



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.742

(04/95)

**DATA NETWORKS AND OPEN SYSTEM
COMMUNICATIONS
OSI MANAGEMENT**

**INFORMATION TECHNOLOGY –
OPEN SYSTEMS INTERCONNECTION –
SYSTEMS MANAGEMENT:
USAGE METERING FUNCTION FOR
ACCOUNTING PURPOSES**

ITU-T Recommendation X.742

(Previously “CCITT Recommendation”)

FOREWORD

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC. The text of ITU-T Recommendation X.742 was approved on the 10th of April 1995. The identical text is also published as ISO/IEC International Standard 10164-10.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

(February 1994)

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Summary

This Recommendation | International Standard specifies a model and management information for the acquisition of information by a managing system of resource usage information. The information may be used as part of a charging and billing process; however, charging and billing is outside the scope of this Recommendation | International Standard. This specification is of generic application and needs to be extended by some application specific purpose. It is expected to be adopted for TMN use.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

**INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION –
SYSTEMS MANAGEMENT: USAGE METERING FUNCTION
FOR ACCOUNTING PURPOSES**

1 Scope

This Recommendation | International Standard defines a systems management function which may be used by an application process in a centralized or decentralized management environment to interact for the purpose of systems management as defined in CCITT Rec. X.700 | ISO/IEC 7498-4. This Recommendation | International Standard defines the usage metering function and consists of service and generic definitions. It is positioned in the application layer of ITU-T Rec. X.200 | ISO/IEC 7498-1 and is defined according to the model provided by ISO/IEC 9545. The role of systems management functions is described by CCITT Rec. X.701 | ISO/IEC 10040.

This Recommendation | International Standard:

- establishes user requirements for service definitions needed to support the usage metering function;
- establishes models that relate the service provided by this function to the user requirements;
- defines the service provided by the function;
- specifies the protocol that is necessary in order to provide this service;
- defines the relationships between the service and the operations and notifications for usage metering managed objects;
- defines the relationships with other Systems Management functions;
- specifies conformance requirements;
- defines generic managed object classes, packages, attributes, operations types and notification types, documented in accordance with guidelines for the definition of managed objects;
- specifies compliance requirements placed upon other standards which make use of these generic definitions.

This Recommendation | International Standard neither defines nor specifies:

- the interactions which are the consequence of the use of usage metering facilities;
- connection establishment or authorization requirements for the use of these facilities;
- which usage metering attributes, management operations and notifications are to be incorporated when defining accounting for the use of specific OSI resources or other resources;
- any procedures for the subsequent use of usage data, whether gathered from a usage metering data object or a log; in particular, procedures for using this data for filing, auditing, correlation or for combining usage data are excluded;
- the process by which usage data, gathered from a managed object, are used to form usage metering records in a log;
- the usage gathering process within the accountable resource;
- the charging process and the billing process.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: ITU-T Conventions for the definitions of OSI services.*
- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview.*
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model.*
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information.*
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Requirements and guidelines for implementation conformance statement proformas associated with OSI management.*
- ITU-T Recommendation X.724 (1993) | ISO/IEC 10165-6:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: ITU-T Conventions for the definitions of OSI services.*
- CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems management: Object management function.*
- CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology – Open Systems Interconnection – Systems management: State management function.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems management: Event report management function.*
- CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems management: Log control function.*
- ITU-T Recommendation X.738 (1993) | ISO/IEC 10164-13:1995, *Information technology – Open Systems Interconnection – Systems management: Summarization function.*
- ITU-T Recommendation X.739 (1993) | ISO/IEC 10164-11:1994, *Information technology – Open Systems Interconnection – Systems management: Metric objects and attributes.*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.200 (1989), *Reference Model of Open Systems Interconnection for CCITT Applications.*
ISO 7498:1984, *Information processing systems – Open Systems Interconnection – Basic Reference Model.*
- CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1).*
ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1).*
- CCITT Recommendation X.209 (1990), *Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1).*
ISO/IEC 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).*
- CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT Applications.*
ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework.*

- CCITT Recommendation X.710 (1991), *Common management information service definition for CCITT applications*.
ISO/IEC 9595:1991, *Information technology – Open Systems Interconnection – Common management information service definition*.
- CCITT Recommendation X.711 (1991), *Common management information protocol specification for CCITT applications*.
ISO/IEC 9596-1:1991, *Information technology – Open Systems Interconnection – Common management information protocol – Part 1: Specification*.

3 Definitions

For the purposes of this Recommendation | International Standard the following definitions apply.

3.1 Basic reference model definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.200 | ISO/IEC 7498.

- a) open system;
- b) systems management.

3.2 Management framework definitions

This Recommendation | International Standard makes use of the following term defined in CCITT Rec. X.700 | ISO/IEC 7498-4:

- managed object

3.3 Systems management overview definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.701 | ISO/IEC 10040

- a) management operation;
- b) notification;
- c) systems management functional unit.

3.4 Common management information definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.710 | ISO/IEC 9595

- attribute

3.5 Management information model definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.720 | ISO/IEC 10165-1:

- a) action;
- b) package;
- c) subclass.

3.6 Log control function definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.735 | ISO/IEC 10164-6:

- a) log;
- b) log record.

3.7 Definitions specific to this standard

- 3.7.1 service subscriber:** Is the legal entity, which has subscribed to a certain service type. It is not necessarily a different party from the service user. (The calling and called parties of a service transaction are service users).
- 3.7.2 service transaction record:** Combines usage metering records, which pertain to a particular service transaction, into a single record. In addition it contains charging information.
- NOTE – The term service transaction is used in its usual English meaning to denote things like a telephone call or the sending of an electronic mail message.
- 3.7.3 usage metering:** The abstraction of activities that monitor the utilization of resources, for the purpose of accounting and controlling the recording of usage data.
- 3.7.4 usage metering control:** Usage metering functionality dedicated to controlling the activities of gathering and reporting data concerning the utilization of resources.
- 3.7.5 usage metering data:** Data which represents usage from which usage metering records may be derived.
- 3.7.6 accountable object:** A managed object representing a resource or another entity for which usage data are to be maintained, requiring its usage to be attributed to a user.
- 3.7.7 usage metering record:** A data item containing usage information relating to a specific period of resource utilization by a specific user.
- 3.7.8 unit of usage (unit):** The unit of measure used to qualify the usage.
- 3.7.9 usage:** A value expressed in terms of a unit of usage, quantifying the utilization of a resource from which information may be derived for the purpose of accounting.
- 3.7.10 user:** An identifiable entity whose use of resources must be accounted.

4 Abbreviations

CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
MAPDU	Management Application Protocol Data Unit
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
SDU	Service Data Unit
SMASE	Systems Management Application Service Element
umf-mo	joint-iso-ccitt ms(9) function(2) part10(10) managedObjectClass(3)
umf-pkg	joint-iso-ccitt ms(9) function(2) part10(10) package(4)
umf-par	joint-iso-ccitt ms(9) function(2) part10(10) parameter(5)
umf-nb	joint-iso-ccitt ms(9) function(2) part10(10) nameBinding(6)
umf-att	joint-iso-ccitt ms(9) function(2) part10(10) attribute(7)
umf-act	joint-iso-ccitt ms(9) function(2) part10(10) action(9)
umf-not	joint-iso-ccitt ms(9) function(2) part10(10) notification(10)

5 Conventions

This Recommendation | International Standard follows the descriptive conventions defined in ITU-T Rec. X.210 | ISO/IEC 10731.

The following notation is used in this document's service parameter tables:

- M The parameter is mandatory.
- U The use of this parameter is a service-user option.
- The parameter is not present in the interaction described by the primitive concerned.
- C The parameter is conditional. The condition(s) are defined by the text which describes the parameter.
- P Subject to the constraints imposed on the parameter by CCITT Rec. X.710 | ISO/IEC 9595.

6 Requirements for usage metering

The usage metering function should fulfil the requirements by which resource utilization is determined so that the data that are gathered may be used for the processes of accounting management and the generation of bills. These requirements are:

- a) There is a requirement for the measurement and collection of data in order to provide information on the usage of OSI services and other services by the users of these services.
- b) Suppliers of OSI and other services need standardized ways of obtaining and representing usage information to advise subscribers of their usage and to facilitate exchange of usage information with other suppliers. A usage metering record should contain all usage data necessary to account for resource utilization relating to a specific instance of utilization by a specific user. More than one usage metering record may be needed in order to support any bill raised. This could include such details as time of usage, type of service offered by the resource and type of tariff.
- c) The usage metering function must enable those responsible for managing accounting to collect, and to control the collection of, data concerning the use of resources.
- d) There are many ways in which the collected data may subsequently be processed by the *charging process*. Hence, the usage metering function must be of sufficient generality to allow any reasonable form of data processing. (For example, it must permit data to be collected so that the supplier or subscriber can determine the extent of the usage of a particular resource; data may be collected so that a service provider can charge for resource utilization.)
- e) The information available through the usage metering function, must enable managers to discover information about the resources whose usage is determined by the usage metering function. Managers must be able to determine the status of metering operation and managing systems need to be informed of metering activity. Thus, the usage metering function must allow sufficient control over the collection of data so that the relevant information can be made available when required, either during the period of resource usage or at any time thereafter. A managing system should (in principle) have the capability to access individual usage metering records instantaneously. For example, this feature is required for real time cost calculation.
- f) In order to store collected usage data, usage metering records are required to provide a historical record of resource usage as determined by the usage data.
- g) The usage metering records should be self contained, i.e. the way in which a usage metering record is to be interpreted, should not depend on the system where the usage metering record was created.
- h) Several resources may be available in a managed system to provide a service. The function should make it possible to relate usage metering records to the resources that are actually used for providing the requested service. Such a resource can be either internal or external to the domain of a service provider. For instance, a specific department within the domain can own the resource providing the service. Also an external service provider can own the resource. (In general an external service provider will receive revenues from a service subscriber through the billing process of the “original” service provider.).
- i) The function should make it possible to relate usage metering records to (one or more) service-users and their roles in the transaction (i.e. calling and called parties). (Recording more than one called-party role can be necessary.) A service-user identification may be necessary for determining the geographical area where the service transaction is taking place in order to determine related charging. It also is necessary that usage metering records contain the information required to facilitate the production of itemized bills.

NOTE 1 – The detailed mechanism to support all of this requirement is not specified in this Recommendation | International Standard, but left open for specialists to specify.
- j) A usage metering record should contain sufficient timestamp information, which is precise enough, in order to be able to relate it to for example, time-related tariffs.
- k) All usage metering records should have a *standardized format*. It should be possible to specialize the usage metering records so that they can be used for specific purposes. Examples are:
 - 1) A usage metering record may need a parameter which relates to the geographical area where the service is provided. Normally, the service-user identification is sufficient. However, for mobile services, the service-user identification may provide insufficient information.
 - 2) The function should provide a mechanism for ‘volume-based’ accounting. It must be possible to modify the volume-unit. (A duration can be seen as a special case of a volume unit.)
- l) The function should support a number of conditions for reporting of a usage metering record. These conditions will cause the creation of a usage metering record. Examples are:
 - 1) invocation or termination of a service-transaction;

- 2) reaching a volume threshold;
- 3) at regular intervals during a practical service transaction.
- m) A usage metering record should identify the actual condition which caused the record to be created.
- n) The function should be able to produce usage metering records which contain sufficient information to correlate usage metering records to each other. In this manner any charging process is able to interrelate and combine the different usage metering records which belong to the same service-transaction, and which possibly emerge from different systems.

NOTE 2 – The detailed mechanism to support all of this requirement is not specified in this Recommendation | International Standard, but left open for specialists to specify.

- o) The function should be able to produce usage metering records which contain an identifier of the service-type. (This is not necessarily the end-to-end service, but can be a supporting service on a lower level.) This service-type identifier can be used by any charging process to determine the algorithm according to which the charging has to be computed.
- p) It must be possible that the completeness of a service transaction record can be determined. This requires additional features in the usage metering function and the usage metering records. However, not all implications to the function are known yet, and further study is required.

7 Model for usage metering and usage logs

7.1 Model for accounting

Accounting for resource utilization has three sub-processes. These sub-processes are:

- The *usage metering process* – This process is responsible for the creation of usage metering records as a consequence of the occurrence of accountable events in systems. The usage metering process is also responsible for logging of the usage metering records. Several accountable events may result in a single usage metering record. In general use of a service which demands the use of several resources will give rise to several usage metering records.
- The *charging process* – This process is responsible for collecting the usage metering records which pertain to a particular service transaction in order to combine them into *service transaction records*. In addition, pricing information (according to a tariff-system) is added to the service transaction records. The charging process is also responsible for logging the service transaction records.
- The *billing process* – This process is responsible for collecting the service transaction records and selecting from these the ones which pertain to a particular service subscriber over a particular time-period and produce the bill from these.

Figure 1 illustrates these processes.

Of the above, this Recommendation | International Standard specifies the activities and management information required to support the usage metering process.

NOTE – The accounting process, which is used in this Recommendation | International Standard purely for descriptive purposes, is a hypothetical process that does not purport to be, or have the characteristics of, any actual accounting process such as the international accounting process.

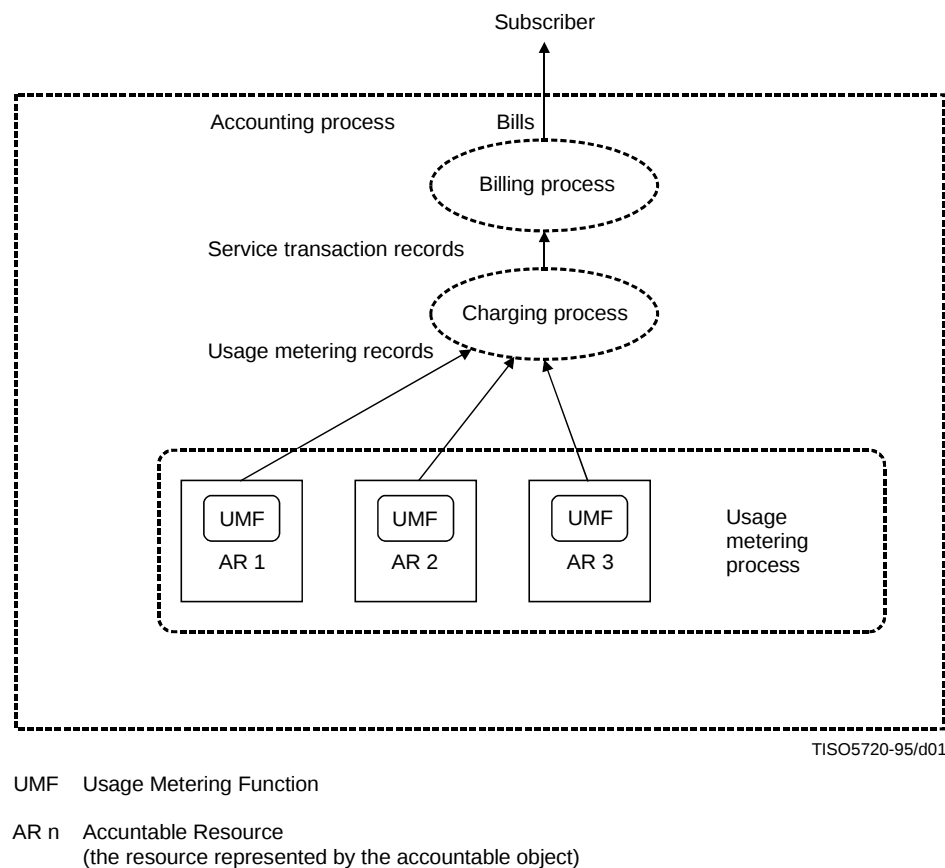


Figure 1 – Example of modelling the accounting process

7.2 Model for usage metering

Usage metering is an abstraction of management characteristics associated with provision of accounting for resource utilization. This is modelled as being associated with an accountable object which may either represent other aspects of that resource, or which may exist solely for the purpose of supporting accounting. There are two aspects to the usage metering:

- control of the recording and reporting of data associated with accounting for usage;
- the specifics of the recorded data.

7.2.1 Usage metering control

Usage metering control allows a managing system to:

- a) control the collection of usage data from an accountable object, start and stop the collection through management operations;
- b) identify which usage data can be collected, and under what circumstances they are to be reported.

Usage metering control specifies the events which will cause usage metering information to be reported. They include periodic events marking the passage of time for which a resource is in use and specified stimuli relating to other aspects of resource use. Reporting may also occur as a result of usage metering control actions.

A managed object dedicated to the control of usage metering is termed a *usage metering control object* (for short: control object). The generic usage metering control object can be specialized to form usage metering control object classes for specific resources. Other managed objects, which also exhibit usage metering control properties can be defined using packages of usage metering control characteristics defined in this Recommendation | International Standard. These objects are formed by using and specializing the various template definitions provided by this Recommendation | International Standard.

7.2.2 Usage metering data

Usage metering data represent the accounted use of a resource. They contain information identifying the user, the service being provided, a measure of the quantity used together with other qualifying data.

Usage data relating to an accountable object can be obtained:

- a) by the inclusion of usage metering data parameters in a usage metering defined notification;
- b) by the use of the GET operation to get corresponding meter data attribute values.

A notification containing usage data is obtained on a predefined basis by identifying triggering events. Triggering events are represented as part of usage metering control.

A managed object dedicated to the provision of accounting management data is termed a *usage metering data object* (for short: data object). The generic data object can be specialized to form data object classes for specific resources. Other managed objects, which also exhibit usage metering properties can be defined using packages of usage metering characteristics. These objects are formed by using and specializing the various template definitions provided by this Recommendation | International Standard. Only the generic behaviour of these properties is defined in this Recommendation | International Standard. An object providing usage metering data shall be specified to include the identity of the user (see Table 2 in 8.2.3.1) and possibly other attributes relating to the instance of use that is being metered.

7.2.3 Relationships between accountable objects, usage metering control and usage metering data objects

Usage metering control may be modelled in terms of either a separate managed object or as part of a managed object representing control aspects of management which include accounting. The usage metering control object may be named relative to either an accountable object or some other managed object in order for it to control the collection of usage data from one or more accountable objects. This implies that one usage metering control object may support and reference several accountable objects. When the functionalities of usage a metering control object are included in the accountable object, the reference is a set of one element containing the pointer to itself.

Usage metering data may be modelled in terms of either a separate managed object or as part of a managed object representing the activities being accounted. If the accountable object exists solely for the purpose of accounting, then the accountable object shall include the usage metering data capability.

Control objects provide a reference to the data objects which they control. Each instance of a control object may exercise its control over several instances of data objects. An instance of a control object applies to all referenced instances of data objects. Each usage metering data object references the accountable object for which it maintains usage metering data. When the functionalities of the data object are included in the accountable object, the reference is a pointer to itself.

Each instance of a data object shall be controlled by one and only one control object, and shall measure usage for one and only one accountable object.

This Recommendation | International Standard recommends that the control object is contained within either:

- a) the managed object which contains the accountable objects; or
- b) the accountable object itself.

7.2.4 Operation of usage meters

Before usage metering data from an accountable object can be made available at least one instance of an object providing control functionality, a *usage metering control object*, must exist. This may be created implicitly or explicitly through the use of a create operation. Upon creation, the control object shall have values for:

- identifying the units of usage;
- the reporting triggers which specify occurrences of events, either within or related to the accountable object or the data object, which cause a data object to emit a usage metering data notification.

Attributes for units of usage are not specified by this function, but must be provided in a specialization. Furthermore, if there is a need to manage the usage metering process, a specialization may incorporate attributes for triggering of recording of usage metering data, the *recording triggers*.

A notification of creation of a control object or a data object shall be provided by the Object Creation Reporting Service of the Object Management Function CCITT Rec. X.730 | ISO/IEC 10164-1. To capture complete usage metering information, a control object must remain in existence as long as there are data objects controlled by the control object. A notification of deletion of a control object or a data object shall be provided by the Object Deletion Reporting Service of the Object Management Function (see CCITT Rec. X.730 | ISO/IEC 10164-1).

Creation of a data object may be implicit or explicit. Explicit creation is achieved by use of a create operation. Implicit creation is the result of an event which is significant for accounting purposes. These events must be specified in detail when this Recommendation | International Standard is specialized for a certain technology.

While a data object is in existence and accounting for the use of a resource, update of its usage metering information is triggered only by internal events, i.e. the value of the metering data is read only. If there is a need to manage which events is used as recording triggers, these can be specified in specializations as a set of recording triggers listed in the corresponding control object.

When there is no further requirement to account for usage, the corresponding data object is deleted. Deletion can be implicit or explicit, through management intervention. Where data object deletion is one of the reporting triggers, the data object shall emit a notification containing usage data prior to its deletion. During the period in which the data object is generating the notification and pending deletion, it shall assert a *terminating* value for its procedural status.

Further control over usage metering objects is provided through the use of action operations. A request for action is directed to a control object and identifies the corresponding data objects whose activity is to be modified.

Data objects may be placed in a suspended condition by the use of a suspend action applied to the corresponding control object identifying the data objects to which the action applies. This has the effect of holding usage parameters constant at their current values. Usage metering may be resumed in a running condition by directing a resume action to the control object with a list of identified data objects to which the action applies. This action has no effect upon data objects which are already in the desired condition. The response to the action lists the data objects upon which the operation was successfully performed and those where it failed, that is the actions are performed using *best effort* synchronisation across the associated data objects.

Usage metering control functionality may be started by directing a start action to the control object. The effect of this action is to re-initialize the values of parameters accounting for usage which are under the control of that object and identified in an action parameter list. Usage metering control functionality is stopped by issuing a suspend action identifying all data objects. All related recording of usage ceases. All data objects are left in the suspended condition. It should be noted that a start action, which is received by a control object, referencing a data object will (re-)start its metering activity and as a result have its usage values reset. During the period in which the data object is suspended, its control status shall take a suspended value. Upon start or resumption of the data object, the suspended value is removed from its control status.

Notifications are emitted by control objects as a result of these actions to indicate the data objects to which the action applied and the associated control parameters.

A notification generated by a data object is the result of an internal event which matches one of the reporting situations listed in the reporting triggers attribute. This internal event may arise from activities within the system containing the accountable object or may be the result of an external management operation. Events can be periodic (that is at specified time intervals), determined by the successful completion of a start, suspend or resume action, by a change in the operational state of the control object or by the data object being deleted. Provision is made in this Recommendation | International Standard for including other reporting stimuli in the set of reporting triggers. The notification contains data together with an indication of the presence of problems in the usage metering data, if any.

Table 1 specifies the various state transitions for the usage data object as a result of the events. The triggers for the events causing the state transitions are a result of either explicit management requests directed at the control object (example start metering) or defined as part of the control object (example recording trigger).

The usage metering function relies upon the facilities of the Event Report Management function as defined in CCITT Rec. X.734 | ISO/IEC 10164-5 to configure one or more event forwarding discriminators in order to send usage metering data notifications (as M-EVENT REPORTs) to specific destinations. Event reports may also be logged in a log that contains *usage metering records*. The usage metering function relies upon the facilities of the Log Control function, CCITT Rec. X.735 | ISO/IEC 10164-6, for the further handling of usage metering records.

Figure 2 is an example of the relationship between the objects when instances of the object classes defined in this Recommendation | International Standard are used to control the collection of the usage metering data for any accountable object. In this example, the managed object representing the resource for which the usage data is gathered is referred to as accountable object. The data object is contained in the accountable object. The collection of the usage metering data is controlled by the control object contained in the system managed object. The report from the data object is logged as a usage metering record object. The control object contains relationship attributes referencing the accountable object and the data object that it controls.

Other possible structural relationship include encapsulating usage metering data packages in an accountable object, thereby including usage metering data capabilities into an accountable object.

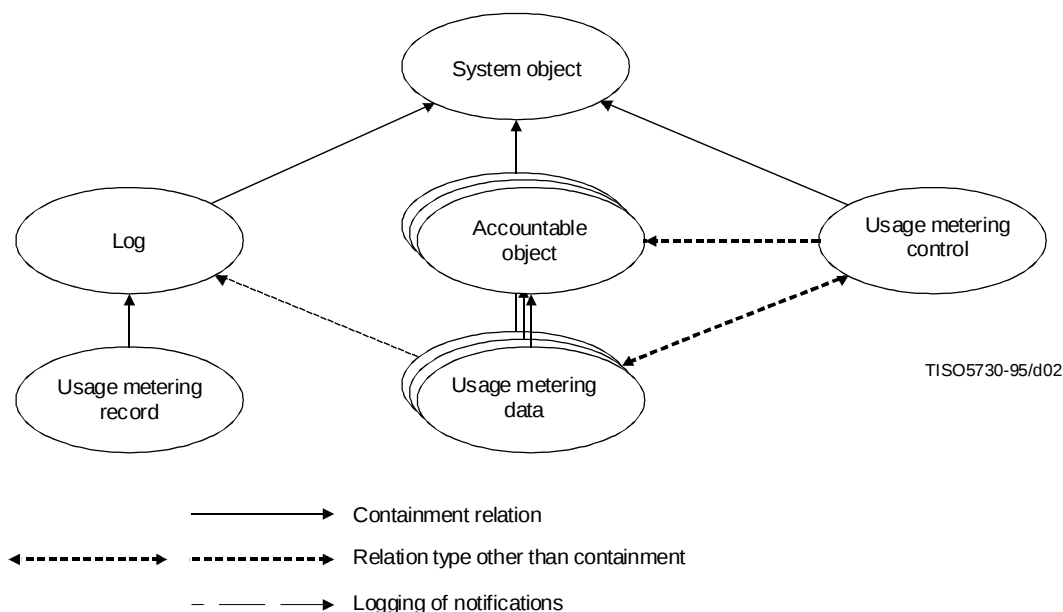


Figure 2 – Example of structural relationship of managed objects

7.3 Model for usage metering records

The data contained within usage metering records is derived as a result of notifications generated by instances of the data object. The definitions of a log and how it is controlled, are given in the Log Control function CCITT Rec. X.735 | ISO/IEC 10164-6. Data are logged according to the discriminator construct used by a log which contains usage metering records.

7.4 Specialization of usage data

The usage metering function is a generic function in the sense that it models the metering and reporting of usage data across various technologies, but it does not specify the precise information content of the usage data. The remaining specifications shall be provided when the function is specialized for use by a specific technology.

An instance of usage information is modelled as a series of basic information blocks. Each block is classified as containing the information pertaining to a specific event in the sequence of events that constitutes an instance of usage. The generic semantics of these events is defined in clause 8, specializations must specify the full semantics of each of the events and the information associated with the events used by the specialization. Detailed requirements on specializations are specified in A.8 as comments to the ASN.1.

This Recommendation | International Standard prescribes the semantics of some parts of the contents of the basic information blocks, but it does not specify the syntax of any of these parts. The prescribed semantics is specified in clause 8. A specialization must specify the syntax of all of the content of the basic information blocks used by the specialization, furthermore it must specify the semantics of any additional content beyond that specified by this function, and it may specialize the semantics specified in clause 8 for its specific use.

Specializations shall only make use of the information blocks defined in clause 8.

Table 1 – State transition diagram for a data object

Event	Current State			
	STA1 Not active	STA2 Usage collection is active, meteringActive is true procedural status is empty	STA3 Usage collection is completed, meteringActive is true procedural status terminating	STA4 Usage collection is active, meteringActive is false, procedural status is empty
Start metering	Reset usage data, emit started collection notification STA2	Reset usage data, emit started collection notification STA2	Return deniedMeteringAction Error STA 3	Reset usage data, emit started collection notification STA2
Recording trigger	–	Update usage data STA 2	STA 3	STA 4
Reporting trigger	–	Emit usage meter data report notification; p1: STA 3 ^p1: STA 2	STA 3	STA 4
Report complete	–	–	Delete object	–
Suspend metering	–	Change meteringActive to false STA 4	Return deniedMeteringAction Error STA 3	STA 4
Resume metering	–	STA 2	Return deniedMeteringAction Error STA 3	Change meteringActive to true STA 2
Delete request	Delete object	Ap1:delete object p1: emit usage meter data report notification; STA 3	Delete object	Delete object
p1 Reporting trigger requires deletion of the object – Not allowed				

8 Generic definitions

This clause defines the generic aspects of usage metering. It defines:

- packages, for both usage metering control and for usage metering data objects, together with their semantics;
- attributes which may be used to enhance the information supplied as part of usage data;
- generic action types together with their applicable arguments and semantics;
- generic notifications together with their applicable parameters, semantics and errors.

Where it is not possible to give a generic set of values, guidance is given as to how the information may be provided; either through specialization of the generic definitions leading to usage metering managed object specifications, or by their importation into the specification of other managed objects, thereby giving them usage metering functionality.

Annex A provides templates and abstract syntax specifications for the items defined in this clause.

8.1 Usage metering control

8.1.1 Generic usage metering control functionality

The functions of usage metering control provided through control objects are characterized through the behaviour of the control object as specified in its packages, their attributes, actions and notifications. Usage metering control contains the following mandatory packages:

- metering control object

which is mandatory within the generic specification of the control object but this package is not imported into other managed object classes which already have an attribute which is used for naming;

- metering control capabilities

which is mandatory for any object claiming to provide the usage metering control function and identifies the usage metering control capabilities of that object.

Usage metering control contains the following conditional packages:

- metering start;
- metering control;
- start notification;
- control notification.

The requirements for the presence of these conditional packages are set out in 8.1.4 and 8.1.5 below.

8.1.2 Metering control object package

This package specifies two attributes:

- a) *Control object id*

The control object identifier specifies an attribute for naming the control object.

- b) *Operational state*

The operational state is that specified in CCITT Rec. X.731 | ISO/IEC 10164-2. It provides an indication of the operability of the usage metering control. If different packages containing the same state attribute are combined into one object, in which case the resulting object will according to CCITT Rec. X.720 | ISO/IEC 10165-1 contain only one attribute of that type, then such a specification shall ensure that the behaviour of the attribute in the combined object does not contradict the behaviour of the attribute as specified in any of the original packages.

Corollary: Metering control capabilities can only be included in the accountable object if the combined objects operational state can be specified with at most one value, otherwise the accountable object and the control object shall be specified as separate objects.

8.1.3 Metering control capabilities package

The attributes of the usage metering control capabilities package are:

- a) *Reporting triggers*

The reporting triggers attribute specifies the events which will cause usage information to be reported.

These events may be of the following kinds:

- 1) Periodically scheduled in time – Typically these are appropriate when the units of usage are time based or volume based;
- 2) Induced as a result of usage metering action (e.g. upon the resumption of accounting for usage (see 8.1.4), upon a change in the operational state of the control object or upon deletion of a data object;
- 3) Result from an identified external stimulus (e.g. as specified in an extension to or specialization of the objects and attributes specified herein).

b) *Accountable objects reference list*

The accountable object reference list is a read-only, set valued attribute whose values reference the accountable objects for which usage control is provided. This attribute is settable at creation time.

c) *Data objects reference list*

The data object reference list is a read-only, set valued attribute whose values reference the data objects for which usage control is provided. It is a property of the system implementing the data object reference list that it shall be capable of introducing a new value into the set upon the creation of a new data object and of removing a value from the set upon the deletion of a data object.

8.1.4 Packages for usage metering actions

Usage metering actions are specified in two conditional packages. These are:

- metering start;
- metering control.

The metering start package is present if the referenced data objects are created in a suspended condition. It references a single action:

- start metering.

The start metering action allows a manager to start or to restart accounting for usage, recording and reporting of usage information for instances of usage metering data. The effect of start is to initialize or re-initialize usage parameter values for all identified, related data objects. And in addition it removes the *suspended* value from the control status attribute of the corresponding data objects, where this value is present. (See 8.2.4.1).

The metering control package is present if suspend and resume operations are required and supported by the control and associated data objects of the usage metering. The package references two actions:

- suspend metering;
- resume metering.

The suspend metering action allows a manager to hold the value of the usage parameter for a selected instance (or set of object instances) of usage metering data so that its value may remain unchanged. This action adds the *suspended* value of the control status attribute of the corresponding data objects.

The resume metering action allows a manager to resume accounting for usage for a selected instance (or set of object instances) of usage metering data so that its value may record usage. This action removes the *suspended* value from the control status attribute of the corresponding data objects. Unlike the start metering action the resume metering action does not re-initialize usage parameters.

Start metering, suspend metering and resume metering actions can reference one or more data objects which are subject to usage metering control (as indicated in the corresponding *data object reference list*). The confirmed action response indicates those data objects upon which the action was successfully performed, those where the outcome was unsuccessful and those where the outcome was indeterminate.

These actions can cause the corresponding data objects to emit notifications containing usage data information if a value of the reporting triggers attribute references the corresponding action.

8.1.5 Packages for usage metering notifications

The above actions give rise to notifications containing usage metering control information. These actions are specified in the

- start notification package; and
- control notification package.

The start notification package is present if there is a static requirement to advise manager(s) other than the one generating the action of the outcome of the action and the metering start package is supported. It references a single

- metering started notification.

The control notifications package is present if there is a static requirement to advise manager(s) other than the one generating the action of the outcome of the action and the metering control package is supported. It references two notifications:

- metering suspended; and
- metering resumed.

All three types of notification are generated as a consequence of completing corresponding actions applied to the control object. They contain data which identifies the corresponding data objects to which the action was applied and the values of the usage metering control attributes.

NOTE — These notifications could result in identical information being sent to the initiator of the CMIS M-ACTION through the M-ACTION response and by means of an M-EVENT-REPORT unless management intervention is used to ensure that event forwarding discriminators are configured to prevent the latter type of communication.

8.2 Usage metering data

8.2.1 Generic usage metering data functionality

The functionality associated with usage metering data is characterized through the behaviour of the usage metering data object, its attributes and notifications. Usage metering data is specified in the following packages:

- *Metering data object*
which is a mandatory package within the generic specification of the data object, containing the data object id. This is not imported, along with other usage metering packages, into other managed object classes which already have an attribute by which they can be named.
- *Metering data info*
which is mandatory for any object claiming to provide data object functionality, where this package contains the timing, usage and user, provider and service information as required for the service or technology for which the data object has been specialized.
- *Metering data condition*
which must be present if the accounting activity can be suspended or can exist in a terminating condition pending the emission of a usage report notification (as documented in 8.2.4.1).

Other aspects of data object functionality may be provided by incorporating further attributes into the specification of objects which provide usage metering functionality.

8.2.2 Metering data object package

The metering data object package specifies a single attribute:

- data object id.

The data object id specifies an attribute for naming the data object.

8.2.3 Metering data info package

The attributes of the metering data info package are:

- usage information;
- accountable object reference;
- data errors;
- provider id.

Usage information is a complex attribute which provides the usage metering data for the utilization of any form of service or resource. This usage metering data is modelled in terms of a requester's transaction where a transaction can be considered as being made up of a number of potentially accountable events. The potential events within a transaction are classified in 8.2.3.1 to 8.2.3.7.

8.2.3.1 Registration

This block represents the detection of the requester by the service provider – for example, a telephony user picks up the handset and listens to dial tone. The registration block shall be present once and only once in the usage information attribute. When specializing the data object for a particular service type, the information in Table 2 is expected to be included in this block.

Table 2 – Registration information block

Identity of user	The semantics of an identity of the user must be present in this block, with sufficient information to eventually identify the subscriber to charge for the usage.
Time stamp	The time the registration event occurred may be part of this block.
NOTE – The mandatory presence of the REGISTRATION block does not imply that the act of registration can necessarily be identified as an event in every accountable usage. The block may contain information registered at installation time in every usage report.	

8.2.3.2 Request

This block represents any form of input generated by the requester such as dialled or keyed destination, input of account code or input of feature activation code. When specializing the accounting meter data object for a particular service type, the information in Table 3 is expected to be included in this block.

Table 3 – Request information block

Identity of remote parties	This identity is used to identify the remote parties in the transaction, in cases where such information is required. The syntax of this field may be a telephone number, an X.400 O/R name, the name of an application, etc.
Service variant	May be used to specify variants of usage, that have been requested, covered by the same usage metering record, e.g. the user facilities in X.25.
Meter information	This field reports the actual usage, and it must identify the units of usage together with a count of the usage. The field may be present on a request block to support the presence of user data on a request.

8.2.3.3 Accept

This block represents any resulting response to a previous request such as the distant end responding, connection to a remote computer application or activation of a feature. Note that this also covers the case where the responding party might not be the same as that which the requester originally asked for – the call being diverted, for example. When specializing the data object for a particular service type, the information in Table 4 is expected to be included in this block.

Table 4 – Accept information block

Identity of remote parties	This identity is used to identify the remote parties in the transaction, in cases where such information is required. The syntax of this field may be a telephone number, an X.400 O/R name, the name of an application, etc. The field is present on the accept to support the possibility of having other parties responding then the originally requested, as in call forwarding.
Service variant	May be used to specify variants of usage, that have been requested, covered by the same usage metering record, e.g. the user facilities in X.25. Used on the accept block to indicate the actual service variant provided.
Meter information	This field reports the actual usage, and it must identify the units of usage together with a count of the usage. The field may be present on an accept block to support the presence of user data on an accept.

8.2.3.4 Complete

This block represents the completion of the provided service such as the remote end clearing, or the completion of a remote application. When specializing the data object for a particular service type, the information in Table 5 is expected to be included in this block.

Table 5 – Complete information block

Meter information	This field reports the actual usage as accumulated at the time of completion, and it must identify the units of usage together with a count of the usage.
Reporting trigger	Used to specify the value of reporting trigger that caused the usage report to be generated.
Completion cause	Used to report the cause of completion, e.g. hang-up by the called party.

8.2.3.5 Corresponding

This block contains the information required to allow a system to correlate many usage metering records to provide a service transaction record – for example, the X.400 message id. The corresponding block shall be present at most once in a usage information attribute. When specializing the data object for a particular service type, the information in Table 6 is expected to be included in this block.

Table 6 – Corresponding information block

Service transaction	Used to contain a unique identifier of the service transaction to be used to correlate usage reports from several instances of usage belonging to the same service transaction.
---------------------	---

8.2.3.6 Bulk

This block represents non-event related usage measurement, that is, usage measured independent of individual transactions – for example, the volume usage over a given period on a permanent virtual circuit. When specializing the data object for a particular service type, the information in Table 7 is expected to be included in this block:

Table 7 – Bulk information block

Meter information	This field reports the actual usage as accumulated at the time of reporting, and it must identify the units of usage together with a count of the usage.
Reporting trigger	Used to specify the value of reporting trigger that caused the usage report to be generated.

8.2.3.7 Interruption

Used to indicate any abnormal events during the accounting metering activity, such as notification of a clock change having occurred during the service utilization being measured. When specializing the data object for a particular service type, the information in Table 8 is expected to be included in this block:

Table 8 – Interruption information block

Meter information	This field reports the actual usage as accumulated at the time of interruption, and it must identify the units of usage together with a count of the usage. It is present if usage is charged even if the transaction is terminated abnormally.
Reporting trigger	Used to specify the value of reporting trigger that caused the usage report to be generated.
Interrupt cause	Used to report the cause of interruption.

8.2.3.8 Attribute syntax

The metering info attribute syntax (SEQUENCE OF CHOICE) is structured to allow any number of each of these call events to document the various usages made during the transaction (e.g. a call) except for the registration and corresponding blocks which must only appear once. This constraint ensures that a usage metering record will cover the potentially chargeable events due to a single requesting service user and that the correlation information only appears once. Therefore the number of these events used is the appropriate amount required to allow for the metering of the utilization of the service concerned.

The structure of this attribute is given in the detailed specification in Annex A.

The accountable object reference is a read only, single valued attribute, which references the accountable object, not necessarily a managed object, for which usage metering data are maintained.

The data errors parameter is used to indicate whether the usage data are believed to be in error. The parameter takes one of two possible values to indicate that either there is no problem or there is a possible error.

The provider identifier indicates the authority (for example, a communication service provider) which is providing the facilities delivered through the accountable object. If the provider is the owner of the system managed object containing the accountable object, its value can be represented as NULL.

8.2.4 Conditional packages

8.2.4.1 Metering data condition package

This package shall be provided if the corresponding control object class explicitly supports actions. Its two attributes are:

- control status; and
- procedural status,

as specified in CCITT Rec. X.731 | ISO/IEC 10164-2. The control status attribute adds the *suspended* value when the data object is not metering the usage of the resource. The procedural status attribute takes a value of *terminating* when the data object has stopped metering as a result of a “delete” request, but a notification, which is required by the value of the corresponding reporting triggers attribute, has yet to be generated. The value *terminating* is used as both the required value and permitted value for the procedural status attribute.

8.2.4.2 Audit information package

This package shall be included if there is a requirement for the support of an audit capability for the usage metering activity. This package contains a single attribute:

- audit information.

This attribute contains any audit information from the source of the usage metering data which may be required by the system processing this data. Such information would include any file or record numbers for the source data from which the usage metering data is being derived.

8.2.5 Usage metering data report notifications

There is one type of usage metering data report notification, generated by a data object supporting the usage metering function. This is the

- usage report notification.

It is generated according to the control specified by the reporting triggers attribute of the related usage metering control object (see 8.1.3). It identifies, through its

- notification cause parameter

the specific reporting trigger value which was the stimulus for the notification. It also contains parameters that are the attributes of the metering data information package and other, optional parameters.

8.3 Usage metering records

The usage metering record is a subclass of the event log record object class. In addition to supporting the inherited characteristics, it incorporates the attributes from the usage metering data object packages which are provided through usage report notifications.

8.4 Parameter definitions

8.4.1 Denied metering action

This parameter specifies the denied metering action error parameter to be returned in response to start metering, suspend metering and resume metering action requests if the usage collection is completed and the usage metering data object has the value “terminating” for the procedural status.

8.5 Compliance

A specification for a managed object which claims to comply with usage metering control shall specify the set of packages and attributes required for control as enumerated in 8.1.

A specification for a managed object which claims to comply with usage metering data shall specify the set of packages and attributes required as enumerated in 8.2.

Managed object class definitions which support functions defined in this Recommendation | International Standard by incorporating the specification of notifications through a reference to the notification template defined in Annex A, shall use the reference mechanism defined in CCITT Rec. X.722 | ISO/IEC 10165-4.

9 Service definition

9.1 Usage metering management service

An instance of a usage metering control object is created whenever it is deemed appropriate to account for the usage of a resource. The lifetime of the instance of the usage metering control object depends upon the meter type. During the lifetime of the usage metering control object, metering may be controlled by starting, suspending or resuming the operation of related usage metering data objects or by stopping the overall activity. During the lifetime, usage metering attributes may be read and, in certain cases, modified using the pass through services specified in CCITT Rec. X.730 | ISO/IEC 10164-1.

An instance of a usage metering data object may be read to obtain usage data related to the usage of resources using the pass through services specified in CCITT Rec. X.730 | ISO/IEC 10164-1. Usage metering data objects may also emit notifications, to provide data concerning resource usage, according to a management policy and controlled by the reporting triggers attribute of the corresponding usage metering control object.

9.1.1 Usage metering action service

Where the control object class includes the metering start or metering control packages, it shall use the CMIS M-ACTION service with parameter assignments shown in Table 9.

The Mode parameter is always confirmed. Either there shall be an action response or an error response. Action type is one of the following:

- start metering
- suspend metering
- resume metering.

Table 9 – Usage metering action parameters

Parameter name	Req/Ind	Resp/Conf
Invoke identifier	P	P
Linked identifier	–	C
Mode	P	–
Base object class	M	–
Base object instance	M	–
Scope	U	–
Filter	U	–
Managed object class	–	C
Managed object instance	–	C
Access control	U	–
Synchronization	U	–
Action type	M	M
Action information	M	–
Current time	–	U
Action response	–	M
Success		C
Failed		C
Indeterminate		C
Errors	–	C

9.1.1.1 Starting usage metering objects

One or more instances of a data object may be started using the CMIS M-ACTION service with an action type *start metering*. Where no specific data objects are identified, data objects referenced by the control object to which the action is directed are started. Action information identifies the corresponding instances of data objects which are the subject of the action. Action response data provides a list of those data objects which are successfully started, have failed or been indeterminate.

9.1.1.2 Suspending usage metering objects

One or more instances of a data object may be subject to a suspend action by using the CMIS M-ACTION service with an action type *suspend metering*. Action information identifies the corresponding instances of data objects which are the subject of the action. Action response data provides a list of those data objects which have been successfully suspended, have failed to be suspended or are in an indeterminate state. Data objects, supporting the data object condition package and suspended in this manner shall add the value *suspended* to the control status attribute of the data object.

An instance of a control object may be stopped and all related data objects suspended using the CMIS M-ACTION service with an action type *suspend metering* but without specifying any data objects. Action response data provides a list of data objects which have been suspended, failed or been indeterminate.

9.1.1.3 Resuming usage metering objects

One or more instances of a data object may be subject to a resume action by using the CMIS M-ACTION service with an action type *resume metering*. Action information identifies the corresponding instances of data objects which are the subject of the action. Action response data provides a list of those data objects which have been successfully resumed, have failed or been indeterminate.

9.1.2 Usage metering action notification service

A control object generates an event to provide data related to actions which may be communicated using the M-EVENT-REPORT service. Event information carries parameters of the notification.

Table 10 lists the parameters for the usage metering control notification service.

Table 10 – Usage metering action notification parameters

Parameter Name	Req/Ind	Resp/Conf
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C (=)
Event time	P	
Event information		
Action response	M	
Reporting triggers	U	
Accountable objects reference list	U	
Data objects reference list	U	
Current time	–	P
Event reply	–	–
Errors	–	P

9.1.3 Usage metering data report notification service

A usage metering data object generates an event to provide data upon the usage of resources which may be communicated using the M-EVENT-REPORT service. Event information carries the parameters of the notification.

Table 11 lists the parameters for the usage metering data report notification service.

Table 11 – Usage metering data report notification parameters

Parameter Name	Req/Ind	Resp/Conf
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C (=)
Event time	P	
Event information		
Accountable object reference	M	
Notification cause	M	
Usage information	M	
Registration	M	
Request	U	
Accept	U	
Complete	U	
Interrupt	U	
Bulk	U	
Corresponding	U	
Audit information	U	
Service	M	
Audit details	M	
Data errors	M	
Provider id	U	
Additional info	U	
Current time	–	P
Event reply	–	–
Errors	–	P

10 Functional units

Two functional units are defined in this Recommendation | International Standard for management of usage metering:

a) *Usage metering report:*

The usage metering report functional unit requires support of at least the usage metering data report notification service;

b) *Suspend – resume functional unit:*

The suspend – resume functional unit requires support of at least the suspend metering and the resume metering actions of the usage metering action service.

The following functional units defined in CCITT Rec. X.730 | ISO/IEC 10164-1 may be negotiated for the purpose of managing usage metering:

- control;
- monitor;
- objectEvents.

The following functional units defined in CCITT Rec. X.731 | ISO/IEC 10164-2 may be negotiated for the purpose of managing usage metering:

- stateChange.

11 Protocol

11.1 Abstract syntax

11.1.1 Usage metering objects

This Recommendation | International Standard references attributes and packages of attributes, actions and notifications which can be used to construct object classes to support the usage metering function. Annex A defines the following usage metering managed objects:

- usage metering control managed object;
- usage metering data managed object;
- usage metering record managed object.

The syntactic definition of packages, attributes, actions and notifications is also presented in Annex A.

11.1.2 Management attributes

This Recommendation | International Standard references management attributes whose abstract syntax is specified in Annex A. The attribute names used in clause 8 are associated with the attribute labels specified in Annex A. For clarity, these are shown in Table 12

Table 12 – Relationship between attribute name and attribute label

Attribute name	Attribute label
Accountable object reference	accountableObjectReference
Accountable objects reference list	accountableObjectsReferenceList
Action response	actionResponse
Audit information	auditInfo
Control object id	controlObjectId
Data object id	dataObjectId
Data objects reference list	dataObjectsReferenceList
Data errors	dataErrors
Notification cause	notificationCause
Provider id	providerId
Reporting triggers	reportingTriggers
Usage information	usageInfo

11.1.3 Management actions

Table 13 defines the management actions for this Recommendation | International Standard, the abstract syntax of which is specified in Annex A.

The abstract syntax referenced by the action type in Table 13 is carried in the MAPDU.

Table 13 – Management actions

Action name	Action type
Start metering	startMetering
Suspend metering	suspendMetering
Resume metering	resumeMetering

11.1.4 Management notifications

Table 14 defines the management notification for this Recommendation | International Standard, the abstract syntax of which is specified in Annex A.

The abstract syntax referenced by the notification type in Table 14 is carried in the MAPDU.

Table 14 – Management notification

Notification name	Notification type
Metering resumed	meteringResumed
Metering started	meteringStarted
Metering suspended	meteringSuspended
Usage report	usageReport

Table 15 identifies the relationship between the parameters of usage metering notifications and management attribute names.

Table 15 – Management attribute mappings

Parameter	Attribute name
Accountable object reference	Accountable object reference
Accountable objects reference list	Accountable objects reference list
Action response	Action response
Data errors	Data errors
Data objects reference list	Data objects reference list
Notification cause	Notification cause
Provider id	Provider id
Reporting triggers	Reporting triggers
Usage information	Usage information

11.2 Elements of procedure

11.2.1 Action invocation

The usage metering action reporting procedures are initiated by the usage metering action request primitive. On receipt of the usage metering action request primitive, the SMASE protocol machine shall construct a MAPDU and send it using the CMIS M-ACTION request primitive. The parameters of the usage metering action request primitive which are marked "P" in Table 9 are mapped directly onto the corresponding parameters of the CMIS M-ACTION request primitive; the remaining parameters are used to construct the MAPDU.

11.2.2 Receipt of action

On receipt of a MAPDU requesting, the usage metering action service via the CMIS M-ACTION indication primitive, the SMASE protocol machine shall, if the MAPDU is well formed, issue a usage metering action indication primitive to the usage metering action service user. The parameters of the usage metering action indication primitive which are marked "P" in Table 9 are mapped directly from the corresponding parameters of the CMIS M-ACTION indication primitive and the remaining parameters are extracted from the MAPDU. Otherwise, the SMASE protocol machine shall construct an appropriate MAPDU containing notification of the error and shall issue a CMIS M-ACTION response service primitive with an error parameter present.

11.2.3 Action response

The SMASE protocol machine shall accept a usage metering action response primitive and shall construct a MAPDU and send it using the CMIS M-ACTION response primitive. The parameters of the usage metering action response service primitive which are marked "P" in Table 9 are mapped directly onto the corresponding parameters of the CMIS M-ACTION response primitive; the remaining parameters are used to construct the MAPDU.

11.2.4 Receipt of action response

On receipt of a MAPDU responding to a usage metering action request primitive via the CMIS M-ACTION confirmation primitive, the SMASE protocol machine shall issue a usage metering action confirmation primitive to the usage metering action service user, thus completing the usage metering action procedure. The parameters of the usage metering action confirmation primitive which are marked "P" in Table 9 are mapped directly from the corresponding parameters of the CMIS M-ACTION confirmation primitive and the remaining parameters are extracted from the MAPDU.

11.2.5 Action notification invocation

The usage metering action notification reporting procedures are initiated by the usage metering action notification request primitive. On receipt of the usage metering action notification request primitive, the SMASE protocol machine shall construct a MAPDU and send it using the M-EVENT-REPORT request primitive. The parameters of the usage metering action notification request primitive which are marked "P" in Table 10 are mapped directly onto the corresponding parameters of the M-EVENT-REPORT request primitive; the remaining parameters are used to construct the MAPDU.

11.2.6 Receipt of action notification

On receipt of a MAPDU requesting the usage metering action notification service via the M-EVENT-REPORT indication primitive, the SMASE protocol machine shall issue a usage metering action notification indication primitive to the usage metering action notification service user, thus completing the usage metering action notification procedure. The parameters of the action notification reporting indication primitive which are marked "P" in Table 10 are mapped directly from the corresponding parameters of the M-EVENT-REPORT indication primitive and the remaining parameters are extracted from the MAPDU.

11.2.7 Data notification invocation

The usage metering data report notification reporting procedures are initiated by the usage metering data report notification request primitive. On receipt of the usage metering data report notification request primitive, the SMASE protocol machine shall construct a MAPDU and send it using the M-EVENT-REPORT request primitive. The parameters of the usage metering data report notification request primitive which are marked "P" in Table 11 are mapped directly onto the corresponding parameters of the M-EVENT-REPORT request primitive; the remaining parameters are used to construct the MAPDU.

11.2.8 Receipt of data notification

On receipt of a MAPDU requesting the usage metering data report notification service via the M-EVENT-REPORT indication primitive, the SMASE protocol machine shall issue a usage metering data report notification indication primitive to the usage metering data notification service user, thus completing the usage metering data report notification procedure. The parameters of the usage metering data report notification indication primitive which are marked “P” in Table 11 are mapped directly from the corresponding parameters of the M-EVENT-REPORT indication primitive and the remaining parameters are extracted from the MAPDU.

11.3 Negotiation of functional unit

This Recommendation | International Standard assigns the following object identifier value

{joint-iso-ccitt ms(9) function(2) part10(10) functionalUnitPackage(1)}

as a value of the ASN.1 type FunctionalUnitPackage defined in CCITT Rec. X.701 | ISO/IEC 10040 for negotiating the availability of the following functional units

- 0 usage metering report;
- 1 suspend – resume functional unit,

where the numbers identify the bit positions in the BIT STRING assigned to the functional units and the names reference the functional units as defined in clause 10.

12 Relationship with other functions

The usage metering function uses the object management function CCITT Rec. X.730 | ISO/IEC 10164-1, state management function CCITT Rec. X.731 | ISO/IEC 10164-2, event report management function CCITT Rec. X.734 | ISO/IEC 10164-5 and log control function CCITT Rec. X.735 | ISO/IEC 10164-6. It uses the operational state, control status and procedural status attributes specified in CCITT Rec. X.731 | ISO/IEC 10164-2; the formal (ASN.1) specification of Time Period from ITU-T Rec. X.739 | ISO/IEC 10164-11.

13 Conformance

Implementations claiming to conform to this Recommendation | International Standard shall comply with the conformance requirements as defined in the following subclauses.

13.1 Static conformance

The implementation shall conform to the requirements of this Recommendation | International Standard in the manager role, the agent role, or both roles. A claim of conformance to at least one role shall be made in Table B.1.

If a claim of conformance is made for support in the manager role, the implementation shall support at least one of the attributes, notifications, actions, managed objects specified by this Recommendation | International Standard. The conformance requirements in the manager role for those management operations and notifications are identified in Table B.3 and further tables referenced by Annex B.

If a claim of conformance is made for support in the agent role, the implementation shall support at least one of the attributes, notifications, actions, managed objects described in Table B.4. A claim of conformance in the agent role requires the support of all the mandatory operations and mandatory notifications specified by those management definitions.

The implementation shall support the transfer syntax derived from the encoding rules specified in CCITT Rec. X.209 | ISO/IEC 8825 named {joint-iso-ccitt asn1(1) basicEncoding(1)} for the abstract data types referenced by the definitions for which support is claimed.

13.2 Dynamic conformance

Implementations claiming to conform to this Recommendation | International Standard shall support the elements of procedure and definitions of semantics corresponding to the definitions for which support is claimed.

13.3 Management implementation conformance statement requirements

Any MCS proforma, MICS proforma, MOCS proforma, MIDS proforma, and MRCS proforma which conforms to this Recommendation | International Standard shall be technically identical to the proformas specified in Annexes B, C, D, E and F preserving table numbering and the index numbers of items, and differing only in pagination and page headers.

The supplier of an implementation which is claimed to conform to this Recommendation | International Standard shall complete a copy of the management conformance summary (MCS) provided in Annex B as part of the conformance requirements together with any other ICS proformas referenced as applicable from that MCS. An ICS which conforms to this Recommendation | International Standard shall:

- describe an implementation which conforms to this Recommendation | International Standard;
- have been completed in accordance with the instructions for completion given in ITU-T Rec. X.724 | ISO/IEC 10165-6;
- include the information necessary to uniquely identify both the supplier and the implementation.

Claims of conformance to the management information defined in this Recommendation | International Standard in managed object classes defined elsewhere shall include the requirements of the MIDS proforma in the MOCS proforma for the managed object class.

Annex A

Usage metering templates and abstract syntax

(This annex forms an integral part of this Recommendation | International Standard)

A.1 Definitions of managed object classes

usageMeteringControlObject MANAGED OBJECT CLASS

DERIVED FROM "CCITT Rec. X.721 | ISO/IEC 10165-2":top;

CHARACTERIZED BY

meteringControlObject PACKAGE

ATTRIBUTES

controlObjectId GET,

"CCITT Rec. X.721 | ISO/IEC 10165-2":operationalState;;

, meteringControlCapabilities PACKAGE

BEHAVIOUR

usageMeterControlBehaviour;

ATTRIBUTES

reportingTriggers GET-REPLACE ADD-REMOVE,

accountableObjectsReferenceList GET,

dataObjectsReferenceList GET;

NOTIFICATIONS

"CCITT Rec. X.721 | ISO/IEC 10165-2":attributeValueChange,

"CCITT Rec. X.721 | ISO/IEC 10165-2":objectCreation,

"CCITT Rec. X.721 | ISO/IEC 10165-2":objectDeletion,

"CCITT Rec. X.721 | ISO/IEC 10165-2":stateChange;

REGISTERED AS {umf-pkg 1};

;

CONDITIONAL PACKAGES

meteringStart

PRESENT IF "corresponding data objects are explicitly created in a suspended condition",

meteringControl

PRESENT IF "suspend and resume operations are required and the corresponding data objects support the meteringDataCondition package",

startNotification

PRESENT IF "there is a static requirement to advise manager(s) other than the one generating the action of the outcome of the action and the meteringStart package is supported",

controlNotification

PRESENT IF "there is a static requirement to advise manager(s) other than the one generating the action of the outcome of the action and the meteringControl package is supported";

REGISTERED AS {umf-mo 1};

usageMeteringDataObject MANAGED OBJECT CLASS

DERIVED FROM "CCITT Rec. X.721 | ISO/IEC 10165-2":top;

CHARACTERIZED BY

meteringDataObject PACKAGE

ATTRIBUTES

dataObjectId GET;;

, meteringDataInfo PACKAGE

BEHAVIOUR

usageMeterDataObjectBehaviour;

ATTRIBUTES

accountableObjectReference GET,

usageInfo GET,

dataErrors GET,

providerId GET;

NOTIFICATIONS

usageReport,

"CCITT Rec. X.721 | ISO/IEC 10165-2":objectCreation,

"CCITT Rec. X.721 | ISO/IEC 10165-2":objectDeletion;

REGISTERED AS { umf-pkg 2 };;

CONDITIONAL PACKAGES**meteringDataCondition**

PRESENT IF "the accounting activity can be suspended or can exist in a terminating condition pending the emission of a usageReport notification",

auditInformation

PRESENT IF "the accounting activity requires the measurement of certain source information for audit purposes";

REGISTERED AS {umf-mo 2};

usageMeteringRecord**MANAGED OBJECT CLASS**

DERIVED FROM "Rec. X.721 | ISO/IEC 10165-2":eventLogRecord;

CHARACTERIZED BY

usageMeteringRecordObject **PACKAGE**

ATTRIBUTES

accountableObjectReference **GET,**
usageInfo **GET,**
dataErrors **GET,**
providerId **GET;;;**

CONDITIONAL PACKAGES**auditInformation**

PRESENT IF "this package has been included in the usageMeteringData object emitting the notification to be stored in this record managed object";

REGISTERED AS { umf-mo 3 };

A.2 Definition of packages**auditInformation** **PACKAGE****ATTRIBUTES**

auditInfo **GET;**

REGISTERED AS { umf-pkg 3 };

controlNotification **PACKAGE****NOTIFICATIONS**

meteringSuspended,
meteringResumed;

REGISTERED AS {umf-pkg 4};

meteringControl **PACKAGE****ACTIONS**

suspendMetering **deniedMeteringAction,**
resumeMetering **deniedMeteringAction;**

REGISTERED AS {umf-pkg 5};

meteringDataCondition **PACKAGE****BEHAVIOUR** **meterConditionBehaviour;****ATTRIBUTES**

"CCITT Rec X.721 | ISO/IEC 10165-2":controlStatus

PERMITTED VALUES **UsageMeteringFunction.ControlStatusValue**

REQUIRED VALUES **UsageMeteringFunction.ControlStatusValue**

GET,

"CCITT Rec X.721 | ISO/IEC 10165-2":proceduralStatus

PERMITTED VALUES **UsageMeteringFunction.ProceduralStatusValue**

REQUIRED VALUES **UsageMeteringFunction.ProceduralStatusValue**

GET;

REGISTERED AS { umf-pkg 6};

meteringStart **PACKAGE****ACTIONS**

startMetering **deniedMeteringAction;**

REGISTERED AS {umf-pkg 7};

startNotification **PACKAGE****NOTIFICATIONS**

meteringStarted;

REGISTERED AS {umf-pkg 8};

A.3 Definition of attributes

accountableObjectReference	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.AccountableObjectReference;
MATCHES FOR		EQUALITY;
REGISTERED AS {umf-att 1};		

accountableObjectsReferenceList	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.AccountableObjectsReferenceList;
MATCHES FOR		EQUALITY, SET-COMPARISON, SET-INTERSECTION;
REGISTERED AS {umf-att 2};		

actionResponse	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.ActionResponse;
MATCHES FOR		EQUALITY;
REGISTERED AS {umf-att 3};		

auditInfo	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.AuditInfo;
MATCHES FOR		EQUALITY;
BEHAVIOUR		usageObjectRecordsIdBehaviour;
REGISTERED AS { umf-att 4};		

controlObjectId	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.UsageMeteringControlObjectId;
MATCHES FOR		EQUALITY;
REGISTERED AS {umf-att 5};		

dataObjectId	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.UsageMeteringDataObjectId;
MATCHES FOR		EQUALITY;
REGISTERED AS {umf-att 6};		

dataObjectsReferenceList	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.DataObjectsReferenceList;
MATCHES FOR		EQUALITY, SET-COMPARISON, SET-INTERSECTION;
REGISTERED AS {umf-att 7};		

dataErrors	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.DataErrors;
MATCHES FOR		EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR dataErrorBehaviour;		
REGISTERED AS {umf-att 8};		

notificationCause	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.NotificationCause;
MATCHES FOR		EQUALITY;
REGISTERED AS {umf-att 9};		

providerId	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.ProviderId;
MATCHES FOR		EQUALITY;
REGISTERED AS {umf-att 10};		

reportingTriggers	ATTRIBUTE	
WITH ATTRIBUTE SYNTAX		UsageMeteringFunction.ReportingTriggers;

MATCHES FOR
BEHAVIOUR
REGISTERED AS {umf-att 11};

EQUALITY;
triggerBehaviour;

usageInfo **ATTRIBUTE**
WITH ATTRIBUTE SYNTAX **UsageMeteringFunction.UsageInfo;**
REGISTERED AS {umf-att 12};

A.4 Definition of notification types

usageReport **NOTIFICATION**
BEHAVIOUR **usageReportBehaviour, usageMeterTimeBehaviour, triggerBehaviour;**
WITH INFORMATION SYNTAX **UsageMeteringFunction.UsageDataInfo**
AND ATTRIBUTE IDS
accountableObjectReference **accountableObjectReference,**
notificationCause **notificationCause,**
usageInfo **usageInfo,**
auditInfo **auditInfo,**
dataErrors **dataErrors,**
providerId **providerId;**
REGISTERED AS {umf-not 1};

meteringResumed **NOTIFICATION**
BEHAVIOUR **meteringResumedBehaviour;**
WITH INFORMATION SYNTAX **UsageMeteringFunction.ControlInfo**
AND ATTRIBUTE IDS
actionResponse **actionResponse,**
reportingTriggers **reportingTriggers,**
dataObjectsreferenceList **dataObjectsReferenceList;**
REGISTERED AS {umf-not 2};

meteringStarted **NOTIFICATION**
BEHAVIOUR **meteringStartedBehaviour;**
WITH INFORMATION SYNTAX **UsageMeteringFunction.ControlInfo**
AND ATTRIBUTE IDS
actionResponse **actionResponse,**
reportingTriggers **reportingTriggers,**
dataObjectsreferenceList **dataObjectsReferenceList;**
REGISTERED AS {umf-not 3};

meteringSuspended **NOTIFICATION**
BEHAVIOUR **meteringSuspendedBehaviour;**
WITH INFORMATION SYNTAX **UsageMeteringFunction.ControlInfo**
AND ATTRIBUTE IDS
actionResponse **actionResponse,**
reportingTriggers **reportingTriggers,**
dataObjectsreferenceList **dataObjectsReferenceList;**
REGISTERED AS {umf-not 4};

A.5 Definition of actions

resumeMetering **ACTION**
BEHAVIOUR **resumeBehaviour;**
MODE CONFIRMED;
WITH INFORMATION SYNTAX **UsageMeteringFunction.ActionArgument;**
WITH REPLY SYNTAX **UsageMeteringFunction.ActionResponse;**
REGISTERED AS {umf-act 1};

startMetering **ACTION**
BEHAVIOUR **startBehaviour;**
MODE CONFIRMED;
WITH INFORMATION SYNTAX **UsageMeteringFunction.ActionArgument;**

WITH REPLY SYNTAX UsageMeteringFunction.ActionResponse;
REGISTERED AS {umf-act 2};

suspendMetering ACTION
BEHAVIOUR suspendBehaviour;
MODE CONFIRMED;
WITH INFORMATION SYNTAX UsageMeteringFunction.ActionArgument;
WITH REPLY SYNTAX UsageMeteringFunction.ActionResponse;
REGISTERED AS {umf-act 3};

A.6 Definition of behaviour

usageObjectRecordsIdBehaviour BEHAVIOUR
DEFINED AS "This attribute provides the storage for audit information which is included in the usage metering record in order to enable a guarantee of completeness of all usage metering data provided";

usageMeterDataObjectBehaviour BEHAVIOUR
DEFINED AS "The data object reports usage metering data when triggered by or on the occurrence of events identified in the reportingTriggers attribute in the associated control object";

usageReportBehaviour BEHAVIOUR
DEFINED AS "On the occurrence of an event specified by the reporting triggers attribute within an object containing usage metering control or the usage metering control object, the usage metering data objects or the objects which contain a meteringDataInfo package, generates a usageReport notification. The notification cause field of the usageReport notification service supplies the value of the reportingTriggers attribute which caused the notification to occur.";

meteringResumedBehaviour BEHAVIOUR
DEFINED AS "A meteringResumed notification is generated when the resume action completes without error.";

meteringStartedBehaviour BEHAVIOUR
DEFINED AS "A meteringStarted notification is generated when the start action completes without error.";

meteringSuspendedBehaviour BEHAVIOUR
DEFINED AS "A meteringSuspended notification is generated when the suspend action completes without error.";

usageMeterControlBehaviour BEHAVIOUR
DEFINED AS "When an instance of usage metering control has been created to account for usage of a named resource, it controls the behaviour of related instances of usage metering data through its reportingTriggers attribute. These identify the internal events which will cause a usageReport notification to be generated within a controlled instance of usage metering data. The triggers may be time related, e.g. as in the case of time related units, they may be determined by operations performed upon the control object e.g. suspend or resume metering, they may be determined by the accountable events as described in 8.2.3 or they may be externally specified. When the associated accountable objects requires no further usage to be metered and there are no more instances of data objects, the instance of usage metering control may be deleted.";

meterConditionBehaviour BEHAVIOUR
DEFINED AS "If the data meter is in a suspended condition, the control status takes the value *suspended*. This status value is removed when the data object is carrying out usage metering after being started or resumed. When a request is made (either explicitly or implicitly) for the data object to be deleted and, where the reporting triggers specify that this is a situation which will lead to a usage report notification, the data object shall take a procedural status value of *terminating* until the required notification has been generated";

resumeBehaviour BEHAVIOUR
DEFINED AS "Upon the completion of a resume ACTION, the response indicates the corresponding data objects upon which the requested operation was successful, those upon which it was unsuccessful and, where the result of the operation is unknown, returns an *indeterminate* response. The action is only effective when the instance of a

selected data object is in a suspended condition. Because the action is idempotent, the action has no additional effect if applied to a data object in a metering condition.";

startBehaviour BEHAVIOUR

DEFINED AS "This action enables a control object to (re-)start usage metering. All parameters for a selected data object (or objects) metering usage which are under the control of that object are re-initialized. Upon the completion of a start ACTION, the response indicates the corresponding data objects upon which the requested operation was successful, those upon which it was unsuccessful and, where the result of the operation is unknown, returns an *indeterminate* response.";

suspendBehaviour BEHAVIOUR

DEFINED AS "Upon the completion of a suspend ACTION, the response indicates the corresponding data objects upon which the requested operation was successful, those upon which it was unsuccessful and, where the result of the operation is unknown, returns an *indeterminate* response. The action is only effective when the instance of a selected data object is already metering. Because the action is idempotent, the action has no additional effect if applied to a data object in a suspended condition.";

triggerBehaviour BEHAVIOUR

DEFINED AS "Given a set of events, which result in some defined activity with respect to metering of resource usage, the event will lead either to the update of meter information (recording triggers) or to the generation of usage report notifications (reporting triggers). Triggering events may be of three kinds: initiated at regular time intervals, induced as the result of a usage metering action (both locally and externally induced), and initiated by identified external stimuli.";

usageMeterTimeBehaviour BEHAVIOUR

DEFINED AS "The usageMeterTime is the current time if metering of usage is taking place. If metering of usage has been suspended or the instance of usage metering data has been deleted, then the usageMeterTime value is the usageStoppedTime.";

dataErrorBehaviour BEHAVIOUR

DEFINED AS "Set matching is only permitted if the set valued syntax choice is selected";

A.7 Definition of name binding

A.7.1 Usage meter data

No name bindings for the usageMeterData object class are provided in this Recommendation | International Standard because of the variety of accountable objects for which the usage data can be collected. Users of this Recommendation | International Standard specializing the usage data are expected to specify name bindings for usageMeterData or its subclasses to make them instantiable.

A.7.2 Usage meter control

One name binding is provided in this Recommendation | International Standard for the usage meter control object class. This can be used only when the accountable object is contained in a managed object that is an instance of either the system managed object class or its subclasses. Other name bindings are expected to be defined by users of this Recommendation | International Standard when the accountable objects have name bindings to objects other than the system or its subclass.

usageMeterControl-system NAME BINDING

SUBORDINATE OBJECT CLASS

usageMeteringControlObject

AND SUBCLASSES;

NAMED BY SUPERIOR OBJECT CLASS

"CCITT Rec. X.721 | ISO/IEC 10165-2":system AND SUBCLASSES;

WITH ATTRIBUTE controlObjectId;

DELETE

DELETES-CONTAINED-OBJECTS;

REGISTERED AS { umf-nb 1};

A.8 Parameter Templates

```

deniedMeteringAction          PARAMETER
CONTEXT      SPECIFIC-ERROR;
WITH SYNTAX  UsageMeteringFunction.DeniedMeteringAction;
BEHAVIOUR
deniedMeteringActionBehaviour BEHAVIOUR
DEFINED AS  "This error is returned if the usage metering control object received a request to start metering or
            suspend metering or resume metering for the data object that has the value of terminating for the
            procedural status.";;
REGISTERED AS { umf-par 1};

```

A.9 Definition of ASN.1 modules

```

UMFObjId {joint-iso-ccitt ms(9) function(2) part10(10) asn1Modules(2) 0}
DEFINITIONS
BEGIN

    umf-mo OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) managedObjectClass(3)}
    umf-pkg OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) package(4)}
    umf-par OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) parameter(5)}
    umf-nb OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) nameBinding(6)}
    umf-att OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) attribute(7)}
    umf-act OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) action(9)}
    umf-not OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part10(10) notification(10)}

END

UsageMeteringFunction {joint-iso-ccitt ms(9) function(2) part10(10) asn1Modules(2) 1}
DEFINITIONS IMPLICIT TAGS ::=
BEGIN
    -- EXPORTS everything

IMPORTS
    ObjectInstance
        FROM CMIP-1 { joint-iso-ccitt ms(9) cmip(1) version1(1) protocol(3) }
    ControlStatus, ProceduralStatus, SimpleNameType, ManagementExtension
        FROM Attribute-ASN1Module { joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 1 }
    TimePeriod
        FROM MetricModule { joint-iso-ccitt ms(9) function(2) part11(11) asn1Module(2) 0 }
    UsageInfo
        FROM UsageMeteringDataInfo { joint-iso-ccitt ms(9) function(2) part(10) asn1Modules(2) 2 }
    ;

AccountableObjectReference ::=          ObjectInstance
AccountableObjectsReferenceList ::=     SET OF ObjectInstance
ActionArgument ::= CHOICE {
    selectedObjects      SET OF ObjectInstance,
                        -- set of data objects, controlled by the control
                        -- object for which the request is appropriate
    allObjects           NULL
                        -- selects all data objects controlled by control
                        -- object --
                        }

ActionResponse ::= SEQUENCE {
                        -- at least one component shall be present
    success              [0] SET OF ObjectInstance OPTIONAL,
    failed               [1] SET OF ObjectInstance OPTIONAL,
    indeterminate        [2] SET OF ObjectInstance OPTIONAL }

AuditInfo ::= SEQUENCE {
    service              OBJECT IDENTIFIER,
    auditDetails         ANY DEFINED BY service }

```

```

ControlInfo ::=
    actionResponse
    reportingTriggers
    accountableObjectsReferenceList
    dataObjectsReferenceList
    additionalInformation
    SEQUENCE {
        ActionResponse,
        [0] ReportingTriggers
        [1] AccountableObjectsReferenceList
        [2] DataObjectsReferenceList
        [3] SET OF ManagementExtension }
    OPTIONAL,
    OPTIONAL,
    OPTIONAL,

ControlStatusValue ::=
    ControlStatus ( WITH COMPONENT ( suspended ) )

DataErrors ::=
    possibleErrors
    noProblem
    CHOICE {
        SET OF PossibleError,
        NULL }

DataObjectsReferenceList ::=
    SET OF ObjectInstance

DeniedMeteringAction ::=
    ENUMERATED {
        canNotStart(0),
        canNotSuspend(1),
        canNotResume(2)}

Induced ::=
    ENUMERATED {
        start(0),
        suspend(1),
        resume(2),
        delete(3),
        disabled(4),
        enabled(5) }

NotificationCause ::=
    periodic
    induced
    event
    stimulus
    CHOICE {
        [1] TimePeriod,
        [2] Induced,
        [3] ReportingEvent,
        [4] OBJECT IDENTIFIER }

PossibleError ::=
    OBJECT IDENTIFIER

ProceduralStatusValue ::=
    ProceduralStatus ( WITH COMPONENT ( terminating ) )

ProviderId ::=
    objectReference
    textualName
    serviceSpecific
    unknown
    CHOICE {
        [1] ObjectInstance,
        [2] GraphicString,
        [3] ServiceSpecificId,
        [4] NULL }

ReportingTriggers ::=
    periodic
    induced
    event
    stimulus
    SET OF CHOICE {
        [1] TimePeriod,
        [2] Induced,
        [3] ReportingEvent,
        [4] OBJECT IDENTIFIER }

ReportingEvent ::=
    ENUMERATED {
        registration (0),
        request (1),
        accept (2),
        complete (3),
        corresponding (4),
        bulk (5),
        interruption (6) }

-- The applicability of each of these values must be specified by a specialization, together
-- with the exact semantics of the values used.
-- NOTE – All of events from 8.2.3 have been included in this enumerated type for the
-- sake of completeness. It does not imply that specializations need to assign semantics to all
-- of them. In particular the values "corresponding (4)" and "bulk (5)" may not be required in
-- certain specializations.

ServiceSpecificId ::=
    service
    serviceSpecificId
    SEQUENCE {
        OBJECT IDENTIFIER,
        ANY DEFINED BY service }

UsageDataInfo ::=
    accountableObjectReference
    notificationCause
    SEQUENCE {
        [0] ObjectInstance,
        [1] NotificationCause,

```

```

usageInfo      [2] UsageInfo,
auditInfo      [3] AuditInfo      OPTIONAL,
dataErrors     [4] DataErrors,
providerId     [5] ProviderId     OPTIONAL,
additionalInformation [6] SET OF ManagementExtension OPTIONAL}

UsageMeteringControlObjectId ::= SimpleNameType
UsageMeteringDataObjectId ::= SimpleNameType

END

UsageMeteringDataInfo {joint-iso-ccitt ms(9) function(2) part10(10) asn1Modules(2) 2}
DEFINITIONS IMPLICIT TAGS ::=

BEGIN

EXPORTS UsageInfo

UsageInfo ::= SEQUENCE {
    serviceType ServiceType,
    usageData    ANY DEFINED BY serviceType }

ServiceType ::= OBJECT IDENTIFIER

-- the following ASN.1 provides the means to include the service-specific information in the usage
-- metering data. The data type XxxUsageData, detailed below, is a prototype of how a
-- specialization shall specify a data type to replace the ANY in the usageData field of the UsageInfo
-- in a way that allows the specifier to include the necessary syntax to fully specify each block. In
-- addition the specialization shall allocate an OBJECT IDENTIFIER value to register the variant of
-- usageData specified by the specialization. A concrete example of a specification, using PSTN as
-- illustration is given in G.1.
--
-- Detail for the contents of each block are given as follows:
--
-- XxxUsageData ::= SEQUENCE OF CHOICE {
--
--     registration      XxxRegistrationType,
--
--     -- The registration block is used to identify the requester using the service. An
--     -- XxxRegistrationType shall be specified by all specializations. The registration component shall
--     -- appear once and only once in every value of the UsageInfo data type, and shall always
--     -- appear as the first element in the XxxUsageData.
--
--     -- The definition of the service-specific syntax to be included in this block, shall include the
--     -- following information:
--     -- identification of the requester (directory number, user address, etc.)
--
--     request           XxxRequestType,
--
--     -- The request block identifies the service request made by the requester. The XxxRequestType
--     -- may be omitted from specializations not requiring it. If an XxxRequestType is specified in a
--     -- specialization, zero or more request components may appear in a value of the XxxUsageData.
--
--     -- The definition of the service-specific syntax to be included in this block, shall include the
--     -- following information:
--     -- service request information which identifies the type of service requested and also any
--     -- additional service parameters, note that this information can be very detailed and complex
--     -- depending on the service type and the types of request that the service supports (e.g.
--     -- destination addresses, electronic mail message information, directory numbers, feature
--     -- codes).
--     -- and the following information may be provided:
--     -- a usage measurement (time, volume);
--     -- a time stamp (date and time).
--
--     accept            XxxAcceptType,
--
--     -- The accept block identifies the details of what service was provided and the associated usage.
--     -- The XxxAcceptType may be omitted from specializations not requiring it. If an XxxAcceptType
--     -- is specified in a specialization, zero or more accept components may appear in a value of the

```

```

-- XxxUsageData.
--
-- The definition of the service-specific syntax to be included in this block, shall include the
-- following information:
--   service information which identifies the type of service provided and also any additional service
parameters;
--   a usage measurement;
--   a time stamp.

-- complete      XxxCompleteType,

-- The complete block identifies the details of the end of some instance of utilization. The
-- XxxCompleteType may be omitted from specializations not requiring it. If an XxxCompleteType
-- is specified in a specialization, zero or more complete components may appear in a value
-- of the XxxUsageData.
--
-- The definition of the service-specific syntax to be included in this block, shall include the
-- following information:
--   a usage measurement;
-- and the following information may be provided:
--   service information which identifies any further details about the provided service
--   (reason for call completion);
--   a time stamp.

-- interrupt      XxxInterruptType,

-- The interrupt block indicates any abnormal occurrence during the transaction
-- for which different charging algorithms may need to be applied by the recipient of the usage
-- metering record. The XxxInterruptType may be omitted from specializations not requiring it.
-- If an XxxInterruptType is specified in a specialization, zero or more interrupt components
-- may appear in a value of the XxxUsageData.
--
-- The definition of the service-specific syntax to be included in this block, shall include the
-- following information:
--   duration of the interruption,
--   reason for the interruption;
-- and the following information may be provided:
--   a usage measurement
--   a time stamp.

-- bulk           XxxBulkType,

-- The bulk block indicates any bulk usage measurements made. The
-- XxxBulkType may be omitted from specializations not requiring it. If an XxxBulkType
-- is specified in a specialization, zero or more bulk components may appear in a
--value of the XxxUsageData.
--
-- The definition of the service-specific syntax to be included in this block, shall include the
-- following information:
--   a usage measurement
-- and the following information may be provided:
--   reason for reporting

-- corresponding  XxxCorrespondingType }

-- The corresponding block includes any specific information to allow many
-- usage metering records to be correlated. The XxxCorrespondingType may be omitted
-- from specializations not requiring it. If an XxxCorrespondingType is specified in a
-- specialization, at most one corresponding components may appear in a value of the
-- XxxUsageData.
--
-- The definition of the service-specific syntax to be included in this block, shall include the
-- following information:
--   an identifying key which relates many usage metering records to one service transaction record.

-- The above data type gives the usage metering record structure, where, for a given requester,

```

- there are associated a set of the events required to describe the transaction, i.e. the
- *SEQUENCE OF CHOICE* construct allows an ordered list of the different event types. The
- registration and corresponding event types will only appear in the sequence once. The
- registration block shall always be present. This constraint ensures that a usage metering record
- only applies to the one requester and that there is only one set of correlation information.

Annex B

MCS proforma

(This annex does not form an integral part of this Recommendation | International Standard)

NOTE – It has been decided to develop ICS proforma for this Recommendation | International Standard as an amendment, therefore this annex is provided only as a placeholder for such an amendment.

Annex C

MICS proforma

(This annex does not form an integral part of this Recommendation | International Standard)

NOTE – It has been decided to develop ICS proforma for this Recommendation | International Standard as an amendment, therefore this annex is provided only as a placeholder for such an amendment.

Annex D

MOCS proforma

(This annex does not form an integral part of this Recommendation | International Standard)

NOTE – It has been decided to develop ICS proforma for this Recommendation | International Standard as an amendment, therefore this annex is provided only as a placeholder for such an amendment.

Annex E

MIDS proforma

(This annex does not form an integral part of this Recommendation | International Standard)

NOTE – It has been decided to develop ICS proforma for this Recommendation | International Standard as an amendment, therefore this annex is provided only as a placeholder for such an amendment.

Annex F

MRCS proforma

(This annex does not form an integral part of this Recommendation | International Standard)

NOTE – It has been decided to develop ICS proforma for this Recommendation | International Standard as an amendment, therefore this annex is provided only as a placeholder for such an amendment.

Annex G

PICS proforma

(This annex does not form an integral part of this Recommendation | International Standard)

NOTE – It has been decided to develop ICS proforma for this Recommendation | International Standard as an amendment, therefore this annex is provided only as a placeholder for such an amendment.

Annex H

Example use of the usage information

(This annex does not form an integral part of this Recommendation | International Standard)

The examples given in this annex are intended only for illustrative purposes, and should not be taken to imply any resemblance with actual usage metering for PSTN or MHS. In particular it should be noted that an accounting management function for MHS is under development as ISO/IEC 11588-3.

H.1 Using the usage metering function for PSTN services

In general, PSTN calls are charged for their duration, time of day and distance, the charge generally being forwarded to the calling party. The duration is based on the connection time, i.e. the time between the called party answering and the call being cleared. The distance is derived from the called party number although currently some exchanges do provide that distance information. Additionally, the PSTN service can provide supplementary services such as alarm calls and advice and duration of charge. Some of these services are charged for on a usage basis.

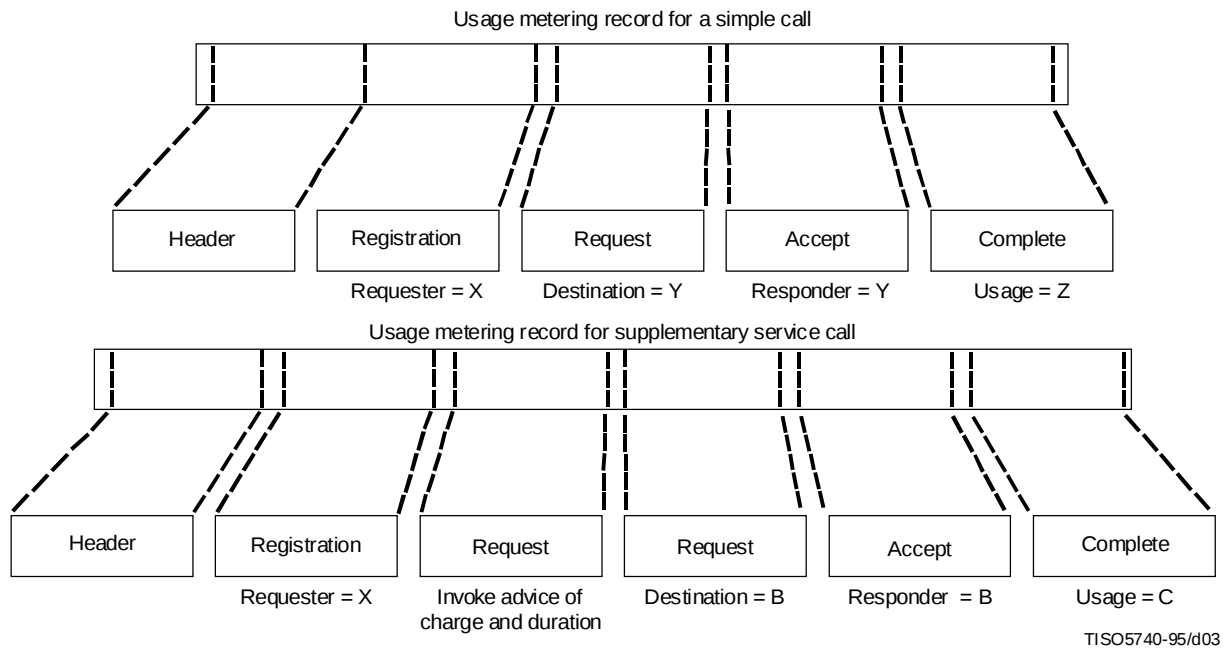
For the PSTN service, the event blocks to represent simple telephony and supplementary service calls in the usageInfo attribute will be used as follows:

Registration	Containing: – the calling party, identified by their Calling Line Identity (CLI)
--------------	---

For the destination called and each supplementary service invoked during a particular call:

Request	Containing: – the request information, which is either: – call to a destination (directory number of called party); or – supplementary service invocation (identifying service code and any additional service parameters of significance to the charging process).
Accept	Containing: – time stamp for the start of the connection to the destination.
Complete	Containing: – the usage measurement which is stated either as a time stamp for the end of the connection or a measure of the duration of the call; – indication of the reason for the call clearing.

These blocks are included in the usageInfo in approximately the order the potentially chargeable events actually occur, as shown in the diagrams below:



NOTE – The ‘header’ block in this diagram contains the usageReport notification attributes other than the usageInfo attribute being considered in detail here.

The following gives an example of the ASN.1 definition needed to be provided by a specialization for PSTN services:

```

PstnUsageData ::= SEQUENCE {
    serviceType          OBJECT IDENTIFIER,
    usageData            SEQUENCE OF CHOICE {
        registration     [0] PSTNServiceRegistration,
        request          [1] PSTNServiceRequest,
        accept           [2] PSTNServiceAccept,
        complete         [3] PSTNServiceComplete } }

PSTNServiceRegistration ::= NumericString -- Calling Line Identity

PSTNServiceRequest ::= CHOICE {
    calledParty          [0] NumericString,
    supplementaryService [1] SupplementaryService}

SupplementaryService ::= SEQUENCE{
    serviceCode          INTEGER {callwaiting(0), callforwarding (1)},
    timeofRequest        GeneralizedTime }

PSTNServiceAccept ::= GeneralizedTime

PSTNServiceComplete ::= SEQUENCE {
    usage                Usage,
    reasonCode           ENUMERATED
        {callingpartyhangup(0), busy(1), calledpartyhangup(2)} }

Usage ::= CHOICE {
    completion time     [0] GeneralizedTime
    duration            [1] INTEGER -- time in minutes}

pstnService OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) part10(10) example(99) pstn(1) }

```

H.2 Metering of the MHS service provided by an X.400 MTA

An X.400 MTA (Message Transfer Agent) will treat a received message in one or more of the following ways:

- 1) Forward the message to a UA (User Agent) which contains a subset of recipients of the message, within the same domain as the MTA – within MHS domains identified by the combination of an ADMD (Administrative Management Domain) and a PRMD (Private Management Domain).
- 2) Forward the message to another MTA on the route towards the final destinations of the message for a subset of the recipients of the message.
- 3) Use a fax-AU (Access Unit) for transmitting the message to a fax-recipients.
- 4) Use a telex-AU for transmitting the message to a telex-recipient.

The steps above will be repeated until all the specified recipients of the message have been reached.

Charging for delivery to other MTAs and UAs is based on the size of the message (measured in octets), the geographical location of the recipients (using a limited set of tariff regions) and the number of different recipients reached via a single destination MTA. Delivery via a fax- or telex-AU is charged in the same way as fax- and telex-transmissions are normally charged (based on duration of transmission and geographical location of the destination).

Using the model in the usage metering record with the information blocks defined in clause 8, an X.400 MTA specific record would look as follows:

Registration	Containing: – the identity of the originator (O/R-name); – a time stamp.
Corresponding	Containing: – the unique message identifier.
Request	Containing: – the size of the message; – the optional properties (priority, importance, delivery reports, receipt reports). NOTE – This request block contains characteristics of the message that are common to all recipients of the message.

For each UA receiving the message:

Request	Containing: – the network address of the UA; – the country, ADMD and PRMD of the UA; – the number of recipients reached via that UA.
Accept	Containing: – a time stamp. This block is present if the message is successfully transmitted to the UA.
Interrupt	Containing: – a time stamp; – error cause. This block is present if transmission of the message to the UA has failed.

For each MTA receiving the message

Request	Containing: – the network address of the MTA; – the country, ADMD and PRMD of the MTA; – the number of recipients reached via that MTA; – a list of recipients reached via that MTA, containing for each recipient the country, the ADMD and the PRMD.
Accept	Containing: – time stamp. This block is present if the message is successfully transmitted to the MTA.
Interrupt	Containing: – a time stamp; – error cause. This block is present if transmission of the message to the MTA has failed.

For each fax- or telex-destination:

Request	Containing: – fax- or telex-number of recipient.
Accept	Containing: – a time stamp.
Complete	Containing: – duration of transmission in seconds; – a time stamp. This block is present if the fax- or telex-transmission has succeeded.
Interrupt	Containing: – a time stamp; – error cause. This block is present if the fax- or telex-transmission has failed.

All pieces of information concerning a particular message are not necessarily present in one usage metering record. If the information is split over several records, each of the records must contain a copy of the blocks with the registration, the common request block and, in particular, the corresponding block.

Appendix I

Alternative ASN.1 definition

(This appendix does not form an integral part of this Recommendation | International Standard)

I.1 Definition of ASN.1 modules

The use of the 1994 version of ASN.1 is illustrated by providing an ASN.1 module, UsageMeteringDataInfoNew, which defines the data type UsageInfo, in a way similar to the way it is defined in the UsageMeteringDataInfo module in A.9.

UsageMeteringFunctionsNew {joint-iso-ccitt ms(9) function(2) part(10) example(99) asn1Modules(2) 1}

DEFINITIONS IMPLICIT TAGS ::=

BEGIN

EXPORTS UsageInfo

-- the following ASN1 provides the means by which to include the service specific information
 -- in the accounting meter data. The CLASS construct
 -- allows the specifier to include the necessary syntax to fully specify each block.
 -- Recommendations for the contents of each block are given.

USAGE-DATA :: = CLASS

```
{
  &RegistrationType
  &RequestType          OPTIONAL,
  &AcceptType           OPTIONAL,
  &CompleteType         OPTIONAL,
  &BulkType             OPTIONAL,
  &CorrespondingType    OPTIONAL,
  &InterruptionType     OPTIONAL,
  &serviceType          OBJECT IDENTIFIER UNIQUE
}
```

WITH SYNTAX

-- The registration block is used to identify the requester using the service. On defining
 -- the service specific syntax to be included in this block, the following information must be provided:
 -- identification of the requester (directory number, user address, etc.)

{ REGISTRATION SYNTAX &RegistrationType

-- The request block identifies the service requests made by the requester. On defining
 -- the service specific syntax to be included in this block, the following information must be provided:
 -- service request information which identifies the type of service requested and also any
 -- additional service parameters, note that this information can be very detailed and complex
 -- depending on the service type and the types of request that the service supports
 -- (e.g. destination addresses, electronic mail message information,
 -- directory numbers, feature codes).
 -- and the following information may be provided:
 -- a usage measurement (time, volume);
 -- a time stamp (date and time).

[REQUEST SYNTAX &RequestType]

-- The accept call event contains the details of what service was provided and the associated usage. On
 -- defining the service specific syntax to be included in this block, the following information may be provided:
 -- service information which identifies the type of service provided and also any additional service
 -- parameters;
 -- a usage measurement;
 -- a time stamp.

[ACCEPT SYNTAX &AcceptType]

-- The complete event contains the details of the end of some instance of utilization. On defining
 -- the service specific syntax to be included in this block, the following information must be provided:
 -- a usage measurement;
 -- and the following information may be provided:
 -- service information which identifies any further details about the provided service
 -- (reason for call completion);
 -- a time stamp.

[COMPLETE SYNTAX &CompleteType]

-- The interrupt event allows the indication of any abnormal occurrence during the transaction for which
 -- different charging algorithms may need to be applied by the recipient of the usage metering record. On
 -- defining the service specific syntax to be included in this block, the following information must be
 -- provided:
 -- duration of the interruption,
 -- reason for the interruption;
 -- and the following information may be provided:
 -- a usage measurement
 -- a time stamp.

[INTERRUPTION SYNTAX &InterruptType]

-- The bulk event allows the indication of any bulk usage measurements made. On defining
 -- the service specific syntax to be included in this block, the following information must be provided:
 -- a usage measurement
 -- and the following information may be provided:
 -- reason for reporting.

[BULK SYNTAX &BulkType]

-- The corresponding event allows the inclusion of any specific information to allow many usage metering
 -- records to be correlated. On defining the service specific syntax to be included in this block, the
 -- following information must be provided:
 -- an identifying key which relates many usage metering records to one service transaction record.

[CORRESPONDING SYNTAX &CorrespondingType]

```
SERVICE TYPE    &serviceType
}
```

PossibleServiceTypes USAGE-DATA ::= {...}

-- Open object set for the set of usage data objects for the different service types. The following data type
 -- gives the usage metering record structure, where, for a given requester, there are associated a set of the
 -- events required to describe the transaction, i.e. the SEQUENCE OF CHOICE construct allows an ordered list of
 -- the different event types. The registration and corresponding event types will only appear in the sequence
 -- once. The registration block shall always be present. This constraint ensures that a usage metering record
 -- only applies to the one requester and that there is only one set of correlation information.

```
UsageInfo{USAGE-DATA: PossibleServiceTypes} ::= SEQUENCE {
  serviceType  USAGE-DATA.&serviceType({PossibleServiceTypes}),
  usageData    SEQUENCE OF CHOICE {
    registration [0] USAGE-DATA.&RegistrationType({PossibleServiceTypes}@serviceType),
    -- the registration alternative shall appear once and only once, and always as the first component
    -- in every instance of a value of usageData component of the UsageInfo type.
    request      [1] USAGE-DATA.&RequestType({PossibleServiceTypes}@serviceType),
    accept        [2] USAGE-DATA.&AcceptType({PossibleServiceTypes}@serviceType),
    complete      [3] USAGE-DATA.&CompleteType({PossibleServiceTypes}@serviceType),
    interrupt     [4] USAGE-DATA.&InterruptType({PossibleServiceTypes}@serviceType),
    bulk          [5] USAGE-DATA.&BulkType({PossibleServiceTypes}@serviceType),
    corresponding [6] USAGE-DATA.&CorrespondingType({PossibleServiceTypes}@serviceType)
    -- the corresponding alternative shall appear at most once in an instance of a value of the
    -- usageData component of the UsageInfo type
  }}
}
```

END

I.2 Example for PSTN usage information

The following ASN.1 data types are provided to illustrate how the CLASS construct of C.1 can be used to define service specific usage metering information for PSTN.

```
pstnUsageData USAGE-DATA ::=
{
  REGISTRATION SYNTAX      PSTNServiceRegistration
  REQUEST SYNTAX           PSTNServiceRequest
  ACCEPT SYNTAX            PSTNServiceAccept
  COMPLETE SYNTAX          PSTNServiceComplete
  SERVICETYPE              pstnService }
```

PSTNServiceRegistration ::= NumericString -- *Calling Line Identity*

PSTNServiceRequest ::= CHOICE {
 calledParty [0] NumericString,
 supplementaryService [1] SupplementaryService}

SupplementaryService ::= SEQUENCE{
 serviceCode INTEGER {callwaiting(0), callforwarding (1)},
 timeofRequest GeneralizedTime }

PSTNServiceAccept ::= GeneralizedTime

PSTNServiceComplete ::= SEQUENCE {
 usage Usage,
 reasonCode ENUMERATED
 {callingpartyhangup(0), busy(1), calledpartyhangup(2)} }

Usage ::= CHOICE {
 completion time [0] GeneralizedTime
 duration [1] INTEGER -- *time in minutes*}

pstnService OBJECT IDENTIFIER ::= { joint-iso-ccitt ms(9) part10(10) example(99) pstn(1) }

PSTNServiceRequest ::= CHOICE {
 calledParty [0] NumericString,
 supplementaryService [1] SupplementaryService}

SupplementaryService ::= SEQUENCE{
 serviceCode INTEGER {callwaiting(0), callforwarding (1)},
 timeofRequest GeneralizedTime }

PSTNServiceAccept ::= GeneralizedTime

PSTNServiceComplete ::= SEQUENCE {
 usage Usage,
 reasonCode ENUMERATED
 {callingpartyhangup(0), busy(1), calledpartyhangup(2)} }

Usage ::= CHOICE {
 completion time [0] GeneralizedTime
 duration [1] INTEGER -- *time in minutes*}

pstnService OBJECT IDENTIFIER ::= { joint-iso-ccitt ms(9) part10(10) example(99) pstn(1) }