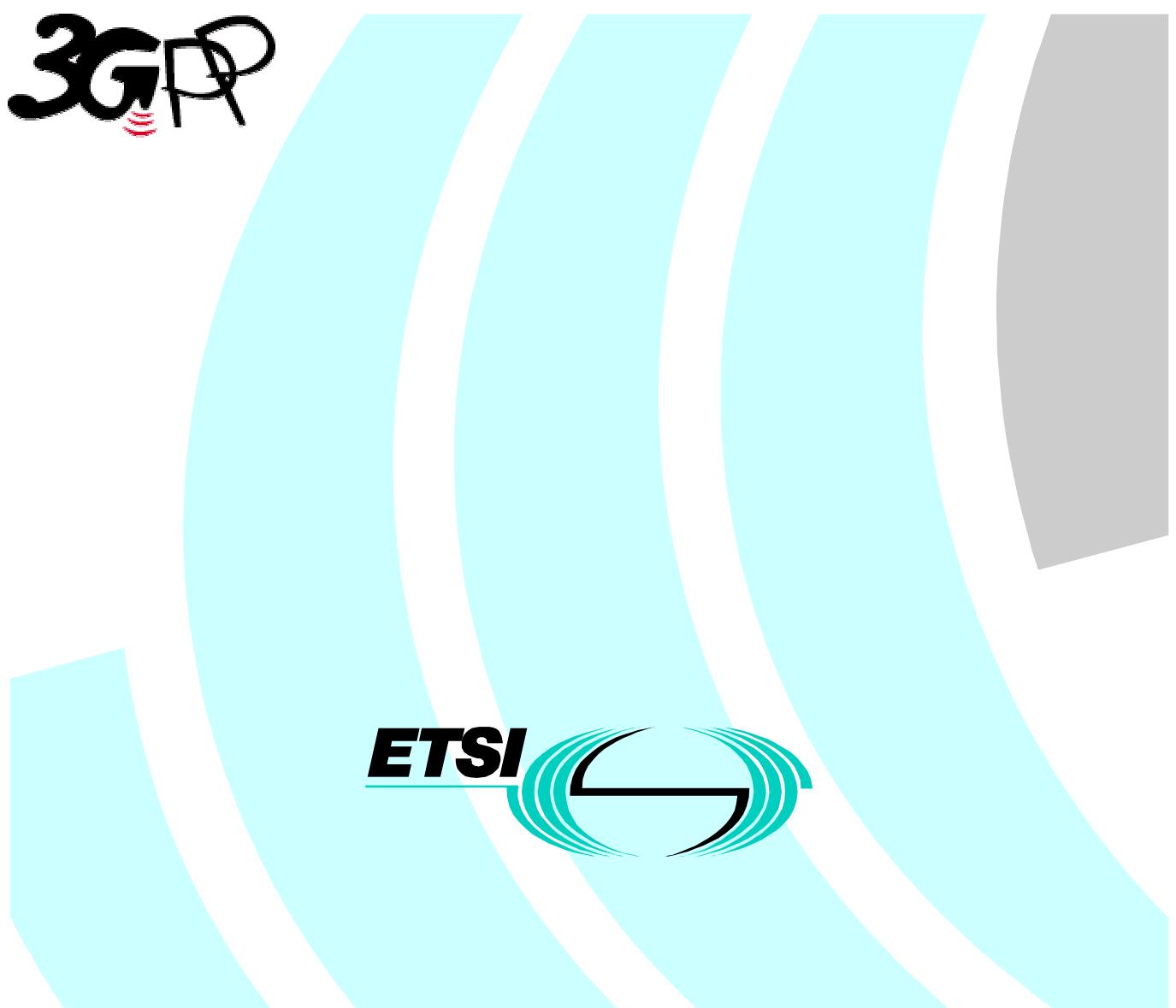


**Universal Mobile Telecommunications System (UMTS);  
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(3G TR 22.924 version 3.1.1 Release 1999)**

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Postal address

F-06921 Sophia Antipolis Cedex - FRANCE

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Office address650 Route des Lucioles - Sophia Antipolis  
Valbonne - FRANCETel.: +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  
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Internet

secretariat@etsi.fr

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## Foreword

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the specification;

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## 1 Scope

This document outlines the requirements and proposed new mechanisms to be used for billing and charging in UMTS. This document is a basis for discussion during the standardisation work within ETSI SMG for UMTS.

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## 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.

[1] UMTS 22.01: "Universal Mobile Telecommunications System (UMTS); UMTS Service Principles".

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## 3 Definitions

**Charging:** A function whereby call information is formatted and transferred in order to make it possible to determine usage for which the subscriber may be billed.

**Call Detail Record(CDR):** formatted collection of information about a single call or datacommunication session, (e.g. time of call set-up, duration of the call, amount of data transferred, etc) for use in billing and accounting.

**Billing:** A function whereby CDRs generated by the charging function are transformed into bills requiring payment.

**Accounting:** The process of apportioning charges between the roles in the UMTS role model.

**Settlement:** Payment of amounts resulting from the accounting process.

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## 4 Introduction

One of the major differentiators between GSM and UMTS will be the mechanisms used for charging and accounting for services. This report outlines why these mechanisms are required, and how they could work.

---

## 5 Background

GSM was designed using many of the principles and systems design from existing fixed networks. This included itemised billing for voice calls, which is implemented by logging one or more CDRs (Call Detail Records) for each individual call made or received. Offline billing systems can then process these records to produce an itemised bill for each customer, applying one of a wide range of specific tariffs. CDRs have been enhanced to contain additional information about the call, such as the location (cell id) of the originator and destination of the call. Ancillary platforms performing value-added services can also output CDR's, which can be processed or matched with ordinary CDR's to charge for value-added services. Immediate post-processing of CDR's is used to provide near real-time charging information for services such as subscriptionless pre-paid SIM cards. Offline processing can also be used for fraud analysis and data-mining for churn reduction activities.

The major limitation of this method is that charges are calculated offline, sometimes many days after being incurred.

This has led to some concerns about fraud, especially when roaming where the home network has no visibility of the charges being accumulated in the foreign network until some days later. The provision of additional services which can be charged in real-time up to a known credit-limit, or the use of the GSM network to pay for non-communications services, is not yet feasible.

The introduction of packet-based services into GSM, in the form of GPRS, has led to a requirement to bill for factors such as duration of an SVC “Switched Virtual Call”, quantity of data actually transferred, and quality of service actually obtained. The billing for these factors is being added to the standard CDR records, but the potential for very long virtual calls will require some additional safeguards.

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## 6 Requirements

The main new requirements for UMTS charging and accounting mechanisms are:

- to allow on-line control of charges between the Home Environment and Serving Network
- to provide an accounting record for all charges incurred and requiring settlement between the above roles;
- to allow itemised billing for all services invoked.

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## 7 Proposed solution

### 7.1 Overview

Two independent mechanisms are proposed to fulfil the identified requirements:

- an online cost control mechanism to limit charges incurred for each user;
- an offline accounting mechanism which acts as the basis for inter-role settlement.

It is not proposed to standardise cost control mechanisms between the Home Environment and Serving Network. This is because the Home Environment can deduce from its commercial agreement with the Serving Network what charges will be due to the Serving Network. The Serving Network is free to make whatever interconnections and commercial agreements it chooses with other networks. If intermediate networks are used during a call, it is transparent to the Home Environment which only makes accounting with the Serving Network. Accounting with other networks is done by the Serving Network.

### 7.2 Online Cost Control Mechanism

Two options are proposed below for the Home Environment to control the charges incurred by the user.

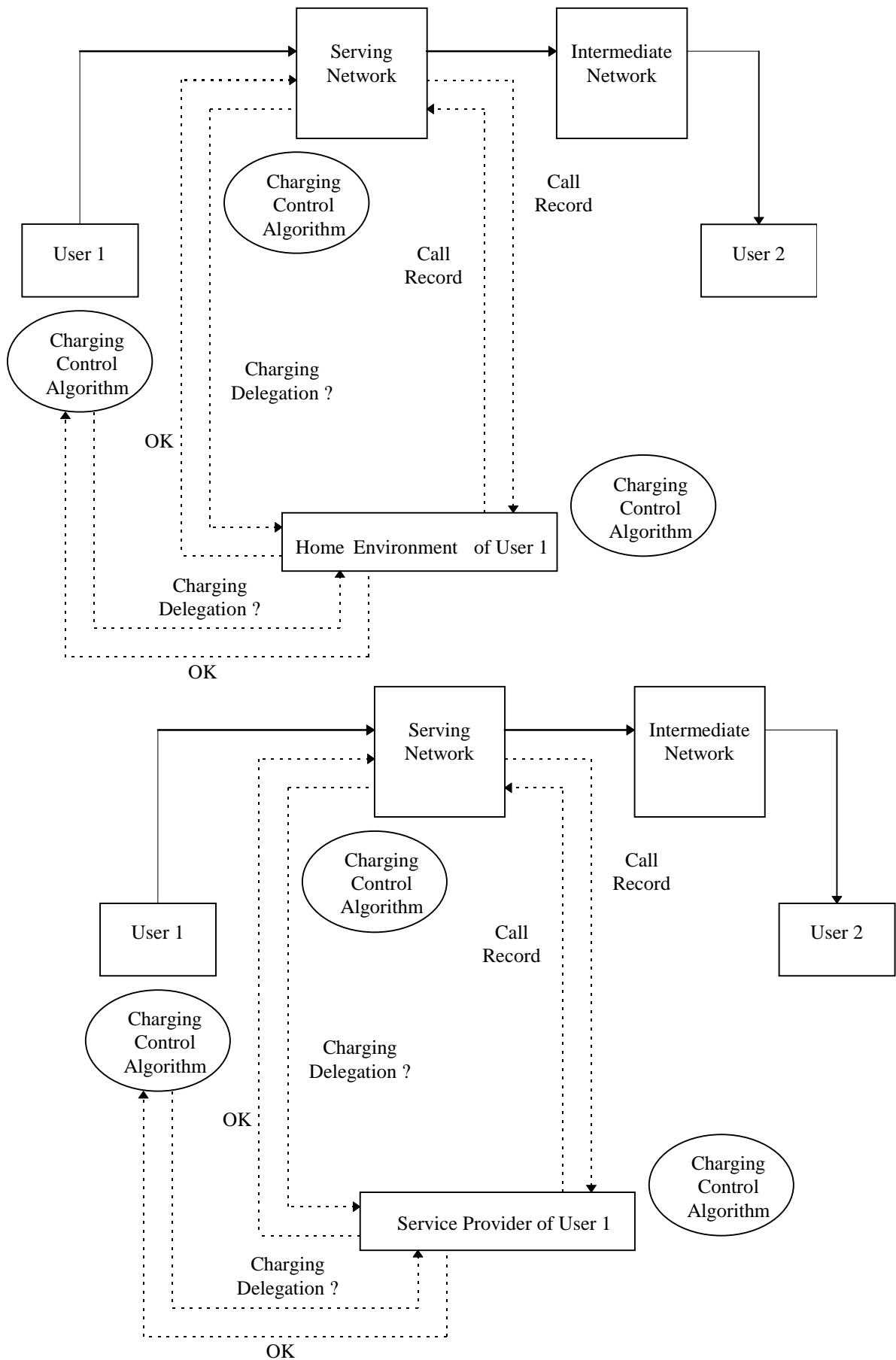


Figure 1: Charging Control Flow for Outgoing Calls

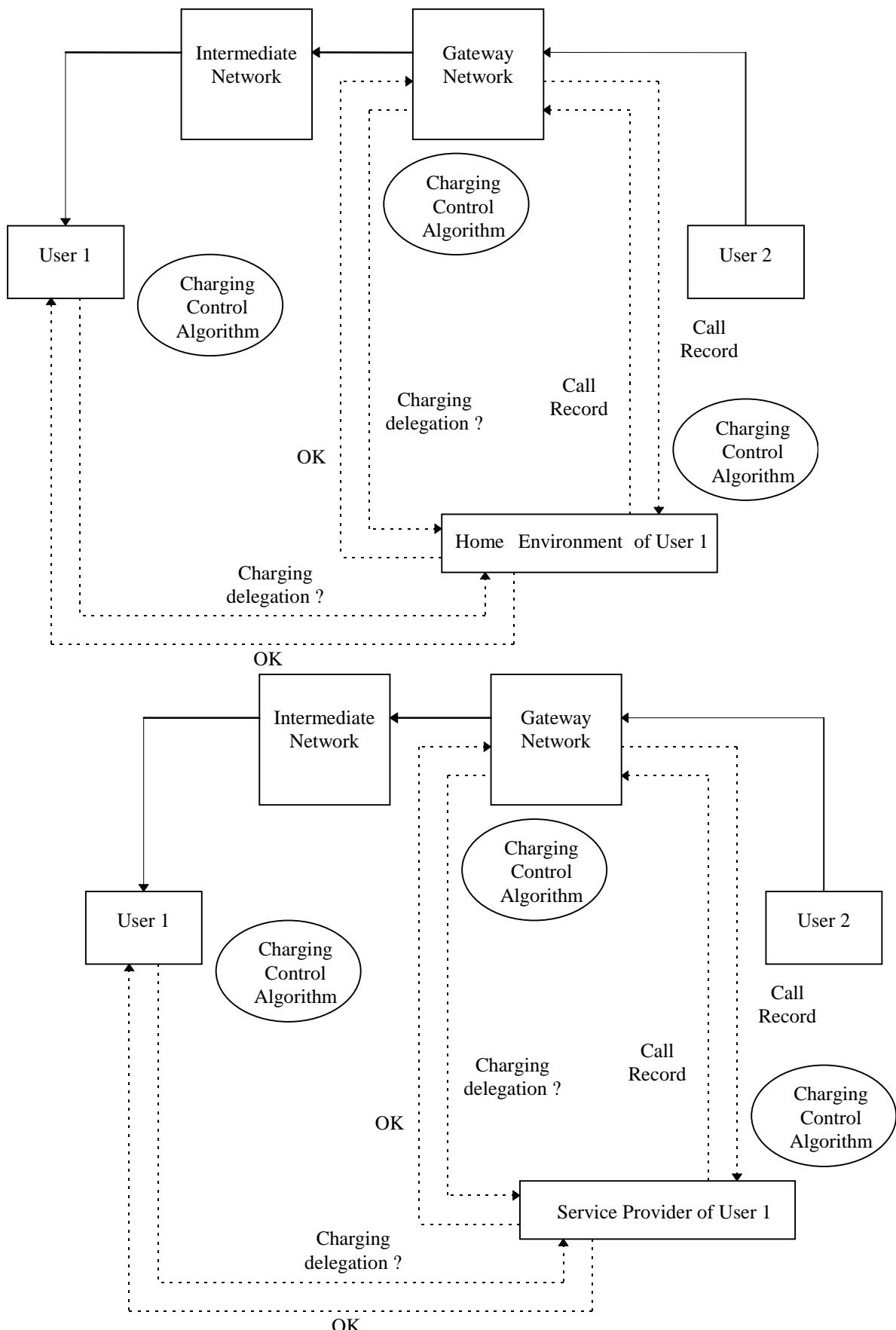


Figure 2: Charging Control Flow for Incoming Calls

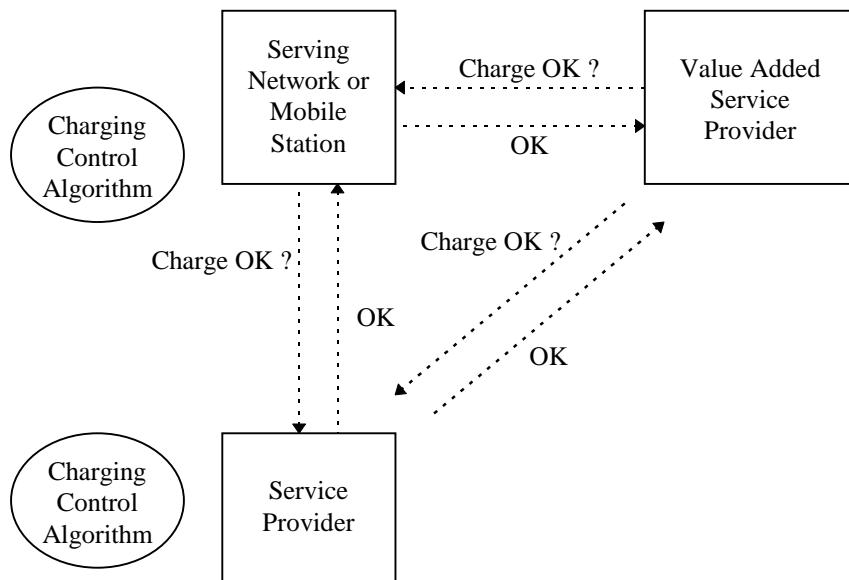
### 7.2.1 Charging Delegation

The serving network (MO call) or the incoming gateway network (MT call) or the mobile station (both MO and MT) have the necessary capabilities to download a charging control algorithm from the Home Environment. This algorithm is used during the calls to control the user's charges. The Home Environment delegates authority to the serving network/gateway network/ mobile station to incur charges up to a limit. The period up to the charge limit is called a charging session. Once a charging session is finished, the Home Environment has to authorise a new charging delegation for the next charging session. The system should be designed such that authorisation for new charges is obtained before the expiry of the previous charge limit.

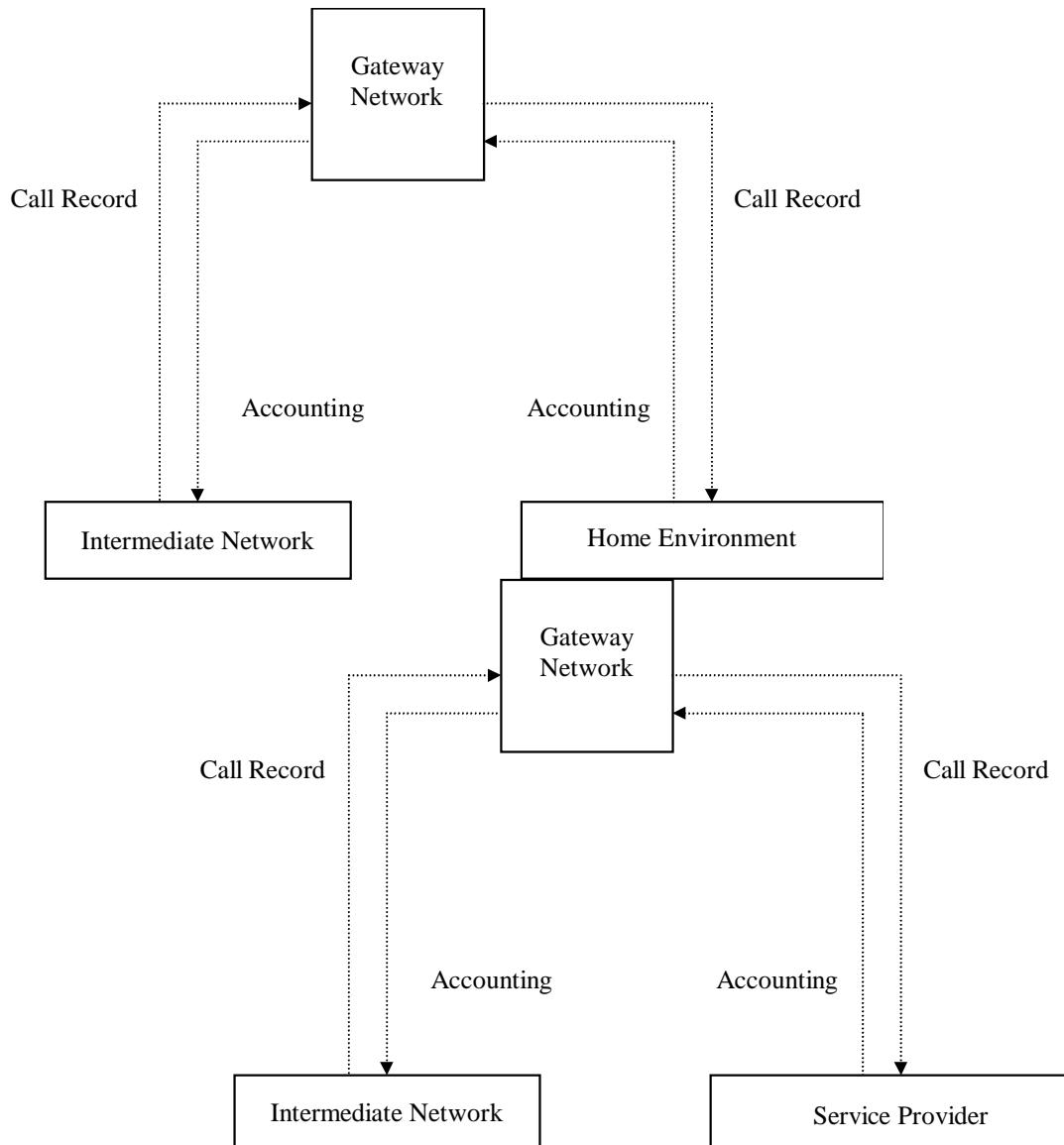
The generation of call records is independent from the duration or cost of charging sessions.

### 7.2.2 On-line forwarding of call records

The charging algorithm runs in the Home Environment premises. Call records are regularly forwarded on-line to the Home Environment so that call continuation is authorised or not. This could be used by the Home Environment as the fallback mechanism when the charging algorithm cannot be downloaded



## 7.3 Offline Settlement



**Figure 4: Accounting Data Flow**

Off-line, the charging records are sent by the serving/gateway network to the Home Environment. These records must itemise every chargeable event incurred. They are used to calculate the user's bill and provide itemised billing to the user. They also act as the basis for settlement between the Home Environment and Serving Network.

Although this mechanism operates offline, ideally records would be sent electronically within a few minutes of their creation. It is likely that charging records will be processed within a few hours. This would allow the method of cost control using forwarded billing records to be applied.

## 7.4 Views from perspective of each role

The following subclause reviews the proposed methods of billing and charging from each of roles.

### 7.4.1 Home Environment

When a user registers on a network, the Home Environment will delegate authority to incur charges up to a set limit on that network. The Home Environment will have great flexibility in the method of calculating charges, because its own charging algorithm is used, whether running the Mobile Station (SIM or ME), serving network or gateway. The serving network will then offer services to the user until that limit is reached, when a request for additional authorisation will be made to the Home Environment to authorise further charges. This allows the Home Environment to exert control of limits to each user and/or serving network as appropriate, much in the same way as credit card authorisation at point of

sale terminals operates today.

Charges which the Home Environment will pay the Serving Network will be based on commercial agreements between the these two roles, and there will not be a standardised procedure for calculating these online.

The Home Environment will receive billing records, usually online, and typically very shortly after they have been generated. These are used to calculate the settlement charges between the Home Environment and Serving Network. They may be passed via a third party (clearing house), which could provide currency conversion and credit control between the Home Environment and different Serving Networks. However, these latter functions are outside the scope of standardisation.

The standardised features of UMTS Charging and Billing will therefore allow the Home Environment to limit its credit risk for each individual user , whilst retaining detailed accounting records for inter-role settlement and itemised billing. The latter could be based on an evolution of the current TAP2 format billing records used in GSM today.

## 7.4.2 Serving Network

The serving network needs to ensure that the users of its network services are authorised to do so, and that it will be paid for the services obtained through it. The concern is therefore primarily between the Home Environment and Serving Network, which is a commercial agreement outside the scope of standardisation. A separate report deals with how the Home Environment and Serving Network can interwork when they have no prior knowledge of each other or commercial agreement in place (see ETSI report "Automatic Negotiation of Roaming Agreements").

The Serving Network must therefore validate users of his network, and receive authorisation from the Home Environment to incur charges for that user. This may involve downloading a charging algorithm which calculates subscriber charges, and causes a revalidation when the charge limit has been reached.

The Serving Network is responsible for generating on-line charging records and forwarding them to the Home Environment for settlement.

The tariffing method which a Serving Network uses, and the commercial basis on which charges for the services used are levied to the Home Environment are outside the scope of the standard.

## 7.4.3 User

It is envisaged that the user shall be able to limit the charges (say on a monthly basis), such that specific additional authorisation from the user is required to exceed the limit. The user should be aware that the granularity of the cost control mechanisms proposed for UMTS shall not allow precise real-time status of current charges, but will provide a maximum charge exposure (the sum total of all outstanding charge delegation authorities plus all received charge records) together with a detailed and accurate itemised billing status based on all received charging records to date.

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# 8 Issues

## 8.1 Long calls

The advent of packet data calls, which can extend for very long periods of time (days, weeks etc), although at low cost because charges are based on data throughput, may mean that billing records are only output at the end of very long periods. This may require call records to be generated mid-call, either when some charge value is reached or some duration or both, to allow for both charging settlement and cost control.

## 8.2 Multimedia calls

Where calls use bandwidth-on-demand to vary the quality and quantity of data sent during a call, the parameters used to calculate charges become considerable. The downloading of a charging algorithm which can access the relevant parameters may be implemented. The variable bandwidth etc. makes it difficult to calculate cost, and may result in very large numbers of billing records.

## 8.3 Low-cost Chargeable Events

Some services offered by networks may be at such a low cost per invocation that they become more expensive to charge and bill for than to provide the service itself. Three solutions are possible:

offer the service for free (or included in the basic subscription). This can lead to significant additional traffic which requires additional infrastructure to support it. Example of this case are SMS in GSM, and Public Internet access through ISPs.

Charge for the service anyway. The high profit margins on the service are seen to justify the limited use. This could be seen as the current market positioning of SMS in some GSM networks today.

Use of a concept of "Postage Stamps", where a pack of electronic low-value units is purchased and used when such services are invoked. This could be done by attaching an electronic stamp to the message when invoking the service, or possibly using an electronic purse in the subscriber's USIM to pay directly at the time of invocation.

## 9 Conclusion

The proposed control mechanisms allow charging control in all situations (even when the terminal is not involved in the call). Only UMTS equipment shall require the deployment of the new charging mechanisms. Other equipment do not need any upgrade. Intermediate networks have a classical technical and commercial relationship with UMTS network operators.

## 10 Impact on Standardisation

The following items have been identified as requiring standardisation work to implement the schemes proposed in this report:

A charge control mechanism whereby a standardised form of service logic can be downloaded from the Home Environment to serving network, terminal equipment/USIM. The service logic execution environment (e.g. MExE) shall be standardised to allow the same charge control logic to operate identically in different networks. The charge control logic shall have access to all relevant parameters to allow it to determine charges in real time, including time of day, number dialled, bearer(s) used, data transferred and Quality of Service achieved. A procedure for online authorisation of charges is also required. This feature effectively supersedes the GSM Advice of Charge service, and would apply to both circuit switched and packet data traffic. The GSM Phase 2+ system shall be enhanced to provide support for this charging mechanism.

Accounting records shall be used as the basis of inter-role accounting and offline billing. The GSM billing record format (TAP3 format) shall be enhanced to accommodate charging parameters required for the more flexible data and multimedia traffic. A standardised procedure for transferring call records online between the serving network and the Service Provider is required.

It is therefore proposed that a new work item be started for GSM Phase 2+: "Online Charge Control Mechanism", to handle both GSM and GPRS traffic with a view to meeting the UMTS requirements.

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## Annex A (informative): Change history

<b>Change history</b>					
<b>SMG No.</b>	<b>TDoc. No.</b>	<b>CR. No.</b>	<b>Section affected</b>	<b>New version</b>	<b>Subject/Comments</b>
SMG#25				3.0.0	Approved at SMG#25 Version 3.0.0
pre-SMG#28	SMG1 Tdoc 98- 0808	A001	Misc	3.1.0	Updated to reflect changes in UMTS Role Model terminology in 22.01
SMG#28				3.1.0	Approved
TSG SA				3.1.1	Reformatted for TSG SA

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## History

<b>Document history</b>		
V3.1.1	January 2000	Publication