ETSI EN 302 405 V7.1.1 (2000-08)

European Standard (Telecommunications series)

**Digital cellular telecommunications system (Phase 2+);
GSM Cordless Telephony System (CTS), Phase 1;
CTS Architecture Description;
Stage 2
(GSM 03.56 version 7.1.1 Release 1998)**

Reference
DEN/SMG-030356Q7

Keywords
Digital cellular telecommunications system,
Global System for Mobile communications
(GSM),GSM Cordless Telephony System (CTS)

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://www.etsi.org/ipr).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Special Mobile Group (SMG).

The present document was submitted to Public Enquiry with the ETSI number 301 405. For Vote the number was changed to 302 405 because the number 301 405 is reserved and was allocated accidentally.

The present document specifies the stage 2 description of the CTS service within the digital cellular telecommunications system.

The contents of the present document are subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of the present document it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 7.x.y

where:

7 Indicates GSM Phase 2+ Release 1998;

x the second digit is incremented for technical enhancements, corrections, updates, etc

y the third digit is incremented when editorial only changes have been incorporated in the specification.

National transposition dates	
Date of adoption of this EN:	21 July 2000
Date of latest announcement of this EN (doa):	31 October 2000
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 April 2001
Date of withdrawal of any conflicting National Standard (dow):	30 April 2001

Introduction

This system architecture stage 2 description is part of the overall standard for a GSM based Cordless Telephony System (GSM-CTS).

The system is intended to provide a cordless connection between the PSTN/ISDN network or a GSM network and GSM-based CTS Mobile Stations (GSM-MS) via a private CTS Fixed Part (CTS-FP).

1 Scope

The present document defines the stage 2 description for the Cordless Telephony System (CTS) based on GSM radio. As the second stage of a three-level structure, it is derived from the stage 1 service description.

As mentioned already in the stage 1 description, a phased approach is indispensable to have an early first specification ready for market needs. The first phase focuses on the requirements necessary to elaborate the radio interface and the security aspects for an application supporting the speech tele-service (including DTMF support) in a residential single cell environment.

The standardisation of the physical layers of the GSM-CTS fixed network interface is not in the scope of the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

[1] GSM 01.04: "Abbreviations and Acronyms", Version 5.0.0.

[2] GSM 02.56: "Digital cellular telecommunications system (Phase 2+), Phase 1; GSM Cordless Telephony System (CTS), Phase 1; Service Description; Stage 1".

[3] GSM 03.03 "Digital cellular telecommunications system (Phase 2+); Numbering, addressing and identification".

[4] GSM 03.20: "Digital cellular telecommunication system (Phase 2+); GSM Cordless Telephony System (CTS), Phase 1, Security related network functions; stage 2".

[5] GSM 03.52 "Digital cellular telecommunication system (Phase 2+); GSM Cordless Telephony System (CTS), Phase 1, Lower layers of the CTS radio interface".

[6] GSM 03.40: " Digital Cellular Telecommunications System (Phase 2+); Technical Realisation of the Short Message Service (SMS) Point-to-Point (PP)".

3 Definitions and abbreviations

3.1 Definitions

Besides the definitions according to the CTS stage 1 service description [2] the following definitions are applicable to the present document:

Fixed network: A PSTN or ISDN network.

Access network: the network on which the CTS-FP is connected and which carries the incoming and outgoing calls to the CTS-FP. It could be either a fixed network or a GSM network.

CTS radio interface: The radio interface between CTS-MS and CTS-FP.

CTS-MSIx: CTS Local Mobile Subscriber Identity related to the xth CTS-MS initialised on a CTS-FP

CTS-MS attachment: CTS-MS attachment is a procedure which a CTS-MS initiates when the CTS-MS detects that it is within coverage of a CTS-FP to which the CTS-MS is enrolled.

CTS-MS detachment: CTS-MS detachment is a procedure that the CTS-MS initiates, and indicates to the CTS-FP that the CTS-MS will be no longer reachable by the CTS-FP.

Enrollment: The procedure by which a CTS-MS is made known to a CTS-FP in order that the CTS-FP can provide CTS service.

3.2 Abbreviations

The following list describes the abbreviations and acronyms used in the present document. The GSM abbreviations explained in GSM 01.04 [1] are not included below.

CTS	Cordless Telephony System
CTS FRA	CTS Frequency allocation functional entity
CTS HLR	CTS Home Location Register Functional entity
CTS-FP	CTS-Fixed Part
CTS-MS	CTS-Mobile Station
CTS-MSI	CTS Mobile Subscriber Identity in the CTS-FP
CTS-MSN	CTS Mobile Station Number
CTS-SAP	CTS Service Access Point
CTS-SIM	CTS Subscriber Identity Module
DPLMN	Donor PLMN
GFL	Generic Frequency List

4 Main concepts

4.1 CTS definition

The CTS operator can provide a CTS service which allows (using a modified GSM radio interface) to provide a cordless telephone service attached to the fixed network or to a cellular network. The services offered by CTS are limited to the type of network to which the CTS-FP is connected. In order to offer this service the CTS operator needs to have an agreement with a GSM operator in order to use the frequencies belonging to his PLMN by the CTS FP. This type of PLMN is termed to be a Donor PLMN (DPLMN).

NOTE: The CTS operator may be a GSM operator.

Depending upon the operator agreements a person wanting to operate a CTS-FP (the CTS FP subscriber) may be required to have at least three subscriptions: one with the CTS operator, and one with the GSM operator; and in addition to these subscriptions the CTS FP subscriber needs to have either a subscription to a fixed or GSM operator to which the CTS FP is to be connected or access to a fixed line interface.

The frequencies which the CTS service uses may be controlled by the operator which holds the license for the GSM frequency band used for the service.

The CTS FP subscriber can have agreements with other CTS MS subscribers to use his base station.

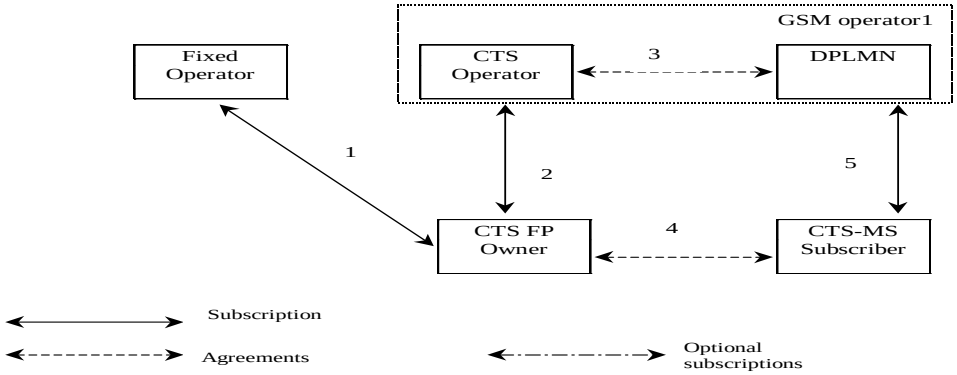
The role model is described in [2].

4.2 CTS Network

A CTS network is defined to be made up of one or more CTS cells. When a CTS network has more than one cell these cells are synchronised (in frequency, at TDMA frame edges and TDMA frame number) on the radio interface.

4.3 CTS Role models

4.3.1 CTS FP owner's role model



CTS role model for a CTS FP subscriber

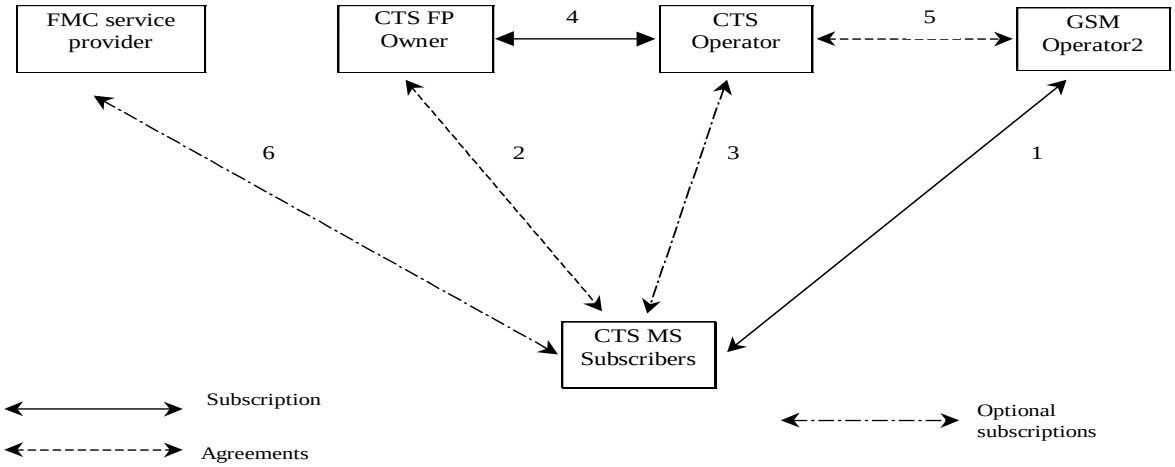
In order to receive a valid CTS-GFL the CTS-FP owner needs to have a subscription (2) with a CTS operator. This subscription is materialised by a CTS-SIM card stored in the CTS-FP. The CTS operator has an agreement (3) with a DPLMN part of a GSM operator1 to use its frequencies for CTS allocation.

When the CTS-FP is used in licence exempt mode, the CTS-FP owner does not need to have a subscription (2) with a CTS operator. In this case the frequency allocation to CTS usage is made directly by national authorities.

CTS-FP owner shall also enrol (4) at least one CTS-MS, which has a valid GSM subscription (5) with the GSM operator1.

In parallel, CTS-FP owner needs a subscription (1) with an access network operator in order establish communication over the network. This access network could be either a fixed network or a GSM network depending of CTS-FP capabilities. When the CTS-FP is connected to a GSM network, this GSM operator does not need to have any relation with the GSM operator1 who provides CTS frequencies (DPLMN).

4.3.2 CTS MS subscriber's role model



CTS MS subscriber's role model

The CTS-MS subscriber has a valid subscription (1) with a GSM operator who allows CTS operations. In case of roaming, the VPLMN shall confirm the authorisation to do CTS operations to this CTS-MS.

The CTS MS subscriber has agreement (2) with one CTS-FP owner that allows him to enrol on his CTS FP.

In order to enrol on a CTS-FP, a CTS-MS subscriber may need a subscription (3) with the CTS-operator who control (4) this CTS-FP. This CTS-operator may have an agreement (5) with the GSM-operator of this CTS-MS.

NOTE: this GSM operator may be different from the one who provides frequencies to the CTS-operator.

In order to have access to value added Fixed Mobile Convergence services (e.g. unified number), the CTS-MS subscriber needs a subscription (6) with a FMC service provider. These services and this subscription are outside of the scope of the GSM-CTS standard.

4.4 CTS Radio interface

The CTS radio interface is based on the use of a modified GSM radio interface as specified in [5].

The concept is to construct a modified GSM radio interface which requires no change of ME hardware, only software need be changed. The modified GSM radio interface shall (on both uplink and downlink) only cause minimal disturbance to the DPLMN.

In order to achieve this, three concepts have been adopted:

- A modified low power radio interface using GSM burst formats that cause limited disturbance to present GSM mobiles and infrastructure, see [5];
- Adaptive Frequency Allocation (AFA), see [5];
- Total Frequency Hopping (TFH), see [5].

4.4.1 Adaptive Frequency Allocation

In order to minimise interference between CTS networks and GSM networks, an Adaptive Frequency Allocation (AFA) mechanism is adopted, where by the CTS FP chooses frequencies within a valid GFL where the up link and down link is interfered the least. The concept and the mechanisms used are described in more detail in [5].

4.4.2 Total Frequency Hopping

To reduce further the possibility of interference (with the GSM PLMNs and others CTS-FP/MS pairs) a Total Frequency Hopping (TFH) mechanism is adopted. The concept of TFH and the mechanisms used are described in more detail in [5].

4.4.3 CTS and GSM compatibility issues

CTS service cannot be offered to existing mobile implementations without a change of software.

Compatibility issues for GSM mobiles which are not operating in CTS mode may be solved by two ways:

- the CTS radio interface is designed in order to create minimum disturbance to existing mobile implementations as specified in [5];
- and by offering the GSM operator control over the frequencies used for CTS operation.

4.5 CTS operational requirements

The CTS operator together with agreements from the GSM operator can define the coverage conditions under which CTS service can be offered to the subscriber. The following coverage conditions are identified:

- GSM coverage from the DPLMN. That is to say where the coverage of the DPLMN meets the cell (re)selection criteria for obtaining DPLMN service.
- Limited coverage from the DPLMN. That is to say where the coverage of the DPLMN doesn't meet cell (re)selection criteria for obtaining service where the CTS-FP is installed.
- No GSM coverage from the DPLMN.

4.5.1 GSM coverage from DPLMN

In this case the CTS FP's coverage is fully within the coverage of the DPLMN.

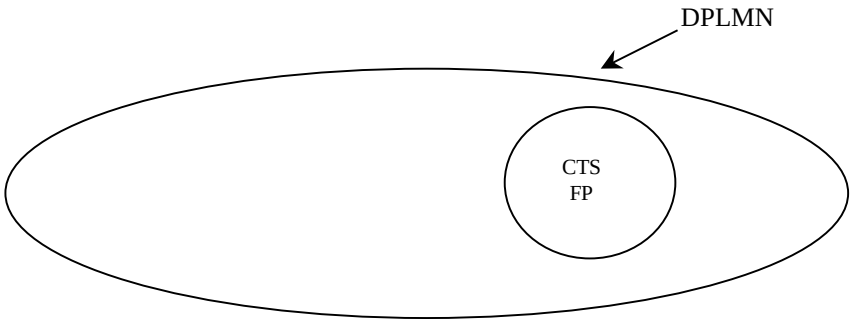


Figure 1: GSM coverage from DPLMN

4.5.2 Limited GSM coverage from DPLMN

Two cases are identified.

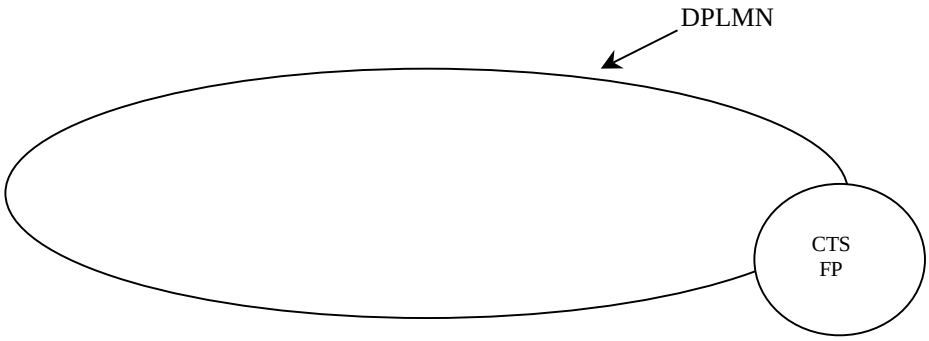


Figure 2: Limited GSM coverage from DPLMN

The coverage of the DPLMN is partially achieved in the range of the CTS FP.

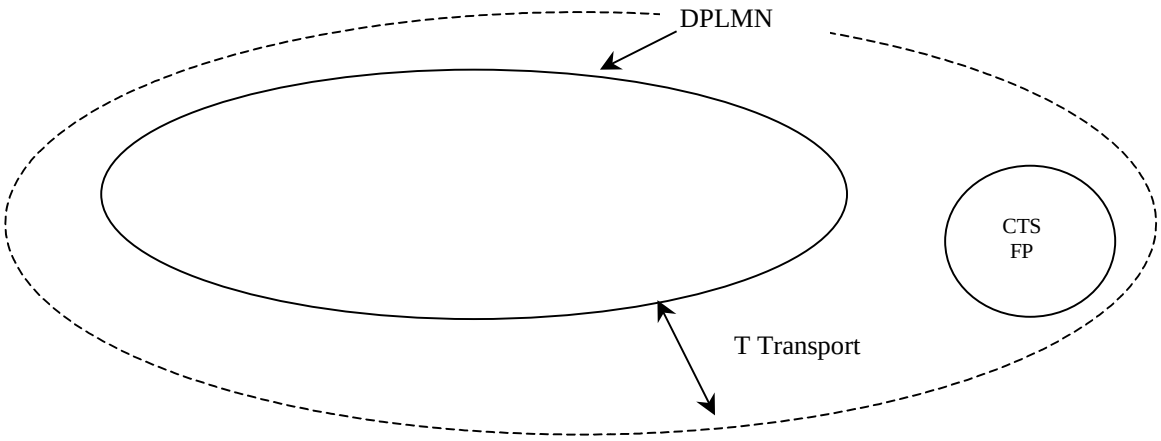


Figure 3: Limited coverage from DPLMN within T TRANSPORT

The coverage of the DPLMN is not achieved in the range of the CTS FP but is located within a distance, such that, the time it takes between loss of contact from the DPLMN to the time the CTS MS can be brought into coverage of the CTS FP is within T_TRANSPORT.

4.5.3 No GSM coverage from DPLMN

The time between leaving DPLMN and entering the CTS FP coverage is longer than T_TRANSPORT.

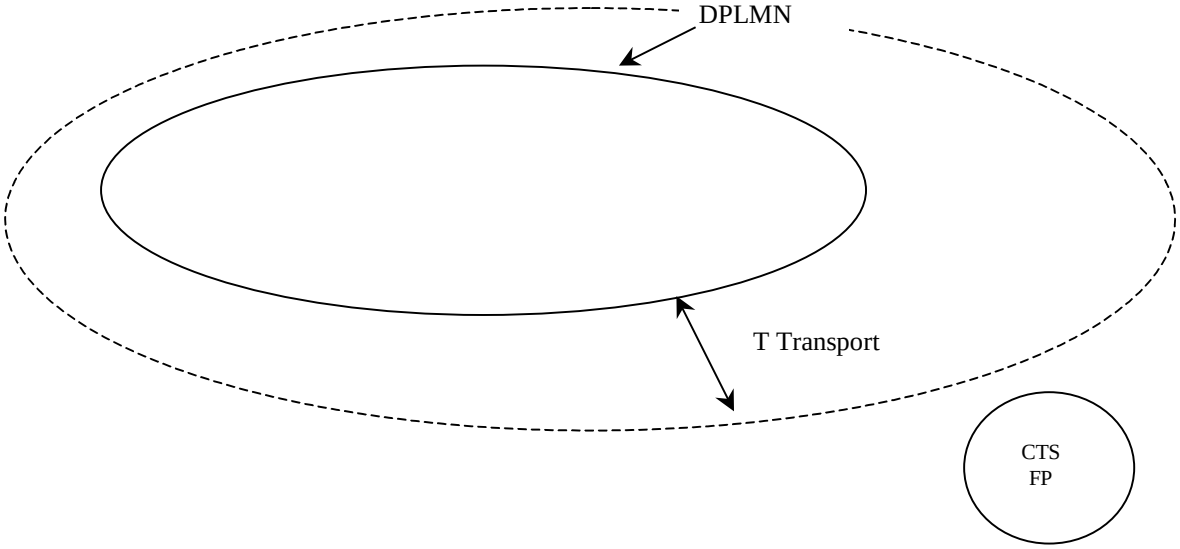


Figure 4: No GSM coverage

4.6 CTS Reference Model

4.6.1 General CTS Reference Model

The general reference model of the CTS service has the following additional network elements:

- the CTS-HLR is the functional entity handling CTS-FP subscriptions;

- the CTS-SN is the functional entity performing the communication with CTS-FP via the Cf interface which uses the fixed network as a bearer.
  The Cd' interface between CTS-SN and CTS-HLR is used for subscription control of the CTS FPSIM.
  The CTS-SN has an interface (Cd) to the GSM HLR in order to receive the challenge/response pairs for authentication of the GSM SIM when authentication of the GSM SIM is required to be performed via the fixed network;

- the CTS-FRA is the functional entity handling the CTS frequency allocation;

- the Local Exchange (is a part of the fixed network), it is accessed by the CTS-MS via the CTS-FP for user communication.
  The Local Exchange may be used as a bearer to provide dialogue between CTS-SN to CTS-FP and CTS-SN to CTS-MS.

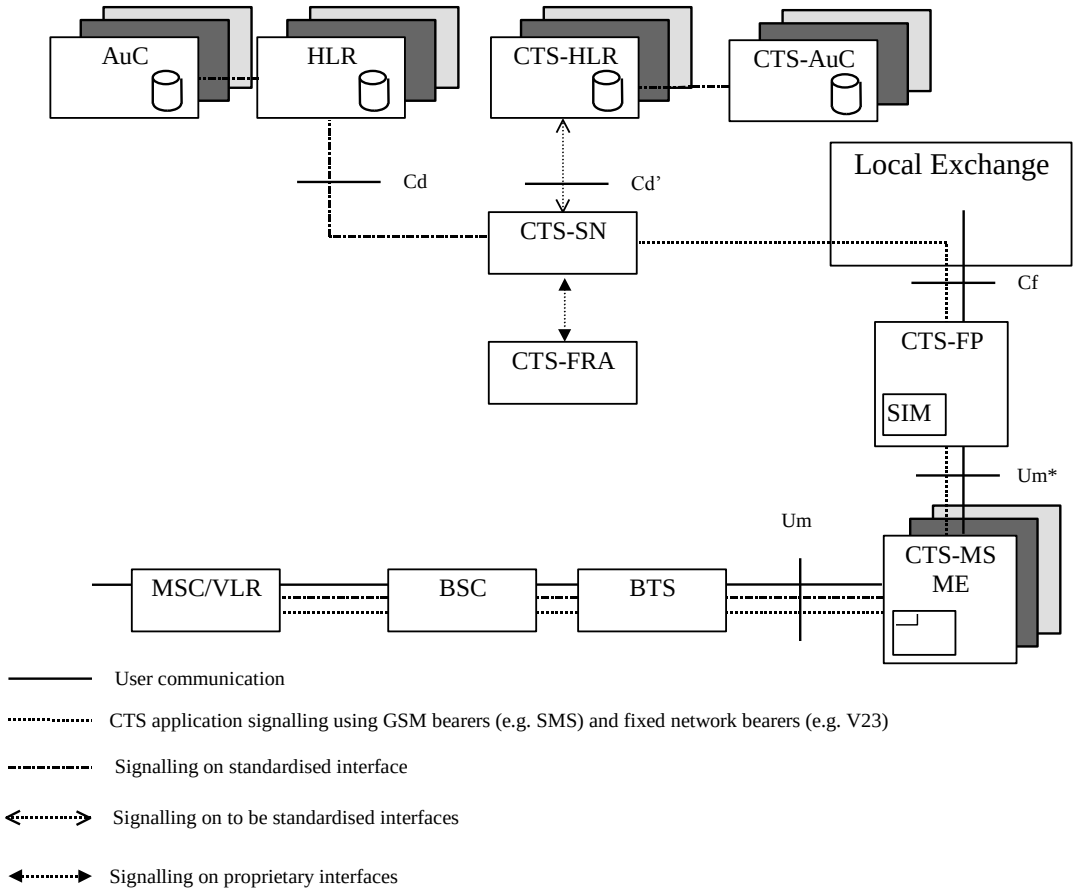


Figure 5: CTS reference model

4.6.2 Simplified CTS reference model (limited enrolment control)

Initial CTS introduction should may allow an easy introduction of the service. This section deals with simplified CTS reference model.

Simplification of the CTS reference model can be achieved if the CTS operator chooses that enrolment is only checked locally in the CTS-FP see section 4.9.1 Enrolment control at the CTS-FP. In this simplified mode of operation the CTS-FP SIM (which is programmed by the CTS operator) holds information as to which IMSI ranges can be accepted for enrolment. In the case where the IMSI of a CTS-MS is not within the ranges, then the enrolment of the CTS-MS is refused by the CTS-FP. Security for those CTS-MS which can be enrolled is assured at the CTS-FP by local security procedures as specified in [4].

In this case authentication of the CTS-MS by the CTS-SN can be avoided and thus the interface between the CTS-SN and GSM-HLR need not be implemented. The simplified CTS reference model is shown below.

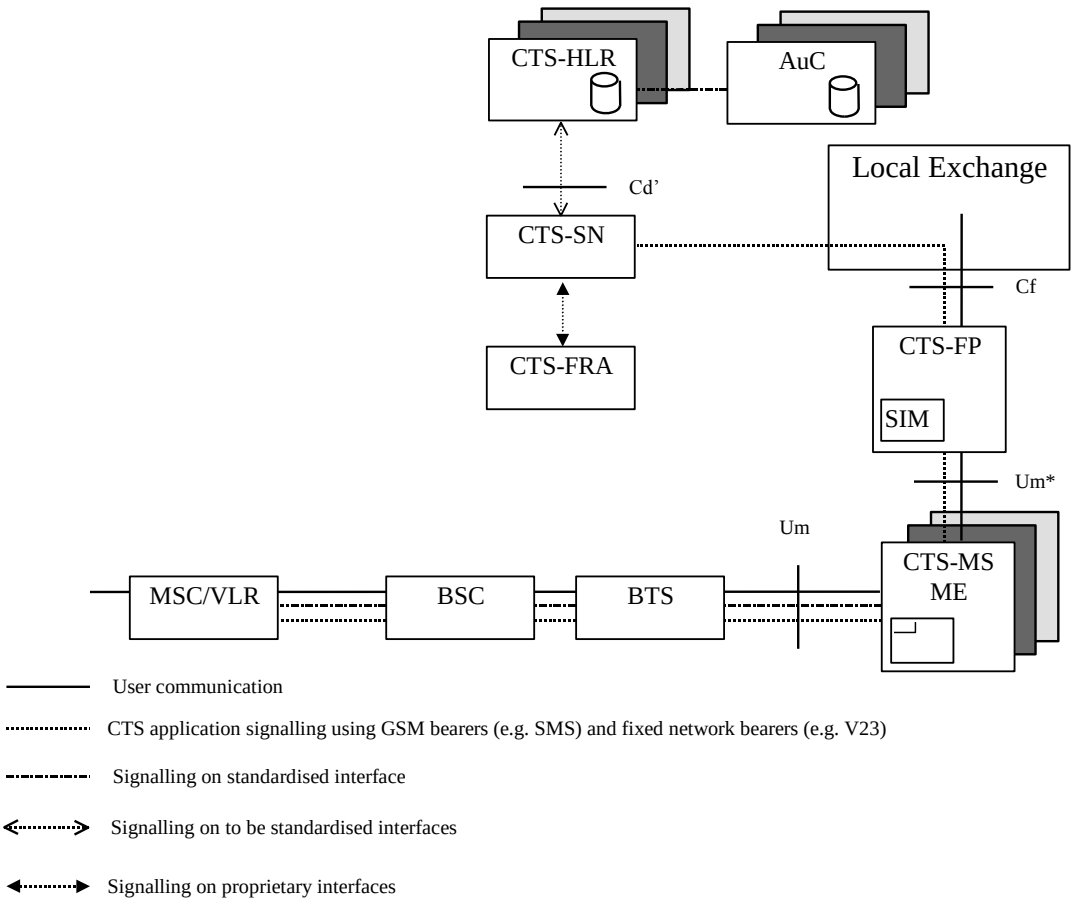
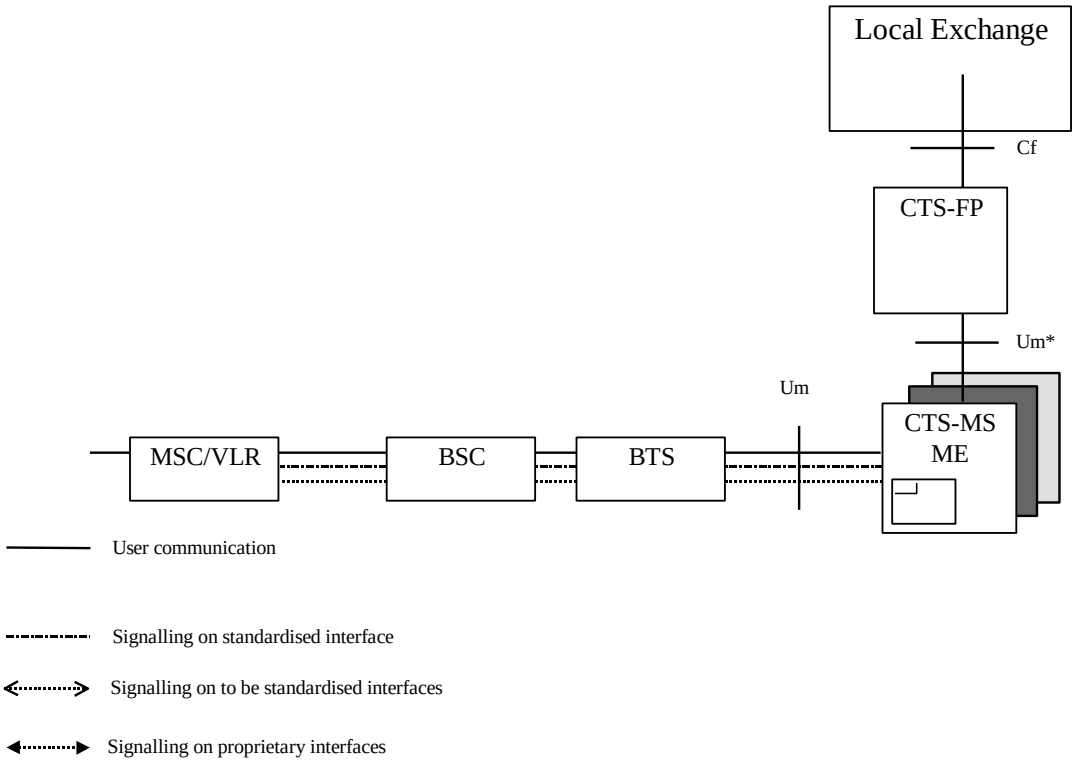


Figure 6: Simplified CTS reference model (limited enrolment control)

4.6.3 Simplified CTS reference model (Licence exempt CTS band)

This section is relative to the usage of CTS capable devices with a CTS license exempt radio band.

In this case the frequency allocation for CTS usage is defined directly by national authorities. All the radio information relative to CTS usage are stored in the CTS-FP by the CTS-FP manufacturer. These radio information are linked with a geographical information which informs the CTS-FP in which country (or region) these frequencies can be used.



When the CTS-FP is used in licence exempt mode, the CTS-FP owner does not need to have a subscription with a CTS operator. Therefore the CTS-FP can work without CTS-SIM card and no exchange with a CTS-SN is necessary.

However when a CTS-SIM card is inserted in the CTS-FP, the CTS-FP shall no more consider the CTS licence exempt information stored in its memory, and shall work operate in licence mode.

The CTS mobile is not informed about the status of the frequency used for CTS (i.e. licensed or licence exempt). The mobile operations are the same in both cases. As in licensed mode all the CTS operations made by the mobile are conditioned to the reception by the MS of the "CTS allowed" information sent by the V-MSC (see chapter 9.2)

4.6.4 CTS connected to PLMN reference model

In the case of a CTS-FP connected to a GSM network the general reference model is modified as described below:

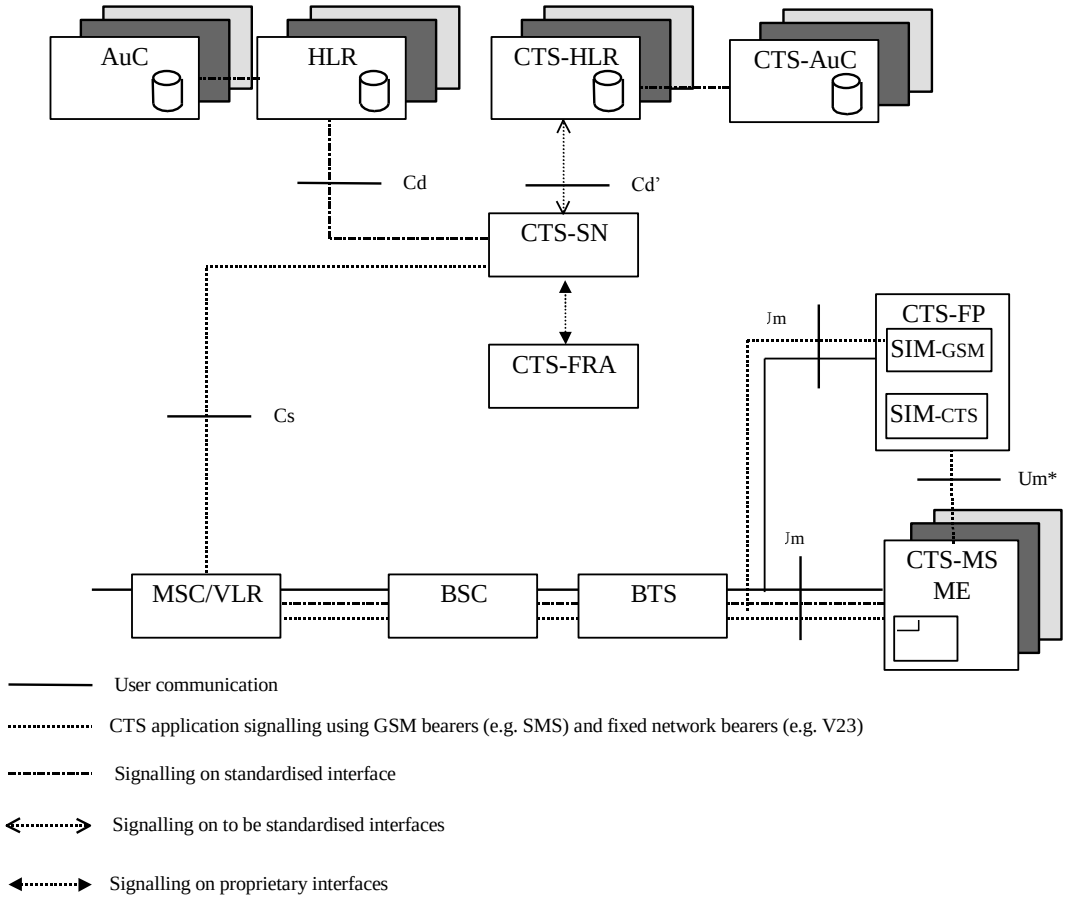


Figure 7: Simplified CTS reference model (limited enrolment control)

The Cf interface between the CTS-FP and the fixed network is replaced by a GSM standard Um interface with a GSM network. On this Um interface the CTS-FP is considered by the GSM network as a standard GSM MS: ie a GSM-ME with a valid GSM SIM card.

It is possible that the GSM network on which the CTS-FP is connected is different from the one used by CTS-MS.

All the exchange between the CTS-SN and the CTS-FP are made via a standard GSM circuit switched data connection, and using the same application signalling than the one defined for the CTS connected to PSTN.

The Cs interface between the CTS-SN and the MSC, will be the most appropriate link to support this circuit switched data stream.

The modifications due to simplified enrolment control (section 4.5.2) are also applicable is the case of CTS connected to PLMN.

4.7 GSM Operator control of CTS service

The GSM operator has control of the CTS service that is operating in his PLMN. The stage 3 CTS specifications shall ensure that it shall not be possile to operate a CTS service without the permission of the GSM operator.

When a CTS capable mobile accesses a GSM PLMN it will be provided with information in order to allow the MS to operate CTS within the GSM PLMN. This may be provided to all CTS_MS or on a per CTS-MS basis depending on the GSM operators requirements. If no information is provided for CTS operation then the CTS MS is prohibited from from operating in CTS mode.

4.7.1 CTS System control

Control of the CTS operation depends of the frequency scenario of the country (or region) in which CTS service is to be provided. Two scenarios are foreseen:

- licence exempt frequency band is used for CTS operation; this is where the relevant authority in a country (or region) has allocated a frequency band for CTS service and the CTS-FP can determine that it is in that country (or region); and
- shared frequency bands for CTS operation; this is where a GSM operator in a country has allocated part of his frequency for CTS service.

4.7.2 GSM Operator control of CTS frequency list

One of the major concepts of CTS is the control of the frequencies for use by the CTS-FPs. The frequency allocation for CTS operation is termed the GFL (Generic Frequency List).

The GFL is the frequency allocation that either a GSM operator has agreed to give to the CTS operator for the operation of a CTS service within a specific geographical area for a specific period of time or a dedicated frequency allocation for CTS operation.

The GFL is made up of a valid period and one or more frequency information.

[Editor's note: frequency information may be valid for specific periods of time during the day (operational period). In this case the clock in the CTS-FP in the CTS-MS should be aligned with the DPLMN; this could be done e.g. by using the GSM NITZ procedure which gives extra mobility information one of which is the local time]

The diagram below represents the structure of a GFL. For a GFL to be valid it must have a current valid period.

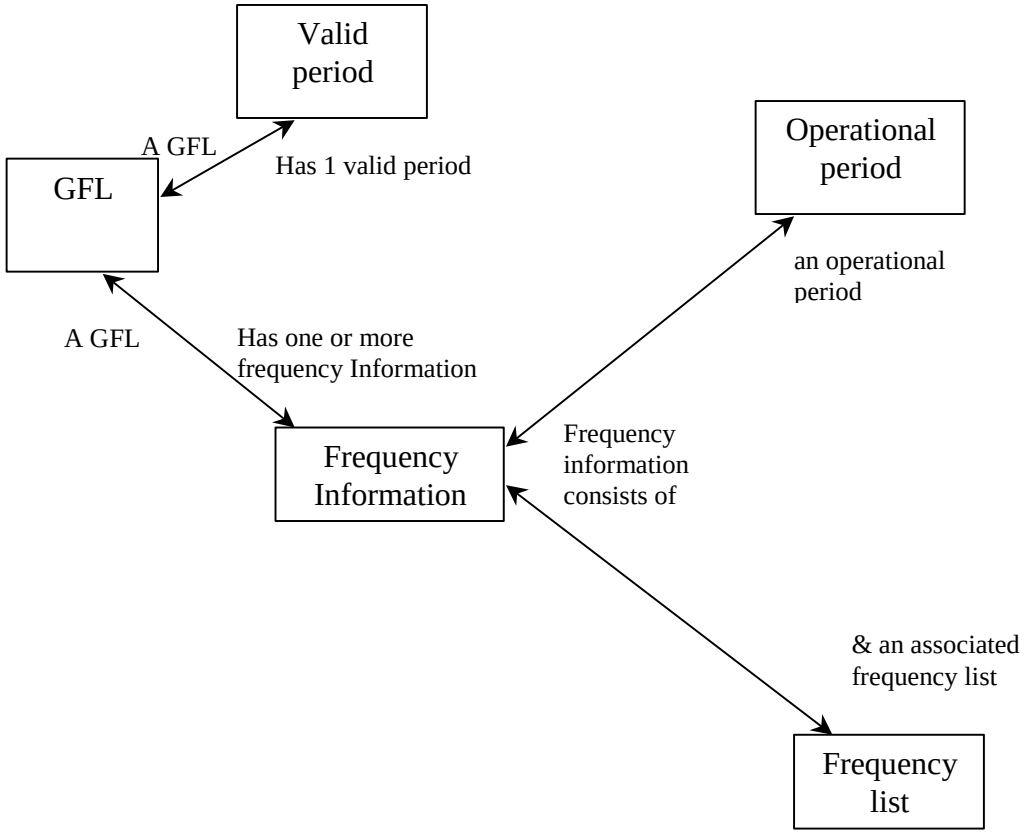


Figure 8: GFL structure

The initialisation of a CTS-FP requires a GFL to be given to a CTS-FP. In some cases the GFL needs to be controlled based on location information within the GSM PLMN. Information on the position of the CTS-FP within the DPLMN may be requested to allocate the correct GFL. As the CTS-FP architecture has no capability to transmit and receive like a normal GSM MS, it can not carry out a direct dialogue using the Um interface with the GSM DPLMN and thus its general position can not be ascertained without the help of the CTS-MS. Therefore the CTS-MS is used to provide positional information that can be used by the DPLMN to allocate a GFL to the CTS-FP.

In order that both DPLMN coverage and limited DPLMN coverage scenarios are catered for, a validity time concept is introduced during which positional information provided by the CTS MS is deemed valid. This allows the CTS-FP location to be ascertained and thus the allocation of the GFL to the CTS-FP can be made.

4.7.3 CTS system initialisation for license exempt frequency band for CTS operation

In this case the frequency allocation for CTS usage is defined directly by national authorities. All the radio information relative to CTS usage are stored in the CTS-FP by the CTS-FP manufacturer. These radio information are linked with a geographical information which informs the CTS-FP in which country (or region) these frequencies can be used.

When the CTS-FP is connected to both mains power and power supply, the CTS-FP can start to make CTS operations (transmit and received radio bursts according with GSM-CTS specification, enrolled CTS-MS, establish call with PSTN network,…). All these operations are made in respect with the radio information (mainly the CTS-GFL) defined by national authorities and stored in the CTS-FP.

4.7.4 CTS system initialisation with DPLMN coverage and limited coverage

In order to avoid that the CTS service be too cumbersome to own, the initialisation of the CTS FP is such that the precise GFL for CTS operational purposes may be obtained sometime after CTS operation has been started. This means that for a short period of time the CTS-FP need not be using the GFL that is best suited to the DPLMN environment in which the CTS-FP is located. During this period the CTS-FP shall operate using a reduced power output.

4.7.4.1 First stage CTS-FP initialisation (Temporary GFL allocation)

The CTS-FP SIM shall have a telephone number which is preloaded by the CTS operator when the service is subscribed. This Telephone number is used by the CTS-FP to call the CTS-SN. The CTS-SN can verify the validity of the subscription and perform authentication of the CTS-FP at this stage. The CTS-FP shall also perform the mutual authentication procedures as defined in ref [4].

In most cases location information will not be available on the first initialisation and thus the CTS-SN/CTS-FRA should allocate a Temporary GFL to allow operation of the Um* interface. The CTS-SN can also pass extra information in order to control other operational modes of the CTS-FP.

As part of the GFL maintenance the CTS-FP will be asked to call back the CTS-SN before the expiry of the temporary GFL. The CTS-FP is now able to operate and provide CTS services using a Temporary GFL.

The CTS-MS need not be present during this operation.

4.7.4.2 Second stage CTS-FP initialisation (GFL confirmation)

As part of the signalling procedures the CTS-FP shall demand the CTS-MS to provide location information to the CTS-FP see "9.1.2 Update of CTS FP frequencies". The CTS-FP stores this information and provides it to the CTS-SN the next time the CTS-FP contacts the CTS-SN. The CTS-SN/CTS-FRA uses this information to allocate/maintain the GFL for CTS operation.

4.7.5 CTS system initialisation without DPLMN coverage

The initialisation of a GFL without DPLMN coverage is FFS.

4.7.6 GFL update

Once a GFL is confirmed, the GFL may be updated by the operator as part of the regular changes he makes in his frequency plan of the network.

4.7.6.1 CTS FP GFL update

Subsequent GFL allocations need not involve the CTS-MS and can be made directly by dialogue between the CTS–FP and the CTS-SN.

In order that frequency planning of the DPLMN can be taken into account when the GFL is updated the CTS -FP with the help of the CTS-MS(s) collects the identity of DPLMN cells which surround the CTS-FP and report this information to the CTS-SN as and when contact to the CTS-FP is made.

These cells are given by the CTS-FP to the CTS-SN network when demanded and are used by the network in the reallocation of the GFL.

The CTS-MSs role in this information gathering is to remember the last cell(s) and time that it camped on before attaching to the CTS FP.

GFL update is controlled by the CTS SN.

The subsequent GFL allocation allows:

- Confirmation of the location of the CTS FP;
- Mutual authentication of the CTS FP and CTS SN (03.20);
- Reallocation of the GFL is based on the analysis of the cell identities and time stamp information and the T_TRANSPORT timer value by the CTS-FRA.

The new GFL is valid when the old GFL expires unless otherwise specified by the CTS-SN.

It should be also possible to update the old GFL during this procedure.

The CTS FP shall handle the two GFLs simultaneously and is responsible for updating the CTS frequencies with the mobiles that are enrolled, as and when, they contact the CTS FP.

4.7.7 Erasure of GFL in the CTS FP

The CTS FP will erase a GFL when the period of validity for a GFL expires.

4.8 De-initialisation of CTS FP

4.8.1 CTS Operator control mode

A CTS FP will become de-initialised if the CTS FP is:

- Disconnected from the mains power for a period of time [10 minutes]; and/or
- Disconnected from the PSTN connection for a period of time [10 minutes]; and/or
- When the CTS-SIM is removed from the CTS-FP;
- When specifically commanded by CTS SN.

In addition to this a CTS-FP will de-initialise itself if after initialisation there is no valid attachment received within [1 week].

4.8.2 Licence exempt mode

A CTS-FP will de-initialise itself if the country code reported by any attached mobiles does not correspond with the country code stored in the CTS-FP. This is made according with the following procedure:

- In order to avoid illegal roaming of CTS-FP, the CTS-MS(s) collects the identity of DPLMN cells which surround the CTS-FP and report this information to the CTS-FP at each attachment.
- The CTS-MSs role in this information gathering is to remember the last cell(s) and time that it camped on before attaching to the CTS FP.
- The CTS-FP only considers as valid cell identity, the cell identity with the lowest time stamp information inferior or equal than the T_TRANSPORT timer value defined by the national authorities and stored in the CTS-FP. (ref. 9.4)
- If [2] consecutive valid cell identity does not correspond with the country (or the region) where the CTS-FP is allowed to work in licence exempt mode, the CTS-FP shall de-initialise itself.

In complement, the CTS-FP is de-initialised:

- if it is disconnected from the mains power for a period of time 10 minutes; or
- if it is disconnected from the PSTN connection for a period of time 10 minutes; or
- if within 1 week after initialisation, there is no valid attachment received;
- If no valid cell identity is reported to the CTS-FP during a period of 1 month.

In addition, if a CTS-SIM card is inserted in the CTS-FP or if a CTS-SN number is reported to the CTS-FP by a CTS-MS, the CTS-FP shall de-initialised itself from licence exempt mode, and shall to make an attempt of GSM controlled CTS initialisation as specified in section 4.6.4

4.9 CTS MS Enrolment

Enrolment is the process of obtaining permission to use the CTS service of a CTS-FP by a CTS-MS. The enrolment process may involve the verification of agreements between a CTS-MS subscriber with a CTS operator, a GSM operator and a CTS-FP subscriber and the exchange of information for control of the CTS subscription at the CTS FP.

The process of enrolment is guarded by security procedures at the CTS FP as specified in [4].

Enrolment can be controlled at two levels (defined by the CTS operator). The first level of enrolment control is at the CTS-FP. The second level of control is at the CTS-SN.

A CTS network can be operated using both methods of control.

4.9.1 Enrolment control at the CTS-FP

Enrolment control at the CTS-FP can be controlled by the operator either:

- pre-populating the SIM of the CTS FP with IMSI ranges; or
- by the CTS-SN during signalling exchanges between the CTS-SN and CTS-FP.

In each of the above cases the CTS-FP is given information as to the range of IMSI values [16 ranges] that the CTS-FP can consider valid for enrolment. The stage 3 shall allow all IMSIs to be valid.

The validity period for each of these locally enrolled CTS-MS shall be controllable by CTS-FP subscriber.

For IMSIs that do not fall into these ranges the CTS operator can specify that the CTS-FP shall contact the CTS-SN for permission before enrolling these mobiles. In the case where the CTS operator doesn't specify that the CTS-SN should be contacted, then the CTS-MS with such IMSIs shall not be allowed to enrol.

The number of enrolled CTS-MS on a CTS-FP is controllable from the CTS-SN.

4.9.2 Enrolment control at the CTS-SN

The CTS-SN can control initial enrolment and surveys enrolment for previously enrolled CTS-MS.

The enrolment process performed at the CTS-SN gives a CTS-MS the right to have CTS services on a CTS-FP for a certain period of time (determined by the CTS operator). This period of time shall not be capable of being altered by the CTS-FP subscriber. In order to have a continuous CTS service the enrolment process requires to be confirmed before this period expires.

4.9.2.1 Initial enrolment at the CTS-SN

The CTS-FP may contact the CTS-SN via the access network to demand enrolment of a CTS-MS. In this case the IMSI of the CTS-MS is given to the CTS-SN.

In this case the CTS-SN shall perform range checking on the IMSI to verify roaming agreements and may interrogate (under operator control) the HLR of the CTS-MS in order to perform subscription checking.

Once the right to enrol has been established the CTS-SN confirms enrolment together with a validity period with which the CTS-FP supervises the subscription for CTS services.

4.9.2.2 Subsequent enrolment at the CTS-SN

Subsequent enrolment is required to check that enrolled CTS-MSs still have the right of using CTS service. As part of the supervisory activities the CTS-FP requires to contact the CTS-SN at specific points in time either for reallocation of the GFL or other supervisory procedures. During these communications the CTS-SN can demand the CTS-FP to give information as to the enrolled CTS-MS on the CTS-FP. The CTS-SN can then check that the CTS subscription is still valid for these CTS-MS and either reconfirm the enrolment of the CTS-MS or withdraw the enrolment right (i.e. de-enrolment).

4.9.3 Agreement between the CTS FP Subscriber and CTS MS subscribers

The CTS FP subscriber chooses to give the right to a CTS MS subscribers to have access to his CTS FP.

This is performed by the CTS FP owner entering information into the CTS FP as defined by [4].

The CTS FP will only allow the CTS MS to have access once the CTS operator authorisation procedure has been successfully completed.

4.9.4 CTS authorisation check of enrolment of a CTS MS onto a CTS FP

Enrolment of the CTS MS to a CTS FP involves:

- Optional Authentication of the CTS MS by the HPLMN via the CTS-SN;
- Optional Subscription check for the CTS MS by the HPLMN via the CTS-SN.

Confirmation of enrolment requires mutual authentication to taken place as described in [4]. The enrolment of a CTS-MS has an associated validity period.

4.10 De-enrolment of CTS MS from a CTS-FP

The CTS FP can receive a command to remove the enrolment of a specific CTS MS at any time see [4].

If the validity period for a particular CTS MS expires then the specific CTS MS shall become de-enrolled.

De-enrolment can be commanded by either the CTS-FP subscriber or the CTS-SN.

4.10.1 Mutual autentication

Mutual authentication is a concept whereby the CTS MS/CTS FP can check that the controlling network is a valid network. This protection mechanism is needed to ensure that both GSM and CTS operator can protect themselves from intrusion see ref [4].

4.11 CTS MM and CM layers

The message exchange on the Um* interface shall be (as close as possible) to the GSM 04.08 interface. The exceptions to this are the security procedures as specified in [4] which may be substituted in place of the normal GSM procedures. The CTS standard still allows the use of the normal GSM authentication and ciphering on the Um* interface.

4.12 CTS MM and CM layers on the fixed network side

The CTS standard specifies the protocols on the CTS Um* interface only. The standard specifying the split between these layers on the fixed network side is left open to implementation.

4.13 CTS Mobility services

CTS mobility services are to be specified for the CTS Um* interface only. Mobility in the fixed network (i.e. towards other nodes in the fixed network) is out of scope of this recommendation.

4.13.1 CTS support in idle mode

Cell selection and reselection mechanisms are described in [5].

It should be possible for the CTS MS subscriber to choose preferences between either GSM or CTS coverage. When in CTS coverage, it should be possible that the user set preferences between different CTS coverage.

4.13.2 CTS attach and detach

CTS mobility services offer the ability to attach an enrolled CTS-MS to a CTS-FP. The camping of a CTS-MS on a CTS-FP requires that the CTS-MS performs an attachment to the CTS FP.

In the case where a CTS-MS is disabled (i.e. turned off, etc) whilst attached to the CTS-FP, the CTS-MS can, under certain circumstances, inform the CTS-FP of this event. This procedure is known as detachment from a CTS-FP.

In the case where a CTS-MS is refused attachment to a CTS-FP due to the fact that it is not enrolled on the CTS-FP, the CTS-MS shall consider itself de-enrolled and should not re-attempt to attach to the same CTS-FP.

The attach and detach procedures shall be those specified in 04.08 with modifications in order to take into account the local CTS security procedures as specified in [4].

4.14 CTS CM layer

The CTS CM layer is specified for the local CTS system only. The CTS CM layer in the fixed network is out of scope of the present document.

The CTS CC layer is specified in GSM 04.08 section 5. The CTS CC layer is modified in order to introduce extra functions (eg Hook Flash) as specified in [4]

4.14.1 CTS service indication

Once attached to a CTS-FP the MS shall indicate that CTS service is available.

The CTS user can define a name (alphanumeric name, icon, etc) for each of the CTS cells to which it has access (i.e. attached). The MS will, when attached and in coverage of a CTS cell and if required by the user, indicate to the user the current CTS cell. The indication may be the name of the current CTS cell, as set by the user. The form of display and indication are left to the CTS-MS manufacturer's choice.

[NOTE: The CTS-FP owner could also define a name for his CTS-cell. This name could be transmitted to the MS, e.g. during attachment by using the NITZ procedure.]

4.15 Subscriber information for CTS

A CTS-MS subscriber may be enrolled on several CTS FPs. It shall be possible for the subscriber to establish an order of preference between the allowed CTS-FPs.

Subscriber specific CTS information can be stored and managed in the HLR.

In addition to subscriber details in the HLR, it is also necessary for subscriber specific CTS information to be stored and managed in the SIM of the CTS MS. This is required because the MS shall prioritise CTS cells in the cell (re)selection process and also for presenting the current CTS cell to the user.

The management of CTS data on SIM may be performed manually.

5 Transmission

No specific requirements are identified.

6 Information storage

6.1 Information managed per CTS-MS subscriber

6.1.1 Stored in the CTS-MS SIM

6.1.2 Stored in the HLR

CTS MS subscriber CTS subscription may be stored in the HLR.

6.1.3 Stored in the MSC/VLR

CTS MS subscriber CTS subscription may be stored in the MSC/VLR.

6.2 Information managed per CTS-FP subscriber

6.2.1 Stored in the CTS-FP SIM

6.2.2 Stored in the CTS-FPE

CTS-SN Telephone Number is stored in non volatile memory in the CTS-FPE.

6.2.3 Stored in the CTS-SN

CTS-FP subscriber's subscription information may be stored in the CTS-SN.

6.2.4 Stored in the CTS-HLR

CTS-FP subscriber's subscription information may be stored in the CTS-HLR.

7 Identities

7.1 Identification of the CTS-FP

7.1.1 IFPSI

A CTS specific identity is assigned to a CTS FP subscriber of a CTS service.

7.1.2 IFPEI

Each CTS-FP is assigned by the manufacturer a unique IFPEI number see GSM 03.03 [3].

The coding rules of the IFPEI and the rules for changing the IFPEI shall be equal to the rules defined for the IMEI in GSM 03.03 [3].

7.1.3 FPBI

The CTS-FP broadcasts (after CTS-FP initialisation has been performed) a beacon which carries information conveying the Fixed Part Beacon Identity which identifies the CTS-FP. The FPBI need not be unique due to the capacity of signalling on the beacon. The FPBI is defined in GSM 03.03 [3]. The use of the beacon and the FPBI related procedures are defined in [5].

7.2 Addressing parameters

7.2.1 Addressing the CTS-FP

7.2.1.1 CTS-FP Fixed Network dialling number

This is the fixed network dialling number (PSTN/ISDN) to which the CTS-FP is connected. A single CTS-FP may have several fixed network dialling numbers.

7.2.1.2 CTS FP name

It shall be possible to assign a subscriber-defined identifier to each CTS FP. The CTS FP name can e.g. be an icon or an alphanumeric text up to 10 characters.

7.2.2 Addressing the CTS-MS subscriber

7.2.2.1 MSISDN

The MSISDN is the dialling number at which the CTS-MS can be reached in the cellular network. It may also be used for CTS applications.

In order to address a CTS-MS by its MSISDN, this number has to be known by the CTS-FP and the CTS-MS. The MSISDN may be submitted to the CTS-FP either:

- from the CTS-HLR at CTS-MS enrolment; or
- by means of user input; or

- by the CTS-MS

7.2.2.2 CTS-MS Subscriber Identity(CTS-MSI)

The CTS-MSI is an CTS-MS identity which has only local significance between a CTS-MS and CTS-FP pair, its purpose is to maintain the anonymity of the users of the CTS service as specified in [4].

The CTS-MSI is assigned and maintained by the CTS-FP during CTS-MS enrolment, and is reallocated by the CTS-FP during CTS attachment and as part of each Mobile originated and Mobile terminated signalling exchange. It is unique for each CTS-MS enrolled at the CTS-FP. The CTS-MSI allocation procedure and CTS-MSI reallocation procedure data flows are specified in [4].

In order to maintain anonymity of the subscriber the CTS-MSI shall be used in all signalling procedures by both CTS-MS and CTS-FP.

The protocols shall ensure that the CTS-FP can detect any CTS-MSI conflicts (e.g. duplicated CTS-MSI). In case of CTS-MSI conflicts, it is up to the CTS-FP to resolve the situation by the appropriate security checks (i.e. by obtaining the IMSI of the CTS-MS, performing local security procedures (see [4]) and verifying the enrolment rights).

8 Operation and maintenance aspects

9 Function and information flows

The following functional flows deal with the initial phase of CTS where roaming is not supported. In this case the DPLMN, HPLMN and the CTS operator need to be the same. If they are the same then this allows the CTS reference model to be simplified as the CTS FRA can be integrated in to the CTS SN thus simplifying the signalling model. The CTS specifications shall provide means to ensure that DPLMN, HPLMN and CTS operator are the same entity.

When there is no indication on the status of the CTS frequencies (i.e. licensed or licensed exempt), the following recommendations are applicable to all cases.

9.1 CTS FP management

9.1.1 CTS FP Initialisation

CTS FP initialisation can be envisaged in two phases.

The data flow diagram below shows the flows required for CTS FP initialisation.

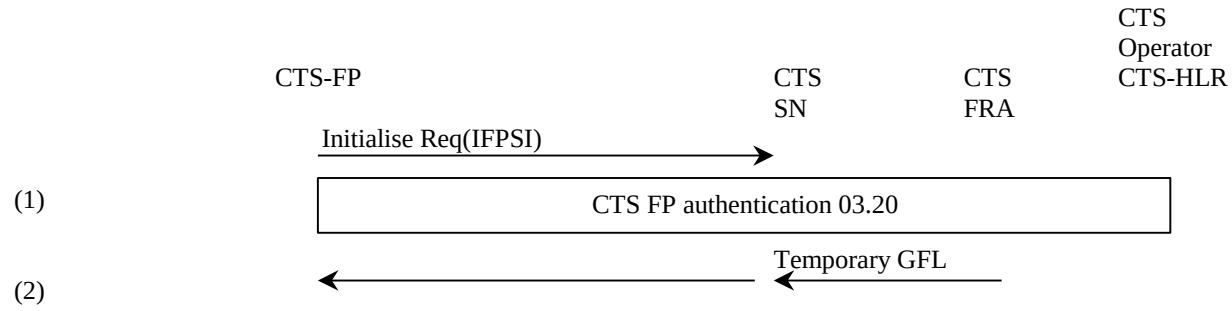


Figure 9: CTS FP initialisation

1 The CTS-FP subscriber wants to initialise a CTS-FP. He triggers an MMI procedure. The CTS-SN telephone number is used by the CTS-FP to contact the CTS-SN. The IFPSI is given to the CTS-SN.
The CTS-SN authenticates the CTS-FP by addressing the CTS-HLR using the IFPSI.

2 In absence of location information the CTS-FRA allocates a temporary GFL.
The CTS-FP is temporarily initialised. Confirmation of the initialisation is performed in future signalling when location information can be provided and a correct GFL allocated.

9.1.2 Update of CTS FP frequencies

The data flow diagrams below shows the flows required for gathering the DPLMN surrounding cells and the updating the CTS FP GFL.

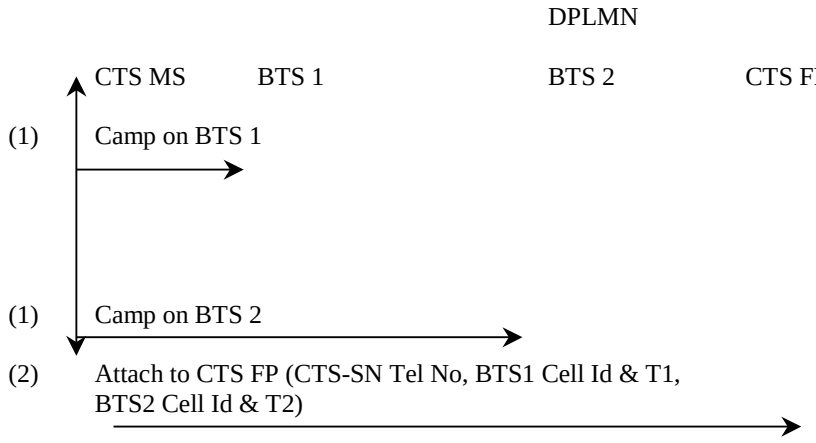


Figure 10: CTS MS Home cell reporting

1 The CTS MS remembers the cells it last camped on from the DPLMN and the time it left each cell.

2 This cell information is given to the CTS FP during signalling exchanges during attachment for example.
In addition if the MS has received a CTS-SN Telephone Number (see 9.2 CTS management for CTS MS) from the DPLMN then this will also be given.

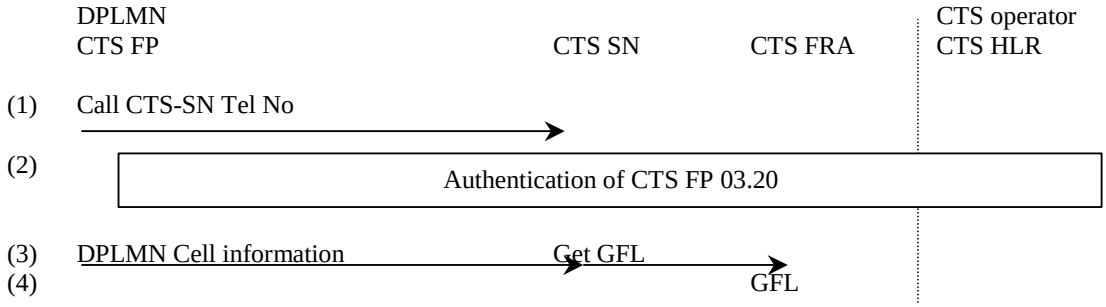


Figure 11: CTS FP update

1 The CTS-FP calls the CTS-SN.
If a CTS-SN Tel No has been received from the DPLMN, then this number is used.

2 Authentication of the CTS FP is made by the CTS SN and HLR

3 DPLMN information is given by the CTS FP for location purposes

4 GFL is updated and the CTS-FP authenticates the CTS-SN.
This procedure also forms part of the CTS-FP initialisation procedure where the Temporary GFL (allocated during the first initialisation) is replaced by the GFL based on location information.

9.2 CTS management for CTS MS

The GSM PLMN controls the MS as to whether it can operate CTS. When the CTS-MS access the GSM PLMN it will receive signalling which informs the CTS-MS whether it can perform CTS operations.

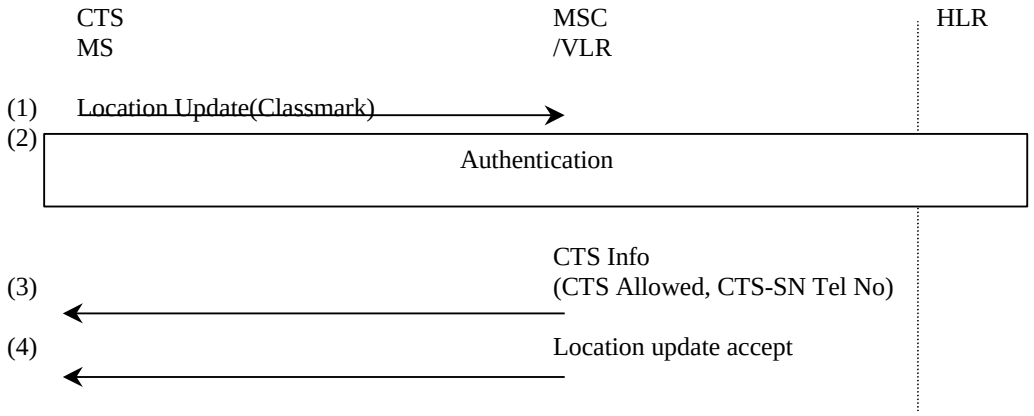


Figure 12

1 The MS performs a location update in the DPLMN.

2 Authentication is performed.

3 If CTS is allowed in the PLMN, or this particular MS has the CTS subscription then the MSC sends CTS info to the MS. The CTS-SN Tel No is optional and indicates the telephone number for this LA/Cell to which The CTS-FP should contact.

4 The location update is accepted.

9.3 CTS integration to Fixed Mobile Convergence applications

In order to use CTS for FMC applications it is suggested that a hook be provided in order to facilitate FMC applications. To this end it is envisaged to allocate a FMC Telephone Number, for instance on the CTS-FP SIM.

9.4 Functions related to MS in idle mode for support of CTS

9.4.1 Cell selection and reselection

The definition of a "suitable cell", as defined in GSM 03.22, is extended with the following criterion:

An CTS-MS with SIM indicating CTS subscription shall always try to select the cell with the highest CTS FP priority according to the information stored on the SIM. The CTS selection parameters last received from the CTS FP shall be used to calculate the selection criteria for the corresponding CTS cell.

9.4.2 DPLMN Cell information gathering

As the CTS-MS roams through the DPLMN it shall gather information as to the cells it has passed through. This cell information is stamped with the time that the MS either left the cell or lost GSM coverage with the cell. The figure below shows the required functional behaviour.

When the CTS-MS gives this information to the CTS-FP the time information is presented by using the relative time (for example: Cell X was last camped on 5 minutes ago).

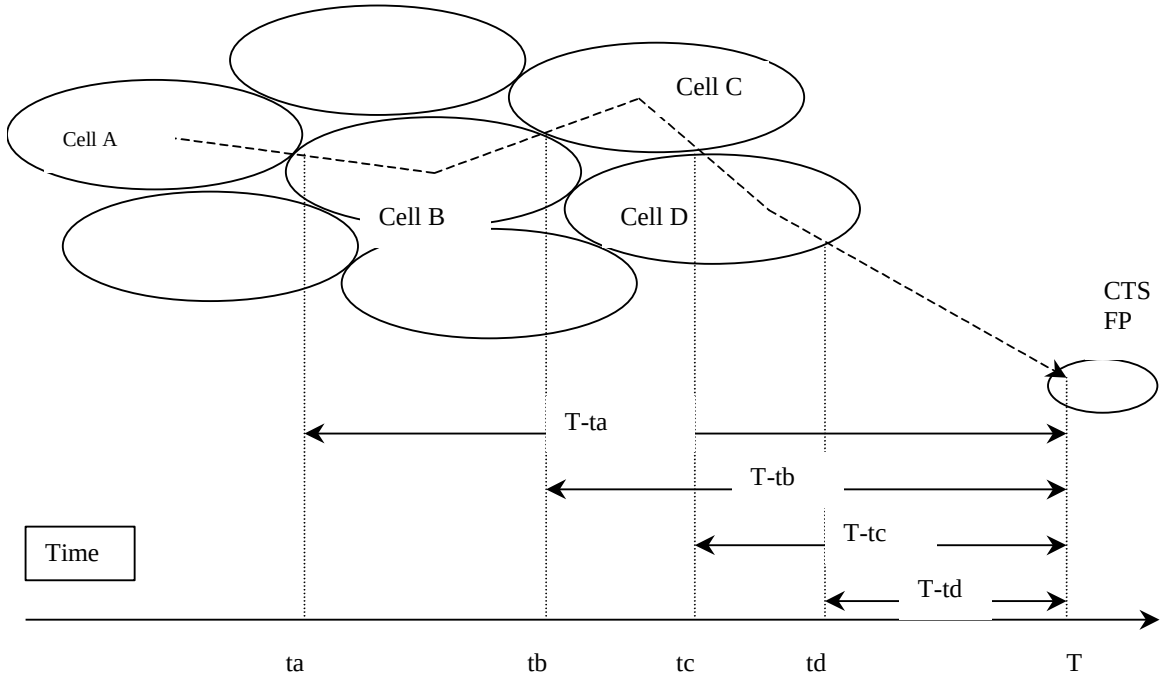


Figure 13: DPLMN cell information gathering

In this figure the cells reported to the CTS FP are as follows:

- Cell D left at T-td
- Cell C left at T-tc
- Cell B left at T-tb
- Cell A left at T-ta

9.4.3 CTS local mobility

The presence and absence of a CTS-MS needs to be determined by the CTS-FP as part of the local CTS mobility procedures.

9.4.3.1 CTS attachment

CTS attachment is a procedure by which a CTS-MSs presence is made known to the CTS-FP. The attachment to a CTS-FP is made by the CTS-MS when the CTS-MS comes within coverage of the CTS-FP.

The CTS Attach procedure shall replicate the protocol as expected as in GSM, with the exceptions to the local security procedures defined in [4].

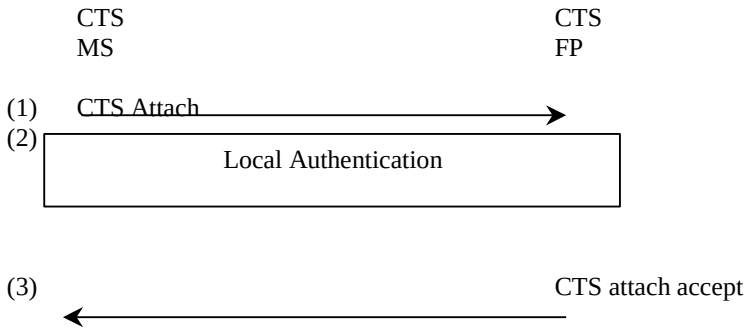


Figure 14: CTS Attachment

1 The CTS-MS comes within coverage of the CTS-FP and initiates attachment.

2 Local authentication is performed see ([4]).

3 The CTS attachment is accepted.

9.4.3.2 CTS detachment

CTS detachment is a procedure by which a CTS-MSs non presence is made known to the CTS-FP. When a CTS-MS is attached the CTS-FP shall regularly ensure that the CTS-MS is within CTS-FP coverage, if the CTS-MS is found to be out of coverage the CTS-FP will mark the CTS-MS as detached. If the MCTS-MS is powered down within coverage of the CTS-FP the CTS-MS shall perform the CTS detach procedure.

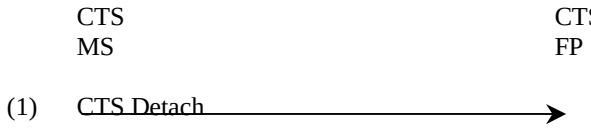


Figure 15: CTS MS detachment

1 The CTS-MS when powered down within coverage of the CTS-FP indicates that it no longer is attached.

Figure 16: CTS-FP detected detachment of CTS-MS

1) The CTS-FP pages and finds that the MS is not present. The CTS-MS is marked as detached.

9.5 Functions related to active mode support of CTS

9.5.1 MS connection establishment for MT and MO calls.

When calls are established the CTS FP shall perform Authentication and Ciphering as specified in 03.20.

9.5.2 Handover

Handover between instances of CTS radio interfaces shall be supported by the CTS MS when the same CTS FP controls these CTS radio interfaces.

9.6 Overview of signalling

Security procedures such as authentication, ciphering and key distribution are defined in order to protect the GSM network and the user communication. CTS operation is initialised by downloading operation control information into the CTS-FP. The operator can change and de-activate CTS operation via the GSM Radio Interface or via the access network.

10 CTS Architecture

10.1 CTS Elements

10.1.1 CTS Fixed Part

CTS Fixed Part (CTS-FP) is the logical and physical element, which provides the link to the access network. For this purpose it controls on the one side one or more CTS Radio Interface and on the other side one or more access network interface. The interworking between both interfaces is implemented in the CTS-FP interworking Function.

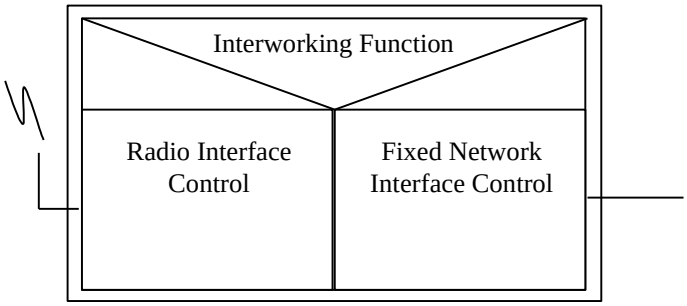


Figure 17: The CTS-FP and its main functional entities

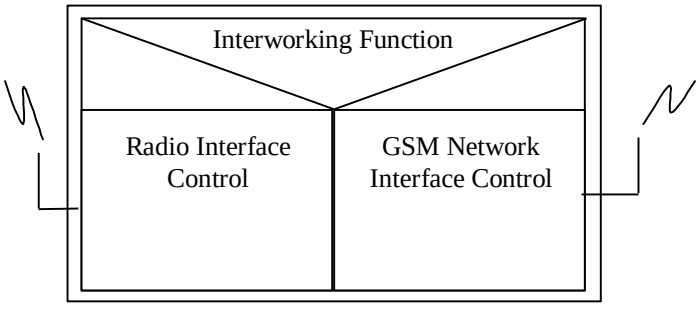


Figure 17bis: The CTS-FP connected to GSM

10.1.2 CTS Mobile Station

The CTS Mobile Station (CTS-MS) is the logical and physical element which provides to the user cordless access to the fixed network or the GSM network. The CTS-MS consists of GSM Mobile Equipment and a GSM-SIM, both with additional CTS capabilities.

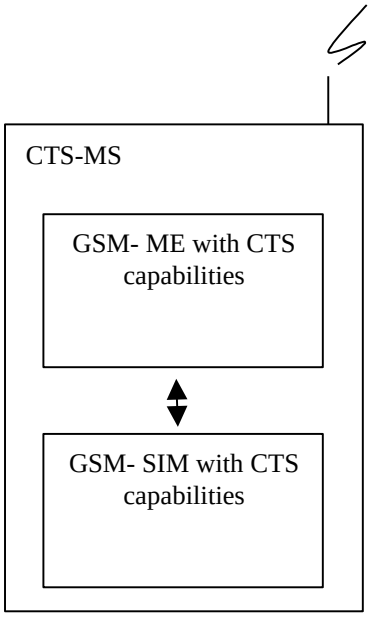


Figure 18: The CTS-MS and its main functional entities

10.1.3 CTS controlling and supporting network entities

In order to control and support the CTS, the following functional entities are situated in the GSM network:

- the CTS-AuC is the functional entity for performing authentication of the CTS-FP SIM;
- the CTS-HLR is the functional entity which contains the data base of the CTS-FP subscribers of the CTS operator. This data base is related to subscription management (including related security control). It may contain additional information, e.g. subscriber specific CTS operation information;
- the CTS-SN is mainly a routing functionality. It provides the interface to the CTS-FP(s) via the access network. The CTS SN also provides the security functions for secure signalling of CTS specific operation information on the CTS access network interface;
- the CTS FRA is considered to be the location of frequency allocation for the CTS operation.

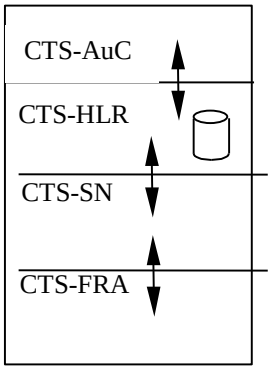


Figure 19: CTS supporting functional entities

10.2 CTS Interfaces

10.2.1 CTS Radio Interface (Um*)

The CTS Radio Interface is used for local communication between CTS MS and the CTS FP. It provides a cordless connection between these two elements. This interface is referred to as Um* in the CTS specifications.

According to GSM 02.56 [2], the CTS Radio Interface is a modified GSM Radio Interface. CTS is to operate in the GSM frequency spectrum of the DPLMN operator or in an license exempt frequency band.

The physical characteristics of the CTS Radio Interface are similar to those of the GSM Radio Interface. The aspects of the radio interface are described in [5].

The Um* interface shall be future proof to support services to be implemented in later phases such as data and fax services etc.

10.2.2 GSM Radio Interface (Um)

On the GSM Radio Interface the CTS-MS shall behave according to the GSM standards. As required in GSM 02.56 [2], means of the GSM Radio Interface shall be used to exchange information relevant for operation control of the CTS. User communication via the GSM Radio Interface is covered by the GSM specifications and not considered in the CTS specifications. The GSM Radio Interface is referred to as Um in the CTS specifications.

10.2.3 CTS Access Network Interface

The Access Network Interface is the connection of the CTS-FP to the Fixed or mobile Network for user communication. According to GSM 02.56 [2], this interface shall also be used to transport information which is relevant for operation control. The Fixed Network Interface is referred to as Cf in the CTS specifications.

10.2.3.1 Physical characteristics of the CTS Fixed Network Interface

The physical characteristics of the Fixed Network Interface, e.g. signal levels, shall correspond to national standards.

10.2.3.2 Physical characteristics of the CTS GSM Network Interface

In the case of a CTS-FP connected to GSM, the physical characteristics of the GSM Network Interface, e.g. signal levels, shall correspond to GSM standards.

10.2.4 Network internal interfaces

10.2.4.1 Interface CTS SN/CTS HLR (Cd)

The Cd interface between the CTSSN and the HLR may use existing MAP procedures to receive challenge/response pairs to be used for the authentication of the CTS FP SIM when communication is performed via the access network.

10.2.4.2 Interface CTS SN/CTS HLR (Cd')

Cd' interface between CTS SN and CTS HLR. The interface is used for CTS FP subscription control.

10.2.4.3 Interface CTS SN/CTS FRA

This interface is used when download of radio parameters shall be performed to the CTS-FP via application signalling.

10.2.4.4 Interface CTS FRA/BSC

This interface is used when download of radio parameters shall be performed to the CTS-FP via GSM layer 3 signalling.

10.3 CTS sub-systems

The CTS can be split in two subsystems, the local CTS and the supervising CTS:

- the local CTS consists of a CTS-FP and one or several CTS-MS, which are enrolled at the CTS-FP.
  The main aspect of the local CTS is that the user communication is provided via the CTS Radio interface and the CTS Access Network Interface;
- the supervising CTS consists of the functional entities to control CTS operation. The main aspect of the supervising CTS is the control of the operation of the local CTS such as:
  - control of the frequencies used by the CTS-FP on the CTS Radio Interface;
  - control of the CTS FP subscription (of the SIM) of the CTS FP;
  - control of the CTS MS subscription (of the SIM) of the CTS MS.

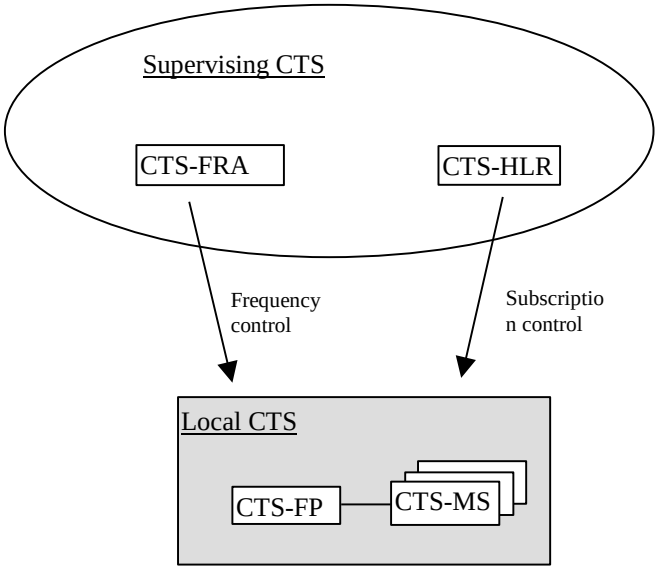


Figure 20: CTS Subsystems

10.4 Network Access

As the purpose of the CTS, the Access Network is accessed by the CTS-MS via the CTS-FP for user communication.

A CTS-MS can, depending on services subscribed, access the GSM network for user communication. This case is covered by the GSM specifications and not considered in the CTS specifications.

According to GSM 02.56 [2], control of the CTS operation can be carried out either via the GSM Network or via the Access Network. In the latter case the Access Network is as a transit network CTS operation control.

A co-ordination between the GSM Network and the Access Networks is not required.

11 CTS main parameters

11.1 Radio Resource Management parameters

The Radio Resource Management specific parameters are defined in [5].

11.2 Identification parameters

11.3 Security specific parameters

The security related parameters such as authentication and ciphering keys are defined in [4].

12 The local CTS

The following elements are part of the local CTS:

- CTS-FP;
- One or several CTS-MS.

The following interfaces have relevance for the local CTS:

- the CTS Radio Interface Um* for signalling and user communication;
- the CTS Access Network Interface Cf or Um for user communication.

Aspects of the local CTS are the following:

- services provided on the CTS radio interface as defined in [2] (e.g. MT and MO calls);
- transmission mechanisms related to these services;
- signalling mechanisms related to these services;
- protocol stacks on the CTS radio interface;
- functions and procedures on the CTS radio interface.

12.1 Transmission and Signalling Planes

12.1.1 Transmission Plane

According to GSM 02.56 [2] user communication is restricted to speech in the first phase of CTS specification. The transmission plane is segmented in two parts, the transmission on the CTS Radio Interface and the transmission on the CTS Access Network Interface.

The transmission of speech on the CTS Radio Interface Um* follows the GSM standard.

The transmission on the CTS Fixed Network Interface follows national standards for the fixed network access and is out of the scope of CTS specifications.

History

Document history				
V7.0.1	May 1999	Public Enquiry (as EN 301 405)	PE 9943:	1999-05-26 to 1999-10-22
V7.1.0	May 2000	Vote	V 20000721:	2000-05-22 to 2000-07-21
V7.1.1	August 2000	Publication		