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Introduction

Today, there exists a clear distinction between the public mobile telephone systems for wide area coverage on the one hand, and private cordless telephone systems for local area coverage on the other hand. Recently, attempts have been made to integrate the wide area cellular and the local area cordless function into one and the same Mobile Equipment (ME). However, because of the incompatibility between the existing cellular and cordless standards, this results in ME implementations with rather low cost-efficiency.

The intention of the GSM Cordless Telephony System (CTS) is therefore to provide cordless functionality to a standard GSM Mobile Station (MS) with minimum impact on the MS. The impact would ideally be limited to an upgrade of the ME and SIM software. This can only be accomplished if the radio interface of the cordless system is identical, or very similar, to the standard GSM radio interface.

1 Scope

The scope of the present document is to describe the Service aspects of a GSM Cordless Telephony System (CTS), which provides the possibility for users of GSM terminals to have cordless access to a fixed network, such as PSTN/ISDN or a radio network such as GSM.

Due to the time constraints to have a first specification ready for market needs, a phased approach is necessary. The first phase aims primarily at an application supporting the speech teleservice (including DTMF support) in a residential single cell environment. The focus is on the requirements necessary to elaborate the radio interface and the security aspects for such an application.

To not prevent or impede the evolution of CTS to additional services and functions, later phases may have to be considered when now defining the means to fulfil the above mentioned requirements for the first phase of CTS. Therefore, additional support on the CTS radio interface for later phase services (e.g. SMS, subscriber authentication and GSM supplementary services), is included already in CTS Phase 1, provided that such services are clearly defined. Other expected services and functions in later phases are included in annex A.

The standardisation of the physical layers of the GSM-CTS fixed network interface is not in the scope of the present document. However, consideration may need to be given to communication of application data between CTS and PLMN via the fixed network.

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.
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- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 22.101: "UMTS Service Principles".
- [3] 3GPP TS 42.009: "Security aspects".
- [4] 3GPP TS 22.081: "Line identification Supplementary Services - Stage 1".
- [5] 3GPP TS 22.096: "Name identification Supplementary Services - Stage 1".
- [6] 3GPP TS 23.040: "Short Message Service (SMS)".
- [7] ETSI ETS 300 111 (1992): "Integrated Services Digital Network (ISDN); Telephony 3,1 kHz teleservice, service description".
- [8] ETSI ETS 300 109 (1992): "Integrated Services Digital Network (ISDN); Circuit-mode 64 kbit/s 8 kHz structured bearer service category usable for speech information transfer, service description".
- [9] ETSI ETS 300 110 (1992): "Integrated Services Digital Network (ISDN); Circuit-mode 64 kbit/s 8 kHz structured bearer service category usable for 3,1 kHz audio information transfer, service description".
- [10] ETSI EN 301 144-1 (V1.1): "The Signalling application for the mobility management service on the alpha interface; Part 1: Protocol specification".
- [11] 3GPP TS 22.030: "Man Machine Interface (MMI) of the Mobile Station (MS)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

FP Enrolment: procedure where a CTS-FP is loaded with data necessary to obtain CTS operation. After this procedure CTS operation may commence.

MS Enrolment: procedure where a CTS-MS is associated for the first time with a CTS-FP. After this procedure CTS-MS has access to this CTS-FP.

Attachment: procedure where an MS attaches to a certain CTS-FP. When attached, it is possible to make and receive calls via the CTS-FP. The CTS-MS must have been initialised correctly to the CTS-FP before attachment can take part.

Generic Frequency List (GFL): Generic Frequency List (GFL) contains all absolute radio frequency channel numbers (ARFCN), as defined in GSM 05.05, on which the CTS-FP is allowed to operate. The CTS-FP will never use frequencies which are not listed in the GFL.

CTS Mobile Station: GSM MS with CTS capability.

CTS Fixed Part: CTS-FP is a device which offers a personal cordless coverage and acts as a link between the CTS-MS and the fixed network or the GSM network.

GSM Operator: GSM operator is the operator who provides GSM cellular service to the MS.

CTS licence exempt frequencies: frequency band that may be allocated by national regulator to CTS usage outside of a GSM licence allocated to a GSM operator.

CTS operator: CTS operator is the operator who provides the GFL to the CTS-FP. The CTS operator may be the same than the GSM operator.

FP-SIM: FP-SIM is the SIM card inserted in the CTS-FP, which materialised the CTS subscription. The FP-SIM belongs to the CTS operator.

CTS subscription: when a GSM licensed band is used, the right to use a CTS operator's frequency spectrum for communication between a CTS-FP and CTS-MS(s).

CTS-FP owner: person who has the CTS-FP control and may authorise MS Enrolment.

CTS user: person who has a CTS-MS which is allowed to do CTS operations.

CTS-MS local number: number in the range of 0-99 optionally assigned to the CTS-MS at enrolment. This number is used for CTS internal calls.

CTS-Roaming: right for an additional CTS-MS to be enrolled to a CTS-FP which is initialised to an operator other than the HPLMN operator of the additional CTS-MS.

3.2 Abbreviations

In addition to those below, abbreviations used in the present document are listed in GSM 01.04.

CTS	Cordless Telephony System
CTS-FP	Cordless Telephony System - Fixed Part
CTS-MS	Cordless Telephony System - Mobile Station
FP – SIM	Fixed Part – Subscriber Identity Module
GFL	Generic Frequency List
IFPEI	International Fixed Part Equipment Identity
ISDN	Integrated Services Digital Network
MS	Mobile Station
PSTN	Public Switched Telephone Network
SMS - MO	Short Message Service - Mobile Originated

4 Description

4.1 System overview

The GSM Cordless Telephone System (GSM-CTS) described in the present document is a radio communications system based on a GSM-compatible cellular interface between a private radio base station called CTS Fixed Part (CTS-FP) and a CTS mobile station (CTS-MS). The CTS-FP is connected either via a wireline to the PSTN/ISDN network or via a radio connection to a GSM network.

When connected to the fixed network, the CTS-FP will be compliant with the existing fixed network standards (e.g. support the telephony 3,1 kHz teleservice (see [7]), the speech bearer service (see [8]) and the 3,1 kHz audio bearer service (see [9] in case of an ISDN CTS-FP and the relevant national standards in case of PSTN CTS-FP). There is no direct radio communication between different CTS-FPs. However, this does not preclude indirect communication, e.g. via the fixed network or via the MS.

When connected to a GSM network, the CTS-FP is compliant with the existing ETSI standards applicable to a GSM mobile. From the GSM network point of view, the CTS-FP is seen as a standard GSM mobile including a standard GSM SIM card. (i.e. the CTS-FP may include 2 SIM cards: one for the GSM subscription and one for the CTS subscription).

An illustration of the CTS concept is shown in figure 1. Due to the low transmit power of the CTS-FP, the coverage area is restricted and limited. When the CTS-MS comes in range of the CTS-FP, it may attach to the CTS. When connected to the fixed network, from then on, the user can make and accept calls directly via the PSTN without the intervention of the public cellular network. When attached, the MS checks whether it is still in range of the CTS and whether it is paged. As an option, the MS may simultaneously work in both the cellular and the cordless mode, in a so called parallel mode, i.e. be attached both in the GSM PLMN and the CTS. When the MS comes out of range of the CTS it may switch to the GSM mode. This switch shall be indicated to the user. When the CTS-MS is in either CTS mode or GSM mode and is searching for a potential channel to attach with in the other mode, it shall be able to respond to paging messages from the mode in which it is currently attached.

The radio interface between the CTS-FP and the CTS-MS is a modified GSM interface. The carrier frequencies used are the same as assigned for cellular service. These carrier frequencies can be part of a licence exempt band or a licensed band.

When CTS-FP operates in a licenced band:

- these frequencies can be reserved by the operator for GSM-CTS usage, or can be shared with the cellular system. In every case, however, the GSM operator controls, on an area and time basis, on which frequencies the CTS is allowed to operate. In case of co-existence in the same operating area, a procedure shall be deployed to minimise interference between GSM PLMN and CTS users.

NOTE: The frequencies used for CTS could be in any frequency band defined for GSM, i.e. GSM900, DCS1800 or PCS1900. This applies both to the CTS-FP and the CTS-MS.

The quality of service (e.g. service accessibility, call set-up time, bit rate for data services) of the 'GSM only' subscribers shall remain unaffected by the introduction of CTS. Means to guarantee that the quality of service of GSM subscribers does not degrade due to CTS introduction have to be defined.

Since the MS uses the same frequency spectrum both for the cellular mode and the cordless mode, the ME hardware can be reused. The intention is that hardware modifications in the radio transceiver of a standard GSM ME should not be necessary. It is also a requirement that the introduction of CTS shall not destabilise any existing GSM mobile equipment or degrade the mobile equipment's dedicated (e.g. in call) or idle mode performance.

When a licensed band is used:

- the CTS operator can administer all CTS-FPs and the corresponding CTS. When the CTS is initialised, the required operation parameters are downloaded into the CTS. This can either be done via the fixed network or via the GSM radio interface.

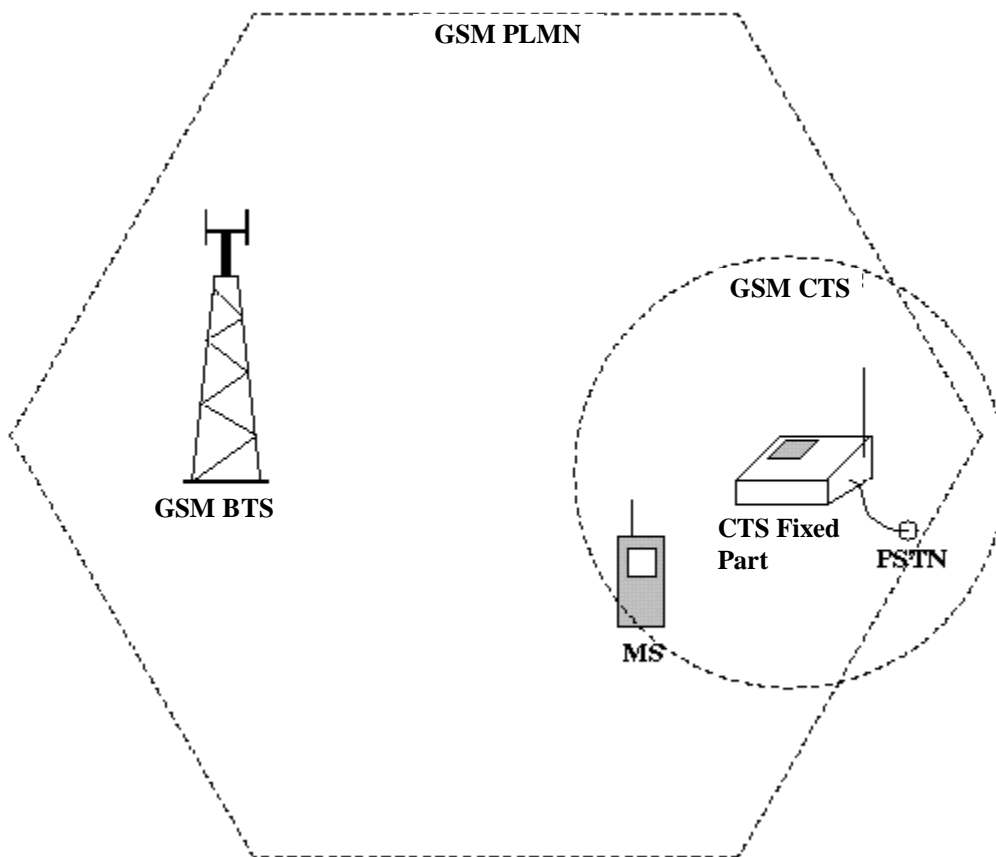


Figure 1: Concept for the GSM CTS functionality when connected to the PSTN

4.2 Service aspects

4.2.1 General

In the first phase of CTS an application for residential environment serving one cell is intended. The services and features to be supported relate to this assumption.

4.2.2 User aspects

The user of the CTS shall be required to perform a simple installation process in order to initialise the CTS operation. This process shall include:

- connection of the CTS-FP to the power supply and to either the fixed network or the GSM network interface;
- enrolment of the CTS-FP (CTS-FP enrolment).
As the CTS-FP shall not be GSM operator specific, it has to be enrolled with operation specific data, e.g. a list of allowed frequencies (Generic Frequency List GFL);
- enrolment of one or several CTS-MSs with the CTS-FP (CTS-MS enrolment).

Once initialised, CTS operation shall not require any specific action of the user to maintain the operation as long as the CTS-FP is not de-activated (see clause 6).

To have service granted by the CTS-FP, a CTS-MS shall attach at the CTS-FP. In order to attach, a CTS-MS has to be enrolled with the CTS-FP, the user has to bring the CTS-MS in range of the CTS-FP and the appropriate operation mode has to be selected (see subclause 4.2.5.1).

4.2.3 Subscriptions

The CTS-FP owner shall have a valid CTS subscription from a CTS operator. This subscription is materialised by an FP-SIM. It gives the right to the CTS-FP owner to initialise the CTS-FP and enroll CTS-MSs under conditions defined by the CTS operator. In exchange of a subscription to a CTS operator, the CTS-FP owner will receive a CTS-GFL in the CTS-FP.

The user of the GSM CTS service shall have a subscription with a GSM operator, which allows CTS service. This CTS authorisation may be given to all the CTS-MSs of a PLMN or may be linked to a specific service subscription given by the GSM operator. By default the CTS-MS are not allowed to do CTS operations. The use of a GSM subscription for 'CTS only' service is not precluded. Corresponding information may be stored in the SIM.

In order to be able to use the CTS service on the fixed network, a subscription to the fixed network is also required. When connected to the GSM network, the fixed network subscription is replaced by a GSM subscription and the CTS-FP shall include a GSM SIM card corresponding to this GSM subscription.

The fixed network, GSM and CTS subscriptions may be independent of each other. However at CTS-FP enrolment (see subclause 5.1) the CTS-FP may obtain operation data specific to the CTS operator, the user of the CTS service has subscribed to, thus the CTS-FP operation may be tied to a specific GSM operator.

The CTS-FP is normally not subscribed to, it is the users' property. After the CTS service subscription to one operator is cancelled, it shall be possible to use the same CTS-FP for a CTS service subscription to another operator.

4.2.3.1 CTS-roaming aspects

A CTS-FP owner may only have one CTS subscription to a single CTS operator. This operator defines which CTS-MSs are allowed to enroll onto a particular CTS-FP. Several control levels are offered by the CTS:

- **uncontrolled roaming:** all CTS-MS from any GSM operator are allowed to enrol on the CTS-FP without CTS-operator control;
- **no roaming:** the CTS-operator and the GSM operator are the same and only the CTS-MSs from the CTS operator are allowed to attach on the CTS-FP;
- **control roaming:** on a case by case basis, the CTS-operator controls CTS-MS enrolment using CTS-MS IMSI.

In any cases, the CTS-FP owner authorisation is mandatory for CTS-MS enrolment.

NOTE: CTS-roaming has no impact on CTS-FP operational mode defined by the CTS-operator (e.g. frequency management).

4.2.3.2 Withdrawal of CTS subscription

When used within a licensed band:

- if the CTS subscription is withdrawn, the user loses the right to use a CTS-operator's frequency spectrum for CTS usage and CTS operation shall stop.

As the CTS service is not obtained directly from the GSM network like other GSM services (e.g. SMS), means of subscription control have to be defined.

4.2.4 GSM coverage

The concept should allow CTS operation during all GSM coverage scenarios, e.g. the following:

- area with no GSM coverage;
- area with GSM coverage of the HPLMN operator;
- area with no HPLMN coverage, but coverage of other PLMN operator(s).

Depending on the enrolment concept being used (see subclause 5.1), a limitation may be that the MS need to be in HPLMN (or at least PLMN) coverage once, before the CTS-FP can be correctly initialised (if the GSM radio interface is used for enrolment data download).

In the case of a CTS-FP connected to a PLMN, a GSM coverage is necessary for CTS operations.

4.2.5 Mobility

4.2.5.1 Mode selection between CTS and PLMN

The CTS-MS may operate in one of six different operation modes. It is not required that the CTS-MS support all the modes. It shall be possible for the user to select between the supported modes at any time, except during an active call.

- a) Manual mode: GSM only, i.e. the normal GSM operation.
- b) Manual mode: CTS only, i.e. calls can only be originated or received via the CTS-FP. The MS is not attached to the GSM PLMN.
- c) Automatic mode with CTS preferred: The MS attaches to CTS, when in range, and then automatically tries to attach with GSM PLMN, when out of CTS range. An MS attached with a GSM PLMN and coming in range of the CTS shall not attach to CTS if a connection in the GSM PLMN is active. In that case the MS shall wait until the connection is finished.
- d) Automatic mode with GSM preferred: the MS attaches to GSM PLMN, when in range, and then automatically tries to attach with CTS, when out of GSM PLMN range. A MS attached with CTS and coming in range of a GSM PLMN shall not attach to the GSM PLMN, if a connection in the CTS is active. In that case the MS shall wait until the connection is finished.
- e) Parallel mode - single active mode: the MS tries to attach with both GSM PLMN and CTS. If a CTS-MS is attached to both CTS-FP and GSM, it shall offer double service in idle mode (i.e. full service on both systems in idle mode), and at least single service in active mode (i.e. when involved in an active call on one system, no service is required on the other system). Techniques shall avoid excessive signalling load on the GSM PLMN.
- f) Parallel mode - double active mode: the MS tries to attach with both GSM PLMN and CTS. If a CTS-MS is attached to both CTS-FP and GSM, it shall offer full service on both types of networks, e.g. the CTS-MS shall be able to successfully handle all applicable terminating calls that are addressed to its MSISDN and to the CTS-FP number.

When switched on, the CTS-MS enters the last selected operation mode.

NOTE: The user may, optionally, define a default mode setting, in which case the default mode is always entered when the CTS-MS is switched on.

The selected mode and the current coverage (CTS and/or GSM) shall be indicated to the user.

The user of the CTS-MS might have subscribed to the CTS service only. Access of the CTS-MS to the GSM network may however be required in order to establish a signalling link, e.g. to exchange operation control data.

4.2.5.2 Attachment of the same CTS-MS with multiple CTS-FPs

A CTS-MS shall be able to attach to all CTS-FPs it is initialised with however it may only be attached with only one CTS-FP at a time.

A list of all CTS-FPs, the CTS-MS is enrolled to, shall be stored in the CTS-MS, preferably on the MS-SIM. This list shall for each CTS-FP/CTS-MS pair contain all data which defines their association.

This list may also define the preference of attachment in the case that the CTS-MS is in range of several CTS-FPs when entering the CTS mode of operation. The user may be able to change the preference order of CTS-FPs in the list.

A manual attachment mode may be implemented which enables the user to scan for CTS-FPs the CTS-MS is enrolled to in order to select a specific CTS-FP, of those in range, for attachment.

4.2.5.3 Attachment of multiple CTS-MSs with the same CTS-FP

Enrolment and parallel attachment of multiple MS on a single CTS-FP shall be possible. The CTS-FP control however what MSs are allowed to be enrolled and attached.

A minimum number of 8 CTS-MSs shall be possible to attach with the same CTS-FP.

4.2.5.4 Attachment status of a CTS-MS

A mechanism to provide information about the attachment status of a CTS-MS shall be supported by the CTS-FP. This mechanism can be used for network information or routing purposes. This mechanism shall provide a notification in the following situations:

- a) when attaching with the CTS;
- b) when de-attaching with the CTS.

This mechanism shall be transparent to the user.

In addition, when the mobile is leaving the GSM network for CTS attachment (i.e. not in the parallel mode), it shall behave towards the GSM network as if it was being switched off.

4.2.6 CTS applications

4.2.6.1 Tele-services

The first phase of CTS shall support the speech teleservice on the CTS radio interface.

Emergency calls shall be supported for attached MSs only. The call origination of an emergency call shall be according to the selected mode. The quality of the speech teleservice shall be at least equal to existing GSM speech qualities. The existing GSM phase 2 requirements on voice codecs according to ref. [xx] shall be applicable to CTS.

If the user attempts to set up calls other than speech or emergency calls, this request shall be sent to the CTS-FP. The CTS-FP may issue a rejection cause.

4.2.6.2 Supplementary services

Supplementary services invoked from the CTS-MS are directed towards the CTS-FP or the GSM network, depending on the current mode and coverage. In parallel mode it should be possible for the user to choose the preferential network and regardless of the preferential origination, to select on a per transaction basis the used network.

As an option (both in the CTS-MS and CTS-FP) the user with CTS should be capable of supporting all the standardized supplementary services that are provided in the GSM. From the point of view of the CTS-MS and the radio interface, the operation of the services shall be the same in GSM and in cordless mode. The CTS radio interface protocol shall therefore support the GSM supplementary services and correspond to the GSM radio interface with respect to the supplementary services. Additional optional procedures may be provided in the CTS-FP, i.e. an interworking function between the CTS radio interface protocol and the fixed network access protocol for the support of supplementary services. Services not supported in the CTS-FP shall be rejected in the same way as in the GSM.

The CTS-MS shall indicate to the user if the CTS-FP cannot be used to handle the requested service, e.g. due to that the line is busy or the CTS-FP do not support the above-mentioned interworking.

4.2.6.3 Additional support for fixed network supplementary services

In order to enable support of supplementary services in the fixed network, DTMF handling on the CTS Radio Interface, during CTS calls, shall be handled in the same way as in GSM. The CTS-FP shall generate the corresponding tones and messages for the fixed network.

Since some fixed networks make use of hook-flash signalling, it shall be possible for the user to send a hook-flash request to the CTS-FP, which shall then perform the hook-flash signalling on the line interface.

4.2.6.4 Man Machine Interface (MMI)

If the CTS mode is selected as the preferential mode for mobile originated activities (see subclauses 4.2.6.2 and 5.5.1 for supplementary service operations and call set-up, respectively), the handset should **not** change its behaviour regarding input MMI string. Normal rules according to GSM 02.30 should be used by the MS and the CTS-FP, which would then perform the proper interworking towards the fixed network or the GSM network on which the CTS-FP is connected.

4.2.6.5 CTS internal calls

In the case when more than one CTS-MS are attached to a CTS-FP, internal calls (without billing) between the MSs at this CTS-FP should be possible, as an option (both in the CTS-MS and CTS-FP).

4.2.6.6 CTS internal call transfer

As an option (both in the CTS-MS and CTS-FP) the user should be able to internally transfer an external network call from one CTS-MS to another if both CTS-MSs are attached to the same CTS-FP.

4.2.6.7 CTS internal call hold

As an option (both in the CTS-MS and CTS-FP) the user should be able to put a external network call on internal hold, i.e. to release the call on the CTS Radio Interface but keep it active on the external network interface. If this option is supported, it shall also be possible to retrieve the call.

4.2.6.8 Mobile hunting

As an option, it should be possible to trigger a general procedure which makes all the attached MSs ring on a special way and therefore allows the user to locate them. The procedure should be triggered by the CTS-FP or CTS-MS.

4.2.6.9 SMS-MT

As an option the user should be able to have a Mobile Terminated Short Message presented, provided this message is made available to the CTS-FP. The support of SMS-MT on the CTS radio interface is mandatory for the CTS-MS.

4.2.6.10 SMS-MO

As an option the user should be able to generate a Mobile Originated Short Message and send it towards the CTS-FP. The CTS-FP may issue a rejection cause, if the feature is not supported.

4.2.6.11 Other services

Other services are not required for the first phase.

4.3 Radio interface and GSM co-existence aspects

4.3.1 General principles

It should be possible to use the GSM-Cordless Telephony System (CTS) on the same carrier frequencies as assigned for the cellular service. These carrier frequencies can be part of a licence exempt band or a licensed band. In the second case these frequencies can be reserved for GSM-CTS usage, or can be shared with the cellular system. In any case a set of frequencies (Generic Frequency List) needs to be defined by a CTS operator or a regulator to enable CTS operations.

The CTS licence exempt mode is only applicable in countries where the national regulator allocates a suitable band.

A mechanism shall be employed to insure that the CTS-FP will only operate in Licence exempt mode in an area or country where it is authorized to do so.

When used within a licensed band:

- it is necessary for the CTS operator to have complete control, on an area and time basis, over the frequencies the CTS can use. These frequencies shall be part of the frequency set under its responsibility.

Interference to the cellular system or other CTS systems shall be minimised.

The requirements in respect to the receiver and transmitter characteristics of the CTS FP shall allow communication with a GSM MS.

The CTS-FP shall also have a self-controlling feature to minimise interference in the case where no attached MS is in range of the CTS-FP.

In the case of the CTS-Fixed Part connected to PLMN, means should be implemented in the CTS-FP in order to minimize unnecessary radio transmissions to the PLMN.

4.3.2 Broadcast channel functionality

For CTS the BCCH-like functionality shall include the following:

- reveal the presence of the CTS;
- page the terminals attached to the CTS;
- accept access requests from the terminals attached at the CTS;
- support intracell handover;
- synchronisation.

4.4 Security requirements

4.4.1 General

1. The use of CTS shall not compromise the security of any PLMN or fixed network.
2. There shall be a mechanism that ensures that security options and parameters for the CTS-FP provided by the CTS operator or by the regulator are followed by the CTS-FP.
3. There shall be a mechanism that ensures that the CTS-FP only obeys security options and parameter received from the PLMN operator to which it is enrolled.

4.4.2 Enrolment

Enrolment of the MS to the FP shall include authentication of the MS-SIM by the PLMN in accordance with the requirements for subscriber identity authentication defined in GSM 02.09, clause 3.

It shall be possible to conduct all CTS-FP and CTS-MS security mechanisms across the fixed network.

Enrolment of the MS to the FP shall include mutual authentication between the CTS-FP and the CTS-MS.

The mutual authentication of MS and FP shall use a CTS specific secret key.

4.4.3 Attachment

Attachment of the MS to the FP shall include mutual authentication between the CTS-FP and the CTS-MS.

The mutual authentication of MS and FP shall use a CTS specific secret key. This key shall not be a key input to the MS via the MS MMI, but shall be a key installed/derived during the enrolment of the MS to the FP.

It shall not be possible for an MS that has not been enrolled to an FP to attach to that FP.

4.4.4 Protection of communications

Local CTS communication (both signalling and user data) shall be protected against unauthorized eavesdropping.

This protection need not be as secure as for the GSM air interface, but it shall employ cryptographic methods and a CTS specific encryption key.

A CTS mobile subscriber shall be identified on the CTS radio path by a local temporary, number, similar to, but not, the TMSI.

Communication across the fixed network of sensitive data required for CTS operation shall be protected against unauthorized eavesdropping.

4.4.5 Security Parameter Storage Requirements

It shall be possible for the GSM operator to ascertain the IMEI of the MS when the CTS-MS is attached with a CTS-FP. Additionally, in order to detect changes in the ME used for CTS, the IMEI shall be passed to the FP when requested.

The CTS-FP shall have a unique identity (IFPEI) stored in a secure way, in accordance with the requirements for storage of the IMEI, described in GSM 02.09.

It shall be possible for the GSM operator to ascertain the IFPEI of the CTS-FP.

The common keys used by the MS and FP for mutual authentication and encryption of local CTS communication shall be securely stored within the MS and FP. The secret keys used for enrolment and attachment shall be stored in the MS-SIM.

The FP shall not contain any algorithms used for GSM security (e.g. A3, A8) unless the storage of these algorithms within the FP meets the requirements for storage of authentication functionality within the MS as defined in 02.09, subclause 3.2.3.

Key management shall be under the control of the PLMN operator.

4.4.6 De-activation

It shall be possible within the operator defined time for the GSM operator to de-activate the CTS service of its subscribers (i.e. de-activate the MS).

It shall be possible, within the operator defined time, for the CTS operator to de-activate a CTS-FP with respect to the use of the operator's frequencies by that CTS-FP (see also subclause 6.3).

5 Normal Procedures

5.1 Enrolment of CTS-FP

5.1.1 CTS operator procedure for enrolment of CTS-FP

At enrolment, the CTS-FP shall receive data needed for correct operation of the CTS radio interface, e.g. the following:

- the set of carrier frequencies;
- the maximum transmit power it is allowed to use;
- data related to CTS-roaming.

At enrolment, the CTS-FP may also receive other data necessary for the CTS-FP to operate, e.g. the following:

- operation data necessary to contact the CTS operator (e.g. a fixed network destination address where the information shall be sent).

As a minimum requirement one of the following three mechanisms to provide data to the CTS-FP shall be supported:

- a) by means of network information via the radio interface (e.g. a SMS message, or a system-information message) from the cellular network to the CTS-MS, which then forwards the information to the CTS-FP. This implies that the MS must recognize that this information is intended for CTS-FP use, i.e. it shall forward the relevant information, without any display to the user. A means of passing the initial parameters to the CTS-FP is required;
- b) directly on a fixed network connection between CTS-FP and the CTS operator;
- c) Directly from the GSM network when the CTS-FP is connected via radio to a GSM PLMN.

Cordless access to the CTS services via this CTS-FP shall not be possible unless enrolment has been successfully completed.

Enrolment shall be based on authentication of the FP-SIM.

5.1.2 User procedure for enrolment of CTS-FP

To prevent misuse of the CTS-FP or unintended start of the enrolment procedure, the following user actions may be required:

- the CTS-FP and a CTS-MS may be used for CTS-FP enrolment;
- a well defined user action at the CTS-FP and/or the CTS-MS in order to enter a CTS-FP enrolment state (e.g. by pressing a button or by entering a certain menu);
- the user is informed when the procedure is finished (e.g. tones or icons).

5.2 Enrolment of CTS-MSs

After enrolment of the CTS-FP it may be possible to initialise several CTS-MSs on that CTS-FP.

To avoid unauthorized enrolment of a CTS-MS onto a CTS-FP, CTS-MS enrolment shall involve mutual authentication of the CTS-MS and the CTS-FP. Some security sensitive information, e.g. the CTS-MS authentication key, shall be securely stored inside the MS-SIM and in CTS-FP. Some other information needs to be exchanged between CTS-FP and CTS-MS to create data records required to recognize and access each other. This shall be done directly via signalling on the GSM-CTS Radio Interface.

Each CTS-MS to be enrolled shall indicate that the CTS service is subscribed to.

In addition, depending on the roaming control level defined by the CTS operator, enrolment may be performed with CTS operator control including CTS-FP authentication by the CTS operator and CTS-MS authentication. To prevent misuse of the CTS-FP by unauthorised users, the following actions shall be required:

- the CTS-FP and a CTS-MS shall be used for CTS-MS enrolment;
- a well defined user action at the CTS-FP and/or the CTS-MS in order to enter a CTS-MS enrolment state (e.g. by pressing a button or by entering a certain menu);
- there shall be a mechanism to prove authorisation of that particular CTS-MS to use the CTS-FP;
- the user is informed, via the CTS-MS, when the procedure is finished (e.g. tones or icons).

At CTS-MS enrolment a unique CTS-MS number is optionally assigned to the CTS-MS. This number is intended to be used to identify a specific CTS-MS, e.g. for de-enrolment or for addressing an internal call or call transfer towards this CTS-MS. This CTS-MS number shall be in the range of 0 to 99.

5.3 De-enrolment of a CTS-MS

It shall be possible to de-initialise a specific CTS-MS which is enrolled at a CTS-FP. This can be performed either by a CTS-MS, by the CTS-FP or by the CTS operator.

In the case de-enrolment is performed by a CTS-MS, to prevent misuse by unauthorised users or unintended CTS-MS de-enrolment, the following actions shall be required:

- the CTS-FP and a CTS-MS shall be used for CTS-MS de-enrolment. The CTS-MS used may be any CTS-MS which is enrolled at the CTS-FP including the one which is going to be de-enrolled;
- a well defined user action at the CTS-FP and/or the CTS-MS in order to enter a CTS-MS de-enrolment state (e.g. pressing a button or entering a certain menu);
- there shall be a mechanism to prove authorisation of that particular CTS-MS to use the CTS-FP;
- the user is informed, via the CTS-MS, when the procedure is finished (e.g. tones or icons).

When de-enrolment is performed by the CTS-FP, the CTS-FP deletes all the data related to the de-enrolled CTS-MS and notifies the CTS-MS when possible.

When de-enrolment is performed by the CTS operator a specific command is sent to the CTS-FP requesting de-enrolment of a given CTS-MS. The CTS-FP sends a de-enrolment notification to the CTS-MS when possible.

The de-enrolled CTS-MS shall not be able to attach to the CTS-FP until it is again enrolled with the CTS-FP.

5.4 Attachment of CTS-MS

An MS cannot attach with a CTS-FP without being enrolled to that CTS-FP. An MS cannot make calls via a certain CTS-FP, without being attached with that CTS-FP.

To avoid unauthorized attachment of a CTS-MS at a CTS-FP, mutual authentication between the CTS-FP and the CTS-MS shall be performed during attachment.

5.5 Call procedures

5.5.1 CTS-MS originated calls

Calls from the CTS-MS are set up via the CTS-FP or the GSM network, depending on the current mode and coverage. In parallel mode it should be possible for the user to choose the preferential call origination network and regardless of the preferential origination, to select on per call basis the call set up network.

The CTS-MS shall indicate to the user if the CTS-FP cannot be used to set-up a call, e.g. due to that the line is busy or the CTS-FP is engaged in a CTS internal call.

In case of network origination, the CTS-MS/CTS-FP pair shall behave as a usual terminal of the network on which the CTS-FP is connected.

If the CTS internal call hold/call retrieve feature is supported, the user can put the call to the network on internal hold, e.g. to set up a CTS internal call, and retrieve it afterwards.

5.5.1.1 Number compatibility between GSM formats and fixed network formats

In order to use the GSM number formats (e.g. using '+' as part of a dialled number) when originating a CTS call via the MMI of the CTS-MS, a number conversion from GSM format to fixed network format is required in the CTS-FP.

The following types of conversions are required:

- replacing the GSM international prefix ('+') with the appropriate fixed network international prefix, as defined by the user, when the country code in the call set-up does not equal the stored (home) country code;
- replacing the GSM international prefix ('+') and the country code with an appropriate prefix, as defined by the user (e.g. a '0'), when the country code in the call set-up equals the stored (home) country code;
- route the Emergency call set-up to the appropriate emergency number in the fixed network;
- removing a potential (home) area code, as defined by the user.

In order to support the above-mentioned features, the user shall either be able to define and modify the following data in the CTS-MS MMI and then pass it to the CTS-FP or define the conversions in the CTS-FP:

- the fixed network international prefix;
- the (home) country code;
- the (home) area code;
- the fixed network emergency number;
- prefix to replace "international part" of a national number (e.g. replacing +468123 with 08123).

5.5.2 CTS-MS terminated calls

External calls to the CTS-MS are directed either via the GSM network (using the MSISDN) or via the CTS-FP (using the CTS-FP network or GSM number). Each network could then direct the call to any destination, e.g. according to registration status or normal "Call forwarding" settings.

In addition, internal calls may be supported, as described in subclause 5.5.3.

Two different types of alerting the CTS-MS from the CTS-FP shall be supported:

- group alerting: all CTS-MSs attached with the CTS-FP will be paged until one CTS-MS (or another fixed network terminal) accepts the call. The other CTS-MSs will then not be paged any more and shall stop alerting the user;
- individual alerting: if a call can be determined, by the CTS-FP, as intended for a certain CTS-MS, only that CTS-MS will be paged. To determine an individual CTS-MS, different methods can be used, e.g. the following:
 - use of the CTS-MS local number;
 - use of the MS-ISDN.

When receiving a call, the user shall be informed where the call comes from, i.e. via GSM network or CTS-FP, and in the case of CTS-FP whether it is a CTS internal call or an external call. As an option in the CTS-MS, an indication on the type of alerting (group or individual) should be given. This could be realised e.g. by different alerting tones.

If an incoming call via the CTS-FP is answered by a fixed terminal (e.g. phone or answering machine), the CTS user shall be able to retrieve the call at any time while the call lasts.

If the CTS internal call hold/call retrieve feature is supported, the user can put the call from the external network on internal hold, e.g. to set up a CTS internal call, and retrieve it afterwards.

If a MS is involved in an internal call and an incoming call for this MS is presented on the CTS-FP, the user shall be informed of the new call, e.g. by a tone. It shall be possible to distinguish internal and external calls. The user will have the possibility to ignore the new call or to release or to hold the current call and to take the new one.

5.5.3 CTS internal calls (optional)

To set up an internal call, a specific action or command shall be used in order to distinguish between external calls (to the fixed network or the GSM network) and CTS internal calls. The CTS-MS number, which is assigned at enrolment shall be used for dialling. It should be possible to find the CTS-MS number corresponding to a MSISDN number by a MMI on the CTS-FP and/or on the CTS-MS.

Only the CTS-MS which is associated with the CTS-MS number will be paged. A specific alerting tone or melody may be defined for internal calls in order to differentiate internal and external calls.

5.5.4 CTS internal call transfer (optional)

If the internal call transfer feature is supported, the user can transfer a call from the fixed network to any CTS-MS which is attached at the same CTS-FP. The destined CTS-MS is addressed by its CTS-MS number which is assigned at enrolment.

An external network call can directly be transferred to the destined CTS-MS or it can be put on hold before (see above).

5.6 Maintenance

The data exchanged during the initialisation may be updated, using the same mechanisms as developed for initialisation. The update of the initialisation parameters intended for correct operation of the CTS radio interface (as described in subclause 5.1.1) after initialisation time shall be under the control of the GSM operator.

Means shall be developed so that a CTS-FP cannot be moved to an area , where the CTS frequencies are not allowed to be used by the CTS subscriber, without having to be re-initialised.

The MS when attached to GSM, but not attached to the CTS-FP, and with a user selection for parallel mode or automatic mode with CTS preferred, shall attach with the CTS-FP within 2 minutes after coming in range of the CTS-FP.

The MS when being switched on within range of the CTS-FP, and with a user selection for CTS mode, automatic mode with CTS preferred, or parallel mode, shall attach with the CTS-FP within 1 minute.

6 CTS de-activation

Three different types of CTS-FP de-activation are possible.

6.1 CTS-FP de-activation by the CTS operator

When used within a licensed band:

- it shall be possible for the CTS operator to de-activate the CTS service on an area and time base. The CTS operator may de-activate specific CTS-FPs. This kind of de-activation shall not delete the data related to the CTS-FP/CTS-MS association.

6.2 CTS-FP de-activation by the user

The user shall be able de-activate the CTS-FP, (i.e. erase the data necessary for CTS operation) In order to restart CTS operation, the user has to initialise the CTS-FP again.

A special action shall be required by the user in order to de-activate the CTS-FP.

6.3 CTS-FP de-activation by self controlling features

When used within a licensed band:

- the CTS-FP shall stop operation when it has not received any update of operation data for a certain period of time. The period shall be under the control of the PLMN. This kind of de-activation shall not delete the data related to the CTS-FP/CTS-MS association;
- when the CTS-FP is de-connected from the fixed network or the GSM network, or/and power supply for a certain period of time, it shall be de-activated. This kind of de-activation shall not delete the data related to the CTS-FP/CTS-MS association;
- when the FP-SIM has been modified (insertion of a new FP-SIM card) the CTS-FP shall be de-activated.

In order to restart CTS operation, the user has to initialise the CTS-FP again.

6.4 CTS-MS de-activation by the CTS operator

It shall be possible for the CTS operator to stop the CTS service on an area and time base. The CTS operator may de-activate specific CTS-FPs. This kind of de-activation shall not delete the data related to the CTS-FP/CTS-MS association.

7 Exceptional procedures

None identified.

8 Charging aspects

The only charging aspects assumed is on a subscription basis, for the use of the spectrum, belonging to the CTS operator. The CTS operator may differentiate the amount of charge if CTS-roaming at a CTS-FP is allowed (see subclause 4.2.3.1).

There are no charging aspects when the CTS operate within a license exempt band.

Fixed network charging is out of the scope of the present document.

9 Cross Phase Compatibility

None identified.

Annex A (informative): Later phases of CTS

NOTE: This annex will be taken out of later versions of the Stage 1 and moved to 10.56.

In order to make the design of the CTS radio interface "future proof", it is of importance that services that are likely to be introduced in later phases of CTS are considered already in the design of the first phase of the CTS radio interface. The following future services shall be taken into account when the first phase of the CTS radio interface is designed (preferably by re-using the existing GSM protocols for these features):

- CTS-CTS handover in a CTS multi-cell environment;
- data and fax services.

Furthermore, later phases of CTS may also include:

- definition of additional protocols and interface standards towards the fixed network in order to include CTS in IN services in an efficient way;
- support of multiple fixed lines.

The CTS-GSM handover (in both directions) is a complex issue which needs further study. Thus, it shall for the moment not be considered as a candidate for CTS.

Annex B (informative): Change History

SMG No.	TDoc. No.	CR. No.	Clauses affected	New version	Subject/Comments
SMG#28	99-049	A001			Integration of SMG10 comments - R98
SMG#28	99-049	A002	4.2.6.4	7.1.0	Management of GSM SS - In order to reduce MS complexity, the MS should behave indifferently in cellular and cordless mode, as much as possible.
SMG#28	99-049	A003			CTS wording clarification: In order to clarify the CTS description, the SMG12 has replaced "MS enrolment" by "MS Enrolment". This clearly separates FP et MS activities.
SMG#28	99-049	A004			Rejected by Plenary, and after removal of Unlicensed band, it was replaced by 0256A005
SMG#28	99-049	A005	3.1, 3.2, 4.1, 4.2.3, 4.2.3.1, 4.2.3.2, 4.3.1, 4.4.1, 4.4.6, 5.1.1, 5.1.2, 6., 6.1, 6.3, 6.4, 8		Introduction of a SIM card in the CTS-FP for CTS subscription management: Since the introduction by the SMG12 of a SIM card in the CTS-FP, it is possible to separate GSM operator and CTS operator roles and increase the overall CTS security.
SMG#28				7.1.1	The version number has been updated to 7.1.1 for Public Enquiry.
SMG#29	P-99-378	A006	Overall	7.2.0	The CTS stage 1 requires some clarifications of CTS description in order to align on SMG12 : CTS-MS « registration » is replaced by « attachment ». Clarification is brought to de-enrolment of a CTS-MS and de-activation of a CTS-FP
SMG#29	P-99-378	A007r1	Overall	7.2.0	The introduction of the feature in the GSM-CTS standard, allows national regulators to allocate licence exempt frequencies to CTS usage. Reason for revision: clarification of the applicability of the license exempt mode and editorial improvements.
SMG#29	P-99-378	A008r1	Overall	7.2.0	This introduction of CTS-FP connected to PLMN, extend the CTS concept application to all GSM operators. It should not require any changes to the CTS-MS.
				8.0.0	Specification upgrade to Release 1997 version 8.0.0
				8.0.1	Update to Version 8.0.1 for Publication

Change History											
TSG#	TSG doc	WG doc	Spec	CR	Rev	Ph	Cat	Title	Old vers	New vers	WI
s28	P-99-030	98-795	02.56	A001		R98	F	Integration of SMG10 comments	7.0.0	7.1.0	CTS
s28	P-99-030	98-796	02.56	A002		R98	F	Management of GSM SS	7.0.0	7.1.0	CTS
s28	P-99-030	98-749	02.56	A003		R98	D	CTS wording clarification	7.0.0	7.1.0	CTS
	P-99-049		02.56	A005		R98	D	Introduction of a SIM card in the CTS-FP for CTS subscription management	7.0.0	7.1.0	CTS
s28								Updated for PE	7.1.0	7.1.1	
s29	P-99-378	1-99-108	02.56	A006		R98	F	Clarifications of CTS description and alignment on SMG12	7.1.0	7.2.0	CTS
s29	P-99-378	1-99-106	02.56	A007	1	R98	B	CTS usage with licence exempt frequencies	7.1.0	7.2.0	CTS
s29	P-99-378	1-99-107	02.56	A008	1	R98	B	Definition of CTS-FP connected to a GSM PLMN	7.1.0	7.2.0	CTS
s29			02.56					Specification upgrade to Release 1997 version 8.0.0	7.2.0	8.0.0	
s29			02.56					Update to Version 8.0.1 for Publication	8.0.0	8.0.1	

SP-11	SP-010065	S1-010258	42.056			Rel-4		Transferred to 3GPP Release 4	8.0.1	4.0.0	
SP-16	SP-020267	S1-021043	42.056			Rel-5		Updated from Rel-4 to Rel5	4.0.0	5.0.0	
SP-26	SP-040744	S1-040997	42.056			Rel-6		Updated from Rel-5 to Rel-6	5.0.0	6.0.0	
SP-36			42.056			Rel-7		Updated from Rel-6 to Rel-7	6.0.0	7.0.0	
SP-42	-	-				Rel-8		Updated from Rel-7 to Rel-8	7.0.0	8.0.0	
SP-46	-	-	-	-	-	-	-	Updated to Rel-9 by MCC	8.0.0	9.0.0	
2011-03	-	-	-	-	-	-	-	Update to Rel-10 version (MCC)	9.0.0	10.0.0	
2012-09	-	-	-	-	-	-	-	Updated to Rel-11 by MCC	10.0.0	11.0.0	
2014-10								Updated to Rel-12 by MCC	11.0.0	12.0.0	
2015-12	-	-	-	-	-	-	-	Updated to Rel-13 by MCC	12.0.0	13.0.0	
2017-03	-	-	-	-	-	-	-	Updated to Rel-14 by MCC	13.0.0	14.0.0	

History

Document history		
V14.0.0	April 2017	Publication