireless office (private systems), circuit switched data, over-the-air-activation, over-the-air programming, encryption, broadcast teleservice transport, general UDP transport, and authentication.

5.3.2.2 Layer 1

The basic premise of UWC-136 operation is spectrum on demand. The amount of spectrum allocated at a given time is a function of the service mix that is required. It allows for incremental channels to be allocated and de-allocated as required. The bandwidth associated with each service is tailored to that service. By aggressively managing the spectrum, UWC-136 allows for high spectral efficiency performance and supports underlay cells which can “steal” spectrum from the overlay network to provide even more capacity in a given geographical region.

The 136+ bearer supports both voice and data service on a 30 kHz RF channel. Two modulation types are supported: π/4-DQPSK and 8-PSK at a common channel symbol rate of 24.3 kSymbols/s. Channels are spaced 30 kHz apart, center to center. Both the voice and data services can operate on either modulation to allow for service differentiation and channel robustness.

The 136HS Outdoor bearer uses a 200 kHz RF carrier to enable the deployment of the high speed outdoor data services. Two modulations are supported: GMSK and 8-PSK at a common channel symbol rate of 270.833 kSymbols/s. The channel coding and modulation can be varied to provide an optimal adaptation of throughput versus channel robustness. Channels are spaced 200 kHz apart, center to center.

Finally, the 136HS Indoor bearer uses a 1.6 MHz RF carrier to enable the deployment of high-speed indoor data services at greater than 2 Mbit/s. Two modulations are supported: B-O-QAM and Q-O-QAM at a common channel symbol rate of 2.6 MSymbols/s. The channel modulation can be varied to provide an optimal adaptation of throughput versus channel robustness. Channels are spaced 1 600 kHz apart, center to center. 136HS Indoor has the additional feature that it can be operated in a TDD mode if desired.

5.3.2.3 Layer 2

Layer 2 provides two different types of functionalities: those to support circuit based operation and those that support packet based operation.

Circuit

In UWC-136 the modulated/encoded voice is carried over the Digital Traffic Channel (DTC). The connection of the traffic channel is supervised using the Coded Digital Verification Color Code (CDVCC) on Layer 2. The Mobile Station (MS) decodes the CDVCC (either explicitly or implicitly) received from the Base Station in every DTC time slot, and compares it with the color code received from the original connection messages or the hand-off message (DVCCs). The MS transmits the coded DVCCs to the Base Station in each burst. The DTC also contains Fast and Slow Associated Control Channels (FACCH and SACCH) which carry control and supervising messages.

Layer 2 of the Digital Control Channel (DCCH) services requests from and provides indications to Layer 3. On the MS side, Layer 2 services the Layer 3 Reverse DCCH (RDCCH) Request Primitive to initiate a mobile station access attempt on the Random Access Channel (RACH) which is controlled by Layer 2. Layer 2 then performs Random or Reserve access procedures, and decoding of the Shared Channel Feedback (SCF) status information. Layer 2 issues a Forward DCCH (FDCCH) Indication Primitive to Layer 3 when the MS receives a complete layer 3 message broadcast or addressed on various FDCCH channels.

On the Base Station side, Layer 2 services the Layer 3 F-BCCH, E-BCCH, S-BCCH, and SPACH Request Primitives containing the Layer 3 messages to be sent to the MS. Layer 2 issues an RDCCH Indication Primitive to deliver to Layer 3 messages received from the MS.

Various Layer 2 protocols can be used to carry RDCCH and FDCCH information in support of layer 3 messages such as Frame Segmentation and Re-assembly, and Automatic Retransmission Request (ARQ) mode of operation. Other functions of the DCCH layer 2 are: Message Concatenation of layer 3 Messages, MSID Management, Header Formatting, and Monitoring Radio Link Quality (MRLQ).

Packet

The overall function Layer 2 provides is to realize radio bearers for Layer 3, taking into consideration the requested QoS objectives. Layer 2 is structured into Logical Link Control (LLC), Radio Link Control (RLC), and Medium Access Control (MAC), (RLC and MAC may be combined into one function referred to as MAC).

The LLC is independent of the radio interface. The LLC provides acknowledged or unacknowledged data transfer.

Three separate MAC entities are included in a single Layer 2 MAC, one entity to support each type of bearer: 136+ bearer, 136HS Outdoor bearer and 136HS Indoor bearer. The main task of the MAC is to dynamically multiplex the radio resource so that the RF resources can be efficiently utilized among multiple users with minimal packet collisions. The MAC supports both an unacknowledged and an acknowledged mode. In acknowledged mode, the MAC is responsible for sequenced delivery of packets to the higher layers, and an error recovery method using a sliding window automatic repeat request is utilized. The MAC also supports transactions with different priorities, and provides quality of service (QoS) information with four levels of priority. UWC-136 also supports several unique design features such as implicit addressing and active mobile identity management which provide link quality robustness, and resource efficiency.

The reason why RLC and MAC are considered as belonging to the same sub-layer is that both entities have direct access to the physical layer and the LLC sub-layer. Furthermore, the LLC protocol does not depend on the radio interface, whereas the RLC/MAC protocol is radio specific.

5.3.2.4 Layer 3

Layer 3 provides two different types of mobility and resource management functionalities: those to support circuit based operation (136 Mobility and Resource Management) and those that support packet based operation (GPRS-136 Mobility and Resource Management).

136 Mobility Management and Radio Resource Management entities at Layer 3 provide UWC-136 circuit switched services. Layer 3 procedures (known as Intelligent Roaming) are defined to provide the user access to the optimum circuit switched service provider. Once the initial control channel selection has been accomplished, cell reselection and handoff algorithms provide continuity of service. The cell reselection algorithms include several trigger conditions and selection criteria to provide versatile management capability.

The GSM based GPRS mobility management function and the 136 mobility management function, operating in parallel, comprise the GPRS-136 Mobility Manager. The GPRS mobility management function provides packet data mobility management, while the 136 mobility management function provides circuit switched service mobility management. Together they ensure that the network knows the current location of Mobile Stations.

The GPRS-136 Radio Resource Management (RRM) entity is similar to the Digital Control Channel Procedures that control voice resources in UWC-136. The main task of the RRM is to dynamically allocate the radio resource among the bearers so that the RF resources can be efficiently utilized among multiple users. Procedures are defined which will spread the load across multiple packet channels in a given cell. Techniques are outlined that allow for rapid finding of packet resources. Continuity of service is supported via cell reselection as a mobile traverses multiple cells. The GPRS-136 Radio Resource Management (RRM) supports all three packet data bearers defined in UWC-136.

In addition to the Management functions Layer 3 provides other capabilities. Layer 3 Message construction rules provides backwards compatibility so that a Mobile Station or Base Station can process a message to the extent it understands it. This capability also allows new functions to be easily added for extensibility.

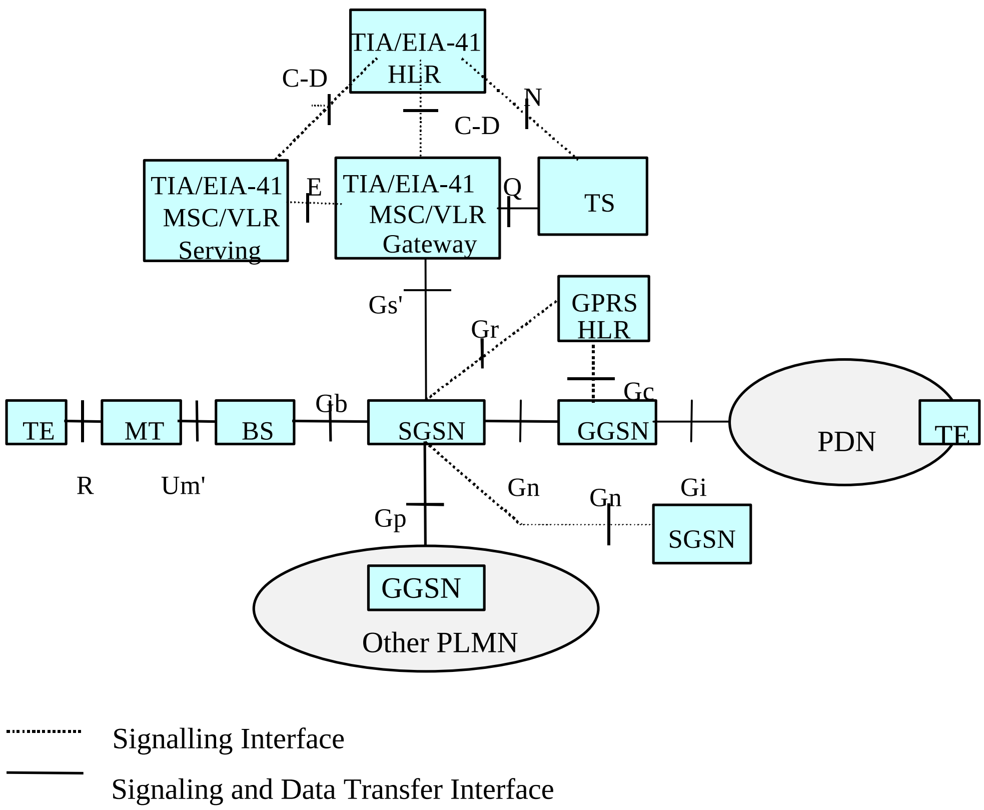
Layer 3 provides a generic R-DATA transport that can function in point-to-point or broadcast mode. This R-DATA transport can carry various Teleservice messages without regard to the exact using entity. This generic capability allows various value added services such as Short Message Services and Over-the-Air programming to be defined or added to using the common transport.

5.3.2.5 Network

A UWC-136 System is realized by uniquely combining a TIA/EIA-136 TDMA Radio Interface with a combined TIA/EIA-41 circuit switched and GPRS packet switched Network. The figure below presents the network elements and the associated reference points that comprise a UWC-136 System. The primary TIA/EIA-41 network node visible to the SGSN is the Gateway MSC/VLR. The interface between the TIA/EIA-41 Gateway MSC/VLR and the SGSN is the Gs’ interface, which allows the tunnelling of TIA/EIA-136 signalling messages between the Mobile Station and the Gateway MSC/VLR. The tunnelling of these signalling messages is performed transparently through the SGSN. Between the Mobile Station and the SGSN, the signalling messages are transported using the Tunnelling of Messages (TOM) protocol layer. TOM uses the LLC unacknowledged mode procedures to transport the signalling messages. Between the SGSN and the Gateway MSC/VLR the messages are transported using the BSSAP+ protocol.

Upon receiving a TIA/EIA-136 signalling message from a Mobile Station via the TOM protocol, the SGSN forwards the message to the appropriate Gateway MSC/VLR using the BSSAP+ protocol. Upon receiving a TIA/EIA-136 signalling message from a Gateway MSC/VLR via the BSSAP+ protocol, the SGSN forwards the message to the indicated Mobile Station using the TOM protocol.

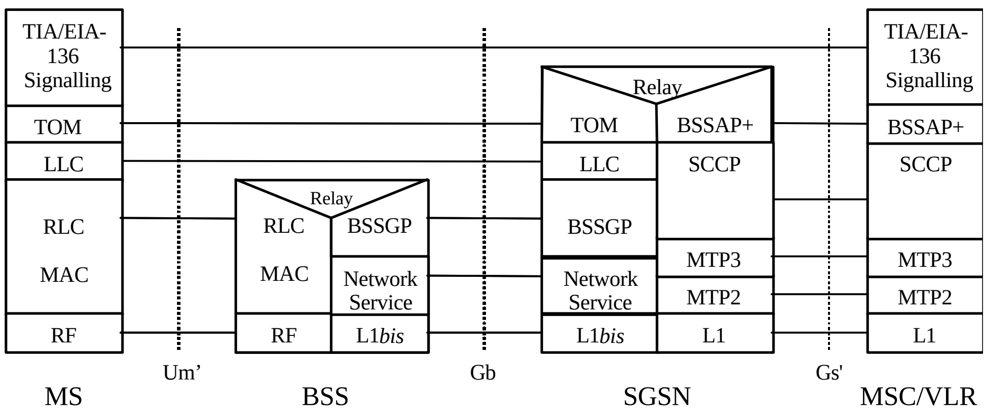
Mobile Stations supporting both circuit and packet services (Class B136 Mobile Stations) perform location updates with the circuit system by tunnelling the Registration message to the Gateway MSC/VLR. When an incoming call arrives for a given Mobile Station, the Gateway MSC/VLR associated with the latest Registration pages the Mobile Station through the SGSN. The page can be a Hard Page (no Layer 3 information including in the message), in which case, the Gs’ interface paging procedures are used by the MSC/VLR and the SGSN. If the circuit page is not for a voice call or, if additional parameters are associated with the page, a Layer 3 Page message is tunnelled to the Mobile Station by the MSC/VLR. Upon receiving a page, the Mobile Station suspends the packet data session and leaves the packet data channel for a suitable Digital Control Channel (DCCH). Broadcast information is provided on the packet control channel to assist the Mobile Station with a list of candidate DCCHs. Once on a DCCH, the Mobile Station sends a Page Response. The remaining call setup procedures, such as traffic channel designation , proceed as in a normal page response situation.



NOTE – For simplicity, not all network elements of a UWC-136 system are shown.

A Primed interface (e.g. Gs') indicates an ETSI GPRS interface that has been modified specifically for GPRS-136.

The signalling plane between a Mobile Station and the Gateway MSC/VLR is shown below.



5.3.2.6 Summary of Major Technical Parameters

The following Table lists the major technical parameters of the UWC-136 Radio Interface.

Parameter	Value	TIA/EIA-136 Reference
Multiple Access Technique	TDMA	TIA/EIA-136-331 TIA/EIA-136-341 TIA/EIA-136-361 TIA/EIA-136-121 TIA/EIA-136-131
Carrier Spacing: 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer	 30 kHz 200 kHz 1.6 MHz	TIA/EIA-136-110
Carrier Symbol Rate: 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer	 24.3 kSymbols/s 270.833 kSymbols/s 2.6 MSymbols/s	 TIA/EIA-136-331 TIA/EIA-136-131 TIA/EIA-136-341 TIA/EIA-136-361
Data Modulation: 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer	 π/4 DQPSK, 8-PSK GMSK, 8-PSK Binary Offset QAM, Quaternary Offset QAM	 TIA/EIA-136-331 TIA/EIA-136-131 TIA/EIA-136-341 TIA/EIA-136-361
Channel Coding: 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer	 Punctured Convolutional codes Punctured Convolutional codes Punctured Convolutional codes, Type II Hybrid ARQ	 TIA/EIA-136-332 TIA/EIA-136-131 TIA/EIA-136-310 TIA/EIA-136-320 TIA/EIA-136-341 TIA/EIA-136-361
Frame Structure: Frame Length 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer Number of Slots per Frame 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer	 40 msec 4.615 (120/26) msec 4.615 (120/26) msec 6 8 16-64	 TIA/EIA-136-331 TIA/EIA-136-121 TIA/EIA-136-131 TIA/EIA-136-341 TIA/EIA-136-361 TIA/EIA-136-331 TIA/EIA-136-341 TIA/EIA-136-361

Parameter	**Value**	**TIA/EIA-136 Reference**
Minimum Operating Bandwidth 136HS Outdoor Bearer 136HS Indoor Bearer	 2 x 600 kHz 2 x 1.6 MHz FDD 1 x 1.6 MHz TDD	TIA/EIA-136-940
Spectrum Efficiency 136+ Bearer (Voice) 136HS Outdoor Bearer 136HS Indoor Bearer	 58.8 Erl/MHz/cell (3 sectors) 0.9495 Mbit/s/MHz/cell (Ped A) 1.1760 Mbit/s/MHz/cell (Veh A50) 1.0380 Mbit/s/MHz/cell (Veh A120) 0.332 Mbit/s/MHz/cell (Indoor A)	TIA/EIA-136-940
Receiver Sensitivity 136+ Bearer 136HS Outdoor Bearer 136HS Indoor Bearer	 -103 dBm (8 km/h) @ 3% BER (DQPSK) -101 dBm (8 km/h) @ 3% BER (8-PSK) -94 dBm (Ped B) @ 10% BLER -100 dBm (Veh A120) @ 10% BLER -95 dBm (Indoor A) @ 10% BLER	 TIA/EIA-136-270/280 TIA/EIA-136-270/280 TIA/EIA-136-290 TIA/EIA-136-290 TIA/EIA-136-290
Standby RF Output Power	-117 dBm	TIA/EIA-136-290
Power Control	Per Slot and Per Carrier	TIA/EIA-136-131 TIA/EIA-136-331
Variable Data Rate	Supported with Slot aggregation and Link Adaptation	TIA/EIA-136-331 TIA/EIA-136-341 TIA/EIA-136-361
Dynamic Channel Allocation	Supported to increase Capacity	TIA/EIA-136-940
Duplexing Scheme	FDD TDD optional for 136HS Indoor	TIA/EIA-136-110 TIA/EIA-136-361
Frequency Stability	Base Station: 0.05 ppm Mobile Station:: 0.1 ppm	TIA/EIA-136-290

5.3.3 Detail Specification of the Radio Interface

[Editor's note:

– *This section corresponds to the "Reference part (70%)".*

– *This section should include all references to ensure worldwide compatibility.*

– *Description style of this section should be based on Annex-1 of Doc. 8-1/TEMP/213.*

– *TG 8/1 requests SDOs to review and update this part.*

– *Terminology : SDO's terminology which should also be referenced in this part*

– *Input material : 8-1/376, 414]*

List of Parts of TIA/EIA-136 from 136-000

Part TIA/EIA-136-000 contains a list of all the parts that make up the complete TIA/EIA-136 specification. The current list of those parts is:

- **TIA/EIA-136-000** **List of Parts**
- **TIA/EIA-136-0XX** **Miscellaneous Information**
  - TIA/EIA-136-005 Introduction, Identification and Semi-permanent Memory
  - TIA/EIA-136-010 Optional Mobile Station Facilities
  - TIA/EIA-136-020 SOC, BSMC, and Other Code Assignments
- **TIA/EIA-136-1XX** **Channels**
  - TIA/EIA-136-100 Introduction to Channels
  - TIA/EIA-136-110 RF Channel Assignments
  - TIA/EIA-136-121 Digital Control Channel Layer 1
  - TIA/EIA-136-122 Digital Control Channel Layer 2
  - TIA/EIA-136-123 Digital Control Channel Layer 3
  - TIA/EIA-136-131 Digital Traffic Channel Layer 1
  - TIA/EIA-136-132 Digital Traffic Channel Layer 2
  - TIA/EIA-136-133 Digital Traffic Channel Layer 3
  - TIA/EIA-136-140 Analog Control Channel
  - TIA/EIA-136-150 Analog Voice Channel
- **TIA/EIA-136-2XX** **Minimum Performance**
  - TIA/EIA-136-210 ACELP Minimum Performance
  - TIA/EIA-136-220 VSELP Minimum Performance
  - TIA/EIA-136-230 US1 Minimum Performance
  - TIA/EIA-136-270 Mobile Stations Minimum Performance
  - TIA/EIA-136-280 Base Stations Minimum Performance
- **TIA/EIA-136-3XX** **Data Services**
  - TIA/EIA-136-310 Radio Link Protocol-1
  - TIA/EIA-136-320 Radio Link Protocol-2
  - TIA/EIA-136-330 Packet-Data Service - Overview
  - TIA/EIA-136-331 Packet-Data Service - Physical Layer
  - TIA/EIA-136-332 Packet-Data Service - Medium Access Control
  - TIA/EIA-136-333 Packet-Data Service - Logical-Link Control
  - TIA/EIA-136-334 Packet-Data Service - Subnetwork-Dependent Convergence Protocol
  - TIA/EIA-136-335 Packet-Data Service - Radio -Resource Management
  - TIA/EIA-136-336 Packet-Data Service - Mobility Management
  - TIA/EIA-136-337 Packet-Data Service - Tunneling of Signaling Messages
  - TIA/EIA-136-340 Packet-Data Service - 136HS Outdoor Overview
  - TIA/EIA-136-341 Packet-Data Service - 136HS Outdoor Physical Layer
  - TIA/EIA-136-342 Packet-Data Service - 136HS Outdoor MAC Layer
  - TIA/EIA-136-360 Packet-Data Service - 136HS Indoor Overview
  - TIA/EIA-136-361 Packet-Data Service - 136HS Indoor Physical Layer
  - TIA/EIA-136-362 Packet-Data Service - 136HS Indoor MAC Layer
  - TIA/EIA-136-350 Data-Service Control
- **TIA/EIA-136-4XX** **Voice Coders**
  - TIA/EIA-136-410 ACELP
  - TIA/EIA-136-420 VSELP
  - TIA/EIA-136-430 US1
- **TIA/EIA-136-5XX** **Security**
  - TIA/EIA-136-510 Authentication, Encryption of Signaling Information/ User Data, and Privacy
  - TIA/EIA-136-511 Messages Subject to Encryption

- **TIA/EIA-136-6XX** **Teleservice Transport**
    - TIA/EIA-136-610 R-DATA/SMDPP Transport
    - TIA/EIA-136-620 Teleservice Segmentation and Reassembly (TSAR)
    - TIA/EIA-136-630 Broadcast Teleservice Transport
      - Broadcast Air-Interface Transport Service (BATS)
- **TIA/EIA-136-7XX** **Teleservices**
    - TIA/EIA-136-700 Introduction to Teleservices
    - TIA/EIA-136-710 Short Message Service
    - - Cellular Messaging Teleservice
    - TIA/EIA-136-720 Over-the-Air Activation Teleservice (OATS)
    - TIA/EIA-136-730 Over-the-Air Programming Teleservice (OPTS)
    - TIA/EIA-136-750 General UDP Transport Service (GUTS)
- **TIA/EIA-136-9XX** **Annexes/Appendices**
    - TIA/EIA-136-900 Introduction
    - TIA/EIA-136-905 Normative Information
    - TIA/EIA-136-910 Informative Information
    - TIA/EIA-136-932 Packet Data Service - Stage 2 Description
    - TIA/EIA-136-933 Packet Data Service - Fixed Coding MAC Textual Description

TIA/EIA-136-340, 136 HS OUTDOOR OVERVIEW

This part provides an overview of the 200 kHz 136HS Outdoor packet data service. An overview of the network reference model, base station and mobile station protocols, channel types, and options is provided.

TIA/EIA-136-341, 136 HS OUTDOOR PHYSICAL LAYER

This part provides the 200 kHz 136HS physical layer specification including slot formats, frame structure, modulation, and channel coding.

TIA/EIA-136-342, 136 HS OUTDOOR MAC LAYER

This part provides the 200 kHz 136HS packet data MAC layer specification including MAC PDUs, transaction management, error recovery, and random access control.

TIA/EIA-136-360, 136 HS INDOOR OVERVIEW

This part provides an overview of the 1.6 MHz 136HS Indoor packet data service. An overview of the network reference model, base station and mobile station protocols, channel types, and options is provided.

TIA/EIA-136-361, 136 HS INDOOR PHYSICAL LAYER

This part provides the 1.6 MHz 136HS physical layer specification including slot formats, frame structure, modulation, and channel coding.

TIA/EIA-136-362, 136 HS INDOOR MAC LAYER

This part provides the 1.6 MHz 136HS packet data MAC layer specification including MAC PDUs, transaction management, error recovery, and random access control.

5.4 Radio interface No.4

5.4.1 Introduction

[Editor's Note:

– *This section corresponds to the "Original part (10%)".*

– *This subsection 5-4 corresponds to materials supplied by SDOs related to 3GPP, i.e. Doc. 8-1/372 (Annex).*

– *TG 8/1 will develop this part based on input contributions.*

– *Terminology : ITU-R M.1224]*

Within the 3GPP partnership project 3GPP TSG RAN is developing the Universal Terrestrial Radio Access Network (UTRAN), with a complete set of Specifications for the Radio Access Network. This set of specification includes signalling protocols between nodes located at the network side as well as signalling over the radio interface. The sets of specifications should be relevant for ITU-R [TG 8/1] since they describe the physical layers up to the radio resource management layer which are seen as radio technology dependent parts.

This description of the 3GPP radio interface includes parts of the "physical layer - general description" and "Radio interface protocol architecture". It is recognised that not all specifications listed in this document may be relevant to ITU-R [TG 8/1], some may be more relevant to the work of ITU-T [SG 11].

5.4.2 Overview of the FDD DS-CDMA and TDD CDMA radio interface

5.4.2.1 Introduction

For FDD and TDD the radio access scheme is Direct-Sequence Code Division Multiple Access (DS-CDMA) with information spread over approximately 5 MHz bandwidth with a chip rate of 3.84 Mcps. The technology employs both, frequency division duplex (FDD) and time division duplex (TDD). It is defined to carry a wide range of user data services (multimedia, packet etc.) simultaneously multiplexed on a single carrier. The specifications are developed and specified within the 3GPP organisation. The overall architecture is briefly introduced in Section 5.4.2.2. Then the description continues with an overview on the radio protocol layers that are relevant for the radio access specific parts, i.e. the physical layer, layer 2 and radio resource layer 3 of the radio interface.

5.4.2.2 Architecture

The overall architecture of the system is shown in Figure 1.

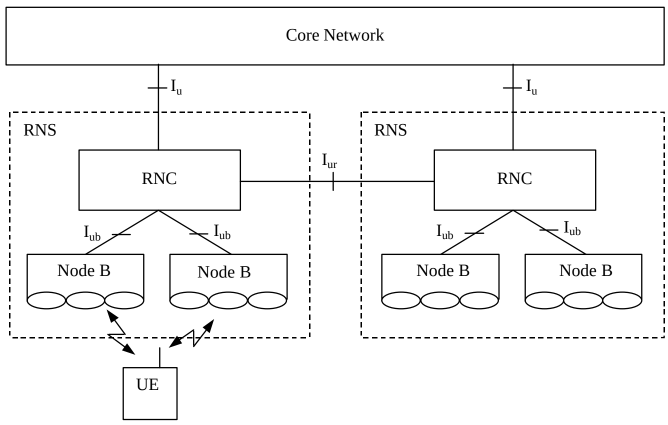


Figure 1. UTRAN Architecture

The Universal Terrestrial Radio Access Network (UTRAN) architecture consists of a set of Radio Network Subsystems (RNS) connected to the Core Network through the I_u interface.

A RNS consists of a Radio Network Controller (RNC) and one or more entities called Node B. Node B are connected to the RNC through the I_{ub} interface. Node B can handle one or more cells (indicated by egg-shaped circles).

The RNC is responsible for the handover decisions that require signalling to the User Equipment (UE).

In case macro diversity between different Node B is used the RNC comprises a combining/splitting function to support it.

The Node B can comprise an optional combining/splitting function to support macro diversity inside a Node B.

Inside the UTRAN, the RNCs of the Radio Network Subsystems can be interconnected together through the I_{ur}. The I_u and I_{ur} are logical interfaces. I_{ur} can be conveyed over physical direct connection between RNCs or via any suitable transport network.

Figure 2 shows the radio interface protocol architecture for the radio access network. On a general level, the protocol architecture is similar to the current ITU-R protocol architecture as described in ITU-R recommendation M.1035. Layer 2 is split into two sublayers, Radio Link Control (RLC) and Medium Access Control (MAC). Layer 3 and RLC are divided into Control (C-) and User (U-) planes.

In the C-plane, Layer 3 is partitioned into sublayers where the lowest sublayer, denoted as Radio Resource Control (RRC), interfaces with layer 2. The higher layer signalling such as Mobility Management (MM) and Call Control (CC) are assumed to belong to the core network. There are no L3 in UTRAN for the U-plane.

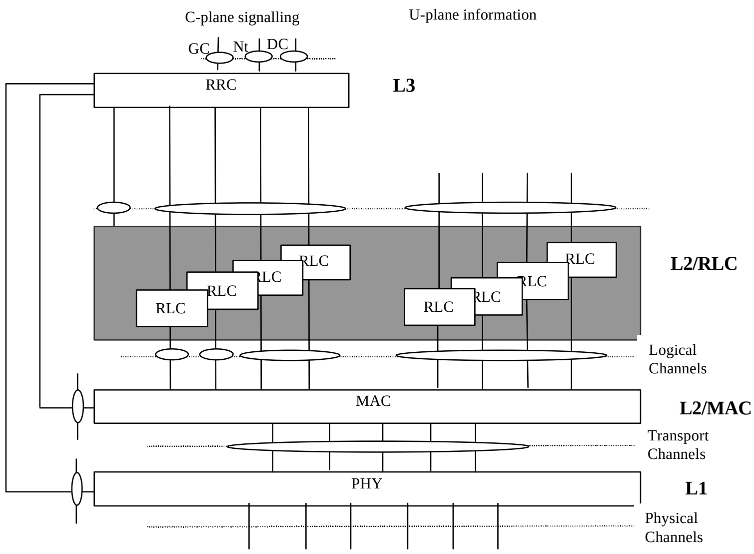


Figure 2. Radio interface protocol architecture of the RRC sublayer, L2 and Physical layer (L1).

Each block in Figure 2 represents an instance of the respective protocol. Service Access Points (SAP) for peer-to-peer communication are marked with circles at the interface between sublayers. The SAPs between RLC and the MAC sublayer provide the logical channels. The type of information transferred characterises a logical channel. The logical channels are divided into control channels and traffic channels. The different types are not further described in this overview. The SAP between MAC and the physical layer provides the transport channels. A transport channel is characterised by how the information is transferred over the radio interface, see Section 5.4.2.3.2 for an overview of the types defined. The physical layer generates the physical channels that will be transmitted over the air. A physical channel corresponds in FDD to a certain carrier frequency, code, and, on the uplink, relative phase (0 or $\pi/2$). In TDD the physical channel is defined by carrier frequency, code, time slot and multi-frame information. In the C-plane, the interface between RRC and higher L3 sublayers (CC, MM) is defined by the General Control (GC), Notification (Nt) and Dedicated Control (DC) SAPs. These SAPs are not further discussed in this overview.

Also shown in the figure are connections between RRC and MAC as well as RRC and L1 providing local inter-layer control services (including measurement results). An equivalent control interface exists between RRC and the RLC sublayer. These interfaces allow the RRC to control the configuration of the lower layers. For this purpose separate Control SAPs are defined between RRC and each lower layer (RLC, MAC, and L1).

Figure 3 shows the general structure and some additional terminology definitions of the channel formats at the various sublayer interfaces indicated in Figure 2. The figure indicates how higher layer Service data Units (SDU) and Protocol Data Units (PDUs) are segmented and multiplexed to transport blocks to be further treated by the physical layer. The transmission chain of the physical layer is described in the next section.

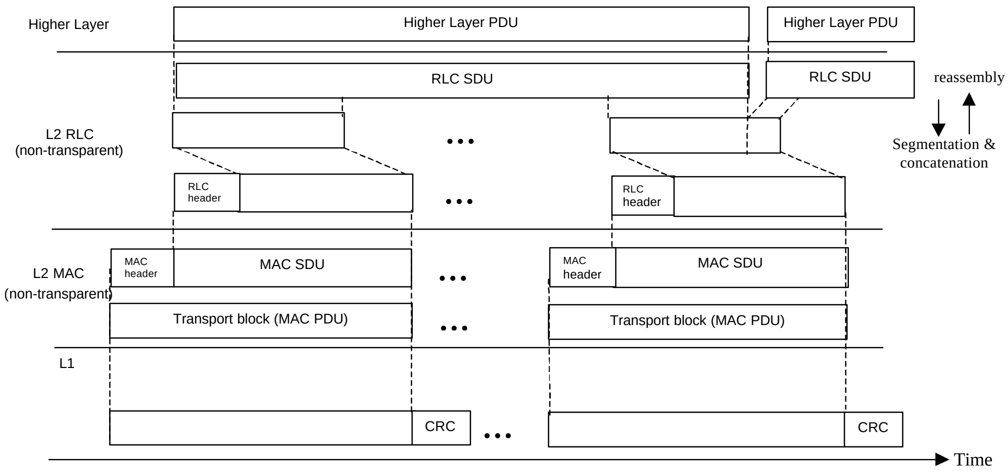


Figure 3. Data flow for a service using a non-transparent RLC and non-transparent MAC, see sections 5.4.2.4.1-2 for further definitions of the MAC and RLC services and functionality.

In TDD the Opportunity Driven Multiple Access (ODMA) is applicable. ODMA operates on relaylinks between different Relays. These Relays may be represented by either UEs with ODMA capability or ODMA seeds (ODMA equipment permanently located in the network). Relays/Seeds may act as gateways to connect the ODMA equipment to the UTRAN. This can be done using either FDD or TDD.

5.4.2.3 Physical layer

5.4.2.3.1 Physical layer functionality and building blocks

The physical layer includes the following functionality:

- Macrodiversity distribution/combining and soft handover execution
- Error detection on transport channels and indication to higher layers
- Forward Error Control (FEC) encoding/decoding of transport channels
- Multiplexing of transport channels and demultiplexing of coded composite transport channels
- Rate matching (data multiplexed on Dedicated Channels (DCH))
- Mapping of coded composite transport channels on physical channels
- Power weighting and combining of physical channels
- Modulation and spreading/demodulation and despreading of physical channels
- Frequency and time (chip, bit, slot, frame) synchronisation
- Radio characteristics measurements including Frame Error Rate (FER), Signal-to-Interference (SIR), Interference Power Level etc., and indication to higher layers
- Closed-loop power control
- Radio Frequency (RF) processing

Figure 4 gives the physical layer transmission chain for the user plane data, i.e. from the level of transport channels down to the level of physical channel. The figure shows how several transport channels can be multiplexed onto one or more dedicated physical data channels (DPDCH). For the TDD mode the left part of Figure 4 is used for both uplink and downlink.

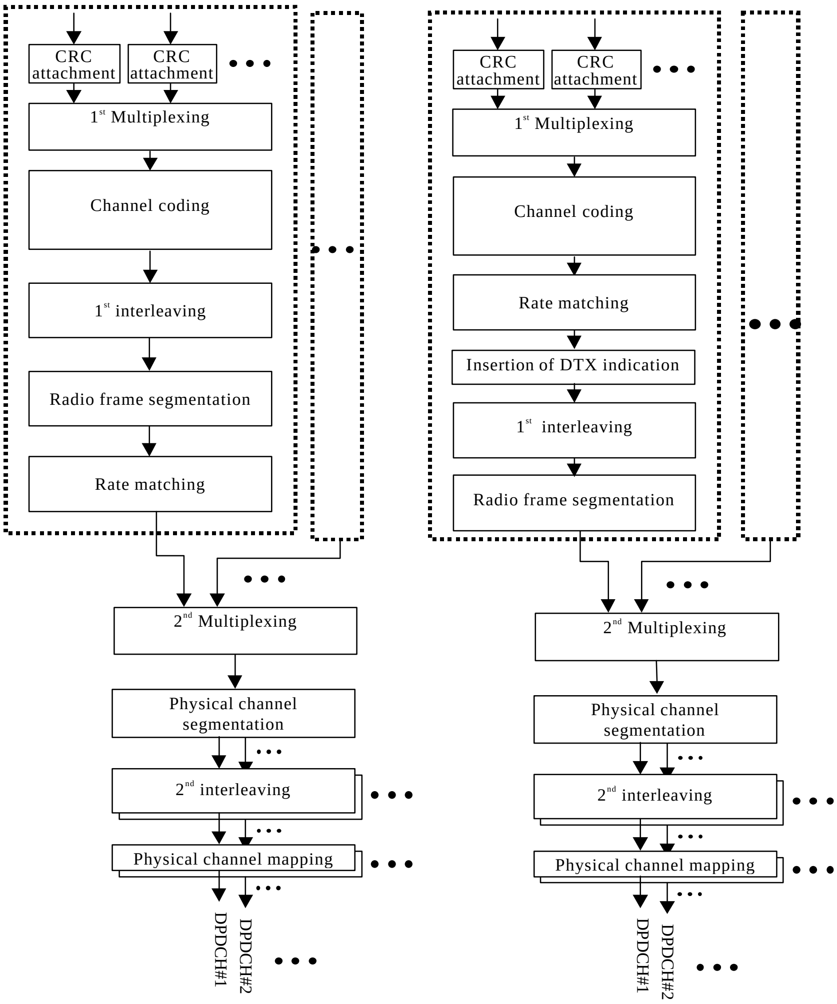


Figure 4. Transport channel multiplexing structure: Left: FDD UL and TDD UL/DL; Right: FDD DL.

The cyclic redundancy check (CRC) provides for error detection of the transport blocks for the particular transport channel. The CRC can take the length zero (no CRC), 8 or 16 depending on the service requirements.

The 1st multiplexing may perform the multiplexing of fixed rate transport channels with the same level of quality of service.

The types of channel coding defined are convolutional coding, turbo coding and no coding. Real-time services use only FEC encoding while non real-time services uses a combination of FEC and ARQ. The ARQ functionality resides in the RLC layer of Layer 2.

The rate matching adapts any remaining differences of the bit rate so the number of outgoing bits fit to the available bit rates of the physical channels. Repetition coding and/or puncturing is used for this purpose.

The 2nd multiplexing stage combines transport channels in a serial fashion. The output of this operation is also called coded composite transport channels.

If several physical channels will be used to transmit the data, the split is made in the physical channel segmentation unit.

In the FDD downlink discontinuous transmission (DTX) on a slot to slot basis can be used for variable rate transmission. This is controlled by the 'Insertion of DTX indication' box.

5.4.2.3.2 Transport channels

5.4.2.3.2.1 Transport channels relevant for both FDD and TDD

The interface to the MAC layer is the transport channels, see Figure 1. The transport channels define how and with which type of characteristics the data is transferred by the physical layer. They are categorised into dedicated channels or common channels where many UEs are sharing the latter type. Introducing an information field containing the address then does the address resolution, if needed. The physical channel itself defines a dedicated channel. Thus no specific address is needed for the UE. Table 1 summarises the different types of available transport channels that are relevant for both FDD and TDD and their intended use.

Table 1. The defined transport channels relevant for both FDD and TDD and their intended use.

Transport channel	Type and direction	Used for
DCH (Dedicated channel)	Dedicated; uplink and downlink	User or control information to a UE (entire cell or part of cell (lobe-forming))
BCH (Broadcast channel)	Common; downlink	Broadcast system and cell specific information
FACH (Forward access channel)	Common; downlink	Control information when system knows UE location or short user packets to a UE
PCH (Paging channel)	Common; downlink	Control information to UEs when good sleep mode properties are needed, e.g. idle mode operation
RACH (Random access channel)	Common; uplink	Control information or short user packets from an UE
DSCH (Downlink shared channel)	Common; downlink	Carries dedicated user data and control information using a shared channel.
DSCH control channel	Common; downlink	Carries control information when the DSCH is not associated with a DCH

The random access channel on the uplink is contention-based while the dedicated channel is reservation-based.

5.4.2.3.2.2 Transport channels relevant for FDD only

Table 2 summarises the different types of available transport channels that are relevant for FDD only and their intended use.

Table 2. The defined transport channels relevant for FDD only and their intended use.

Transport channel	Type and direction	Used for
FAUSCH (Fast uplink signalling channel)	Dedicated; uplink	FDD only. Carries control information from an UE
CPCH (Common packet channel)	Common; uplink	FDD only. Short and medium sized user packets. Always associated with a downlink channel for power control

The common packet channel on the uplink is contention-based while the dedicated channel is reservation-based.

5.4.2.3.2.3 Transport channels relevant for TDD only

Table 3 summarises the different types of available transport channels that are relevant for TDD only and their intended use.

Table 3. The defined transport channels relevant for TDD only and their intended use.

Transport channel	Type and direction	Used for
USCH (Uplink shared channel)	Common; Uplink	TDD only. Carries dedicated user data and control information using a shared channel
ODCH (ODMA Dedicated channel)	Dedicated	TDD only. Applicable for ODMA relaying
ORACH (ODMA Random Access Channel)	Common	TDD only. Applicable for ODMA relaying

5.4.2.3.3 Transport channels to Physical channel mapping

The transport channels are mapped onto the physical channels. Figure 5 (FDD) and Figure 6 (TDD) show the different physical channels and summarises the mapping of transport channels onto physical channels. Each physical channel has its tailored slot content. The dedicated channel (DCH) is shown in section 5.4.2.3.4.

5.4.2.3.3.1 Transport channels, physical channels and their mapping for FDD

Transport Channels	**Physical Channels**
BCH	Primary Common Control Physical Channel (Primary CCPCH) (Downlink; 30 kbps fixed rate)
FACH	Secondary Common Control Physical Channel (Secondary CCPCH) (Downlink; Variable rate.)
PCH	
RACH	Physical Random Access Channel (PRACH)
FAUSCH	(Uplink)
CPCH	Physical Common Packet Channel (PCPCH)
	(Uplink)
DCH	Dedicated Physical Data Channel (DPDCH)
	(Downlink/Uplink)
	Dedicated Physical Control Channel (DPCCH)
	(Downlink/Uplink; Associated with a DPDCH)
DSCH	Physical Downlink Shared Channel (PDSCH)
	(Downlink)
DSCH control channel	Physical Shared Channel Control Channel (PSCCCH)
	(Downlink)
	Synchronisation Channel (SCH) (Downlink; uses part of the slot of primary CCPCH; used for cell search)
	Common Pilot Channel (CPICH) (Downlink, used as phase reference for other downlink physical channels)
	Acquisition Indication Channel (AICH) (Downlink; used to carry acquisition indicator for the random access procedure)
	Page Indication Channel (PICH) (Downlink; used to carry page indicators to indicate the presence of a page message on the PCH)

Figure 5: Transport –channels, physical –channels and their mapping – FDD

5.4.2.3.3.2 Transport channels, physical channels and their mapping for TDD

Transport Channels	**Physical Channels**
DCH ODCH*	Dedicated Physical Channel (DPCH)
BCH FACH PCH	Common Control Physical Channel (CCPCH)
RACH ORACH*	Physical Random Access Channel (PRACH)
SCH	Physical Synchronisation Channel (PSCH)
USCH	Physical Uplink Shared Channel (PUSCH)
DSCH	Physical Downlink Shared Channel (PDSCH)
	Page Indicator Channel (PICH)

* in case of ODMA networks

Figure 6 Transport channels, physical channels and their mapping - TDD

5.4.2.3.4 Physical frame structure - FDD

The basic physical frame rate is 10 milliseconds with 15 slots. Figure 7 shows the frame structure.

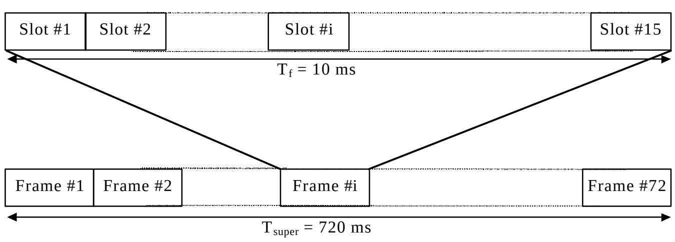


Figure 7. Basic frame structure.

Figure 8 shows the content for a slot used by the DCH. For the FDD the uplink physical channels DPDCH and DPCCH are I/Q multiplexed while the downlink channels are time multiplexed. The DPDCH, the channel where the user data is transmitted on, is always associated with a DPCCH containing Layer 1 control information. The Transport Format Combination Indicator (TFCI) field is used for indicating the demultiplexing scheme of the data stream. The TFCI field does not exist for combinations that are static (i.e. fixed bit rate allocations) or blind transport format detection is employed. The Feedback Information (FBI) field is used for transmit and site diversity functions. The Transmit Power Control (TPC) bits are used for power control.

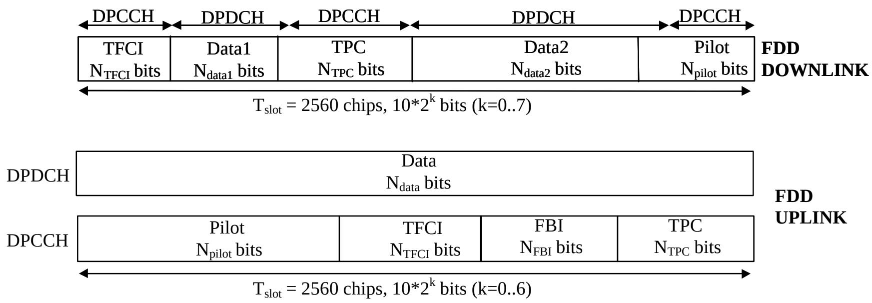


Figure 8. The slot content for the DPDCH/DPCCH. The exact bit allocations are not shown.

A Common Pilot Channel (CPICH) is defined. It is an unmodulated downlink channel, that is the phase reference for other downlink physical channels.

There is always one primary CPICH in each cell. There may also be additional secondary CPICHs in a cell.

For the uplink, the maximum physical channel bit rate is 960 kbps using a spreading factor of 4. To obtain higher bit rates for a user several physical channels can be used. The channel bit rate of the DPCCH is fixed to 16 kbps. For the downlink the maximum channel bit rate is 1920 kbps with a spreading factor of 4. Note that the symbol bit rate is equal to the channel bit rate for the uplink while it is half of the channel bit rate for the downlink. The maximum spreading factors are 512 for the downlink and 256 for the uplink.

To be able to support inter-frequency handover as well as measurements on other carrier frequencies or carriers of other systems, like GSM, a compressed mode of operation is defined. The function is implemented by having some slots empty, but without deleting any user data. Instead the user data is transmitted in the remaining slots. The number of slots that is not used can be variable with a minimum of three slots (giving minimum idle lengths of at least 1.73 milliseconds). The slots can be empty either in the middle of a frame or at the end and in the beginning of the consecutive frame. If and how often is controlled by the RRC functionality in Layer 3.

5.4.2.3.5 Physical frame structure – TDD

The basic physical frame rate is 10 milliseconds with 15 slots. Figure 9 shows the frame structure.

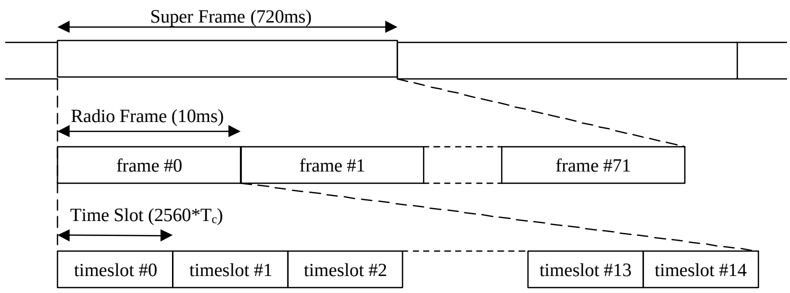


Figure 9: Basic frame structure – TDD

Each 10 ms frame consists of 15 time slots, each allocated to either the uplink or the downlink. With such a flexibility , the TDD mode can be adapted to different environments and deployment scenarios. In any configuration at least one time slot has to be allocated for the downlink and at least one time slot has to be allocated for the uplink.

When operating ODMA at least one common timeslot has to be allocated for the ORACH. If large quantities of information have to be transferred between ODMA nodes then it is normal to use at least one timeslot for the ODCH (Figure 10).

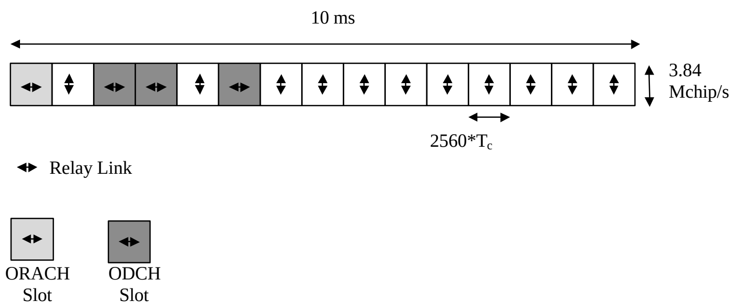


Figure 10: TDD frame structure example for ODMA operation

Figure 11 and Figure 12 show the two burst formats stating the content for a slot used by a DCH. The usage of either burst format 1 or 2 is depending on the application for UL or DL and the number of allocated users per timeslot.

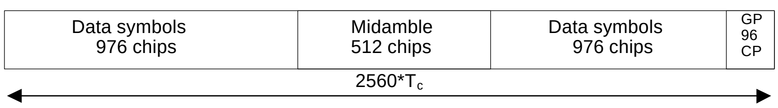


Figure 11: Burst structure of the burst type 1. GP denotes the guard period and CP the chip periods.

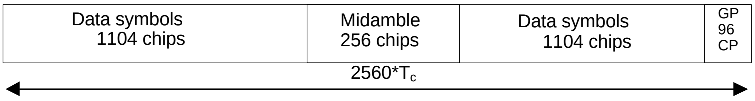


Figure 12: Burst structure of the burst type 2. GP denotes the guard period and CP the chip periods.

In both cases data bits are QPSK modulated and the resulting symbols are spread with a channelisation code of length 1 to 16. Due to this variable spreading factor, each data part of one burst provides the number of symbols as shown in Table 4 below.

Table 4 Number of data symbols in TDD bursts.

Spreading factor (Q)	*Number of symbols (N) per data field in Burst 1*	**Number of symbols (N) per data field in Burst 2**
1	976	1104
2	488	552
4	244	276
8	122	138
16	61	69

Thus, the number of bits per TDD burst is four times the number shown in Table.Usage of multicode and multiple timeslots can be applied.

5.4.2.3.6 Spreading, modulation and pulse shaping

Uplink - FDD

Spreading consists of two operations. The first is the channelisation operation, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. The number of chips per data symbol is called the Spreading Factor (SF). The second operation is the scrambling operation, where a scrambling code is applied to the spread signal.

In the channelisation operation, data symbol on so-called I- and Q-branches are independently multiplied with a code. The channelisation codes are Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between a user's different physical channels. With the scrambling operation, the resultant signals on the I- and Q-branches are further multiplied by complex-valued scrambling code, where I and Q denote real and imaginary parts, respectively. Note that before complex multiplication binary values 0 and 1 are mapped to +1 and -1, respectively.

Figure 13 illustrates the spreading and modulation for the case of multiple uplink DPDCHs when total data rate is less than or equal to 960 kbps in the 5MHz band (the 1920 kbps case is not shown here). Note that this figure only shows the principle, and does not necessarily describe an actual implementation. Modulation is dual-channel QPSK (i.e.; separate BPSK on I- and Q-channel), where the uplink DPDCH and DPCCH are mapped to the I and Q branch respectively. The I and Q branches are then spread to the chip rate with two different channelisation codes and subsequently complex scrambled by a UE specific complex scrambling code C_{scramb}. There are 2^{24} uplink-scrambling codes. Either short (256 chips from the family of S(2) codes) or long (38400 chips equal to one frame length, Gold code based) scrambling codes is used on the uplink. The short scrambling code is typically used in cells where the base station is equipped with an advanced receiver, such as a multi-user detector or interference canceller whereas the long codes gives better interference averaging properties.

The pulse-shaping filters are root-raised cosine (RRC) with roll-off a=0.22 in the frequency domain.

The modulation of both DPCCH and DPDCH is BPSK. The modulated DPCCH is mapped to the Q-branch, while the first DPDCH is mapped to the I-branch. Subsequently added DPDCHs are mapped alternatively to the I or Q-branches.

Downlink - FDD

Figure 14 illustrates the spreading and modulation for the downlink DPCH. Data modulation is QPSK where each pair of two bits are serial-to-parallel (S/P) converted and mapped to the I and Q branch respectively. The I and Q branch are then spread to the chip rate with the same channelisation code c_{ch} (real spreading) and subsequently scrambled by the scrambling code C_{scramb} (complex scrambling).

The channelisation codes are the same codes as used in the uplink that preserve the orthogonality between downlink channels of different rates and spreading factors. There are a total 512*512 = 262,144 scrambling codes, numbered 0…262,143. The scrambling codes are divided into 512 sets each of a primary scrambling code and 511 secondary scrambling codes. Each cell is allocated one and only one primary scrambling code. The primary CCPCH is always transmitted using the primary scrambling code. The other downlink physical channels can be transmitted with either the primary scrambling code or a secondary scrambling code from the set associated with the primary scrambling code of the cell.

The pulse-shaping filters are root raised cosine (RRC) with roll-off a=0.22 in the frequency domain.

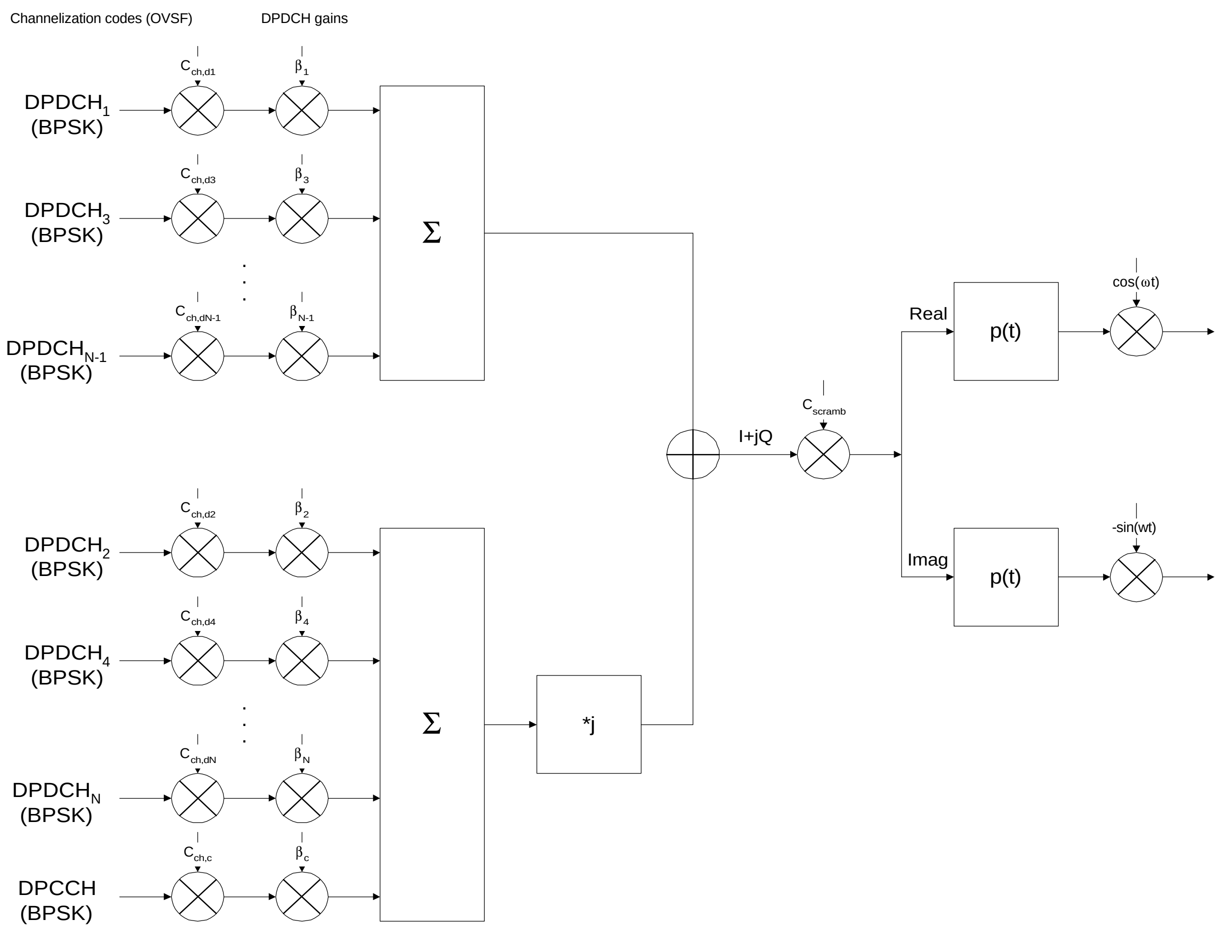


Figure 13. Spreading/modulation for uplink DPDCH/DPCCH for user services less than or equal to 960kbps in the 5MHz band

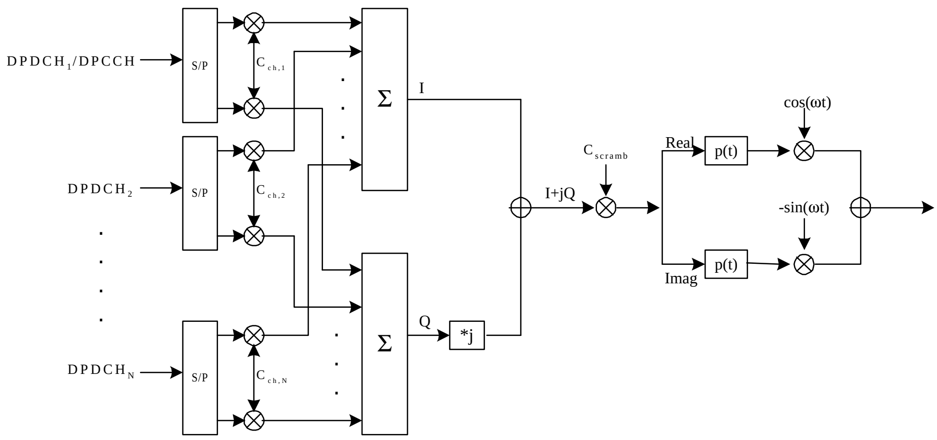


Figure 14. Spreading/modulation for downlink DPCH.

Up- and Downlink – TDD

Spreading is applied after modulation and before pulse shaping. It consists of two operations. The first is the channelisation operation, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. The number of chips per data symbol is called the Spreading Factor (SF) and is in the range of 1 to 16. The second operation is the scrambling operation, where a scrambling code is applied to the spread signal. This procedure is similar to FDD Mode, but it should be noted that the midamble part in TDD bursts (see Figure 11 and Figure 12) is not spread.

The applied channelisation codes are OVSF-codes (Orthogonal Variable Spreading Factor-codes) that preserve the distinguishability of different users. The applied scrambling code is cell-specific and 128 different scrambling codes are available.

In the Uplink, the applied midamble is user specific and derived from a cell-specific Basic Midamble Sequence. In the Downlink, the applied midamble is either user specific or common for the whole cell. In each case 128 different Basic Midamble sequences are available.

After spreading same pulse-shaping is applied as in FDD Mode, i.e. the filters are root-raised cosine with roll-off a=0.22 in the frequency domain.

5.4.2.4 Layer 2

5.4.2.4.1 Medium Access Control (MAC) layer

The MAC sublayer is responsible for the handling of the data streams coming from the RLC and RRC sublayers. It provides an unacknowledged transfer mode service to the upper layers. It also reallocates radio resources on request by the RRC sublayer as well as provides measurements to the upper layers. Thus, the functionality handles issues like:

- Mapping of the different logical channels to the appropriate transport channels and selection of appropriate transport format for the transport channels based on the instantaneous source bit rate. It also performs the multiplexing /demultiplexing of the PDUs to/from transport blocks which are thereafter further treated by the physical layer.
- performs dynamic switching between common and dedicated transport channels based on information from the RRC sublayer
- handles priority issues for services to one UE according to information from higher layers and physical layer (e.g. available transmit power level) as well as priority handling between UEs by means of dynamic scheduling in order to increase spectrum efficiency
- monitor traffic volume that can be used by the RRC sublayer
- In TDD only, the routing of higher layers signalling, the support of fast DCA by monitoring the links of assigned resources and the maintenance of the respective MAC signalling connection are additionally supported by the MAC.

5.4.2.4.2 Radio Link Control (RLC) sublayer

The RL C sublayer provides three different types of data transfer modes:

- **Transparent data transfer**. This service transmits higher layer PDUs without adding any protocol information, possibly including segmentation/reassemble functionality.

- **Unacknowledged data transfer**. This service transmits higher layer PDUs without guaranteeing delivery to the peer entity. The unacknowledged data transfer mode has the following characteristics:
    - Detection of erroneous data: The RLC sublayer shall deliver only those SDUs to the receiving higher layer that are free of transmission errors by using the sequence-number check function.
    - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.
    - Immediate delivery: The receiving RLC sublayer entity shall deliver a SDU to the higher layer receiving entity as soon as it arrives at the receiver.
- **Acknowledged data transfer**. This service transmits higher layer PDUs and guarantees delivery to the peer entity. In case RLC is unable to deliver the data correctly, the user of RLC at the transmitting side is notified. For this service, both in-sequence and out-of-sequence delivery are supported. In many cases a higher layer protocol can restore the order of its PDUs. As long as the out-of-sequence properties of the lower layer are known and controlled (i.e. the higher layer protocol will not immediately request retransmission of a missing PDU) allowing out-of-sequence delivery can save memory space in the receiving RLC. The acknowledged data transfer mode has the following characteristics:
    - Error-free delivery: Error-free delivery is ensured by means of retransmission. The receiving RLC entity delivers only error-free SDUs to the higher layer.
    - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.
    - In-sequence delivery: RLC sublayer shall provide support for in-order delivery of SDUs, i.e., RLC sublayer should deliver SDUs to the receiving higher layer entity in the same order as the transmitting higher layer entity submits them to the RLC sublayer.
    - Out-of-sequence delivery: Alternatively to in-sequence delivery, it shall also be possible to allow that the receiving RLC entity delivers SDUs to higher layer in different order than submitted to RLC sublayer at the transmitting side.

It also provides for RLC connection establishment/release. As well as QoS setting and notification to higher layers in case of unrecoverable errors.

5.4.2.5 Layer 3 (Radio resource control sublayer)

The Radio Resource Control (RRC) sublayer handles the control plane signalling of Layer 3 between the UEs and UTRAN. In addition to the relation with the upper layers (such as core network) the following main functions are performed:

- **Broadcast of information provided by the non-access stratum (Core Network).** The RRC layer performs system information broadcasting from the network to all UEs. The system information is normally repeated on a regular basis. This function supports broadcast of higher layer (above RRC) information. This information may be cell specific or not. As an example RRC may broadcast Core Network location service area information related to some specific cells.

- **Broadcast of information related to the access stratum.** The RRC layer performs system information broadcasting from the network to all UEs This function supports broadcast of typically cell-specific information.
- **Establishment, maintenance and release of an RRC connection between the UE and UTRAN.** The establishment of an RRC connection is initiated by a request from higher layers at the UE side to establish the first Signalling Connection for the UE. The establishment of an RRC connection includes an optional cell re-selection, an admission control, and a layer 2 signalling link establishment.
- **Establishment, reconfiguration and release of Radio Access Bearers.** The RRC layer will, on request from higher layers, perform the establishment, reconfiguration and release of radio access bearers in the user plane. A number of radio access bearers can be established to an UE at the same time. At establishment and reconfiguration, the RRC layer performs admission control and selects parameters describing the radio access bearer processing in layer 2 and layer 1, based on information from higher layers.
- **Assignment, reconfiguration and release of radio resources for the RRC connection.** The RRC layer handles the assignment of radio resources (e.g. codes and, for TDD only, timeslots) needed for the RRC connection including needs from both the control and user plane. The RRC layer may reconfigure radio resources during an established RRC connection. This function includes co-ordination of the radio resource allocation between multiple radio bearers related to the same RRC connection. RRC controls the radio resources in the uplink and downlink such that UE and UTRAN can communicate using unbalanced radio resources (asymmetric uplink and downlink). RRC signals to the UE to indicate resource allocations for purposes of handover to GSM or other radio systems.
- **RRC connection mobility functions.** The RRC layer performs evaluation, decision and execution related to RRC connection mobility during an established RRC connection, such as handover, preparation of handover to GSM or other systems, cell re-selection and cell/paging area update procedures, based on e.g. measurements done by the UE**.**
- **Paging/notification.** The RRC layer can broadcast paging information from the network to selected UEs. The RRC layer can also initiate paging during an established RRC connection.
- **Routing of higher layer PDUs.** This function performs at the UE side routing of higher layer PDUs to the correct higher layer entity, at the UTRAN side to the correct RANAP entity.
- **Control of requested QoS**. This function ensures that the QoS requested for the radio access bearers can be met. This includes the allocation of a sufficient number of radio resources.
- **UE measurement reporting and control of the reporting.** The measurements performed by the UE are controlled by the RRC layer, in terms of what to measure, when to measure and how to report, including both UMTS air interface and other systems. The RRC layer also performs the reporting of the measurements from the UE to the network.
- **Outer loop power control.** The RRC layer controls setting of the target of the closed loop power control.
- **Control of ciphering.** The RRC layer provides procedures for setting of ciphering (on/off) between the UE and UTRAN.

- **Initial cell selection and re-selection in idle mode.** Selection of the most suitable cell based on idle mode measurements and cell selection criteria.
- **Arbitration of the radio resource allocation between the cells**. This function shall ensure optimal performance of the overall UTRAN capacity.

The following functions are for TDD only:

- **Broadcast of ODMA relay node neighbour information.** The RRC layer performs probe information broadcasting to allow ODMA routeing information to be collected.
- **Collating ODMA neighbour list and gradient information.** The ODMA relay node neighbour lists and their respective gradient information maintained by the RRC.
- **Maintenance of number of ODMA relay node neighbours.** The RRC will adjust the broadcast powers used for probing messages to maintain the desired number of neighbours.
- **Establishment, maintenance and release of a route between ODMA relay nodes.** The establishment of an ODMA route and RRC connection based upon the routeing algorithm.
- **Interworking between the Gateway ODMA relay node and the UTRAN.** The RRC layer will control the interworking communication link between the Gateway ODMA relay node and the UTRAN.
- **Contention resolution**. The RRC handles reallocations and releases of radio resources in case of collisions indicated by lower layers.
- **Slow DCA**. Allocation of preferred radio resources based on long-term decision criteria.

5.4.3 Detail Specification of the Radio Interface

[Editor's Note:

– *This section corresponds to the "Reference part (70%)".*

– *This section should include all references to ensure worldwide compatibility.*

– *Description style of this section should be based on Annex-1 of Doc. 8-1/TEMP/213.*

– *TG 8/1 requests SDOs to review and update this part.*

– *Terminology : SDO's terminology which should also be referenced in this part*

– *Input material : 8-1/372 (Annex)]*

5.4.3.1 Detailed Specifications

The most recent versions of the 25.200, 25.300, and 25.100 series of draft specifications as developed within the 3GPP RAN TSG. Some of them were approved or endorsed during the RAN TSG#3 meeting.

[www.3gpp.org/Documents/TSG_RAN/TSG_RAN/TSGR_03/Docs/pdfs

25.200 series: 233, 234 , 289, 236, 237, 238, 290, 240, 241, 242

25.300 series: 259, 260, 261, 262, 263, 264, 265

25.100 series: 276, 277, 278, 279, 280, 281]

5.4.3.2 25.200 Series

The 25.200 series specifies Um point for the 3G mobile system. This series defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

25.201 PHYSICAL LAYER - GENERAL DESCRIPTION

This specification describes the documents being produced by the 3GPP TSG RAN WG 1and first complete versions expected to be available by end of 1999. This specification gives also general description of the physical layer of the UTRA air interface.

25.211 PHYSICAL CHANNELS AND MAPPING OF TRANSPORT CHANNELS ONTO PHYSICAL CHANNELS (FDD)

This specification describes the characteristics of the Layer 1 transport channels and physicals channels in the FDD mode of UTRA. The main objectives of the document are to be a part of the full description of the UTRA Layer 1, and to serve as a basis for the drafting of the actual technical specification (TS).

25.212 MULTIPLEXING AND CHANNEL CODING (FDD)

This specification describes the documents being produced by the 3GPP TSG RAN WG 1 and first complete versions expected to be available by end of 1999. This specification describes the characteristics of the Layer 1 multiplexing and channel coding in the FDD mode of UTRA.

The 25.200 series specifies Um point for the 3G mobile system. This series defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

25.213 SPREADING AND MODULATION (FDD)

The present document describes spreading and modulation for UTRA Physical Layer FDD mode.

25.214 PHYSICAL LAYER PROCEDURES (FDD)

This document specifies and establishes the characteristics of the physicals layer procedures in the FDD mode of UTRA.

25.221 PHYSICAL CHANNELS AND MAPPING OF TRANSPORT CHANNELS ONTO PHYSICAL CHANNELS (TDD)

25.222 MULTIPLEXING AND CHANNEL CODING (TDD)

This 3GPP Report describes multiplexing, channel coding and interleaving for UTRA Physical Layer TDD mode.

Text without revision marks has been approved in the previous TSG-RAN WG 1 meetings, while text with revision marks is subject to approval.

25.223 SPREADING AND MODULATION (TDD)

This document establishes the characteristics of the spreading and modulation in the TDD mode. The main objectives of the document are to be a part of the full description of the Layer 1, and to serve as a basis for the drafting of the actual technical specification (TS).

25.224 PHYSICAL LAYER PROCEDURES DESCRIPTION (TDD)

25.231 PHYSICAL LAYER - MEASUREMENTS

This 3GPP Telecommunication Specification TS contains the description of the measurements done at the UE and network in order to support operation in idle mode and connected mode.

As far as the measurements in idle mode are concerned, this TS described the following:

– measurements for the cell selection for a UE supporting FDD and/or TDD;

– measurements for cell reselection for a UE camping on an FDD or TDD cell.

As far as the measurements in connected mode are concerned, this TS describes measurements when the UE is connected to an FDD cell or cells (in Soft handover) or a TDD cell for the cell connected state (see reference [8]), or camping on an FDD cell for the UTRA connected state. This TS provides the minimum requirements for the UE and networks. Some explanatory text is also contained in the TS but it is more of a descriptive nature than normative.

As far as the measurements for the handover preparation, this specification defines the requirements to the UE and UTRAN, as well as parametrisation rules for the compressed mode in order to accommodate idle periods. This latter aspects may need to be moved to some other specifications. The description of the compressed mode (different type of compressed frames define by the compressed mode A/B, the number if idle slots and the position of such transmission gap) is outside the scope of this specification and is covered in 25.211 and 25.212.

5.4.3.3 25.300 Series

25.301 RADIO INTERFACE PROTOCOL ARCHITECTURE

The present document shall provide an overview and overall description of the UE-UTRAN radio interface protocol architecture as agreed within the 3GPP TSG RAN working group 2. Details of the radio protocols will be specified in companion documents.

25.302 SERVICES PROVIDED BY THE PHYSICAL LAYER

The present document is a technical specification of the services provided by the physical layer of UTRA to upper layers.

25.303 UE FUNCTIONS AND INTERLAYER PROCEDURES IN CONNECTED MODE

This document defines the UE States and the principal tasks undertaken by the UE when in Connected Mode. It includes informative interlayer procedures for the UE to perform the required tasks.

This document attempts to provide a comprehensive overview of the different states and transitions within the connected mode of a UMTS terminal. The applicable set of states for a given service may be a subset of the total set of possible states.

In addition to describing the states and related transitions, this document describes all procedures that assign, reconfigure and release radio resources. Included are e.g. procedures for transitions between different states and substates, handovers and measurement reports. The emphasis is on showing the combined usage of both peer-to-peer messages and interlayer primitives to illustrate the functional split between the layers, as well as the combination of elementary procedures for selected examples. The peer-to-peer elementary procedure descriptions are described in the related protocol descriptions /1, 2, 3/ and they are thus not within the scope of this document.

25.304 UE PROCEDURES IN IDLE MODE

The present document shall describe the overall idle mode process for the UE and the functional division between the non-access stratum and access stratum in the UE. The UE is in idle mode when the connection of the UE is closed on all layers, e.g. there is neither an MM connection nor an RRC connection.

This document presents also examples of inter-layer procedures related to the idle mode processes and describes idle mode functionality of a dual mode UMTS/GSM UE.

25.321 MEDIUM ACCESS CONTROL (MAC) PROTOCOL SPECIFICATION

The scope of this description is the specification of the MAC protocol.

The following lists the contents for the specification of the MAC protocol:

1) list of procedures;
2) logical flow diagrams for normal procedures;
3) logical description of message;
4) principles for error handling;
5) some exceptional procedures which are felt criteria;
6) it should, as far as possible, have the same format and outline as the final specification;
7) exact message format;
8) all scenarios.

25.322 RADIO LINK CONTROL (RLC) PROTOCOL SPECIFICATION

The scope of this description is to describe the RLC protocol. A description document is intermediate between a stage 2 document and a protocol specification. Once completed, it should be sufficient for manufacturers to start some "high level design" activities. It should allow as well to assess the complexity of the associated protocol. After the completion of a description document, the drafting of the protocol specification should not have to face difficulties which would impact the other protocols i.e. the radio interface protocol architecture should be stable. This means that some procedures which are felt critical in terms of complexity will need to be studied in more details in the description document so that no problem is faced in the writing of the final protocol.

The following lists typical contents for a description document:

1) list of procedures;
2) logical flow diagrams for normal procedures;
3) logical description of message (where it should be possible to guess roughly the size of the various information elements);
4) principles for error handling;
5) some exceptional procedures which are felt critical;
6) it should, as far as possible, have the same format and outline as the final specification.

The following is not covered:

1) exact message format;
2) all scenarios.

25.331 RADIO RESOURCE CONTROL (RRC) PROTOCOL SPECIFICATION

The scope of this specification is to describe the Radio Resource Control protocol for the 3GPP radio system.

5.4.3.4 25.400 Series

25.401 UTRAN OVERALL DESCRIPTION

This document describes the overall architecture of the UTRAN, including internal interfaces and assumptions on the radio and Iu interfaces.

25.410 UTRAN IU INTERFACE: GENERAL ASPECTS AND PRINCIPLES

25.411 UTRAN IU INTERFACE LAYER 1

25.412 UTRAN IU INTERFACE SIGNALLING TRANSPORT

The present document specifies the standards for user data transport protocols and related signalling protocols to establish user plane transport bearers.

25.413 RANAP SPECIFICATION

25.414 UTRAN IU INTERFACE DATA TRANSPORT & TRANSPORT SIGNALLING

The present document specifies the standards for user data transport protocols and related signalling protocols to establish user plane transport bearers.

25.415 IU INTERFACE CN-UTRAN USER PLANE PROTOCOLS

This Technical Specification defines the protocols being used to transport and control over the Iu interface, the Iu User Data Streams.

25.420 UTRAN IUR INTERFACE: GENERAL ASPECTS AND PRINCIPLES

25.421 UTRAN IUR INTERFACE LAYER 1

25.422 UTRAN IUR INTERFACE SIGNALLING TRANSPORT

The present document specifies the standards for user data transport protocols and related signalling protocols to establish user plane transport bearers.

25.423 RNSAP SPECIFICATION

25.424 IUR INTERFACE DATA TRANSPORT & TRANSPORT SIGNALLING FOR COMMON TRANSPORT CHANNEL DATA STREAMS

This document shall provide a description of the UTRAN RNS-RNS (Iur) interface Data Transport and Transport Signalling for Common Transport Channel data streams as agreed within the TSG-RAN Working Group 3.

25.425 UTRAN IUR INTERFACE USER PLANE PROTOCOLS FOR COMMON TRANSPORT CHANNEL DATA STREAMS

This document shall provide a description of the UTRAN RNS-RNS (Iur) interface user plane protocols for Common Transport Channel data streams as agreed within the TSG-RAN Working Group 3.

25.426 IUR & IUB INTERFACE DATA TRANSPORT & TRANSPORT SIGNALLING FOR DCH DATA STREAMS

25.427 IUR & IUB INTERFACE USER PLANE PROTOCOL FOR DCH DATA STREAMS

25.430 UTRAN IUB INTERFACE: GENERAL ASPECTS AND PRINCIPLES

25.431 IUB INTERFACE LAYER 1

25.432 UTRAN IUB INTERFACE SIGNALLING TRANSPORT

25.433 NBAP SPECIFICATION

25.434 UTRAN IUB INTERFACE DATA TRANSPORT & TRANSPORT SIGNALLING FOR COMMON TRANSPORT CHANNEL DATA STREAMS

This document shall provide a description of the UTRAN RNC-Node B (Iub) interface Data Transport and Transport Signalling for CCH data streams as agreed within the TSG-RAN Working Group 3.

25.435 IUB INTERFACE USER PLANE PROTOCOLS FOR COMMON TRANSPORT CHANNEL DATA STREAMS

This document shall provide a description of the UTRAN RNC-Node B(Iub) interface user plane protocols for Common Transport Channel data streams as agreed within the TSG-RAN Working Group 3.

5.4.3.5 25.100 Series

25.101 UE RADIO TRANSMISSION AND RECEPTION (FDD)

This document establishes the minimum RF characteristics of the FDD mode of UTRA.

25.104 BTS RADIO TRANSMISSION AND RECEPTION (FDD)

This document establishes the Base Station minimum RF characteristics of the FDD mode of UTRA.

25.102 UE RADIO TRANSMISSION AND RECEPTION (TDD)

This document establishes the minimum RF characteristics of the TDD mode of UTRA for the User Equipment (UE).

25.105 BTS RADIO TRANSMISSION AND RECEPTION (TDD)

This document establishes the minimum RF characteristics of the TDD mode of UTRA.

25.103 RF PARAMETERS IN SUPPORT OF RADIO RESOURCE MANAGEMENT

This Technical Specification shall describe RF parameters and Requirements for the Radio Resource Management.

25.141 BASESTATION CONFORMANCE TESTING (FDD)

This specification describes the documents being produced by the 3GPP TSG RAN WG 4 and first complete versions expected to be available by end of 1999. This specification gives also general description of the physical layer of the UTRA air interface.

The 25.100 series specifies.

For each test, two conformance requirements are specified:

– essential conformance requirements;

– complete conformance requirements.

Essential conformance requirements are those which are required:

a) to ensure compatibility between the radio channels in the same cell;

b) to ensure compatibility between cells, both coordinated and uncoordinated;

c) to ensure compatibility with existing systems in the same or adjacent frequency bands;

d) to verify the important aspects of the transmission quality of the system.

Essential conformance requirements are sufficient to verify the performance of the equipment for radio type approval purposes, in countries where this is applicable.

Complete conformance requirements may be tested to verify all aspects of the performance of a BSS. These requirements are intended to be used by manufacturers and operators to allow conformance and acceptance testing to be performed in a consistent manner; the tests to be performed should be agreed between the parties.

In some tests there are separate requirements for micro-BTS and BTS. If there is no separate requirement for a micro-BTS, the requirements for the BTS apply to a micro-BTS.

In the present document, the reference point for RF connections (except for the measurement of mean transmitted RF carrier power) is the antenna connector, as defined by the manufacturer. This EN does not apply to repeaters or RF devices which may be connected to an antenna connector of a BSS, except as specified in subclause 4.10.

25.142 BASESTATION CONFORMANCE TESTING (TDD)

25.113 BASESTATION EMC[4]

5.5 Radio Interface No-5

5.5.1 Introduction

[Editor's Note:

– *This section corresponds to the "Original part (10%)".*

– *This subsection 5-5 corresponds to materials supplied by SDOs related to 3GPP2, i.e. Doc. 8-1/371(Annexes).*

[4] This Specification does not include the antenna port immunity and emissions.

– *TG 8/1 will develop this part based on input contributions.*

– *Terminology : ITU-R M.1224]*

The cdma2000 standard specifies a spread spectrum radio interface that uses CDMA technology to meet the needs for the next generation of wireless communication systems. Figure 1 shows the general architecture of cdma2000. Development of the cdma2000 standard has, to the greatest extent possible, adhered to the architecture by specifying different layers in different volumes of the standard. For example, in Phase I development of cdma2000 specification in TIA, the physical layer is specified in IS-2000-2, the MAC in IS-2000-3, the LAC in IS-2000-4, and upper layer signaling in IS-2000-5. This architecture will be carried over into future development of so called Release A of cdma2000. The shaded services shown in the Upper Layers row in Figure 5.5.1-1. are associated with, but are not part of, IS-2000.

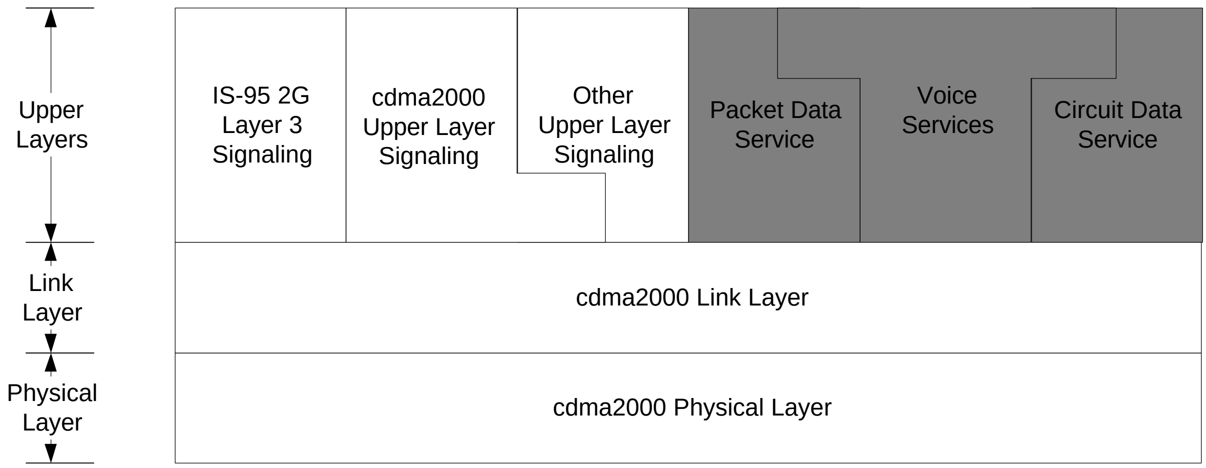


FIGURE 5.5.1-1

General Architecture of cdma2000

5.5.2 Overview of cdma2000 Radio Interface

5.5.2.1 Introduction

The cdma2000 radio interface is a wideband spread spectrum radio interface that uses CDMA technology to meet the needs of the third generation (3G) wireless communication systems. In addition, the cdma2000 radio interface meets the requirements for the 3G evolution of the current TIA/EIA-95-B family of standards.

As shown in Figure 5.5.2.1-1, the current TIA/EIA-95-B systems have a layered structure providing voice, packet data (up to 64 Kbps), simple circuit data (e.g., async Fax), and simultaneous voice and packet data services. At the most basic level, cdma2000 provides protocols and services that correspond to the bottom two layers of the ISO/OSI Reference Model (i.e., Layer 1 - the Physical Layer, and Layer 2 - the Link Layer) according to the general structure specified by the ITU for IMT-2000 systems. Layer 2 is further subdivided into the Link Access Control (LAC) sublayer and the Medium Access Control (MAC) sublayer. Applications and upper layer protocols corresponding to OSI Layers 3 through 7 utilize the services provided by the cdma2000 LAC services. Examples include Signaling Services, Voice Services, Packet Data Applications, and Circuit Data Applications. Development of the cdma2000 standards has, to the greatest extent possible, adhered to the architecture by specifying different layers in different volumes, i.e. the physical layer is specified in IS-2000-2, the MAC in IS-2000-3, the LAC in IS-2000-4, and upper layer signaling in IS-2000-5.

Motivated by higher bandwidths and the need to handle a wider variety of services, several enhancements have been incorporated into cdma2000 (these have been highlighted in Figure 5.5.2.1-1). In cdma2000, a generalized multi-media service model is supported. This allows any combination of voice, packet data, and high-speed circuit data services to be operating concurrently (within the limitations of the air interface system capacity). cdma2000 also includes a Quality of Service (QoS) control mechanism to balance the varying QoS requirements of multiple concurrent services (for example, to provide B-ISDN or RSVP QoS capabilities).

cdma2000 includes a flexible and efficient MAC entity that supports multiple data service state machine instances, one for each active packet or circuit data service instance. Along with the QoS Control entity, the MAC realizes the complex multi-media, multi-service capabilities of next generation wireless systems with QoS management capabilities for each active service.

cdma2000 also introduces a Link Access Control (LAC) protocol entity to support point-to-point transmission over the air for signaling services and (optionally) for circuit data services. To provide a high degree of flexibility in the evolution of Voice Services, cdma2000 provides the framework and services to transport encoded voice data in the form of packet data or circuit data traffic, as well as in a manner that is backward compatible with the current TIA/EIA-95-B family of standards (i.e., the encoded voice data is transported directly by the Physical Layer). In the latter example, the LAC and MAC services are considered to be null. As shown in Figure 5.5.2.1-1, the cdma2000 LAC sublayer is required to provide a reliable, in-sequence delivery transmission control function over the point-to-point radio transmission link. The LAC sublayer service may be accomplished using a suitable ARQ (retransmission) protocol if necessary. Alternatively, if the lower layers provide an adequate QoS, the LAC sublayer may be omitted (null).

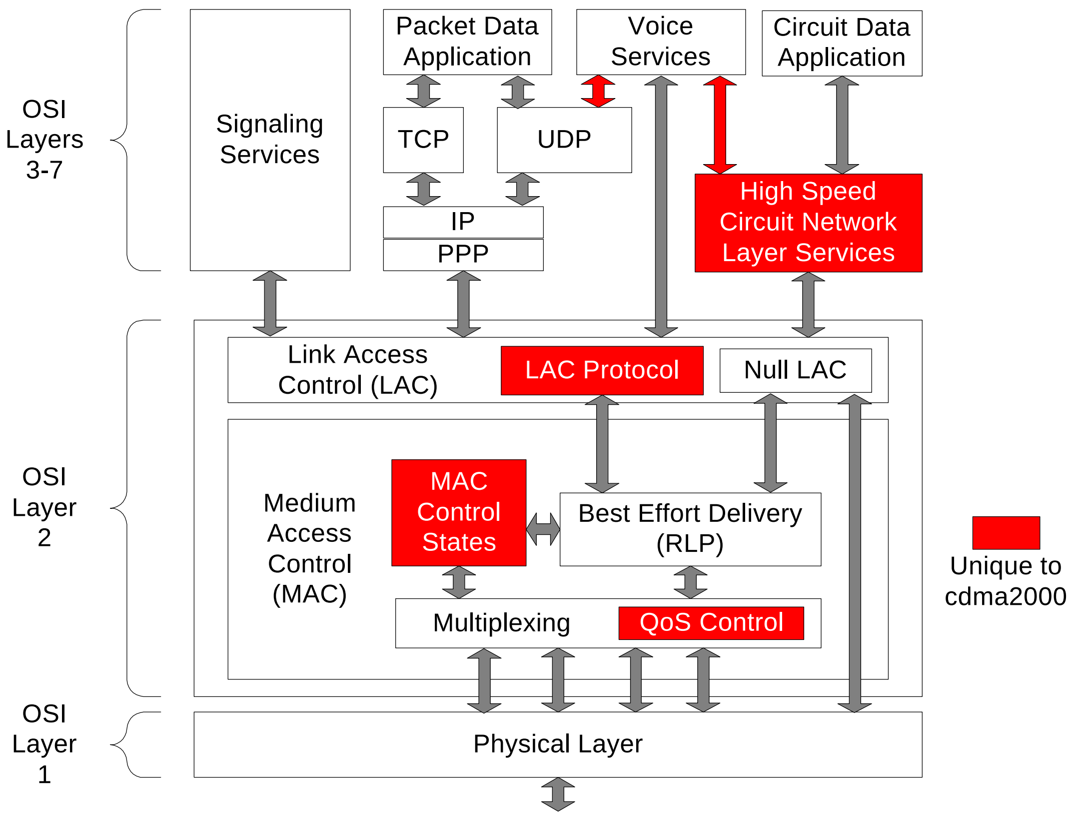


FIGURE 5.5.2.1-1

cdma2000 Layer Structure

5.5.2.2 Physical Layer

5.5.2.2.1 Introduction

cdma2000 supports RF channel bandwidths of N x 1.25 MHz (N = 1, 3, 6, 9, 12), where N is the Spreading Rate of the system. cdma2000 supports a class of band plans as specified in the IS-2000 standards. Signals transmitted on the Traffic Channel are specified by radio configurations. Radio configurations specify the data rates, channel encoding, and modulation parameters supported on the Traffic Channel. For Spreading Rates 1 and 3, there are six radio configurations for the reverse link and nine radio configurations for the forward link. Radio Configurations 1 and 2 are specified to provide backward compatibility with TIA/EIA-95-B systems.

5.5.2.2.2 cdma2000 Reverse Link (Uplink)

5.5.2.2.2.1 Channel Structure

As shown in Figure 5.5.2.2.2.1-1, the **Reverse Pilot Channel (R-PICH)** is an unmodulated spread spectrum signal used to assist the base station in detecting the mobile station transmission. The mobile station also inserts a **Reverse Power Control Subchannel** in the Reverse Pilot Channel. The Reverse Power Control Subchannel is used to transmit forward power control commands.

The **Access Channel (R-ACH)** is used by the mobile station to initiate communication with the base station and to respond to Paging Channel messages.

The **Enhanced Access Channel (R-EACH)** is used by the mobile station to initiate communication with the base station or to respond to a mobile station directed message. The Enhanced Access Channel can be used in three possible modes: Basic Access Mode, Power Controlled Access Mode, and Reservation Access Mode. Enhanced Access Channels are uniquely identified by their long codes.

The **Reverse Common Control Channel (R-CCCH)** is used for the transmission of user and signaling information to the base station when Reverse Traffic Channels are not in use. The Reverse Common Control Channel can be used in one of two possible modes: Reservation Access Mode and Designated Access Mode. Reverse Common Control Channels are uniquely identified by their long codes.

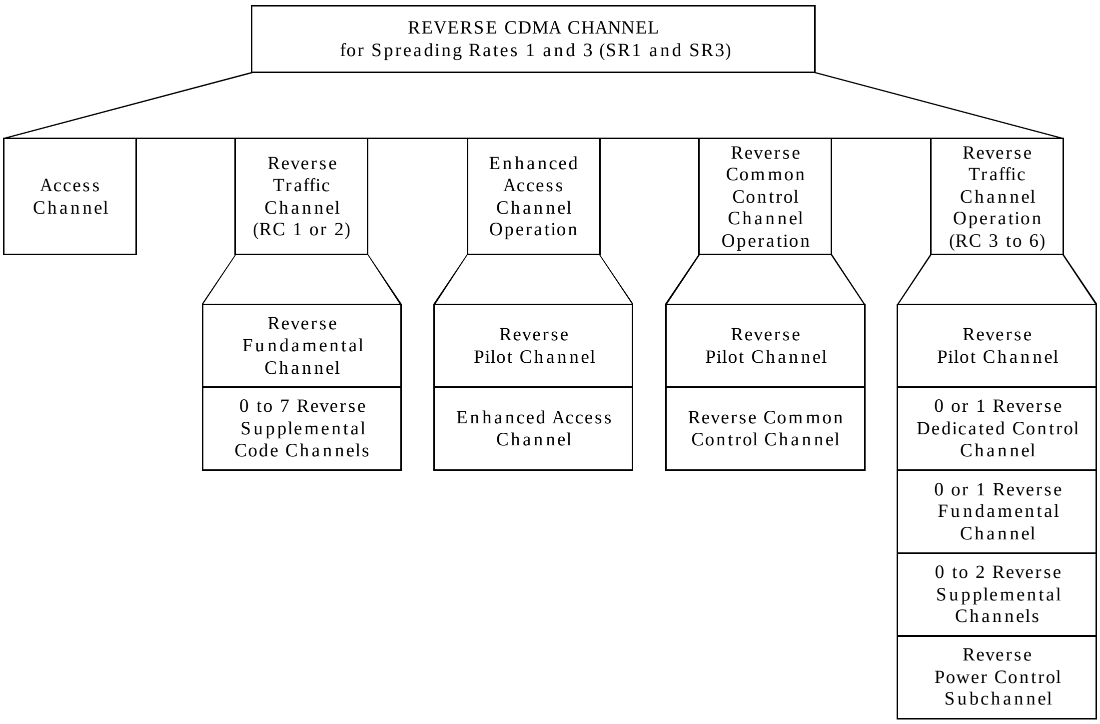


FIGURE 5.5.2.2.2.1-1

Reverse CDMA Channels Received at the Base Station

The Reverse Traffic Channels with Radio Configurations 1 and 2 include the **Reverse Fundamental Channel (R-FCH)** and **Reverse Supplemental Code Channel (R-SCCH).** The Reverse Traffic Channels with Radio Configurations 3 through 6 include the **Reverse Dedicated Control Channel (R-DCCH),** Reverse Fundamental Channel**,** and **Reverse Supplemental Channel (R-SCH).** The Reverse Dedicated Control Channel and Reverse Fundamental Channel are used for the transmission of user and signaling information to the base station during a call. The Reverse Supplemental Channel and Reverse Supplemental Code Channel are used for the transmission of user information to the base station during a call.

5.5.2.2.2.2 Channel Coding

Two types of channel coding methods are supported. Convolutional codes with rate 1/2, 1/3, or 1/4 and constraint length 9 are supported. Turbo codes with rate 1/2, 1/3, or 1/4 are supported on the Supplemental Channel for frames containing 360 or more information bits.

5.5.2.2.2.3 Code Symbol Repetition and Puncturing

Channel encoded symbols are repeated and punctured to match a nominal value of data rate before entering the block interleaver.

5.5.2.2.2.4 Block Interleaving

Block interleaving is used on the Access Channel, the Enhanced Access Channel, the Reverse Common Control Channel, and the Reverse Traffic Channels prior to modulation and transmission.

5.5.2.2.2.5 Spreading and Modulation

The modulation symbols are BPSK data modulated and direct spread prior to transmission. The spreading chip rate is N × 1.2288 Mcps (N = 1, 3, 6, 9, 12). For example, the spreading and modulation operation for N = 3 is shown in Figure 5.5.2.2.2.5-1.

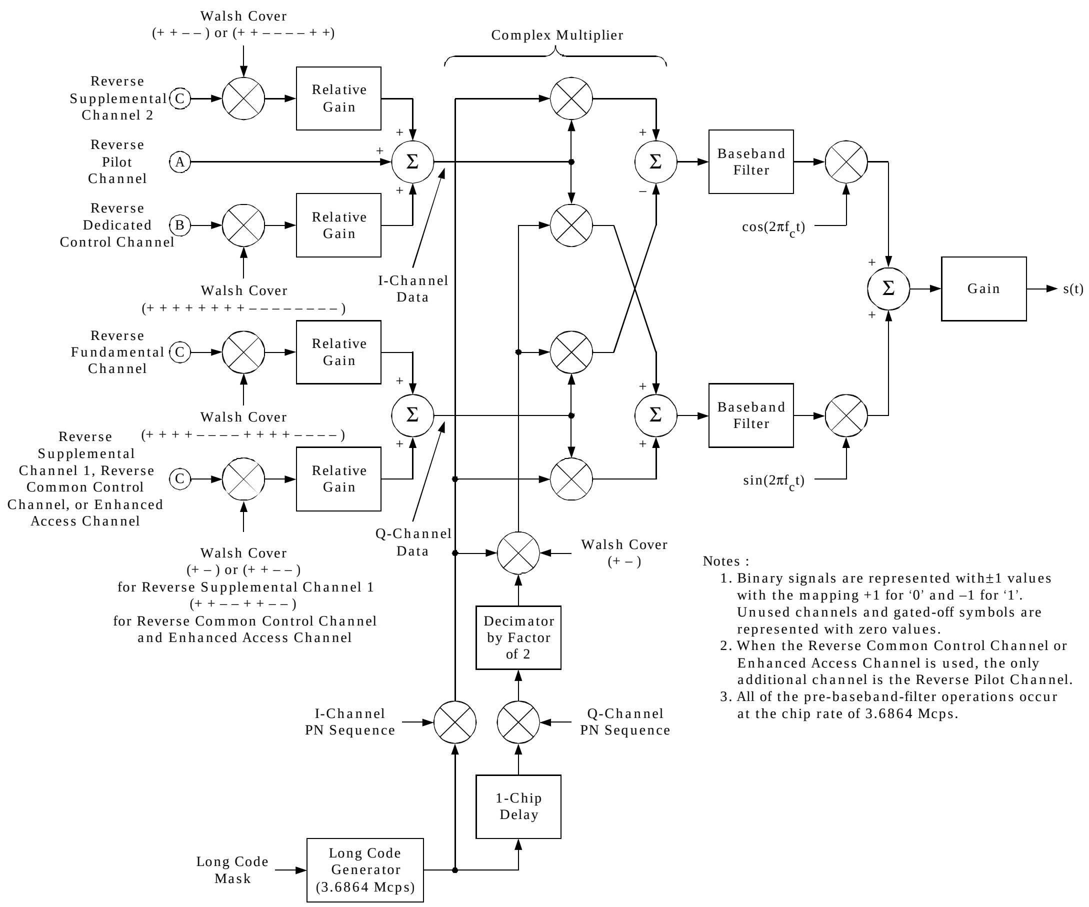


FIGURE 5.5.2.2.2.5-1

Example Spreading and Modulation for cdma2000 Reverse Link (N=3)

5.5.2.2.2.6 Power Control

The mobile station supports both inner loop and outer loop power control for Forward Traffic Channels. The outer loop estimates the setpoint value based on E_b/N_t to achieve the target frame error rate (FER) on each assigned Forward Traffic Channel. The inner loop compares the E_b/N_t of the received Forward Traffic Channel with the corresponding outer loop setpoint to determine the value of the power control bit to be sent on the Reverse Power Control Subchannel every 1.25 ms. The mobile station transmits the Erasure Indicator Bits (EIB) on the Reverse Power Control Subchannel upon the command of the base station.

5.5.2.2.2.7 Soft Handoff

Soft handoff is supported on cdma2000 reverse link. Soft handoff is achieved by performing diversity or selection combining at the base station.

5.5.2.2.3 cdma2000 Forward Link (Downlink)

5.5.2.2.3.1 Channel Structure

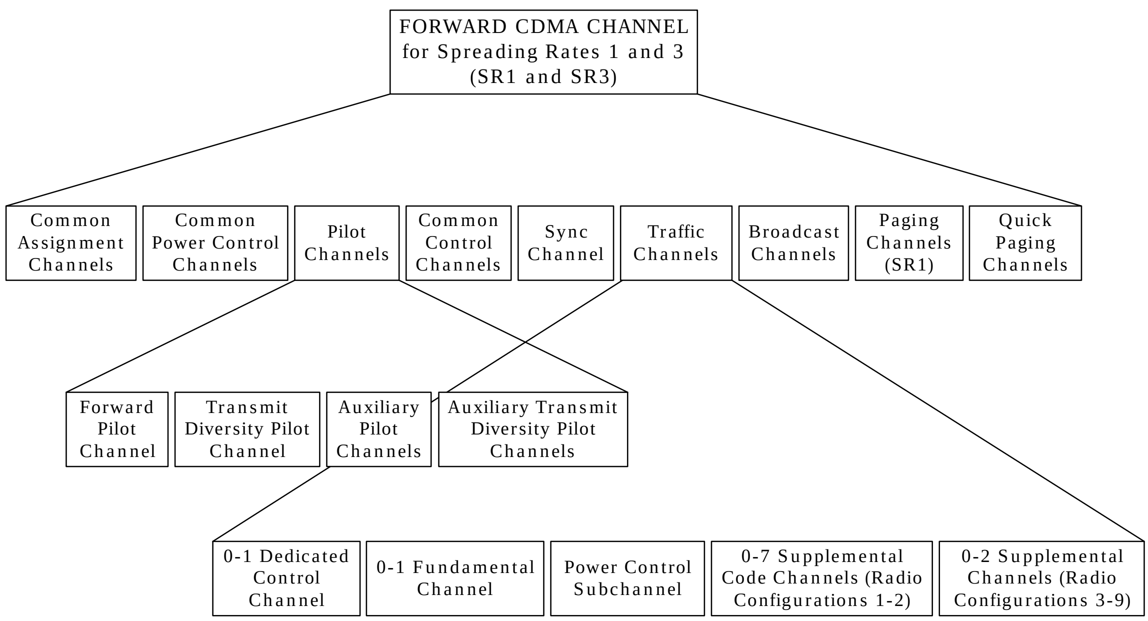


FIGURE 5.5.2.2.3.1-1

Forward CDMA Channels Received at the Mobile Station

As shown in Figure 5.5.2.2.3.1-1, the **Forward Pilot Channel (F-PICH)**, the **Transmit Diversity Pilot Channel (F-TDPICH)**, the **Auxiliary Pilot Channels (F-APICH)**, and the **Auxiliary Transmit Diversity Pilot Channels (F-ATDPICH)** are unmodulated spread spectrum signals used for synchronization by a mobile station operating within the coverage area of the base station. The Forward Pilot Channel is transmitted at all times by the base station on each active Forward CDMA Channel. The Auxiliary Pilot Channel is transmitted in a beam forming application. The Transmit Diversity Pilot Channel and the Auxiliary Transmit Diversity Pilot Channel are transmitted when transmit diversity is used.

The **Sync Channel (F-SYNCH)** is used by mobile stations operating within the coverage area of the base station to acquire initial time synchronization.

The **Paging Channel (F-PCH)** is used by the base station to transmit system overhead information and mobile station specific messages.

The **Broadcast Channel (F-BCH)** is used by the base station to transmit system overhead information.

The **Quick Paging Channel (F-QPCH)** is used by the base station to inform mobile stations, operating in the slotted mode while in the idle state, whether or not to receive the Forward Common Control Channel, the Broadcast Channel, or the Paging Channel.

The **Common Power Control Channel (F-CPCCH)** is used by the base station for transmitting common power control subchannels (one bit per subchannel) for the power control of multiple Reverse Common Control Channels and Enhanced Access Channels. The common power control subchannels are time multiplexed on the Common Power Control Channel. Each common power control subchannel controls a Reverse Common Control Channel or an Enhanced Access Channel.

The **Common Assignment Channel (F-CACH)** is used by the base station to provide quick assignment of the Reverse Common Control Channel.

The **Forward Common Control Channel (F-CCCH)** is used by the base station to transmit mobile station-specific messages.

For Radio Configurations 1 and 2, the Forward Traffic Channels include the **Forward Fundamental Channel (F-FCH) and Forward Supplemental Code Channel (F-SCCH).** For Radio Configurations 3 through 9, the Forward Traffic Channels include the **Forward Dedicated Control Channel (F-DCCH), Forward Fundamental Channel (F-FCH),** and **Forward Supplemental Channel (F-SCH).** Similar to the corresponding Reverse Traffic Channels, they are used for transmission of user and/or signaling information to a specific mobile station during a call. The Forward Traffic Channels also include the **Forward Power Control Subchannel.** It is used to transmit reverse power control commands and is transmitted either on the Forward Fundamental Channel or Forward Dedicated Control Channel.

5.5.2.2.3.2 Channel Coding

Two types of channel coding methods are supported. Convolutional codes with rate 1/2, 1/3, 1/4, or 1/6 and constraint length 9 are supported. Turbo codes with rate 1/2, 1/3, or 1/4 are supported on the Supplemental Channel for frames containing 360 or more information bits.

5.5.2.2.3.3 Code Symbol Repetition and Puncturing

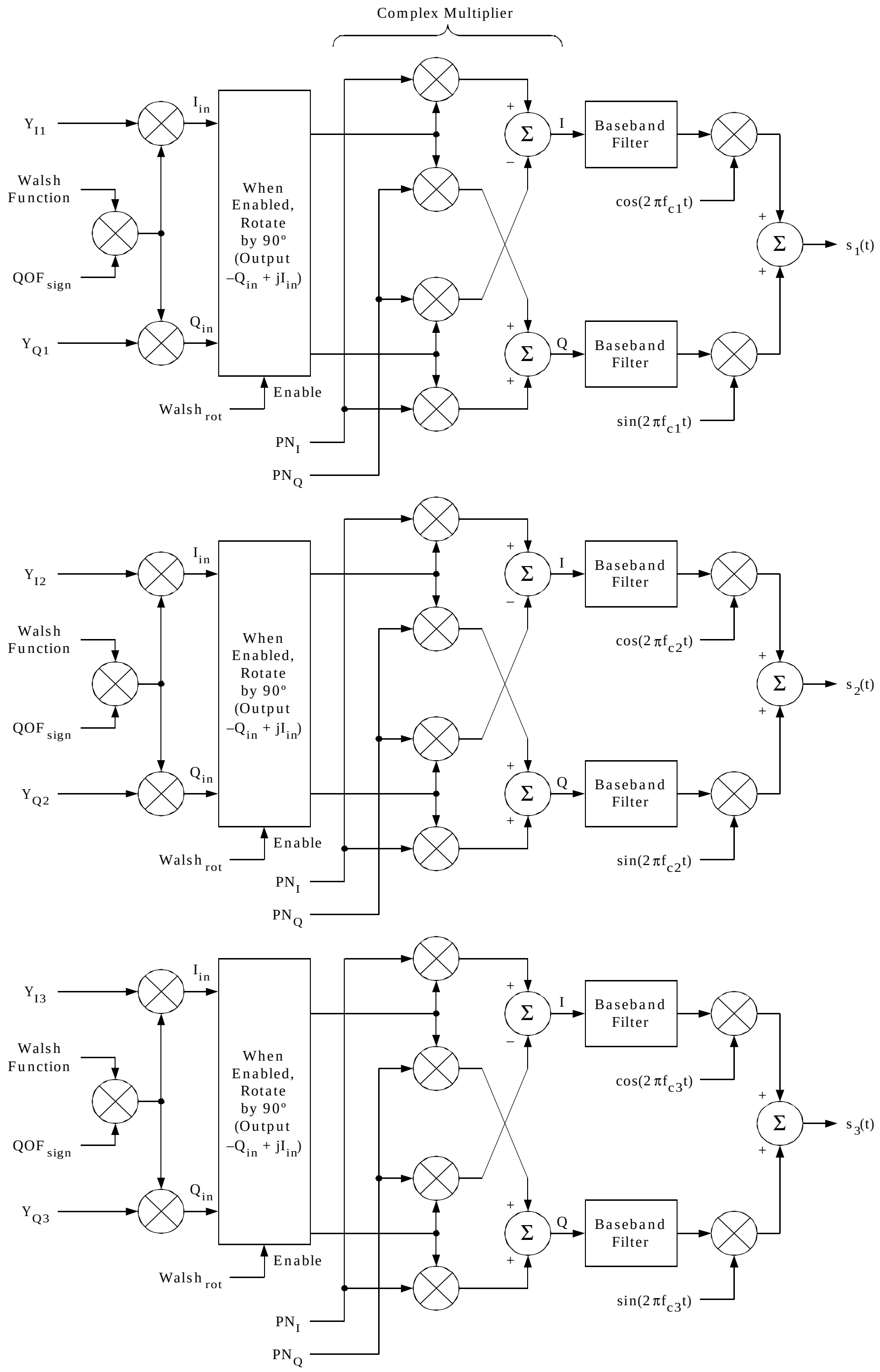
Channel encoded symbols are repeated and punctured to match a nominal value of data rate before entering the block interleaver.

5.5.2.2.3.4 Block Interleaving

Block interleaving is used on the Sync Channel, the Paging Channels, the Broadcast Channel, the Common Assignment Channel, the Forward Common Control Channel, and the Forward Traffic Channels prior to modulation and transmission.

5.5.2.2.3.5 Spreading and Modulation

When operating in Spreading Rate 1 (N=1), the output symbols from the block interleaver are mapped into pairs of quadrature modulation symbols. Each modulation symbol is spread by the appropriate Walsh or quasi-orthogonal function and then spread by a quadrature pair of PN sequences at a fixed chip rate of 1.2288 Mcps as shown in Figure 5.5.2.2.3.5-1. When operating with Orthogonal Transmit Diversity (OTD), interleaver output symbols are de-multiplexed into two pairs of quadrature modulation symbols, with each pair being spread by the appropriate Walsh or quasi-orthogonal function and a quadrature pair of PN sequences, then transmitted on two separate antennas. When operating in the Spreading Rate N (N=3, 6, 9, or 12) Multi-Carrier mode, the interleaver output symbols are de-multiplexed into N pairs of quadrature modulation symbols, with each pair being spread to a chip rate of 1.2288 Mcps and transmitted on N adjacent carriers. For example, the spreading and modulation for Spreading Rate 3 (N=3) Multi-Carrier forward link is shown in Figure 5.5.2.2.3.5-1. The cdma2000 Multi-Carrier system can be deployed as an overlay on up to N carriers of TIA/EIA-95-B family of standards. The cdma2000 Multi-Carrier system can also be deployed in clear spectrum.



Walsh Function = ±1 (Mapping: '0' → +1, '1' → –1)
QOF_{sign} = ±1 Sign Multiplier QOF Mask (Mapping: '0' → +1, '1' → –1)
$Walsh_{rot}$ = '0' or '1' 90º-Rotation-Enable Walsh Function
$Walsh_{rot}$ = '0' means no rotation
$Walsh_{rot}$ = '1' means rotate by 90º
The NULL QOF has QOF_{sign} = +1 and $Walsh_{rot}$ = '0'.
PN_I and PN_Q = ±1 I-Channel and Q-Channel PN sequences

FIGURE 5.5.2.2.3.5-1

Example Spreading and Modulation for cdma2000 Forward Link (N=3)

5.5.2.2.3.6 Power Control

The base station supports both inner loop and outer loop power control for the Reverse Traffic Channel similar to that for the Forward Traffic Channel.

5.5.2.2.3.7 Soft Handoff

Soft handoff is supported in cdma2000 forward link. Soft handoff is achieved by performing diversity combining at the mobile station.

5.5.2.2.3.8 Transmit Diversity

Transmit diversity is achieved by transmitting alternate coded and interleaved symbols on separate transmit antennas (OTD) or by transmitting separate carriers on separate antennas (Multi-Carrier Transmit Diversity).

5.5.2.3 Layer 2 – MAC

5.5.2.3.1. Introduction

The cdma2000 MAC sublayer provides three important functions:

- MAC Control States - procedures for controlling the access of data services (packet and circuit) to the Physical Layer (including contention control between multiple services from a single user, as well as between competing users within the wireless system);
- Best Effort Delivery - reasonably reliable transmission over the radio link with a Radio Link Protocol (RLP) that provides a “best effort” level of reliability; and
- Multiplexing and QoS Control - enforcement of negotiated QoS levels by mediating conflicting requests from competing services and the appropriate prioritization of access requests.

5.5.2.3.2 Layering Structure

The cdma2000 layering structure is composed of two separate planes: the control plane and the data plane. The principal advantage of this structuring is the clear definition of the service interfaces between all of the functional entities described by the cdma2000 layering structure.

The cdma2000 standard defines a *Resource Configuration Database*, which is a data structure that captures all of the complexity of the advanced multi-media/multi-service operating modes supported by a cdma2000 mobile station. The database can be read from and written to by the base station to precisely control the operating configuration of the mobile station, including such attributes as the current logical-to-physical channel mapping assignments and the currently defined physical channel configuration (e.g., dedicated vs. common control operation, number of active SCHs, DCCH vs. FCH, etc.).

Figure 5.5.2.3.2-1 depicts the major functional blocks of the Control and Data Planes. Note that in TIA/EIA/IS-2000, the interface between Upper Layer Signaling and the Physical Layer does not use service interface primitives, and that the MAC layer has an interface with Upper Layer Signaling (via the Resource Control entity). All MAC control procedures for both Upper Layer Signaling and the Physical Layer are implemented with primitives on the Resource Control to Upper Layer Signaling service interface. The following subsection describes the major entities within the revised functional model.

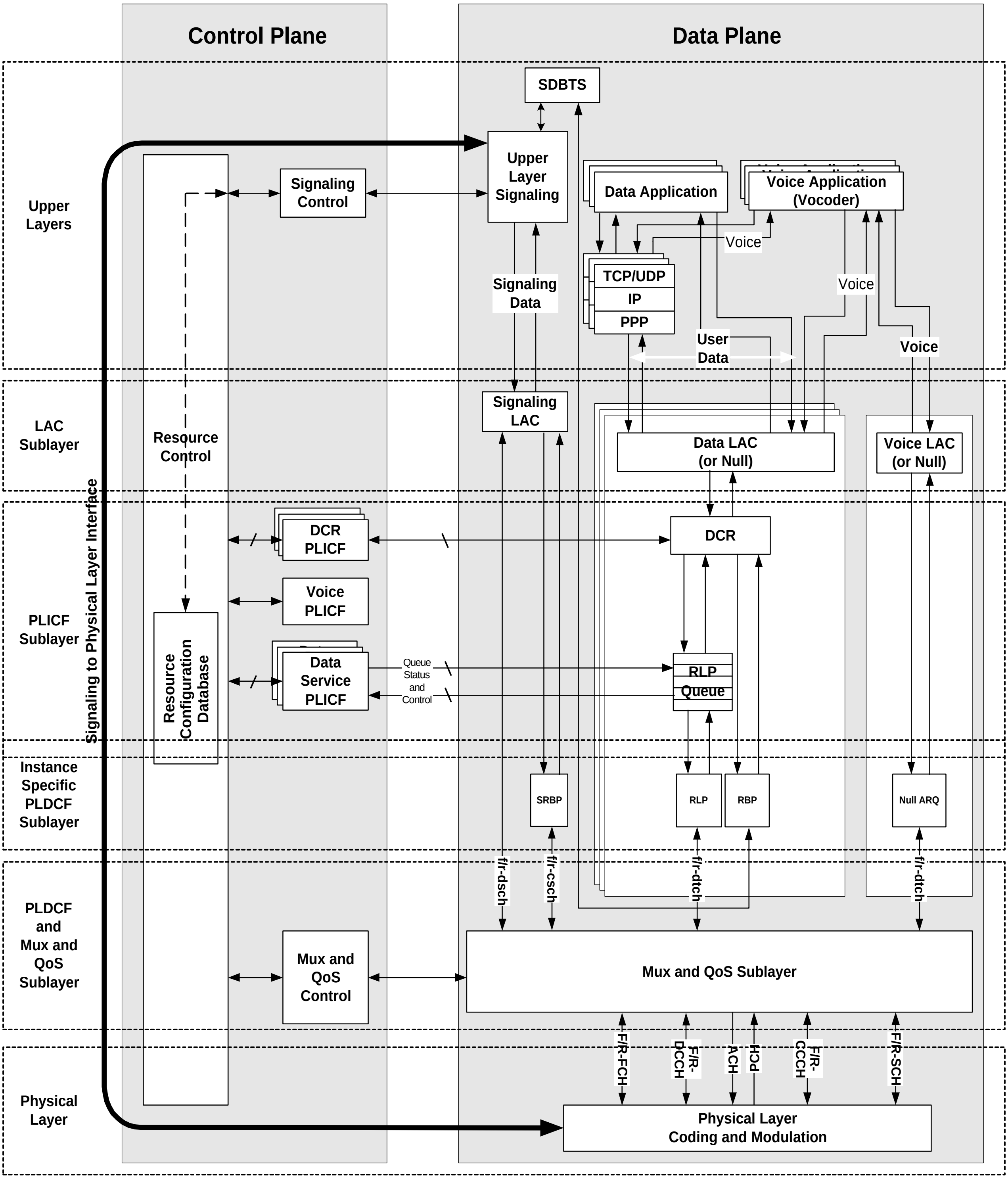


FIGURE 5.5.2.3.2-1

Layering Structure and Entities of the Control Plane and the Data Plane

5.5.2.3.3 Entities

5.5.2.3.3.1 Signaling Control

There is a single instance of the Signaling Control entity in each mobile station and a corresponding entity in the base station for each mobile station. This entity serves primarily as an agent to perform any required Control Plane operations on behalf of Upper Layer Signaling. This includes performing required access operations on the Resource Configuration Database (RCD) to satisfy Upper Layer Signaling requests to read/write information from/to the RCD. Signaling Control also transmits to Upper Layer Signaling any indications of events within the Control Plane that are significant from a signaling perspective. These indications are passed to the Signaling Control entity from the Resource Control entity (which acts as a central clearinghouse for resource requests).

5.5.2.3.3.2 DCR PLICF

There is one instance of the DCR PLICF corresponding to each active instance of data service and a corresponding entity in the base station for each data service instance in the mobile station. A DCR supports the routing of data traffic to the RLP protocol or the RBP protocols. The DCR PLICF entity for a Data Service instance provides the necessary configuration status information from Resource Control to DCR in order to determine whether LAC PDUs should be transmitted via RLP over dedicated channel or via RBP, which can be carried on either a dedicated or common channel.

The DCR PLICF enables Dormant State Short Data Bursts by ensuring a unique data service LAC PDU delivery path, depending upon whether the data service is operating over a Dedicated or Common Traffic Channel. This is accomplished by directing the transfer of LAC PDUs to RLP or RBP, depending upon whether the data service option is connected (i.e., RLP) or not (i.e., Dormant Burst Mode via RBP). The DCR PLICF instance exists even when the data service is in the Dormant State (in contrast to the Data Service PLICF which exists only when a data service option is connected).

5.5.2.3.3.3 Voice PLICF

There is one instance of the Voice PLICF for each voice service instance on the mobile station and a corresponding entity in the base station for each mobile station instance. This entity performs the Control Plane functions required to support the voice protocol stack. The primary function of the Voice PLICF is to request resources from the Resource Control entity, to satisfy the needs of voice services, e.g., to allocate a Dedicated Traffic Channel (dtch), and to indirectly cause the allocation of Physical Layer resources on which this logical channel is carried (i.e., the FCH).

5.5.2.3.3.4 Data Service PLICF

There is one instance of the Data Service PLICF for each instance of packet data service or circuit data service on the mobile station, and a corresponding entity in the base station for each mobile station instance. This entity performs the Control Plane functions required to support data service operation whenever the data service option is connected (e.g., in the Active, Control Hold, or Suspended States).

5.5.2.3.3.5 Resource Control

There is one instance of the Resource Control entity in the mobile station and a corresponding entity in the base station for each mobile station. This entity acts as a central clearinghouse for all resource requests on the mobile station (including both logical and physical channels). Resource Control also maintains a database of all configuration information about the mobile station in the Resource

Configuration Database. This configuration information is under direct control of the base station, which updates the database via Upper Layer Signaling messages. Accesses to the database are performed on behalf of Upper Layer Signaling by the Signaling Control entity.

All resource requests to the Resource Control entity (from Control Plane PLICF entities) are made via a set of primitives based upon a two-stage model:

1) *Request* the logical resource that is to be allocated and initialized.

2) *Lock* the resource for use by the requesting entity.

Because the cdma2000 association of logical-to-physical channels is not a simple one-to-one mapping, it is necessary to “logically OR” the logical channel requests from each of the active services (e.g., voice, packet data, and circuit data) to arrive at a set of physical channels that are required for the currently active bearer service configuration. This function is accomplished by the Resource Control entity. Resource Control essentially “merges” the resource *lock* requests from all PLICF entities, and determines the minimal set of physical resources that are required to meet the needs. Resource Control makes requests (via Signaling Control) to Upper Layer Signaling for any additional resources required from the base station (e.g., physical channels).

When Resource Control determines (via primitives from Signaling Control) that all resources requested by a PLICF have been secured, Resource Control sends lock confirmations to the appropriate PLICF entities. The PLICF entities may then complete any required state transitions based upon the confirmed resource availability (e.g., transitioning from the Control Hold to the Active State).

Resource Control maintains an association in the RCD of all requesting entities to the actual logical and physical resources. Whenever a resource is *unlocked* by all PLICF entities, that resource can be released by Resource Control. Following this release, a *resource release indication* is sent to any PLICF entities that had previously *requested* the resource. From this point on, the PLICF may *not* use the released resource (e.g., by performing another lock request). The resource must be *requested* again before it may be *locked* for use.

5.5.2.3.3.6 Signaling Control to Resource Control

Signaling Control has the following service interface with the Resource Control entity:

- logical resource allocation and locking/unlocking services;
- Control Plane entity creation and termination (e.g., when adding a Voice, Data Service PLICF instance when Upper Layer Signaling is requested to connect a particular Service Option);
- indications of required Upper Layer Signaling to support the currently active PLICFs (e.g., to obtain resources requested by PLICFs that are not currently assigned); and
- indications of changes in the active Logical-to-Physical Mappings due to Physical Layer changes.

5.5.2.4 Layer 2 – LAC

5.5.2.4.1 Introduction

The LAC Sublayer performs the following functions:

- Delivery of SDUs to the Layer 3 peer entity using ARQ techniques, when needed, to provide reliability.
- Building and validating well-formed PDUs, appropriate for carrying the SDUs.
- Segmentation of encapsulated PDUs into LAC PDU fragments of sizes suitable for transfer by the MAC Sublayer.
- Re-assembly of LAC PDU fragments into encapsulated PDUs.
- Access control through “global challenge” authentication. Conceptually, some messages failing authentication on a common channel should not be delivered to the Upper Layers for processing.
- Address control to ensure delivery of PDUs based upon addresses that identify particular mobile stations.

LAC signaling for IS-2000 is modeled as follows:

- **Planes**. There are two planes: the **Data Plane** (used for the signaling protocols) and the **Control Plane** (used for supervision of the protocol according to functional requirements).
- **Protocol Layers**. The LAC Sublayer provides services to Layer 3 in the Data Plane. SDUs are passed between Layer 3 and the LAC Sublayer. The LAC Sublayer provides the proper encapsulation of the SDUs into LAC PDUs, which are subject to segmentation and re-assembly and are transferred as LAC PDU fragments to the MAC Sublayer.
- **Sublayers**. Processing within the LAC Sublayer is done sequentially in the Data Plane, with processing entities passing the partially formed LAC PDU to each other in a well established order (sublayers are coordinated in the Control Plane).
- **Logical Channels**. SDUs and PDUs are processed and transferred along functional paths, without the need for the Upper Layers to be aware of the radio characteristics of the physical channels.

5.5.2.4.2 Control Plane and Data Plane

As shown in Figure 5.5.2.3.2-1, the general architecture is presented in two planes: a Control Plane, where processing decisions are made, and a Data Plane, where PDUs are generated, processed and transferred. The Data Plane contains the protocol, and is layered.

5.5.2.4.3 Protocol Sublayers

As a generated or received data unit traverses the protocol stack, it is processed by various protocol sublayers in sequence. Each sublayer processes only specific fields of the data unit that are associated with the sublayer-defined functionality. The general processing of data units by the LAC Sublayer and its sublayers is shown in Figure 5.5.2.4.3-1.

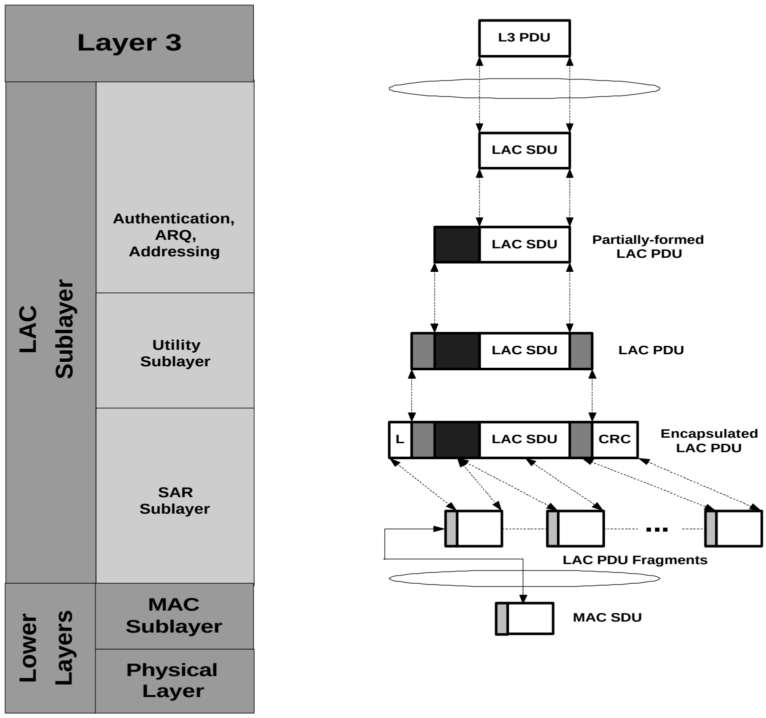


FIGURE 5.5.2.4.3-1

LAC Data Unit Processing

5.5.2.4.4. Logical Channels

In the Data Plane, Layer 3 and the LAC Sublayer send and receive signaling information on *logical channels*, thus avoiding the need to be sensitive to the radio characteristics of the physical channels used at Layer 1. IS-2000 systems use the following types of logical channel to carry signaling information:

- f-csch/r-csch (forward and reverse common signaling channel, respectively).
- f-dsch/r-dsch (forward and reverse dedicated signaling channel, respectively).

Logical channels are defined for the following purposes on IS-2000 systems:

- Synchronization.
- Broadcast.
- General signaling.
- Access.
- Dedicated signaling.

Multiple instances of the same logical channel may be deployed. Figures 5.5.2.4.4-1 and 5.5.2.4.4-2 show the IS-2000 logical channels on the forward and reverse links, respectively.

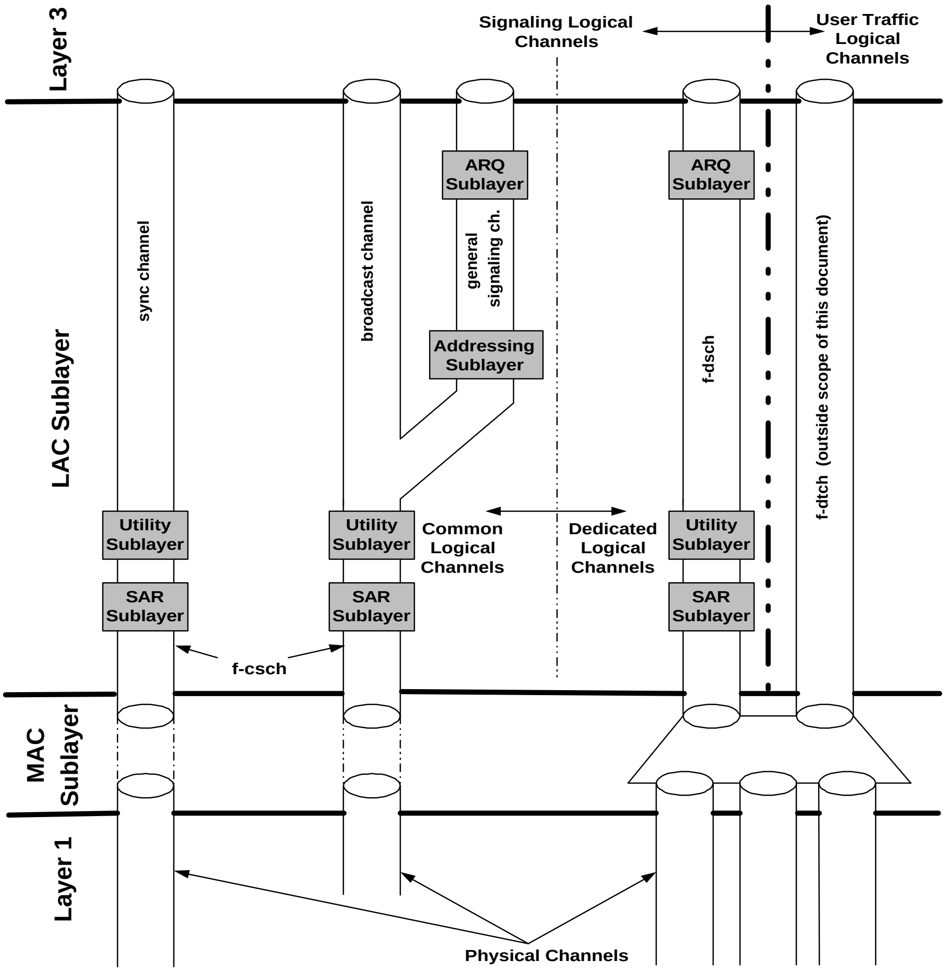


FIGURE 5.5.2.4.4-1

Forward Logical Channel Architecture

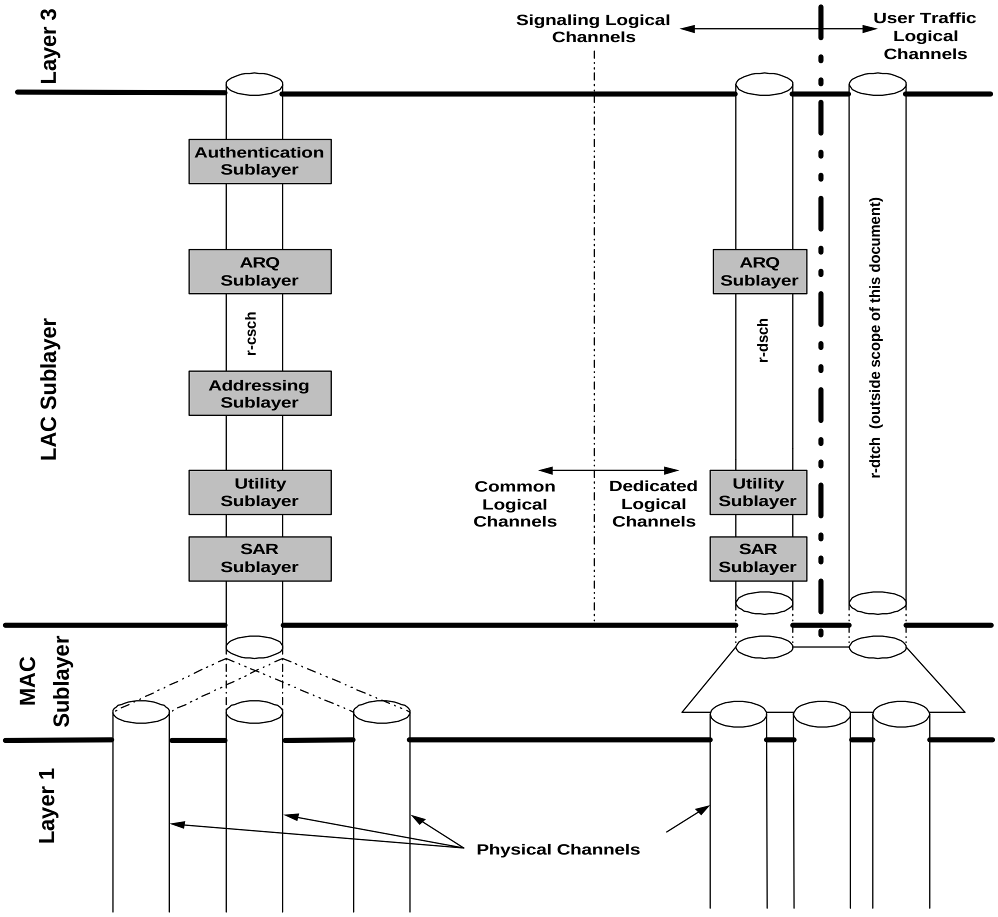


FIGURE 5.5.2.4.4-2

Reverse Logical Channel Architecture

5.5.2.5 Layer 3 Signaling

Layer 3 Signaling provides a flexible structure designed to support a wide range of radio interface signaling alternatives:

- Backward compatible to TIA/EIA-95-B Layer 3 signaling.
- Native cdma2000 Upper Layer Signaling; and
- Other existing or future Upper Layer Signaling entities.

In addition to supporting the standard Cellular and PCS features, Layer 3 Signaling also supports the following radio dependent features and capabilities:

- Radio configuration negotiation.
- Quick Paging Operation to improve battery life.
- Handoff Capabilities (i.e., soft handoff, hard handoff, idle handoff, access probe handoff, and access handoff).

- Power Control.
- High Speed Data.
- MAC State transitions.

Layer 3 Signaling also supports operations on the Access Channel, Sync Channel, Paging Channel, Quick Paging Channel, Dedicated Control Channel, Fundamental Channel, Supplemental Channel, and Supplemental Code Channel.

5.5.2.6 Summary of Major Technical Parameters

TABLE 5.5.2.6-1

Summary of Major Technical Parameters

Parameter	Value	Reference
Multiple access technique and duplexing scheme	Multiple access technique: DS-CDMA (UL); MC-CDMA (DL) Duplexing Scheme: FDD	TIA/EIA/IS-2000-2 Sections 2.1.3.1 (UL) and 3.1.3.1 (DL)
Chip rate	N X 1.2288 Mcps, where N = 1, 3, 6, 9, 12	TIA/EIA/IS-2000-2 Sections 2.1.3.1.2 (UL) and 3.1.3.1.2 (DL)
Inter base station asynchronous/ synchronous operation	Synchronous operation is required.	TIA/EIA/IS-2000-2 Sections 1.3 and 3.1.3.3
Pilot structure	Code divided continuous dedicated pilot (UL) Code divided continuous common pilot (DL) Code divided continuous common or dedicated auxiliary pilot (DL)	TIA/EIA/IS-2000-2 Sections 2.1.3.2 (UL) and 3.1.3.2 (DL)
Frame length	5, 10, 20, 40, 80 ms	TIA/EIA/IS-2000-2 Sections 2.1.3.3 - 2.1.3.9 (UL) and 3.1.3.3 - 3.1.3.13 (DL)
Modulation and detection	Data modulation: UL - BPSK; DL - QPSK Spreading modulation: UL - HPSK; DL - QPSK Detection: Pilot aided coherent detection	TIA/EIA/IS-2000-2 Sections 2.1.3.1.1 (UL) and 3.1.3.1.1 (DL)
Channelization code	Walsh codes (UL) Walsh codes or quasi-orthogonal codes (DL)	TIA/EIA/IS-2000-2 Sections 2.1.3.1.8 (UL) and 3.1.3.1.12 (DL)
Scrambling code	Long code (with a period of 2^42-1 chips for N=1) Short PN code (with a period of 2^15 chips for N=1) where N is the spreading rate number.	TIA/EIA/IS-2000-2 Sections 2.1.3.1.11 - 2.1.3.1.12 (UL) and 3.1.3.1.12 (DL)

TABLE 5.5.2.6-1 (*CONTINUED*)

Summary of Major Technical Parameters

Parameter	Value	Reference
Channel coding	Convolutional code with K=9, R=1/2, 1/3, 1/4, or 1/6 Turbo code with K=4, R=1/2, 1/3, or 1/4	TIA/EIA/IS-2000-2 Sections 2.1.3.1.4 (UL) and 3.1.3.1.4 (DL)
Interleaving	5, 10, 20, 40, 80 ms channel interleaving	TIA/EIA/IS-2000-2 Sections 2.1.3.1.7 (UL) and 3.1.3.1.7 (DL)
Access Scheme	RsMA - Flexible Random Access Scheme allowing three modes of access: – Basic Access – Power Controlled Access – Reserved Access Designated Access Scheme - access scheme initiated by the base station message	TIA/EIA/IS-2000-2 Sections 2.1.3.4 and 2.1.3.5
Power control	Open loop Close loop (800 Hz or 50 Hz update rate) Power control steps: 1.0, 0.5, 0.25 dB	TIA/EIA/IS-2000-2 Sections 2.1.2.3.2 and 2.1.3.1.10 (UL), and 3.1.3.1.10 (DL)
Standby RF output power	Should be less than -61 dBm/MHz measured at the mobile station antenna connector.	TIA/EIA/IS-2000-2 Section 2.1.2.2.3

5.5.3 Detail Specification of the Radio Interface

[Editor's Note:

– *This section corresponds to the "Reference part (70%)".*

– *This section should include all references to ensure worldwide compatibility.*

– *Description style of this section should be based on Annex-1 of Doc. 8-1/TEMP/213.*

– *TG 8/1 requests SDOs to review and update this part.*

– *Terminology : SDO's terminology which should also be referenced in this part*

– *Input material : 371 (Annex B, 3GPP2)]*

5.5.3.1 References

The six volumes in the TIA ballot version of IS-2000 are:

IS-2000-1 – Introduction to cdma2000 Standards for Spread Spectrum Systems

IS-2000-2 – Physical Layer Standard for cdma2000 Spread Spectrum Systems

IS-2000-3 – Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems

IS-2000-4 – Signaling Layer 2 Standard for cdma2000 Spread Spectrum Systems

IS-2000-5 – Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems

In addition, IS-2000 includes the standard that specifies analog operation, to support dual-mode mobile stations and base stations:

IS-2000-6 –Analog Standard for cdma2000 Spread Spectrum Systems

5.5.3.2 IS-2000 Layer One (Physical) Table of Content (See the ballot version of IS-2000-2 for details)

5.5.3.3. IS-2000 Layer Two MAC Table of Content (See the ballot version of IS-2000-3 for details)

5.5.3.4. Base Station Performance Table of Content (See the to-be-published IS-97D for details)

5.5.3.5 Mobile Station Performance Table of Content (See the to-be-published IS-98D for details)

13 CDMA Protocol Conformance Testing

14 CDMA Options

15 Subscriber Interface Requirements

5.5.3.6 Other Specifications

– IS-126

– Voice Services (see IS-127 for details)

– High Speed Data Services (see IS-707 for details)

– Core Network (see ANSI-41 evolved specifications for details)

5.6 Radio Interface No.-N

5.6.1 Introduction

[Editor's Note:

– *This section corresponds to the "Original part (10%)".*

– *This subsection 5-X corresponds to materials supplied by [SDO], i.e. Docs. 8-1/xxx, 8-1/yyy, and 8-1/zzzz.*

– *TG 8/1 will develop this part based on input contributions.*

– *Terminology : ITU-R M.1224]*

5.6.2 Overview of the Radio Interface

[Editor's Note:

This section gives summary information of the radio interface. The complete definition of the radio interface is given in section 5.6.3.

– *This section corresponds to the "Extracted part (20%)".*

– *This section should have the structure and style defined by Annex-1 of Doc. 8-1/TEMP/213.*

– *This section should include the Summary of Major Technical Parameters Table shown in the format defined by Annex-1 of Doc. 8-1/TEMP/213.*

– *TG 8/1 requests SDOs to develop this part using the style guide defined above.*

– *Terminology : SDO's terminology]*

5.6.3 Detail Specification of the Radio Interface

[Editor's Note:

– This section corresponds to the "Reference part (70%)".

– This section should include all references to ensure worldwide compatibility.

– Description style of this section should be based on Annex-1 of 8-1/TEMP/213.

– TG 8/1 requests SDOs to review and update this part.

– Terminology : SDO's terminology which should also be referenced in this part]

6 Recommendations (Satellite Component)

[Editor's Note: This section is for Recommend 2 on Satellite Component Radio interfaces.]

6.1 Introduction

[Editor's Note: Text will be developed if necessary].

6.2 Core Network Interface

[Editors's Note: Elements for consideration include:

– *Common signalling for seamless roaming with terrestrial networks*

– *Database management and registration requirements*

– *Satellite/terrestrial interoperability]*

6.3 Satellite/Terrestrial Terminal Interface

[Editor's Note: Since satellite systems are inherently global in nature, it is not necessary to define roaming and interoperability between different satellite networks. Thus, this section focuses on the roaming and interoperability between satellite and terrestrial networks.

– *Multi-mode terminals interworking with terrestrial networks*

– *Use of numbering*

– *Component choice and use*

– *User Identity Module]*

6.4 Radio Interface Specifications

The specification of each satellite radio interface is given in the following sub-sections. These include only elements related to the service link interface; the feeder link and inter-satellite link interfaces are not specified in this recommendation.

Because of the strong dependency between the radio interface design and overall satellite system optimisation, this section includes the architectural and system descriptions as well as the RF and baseband specifications of radio interfaces.

6.4.1 Satellite Radio Interface A Specifications

6.4.1.1 Architectural description

6.4.1.1.1 Constellation

6.4.1.1.2 Satellites

6.4.1.2 System description

6.4.1.2.1 Service features

6.4.1.2.2 System features

6.4.1.2.3 Terminal features

6.4.1.3 RF specifications

6.4.1.4 Baseband specifications

6.4.2 Satellite Radio Interface B Specifications

6.4.3 Satellite Radio Interface C Specifications

_ …

6.5 Coexistence with Other Systems and Services

[NOTE – Recommendation RSPC should describe at a high level those elements needed for worldwide compatibility of operation. For separate systems and services to coexist, one of the important criteria is that the interference between these systems should be kept to a minimum. Reference should be made to Recommendation ITU-R M.1343 and Recommendation ITU-R M.xxx (currently being developed in WP 8D) as the appropriate Recommendations containing unwanted emission limits for IMT-2000 satellite terminals.]

[Editor' Note: This section may be merged to Section 7 on the generic unwanted emission limit for IMT-2000 terminals.]

7 Recommendations (Generic Unwanted Emission Limits)

[Editor's note: This section is for Recommend 3 on Unwanted Emission Limits.]

[See Document 8-1/TEMP/203.]