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IPCablecom

Event message requirements for the support of real-time services over cable television networks using cable modems

ITU-T Recommendation J.164

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Summary

ITU-T Recommendation J.164 describes the concept of Event Messages used to collect usage for the purposes of billing within the IPCablecom architecture. It details the RADIUS protocol used to carry these messages, defines the various Event Messages, lists the attributes each Event Message contains, and lists the required and optional Event Messages associated with each type of end-user service supported.

Source

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History

Edition		Approval
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3.0	J.164	2007-12-14

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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1 Scope

This Recommendation describes the concept of Event Messages used to collect usage for the purposes of billing within the IPCablecom architecture. It details the RADIUS protocol used to carry these messages, defines the various Event Messages, lists the attributes each Event Message contains, and lists the required and optional Event Messages associated with each type of end-user service supported.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T J.112] ITU-T Recommendation J.112 (1998), *Transmission systems for interactive cable television services*.

[ITU-T J.112-A] ITU-T Recommendation J.112 Annex A (2001), *Digital Video Broadcasting: DVB interaction channel for Cable TV (CATV) distribution systems*.

[ITU-T J.112-B] ITU-T Recommendation J.112 Annex B (2004), *Data-over-cable service interface specifications: Radio-frequency interface specification*.

[ITU-T J.162] ITU-T Recommendation J.162 (2007), *Network call signalling protocol for the delivery of time-critical services over cable television networks using cable modems*.

[ITU-T J.163] ITU-T Recommendation J.163 (2007), *Dynamic quality of service for the provision of real-time services over cable television networks using cable modems*.

[ITU-T J.170] ITU-T Recommendation J.170 (2005), *IPCablecom security specification*.

[ITU-T J.171.x] ITU-T Recommendation J.171.x (2005), *IPCablecom trunking gateway control protocol (TGCP)*.

[ITU-T X.680] ITU-T Recommendation X.680 (2002), *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

[ITU-T X.681] ITU-T Recommendation X.681 (2002), *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification*.

[ITU-T X.682] ITU-T Recommendation X.682 (2002), *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification*.

[ITU-T X.683] ITU-T Recommendation X.683 (2002), *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications*.

[ITU-T X.690] ITU-T Recommendation X.690 (2002), *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*

[IETF RFC 2865] IETF RFC 2865 (2000), *Remote Authentication Dial In User Service (RADIUS).*

[IETF RFC 2866] IETF RFC 2866 (2000), *RADIUS Accounting.*

3 Terms and definitions

This Recommendation defines the following terms:

3.1 cable modem: A cable modem is a layer two termination device that terminates the customer end of the J.112 connection.

3.2 attribute: An ***Event Message Attribute*** is a predefined data element described by an attribute definition and attribute type.

3.3 call: A ***call*** is an instance of user-initiated voice communication capabilities. In traditional telephony, a call is generally considered as the establishment of connectivity directly between two points: originating party and terminating party. In the IPCablecom context, as noted above, the communication between the parties is "connectionless" in the traditional sense.

3.4 event message: An ***Event Message*** is a set of data, representative of an event in the IPCablecom architecture that could be indicative of usage of one or more billable IPCablecom capabilities. An Event Message by itself may not be fully indicative of a customer's billable activities, but an Event Message correlated with other Event Messages builds the basis of a billable Usage Detail Record.

3.5 IPCablecom: An ITU-T project that includes an architecture and a series of Recommendations that enable the delivery of real-time services over cable television networks using cable modems.

3.6 IPCablecom transaction: An IPCablecom ***transaction*** is a collection of events on the IPCablecom network when delivering a service to a subscriber. Event Messages for the same transaction are identified by one unique billing correlation ID (as described in Table 39). For some services, multiple transactions may be required to provide information that is necessary to collect the total usage for the service. Multiple Event Messages may be required to track resources for each individual service used. A transaction may persist over time.

3.7 service: A ***service*** is an individual or package of communications features a subscriber may select. A service is identified by a set of one or more "calls" or transactions that deliver the desired functionality to the subscriber. Examples of a service include: a voice communication between two local IPCablecom subscribers, a 3-way call, pay-per-view movie, and a web-surfing session. A service may be instantaneous or persist over time.

4 Abbreviations and conventions

4.1 Abbreviations

This Recommendation uses the following abbreviations:

AMA	Automated Message Accounting
CDR	Call Detail Record
CM	Cable Modem
CMS	Call Management Server

CPE	Customer Premises Equipment
FID	Flow Identifier
HFC	Hybrid Fibre Coax
IP	Internet Protocol
MGC	Media Gateway Controller
MTA	Media Terminal Adapter
OSS	Operations Support System
PSTN	Public Switched Telephone Network
RKS	Record-Keeping Server
SS7	Signalling System No. 7
VAD	Voice Activity Detection

4.2 Conventions

Throughout this Recommendation, the words that are used to define the significance of particular requirements are capitalized. These words are:

"MUST" This word or the adjective "REQUIRED" means that the item is an absolute requirement of this Recommendation.

"MUST NOT" This phrase means that the item is an absolute prohibition of this Recommendation.

"SHOULD" This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.

"SHOULD NOT" This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.

"MAY" This word or the adjective "OPTIONAL" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

5 Background

An Event Message is a data record containing information about network usage and activities. A single Event Message may contain a complete set of data regarding usage or it may only contain part of the total usage information. When correlated by the record-keeping server (RKS), information contained in multiple Event Messages provides a complete record of the service. This complete record of the service is often referred to as a call detail record (CDR). Event Messages or CDRs may be sent to one or more back-office applications such as a billing system, fraud detection system, or prepaid services processor.

The structure of the Event Message data record is designed to be flexible and extensible in order to carry information about network usage for a wide variety of services. Examples of these services include IPCablecom voice, video and other multimedia services, such as video-on-demand, pay-per-view and J.112 high-speed data services.

This IPCablecom Event Messages Recommendation defines a transport protocol independent Event Message attribute TLV format, an Event Message file format, as well as the mandatory RADIUS protocol and the optional FTP transport protocol. Although the scope of this Event Message Recommendation is limited to defining Event Messages for simple voice communication activities, it is expected that this Recommendation will be expanded to support additional IPCablecom services as well as high-speed data services.

5.1 Traditional telephony billing formats

The telephony industry has traditionally recorded call detail transactions on telephone switches utilizing various standard and proprietary billing formats such as automated message accounting (AMA). The switches generate multiple transactions based upon the type of call the customer placed. These transactions are correlated and packaged into a single call detail record (CDR) at the end of the service instance for billing purposes. In this traditional telephony model, services and awareness of "call state" are usually maintained in one or at most two nodes of the network, which makes such correlation relatively straightforward. The CDR is then delivered to the billing system for the purpose of placing a charge on the customer's account.

5.2 Motivation for event-based billing

The event-based approach to capturing information to be used for billing is necessary to accommodate the distributed architecture of IPCablecom. "Call state awareness" no longer resides in one or two network elements, but is instead spread out among many. Each network element MUST be responsible for generating Event Messages for the portion of the communication pertaining to them.

The primary motivating factor behind articulating the structure and details of these various Event Messages is to support multi-vendor interoperability between network elements and record-keeping servers. This Recommendation defines the Event Message syntax and, in addition, it describes the transport protocols.

Event-based billing has the added advantage that it enables IPCablecom services to be billed in real time, making the information about billable communications available as the network equipment processes them. This allows the system as a whole to be more responsive, allowing, for example, fraudulent behaviour to be detected sooner, saving revenue for the provider. It also allows a more fully integrated solution, as it becomes possible for the billing system and the network equipment to exchange information about the availability of a service as the customer is requesting that service.

With respect to the Event Message format, there are a large number of formats in use today. The most widely used formats carry the legacy of the traditional CDR, which is generated at the end of the call. While these formats capture much of the information content needed to bill for IPCablecom services, bringing along their full structure would make it difficult to support the real-time nature of certain enhanced IPCablecom services. This Recommendation leverages the value of the information content from the existing billing formats, augmenting that with the distributed nature of the IPCablecom architecture.

5.3 Originating/terminating call model to support customer billing and settlements

The IPCablecom Event Messages contain sufficient per-call information to support customer billing for service as well as settlement between IPCablecom network providers for access. The information contained in the Event Messages supports a wide variety of billing and settlement models. IPCablecom does not mandate the use of specific billing or settlement models as these models are defined by and based on the specific business requirements of the individual operators. IPCablecom neither mandates nor precludes the use of a clearinghouse for settlements.

The IPCablecom Event Messages are based on a model where a call or service is divided into an originating half and a terminating half. The originating CMS or MGC MUST generate a unique billing correlation ID (BCID) to identify all Event messages associated with the originating half of the call. The terminating CMS or MGC MUST generate a unique BCID to identify all Event Messages associated with the terminating half of the call. For each half of the call or service, the set of IPCablecom network elements that generate Event Messages (CMS, MGC, CMTS) must provide all necessary information required for billing and/or settlements, as appropriate, based on the service. The information generated by the originating half MUST be sent to the RKS supporting the originating half. The information generated by the terminating half MUST be sent to the RKS supporting the terminating half. The IPCablecom network elements also generate Event Messages that are not associated with any call. For those cases, the network element generating the Event Message MUST generate a unique BCID for the event and send the Event Message to the appropriate RKS supporting the network element.

The IPCablecom Event Messages support billing and settlement for single-zone, intra-domain and inter-domain architectures. In most cases, the basic set of Event Messages, their associated attributes, and the triggers for the Event Message, are identical for these three architectures. In the case of intra-domain and inter-domain architectures, additional triggers exist for a subset of the Event Messages. The IPCablecom Event Message specification details these requirements.

For the purposes of settlements, each IPCablecom zone is divided into one or more logical Financial Entities. Settlements occur between Financial Entities. Each Financial Entity is identified by a Financial Entity ID (FEID). FEIDs are pre-assigned to every CMS and MGC in the IPCablecom network. A single CMS may be assigned at most one FEID. One or more CMSes may be assigned the same FEID.

In the Intra-domain and Inter-domain cases, the originating and terminating CMSes exchange BCIDs and FEIDs. The originating CMS sends its BCID and FEID in the INVITE message. The terminating CMS sends its BCID and FEID in the first response to the INVITE message which is typically the 183 SDP.

5.4 Real-time billing

The billing system can be regarded as a functional block of the back-office operations support system (OSS). The inputs to the billing system are the billing events and the outputs are the account balance and invoice. The billing system relates the billing events to the account balance by rating the events according to the pricing structure and other business logic.

Real-time billing systems relate the billing events to the account balance as events occur. As the billing system receives these real-time billing events, its rating engine rates the events and immediately posts balances. Real-time billing systems may be required to support advanced IPCablecom features such as prepaid calling card, real-time fraud prevention, and real-time credit enforcement.

The IPCablecom Event Message architecture can be used to support both real-time and batch billing systems.

5.5 Real-time and batch event message delivery

Event Messages may be delivered to the RKS in real time as they are created. This enables support for a growing number of services that require purchase limits such as prepaid calling cards.

As an alternative, Event Messages may be stored for some period of time and batched together before being sent to the RKS. This approach provides a more efficient use of network resources.

5.6 Terminology and concepts

This clause defines terminology (see Figure 1) associated with usage data as it relates to IPCablecom services. The concept of a "call" is well understood and used within the telecommunications marketplace today. A traditional telephony "call" involves establishing a dedicated, circuit-switched path between the calling and called parties. Packet-switched architectures, including IPCablecom, do not establish any such dedicated paths. On the contrary, the IPCablecom architecture assumes a shared medium between the headend and the customer, as compared to the dedicated loop plant in traditional telephony; and during a traditional telephone call, as noted above, a circuit-switched "connection" is established between the parties, whereas packet switching is inherently "connectionless". All that said, the term "call" is sufficiently well entrenched for it to be used in this Recommendation to refer to packet-mode voice communications between two parties over an IPCablecom network even though, in technical terms (as will be seen), there is little resemblance to a traditional telephone "call". It is envisioned that many new voice, video, data, and other multimedia services will be developed to take advantage of the inherent extensibility of the IPCablecom architecture. These new services, which likely will not be derived from traditional telephony principles, will be based on the term "transaction", which is more indicative of the data flows across the IPCablecom network. The Event Message structure is designed to be flexible and to enable the addition of new IPCablecom services and features while maintaining backward compatibility with existing applications. Event Messages MAY support information required for billing of CM data services, video services, and the encapsulation of vendor-specific proprietary data.

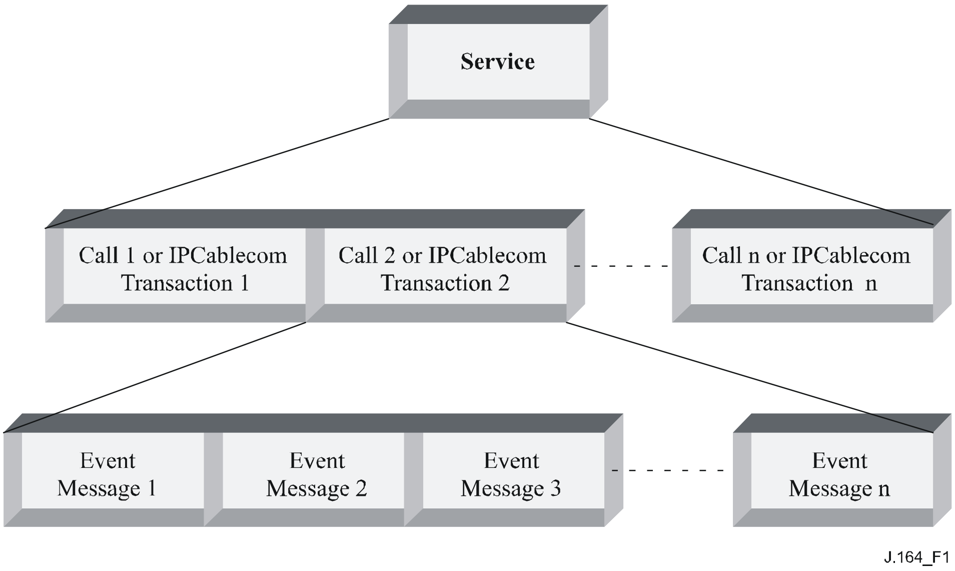
Service
Call 1 or IPCablecom Transaction 1
Call 2 or IPCablecom Transaction 2
Call n or IPCablecom Transaction n
Event Message 1
Event Message 2
Event Message 3
Event Message n
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Figure 1 – IPCablecom terminology

5.6.1 Service

A service is an individual or package of communication features a subscriber may select. A service is identified by a set of one or more "calls" or transactions that deliver the desired functionality to the subscriber. Examples of a service include: a voice communication between two local IPCablecom subscribers, a 3-way call, pay-per-view movie, and a web-surfing session. A service may be instantaneous or persist over time. Service in the context of IPCablecom 1.0 implies voice communications only and may not necessarily apply to the variety of other services such as Data, traditional IP, E-Commerce, etc.

5.6.2 IPCablecom transaction

An IPCablecom transaction is a collection of events on the IPCablecom network when delivering a service to a subscriber. Event Messages for the same transaction are identified by one unique BCID (as described in Table 39). For some services, multiple transactions may be required to provide information that is necessary to collect the total usage for the service. Multiple Event Messages may be required to track resources for each individual service used. A Transaction may persist over time.

5.6.3 Call

A call is an instance of user-initiated voice communication capabilities. In traditional telephony, a call is generally considered as the establishment of connectivity directly between two points: originating party and terminating party. In the IPCablecom context, as noted above, the communication between the parties is "connectionless" in the traditional sense.

5.6.4 Event Message

An Event Message is a set of data, representative of an event in the IPCablecom architecture that could be indicative of usage of one or more billable IPCablecom capabilities. An Event Message by itself may not be fully indicative of a customer's billable activities, but an Event Message correlated with other Event Messages builds the basis of a billable usage detail record.

5.6.5 Attribute

An Event Message Attribute is a predefined data element described by an attribute definition and attribute type.

5.7 Supporting documentation

A number of documents and specifications describe the IPCablecom project. The IPCablecom Architecture Framework Recommendation [b-ITU-T J.160] is the starting point for understanding the IPCablecom project and the various IPCablecom Interface Recommendations, technical reports and other IPCablecom documents.

6 IPCablecom objectives

6.1 IPCablecom required services and capabilities

IPCablecom provides basic voice capabilities and, therefore, MUST support Event Messages for the following services. These services are described in more detail in clause 8.

- Interconnection with circuit-switched PSTN;
- Support for Emergency Services;
- Short Code Services;
- Freephone Services;
- Operator Services;
- Call Block Service;
- Call Waiting Service;
- Call Forwarding/Call Redirection Services;
- Return Call Service;
- Repeat Call Service;
- Voicemail Service;
- Message Waiting Indicator Service (E-mail/Voicemail notification).

6.2 Additional IPCablecom supported services and capabilities

The following represents a list of possible additional IPCablecom services that MAY be supported. The list, though meant as a rough guideline, is not comprehensive, and it is expected that, as the scope of services grows, so too will this list. A detailed definition of these services is not provided in this Recommendation.

- 3-way Communication;
- Call Transfer;

- Speed Dialling;
- Caller Name and Number;
- Caller Name and Number Privacy;
- Selective Screening Services;
- Pay-Per-Communication Services;
- Distinctive Notification (to identify callee in a multiple-party household);
- Priority Notification (to prioritize incoming communications);
- Customer Originated Trace;
- Selective Forwarding;
- Rejection (activate and deactivate);
- Teletype Translation Services;
- Multi-line Hunt Group Services;
- Virtual second line (Multiple lines);
- Alternate billing methods (collect, third number billed, credit card, prepaid services, etc.).

6.2.1 IPCablecom supported services and capabilities

The following represents a list of IPCablecom services that MUST be supported in addition to the IPCablecom services by IPCablecom EM implementations. These services are described in more detail in clause 8.

- Three-Way Call;
- Customer Originated Trace.

In addition, the following list represents a set of IPCablecom services that MAY be supported by IPCablecom CMS network elements. These additional services MUST be supported by IPCablecom RKS network elements. When these services are supported by an IPCablecom compliant CMS, they MUST be supported as defined in this Recommendation. These services are described in more detail in clause 8.

- Account Code and Authorization Code.

6.2.2 IPCablecom multimedia

The IPCablecom Multimedia specification (see ITU-T Rec. J.179) defines a service delivery framework that provides general-purpose QoS, event-based accounting, and security functionality founded upon the mechanisms defined in IPCablecom. The IPCablecom Multimedia specification extends this Recommendation and the capabilities of the present Event Messages specification; refer to ITU-T Rec. J.179 for more details.

6.3 Assumptions

The following assumptions have been made which apply to the entire Recommendation:

- IPCablecom does not specify the interface between an RKS and a billing system.
- All IP-based Intelligent Peripherals (these include Announcement Servers, for example) will be connected to the originating CMS or MGC.
- IPCablecom does not support line information database (LIDB) queries. Calls requiring LIDB determination, such as calling card personal identification number validation, are sent directly to the PSTN.
- IPCablecom supports local number portability (LNP). The following information and references are applicable to LNP:

1) Location routing number (LRN) identifies routing information for a ported called party number; and jurisdiction information parameter (JIP) identifies the network element where the ported calling party number is currently getting the service from. The JIP parameter received in SS7 message is needed for billing settlement purpose.

2) The originating half determines if the caller is ported-in and the terminating half determines if the called party is ported-in. The CMS or MGC determines if a number is ported based on different data including:

   a) provisioned data;

   b) signalling messages;

   c) number portability database.

- Non-IPCablecom network elements, such as those residing in the public switched telephone network (PSTN) to which an IPCablecom system may interconnect with, will NOT generate and send Event Messages to the RKS.
- PSTN intelligent peripheral Event Messages are generated by the originating CMS.
- IPCablecom Event Messages currently only support messages for actual billable events. This Recommendation does not specify messages related to provisioning of services by the operator of an IPCablecom network. This Recommendation does support Event Messages for subscriber service activation. This Recommendation does not specify messages related to selection of an entity other than the IPCablecom network operator to handle off-network activities (e.g., inter-exchange communications).
- The initiating party number and the terminating party number are the only two attributes defined in IPCablecom that can be used to associate a subscriber with usage of network resources.
- IPCablecom supports interconnection to both transit and local switches.
- IPCablecom supports an emergency trunk group.
- IPCablecom trusted network elements are expected to be pre-provisioned with a minimum set of data using a vendor-proprietary mechanism. Examples of this data may include:
  - Element Type, identifying the element as a CMTS, CMS, or MGC.
  - Element ID.
  - A list of which Event Messages are required and which Event Messages are optional, as defined by the network operator. For each of these Event Messages, identify if the Event Messages:
    1) are to be transported to the RKS as a single Event Message in real-time; or
    2) are to be batched and transported to the RKS as multiple Event Messages at a later time;
    3) provide capability to configure both how many Event Messages are batched before being sent to the RKS.
  - Number of days to keep Event Messages for short-term storage.
  - Others.
- Enable or disable Media_Alive Event Message, configure the frequency of Media_Alive message (suggested 0 to 1440 minutes, with 0 being no Media_Alive Events).

7 Event messages architecture

Figure 2 shows a representative IPCablecom Event Messages architecture. By standardizing the transport, syntax and collection of appropriate Event Message attributes from a distributed set of network elements, the IPCablecom architecture provides a single reference point to interface to existing billing, settlement, reconciliation and other systems. Note that only the shaded components are included within the scope of the IPCablecom architecture. Interfaces between the RKS and the shaded IPCablecom network elements are within scope of IPCablecom. Interfaces between the RKS and back-office servers or applications are NOT within the scope of IPCablecom. It should be understood that the back-office servers and applications shown in Figure 2 are representative, and are not mandated by the IPCablecom architecture.

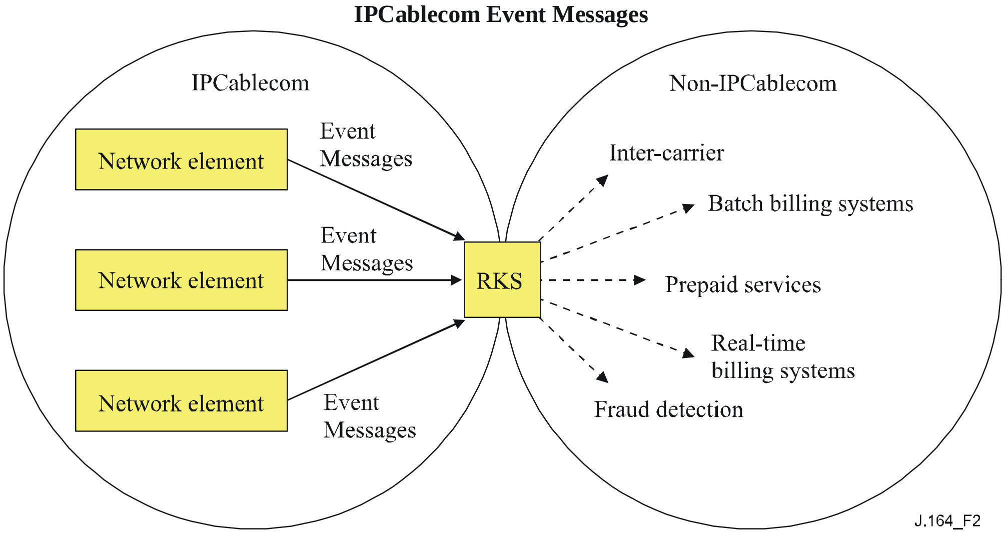


Figure 2 – Representative IPCablecom Event Messages architecture

7.1 IPCablecom Event Message collection

Event Message collection occurs as follows: when trigger events occur (such as call signalling starts, activation of QoS service resources, call signalling stops, etc.), the relevant IPCablecom network element generates an Event Message. These messages may be sent immediately to the RKS, or a group of messages may be collected and sent at a later time. In either case, the actual time of the trigger event is reported, allowing the back-office applications to accurately calculate time-based resource usage. As these Event Messages are accumulated within the RKS, the network operator can then export them into their billing systems based on their business requirements. The data from multiple network elements are linked to a transaction (e.g., call) via a unique billing correlation ID (BCID), which can be leveraged for reconciliation and non-repudiation purposes.

7.2 IPCablecom network elements

The IPCablecom architecture supports a system capable of creating, collecting, and delivering usage data from a subset of IPCablecom network elements to a cable operator's back-office applications. Trusted IPCablecom network elements that create Event Messages include the call management server (CMS), cable modem termination system (CMTS), and media gateway controller (MGC).

The IPCablecom architecture contains trusted and untrusted network elements. Trusted network elements are typically located within a cable operator's facility and are controlled by the cable operator. Untrusted network elements are typically located within the consumer's home or outside of the cable operator's facility or exclusive control. In the IPCablecom architecture, Event Messages are only accepted from trusted IPCablecom network elements.

[b-ITU-T J.160] contains a detailed description of the IPCablecom network elements. A brief explanation of the IPCablecom network elements that will most likely generate IPCablecom Event Messages is listed in this clause for completeness.

7.2.1 Call management server (CMS)

The call management server (CMS) provides signalling services necessary for voice communications. The primary purpose of the CMS is to establish standard "calls", as that term is used in the IPCablecom context. The media servers also provide support services for the media streams such as conference-mixing bridges and announcement servers.

The CMS MUST create a billing correlation ID:

- on receipt of an NCS-signalling NTFY message from an MTA; or
- when an Event Message not associated with any call is generated.

The CMS MUST send the billing correlation ID and other data as defined in Table 1 to the CMTS via the DQoS GateSet message as specified in [ITU-T J.163].

Table 1 – IPCablecom event reporting common elements

1	Billing_Correlation_ID (see Table 39)
2	IP address and port number of the primary RKS
3	IP address and port number of the secondary RKS
4	Flag indicating if CMTS should send Event Messages to the RKS in real time

The CMS MUST generate the appropriate Event Messages as defined in this Recommendation.

7.2.2 Media gateway controller (MGC)

The media gateway controller (MGC) is the overall controller function of the PSTN gateway. It receives, mediates, and routes call signalling information between the IPCablecom and PSTN domains and it maintains and controls the overall call state for all calls connecting to and from the PSTN. It controls the media gateway function and communicates with the signalling gateway function via the MGC-SG protocol defined for the major protocol family in question, i.e., ISUP, in-band or TCAP.

The MGC MUST create a billing correlation ID on receipt of:

- an SS7 IAM message; or
- a TGCP NTFY with digits (operator services);
- when an Event Message not associated with any call is generated.

The MGC MUST generate the appropriate Event Messages as defined in this Recommendation.

7.2.3 Cable modem termination system (CMTS)

The cable modem termination system (CMTS) terminates the connection from the CM on the customer premises into the IPCablecom network. The CMTS generates QoS Event Messages. QoS Event Messages are generated individually for both upstream and downstream bandwidth.

The CMTS MUST generate the appropriate Event Messages as defined in this Recommendation. For all EM messages it generates other than Time_Change, the CMTS MUST use the unique Billing-Correlation-ID assigned by the CMS and received from the CMS in the Event-Generation-Info object of the DQoS GateSet message as defined in 7.3.2.7 of [ITU-T J.163]. See 9.16 for the generation of BCID in Time_Change events.

DOCSIS provides a mechanism by which multiple sessions can be placed on a single upstream service flow. DQoS supports this feature and refers to it as multiple grants per interval. There are two side effects to Event Messages when an MTA uses multiple grants per interval. The service flow ID (SFID) will be common among the events for all sessions that share that flow. The QoS Descriptor attribute re-elects the total bandwidth of all sessions using the flow.

7.2.4 Record-keeping server (RKS)

The record-keeping server (RKS) is a trusted network element function. In many cases, for simplicity reasons, the RKS is depicted in this Recommendation as a separate stand-alone element, but this Recommendation does not preclude a CMS, billing system, or other application from performing the RKS functionality. The RKS is the mediation layer between the call signalling and transport layer and the back-office applications. The RKS is expected to pre-process the data from the call signalling and transport layer and present it to the back-office applications in the format and within the time constraints deemed necessary by the operator.

The RKS also, at a minimum, is a short-term repository for IPCablecom Event Messages. It receives Event Messages from various trusted IPCablecom network elements. The RKS assembles the Event Messages into coherent sets, which are then made available to a usage-processing platform and potentially to several other back-office systems. It acts as the demarcation point between the IPCablecom network and the back-office applications.

Figure 3 gives a representative RKS deployment for information only and does not imply an implementation requirement.

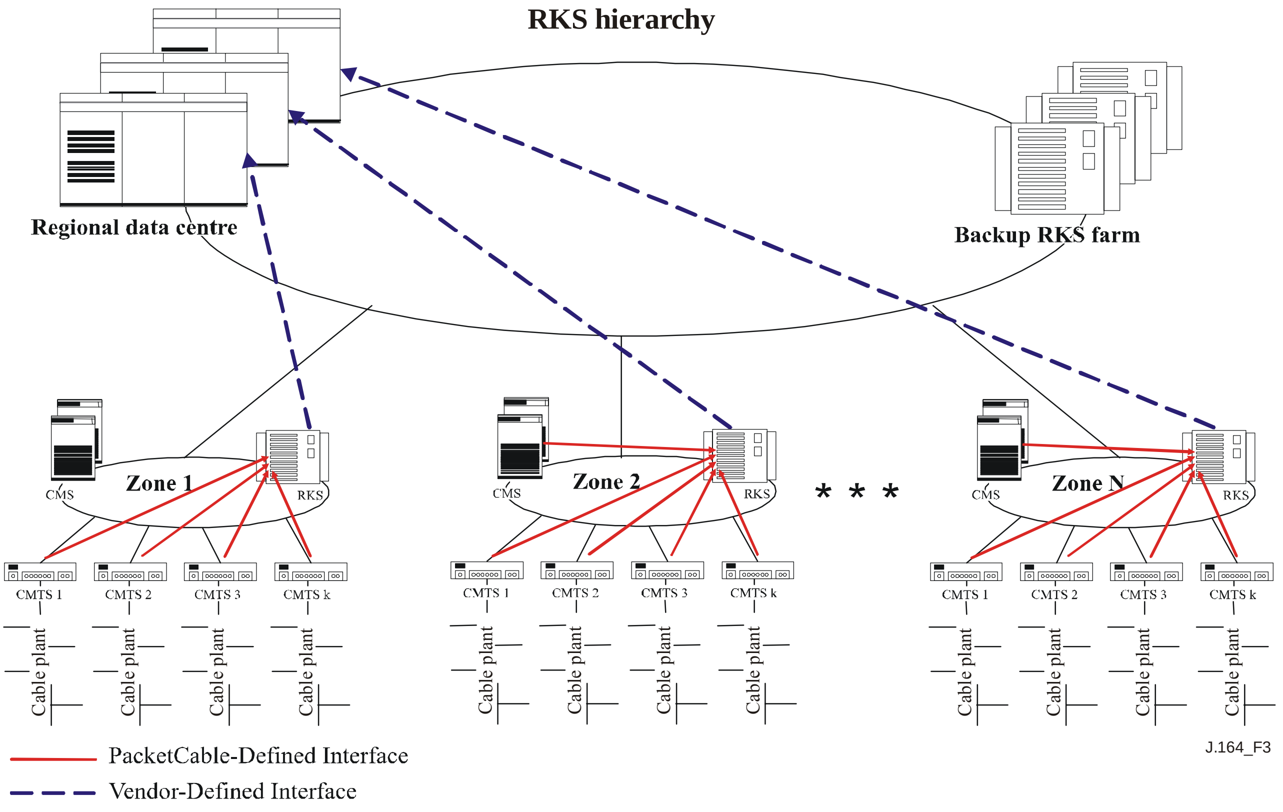


Figure 3 – Example RKS architecture

The RKS is expected to perform the following functions:

- The RKS MUST receive Event Messages.
- The RKS MUST be capable of correlating all Event Messages related to an individual call and have an extensible output to meet the needs of the downstream applications.
- The RKS MUST assemble Events and Determine Completeness. This MUST include the capability to distinguish Event Messages, and recognize when a complete set, representing a coherent set of billing data, is available for transport to the back-office system.

- The RKS MUST provide interface network functions that require real-time or near real-time based on priority and where messages are being sent, as defined in clause 9. For example, a call may be sent real-time and a report may be sent at night. The correlation process MUST be user-definable to support the various call events defined herein and defined in the future.
- The RKS MUST have the ability to store the Event Messages for at least one week or until sent to the other back-office systems and successful receipt is acknowledged from those systems.
- The RKS MUST have the ability to dump the Event Messages to some other type of offline storage device on a regular basis (CD, Tape, or other media) for retrieval and regulatory purposes.

The following list deals with other possible capabilities of an RKS. They are, therefore, beyond the scope of the requirements of this Recommendation, and are included here for informational use only. Decisions on these optional requirements will be based upon the operator response to many regulatory and business variables.

- An RKS-RKS security interface MAY be required. IPCablecom does not define this interface. The security interface between the RKS and other IPCablecom trusted network elements is defined in [ITU-T J.170], *IPCablecom security specification*.
- The RKS MAY support Backup and Recovery. This includes a nominal ability to restore the state and contents of billing data in the event of application or platform failures.
- The RKS MAY support distribution of billing data to all appropriate systems. This includes the implementation of a protocol that ensures data integrity and reliability on the usage collator interface.
- The RKS MAY support monitoring and reporting. This includes the ability to produce and send alarms to a network management system, and create various audit and measurement reports.
- The RKS MAY allow remote testing and maintenance capability.
- The RKS MAY support a Service Creation Environment.
- The RKS MAY support user-defined fault handling in the case of incomplete Event Messages or other such anomalies.
- The RKS MAY support multiple downstream applications, and various transport methodologies.
- The RKS MAY support full auditability of data and processes.
- The RKS MAY support a user-definable long-term storage mechanism.
- The RKS MAY support disaster planning and recovery processing.

7.3 General IPCablecom network element requirements

This clause lists requirements placed on the IPCablecom network elements:

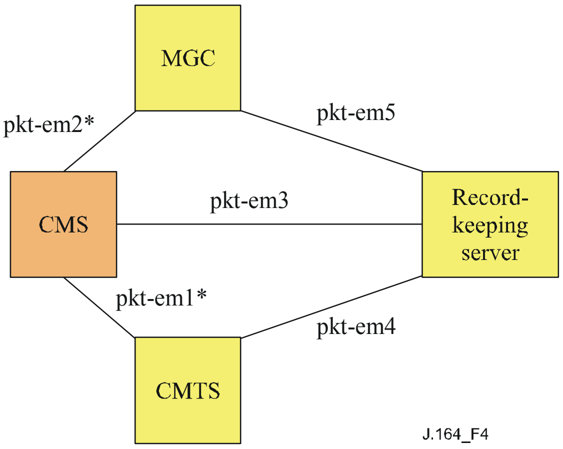
- The CMS, CMTS, and MGC MUST create a security relationship with each RKS that these network elements will send Event Messages as defined in [ITU-T J.170].
- The CMS MUST support multiple sets of primary and secondary RKSs, which might be required in cases in which total Event Message traffic exceeds the throughput capability of a single RKS.
- For each call, the CMS or the MGC MUST create a unique Billing_Correlation_ID (BCID), identify the primary and secondary RKSs, and determine if the Event Messages are to be delivered in real-time or batched and sent at a later time.

- The trusted IPCablecom network elements that generate Event Messages MUST timestamp Event Messages in 1 millisecond granularity ±100 milliseconds based on information reported by network time sources such as edge devices (Clients and Gateways).
- All IPCablecom network elements that generate Event Messages MUST synchronize their clocks at least once per hour to a network clock source. This synchronization MUST assure the reporting device's own clock remains within ±100 milliseconds real-time of the last synchronization value.
- IPCablecom network elements that generate Event Messages MUST support network time protocol (NTP) time synchronization as defined in IETF RFC 1305.
- The IPCablecom network elements MUST support transport to a primary RKS and failover to a secondary RKS when communication with the primary RKS fails for any reason (including situations where the primary RKS becomes inoperable).
- IPCablecom network elements MUST support the transport of a single Event Message as well as a batch of Event Messages.

  NOTE – Batch mode = multiple Event Message per single Radius message.
- Each trusted IPCablecom network element that generates an Event Message MUST identify itself with a static, unique element ID.
- Implementations that combine CMS and MGC functionality MAY share a single element ID. Event Messages generated by a combined CMS/MGC MUST indicate which IPCablecom functional element (e.g., MGC or CMS) initiated the message using the Element_Type field in the EM_Header.

7.4 Event Message interfaces

This clause describes the interfaces between the IPCablecom network elements that are involved in the Event Messages process. It should be noted that additional requirements are imposed on these by other IPCablecom Recommendations and that the requirements listed in this Recommendation are specific to Event Messages. It should also be noted that additional requirements are specified for these interfaces and these IPCablecom network elements in other clauses of this Recommendation.



* indicates that the billing correlation ID and other data defined in Table 1 are carried on an existing signalling interface.

Figure 4 – Event message billing interfaces

7.4.1 CMS to CMTS (pkt-em1*)

The CMS to CMTS interface is defined by the IPCablecom DQoS protocol in [ITU-T J.163].

The CMS sends the billing correlation ID and other data as defined in Table 1 to the CMTS via the DQoS GateSet message as specified in [ITU-T J.163].

7.4.2 CMS to MGC (pkt-em2*)

The CMS to MGC interface is defined by the IPCablecom CMSS (ITU-T Rec. J.178). The CMS and MGC exchange originating/terminating information such as BCID, FEID, etc., across this interface as defined in [ITU-T J.178].

7.4.3 CMS to RKS (pkt-em3)

The CMS to RKS interface is defined by [ITU-T J.170] and also by the Event Message transport and syntax rules defined in this Recommendation.

7.4.4 CMTS to RKS (pkt-em4)

The CMTS to RKS interface is defined by [ITU-T J.170] and by the Event Message transport and syntax rules defined in this Recommendation.

7.4.5 MGC to RKS (pkt-em5)

The MGC to RKS interface is defined by [ITU-T J.170] and by the Event Message transport and syntax rules defined in this Recommendation.

7.4.6 CMS to CMS (pkt-em6)

The CMS to CMS interface is defined by the IPCablecom CMSS specification, (ITU-T Rec. J.178). The originating CMS and terminating CMS exchange originating/terminating information such as BCID, FEID, etc., across this interface as defined in ITU-T Rec. J.178.

7.4.7 Security requirements

When the network IPSec Security Associations are established, security keys MUST be created and exchanged between each RKS (primary, secondary, etc.) and every CMS, CMTS, and MGC that will send Event Messages to any of those RKSs. The Event Messages are sent from the CMS CMTS, and MGC to the RKS using one of the supported transport mechanisms, each of which must be possible to secure by IPSec. Refer to [ITU-T J.170] for a detailed description of the security requirements for the IPCablecom Event Message interfaces.

8 IPCablecom services and their associated Event Messages

This clause defines the supported IPCablecom services and their associated Event Messages. Although many of the IPCablecom+ services can be billed using the Event Messages and attributes defined in this Recommendation, the services described in this clause are currently limited to IPCablecom services.

In order to identify appropriate Event Messages required for each service, representative call flows were developed for IPCablecom basic call configurations.

8.1 IPCablecom call configurations

This clause describes the three basic IPCablecom call configurations: on-net-to-on-net, on-net-to-off-net, and off-net-to-on-net. A required minimum set of Event Messages MUST be generated for each of these three basic call configurations. If specific services are initiated along with the basic call, then refer to 8.2 for a list of additional Event Messages for these specific services.

8.1.1 On-net-to-on-net call configuration

The most basic IPCablecom call configuration is an on-net-to-on-net call (see Table 2) within a single operator's network, using two different MTAs that are both connected to the same CMS. For

IPCablecom, it is assumed that both the originating and terminating MTAs are using the same CMS and possibly two different CMTSs.

Both intra-domain and inter-domain on-net-to-on-net call configurations use two different MTAs that are both connected to two different CMSes.

For any on-net-to-on-net call configuration, the originating half and the terminating half of the call MUST each generate a complete set of Event Messages.

Table 2 – On-net-to-on-net call configuration

Event Message	Required or optional	Comments
Database_Query	O	If LNP is Required
Signalling_Start	R	CMS is starting signalling to support a call start
QoS_Reserve	R	CMTS reserves QoS
QoS_Commit	R	CMTS commits QoS
Intelligent_Peripheral_Usage_Start	O	e.g., if an announcement is needed NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Intelligent_Peripheral_Usage_Stop	O	e.g., if an announcement is needed NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation
Call_Answer	R	Indicates start of media stream
Call_Disconnect	R	Indicates termination of media steam
QoS_Release	R	CMTS is releasing QoS
Signalling_Stop	R	Signalling for the service is complete
Media_Statistics	O	Media stream statistics reported by the gateway

8.1.2 On-net-to-off-net call configuration (outgoing PSTN interconnect)

The only off_net interconnection supported by IPCablecom is to the PSTN. Therefore, the CMS sends all off_net calls to the PSTN. The Interconnect_Start Event Message identifies the type of off_net trunk. The off_net call may require an LNP query. The CMS MUST generate a database query Event Message each time a LNP database is accessed (regardless of whether this query is requested from a PSTN database or an IP database). (See Table 3.)

For any on-net-to-off-net call configuration, the originating half and the terminating half of the call MUST each generate a complete set of Event Messages.

Table 3 – On-net-to-off-net call configuration

Event Message	Required or optional	Comments
Database_Query	O	If LNP is Required
Signalling_Start	R	Start signalling to support a call start
QoS_Reserve	R	CMTS reserves QoS
QoS_Commit	R	CMTS commits QoS

Table 3 – On-net-to-off-net call configuration

Event Message	Required or optional	Comments
Intelligent_Peripheral_Usage_Start	O	e.g., if an announcement is needed NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Intelligent_Peripheral_Usage_Stop	O	e.g., if an announcement is needed NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Interconnect_Start	R	For call setup
Call_Answer	R	Indicates start of media stream
Call_Disconnect	R	Indicates termination of media steam
Interconnect_Stop	R	For call tear-down
QoS_Release	R	CMTS releases bandwidth
Signalling_Stop	R	Indicates end of signalling
Media_Statistics	O	Media stream statistics reported by the gateway

8.1.3 Off-net-to-on-net service (incoming PSTN interconnection)

The CMS receives calls that are incoming from other entities and establishes communications with the MTA on the operator's network. For IPCablecom, it is assumed that all incoming calls are from the PSTN. (See Table 4.)

For any off-net-to-on-net call configuration, the originating half and the terminating half of the call MUST each generate a complete set of Event Messages.

Table 4 – Off-net-to-on-net call configuration

Event Message	Required or optional	Comments
Signalling_Start	R	Starting signalling to service a request to start a call
Interconnect_Start	R	For call setup
QoS_Reserve	R	CMTS reserves bandwidth
QoS_Commit	R	CMTS commits bandwidth
Intelligent_Peripheral_Usage_Start	O	e.g., if an announcement is needed NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Intelligent_Peripheral_Usage_Stop	O	e.g., if an announcement is needed NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Call_Answer	R	Indicates start of media stream
Call_Disconnect	R	Indicates termination of media steam
Interconnect_Stop	R	For call tear-down

Table 4 – Off-net-to-on-net call configuration

Event Message	Required or optional	Comments
QoS_Release	R	CMTS releases bandwidth
Signalling_Stop	R	Indicates end of signalling
Media_Statistics	O	Media stream statistics reported by the gateway

8.2 Specific services

A basic set of Event Messages MUST be generated based on the type of call configuration: On_Net to On_Net, On_Net to Off_Net, Off_Net to On_Net. The basic set of Event Messages is described in 8.1.

This clause describes additional Event Messages that MUST be generated along with the basic set in order to describe specific IPCablecom services. This clause also describes optional Event Messages that MAY be generated along with the basic set and any additional required Event Messages. These additional required and optional Event Messages are identified in the tables in this clause. It is expected that these additional Event Messages will be able to be generated regardless of the particular implementation of the service.

8.2.1 Emergency service

An emergency call follows the standard on-net-to-off-net Event Message flow described in 8.1.2. Emergency calls require special treatment. In IPCablecom, it is assumed that the operator sends emergency calls to the PSTN on a special trunk. The Trunk Group ID is captured in the Interconnect_Start and Interconnect_Stop Event Messages, and it is assumed that the RKS or some element downstream of the RKS has the capability of inferring this trunk group type from that unique Trunk Group ID.

No additional Event Messages are required beyond the basic ones listed for an On_Net to Off_Net call in 8.1.2.

8.2.2 Other short code services

These calls are identical to the emergency call both from a call flow and Event Message perspective. The determination of whether to bill or not can be performed at the billing system based on the "Called Party Number" attribute. For example, charges for calls to directory assistance may be different than charges for emergency calls, which are free, but the Event Messages, which capture the usage for both types of services, are the same. They would differ only in the content of specific attribute values such as the Called_Party_Number within the Call_Answer Event Message. The billing system is expected to make a determination as to how much to bill the customer based on these attributes together with other factors such as whether the call is completed or not.

8.2.3 Freephone services

Freephone services follow the standard on-net-to-off-net Event Message flow described in 8.1.2. In IPCablecom, toll-free calls can be handled in two ways:

- Send all toll-free calls to the PSTN on a special trunk. The call is treated exactly like the emergency services case discussed in 8.2.1 in terms of Event Messages, meaning that no additional Event Messages are required.
- Initiate a query to the toll-free SCP (in IP or PSTN) and, depending on the specified carrier identification code, route the call to the appropriate network. A Database_Query Event Message MUST be generated to record the query to the toll-free database. (See Table 5.)

Table 5 – Toll-free services

Additional Event Messages	Required or optional	Comments
Database_Query	R	Not used for scenario 1 but required for scenario 2

8.2.4 Operator services

Operator services follow the standard on-net-to-off-net event message configuration described in 8.1.2. There will be no new additional Event Messages beyond those already described for the on-net-to-off-net calls in that clause. The CMS will send that call to the designated operator service provider using the PSTN. There may be multiple operator service providers with which the operator has contracts. The caller will just dial the normal code for operator services.

The CMS will generate an event identifying that call as a short code number dialled without any subsequent digits by using an appropriate value in the Called Number field. The CMS will replace the short code in the Called Number field with the number of the operator service provider (OSP). These parameters will be sent to PSTN so that the call can be sent via PSTN to the OSP. It is assumed that dedicated private lines to the OSP from each IP-switch are impractical and expensive for operators, and not considered as an option.

For the purposes of IPCablecom, it is assumed that operator services only encompass Short Code Services. Short Code plus Service, in which the customer keys the dialled number in together with the initial short code, is not supported in IPCablecom.

8.2.5 Call block service

Event Messages are generated for Call Block Service (see Table 6) only if the CMS blocks a call. Call Blocking is supported by all of the three basic call configurations: On_Net to On_Net, On_Net to Off_Net, and Off_Net to On_Net.

The CMS can block calls depending on the policies laid out by the operator. For example, the operator may allow the end-user to block all 900 calls at the user's request. As another example, the operator may recognize some calls as fraudulent and block those fraudulent calls. In this case an Event Message needs to be generated with some reason attributes as to why the call was blocked. In addition, depending on the type of blockage, the operator may desire to play an appropriate announcement (e.g., "Sorry your time is up …"). The CMS may initiate another call to the Announcement Server via the PSTN and play it to the caller. A series of Event Messages will be generated for this call, using the same Billing_Correlation_ID as the standard Event Messages associated with off-hook, dialling, etc., which is not expected to be used for billing this call to the end-user.

Table 6 – Call block service

Additional Event Messages	Required or optional	Comments
Service_Instance	R	None
Intelligent_Peripheral_Usage_Start	O	NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Intelligent_Peripheral_Usage_Stop	O	NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.

8.2.6 Call waiting service

At any given time, the caller may be talking and will hear the call waiting tone when another call is incoming. It is understood that at some point prior to this call, the called party subscribed to call Waiting Service. The called party can switch back and forth between the two calls by using the flash hook. Call Waiting can be supported by any of the three basic call configurations: On_Net to On_Net, On_Net to Off_Net, and Off_Net to On_Net.

The call flow is as follows:

There is an existing call to a number connected via the MTA/CMTS/CMS. Another call attempt is made to that number; the CMS:

- verifies that an existing call is already in progress;
- checks its internal database to verify whether the called party has subscribed to Call Waiting. If yes:
  - – establishes a voice connection to the Announcement Server (which will play the call waiting tone);
  - – creates an Event Message indicating that Call Waiting is being initiated;
  - – mixes the two voice calls (the currently established voice call and the Call Waiting tone voice call) so that the called party can hear the call waiting tone.

It is assumed that Call Waiting only supports two calls (one active and the other on hold) in IPCablecom. The call on hold will not be connected to any announcement server.

Both of the calls between which the subscriber is switching will generate a complete set of Event Messages on their own as detailed in clauses 8.1.2 and 8.1.3, but there may also be three additional Event Messages associated with this instance of Call Waiting, as detailed in Table 7. If the Announcement Server is located on the PSTN, then the previously discussed Call_Answer and Call_Disconnect Event Messages will be generated for this call.

Table 7 – Call waiting service

Event Message	Required or optional	Comments
Interconnect_Start	O	Required only if Announcement Server for Call Waiting tone is Off_Net on PSTN
Interconnect_Stop	O	Required only if Announcement Server for Call Waiting tone is Off_Net
Intelligent_Peripheral_Usage_Start	O	Required only if Announcement Server is On_Net NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Intelligent_Peripheral_Usage_Stop	O	Required only if Announcement Server is On_Net NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Service_Instance	R	None

8.2.7 Call forwarding service

Call forwarding service (see Table 8) applies only to calls terminating On_Net as described in clauses 8.1.1 and 8.1.3.

The CMS gets notification that a call needs to be completed to a specific dialled number/end device. The CMS checks its internal database and determines that the called number has subscribed to Call Forwarding, Call Forwarding is currently active, and the forwarding number is XYZ. The CMS initiates another call to the forwarded number on behalf of the original calling party. The CMS MUST generate a Service_Instance Event Message with the Calling_Party_Number attribute containing the original calling party number, the Charge_Number attribute containing the original called party number (the party number of the subscriber who has call forwarding service enabled), and the Called_Party_Number containing the forwarded number XYZ. Event Messages will be generated for the fact that a Call Forwarding service instance was initiated. The Billing_Correlation_ID for this leg will be different than the first call. The rationale for using the Related Billing_Correlation_ID as the common identifier for call forwarding is that it may be desirable to flag calls made automatically by invocation of call forwarding on the subscriber's monthly statement in order to make clear the reason those calls were placed. For all purposes, the original call and the forwarded call will be two different billable calls. This will require the RKS to replace the Calling Party Number with the value of the Charge Number for the forwarded call's AMA record. The Calling_Party_Number attribute in the Service_Instance Event Messages is consistent with current industry practice.

Table 8 – Call forwarding service

Event Message	Required or optional	Comments
Service_Instance	R	None

8.2.8 Return call service

This service (see Table 9) applies only to calls originating On_Net, described in clauses 8.1.1 and 8.1.2. The CMS MUST keep a register with the Calling Party Number of the last call.

Return Call Service will return the last call that was made to an MTA. Upon instantiation of Return Call feature, the CMS will initiate another call with the Calling Party Number of the last call, retrieved from the register just described, as the Dialled number. Event Messages will be generated for the fact that the Return Call feature was initiated, using the Billing_Correlation_ID of this call. If the Calling Party Number of the last call had Caller ID privacy restrictions, then the CMS may conference in a recording from an announcement server saying that this call cannot be completed.

Table 9 – Return call service

Event Message	Required or optional	Comments
Service_Instance	R	None
Interconnect_Start	O	Required only if Announcement Server for delivering the Message indicating reason Return Call cannot be activated is Off_Net on PSTN
Interconnect_Stop	O	Required only if Announcement Server for delivering the Message indicating reason Return Call cannot be activated is Off_Net on PSTN

Table 9 – Return call service

Event Message	Required or optional	Comments
Intelligent_Peripheral_Usage_Start	O	Required only if Announcement Server for delivering the Message indicating reason Return Call cannot be activated is On_Net NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
Intelligent_Peripheral_Usage_Stop	O	Required only if Announcement Server for delivering the Message indicating reason Return Call cannot be activated is On_Net NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.

8.2.9 Repeat call service

Repeat call service (see Table 10) applies only to calls terminating On_Net as described in clauses 8.1.1 and 8.1.3.

Repeat Call can be initiated when the caller dials a number and gets a busy signal. With this feature, the caller dials a special pre-determined string of digits (e.g., *66 in USA) which then instructs the network to keep polling the called and calling party and, when both are free, establish the communication. In IPCablecom, the originating CMS will keep trying to establish communications to the called number for a pre-determined amount of time.

Table 10 – Repeat call service

Event Message	Required or optional	Comments
Service_Instance	R	None
Interconnect_Start	O	Required if Announcement Server for delivering the Message indicating reason Repeat Call cannot be activated is Off_Net on PSTN.
Interconnect_Stop	O	Required only if the appropriate Interconnect_Start was activated
Intelligent_Peripheral_Usage_Start	O	Required only if Announcement Server for delivering the Message indicating reason Repeat Call cannot be activated is On_Net. NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.

Table 10 – Repeat call service

Event Message	Required or optional	Comments
Intelligent_Peripheral_Usage_Stop	O	Required only if Announcement Server for delivering the Message indicating reason Repeat Call cannot be activated is On_Net. NOTE – This Event Message will be defined in a future release of this IPCablecom Recommendation.
NOTE – There may be multiple Interconnect_Start and Stops capturing the multiple different times the originating CMS tries to make an Off-Net call to try to complete a Repeat Call request.		

8.2.10 Voicemail service

Voicemail service only applies to calls terminating On_Net, described in clauses 8.1.1 and 8.1.3.

It is assumed that the voicemail server will be located Off_Net for IPCablecom. It is, therefore, assumed that if voicemail billing is usage sensitive, connections to the Off_Net voicemail system will be counted in the same way whether they are voicemail messages being left for the subscriber (deposit) or calls to retrieve the messages on the voicemail server.

Voicemail deposit and retrieval scenarios will be treated as separate transactions that have associated Event Messages. Event Messages for voicemail deposit will look like a standard On_Net to Off_Net call. When the call is transferred to the Voicemail Server, the Routing Number MUST be captured and populated with the Voicemail Server Address.

The connection time to the Voicemail Server MAY also be derived through the standard On_Net to Off_Net Event Messages. Since the Voicemail Server is located Off_Net, Event Messages for voicemail retrieval MAY only be generated if the retrieval is initiated from a device within the operator's network (e.g., On_Net to Off_Net call).

8.2.11 Message waiting indicator service

It is assumed that an Off_Net voicemail system is used as described in clause 8.2.10. Because it seems unreasonable for the CMS to have to place a separate call to the Off_Net system each time a voicemail subscriber goes off-hook, it is assumed that a mechanism exists which allows the Off_Net voicemail system to pass the information to the CMS indicating which subscribers have voicemail waiting. A further assumption is that the MTA is capable of delivering the audible stutter-tone message-waiting indicator to the subscriber's MTA port going off-hook, on the command of the CMS.

Under the scenario described in the assumptions clause, and given the fact that billing will not be based on any per-use delivery of the stutter tone, there will be no Event Messages required for this service. Billing will be based on a combination of information obtained from the Voicemail send/retrieve Event Messages discussed in clause 8.2.10 and provisioning information indicating when a subscriber has signed up for voicemail services.

8.2.12 Three-way call service

The Three-Way Call Service (see Table 11) allows a subscriber to add a third party to an active call. Three-Way Call Service applies to the originating and terminating CMS. To operate Three-Way Call Service, the subscriber dials the first call party. While on the first call, the subscriber presses the switch hook or flash key to place the first party on hold and, after listening for a dial tone, dials a second party number. The second party answers, the subscriber may speak privately or create a Three-Way Call by depressing the hook switch or pressing the flash key once again to merge the two calls. The Three-Way Call Service is then initiated and the Service_Instance Event Message is generated by the subscriber's CMS.

Table 11 – Three-way call service

Event Message	Required or optional	Comments
Service_Instance	R	If the Three-Way Call Service is supported by the CMS, the CMS MUST generate a Service_Instance Event Message when the Three-Way Call service is initiated.

8.2.13 Customer originated trace service

The customer originated trace (COT) Service (see Table 12) allows subscribers to activate an immediate trace on an annoyance or nuisance call. After a nuisance call is terminated, a subscriber who wishes to trace the call picks up the handset and goes off-hook, listens to dial tone, and then dials the Customer Originated Trace activation code (for example, in the United States, the customer originated trace activation code is *57).

Table 12 – Customer originated trace service

Event Message	Required or optional	Comments
Service_Activation	R	If the Customer Originated Trace Service is supported by the CMS, the CMS MUST generate a Service_Activation Event Message when the Customer Originated Trace Service is initiated.

Note that when the COT Service is activated, it only applies to one call (the last call received by the subscriber), and no Service_Deactivation Event Message is generated.

8.2.14 Account code and authorization code service

The account code and authorization code service (see Table 13) defines two service capabilities as one service in support of account and authorization codes. The account and authorization codes may be used by business support systems (BSS) to apply various accounting and charging rules based on the codes.

Account codes allow call charging to user projects, departments or special accounts, etc. A subscriber may activate the Account Code service capability when initiating a call (usually a long distance call) in order to have the call accounting recorded under a special project or account. The account code may then be used in the BSS systems for various purposes including call accounting and charging; it is usually not subject to verification by the CMS.

Authorization codes provide the capability for a subscriber to override call restrictions for a single call. A subscriber may be restricted from making toll calls and may decide to activate the Authorization Code service capability when placing a long-distance phone call in order to remove the default call restrictions for that one call. The subscriber can typically override the restriction by dialling an authorization code that grants enough privileges to make long-distance calls. The Authorization Code Service capability is used in a business group environment where multiple authorization codes may be assigned to grant various call privileges. Some authorization codes may be used to logically segment a given account code.

Table 13 – Account code and authorization code Service

Event Message	Required or optional	Comments
Service_Instance	R	If the Account Code and Authorization Code Service is supported by the CMS, the CMS MUST generate a Service_Instance Event Message when either the account or authorization code service capability is initiated.

The CMS MUST generate a Service_Instance Event Message when the Account Code and Authorization Code Service is initiated even when the dialled code is invalid and the call is not successfully made. The Call_Termination_Cause attribute MUST be present in the Service_Instance Event Message for this service and it MUST be encoded as defined in clause 10.2 to report the appropriate Call Completion Code. This attribute indicates whether the service is successfully completed or the reason for the service failure (e.g., the dialled code provided by the subscriber is not authorized or invalid). A successful call completion code reported in the Service_Instance Event Message only means that the Account Code and Authorization Code Service is successfully attempted and that the call signalling may proceed (other errors could occur resulting in a call failure during the call setup which may be reported in other Event Messages, like the Signalling_Stop Event Message for example).

9 IPCablecom Event Message structure

This clause describes the various Event Messages, together with their associated list of attributes. Refer to clause 10 for a detailed description of the attributes described in this clause. Refer to clause 8 for a detailed description of the services and their associated Event Messages.

The description of each Event Message in this clause includes:

- A summary of the EM purpose and conditions under which it is sent.
- Mandatory requirements for triggers that cause the EM to be created and time-stamped during a call that is completely set up and terminates normally. Throughout this clause, the time-stamp triggers for each EM are clearly defined. When a time-stamp requirement exists for an Event Message, there is an assumption that the event message will be generated as well; however, when the message is actually transmitted depends on whether the NE is operating in immediate or batch mode (see clause 7.1).
- A table showing mandatory and optional attributes in the EM.

Note that, even though only mandatory EM trigger requirements for normal completed calls are specified, the NEs are expected to implement reasonable triggers for all call and exception scenarios. Additionally, NEs are expected to implement reasonable triggers if they have not implemented all IPCablecom interfaces (for example, if CMS-to-CMS signalling is not used for CMS-to-MGC communication).

The following tables show the association between IPCablecom services, supported by the aforementioned call configurations, and proposed Event Messages that may be generated for each service. Voice communications services that IPCablecom will provide are based on three main call configurations:

- On-net-to-on-net;
- On-net-to-off-net;
- Off-net-to-on-net.

Table 14 provides a list of IPCablecom Event Messages defined in this Recommendation. More than one set of Event Messages MAY be generated during a particular service instance.

Table 14 – IPCablecom Event Message summary

Event Message ID	IPCablecom Event Message	Description
0	Reserved	
1	Signalling_Start	Start of signalling for originating or terminating part of the call
2	Signalling_Stop	Stop of signalling for originating or terminating part of the call
3	Database_Query	An inquiry into an external database; for example, a toll-free number database
4	Intelligent_Peripheral_Usage_Start	Deferred
5	Intelligent_Peripheral_Usage_Stop	Deferred
6	Service_Instance	Indicates an occurrence of a service
7	QoS_Reserve	Reservation of QoS for originating or terminating part of the call
8	QoS_Release	Release of QoS for originating or terminating part of the call
9	Service_Activation	Indicates a subscriber has activated a service
10	Service_Deactivation	Indicates a subscriber has deactivated a service
11	Media_Report	Indicates a change in media session information
12	Signal_Instance	Indicates an NCS signal instance
13	Interconnect_(Signalling)_Start	Start of network interconnect signalling (between IPCablecom and PSTN) for originating or terminating part of the call
14	Interconnect_(Signalling)_Stop	Stop of network interconnect signalling (between IPCablecom and PSTN) for originating or terminating part of the call
15	Call_Answer	Indicates that all network resources have been allocated for originating or terminating part of the call
16	Call_Disconnect	Indicates that all network resources have been released for originating or terminating part of the call
17	Time_Change	Indicates time change on a network element
19	QoS_Commit	Commitment of QoS for originating or terminating part of the call
20	Media_Alive	Indicates if the call is still active
21	Conference_Party_Change	A party is added, placed on hold, or retrieved from hold in a call involving multiple parties.
22	Media_Statistics	Media stream statistics reported by the gateway
23	Surveillance_Stop	Indicates end of call content and/or call data. Generally, this will mean the end of a call. However, this can also indicate that call content and/or call data can no longer be intercepted (e.g., a call has been forwarded to another service provider's network and cannot be intercepted).

Table 14 – IPCablecom Event Message summary

Event Message ID	IPCablecom Event Message	Description
24	Redirection	Indicates that a call involving the surveillance subject has been redirected by either the surveillance subject or an associate in those scenarios where a Service_Instance is not sent.
31-39	Reserved	Reserved for IPCablecom Multimedia

The Signalling_Start, Signalling_Stop, Call_Answer, and Call_Disconnect messages are important for accounting purposes and tracking the signalling overhead for media session establishment. The following are some assumptions on how these messages will be used:

- Signalling_Start and Signalling_Stop messages bracket the time-frame during which the CMS or MGC is processing dialled digits, performing signalling, and maintaining state for a call. Thus, the time-stamp on a Signalling_Start is time-stamped as early in the flow as possible on both the originating and terminating side after the message containing routable digits from the originator. A routable set of digits can be defined as a set of digits that are collected by the MTA matching the digit map, and will trigger call routing processing (e.g., *69 would not be considered routable digits, but 00 would). The time-stamp on the Signalling_Stop is time-stamped when signalling for the call is completed, generally when a DLCX is sent to an endpoint.
- A Signalling_Stop is generated if and only if a Signalling_Start was generated. Under normal circumstances, an RKS can expect a Signalling_Start and Signalling_Stop message for each set of event messages it receives for a specific BCID.
- Call_Answer and Call_Disconnect messages bracket the time-frame during which 2-way media path is active. The time-stamps on these messages are used to calculate call time and duration for any calls that have usage billing. The time-stamp on the Call_Answer will closely match the time at which the terminating party goes off-hook, and the time-stamp on the Call_Disconnect will closely match the time at which the media path is torn down.
- A Call_Disconnect is generated if and only if a Call_Answer was generated. Existence of these two EMs in a set of EMs for a BCID indicates that all the conditions for a 2-way media path were met.
- The Called_Party_Number in Signalling_Start is the E.164 number of the terminating party. This number is intended to capture the destination of the call as specified by the originator. It often indicates the dialled-digits from the originator (e.g., for the 3-digit calls like 911, 411, this attribute captures this 3-digit number). However, there are several cases in which this field does not reflect the actual input of the user (e.g., in case of features like speed-dial, it is populated with the digits configured for the speed-dial digits). A few examples:
  1) Subscriber is in area code 972 and has 7-digit dial plan. When the subscriber dials 234-1234, the Called_Party_Number in Signalling_Start is populated with the 10-digit number including the area code, 9722341234.
  2) Subscriber has a speed-dial feature and configured 11 to 972-234-1234. When the subscriber dials 11#, the Called_Party_Number in Signalling_Start is populated with the 10-digit number configured for the speed dial 11, 9722341234.
  3) When a subscriber dials 911 for an emergency call, the Called_Party_Number in Signalling_Start is populated with 3-digit 911.

4) When the subscriber dials 1-919-234-1234, the Called_Party_Number in Signalling_Start is populated with the 10-digit number without the prefix, 9192341234.

5) When the subscriber dials a dial around code, 1010288, and then dials 919-234-1234, the Called_Party_Number in Signalling_Start is populated with the 10-digit number without the dial around code, 9192341234.

6) When the subscriber dials 1-800-228-8288, the Called_Party_Number in Signalling_Start is populated with 8002888288, and the Routing_Number is populated with the translated number after the database dip.

Table 15 – Services supported by on-net-to-on-net call configuration

Service	Event Message ID																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**19**	**20**	**21**	**22**
Basic	X	X	X	X	X		X	X			X	X			X	X		X	X		X
Call Block	X	X		X	X	X	X	X	X	X	X	X			X	X		X			X
Call Waiting	X	X		X	X	X	X	X	X	X	X	X			X	X		X			X
Call Forwarding	X	X		X	X	X	X	X	X	X	X	X			X	X		X			X
Return Call	X	X		X	X	X	X	X			X	X			X	X		X			X
Repeat Call	X	X		X	X	X	X	X			X	X			X	X		X			X
Voice Mail	X	X		X	X		X	X			X	X			X	X		X			X
Three-Way Call	X	X		X	X	X	X	X				X			X	X		X		X	X
Customer Originated Trace	X	X		X	X		X	X	X			X			X	X		X			X

Table 16 – Services supported by on-net-to-off-net call configuration

Service	Event Message ID																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**19**	**20**	**21**	**22**
Basic	X	X	X	X	X		X	X			X	X	X	X	X	X		X	X		X
Call Block	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X			X
Call Waiting	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X			X
Return Call	X	X		X	X	X	X	X			X	X	X	X	X	X		X			X
Repeat Call	X	X		X	X	X	X	X			X	X	X	X	X	X		X			X
Emergency	X	X	X	X	X		X	X			X	X	X	X	X	X		X			X
Short Code	X	X	X	X	X		X	X			X	X	X	X	X	X		X			X
FreePhone	X	X	X	X	X		X	X			X	X	X	X	X	X		X			X
Operator	X	X		X	X		X	X			X	X	X	X	X	X		X			X
Three-Way Call	X	X		X	X	X	X	X				X	X	X	X	X		X		X	X

Table 17 – Services supported by off-net-to-on-net call configuration

Service	Event Message ID																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22
Basic	X	X	X	X	X		X	X			X	X	X	X	X	X		X	X		X
Call Block	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X			X
Call Waiting	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X			X
Repeat Call	X	X		X	X	X	X	X			X	X	X	X	X	X		X			X
Call Forwarding	X	X		X	X	X	X	X	X	X	X	X			X	X		X			X
Voice Mail	X	X		X	X		X	X			X	X	X	X	X	X		X			X
Three-Way Call	X	X		X	X	X	X	X				X	X	X	X	X		X		X	X
Customer Originated Trace	X	X		X	X		X	X	X			X	X	X	X	X		X			X

9.1 Event Message structure

An Event Message contains a header followed by attributes. The header is required on every Event Message. The attributes will vary based on the type of service the Event Message is describing. Refer to Table 38 for a description of the Event Message Header (EM_Header Attribute Structure).

9.2 Service_Instance

This event captures the fact that a service event has happened. The Event_Time attribute in the Event Message Header Structure (see Table 38) MUST contain the time at which the service occurred.

This Event Message indicates the time at which the CMS provides an instance of a call control/feature service: for example, the time at which a call is put on hold, the time at which a call is forwarded, the time at which a last call return service is provided, the time at which a call-waiting service is provided, etc.

The CMS MUST timestamp these messages immediately upon operation of the service instance being reported.

The following generic call scenarios and BCIDs are used to specify the call leg for which the CMS sends the Service_Instance Event Message for Call Forwarding, Call Waiting and Three-Way Call Services:

– For Call Forwarding, Subscriber A (BCID-A) calls Subscriber B (BCID-B1), Subscriber B (BCID-B2) forwards to Subscriber C (BCID-C). In this case, the CMS managing Subscriber B MUST generate a Service_Instance Event Message with the BCID (BCID-B2) in the EM_Header attribute and the Related_Call_Billing_Correlation_ID attribute MUST be BCID (BCID-B1).

– For Call Waiting, Subscriber A (BCID-A) calls Subscriber B (BCID-B1) and after the call is established, Subscriber C (BCID-C) calls Subscriber B (BCID-B2), who uses call waiting to talk to Subscriber C. In this case, the CMS managing Subscriber B MUST generate the Service_Instance Event Message with the BCID (BCID-B2) in the EM_Header attribute and the Related_Call_Billing_Correlation_ID attribute MUST be BCID (BCID-B1).

– For Three-Way Call, Subscriber A (BCID-A1) calls Subscriber B (BCID-B1) and after call is established, either A or B can make Three-Way Call to Subscriber C. When A (BCID-A2) makes Three-Way Call to Subscriber C (BCID-C), the CMS managing

Subscriber A MUST generate the Service_Instance Event Message with BCID (BCID-A2) in the EM_Header attribute and the Related_Call_Billing_Correlation_ID attribute MUST be BCID (BCID-A1). When Subscriber B (BCID-B2) makes a Three-Way Call to Subscriber C (BCID-C), the CMS managing Subscriber B MUST generate the Service_Instance Event Message with BCID (BCID-B2) in the EM_Header attribute and the Related_Call_Billing_Correlation_ID attribute MUST be BCID (BCID-B1).

The following services are part of the supported service capabilities (see clause 6.2.1).

- Three_Way_Call;
- Acct_Auth_Code (Account and Authorization Code Service).

When a Service_Instance Event Message is generated with a Service_Name of Acct_Auth_Code, at least one of the attributes Account_Code or Authorization_Code MUST be present, and both MAY be present.

Table 18 – Service_Instance event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Service_Name	R	The Service_Name attribute MUST be present. Class Service name Call_Block Call_Forward Call_Waiting Repeat_Call Return_Call Three_Way_Call Acct_Auth_Code
Call_Termination_Cause	O	The Call_Termination_Cause attribute MUST be present if the Service_Name is Call_Block or Acct_Auth_Code. If the Service_Name is Acct_Auth_Code, the Source_Document field of the Call_Termination_Cause attribute MUST indicate that the source document is [b-GR-1100-CORE], Table 235, and the Cause_Code field MUST include the Call Completion Code as defined in [b-GR-1100-CORE], Table 235.
Related_Call_Billing_Correlation_ID	O	The Related_Call_Billing_Correlation_ID attribute MUST be present if Service_Name is Call_Forward, Call_Waiting or Three_Way_Call.
Charge_Number	O	Required in the case of Call Forward, Call Waiting, Repeat Call, Return Call or three-way call
First_Call_Calling_Party_Number	O	Required in the case of Call Waiting
Second_Call_Calling_Party_Number	O	Required in the case of Call Waiting
Called_Party_Number	O	Required in the case of Call Waiting

Table 18 – Service_Instance event message

Attribute name	Required or optional	Comment
Routing_Number	O	Required in the case of Repeat Call or Return Call
Calling_Party_Number	O	Required in the case of Repeat Call or Return Call
Account_Code	O	The Account_Code attribute MAY be present if Service_Name is Acct_Auth_Code.
Authorization_Code	O	The Authorization_Code attribute MAY be present if Service_Name is Acct_Auth_Code.

9.3 Service_Activation

This event (see Table 19) captures a subscriber activating a service. The Event_Time attribute in the Event Message Header Structure (see Table 38) MUST contain the time when the service was activated.

This Event Message indicates the time at which the CMS records an attempt to activate a service: for example, the time at which call forwarding is activated by the MTA user, the time at which the call-waiting service is activated by the MTA user, etc. These service activations are typically requested via a ∗XX dial-string.

The CMS MUST timestamp this message immediately upon successful activation of the requested service.

The CMS MUST create a new billing correlation ID for this Event Message even if a service is activated during an existing call.

Table 19 – Service_Activation event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Service_Name	R	The Service_Name attribute MUST be present. Class Service name Call_Block Call_Forward Call_Waiting Customer_Originated_Trace
Calling_Party_Number	R	The Calling_Party_Number attribute MUST be present if the Service_Name is Call_Forward. The Calling_Party_Number attribute MUST be present if the Service_Name is Call_Waiting, Call_Block or Customer_Originated_Trace and if the calling party number is known. Otherwise, this attribute may be omitted

Table 19 – Service_Activation event message

Attribute name	Required or optional	Comment
Charge_Number	R	The Charge_Number attribute MUST be present.
Forwarded_Number	O	The Forwarded_Number attribute MUST be present if Service_Name is Call_Forward.

9.4 Signalling_Start

This Event Message (see Table 20) indicates the time at which signalling starts. It is intended to capture the point at which the NE starts processing a call once a routable set of digits have been obtained from the originator.

The CMS or MGC MUST timestamp this message prior to digit translation. Note that the attributes contained in this Event Message contain information that is obtained after digit translation. In the event that a database dip is required, then the Signalling_Start message MUST be generated after the response from the database dip.

Originating CMS

In all scenarios, the originating CMS MUST timestamp this message immediately upon receipt of a NCS-signalling NTFY message with a routable set of digits that indicate a call attempt.

Terminating CMS

In the single-zone scenario, the terminating CMS MUST timestamp this Event Message based on a vendor-proprietary trigger.

In the intra-domain and inter-domain scenarios, the terminating CMS MUST timestamp this Event Message immediately upon receipt of an INVITE message with a routable set of dialled digits.

Originating MGC (off-on)

The originating MGC MUST timestamp this message immediately upon receipt of: an SS7 IAM message; or a TGCP NTFY with digits (operator services).

Terminating MGC (on-off)

The terminating MGC MUST timestamp this message immediately upon receipt of an INVITE message with a routable set of dialled digits. If the MGC is integrated with the CMS, the terminating MGC MUST timestamp this message based on vendor proprietary trigger. The proprietary trigger MAY be based on when the IAM is transmitted. The Trunk_Group_Number in the Trunk_Group_ID attribute in this message is the trunk group number used to formulate the first IAM transmitted to the Signalling Gateway that communicates with PSTN SS7 network for this call. It is referenced to the first IAM because potentially due to reattempt handling another IAM may be attempted to complete the same call.

Table 20 – Signalling_Start event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Direction_indicator	R	The Direction_Indicator attribute MUST be present.
MTA_Endpoint_Name	O	If the originating CMS generates this message, MTA_Endpoint_Name attribute MUST contain the endpoint name of the originating MTA. If the terminating CMS generates this message, MTA_Endpoint_Name attribute MUST contain the endpoint name of the terminating MTA. If the originating MGC generates this message, MTA_Endpoint_Name attribute MAY contain the endpoint ID of the originating MG. If the terminating MGC generates this message, the MTA_Endpoint_Name attribute MAY contain the endpoint ID of the terminating MG.
Calling_Party_Number	O	The Calling_Party_Number attribute MUST be included in the Signalling_Start Event Message whenever it is available in SS7 or CMSS signalling. For example, in the off-net to on-net scenario, this attribute may not be present when the Originating MGC and Terminating CMS do not have the Calling_Party_Number attribute available from SS7 signalling.
Called_Party_Number	R	The Called_Party_Number attribute MUST be present, it indicates terminating address (E.164 format)
Routing_Number	R	The Routing_Number attribute MUST be present, it indicates a routable number
Location_Routing_Number	O	The Location_Routing_Number attribute MUST be included for local number portability use.
Carrier_Identification_Code	O	This attribute MUST be included when the MGC generates this message.
Trunk_Group_ID	O	This attribute MUST be included when the MGC generates this message.
Intl_Code	O	The Intl_Code attribute MUST be included for call origination of an internationally routed call.
Dial_Around_Code	O	The Dial_Around_Code attribute MUST be included for call origination where the inter-exchange carrier was specified by keying in a dial-around code (e.g., 1010288).

Table 20 – Signalling_Start event message

Attribute name	Required or optional	Comment
Jurisdiction_Information_Parameter	O	If the originating MGC generates this message, the Jurisdiction_Information_Parameter (JIP) MUST be included when JIP was received in SS7 message or if the incoming trunk group is provisioned with LRN of remote end. If the originating CMS generates this message, the Jurisdiction_Information_Parameter MUST be included when the calling party number is ported-in number. In this case, JIP is per-CMS provisioning. Note that this may be present even if the calling party is not ported in number. If the terminating CMS generates this message, the Jurisdiction_Information_Parameter MUST be included when JIP is received in CMSS interface.
Called_Party_NP_source	O	Number Portability source. The Called_Party_NP_Source indicates how CMS or MGC obtained LRN of called party.
Calling_Party_NP_source	O	Number Portability source. The Calling_Party_NP_Source indicates how CMS or MGC obtained local number portability information for calling party.
Ported_In_Calling_Number	O	If the originating CMS generates this message, the Ported_In_Calling_Number attribute MUST be included when the calling party number is ported-in number.
Ported_In_Called_Number	O	If the terminating CMS generates this message, the Ported_In_Called_Number attribute MUST be included when the called party number is ported-in number.
Billing_Type	O	The Billing_Type attribute MUST be included for call origination where the originating endpoint is a measured rate subscriber.
Related_ICID	O	If the CMS or MGC generates this message as a result of receiving a SIP INVITE, the Related_ICID attribute MUST contain the ICID as received in the P-Charging-Vector SIP Header. Otherwise, the CMS or MGC MUST populate the Related_ICID attribute based on the ICID created by the CMS or MGC and placed in the P-Charging-Vector SIP header of an outbound INVITE message. If the ICID is not provided or received, this attribute may be omitted.

9.5 Signalling_Stop

This Event Message (see Table 21) indicates the time at which signalling terminates. It is intended to capture the point at which the NE processes the final signalling message for the call. A Signalling_Stop message MUST NOT be generated unless a Signalling_Start message with the same BCID has been generated for the call. A Signalling_Stop message MUST be generated if a Signalling_Start message with the same BCID has been generated for the call (in exception cases, this may be the result of a proprietary time-out or clean-up process).

Originating CMS

In the single-zone scenario, the originating CMS MUST timestamp this EM message immediately upon transmission of the NCS-signalling DLCX message.

In the intra-domain or inter-domain scenario, the originating CMS MUST timestamp this message upon transmission of the last signalling event in the following list:

- transmission of the NCS-signalling DLCX message; or
- transmission of the CMSS-signalling BYE message or CANCEL message.

Terminating CMS

In the single-zone scenario, the terminating CMS MUST timestamp this EM message immediately upon transmission of the NCS-signalling DLCX message.

In the intra-domain or inter-domain scenario, the terminating CMS MUST timestamp this message upon transmission of the last signalling event in the following list:

- transmission of the NCS-signalling DLCX message; or
- transmission of the CMSS-signalling BYE message or the transmission of the CMSS-signalling acknowledgment response message to a CANCEL request.

Originating MGC (off-net-to-on-net)

The originating MGC MUST timestamp this EM message immediately upon the last signalling event in the following list:

- transmission/receipt of an RLC to/from the Signalling Gateway that communicates with the SS7 network;
- transmission of the MGC-issued TGCP DLCX message;
- receipt of an MG-issued TGCP DLCX; or
- transmission of the CMSS-signalling BYE message or CANCEL message.

Terminating MGC (on-net-to-off-net)

The terminating MGC MUST timestamp this EM message immediately upon transmission of the TGCP-signalling DLCX message.

Table 21 – Signalling_Stop event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Related_Call_Billing_Correlation_ID	O	If the originating CMS or MGC generates this message, the Related_Call_Billing_Correlation_ID attribute MUST contain the BCID of the terminating CMS or MGC when terminating CMS or MGC is known. If the terminating CMS or MGC is not known, this attribute may be omitted. If the terminating CMS or MGC generates this message, the Related_Call_Billing_Correlation_ID attribute MUST contain the BCID of the originating CMS or MGC if known. If the BCID of the originating CMS or MGC is not known, this attribute may be omitted.
FEID	O	If the originating CMS or MGC generates this message, the FEID attribute MUST contain the FEID of the terminating CMS or MGC when terminating CMS or MGC is known. If the terminating CMS or MGC is not known, this attribute may be omitted. If the terminating CMS or MGC generates this message, the FEID attribute MUST contain the FEID of the originating CMS or MGC if known. If the BCID of the originating CMS or MGC is not known, this attribute may be omitted.
Call_Termination_Cause	R	The Call_Termination_Cause code MUST be present.

9.6 Service_Deactivation

This Event Message (see Table 22) indicates the time at which the CMS records an attempt to deactivate a service. For example, the time at which call forwarding is deactivated by the MTA user, the time at which the call-waiting service is deactivated by the MTA user, etc. These service deactivations are typically requested via a ∗XX dial-string.

The CMS MUST timestamp this message immediately upon successful deactivation of the requested service. Failed Deactivation attempts are not reported at this time.

The CMS MUST create a new billing correlation ID for this Event Message even if a service is deactivated during an existing call.

Table 22 – Service_Deactivation event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Service_Name	R	The Service_Name attribute MUST be present. Class Service Name: Call_Block Call_Forward Call_Waiting
Calling_Party_Number	R	The Calling_Party_Number attribute MUST be present.
Charge_Number	R	The Charge_Number attribute MUST be present.

Note that in the case of the Call_Waiting Service, the service deactivation or cancellation only applies to the duration of one call. If the subscriber has Call_Waiting Service, by default, any call placed or received after the Call_Waiting Service deactivation will have call waiting enabled. As a consequence, no Service_Activation Event Message is generated to activate this service again.

9.7 Database_Query

This Event Message (see Table 23) indicates the time at which a one-time request/response transaction or database dip is completed by an intelligent peripheral (Freephone database, LNP database, etc.).

The CMS originating the call MUST timestamp this message immediately upon a receipt of the response from the Intelligent Peripheral.

Table 23 – Database_Query event message

Attribute name	Required or optional	Comment
[Event Message Header] (Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM
Database_ID	R	None
Query_Type	R	Freephone Number Lookup, LNP lookup, etc.
Called_Party_Number	R	None
Returned_Number	R	NOTE 1 – In the PSTN, only a single number is returned per a query for Freephone/LNP/Calling Name service. There may be multiple numbers returned such as the Freephone translation results in a ported number in an optimized response available in AIN 0.2. This is optional for use in TCAP query of these services.

Table 23 – Database_Query event message

Attribute name	Required or optional	Comment
		If multiple numbers are returned, this attribute SHOULD reflect the result associated with the original query as indicated in the attribute Query_Type in this message. Any additional database dip result SHOULD be included in the corresponding specific attribute. In the case of LNP as a bundled response to the Freephone query, the Location_Routing_Number SHOULD be included to convey the additional returned number result from a single database query to the SCP. As an alternative, the Returned_Number MAY be included for each number returned, but SHOULD be included as a pair with Query_Type in an ordered sequence. The first pair denotes the returned number associated with the original query type. The next pair denotes the next returned number of the next bundled database dip of the same original query. This repeats until the last returned number is conveyed. NOTE 2 – For a calling name database query, this field should contain the calling party number provided to the database for which the name is being requested.
Location_Routing_Number	O	See Note above.
Query_Type	O	As a pair with Returned_Number for each of the subsequent database dip result within a single original database query. See Note in the Returned_Number comment column above.
Returned_Number	O	As a pair with Query_Type for each of the subsequent database dip result within a single original database query. See Notes above.

9.8 Intelligent_Peripheral_Usage_Start

Deferred.

9.9 Intelligent_Peripheral_Usage_Stop

Deferred.

9.10 Interconnect_Start

This Event Message (see Table 24) indicates the time at which the start of network interconnect occurs. Only the MGC is permitted to issue this Event Message.

The MGC MUST timestamp this message immediately upon transmission/receipt of an IAM to/from the Signalling Gateway that communicates with the SS7 network.

The terminating MGC MUST generate this message only after the ACM/ANM is received. This is so that if another IAM is attempted due to reattempt handling with a different trunk group number before the ACM/ANM is received, the Interconnection_Start reports the latest trunk group number along with the latest timestamp of the final IAM used to complete the call. (The Signalling_Start reports the first IAM attempted trunk group number of the same call.)

The originating MGC MAY generate this message when the ACM is transmitted although it is timestamp upon receipt of an IAM.

The MGC MUST timestamp this message immediately upon transmission/receipt of digits to/from the Media Gateway that communicates with the MF/DTMF network.

The originating MGC MUST generate this message only after call answer is transmitted. The Interconnection_Start reports the latest trunk group number along with the latest timestamp of answer used to complete the call. (The Signalling_Start reports the first attempted trunk group number of the same call.)

The terminating MGC MAY generate this message when call answer is received although it is timestamp upon sending the digits to the Media Gateway that communicates with the MF/DTMF network.

Table 24 – Interconnect_Start event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM
Carrier_Identification_Code	R	CIC Code of connecting operator
Trunk_Group_ID	R	TGID of the trunk over which the interconnection is occurring
Routing_Number	R	none

9.11 Interconnect_Stop

This Event Message (see Table 25) indicates the termination of bandwidth between the IPCablecom network and the PSTN. Only the MGC is permitted to issue this Event Message.

The MGC MUST timestamp this message immediately upon transmission/receipt of an RLC to/from the Signalling Gateway that communicates with the SS7 network.

The MGC MUST timestamp this message immediately upon transmission/receipt of a Release Complete to/from the Media Gateway that communicates with the MF/DTMF network.

Table 25 – Interconnect_Stop event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Carrier_Identification_Code	R	CIC Code of connecting operator
Trunk_Group_ID	R	TGID of the trunk over which the interconnection is occurring

9.12 Call_Answer

This Event Message (see Table 26) indicates that the media connection is open because answer has occurred. It is intended to capture the earliest point at which the NE can determine that the termination side has gone off-hook, resulting in a 2-way media path.

Originating CMS

In the single-zone scenario, the originating CMS MUST timestamp this Event Message based on its knowledge of media connection establishment. This trigger should correspond as closely as possible to the time at which the terminating side has determined that off-hook has occurred.

In the multi-zone scenario, the originating CMS MUST timestamp this Event Message immediately upon receipt of the CMSS signalling 200 OK sent in response to the original INVITE message indicating call answer.

Terminating CMS

The terminating CMS MUST timestamp this message immediately upon receipt of the NCS-signalling NTFY message indicating off-hook at the terminating MTA.

Originating MGC (off-on)

The originating MGC MUST timestamp this message immediately upon transmission of an SS7 ANM message to the PSTN via the SG, or commanding the MG to generate answer indication on the operator services trunk.

Terminating MGC (on-off)

The terminating MGC MUST timestamp this message immediately upon receipt of an SS7 ANM message from the PSTN via the SG or an answer indication from the MG indicating answer has occurred on an operator services trunk.

Table 26 – Call_Answer event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Charge_Number	R	The Charge_Number attribute MUST contain the charge number in the appropriate cases such as collect call, calling-card call, call billed to a 3rd party, or others.
Related_Call_Billing_Correlation_ID	O	If the originating CMS or MGC generates this message, the Related_Call_Billing_Correlation_ID attribute MUST contain the BCID of the terminating CMS or MGC when terminating CMS or MGC is known. If the terminating CMS or MGC is not known, this attribute may be omitted. If the terminating CMS or MGC generates this message, the Related_Call_Billing_Correlation_ID attribute MUST contain the BCID of the originating CMS or MGC if known. If the BCID of the originating CMS or MGC is not known, this attribute may be omitted.

Table 26 – Call_Answer event message

Attribute name	Required or optional	Comment
FEID	O	If the originating CMS or MGC generates this message, the FEID attribute MUST contain the FEID of the terminating CMS or MGC when terminating CMS or MGC is known. If the terminating CMS or MGC is not known, this attribute may be omitted. If the terminating CMS or MGC generates this message, the FEID attribute MUST contain the FEID of the originating CMS or MGC.

9.13 Call_Disconnect

This Event Message (see Table 27) indicates the time at which the media connection is closed because the calling party has terminated the call by going on-hook, or that the destination party has gone on-hook and the called-party's call-continuation timer[1] has expired. The call termination cause attribute must be included as an attribute in a Call_Disconnect message; its structure is defined in Table 41 and its Cause_Code sub-field is normatively defined in [b-Telcordia], GR-1100-CORE, Table 411. Call_Disconnect should be time-stamped by the NE as closely as possible to the time that the media connection is torn down. A Call_Disconnect message MUST NOT be generated unless a Call_Answer message with the same BCID has been generated for the call. A Call_Disconnect message MUST be generated if a Call_Answer message with the same BCID has been generated for the call (in exceptional cases, this may be the result of a proprietary time-out or clean-up process).

Originating CMS

The originating CMS MUST timestamp this EM message immediately upon transmission of the NCS-signalling DLCX message (for calls that have reached the state where the terminating party has gone off-hook and the Call_Answer message was sent).

Terminating CMS

The terminating CMS MUST timestamp this message immediately upon transmission of the DLCX or upon expiration of the terminating MTA's call-continuation timer.

Originating MGC (off-net-to-on-net)

The originating MGC MUST timestamp this EM message upon receipt of an SS7 REL message from the PSTN via the SG, or upon sending a CMSS-signalling 200-OK message in response to a BYE message from the terminating CMS.

Terminating MGC (on-net-to-off-net)

The terminating MGC MUST timestamp this message upon receipt of an SS7 RLC message from the PSTN via the SG, an indication from the MG that an operator services trunk has disconnected, or upon sending a 200-OK message in response to a BYE message from the originating CMS.

[1] In the current telephony network, when the called party goes on-hook, a 10- to 11-second timer is started. If the calling party remains off-hook, and the called party goes off-hook again within that time period, the call continues.

Table 27 – Call_Disconnect event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Call_Termination_Cause	R	Normal termination

9.14 QoS_Reserve

This Event Message (see Table 29) indicates the time at which the CMTS reserves bandwidth on the IPCablecom access network. The CMTS MUST also generate this event if the Reserved bandwidth changes or if the service flow is authorized by another gate (through the association of a different Gate than originally authorized the flow).

The originating and terminating CMTS MUST timestamp this message immediately upon:

Table 28 – QoS reserve timestamp generation

Client initiated	CMTS initiated
Client initiated DSA-REQ or DSC-REQ	CMTS initiated DSA-REQ or DSC-REQ
Reception of a DSA/DSC-ACK acknowledging a successful DSA/DSC-RSP (confirmation code == success).	Transmission of a DSA/DSC-ACK acknowledging a successful DSA/DSC-RSP (confirmation code == success)
If a DSA/DSC-ACK is not received, the CMTS MUST NOT generate this message.	If a DSA/DSC-ACK is not transmitted, the CMTS MUST NOT generate this message.

If the DSA/DSC-RSP confirmation code is not successful, the CMTS MUST NOT generate this message.

Table 29 – QoS_Reserve event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
QoS_Descriptor	O	None
MTA_UDP_Portnum	R	None
SF_ID	R	None
Flow_Direction	R	None

9.15 QoS_Release

This Event Message (see Table 30) indicates the time at which the CMTS released its bandwidth commitment on the IPCablecom access network.

The originating and terminating CMTS MUST timestamp this message immediately upon:

- transmission of a DSC-RSP that indicates that authorization and admission control for a DSC-REQ against an existing service flow have succeeded against a separate Gate, indicating that the previous Gate will be deleted; or
- transmission of a DSD-RSP that indicates the request to delete bandwidth contained in the DSD-REQ from the MTA was successful;

- transmission of a DSC-RSP that indicates the request to delete bandwidth contained in the DSC-REQ from the MTA was successful. This occurs when the MTA is utilizing multiple grants per interval to place multiple sessions on a single service flow and uses a DSC-REQ to delete bandwidth for one of the sessions.

Table 30 – QoS_Release event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
SF_ID	R	None
Flow_Direction	R	None

9.16 Time_Change

This Event Message (see Table 31) captures an instance of a time change. Whenever the (IPCablecom) clock on the network element (CMS, MGC or CMTS) is changed by more than 200 milliseconds, the network element MUST generate a Time Change message. This includes time shift events (Daylight savings time), step adjustments to synchronize with the NTP reference clock and manual time setting changes. The Event_Time attribute in the Event Message Header Structure (Table 38) MUST reflect the new (adjusted) notion of time. Note that Time_Change message is not required for slew adjustments performed by NTP.

The network element (CMS, MGC and CMTS) MUST send the Time Change event message to the active (current primary) RKS. The Time Change event message MUST be generated when one or more calls are active or in the process of being set up. For the CMS and MGC active or in process is after a Signalling Start event has been generated. For the CMTS, active or in process is indicated by the presence of a DQoS gate. The Time Change event message need not be generated when calls are not active or in the process of being set up. Only one Time Change event message is sent to each primary RKS (if there is more than one primary RKS) regardless of how many calls may be active.

The BCID in the EM_Header of the Time Change event message MUST be generated locally by the network element at the time of the event. The BCID is not associated with any call related BCID, it is a unique BCID for this event.

Table 31 – Time_Change event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
Time_Adjustment	R	None

9.17 QoS_Commit

This Event Message (see Table 33) indicates the time at which the CMTS commits bandwidth on the IPCablecom access network. The CMTS MUST also generate this event if the Committed bandwidth changes or if the service flow is authorized by another gate (through the association of a different Gate than originally authorized the flow).

The originating and terminating CMTS MUST timestamp this message immediately upon:

Table 32 – QoS commit timestamp generation

Client initiated	CMTS initiated
Client-initiated DSC-REQ or a DSA-REQ (when the CMTS reserves and commits the bandwidth in one-step).	CMTS-initiated DSC-REQ or a DSA-REQ (when the CMTS reserves and commits the bandwidth in one-step).
Reception of a DSA/DSC-ACK acknowledging a successful DSA-RSP/DSC-RSP (confirmation code == success).	Transmission of a DSA/DSC-ACK acknowledging a successful DSA/DSC-RSP (confirmation code == success).
If a DSA/DSC-ACK is not received, the CMTS MUST NOT generate this message.	If a DSC-ACK is not transmitted, the CMTS MUST NOT generate this message.

If the DSA/DSC-RSP confirmation code is not successful, the CMTS MUST NOT generate this message.

Table 33 – QoS_Commit event message

Attribute name	Required or optional	Comment
[Event Message Header] (see Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.
QoS_Descriptor	O	None
MTA_UDP_Portnum	R	None
SF_ID	R	None
Flow_Direction	R	None

9.18 RTP_Connection_Parameters event message

Deferred.

9.19 Media_Alive

If the IPCablecom architecture is expected to support this Media_Alive Event Message, then it is recommended that all CMS, CMTS and MGC be pre-configured with the same Media_Alive generation time.

This Event Message (see Table 34) indicates that service is active due to the continued existence of a bearer connection. This Event Message MAY be generated by any trusted IPCablecom network element (CMS, CMTS, MGC) as defined below.

If an NE is configured to generate the optional Media_Alive event message, it must check for the status of all calls at the configured Media_Alive generation time. At the configured Media_Alive generation time (e.g., 00:00 means midnight, 23:59 means 11:59 PM) the NE checks if any of the active calls are equal to or older than 1440 minutes (24 hours). Only if a call is equal to or older than 1440 minutes, a Media_Alive event message for that call MUST be generated.

The call starting time for different NE types are specified by:

- CMTS: the first QoS_Commit event message EM_Header attribute Event_time for a gate.
- CMS: the Call_Answer event message EM_Header attribute Event_time. The EM_Header attribute Event_time is time stamped as per clause 9.12, Call_Answer.
- MGC: the Call_Answer event message EM_Header attribute Event_time. The EM_Header attribute Event_time is time stamped as per clause 9.12, Call_Answer.

NEs MUST (when configured to generate the Media_Alive EMs) generate the Media_Alive EMs at the Media_Alive EM generation time. Even though the Media_Alive EM generation time is configurable, the default value for the Media_Alive EM generation time MUST be midnight. Thus, a service provider can have a synchronized network simply by accepting the default value from all NEs. If a service provider wants different time for Media_Alive EM generation time, it is up to the service provider to configure the different Media_Alive EM generation time.

Figure 5 illustrates how a long duration call is identified.

Assumption: the Media_Alive EM generation on the NE has been configured to midnight (00:00) (the default value).

Call A is not a long duration call because its duration is less than 24 hours (or 1440 minutes) long.

Call B is not a long duration call because its duration is longer than 24 hours but it is less than 1440 minutes long at the Media_Alive EM generation time (midnight).

Call C is a long duration call because at the second midnight after the call was established, its duration is longer than 1440 minutes (actually 2340 minutes long). Only one Media_Alive is generated because it is terminated prior to the next Media_Alive EM generation time (midnight).

Call D is also a long duration call because it meets the same criterion as Call C. Because it stays up across the midnight boundary after becoming a long duration call, two Media_Alive EMs are generated.

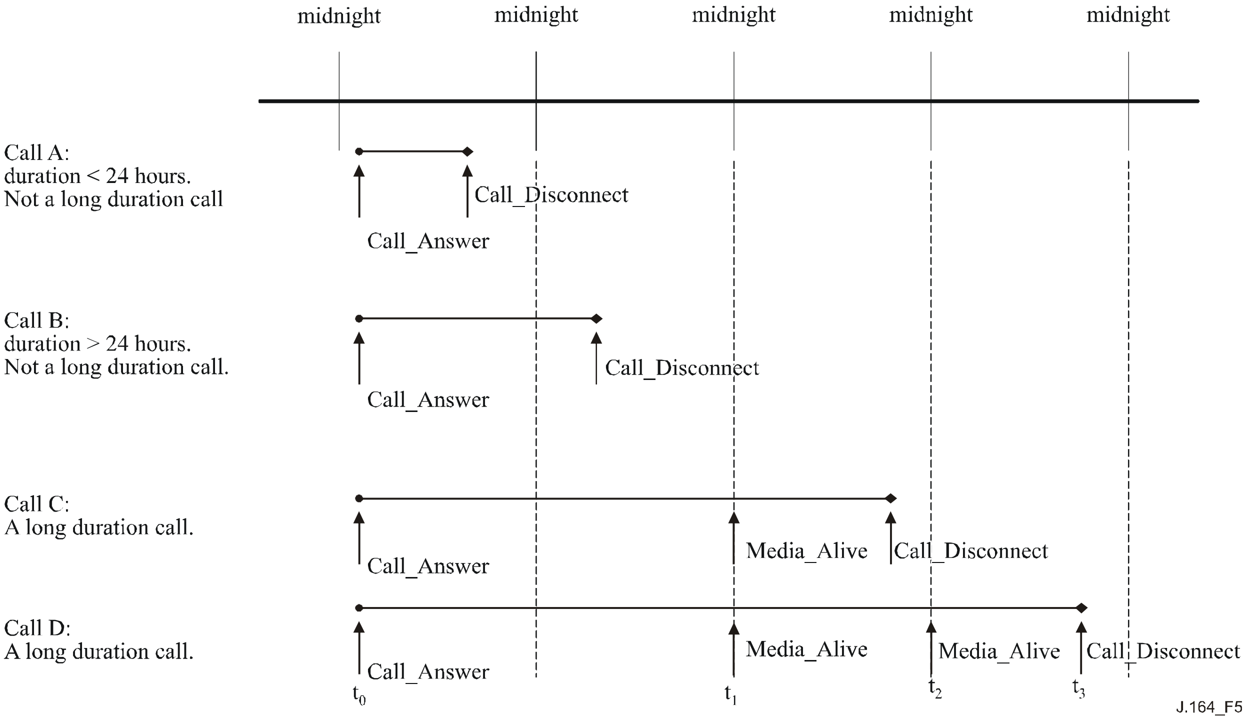


Figure 5 – Long duration call identification

From Figure 5, Call D will be used to illustrate the contents of the long duration call records belonging to a same call id (BCID).

In the above scenario, there will be three records generated from Call D, which can be identified as records 1, 2 and 3.

Call D starts on day 0 at 9:00:00 AM. (t^0 July 27, 2001).

At first midnight crossing, the call is 900 minutes long (or 5400 seconds). So no record is generated.

At second midnight crossing (t[1]), the call is 2340 minutes long (or 140400 seconds). So a Media_Alive Event Message is generated with the following value:

- EM Header.Event_time = 20010729000000.000

At third midnight crossing (t[2]), the call is 3780 minutes long (or 226800 seconds). A Media_Alive event message with the following value is generated:

- EM Header.Event_time = 20010730000000.000

At 5:00 pm, following the third midnight, the call is terminated, (t[3]). The overall duration of the call is 4800 minutes long (or 288000 seconds). A Call_Disconnect event message with the following value is generated for this call BCID.

- EM Header.Event_time = 20010730170000.000

Table 34 – Media_Alive event message

Attribute name	Required or optional	Comment
EM_Header, see (Table 38)	R	The EM_Header attribute MUST be present as the first attribute of the EM.

9.20 Media_Statistics

This Event Message (see Table 35) is generated when a gateway returns VoIP Metrics in NCS or TGCP messages.

CMSs and MGCs MAY generate and time-stamp this message when an NCS or TGCP signalling message is received from the MTA/MG that contains VoIP Metrics data. If this optional Event Message is generated, it MUST contain all of the VoIP metrics data received as specified in Table 35. VoIP metrics data is defined as that contained within the Local and Remote XR_Blocks; RTCP data is not considered VoIP metrics data even though it is contained in this message. See [ITU-T J.162] for more information on how this data is represented in NCS signalling, and to determine which NCS messages may carry this data. CMSs and MGCs MUST NOT generate this message when no VoIP Metrics data is received in the NCS or TGCP signalling messages.

Within the NCS or TGCP Signalling response from the MTA/MG, the RTCP_Data metrics are found in the P: parameter, the Local_XR_Block metrics are found in the XRM/LVM: parameter, and the Remote_XR_Block metrics are found in the XRM/RVM parameter. The CMS and MGC MUST remove the parameter name, and copy the metrics as they appear in NCS or TGCP into the appropriate Media_Statistics attribute.

Note that in a very common case, VoIP Metrics data is included in response to a DLCX message. In this case, the time-stamp is later than the Signalling_Stop message. Thus, it is not valid to assume that the Signalling_Stop message is necessarily the last message associated with a voice connection.

Table 35 – Media_Statistics event message

Attribute name	Required or optional	Comment
EM_Header	R	The EM_Header attribute MUST be present as the first attribute of the EM.
RTCP_Data	O	The RTCP_Data attribute MUST be present if an NCS or TGCP message was received with any RTCP report data included.
Local_XR_Block	O	The Local_XR_Block MUST be present if an NCS or TGCP message was received with any local VoIP metrics data included.
Remote_XR_Block	O	The Remote_XR_Block MUST be present if an NCS or TGCP message was received with any remote VoIP metrics data included.

10 IPCablecom Event Message attributes

This clause describes the IPCablecom attributes that are included in the IPCablecom Event Messages. Event Messages and attributes denoted by an asterisk "*" in Table 36 indicate that the message or attribute is specific to electronic surveillance Event Messages. Electronic surveillance specific Event Messages and/or attributes MUST NOT be sent to the RKS.

Table 36 shows a mapping of the IPCablecom Event Messages and their associated IPCablecom attributes.

Table 36 – IPCablecom attributes mapped to IPCablecom event messages

EM attribute ID	EM attribute name	Event Message ID																						
		1 – Signalling_Start	2 – Signalling_Stop	3 – Database_Query	4 – Deferred	5 – Deferred	6 – Service_Instance	7 – QoS_Reserve	8 – QoS_Release	9 – Service_Activation	10 – Service_Deactivation	11 – Media_Report*	12 – Signal_Instance*	13 – Interconnect_Start	14 – Interconnect_Stop	15 – Call_Answer	16 – Call_Disconnect	17 – Time_Change	19 – QoS_Commit	20 – Media_Alive	21 – Conference_Party_Change*	22 – Media_Statistics	23 – Surveillance_Stop*	24 – Redirection *
0	Reserved																							
1	EM_Header	X	X	X			X	X	X	X	X	X*	X*	X	X	X	X	X	X	X	X*	X	X*	X*
2	Undefined																							
3	MTA_Endpoint_Name	X																						
4	Calling_Party_Number	X					X			X	X													
5	Called_Party_Number	X		X			X																	
6	Database_ID			X																				
7	Query_Type			X																				
8	Undefined																							
9	Returned_Number			X																				
10	Undefined																							
11	Call_Termination_Cause		X				X										X							
12	Undefined																							

Table 36 – IPCablecom attributes mapped to IPCablecom event messages

EM attribute ID	EM attribute name	Event Message ID																							
		1 – Signalling_Start	2 – Signalling_Stop	3 – Database_Query	4 – Deferred	5 – Deferred	6 – Service_Instance	7 – QoS_Reserve	8 – QoS_Release	9 – Service_Activation	10 – Service_Deactivation	11 – Media_Report*	12 – Signal_Instance*	13 – Interconnect_Start	14 – Interconnect_Stop	15 – Call_Answer	16 – Call_Disconnect	17 – Time_Change	19 – QoS_Commit	20 – Media_Alive	21 – Conference_Party_Change*	22 – Media_Statistics	23 – Surveillance_Stop*	24 – Redirection *
13	Related_Call_Billing_ Correlation_ID		X				X									X								X*
14	First_Call_Calling_ Party_Number						X																	
15	Second_Call_Calling_ Party_Number						X																	
16	Charge_Number						X			X	X					X								
17	Forwarded_Number									X														
18	Service_Name						X			X	X													
19	Undefined																							
20	Intl_Code	X																						
21	Dial_Around_Code	X																						
22	Location_Routing_ Number	X		X																				
23	Carrier_Identification_ Code	X					X*							X	X									X*
24	Trunk_Group_ID	X												X	X									
25	Routing_Number	X					X							X										
26	MTA_UDP_Portnum							X											X					
27	Undefined																							
28	Undefined																							
29	Channel_State											X*												
30	SF_ID							X	X										X					
31	Error_Description																							
32	QoS_Descriptor							X											X					
33	Undefined																							
34	Undefined																							
35	Undefined																							
36	Undefined																							
37	Direction_indicator	X																						
38	Time_Adjustment																	X						
39	SDP_Upstream											X*												
40	SDP_Downstream											X*												
41	User_Input	X*																						
42	Translation_Input	X*																						
43	Redirected_From_Info	X*																						
44	Electronic_Surveillance_ Indication	X*																					X*	
45	Redirected_From_Party_ Number						X*																	X*

Table 36 – IPCablecom attributes mapped to IPCablecom event messages

EM attribute ID	EM attribute name	Event Message ID																						
		1 – Signalling_Start	2 – Signalling_Stop	3 – Database_Query	4 – Deferred	5 – Deferred	6 – Service_Instance	7 – QoS_Reserve	8 – QoS_Release	9 – Service_Activation	10 – Service_Deactivation	11 – Media_Report*	12 – Signal_Instance*	13 – Interconnect_Start	14 – Interconnect_Stop	15 – Call_Answer	16 – Call_Disconnect	17 – Time_Change	19 – QoS_Commit	20 – Media_Alive	21 – Conference_Party_Change*	22 – Media_Statistics	23 – Surveillance_Stop*	24 – Redirection *
46	Redirected_To_Party_ Number						X*																	X*
47	Undefined																							
48	CCC_ID							X*	X*			X*							X*					
49	FEID		X													X								
50	Flow_Direction							X	X			X*							X					
51	Signal_Type												X*											
52	Alerting_Signal												X*											
53	Subject_Audible_Signal												X*											
54	Terminal_Display_Info												X*											
55	Switch_Hook_Flash												X*											
56	Dialled_Digits												X*											
57	Misc_Signalling_ Information												X*											
61-79	Reserved																							
80	Account_Code						X																	
81	Authorization_Code						X																	
82	Jurisdiction_Information_ Parameter	X																						
83	Called_Party_NP_ Source	X																						
84	Calling_Party_NP_ Source	X																						
85	Ported_In_Calling_ Number	X																						
86	Ported_In_Called_ Number	X																						
87	Billing_Type	X																						
88	Signalled_To_Number												X*											
89	Signalled_From_Number												X*											
90	Communicating_Party																				X*			
91	Joined_party																				X*			
92	Removed_Party																				X*			
93	RTCP_Data																					X		
94	Local_XR_Block																					X		
95	Remote_XR_Block																					X		
96	Surveillance_Stop_Type*																						X*	
97	Surveillance_Stop_ Destination*																						X*	
98	Related_ICID	X																						

Table 37 provides a detailed list of the IPCablecom Event Message attributes. A data value of an attribute may be represented by a simple data format (one data field) or by a more complex data format (Data Structure). Data Structure formats of the appropriate attributes are detailed in Tables 37 through 43. It should be noted that Event Message 17 is not service-dependent.

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
0	Reserved			
1	76 bytes	EM_Header	Data structure. See Table 38.	Common data required on every IPCablecom Event Message
2	Undefined			
3	Variable length, maximum of 247 bytes (247 is maximum length of vendor-specific attribute)	MTA_Endpoint_ Name	ASCII character string	Physical Port name (aaln/#) as defined in the IPCablecom NCS Specification (ITU-T Rec. J.162).
4	20 bytes	Calling_Party_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the Originating party. In the future, other numbering plans will be addressed.
5	20 bytes	Called_Party_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the terminating party. In the future, other numbering plans will be addressed.
6	Variable length, maximum of 247 bytes (247 is maximum length of vendor-specific attribute)	Database_ID	Right-justified, space-padded ASCII character string	A unique identifier of the referenced database.
7	2 bytes	Query_Type	Unsigned integer	Query type: 0 = Reserved 1 = Toll-Free Number Lookup 2 = LNPNumberLookup. 3 = Calling Name Delivery Lookup
8	Undefined			

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
9	20 bytes	Returned_Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number resulting from a database query. In the future, other numbering plans will be addressed.
10	Undefined			
11	6 bytes	Call_Termination_ Cause	Data structure. See Table 41.	Termination code identifier
12	Undefined			
13	24 bytes	Related_Call_ Billing_ Correlation_ID	Data structure. See Table 39.	Billing Correlation ID for possible use in value added services or to identify the matching originating/terminating half of the service.
14	20 bytes	First_Call_ Calling_Party_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the calling party. In the future, other numbering plans will be addressed.
15	20 bytes	Second_Call_ Calling_Party_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the calling party. In the future, other numbering plans will be addressed.
16	20 bytes	Charge_Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of billable party. In the future, other numbering plans will be addressed.
17	20 bytes	Forwarded_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the Forwarded Number. In the future, other numbering plans will be addressed.

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
18	32 bytes	Service_Name	Right-justified, space-padded ASCII character string	Class Service Name. Allowed names are: "Call_Block" "Call_Forward" "Call_Waiting" "Repeat_Call" "Return_Call". Three_Way_Call Customer_Originated_Trace
19	Undefined			
20	4 bytes	Intl_Code	Right-justified, space-padded ASCII character string	International Country Code
21	8 bytes	Dial_Around_ Code	Right-justified, space-padded ASCII character string	Dial-around code used for per-call selection of inter-exchange carrier
22	20 bytes	Location_Routing_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the terminating party. In the future, other numbering plans will be addressed.
23	8 bytes	Carrier_ Identification_ Code	Right-justified, space-padded ASCII character string	If the operator provides a service for a telecommunications operator, the carrier identification code (CIC) or other identification is recorded in this field.
24	6 bytes	Trunk_Group_ID	Data structure. See Table 42.	Trunk group identification
25	20 bytes	Routing_Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the terminating party. In the future, other numbering plans will be addressed.
26	4 bytes	MTA_UDP_ Portnum	Unsigned integer	MTA Endpoint UDP Port Number Destination port field value in DQoS Gate-spec object received in DQoS Gate-Set message.
27	Undefined			

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
28	Undefined			
29	2 bytes	Channel_State	Unsigned integer	Channel State: 0 = Not Used/Reserved 1 = Open 2 = Change 3 = Close
30	4 bytes	SF_ID	Unsigned integer	Service Flow ID, a 32-bit integer assigned by the CMTS to each DOCSIS Service Flow defined within a DOCSIS RFMAC domain. SFIDs are considered to be in either the upstream direction (USFID) or downstream direction (DSFID). USFIDs and DSFIDs are allocated from the same SFID number space.
31	32 bytes	Error_Description	Right-justified, space-padded ASCII character string	A user-defined description of the error conditions. Refer to Table 40.
32	Variable; Min 8 bytes	QoS_Descriptor	Data structure. See Table 43.	QoS parameters data
33	Undefined			
34	Undefined			
35	Undefined			
36	Undefined			
37	2 bytes	Direction_ indicator	Unsigned integer	Specifies if a device acts on behalf of an originating or terminating part of the call at the time an Event Message is being generated. 0 = Undefined 1 = Originating 2 = Terminating.
38	8 bytes	Time_Adjustment	Signed integer	Time adjustment of an element's (CMS, CMTS, MGC) clock. This time is in millisecond, detailing the amount of the time change.

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
39	variable	SDP_Upstream	ASCII character string	Description of upstream packet flow
40	variable	SDP_Downstream	ASCII character string	Description of downstream packet flow
41	variable	User_Input	ASCII character string	Sequence of dialled digits as entered by user
42	20 bytes	Translation_Input	Right-justified, space-padded ASCII character string	E.164 address of the input to an external translation lookup
43	42 bytes	Redirected_From_ Info	Data Structure	Information about previous redirections of this call
44	variable	Electronic_ Surveillance_ Indication	Data Structure	Additional destination of CCC and CDC for redirected call
45	20 bytes	Redirected_From_ Party_Number	Right-justified, space-padded ASCII character string	E.164 address of the party initiating a redirection
46	20 bytes	Redirected_To_ Party_Number	Right-justified, space-padded ASCII character string	E.164 address of the destination party of a redirection
47	Variable	Undefined	Binary octet string	A pre-shared key that is used to authenticate DF-DF IKE key exchanges. The source DF receives the same key in the Electronic-Surveillance-Indication attribute, field DF-DF-Key.
48	4 bytes	CCC_ID	Unsigned integer	Call Content identifier assigned by CMS or MGC

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
49	Variable length, maximum of 247 bytes	FEID	ASCII character string.	Financial Entity ID. The first 8 bytes constitute operator defined data. By default, the first 8 bytes are zero filled. From the 9th byte on the field contains the operator's domain name which uniquely identifies the operator for billing and settlement purposes. The operator's domain name is limited to 239 bytes.
50	2 bytes	Flow_Direction	Unsigned integer	Flow direction: 0 = Reserved 1 = Upstream 2 = Downstream
51	2 bytes	Signal_Type	Unsigned integer	Type of signal: 0 = Reserved 1 = Network_Signal 2 = Subject_Signal
52	4 bytes	Alerting_Signal	Unsigned integer	Type of alerting signal[a)]: 0 = Reserved 1 = Ringing (rg) 2 = Distinctive ringing 2 (r2) 3 = Distinctive ringing 3 (r3) 4 = Distinctive ringing 4 (r4) 5 = Ringsplash (rs) 6 = Call waiting tone 1 (wt1) 7 = Call waiting tone 2 (wt2) 8 = Call waiting tone 3 (wt3) 9 = Call waiting tone 4 (wt4) 10 = Reserved 11 = Distinctive ringing 0 (r0) 12 = Distinctive ringing 1 (r1) 13 = Distinctive ringing 5 (r5) 14 = Distinctive ringing 6 (r6) 15 = Distinctive ringing 7 (r7)

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
53	4 bytes	Subject_Audible_ Signal	Unsigned Integer	Type of audible signal[b)]: 0 = Reserved 1 = Dial tone (dl) 2 = Stutter dial tone (sl) 3 = Ring back tone (rt) 4 = Reorder tone (ro) 5 = Busy tone (bz) 6 = Confirmation tone (cf) 7 = Reserved 8 = Message waiting indicator (mwi) 9 = Off-hook warning tone 10 = Reserved 11 = Reserved 12 = Reserved 13 = Reserved 14 = Reserved 15 = Reserved 16 = Reserved 17 = Reserved 18 = Reserved 19 = Reserved 20 = Reserved 21 = Reserved
54	Variable length, maximum of 201 bytes	Terminal_Display_ Info	Data Structure	Provides information signalled for display on surveillance subject's terminal.
55	Variable length, maximum of 128 bytes	Switch_Hook_Flash	ASCII character string	Indicates signalling of a flash hook. Value is "FLASHHOOK" for Flash hook signal (hf).
56	Variable length, maximum of 128 bytes	Dialled_Digits	ASCII character String	Provides digits dialled. Value is digits received for DTMF digits signal (0-9,*,#,A,B,C,D).

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
57	Variable length, maximum of 128 bytes	Misc_Signalling_ Information	ASCII character string	Provides miscellaneous signalling information. Attribute is populated as follows: – Value is digits sent for DTMF digits signal (0-9,*,#,A,B,C,D). – Value is "FAX TONE" for Fax tone signal (ft). – Value is "MODEM TONE" for Modem tone signal (mt). – Value is "TDD TONE" for TDD signal (TDD).
61-79				Reserved for IPCablecom Multimedia
80	24 bytes	Account_Code	Right-justified, space-padded ASCII character string	Account code used for this call.
81	24 bytes	Authorization_Code	Right-justified, space-padded ASCII character string	Authorization code used for this call; it may be used to segment an account code.
82	6 bytes	Jurisdiction_Information_Parameter	Right-justified, space-padded ASCII character string	The originating network element's JIP.
83	2 bytes	Called_Party_NP_ Source	Unsigned integer	1) Provisioned data 2) Signalling Information 3) NPDB
84	2 bytes	Calling_Party_NP_ Source	Unsigned integer	1) Provisioned data 2) Signalling Information 3) NPDB
85	2 bytes	Ported_In_Calling_ Number	Unsigned integer	Value: 0 = Not ported In 1 = Ported In
86	2 bytes	Ported_In_Called_ Number	Unsigned integer	Value: 0 = Not ported In 1 = Ported In

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
87	2 bytes	Billing_Type	Unsigned integer	Indicates if the call is measured rate or flat rate. Value: 1 = Measured rate (aligned with BAF call type 1 that indicates a local message rate call or a measured call). 3 = Flat rate (aligned with BAF call type 3 that indicates local message rate that is not timed).
88	20 bytes	Signalled_To_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the Originating party. In the future, other numbering plans will be addressed.
89	20 bytes	Signalled_From_ Number	Right-justified, space-padded ASCII character string	IPCablecom will use E.164 formatted address specifying the number of the Originating party. In the future, other numbering plans will be addressed.
90	26 bytes	Communicating_ Party	Data Structure (see Table 47)	CCC_ID and Party ID of the communicating party in the conference.
91	26 bytes	Joined_Party	Data Structure (see Table 47)	CCC_ID and Party ID of the party that joined the conference.
92	26 bytes	Removed_Party	Data Structure (see Table 47)	CCC_ID and Party ID of the party removed from the conference.
93	variable	RTCP_Data	ASCII character string	RTCP metrics available on a connection.
94	variable	Local_XR_Block	ASCII character string	Local RTCP-XR VoIP Metrics Block data available on a connection.
95	variable	Remote_XR_Block	ASCII character string	Remote RTCP-XR VoIP Metrics Block data available on a connection.

Table 37 – IPCablecom event message attributes

EM attribute ID	EM attribute length	EM attribute name	EM attribute value type	Attribute data description
96	2 bytes	Surveillance_Stop_ Type	Unsigned Integer	Value: 0 = Reserved 1 = End of surveillance (CDC and, if present, CCC) 2 = End of CCC only (CDC will continue)
97	2 bytes	Surveillance_Stop_ Destination	Unsigned Integer	Value: 0 = Reserved 1 = Surveillance_Stop applies to local surveillance only 2 = Surveillance_Stop applies to both local and remote surveillance 3 = Surveillance_Stop applies only to remote surveillance
98	variable	Related_ICID	ASCII character string	IMS charging identifier (ICID) is used to allow correlation of Event Messages generated by CMSs and MGCs with Accounting Events generated by other network elements

[a] The values are the standard values defined for a circuit-switched environment to report alerting signals for voice services to law enforcement. The "Reserved" values are for alerting signals that are not relevant to an IPCablecom environment, and have been reserved to achieve consistent reporting across different voice environments.

[b] The values are the standard values defined for a circuit-switched environment to report audible signals for voice services to law enforcement. The "Reserved" values are for audible signals that are not relevant to an IPCablecom environment, and have been reserved to achieve consistent reporting across different voice environments.

10.1 EM_Header attribute structure

Table 38 contains a detailed description of the fields in the EM_Header attribute structure. This Event Message Header attribute MUST be the first attribute in every IPCablecom Event Message.

Table 38 – EM_Header attribute structure

Field name	Semantics	Value type	Length
Version ID	Identifies version of this structure 1 = Deprecated 2 = Deprecated 3 = IPCablecom Multimedia 4 = IPCablecom The CMS, MGC and CMTS network element MUST set the value of the Version_ID to 4. NOTE – A value of ≥ 2 indicates the Event_Object field in this header is used	Unsigned integer	2 bytes
Billing Correlation ID	Unique identifier for a transaction within a network. See clause 10.1.1.	Data structure. See Table 39.	24 bytes
Event Message Type	Identifies the type of Event Message. Refer to Table 14 for a listing of Event message types.	Unsigned integer	2 bytes
Element Type	Identifies type of Originating Element: 0 = Reserved 1 = CMS 2 = CMTS 3 = Media Gateway Controller	Unsigned integer	2 bytes
Element ID	Network wide unique identifier, 5 digits (statically configured element number unique within an IPCablecom domain in the range of 0-99,999)	Right-justified, space-padded ASCII character string	8 bytes
Time_Zone	Identifies daylight savings time and offset from universal time (UTC). Daylight Savings Time: 0 = Standard Time 1 = Daylight Savings The Daylight-Savings Time indicator MUST be set to a value of 1 if the network element is in a region that implements DST and then only during the daylight-saving-time period (usually the summer months). Since there may be areas in which the daylight-saving-time offset indicates a time-change other than 1 hour, the receiving system (e.g., RKS) needs to correctly calculate local time based on knowledge of the area(s) in which the subscriber and the network element reside. UTC offset: + HHMMSS The offset is reported from the network element (CMS/MGC/CMTS) point of view; not based on the subscriber point of view. The UTC offset represents the time offset from universal time (formerly called Greenwich Mean Time, or GMT) when standard time is in effect and MUST NOT change on transition into or out of daylight-saving-time.	ASCII character string	1 byte 7 bytes

Table 38 – EM_Header attribute structure

Field name	Semantics	Value type	Length
Sequence Number	Each network element MUST assign a unique and monotonically increasing unsigned integer for each Event Message sent to a given RKS pair (primary/secondary). For the purpose of this Recommendation, monotonically increasing is to be interpreted as increasing by 1. This is used by the RKS to determine if Event Messages are missing from a given network element.	Unsigned integer	4 bytes
Event_time	Event generation time and date. Millisecond granularity. This specifies the local time, i.e., after applying Time_Zone UTC offset and Daylight Savings Time adjustment to UTC time. Format: yyyymmddhhmmss.mmm	ASCII character string	18 bytes
Status	Status indicators	See Table 40	4 bytes
Priority	Indicates the importance to be assigned relative to other event messages. The processing of event message priority is defined as: – as long as there are higher priority messages within the system, lower priority messages SHOULD NOT be processed; – arrival of a higher priority message will not interrupt current lower priority message processing. Only after the completion of the message processing, the newly arrived higher message will be processed. For IPCablecom, values for this field will be service-provider assigned. 255 = highest priority 0 = lowest priority 128 = default.	Unsigned integer	1 byte
Attribute Count	Indicates the number of attributes that follow (or are appended to) this header in the current Event Message	Unsigned integer	2 bytes
Event Object	The Event_Object field allows for a grouping of services. 0 = Accounting Event Message 1 = PCES Event Message The CMS, CMTS and MGC network elements MUST set the value of the Event_Object field to 0 if the Event Message is sent to the RKS. The RKS MUST discard EM messages when the Event_Object field is set to 1. The CMS, CMTS and MGC network elements MUST set the value of the Event_Object field to 1 if the Event Message is sent to the DF. The DF MUST discard EM messages when the Event Object field is set to a value different than 1.	Unsigned integer	1 byte

10.1.1 Billing correlation ID (BCID) field structure

Table 39 describes the billing correlation ID field (BCID). The RKS, or some other back-office application, uses the billing correlation ID to correlate Event Messages that are generated for a single transaction. It is one of the fields in the Event Message Header attribute. The billing correlation ID is unique for each Transaction in the network. All Event Messages with the same billing correlation ID SHOULD be sent to the same primary RKS except in failover circumstances in which case the Event Messages MUST be sent to the secondary RKS.

Table 39 – BCID field description

Field name	Semantics	Value type	Length
Timestamp	High-order 32 bits of NTP time reference	Unsigned integer	4 bytes
Element_ID	Network-wide unique identifier 5 digits (statically configured element number unique within an IPCablecom domain in the range of 0-99,999)	Right-justified, space-padded ASCII character string	8 bytes
Time_Zone	Identifies daylight savings time and offset from universal time (UTC). Daylight Savings Time: 0 = Standard Time 1 = Daylight Savings The Daylight-Savings Time indicator MUST be set to a value of 1 if the network element is in a region that implements DST and then only during the daylight-saving-time period (usually the summer months). Since there may be areas in which the daylight-saving-time offset indicates a time-change other than 1 hour, the receiving system (e.g., RKS) needs to correctly calculate local time based on knowledge of the area(s) in which the subscriber and the network element reside. UTC offset: + HHMMSS The offset is reported from the network element (CMS/MGC/CMTS) point of view; not based on the subscriber point of view. The UTC offset represents the time offset from universal time (formerly called Greenwich Mean Time, or GMT) when standard time is in effect and MUST NOT change on transition into or out of daylight-saving-time.	ASCII character string	1 byte 7 bytes
Event Counter	Monotonically increasing for each Transaction. For the purpose of this Recommendation, monotonically increasing Event_Counter is to be interpreted as an increasing number that is greater than the preceding number	Unsigned integer	4 bytes

The Related_Call_Billing_Correlation_ID attribute structure is shown in Table 38.

10.1.2 Status field structure

The Status field of the Event Message Header is a 32-bit mask. Bit 0 is the low-order bit; the field is treated as a 4-byte unsigned integer. Table 40 presents Status Field description.

Table 40 – Status field description

Start bit	Semantics	Bit Count
0-1	Error indicator: 0 = No Error 1 = Possible Error 2 = Known Error 3 = Reserved NOTE 1 – If the Error Indicator bit of the Status field is set to 2 (Known Error), the Error_Description attribute (EM attribute ID 31) MUST be included in the Event Message corresponding to this header. NOTE 2 – If the Error Indicator bit of the Status field is set to 1 (Possible Error), the Error_Description attribute (EM attribute ID 31) MAY be included in the Event Message corresponding to this header.	2
2	Event Origin: 0 = Trusted Element 1 = Untrusted Element	1
3	Event Message Proxied: 0 = Not proxied, all data known by sending element 1 = Proxied: data sent by a trusted element on behalf of an untrusted element.	1
4-31	Reserved. The Status field bits 4 to 31 MUST be set to 0.	28

10.2 Call termination cause attribute structure

Table 41 describes the data structure of the Call_Termination_Cause attribute. It is important to note that in some cases, the Call_Termination_Cause attribute may include a Call Completion Code that may indicate a successful call completion.

Table 41 – Call termination cause data structure

Field name	Semantics	Value type	Length
Source_Document	Identifies the source Document of the Cause Codes: 0 = Reserved 1 = Telcordia Technologies Generic Requirements GR-1100-CORE, Section 2.9, Table 411 2 = Telcordia Technologies Generic Requirements GR-1100-CORE, section 2.9, Table 265. A Source_Document value of 2 must only be used with the Service_Instance Event Message. 3 and above for future use.	Unsigned integer	2 bytes

Table 41 – Call termination cause data structure

Field name	Semantics	Value type	Length
Cause_Code	Cause Code Identifier. Meaning determined by Source_Document defined in previous field. The Cause_Code attribute is a 4-byte value. In the case where Source_Document = 1, the IPCablecom Cause_Code is populated based only on the GR-1100-CORE (Table 411) definition of character 2 (Cause Category) and characters 3-5 inclusive (Cause Indication), and encoding these 4 characters as an unsigned integer. Characters 1 and 6 of Table 411 are not relevant. For example, the encoding of a Cause_Code with Cause Category of ITU Standard (0) and a Cause Indication of "Normal Call Clearing" (016) is the unsigned integer value 0016. In the case where Source_Document = 2, the IPCablecom Cause_Code is populated based on the GR-1100-CORE – Table 265 character 1. For example, the encoding of a Cause_Code with a Call Completion Code "Not completed: Invalid authorization code" (3) is the unsigned integer value of 0003.	Unsigned integer	4 bytes

10.3 Trunk group ID attribute structure

Table 42 describes the Trunk Group ID data structure.

Table 42 – Trunk group ID data structure

Field name	Semantics	Value type	Length
Trunk_Type	1 = when Non-SS7 (MF) direct trunk group is used 2 = Not used 3 = when an SS7 signalling trunk is directly connected to IC/INC, SS7 direct trunk group number 4 = when an SS7 signalling trunk is connected to IC via AT and SS7 from AT to EO 5 = Not used 6 = when Non-SS7 trunk is used between the EO and AT and SS7 signalling trunk is used between AT and IC. (Terminating only) 9 = Signalling type not specified	Unsigned integer Value is the Trunk Group Signalling Type Indicator as defined in Telcordia GR-1100-CORE, Table 83	2 bytes
Trunk Group_Number	ASCII identifier. Values in the range 0000-9999	Right-justified, space-padded ASCII character string	4 bytes

10.4 QoS descriptor attribute structure

Table 43 describes the QoS Descriptor data structure.

Table 43 – QoS descriptor data structure

Field name	Semantics	Value type	Length
Status_Bitmask	Bitmask describing structure contents. (See Table 44)	Bitmap	4 bytes
Service_Class_Name	Service profile name	Right-justified, space-padded ASCII character string	16 bytes
QoS_Parameter_Array	QoS Parameters. Contents determined by Status Bitmask	Unsigned integer array	Variable length array of 32-bit unsigned integers

Table 44 describes the QoS Status_Bitmask field of the QoS Descriptor attribute. Bits 2-17 describe the contents of the QoS_Parameter_Array. Each of these bits indicates the presence (bit = 1) or absence (bit = 0) of the named QoS parameter in the array. The location of a particular QoS parameter in the array matches the order in which that parameter's bit is encountered in the bitmask, starting from the low-order bit.

Each QoS parameter present in the QoS_Parameter_Array must occupy four bytes. The definition and encoding of the QoS parameters can be found in [ITU-T J.112]. QoS parameters whose definition specifies less than four bytes must be right justified (where the 4 bytes are to be treated as an unsigned integer) in the four bytes allocated for the array element.

Table 44 – QoS status bit mask

Start bit	Semantics	Bit count
0	State indication: 0 = Illegal value 1 = Resource reserved but not Activated 2 = Illegal value 3 = Resource reserved and activated	2
2	Service Flow Scheduling Type	1
3	Nominal Grant Interval	1
4	Tolerated Grant Jitter	1
5	Grants Per Interval	1
6	Unsolicited Grant Size	1
7	Traffic Priority	1
8	Maximum Sustained Rate	1
9	Maximum Traffic Burst	1
10	Minimum Reserved Traffic Rate	1
11	Minimum Packet Size	1
12	Maximum Concatenated Burst	1
13	Request/Transmission Policy	1

Table 44 – QoS status bit mask

Start bit	Semantics	Bit count
14	Nominal Polling Interval	1
15	Tolerated Poll Jitter	1
16	IP Type of Service Override	1
17	Maximum Downstream Latency	1

10.5 Redirected-from-info attribute structure

Table 45 describes the data structure of the Redirected-From-Info.

Table 45 – Data structure of the redirected-from-info attribute

Field name	Semantics	Value type	Length
Last_Redirecting_Party	E.164 address of most recent redirecting party	ASCII string	20 bytes
Original_Called_Party	E.164 address of the original called party	ASCII string	20 bytes
Number_of_Redirections	Number of times this call has been redirected	Unsigned integer	2 bytes

10.6 Electronic-surveillance-indication attribute structure

Table 46 describes the data structure of the Electronic-Surveillance-Indication. The Electronic-Surveillance-Indication attribute appears in the Signalling_Start EM or Surveillance_Stop EM.

This attribute creates a "chain" of DFs as calls are redirected from one endpoint to another. In such scenarios, the DF associated with each CMS will be responsible for forwarding the call content and/or call data to the next DF in the chain. The last DF in the chain will then report the call content and/or call data to the appropriate LEA. If multiple surveillances are being performed, a DF in the middle of the chain may report the call content and/or call data to the appropriate LEA, as well as forward the call content and/or call data to the next DF in the chain.

This attribute is included in a Signalling_Start EM to indicate to the DF where to forward call content and/or call data for a particular intercept. For example, in a CMSS environment, a CMS may perform surveillance at the request of another CMS due to a redirection by the subject. In such a scenario, the CMS would send call content and/or call data to its DF, and the DF would then forward the call data and call content to the DF responsible for delivering the call content and/or call data to the appropriate law enforcement agency (LEA).

This attribute is included in a Surveillance_Stop EM when a CMS needs to indicate that surveillance will end, but the DF is not part of the surveillance chain as described above. This will occur in a CMSS environment when a CMS is redirected, and surveillance is requested as part of the redirection. In such a scenario, the CMS will normally request that the redirected-to CMS perform surveillance on behalf of the redirecting CMS, and a chain will be established between the redirected-to CMS and the redirecting CMS. However, the redirecting CMS may be in a jurisdiction in which surveillance cannot be performed. As a result, the CMS would send a Surveillance_Stop EM, and include the Electronic-Surveillance-Indication attribute, to ensure that the EM is forwarded to the DF of the redirecting CMS.

Table 46 – Data structure of the electronic-surveillance-indication attribute

Field name	Semantics	Value type	Length
DF_CDC_Address	IP address of the electronic surveillance Delivery Function of the forwarding party for event messages	IP Address	4 bytes
DF_CCC_Address	IP address of the electronic surveillance Delivery Function of the forwarding party for call content packets	IP Address	4 bytes
CDC_Port	Port number to which to send a copy of event messages	Unsigned integer	2 bytes
CCC_Port	Port number to which to send a copy of call content packets	Unsigned integer	2 bytes
Local_CCC_ID	Call Content Identifier assigned by CMS or MGC	Unsigned integer	4 bytes
Remote_CCC_ID	Call Content Identifier assigned by CMS or MGC	Unsigned integer	4 bytes
Remote_Surveillance_ Subject_BCID	BCID of the surveillance subject at the redirecting CMS	Data Structure	24 Bytes

10.7 Attributes for conference parties

Table 47 describes the data structure of the attributes Communicating_Party, Joined_Party and Removed_Party.

Table 47 – Communicating_Party, Joined_Party and Removed_Party attributes

Field name	Semantics	Value type	Length
Party_ID	E.164 formatted address specifying the number of the party. In the future, other numbering plans will be addressed.	Right-justified, space-padded ASCII character String.	20 bytes
CCC_ID_Valid	When CCC_ID is present, this field is set to 1; otherwise it is set to 0.	Unsigned integer	2 bytes
CCC_ID	The CCC_ID associated with the call leg for the Party_ID. When the subject is one of the party in the conference, any of the active CCC_IDs can be used. When CCC_ID_Valid is not set (CCC_ID not valid in the case of Call Data), this field is filled with the default binary value of all ones.	Unsigned integer	4 bytes

11 Transport-independent event message attribute TLV format

Every Event Message Attribute is defined by a type length value (TLV) tuple. An attribute TLV tuple has the following format (see Table 48):

Table 48 – Event message attribute TLV-tuple format

Field name	Semantics	Field length
Attribute Type	IPCablecom Attribute Type	1 bytes (refer to Table 37)
Attribute Length	IPCablecom Attribute Length	1 byte (refer to Table 37) NOTE – Value is Attribute Length + 2
Attribute Value	IPCablecom Attribute Value	Attribute Length bytes

12 IPCablecom event message file format

The IPCablecom Event Message File Format has the following basic structure:

12.1 File bit/Byte order

Table 49 defines the Bit/Byte order for the Event Message file. For fields that span multiple bytes, the high-order bit of the field is the highest order bit of the lowest-numbered byte. Conversely, the low-order bit of a multi-byte field is the lowest-order bit of the highest-numbered byte.

Table 49 – Bit/Byte order for the event message file

Bit/Byte order		High-order bit							Low-order bit
Binary		7	6	5	4	3	2	1	0
High-order Byte	Byte 1								
Low-order Byte	Byte n								

12.2 File header

The following header MUST be written at the start of a file formatted using the IPCablecom Event Message File Format:

Table 50 – IPCablecom event message file format

Field name	Semantics	Length	Type
Format Version	Identifies the version of this file format. The value must be 1 to comply with this version of the EM specification.	4 bytes	Unsigned int
EM Count	Number of EMs in File	8 bytes	Unsigned int
File Creation Timestamp	YYYYMMDDHHMMSS.MMM	18 bytes	ASCII
File Sequence Number	Monotonically increasing for each new file. For the purpose of this Recommendation, monotonically increasing is to be interpreted as increasing by 1.	8 bytes	Unsigned int
Element_ID	Network-wide unique identifier 5 digits (statically configured element number unique within an IPCablecom domain in the range of 0-99,999)	8 bytes	Right-justified, space-padded ASCII character string

Table 50 – IPCablecom event message file format

Field name	Semantics	Length	Type
Time_Zone	Identifies daylight savings time and offset from universal time (UTC). Daylight Savings Time: 0 = Standard Time 1 = Daylight Savings The Daylight-Savings Time indicator MUST be set to a value of 1 if the network element is in a region that implements DST and then only during the daylight-saving-time period (usually the summer months). Since there may be areas in which the daylight-saving-time offset indicates a time-change other than 1 hour, the receiving system (e.g., RKS) needs to correctly calculate local time based on knowledge of the area(s) in which the subscriber and the network element reside. UTC offset: +HHMMSS The UTC offset represents the time offset from universal time (formerly called Greenwich Mean Time, or GMT) when standard time is in effect and MUST NOT change on transition into or out of daylight-saving-time.	1 byte 7 bytes	ASCII character string
File Completion Timestamp	YYYYMMDDHHMMSS.MMM	18 bytes	ASCII

NOTE – There is no checksum included in the file header. It is assumed that the transport mechanism is responsible for delivery of damage-free files. For example, both of the IP transport protocols, UDP and TCP contain a checksum to protect against damaged messages.

12.3 File-naming convention

Files created using the IPCablecom Event Message File Format MUST use the following naming convention: "PKT-EM-yyyymmddhhmmss-pri-nodeid-seq.bin".

12.3.1 Filename components

Table 51 describes each of the components of the filename:

Table 51 – Filename components

Component	Semantics	Type	Length
File ID	Identifies this file as containing IPCablecom Event Messages	Literal string "PKT-EM"	6 characters
Timestamp	Time at which file was opened by the network element	yyyymmddhhmmss	14 characters

Table 51 – Filename components

Component	Semantics	Type	Length
Priority	Priority of this file When processing multiple files with differing priorities, files of higher priority must be processed before the lower priority files. File priority should be established by the application creating the file.	Integer in the range 1-4 4 is the highest 1 is the lowest A default value of 3 is recommended.	1 character
Record_Type	This flag identifies the record type contained in the file. Primary records indicate new, while secondary records indicate previously transmitted.	Binary If the file contains primary usage data this will be a 0 (zero), if it contains a 1 (one) the file contains secondary data.	1 character
Element_ID	Network-wide unique identifier 5 digits (statically configured element number unique within an IPCablecom domain in the range of 0-99,999) with leading zeros for padding. e.g., element id = 99 PKT-EM-yyyymmddhhmmss-pri-00099-seq.bin	Right-justified, zero-padded ASCII character string	5 characters
Sequence number	Monotonically increasing sequence number for each new file. For the purpose of this Recommendation, monotonically increasing is to be interpreted as increasing by 1.	A fixed length character string that allows only the characters 0-9, with an interger range of 000001-999999. Left most positions are always padded with zero.	6 characters

Each element of the filename components is separated by an underscore "_" character. The segment delimiter will also enable segments to be distinguishable simply by a parsing process.

12.4 Configuration items

The following items MUST be configurable by the IPCablecom network element creating the file:

Table 52 – IPCablecom network element

Name	Semantics	Type	Length
Maximum File Length	Maximum size of file, in bytes, to which flat file can grow before being closed for transport.	Unsigned integer	4 octets
Maximum Open Time	Maximum amount of time, in seconds, before file must be closed for transport.	Unsigned integer	4 octets

The IPCablecom Network Element that created the file MUST close any currently open flat file at the first occurrence of either of the following events:

- The file size exceeds the Max File Length.
- The file open duration exceeds the Maximum Open Time.

12.5 File EM structure header

When an EM is written out to a file, each event message MUST be identified by a structure header.

The following identifies the File-based EM Packet Structure:

Table 53 – File-based EM packet structure

Field name	Semantics	Description
ID	Indicates an EM structure	2 bytes, value of 0xAA 55. The value 0xAA 55 is chosen to enable synchronization of the EM boundary if there are any errors within an event message.
Length	Indicate the length of the entire EM structure	2 bytes, length of all attributes + 4
Attributes	Refer to Table 48 Event Message Attribute TLV-tuple format.	Event Message attributes

13 Transport protocol

13.1 Radius protocol introduction

This clause specifies the possible transport protocols used between the IPCablecom network elements that generate Event Messages (CMS, CMTS, MGC) and the record-keeping server (RKS). These network elements MUST support RADIUS accounting [IETF RFC 2866] with IPCablecom extensions as defined in this Recommendation. The optional transport protocol is FTP as defined in this Recommendation.

The following are the IPCablecom transport requirements:

- The transport protocol MAY support confidentiality of Event Messages.
- End-to-end security across multiple administrative domains is not required.
- RADIUS protocol parameters:
  - Retry interval and Retry count;
  - For each RKS that may receive Event Messages, its IP address and UDP port;
  - The IP address of each RADIUS server that it may communicate with.

13.2 RADIUS accounting protocol

The RADIUS accounting protocol is a client/server protocol that consists of two message types: Accounting-Request and Accounting-Response. IPCablecom network elements that generate Event Messages are RADIUS clients that send Accounting-Request messages to the RKS. The RKS is a RADIUS server that sends Accounting-Response messages back to the IPCablecom network elements indicating that it has successfully received and stored the Event Message.

The Event Messages are formatted as RADIUS Accounting-Request and Accounting-Response packets as specified in [IETF RFC 2866]. Although IPCablecom specifies RADIUS as the transport protocol, alternate transport protocols MAY be supported in future IPCablecom releases.

13.2.1 Reliability

The RADIUS messages are transported over UDP, which does not guarantee reliable delivery of messages, hence the request/response nature of the protocol (see [IETF RFC 2865] for the technical justification of choosing UDP over TCP for the transport of Authentication, Authorization and Accounting messages).

When an RKS receives and successfully records all IPCablecom Event Messages in a RADIUS Accounting-Request message, it MUST send an Accounting-Response message to the client. If the IPCablecom network element does not receive an Accounting-Response within the configured retry interval, it MUST resend the same Accounting-Request either to the same RKS or the alternate RKS (retries may alternate between primary and secondary RKS in a vendor-specific way). The IPCablecom network element MUST continue resending the Accounting-Request until it receives an acknowledgement from an RKS or the maximum number of retries is reached. The RADIUS server MUST NOT transmit any Accounting-Response reply if it fails to successfully record the Event Message.

Once a network element succeeds in sending event messages to the secondary RKS server, a failover to the secondary RKS should occur. This is a non-revertive failover, meaning that the secondary RKS becomes active, and is the new primary RKS. For calls in progress, all subsequent event messages should be sent to the now active secondary RKS. For all new calls, the CMS should instruct the CMTS and MGC to use the new active RKS as the primary (i.e., the previous secondary RKS becomes the new primary for subsequent calls).

13.2.2 RADIUS client reliability

All network elements MUST store Event Messages until they have received an Acknowledgement (Ack) from an RKS that the data was correctly received and stored, or until the maximum number of retries has been reached. Only when an Ack is received or the maximum retries reached are the NEs allowed to delete these Event Messages. If the maximum retries is reached, the NEs SHOULD write the Event Messages to an error file before deleting these Event Messages.

In order to guarantee the reliable transfer of the data, the Radius Client should implement a user configurable Radius message Ack interval and the number of times the client needs to retransmit the event or message. The time interval should be configurable (suggested: 10 ms to 10 s), the number of retries should be configurable (suggested: 0 to 9). The number of retries should be attempted on both the primary RKS and secondary RKS. After exhausting the number of retries, the Event Message SHOULD be written to an error file and the Event Message can then be deleted from the network element.

NOTE 1 – The Radius Client MIB (IETF RFC 2620) does *not* contain these parameters.

NOTE 2 – This requirement implies that the RKSs use highly reliable storage media and are also highly available.

13.2.3 Authentication and confidentiality

Refer to [ITU-T J.170] for details concerning the use of IPSec to provide both authentication and confidentiality of the RADIUS messages, and the details of the correct usage of the RADIUS shared secret.

13.2.4 Standard RADIUS attributes

Each RADIUS message starts with the standard RADIUS header shown in Table 54.

Table 54 – RADIUS message header

Field name	Semantics	Field length

Code	Accounting-Request = 4
	Accounting-Response = 5
		1 byte

Identifier	Used to match Accounting-Request and Accounting-Response messages	1 byte
Length	Total length of RADIUS message. Min value = 20, Max value = 4096	2 bytes
Authenticator	Computed as per RADIUS Specification IETF RFC 2865.	16 bytes

Two standard RADIUS attributes MUST follow the RADIUS Message Header: NAS-IP-Address and Acct_Status_Type. These two fields are included to improve interoperability with existing RADIUS server implementations since they are mandatory attributes in a RADIUS Accounting-Request packet.

The NAS-IP-Address indicates the originator of the Accounting-Request message and MUST contain the IP address of the originating IPCablecom network element.

The Acct-Status-Type attribute typically indicates whether the Accounting-Request marks the beginning of the user service (Start) or the end (Stop). Since an IPCablecom Accounting-Request message may contain multiple Event Message Packets, it could contain Event Messages which mark both the beginning and end of the user service. For this reason, an Acct-Status-Type value of Interim-Update is used to represent IPCablecom Event Messages.

Table 55 – Mandatory RADIUS attributes

Name	Type	Length	Value
NAS-IP-Address	4	6	IP address of originating IPCablecom network element
Acct-Status-Type	40	6	Interim-Update = 3

Table 56 – RADIUS Acct_Status_Type

Type	Length	Value
40	6 bytes	Interim-Update = 3

IPCablecom attributes are defined in clause 10. IPCablecom attributes are encoded in the RADIUS vendor-specific attributes (VSA) structure as described in this clause. Additional IPCablecom or VSAs can be added to existing Event Messages by adding additional RADIUS VSAs to the message.

Table 57 – Radius VSA structure for IPCablecom attributes

Field name	Semantics	Field length
Type	Vendor Specific = 26	1 byte
Length	Total Attribute Length NOTE – Value is Vendor Length + 8.	1 byte
Vendor ID	CableLabs = 4491	4 bytes
Vendor Attribute Type	IPCablecom Attribute Type	1 byte

Table 57 – Radius VSA structure for IPCablecom attributes

Field name	Semantics	Field length
Vendor Attribute Length	IPCablecom Attribute Length	1 byte NOTE – Value is Vendor Length + 2
Vendor Attribute Value	IPCablecom Attribute Value	Vendor Length bytes

The VSA includes a field to identify the vendor and the Internet Assigned Number Authority (IANA) has assigned IPCablecom an SMI Network Management Private Enterprise Number of 4491 for the encoding of these attributes. The RKS server SHOULD ignore Event Messages where the IPCablecom "Event Message type" is unidentified. The RKS server SHOULD also ignore IPCablecom event attributes where the event attribute type is unidentified.

13.2.5 IPCablecom extensions

13.2.5.1 IPCablecom RADIUS accounting-request packet syntax

```
<RADIUS Accounting-Request> ::==
<RADIUS message Header>
<RADIUS Acct-Status-Type Attribute>
<IP Cablecom EM List>

<IP Cablecom EM List> ::==
<IP Cablecom EM> |
<IP Cablecom EM List> <IP Cablecom EM>

<IP Cablecom EM> ::==
<RADIUS VSA for IP Cablecom EM Header Attribute>
<IP Cablecom EM Attribute List>

<IP Cablecom EM Attribute List> ::==
<RADIUS VSA for IP Cablecom EM Attribute> |
<IP Cablecom EM Attribute List> <RADIUS VSA for IP Cablecom EM Attribute>
```

The potential of a high Event Message volume raised the concern that the RADIUS mechanism for ensuring reliability via request/response may consume too much bandwidth or be too computationally intensive. This led to the requirement that it be possible to transit multiple IPCablecom Event Messages in a single RADIUS message. The use of this "batch mode" is left to the discretion of the IPCablecom network element and will likely depend on the latency requirements of the particular event type. The number of Event Messages encapsulated in a single RADIUS message is still subject to the maximum RADIUS message length restriction of 4096 bytes.

The Event Message Header MUST be the first attribute within a given Event Message. If multiple Event Messages are sent in a single RADIUS Accounting-Request, the Event Message Header attribute indicates the start of a new Event Message. The order of the Event Message attributes which follow the Event Message Header is arbitrary.

IPCablecom extends RADIUS Accounting by introducing new attributes and new values for existing attributes. Since the RADIUS protocol is extendable in this manner, it is expected that existing RADIUS server implementations will require minimal modifications to support the batch collection of IPCablecom Event Messages.

13.2.5.2 Concatenation of attributes

The vendor specific attribute (VSA) limits the size of the attribute value to 247 bytes (see Table 57). However there may be instances where the attribute value cannot fit into a single VSA, for example, the SDP attributes used in electronic surveillance. In cases where the value of an attribute is greater than 247 bytes, the network element MUST create multiple attributes of the same type in the RADIUS message. The attributes MUST be adjacent to one another within the message and MUST be sequential such that the order of the original attribute value is maintained. The recipient in this case MUST concatenate the multiple attributes into a single attribute value. Note that regardless of multiple attributes being present in an event message, the message is subject to the maximum RADIUS message length restriction of 4096 bytes. Attributes that are concatenated in this manner MUST be from the list presented in Table 58.

Table 58 – Concatenated attributes

EM attribute name	EM attribute ID
SDP_Upstream	39
SDP_Downstream	40
RTCP_Data	93
Local_XR_Block	94
Remote_XR_Block	95

13.3 File transport protocol (FTP)

The file transfer protocol (FTP) MAY be used to transport Event Messages from IPCablecom network elements to the RKS. The RKS MUST have FTP Server support. If this transport protocol is used, the RKS hosts an FTP server to accept files transferred by the IPCablecom network element. The IPCablecom network element acts as the FTP client, pushing the files to the RKS for processing.

If FTP is used as a transport protocol, then the file MUST be formatted using the IPCablecom Event Message File Format.

13.3.1 Required FTP server capabilities

The FTP server at the RKS MUST have, at minimum, the following capabilities:

- Minimum implementation as described in Internet Protocol Standards – IETF STD 9 section 5.1;
- PASV Mode (passive mode) command;
- Data Type I, Image (binary);
- Authentication support (PASS command);
- File Transfer logging.

The FTP client SHOULD listen for the 226 response to the STOR (close data connection) to indicate the file was successfully transferred and accepted by the RKS before marking the file as transferred. The NE SHOULD attempt to resend the file during the next scheduled FTP session if a response other than 226 is received.

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