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Specification for Priority in Preferential Telecommunications over IPCablecom2 Networks

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Summary

NOTE: This document is identical to SCTE 173-4 2010 except for informative components which may have been updated such as the title page, NOTICE text, headers and footers. No normative changes have been made to this document.

This standard is one of a series of Standards to enable support for preferential telecommunication services over IPCablecom2 networks. It defines the specifications for priority for preferential telecommunication services over IPCablecom2 networks. These specifications satisfy the requirements defined in SCTE 173-1 2010. The essential aspects of preferential telecommunications over IPCablecom2 can be grouped into two areas: prioritization and authentication. This Standard provides specifications for prioritization only. Prioritization may be utilized for premium services and for emergency services in IPCablecom2 that may require preferential treatment (e.g., telecommunications for disaster relief and the emergency telecommunications service).

The implementation of priority and authentication is necessary for the support of preferential telecommunications services in IPCablecom networks. This Standard only covers technical aspects for achieving prioritized treatment in IPCablecom2 networks.

Introduction

Emergency and disaster communications for authorized users plays a vital role in the health, safety, and welfare of people in all countries. The common thread to facilitate emergency/disaster operations is the utility of assured capabilities for user-friendly preferential telecommunication services that may be realized by technical solutions and/or administrative policy. The IPCablecom2 infrastructure offers an important resource for assured emergency/disaster telecommunications.

Emergency and disaster situations can impact telecommunication infrastructures. Typical impacts may include congestion overload and the need to re-deploy or extend communications capabilities beyond that covered by existing infrastructures. Even when telecommunications infrastructures are not damaged by these situations, demand for telecommunication resources soar during such events. Therefore, priority mechanisms are needed so that limited bandwidth resources can be allocated to authorized emergency workers during emergency and disaster situations.

Generally, when prioritized or preferential treatment of telecommunication capabilities are offered, users of the associated service or services will be authenticated and authorized. Whether authentication and authorization are required or not is a national decision. However, without authentication and authorization, preferential treatment capabilities may be subject to abuse by non-authorized individuals.

This Standard provides specifications stemming from the requirements of SCTE 173-1 2010 for mechanisms to provide priority in IPCablecom2 networks in support of preferential/prioritized treatment to services that need or benefit from such treatment.

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1 Scope

This Standard is one of a series of Standards to enable support for preferential telecommunication services over IPCablecom networks. These specifications do not apply to ordinary emergency calls such as people calling the police, the fire department, ambulances, etc.

Aspects of preferential telecommunications include provisions for authentication and priority (special handling). The objective of this Standard is to provide an initial set of priority specifications for preferential telecommunications within IPCablecom2 networks according to the framework described in [SCTE 173-2]. This Standard defines two options for introducing the priority header during signalling. This Standard defines specifications for capabilities which, when implemented, should help support preferential telecommunication services.

NOTE – Pre-emption specifications and authorization specifications are outside the scope of this Standard and are considered to be national matters.

2. References

2.1 SCTE References

The following documents contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of subcommittee approval, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

[ANSI/SCTE 159-1] IPCablecom Multimedia Part 1: Multimedia Applications and Service

[SCTE 173-1] Requirements for preferential telecommunications over IPCablecom networks

[SCTE 173-2] Framework for implementing preferential telecommunications in IPCablecom and IPCablecom2 networks

2.2 Other References

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

[IETF RFC 4412] IETF RFC 4412 (2006), *Communications Resource Priority for the Session Initiation Protocol (SIP)*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 assured capabilities [SCTE 173-1]: Capabilities providing high confidence or certainty that critical telecommunications are available and perform reliably.

3.1.2 authentication [SCTE 173-1]: The act or method used to verify a claimed identity.

3.1.3 authorization [SCTE 173-1]: The act of determining if a particular privilege, such as access to telecommunications resources, can be granted to the presenter of a particular credential.

3.1.4 emergency situation [SCTE 173-1]: A situation, of serious nature, that develops suddenly and unexpectedly. Extensive immediate important efforts, facilitated by telecommunications, may be required to restore a state of normality to avoid further risk to people or property. If this situation escalates, it may become a crisis and/or disaster.

3.1.5 international emergency situation [SCTE 173-1]: An emergency situation, across international boundaries, that affects more than one country.

3.1.6 label [SCTE 173-1]: An identifier occurring within or attached to data elements. In the context of preferential telecommunications it is an indication of priority. This identifier can be used as a mapping mechanism between different network priority levels.

3.1.7 policy [SCTE 173-1]: Rules (or methods) for allocating telecommunications network resources among types of traffic that may be differentiated by labels.

3.1.8 preferential [SCTE 173-1]: A capability offering advantage over regular capabilities.

3.1.9 priority treatment capabilities [SCTE 173-1]: Capabilities that provide premium access to, and/or use of telecommunications network resources.

4 Abbreviations and acronyms

This Standard uses the following abbreviations:

CM	Cable Modem
CMTS	Cable Modem Termination System
COPS	Common Open Policy Service (defined in [b-IETF RFC 2748])
CSCF	Call Session Control Function
DSA	Dynamic Service Add
DSCP	Differentiated Services Code Point
MTA	Media Terminal Adapter
P-CSCF	Proxy Call Session Control Function
PCRF	Policy Control and Charging Rules Function
PIN	Personal Identification Number
PRACK	Provisional Response ACKnowledgement
PSTN	Public Switched Telephone Network
R-P	Resource Priority
RTP	Real-time Transport Protocol
UA	User Agent

5 Conventions

None.

6 Priority in IPCablecom2

Prioritization entails obtaining a higher probability for completing a call or session. This capability should exist on the access link and it must also be propagated throughout all relevant network entities to provide, as much as possible, end-to-end preferential treatment.

The framework standard [ANSI/SCTE 173-2] defines three aspects related to priority: the labelling, signalling and enabling mechanisms. The following clauses contain the specifications for the signalling and an enabling mechanism. As stated in the framework, placing the priority label in the data packets transmitted using RTP is not available. As a result, this Standard addresses only the requirements for signalling and enabling mechanisms. Several alternative methods are defined, which include the following:

- defining a new per hop behaviour for preferential traffic,
- a new shim layer protocol over IP,
- marking an application layer packet, and
- allocating a Diffserv code point, MPLS label, Ethernet Class of Service or other priority markings to label the packets associated with particular messages.

6.1 Priority signalling in IPCablecom2

The framework identifies the use of Resource-Priority and Accept-Resource-Priority headers defined in [IETF RFC 4412] to signal the priority in SIP request and response messages. [IETF RFC 4412] defines the term RP actor. This term refers to all entities that act upon the Resource-Priority header. These entities are the SIP proxies and the SIP user agents (UAs). In IPCablecom2, the SIP proxies are collectively called CSCF (call session control function). The UAs are the end points that initiate and receive a session: they are respectively the SIP UAC (user agent client) and SIP UAS (user agent server). These will both be referred to as the SIP UA.

There are two options for handling the R-P header. In the first option, the SIP UA shall include the R-P header, as described in section 4.7.1 of [IETF RFC 4412], in the request messages when requesting sessions in support of preferential telecommunication services. In the second option, a proxy CSCF shall generate and insert an appropriate R-P header based upon the information received in the session set-up request. The requirements to be supported by the functional entities in IPCablecom2 networks are included in clause 7.

The R-P header syntax, as defined by [IETF RFC 4412], requires defining a namespace, values for priority levels, an algorithm to be used by the RP actors and new response (error) codes relevant for this namespace. The namespace definition must be registered with IANA.

[IETF RFC 4412] defines two algorithms for providing priority even though the new namespace definition may specify other algorithms. The two algorithms defined by the RFC are preemption and priority queuing.

Appendix I illustrates the components required for a namespace definition according to [IETF RFC 4412]. Annexes A to E identify the namespace specific to each ITU region.

6.2 Priority-enabling mechanisms in IPCablecom2

Appendix II of [b-ITU-T J.360] and [ANSI/SCTE 159-1] define interfaces to set up policies and control for enabling QoS to support resource management for new services, including those that require preferential treatment. Even though QoS is not meant to imply priority, one of the considerations for the QoS architecture in IPCablecom2 networks is prioritization for sessions. [ANSI/SCTE 159-1]-specified COPS interfaces between the application manager, the policy server and CMTS may be used to perform resource management and admission control. Expanding on the COPS-defined objects, a new object called GateSpec is defined. The GateSpec object specifies a session class ID with several subfields to set priority and enable preemption of lower priority

services if necessary (and allowed). The session class ID has bits 0-2 with priority values between 0 (lowest) to 7 (highest). This Standard does not assign values for the services that require preferential treatment. It is, therefore, necessary for users and service providers to assign the values associated with the different services.

The enabling of prioritization in IPCablecom2 networks is composed of two components. The first is at the data link layer and involves making DOCSIS service flows more promptly available for gates of a certain session class. The second is at the session layer and involves describing the priority status of a call so that the information can be propagated to all relevant entities in the network. [ANSI/SCTE 159-1] defines the process for associating the gates to the service flows.

In order to describe the flow of messages between the various functional entities, different scenarios can be studied. Two examples are shown here and they correspond to the following cases:

1) The flow is shown from the call origination perspective and resources are available immediately (Figures 1 and 2).

2) The flow is shown from the call origination perspective and the resources are available later, during the call set up (Figure 3).

Depending on the two options discussed in clause 6.1 relative to where the R-P header is inserted, the service flow is set up by the CMTS without requiring any gates to be set up by the PCRF. In option 1, the CM may request service flows (downstream and upstream) be set up with traffic priority for preferential services, based on a configuration file. The CM sends the INVITE in this service flow instead of in the primary service flow, as in option 2. The CMTS, based on the R-P header priority, can offer requests for additional bandwidth and contention request opportunities when congestion may prevent the CM from sending requests through to CMTS for upstream traffic. Option 1 may, in addition, use the exchanges to set up gates, as in option 2, for resource management and admission control.

6.2.1 Priority call/session origination example for option 1 – Resources available during session request

The flows in Figure 1 show the case of option 1 to set up QoS-based service flows for preferential telecommunications in the cable access network over an IPCablecom2 network. The key items illustrated are: (1) how the CM, provisioned for priority signalling during registration, forwards the initial INVITE request from the SIP UA on that service flow; (2) how the P-CSCF reserves and activates priority resources for the bearer to support preferential treatment; and (3) how the cable access network implements requests from the P-CSCF for priority resources. In this example, the call/session originates from a device that is authorized for preferential telecommunication services. If the call/session originates from a device that supports processing the R-P header, then a dynamic service flow for priority signalling will be set up using the DSA message, if it was not already set up during registration. The service flow will be created with the appropriate traffic priority associated with the reservation priority in the R-P header.

The message sequence to set up a call/session from a preferential telecommunication service user is shown in Figure 1. The flow only shows the steps through setting up the bearer resources. The service flow set up during registration is for priority signalling and bearer. Resources are reserved after the P-CSCF processes the INVITE request. The remaining steps use the illustrated service flows for signalling and bearer between the CM and the CMTS. The details of the release sequence and error conditions are not included in the example below.

A high level summary of the message exchange is provided below:

1. The SIP UA generates the initial INVITE with the R-P header in step A1.

2. When the CM receives A1, it processes the R-P header and determines the service flow that was set up for preferential telecommunication service. It waits for the special contention request opportunity for that service flow and then sends the contention request (A2).

3. The CMTS processes the request and determines the traffic priority for that service flow. It includes a grant in a subsequent MAP message (A3) for that service flow.
4. This allows the CM to send the packet (A4) over the signalling service flow for the preferential treatment service.
5. Having received a packet, the CMTS processes it and sends a completed IP packet to the P-CSCF (A5). If the IP packet needed to be segmented or if the initial INVITE was split into multiple IP packets by the UE, steps A2-A5 would be repeated until the entire INVITE is sent to the P-CSCF. The only difference is that the CM could include a follow-up request to send in the data packet in step A4, which would eliminate the need to wait for another contention request opportunity. The CMTS processes the request according to the traffic priority assigned for the service flow by giving it a priority over other normal sessions.
6. When the P-CSCF receives the INVITE, it recognizes that this is a preferential telecommunication service request (A6) and, at this point, special processing is invoked. For the remainder of the session, it will give priority over normal sessions in processing messages related to this session.
7. The P-CSCF issues a Diameter AA-request to the PCRF (A7) to reserve bearer resources, as normal, with the following enhancements for preferential treatment: (1) it will set the value of the Reservation-Priority AVP to the appropriate priority as specified by the service provider or regional authority and (2) it may include a special DSCP value to be used for transmitting IP packets in the service provider's network.
8. The PCRF will recognize the Reservation-Priority value and give priority in processing the message. The resulting Gate-Set messages (A8) sent to the CMTS will include a SessionClassID value that would be assigned for preferential treatment. Since the cable access network service flows are unidirectional, the PCRF would prepare a pair of Gate-Set messages: upstream and downstream.
9. The CMTS will recognize the value of the SessionClassID value and give priority in processing the request. If resources are available, a normal DSA-REQ (A9), DSA-RSP (A10), and DSA-ACK (A11) sequence occurs.
10. When the PCRF has received the Gate-Set ACK (A12) and forwarded the reservation response to the P-CSCF (A13), the P-CSCF sends the INVITE with the RPH header to the core network (A14).
11. After the INVITE has been processed in the core network, a message will be sent back to the P-CSCF with the answer to the offer, namely, the 183 Session Progress message. The same sequence will occur in the cable access network whenever the answer is received. When the P-CSCF receives the answer (C1), it will forward the answer to the SIP UA (C2-C3) and the message will be sent using the priority signalling flow that was established during registration.
12. The P-CSCF will also activate the bearer resources (C4) that had been previously reserved.

    (NOTE – The answer may modify the original offer, but the same sequence of messages occurs.)
13. Since the activation request includes the preferential treatment Reservation-Priority value, the PCRF treats this as a priority request and creates the appropriate Gate-Set messages (C5). The CMTS processes them with priority (C6-C8) and since the resources have already been reserved, the pre-assigned resources are activated. Since the UGS upstream service flow has defined QoS parameters, there is no need for any additional preferential treatment priority. The QoS parameters in the downstream flow guarantee that the CMTS will transmit downstream traffic correctly. The downstream flow will be assigned the Traffic Priority value to allow cable modems to give priority when sending the data packets to the SIP UA.
14. After the flows are activated, the CMTS responds to the PCRF (C9) and the PCRF responds to the P-CSCF (C10). At this point, the bearer stream is active for the session.

15. The SIP UA will respond with a PRACK (D1). The CM will use the signalling service flow set up during registration to send the request (D2). It will use a special contention request opportunity to send a request.

16. The CMTS will recognize that the Traffic Priority for this service flow has the preferential treatment Traffic Priority value and will give this request priority over other best effort service flow requests. It will send a grant message (D3) and the CM will send the data packet in the slot provided (D4). This packet will be forwarded by the CMTS to the P-CSCF (D5). The IP packet may be assigned a special DSCP value to ensure the packet has priority in the service provider's network.

17. The remainder of the call set-up proceeds normally using the service flows that have been set up for signalling and bearer.

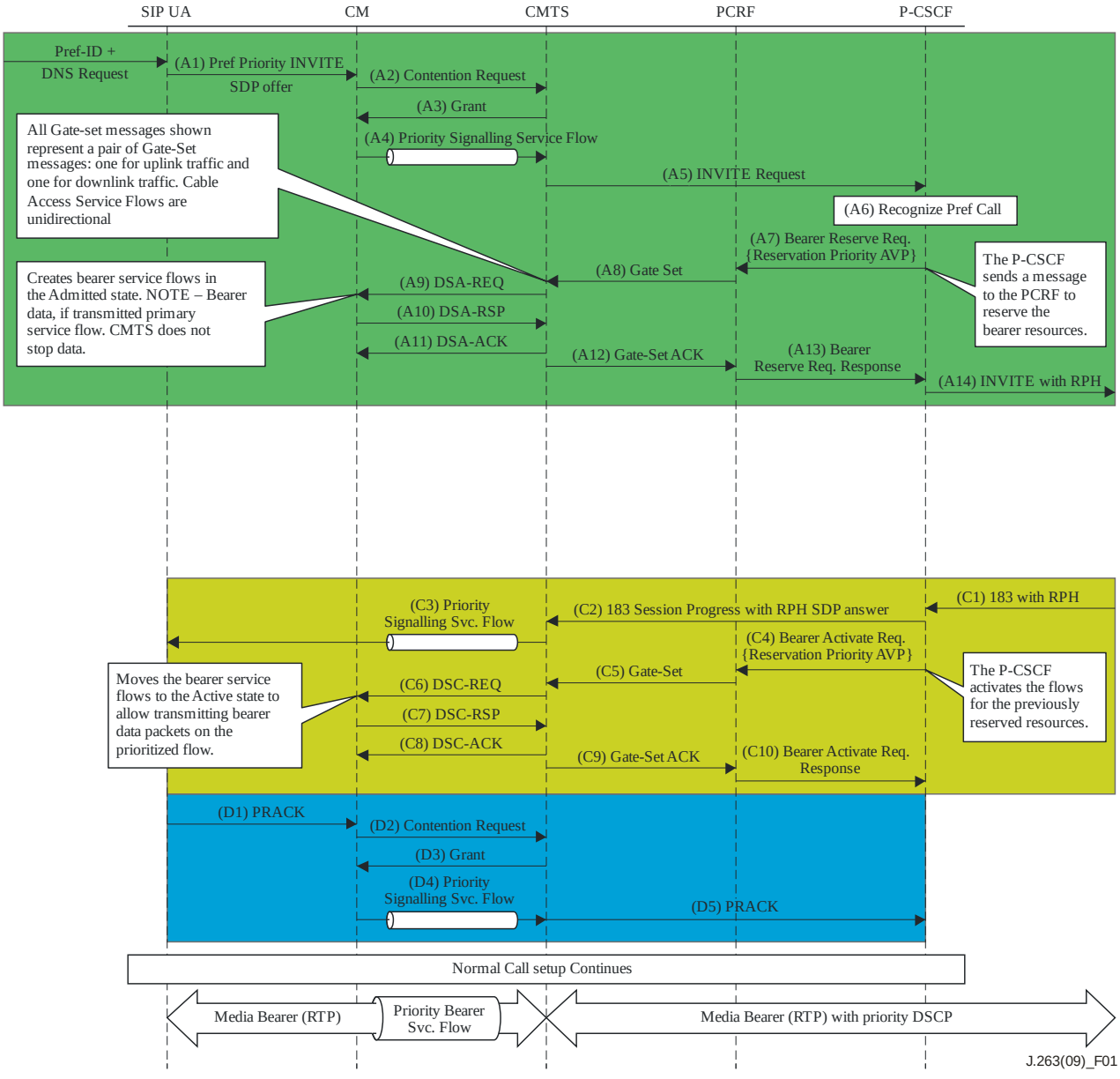

Figure 1 – Priority call/session origination example for option 1 – Resources available during session request

6.2.2 Priority call/session origination example for option 1– Initial resource failure

The sequence of messages to process and transmit the INVITE with the R-P header to the P-CSCF is the same as in Figure 1. The exchange of messages and the resulting success or failure to complete the call/session set up when resources are not available initially (when request for reservation was sent) follows the same steps described in 6.2.4 for option 2, except for the steps required for setting up the signalling service flow.

6.2.3 Priority call/session origination example for option 2 – Resources available during session request

The flows in Figure 2 show the case of option 2 to set up QoS-based service flows for preferential telecommunications in the cable access network over an IPCablecom2 network. The key items illustrated are (1) how the CM forwards the initial INVITE request from the UE, before the P-CSCF requests priority signalling resources; (2) how the P-CSCF reserves and activates priority resources for the bearer to support preferential treatment; and (3) how the cable access network implements requests from the P-CSCF for priority resources.

The message sequence to set up a call from a preferential telecommunication service user is shown in Figure 2. The flow only shows the steps through setting up the bearer resources. The remaining steps use the illustrated service flows for signalling and bearer between the CM and the CMTS. The details of the release sequence and error conditions are not included in the example.

A high level summary of the message exchange is provided below:

1. The SIP UA generates the initial INVITE in step A1.
2. When the CM receives A1, it does normal processing to request permission to send a packet on the upstream channel. It waits for a contention request opportunity and then sends the contention request (A2).
3. The CMTS does normal processing and includes a grant in a subsequent MAP message (A3).
4. This allows the CM to send the packet (A4) over the primary service flow. On the primary service flow, the CM competes with all other CMs that are serviced on the same upstream channel by the CMTS.
5. Having received a packet, the CMTS processes it and then sends a completed IP packet to the P-CSCF (A5). If the IP packet needed to be segmented or if the initial INVITE was split into multiple IP packets by the UE, steps A2-A5 would be repeated until the entire INVITE is sent to the P-CSCF. The only difference is that the CM could include a follow-up request to send in the data packet in step A4, which would eliminate the need to wait for another contention request opportunity. Since normal priority is used in these steps, there could be delay in the presence of overload before the INVITE arrives at the P-CSCF.
6. When the P-CSCF receives the INVITE, it recognizes that this is a preferential telecommunication service request (A6) and, at this point, special processing is invoked. For the remainder of the session, it will give priority over normal sessions in processing messages related to this session.
7. The P-CSCF issues a Diameter AA-request to the PCRF (A7) to reserve bearer resources, as normal, with the following enhancements for preferential treatment: (1) it will set the value of the Reservation-Priority AVP to the appropriate priority as specified by the service provider or regional authority and (2) it may include a special DSCP value to be used for transmitting IP packets in the service provider's network.

8. The PCRF will recognize the Reservation-Priority value and give priority in processing the message. The resulting Gate-Set messages (A8) sent to the CMTS will include a SessionClassID value that would be assigned for preferential treatment. Since the cable access network service flows are unidirectional, the PCRF would prepare a pair of Gate-Set messages: upstream and downstream.
9. The CMTS will recognize the value of the SessionClassID value and give priority in processing the request. If resources are available, a normal DSA-REQ (A9), DSA-RSP (A10), and DSA-ACK (A11) sequence occurs.
10. When the PCRF has received the Gate-Set ACK (A12) and forwarded the reservation response to the P-CSCF (A13), the P-CSCF sends the INVITE to the core with the RPH header added (A14) to the invite (in option 1 additional processing to insert the R-P header is not required because the request from the SIP UA includes this header).
11. While the bearer reservation processing is occurring, the P-CSCF will also request establishment of priority signalling flows for subsequent signalling messages between it and the SIP UA. It does this by sending two Diameter AA-requests to the PCRF (B1) to create a new priority upstream signalling flow and a new priority downstream signalling flow that will be assigned the preferential telecommunication service Traffic Priority value.
12. The PCRF recognizes the Reservation-Priority value and gives priority in preparing Gate-Set messages to the CMTS. This (B2) is a request to create and activate new priority service flows with the Traffic Priority and the SessionClassID values assigned for the preferential telecommunication service. The classifier in the Gate-Set messages identifies the appropriate signalling IP addresses and ports.
13. The CMTS recognizes the SessionClassID value and gives priority in processing the request. It creates two priority signalling service flows (B3-B5) that have the preferential treatment Traffic Priority value. This Traffic Priority value will be used by the CMTS to give priority to upstream requests to send data packets and to give priority in processing data packets destined to the CM for downstream traffic. The classifier in the service flow will distinguish SIP signalling messages from other data traffic.
14. When the flows are set up, the CMTS responds back to the PCRF (B6) and the PCRF responds back to the P-CSCF (B7). All future signalling messages will use these flows. When the session is terminated, messages will be sent to delete the signalling service flows.
15. After the INVITE has been processed in the core network, a message will be sent back to the P-CSCF with the answer to the offer, namely, the 183 Session Progress message. The same sequence will occur in the cable access network whenever the answer is received. When the P-CSCF receives the answer (C1), it will forward the answer to the SIP UA (C2-C3) and the message will be sent using the priority signalling flow that was just established.

    NOTE 1 – This flow for option 2 covers the case where the answer included the same RPH value as in the request. In [IETF RFC 4412], RPH in responses are not allowed. This is under discussion in IETF. Therefore, the feasibility of implementing option 2 depends on further development work by the IETF with respect to RPH responses.
16. The P-CSCF will also activate the bearer resources (C4) that had been previously reserved.

    NOTE 2 – The answer may modify the original offer, but the same sequence of messages occurs.

17. Since the activation request includes the preferential treatment Reservation-Priority value, the PCRF treats this as a priority request and creates the appropriate Gate-Set messages (C5). The CMTS processes them with priority (C6-C8) and since the resources have already been reserved, the pre-assigned resources are activated. Since the UGS upstream service flow has defined QoS parameters, there is no need for any additional preferential treatment priority. The QoS parameters in the downstream flow guarantee the CMTS will transmit downstream traffic correctly. The downstream flow will be assigned the Traffic Priority value to allow cable modems to give priority when sending the data packets to the SIP UA.
18. After the flows are activated, the CMTS responds to the PCRF (C9) and the PCRF responds to the P-CSCF (C10). At this point, the bearer stream is active for the session.
19. The SIP UA will respond with a PRACK (D1). Since the priority signalling flow is now active, the CM will use the service flow classifiers to send the request (D2) on that flow. It will either use a normal contention request or a special contention request opportunity to send a request to send.
20. The CMTS will recognize that the Traffic Priority for this service flow has the preferential treatment Traffic Priority value and give this request priority over other best effort service flow requests. It will send a grant message (D3) and the CM will send the data packet in the slot provided (D4). This packet will be forwarded by the CMTS to the P-CSCF (D5). The IP packet may be assigned a special DSCP value to ensure the packet has priority in the service provider's network.
21. The remainder of the call set up proceeds normally using the service flows that have been set up for signalling and bearer.

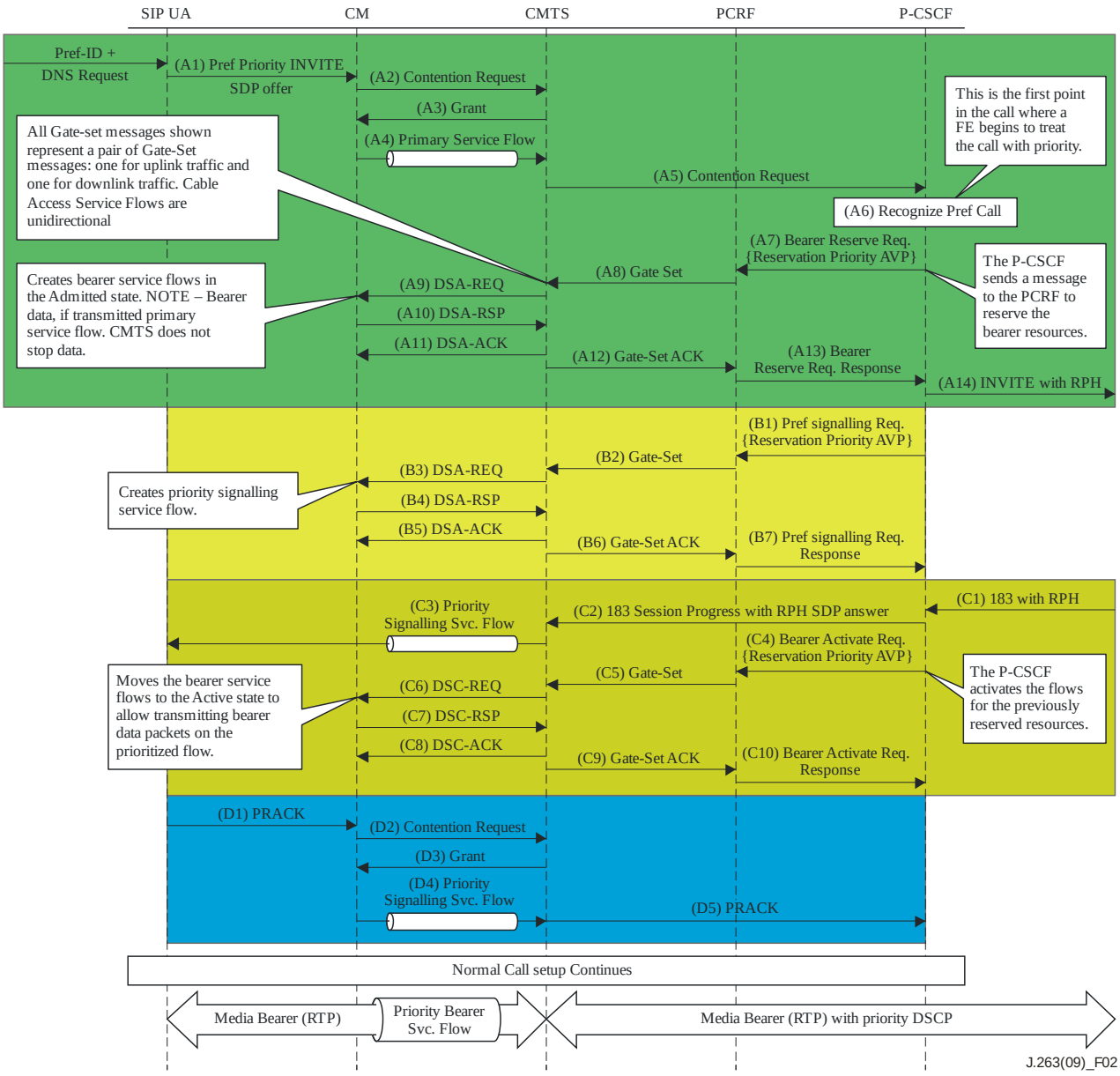

Figure 2 – Priority call/session origination example for option 2 – Resources available during session request

6.2.4 Priority call/session origination example for option 2 – Initial resource failure

When resources are not available, there are two possible scenarios: (1) the resources are not available when the initial INVITE arrives but become available when the SIP answer arrives, and (2) the resources are not available when the initial INVITE arrives and are still not available when the SIP answer arrives. In the first case, the call proceeds normally with no visible impact. In the second case, the call is cancelled when the resource activation request fails (see Figure 3).

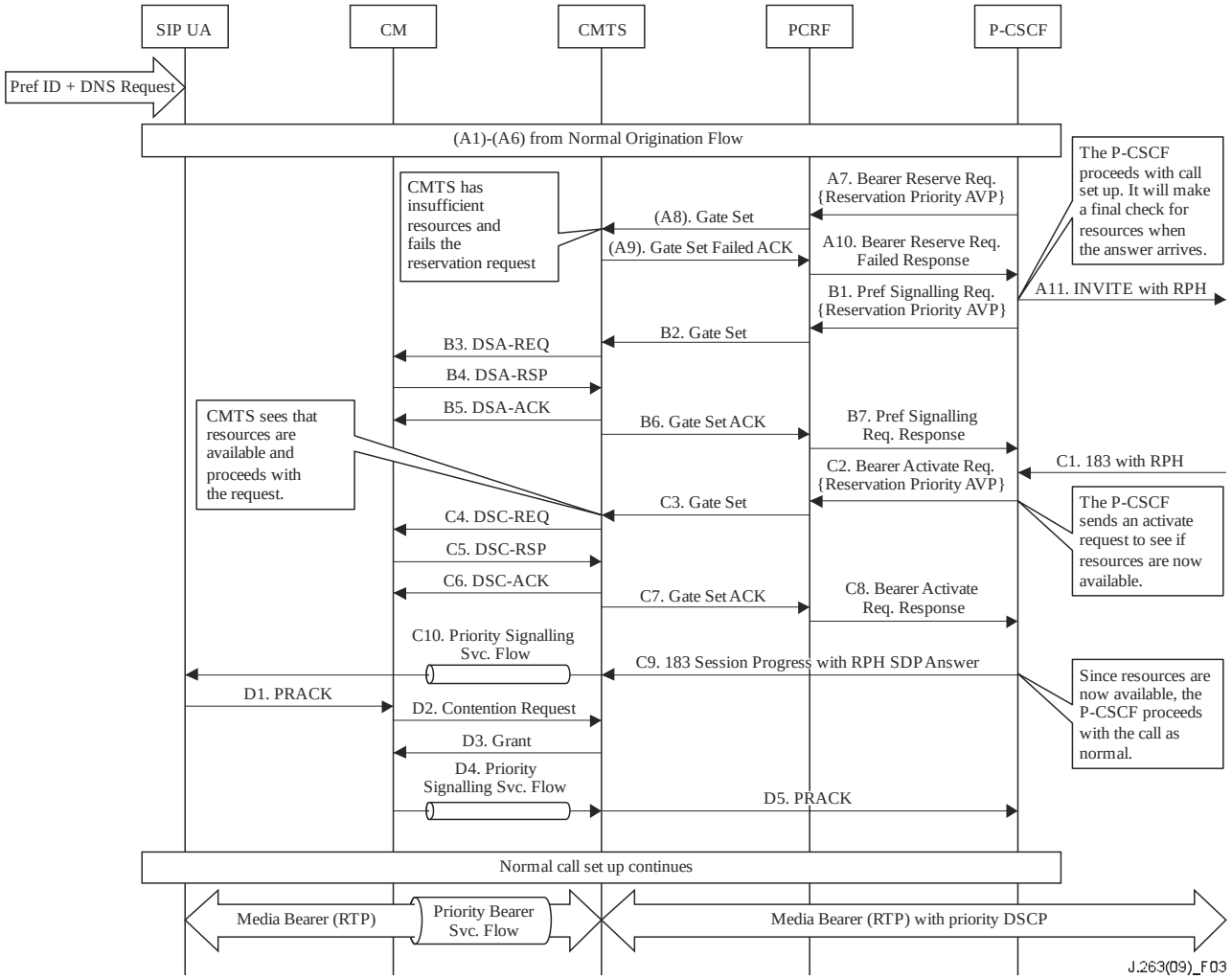

Figure 3 – Priority call/session origination example for option 2 – Initial resource failure

Since resources are not available in the CMTS when the Gate-Set message (A8) arrives, the CMTS fails the request and sends a new failed reply response to the PCRF (A9) and the PCRF forwards this back to the P-CSCF (A10). The P-CSCF has two options at this point, it could fail the call or, as shown above, the P-CSCF can proceed with normal call set up and send the INVITE on (A11). In this case, the P-CSCF will do a final check for resources when the SIP answer arrives.

When the answer arrives (C1), the P-CSCF sends an activate message to the PCRF (C2), just as if the original reservation request had succeeded. In this case, resources are available and the call proceeds normally.

If the resources are still not available when the SIP answer arrives, the P-CSCF attempts to activate resources, the request still fails. At this point, the P-CSCF will begin normal steps to cancel the call. Because a priority service flow for signalling (B1-B7) has been set up, the P-CSCF sends a message to the PCRF (E1) to delete the priority signalling service flow.

7 Requirements for signalling priority in IPCablecom2

7.1 Requirements using option 1

In option 1, the SIP UA includes the R-P header in the SIP INVITE message.

7.1.1 Requirements for the SIP UA and CM

The SIP UA and CM shall process the SIP-INVITE message with the R-P header to determine that this session requires priority treatment. The CM shall use the preferential telecommunications service flow to send requests for these sessions.

7.1.2 Requirements for the CMTS

The CMTS shall recognize and process the R-P header to give priority to these requests over other session requests.

7.1.3 Requirements for the P-CSCF

The P-CSCF shall recognize the request for priority treatment based on the information in the SIP INVITE from the SIP UA and processes the request as defined in [IETF RFC 4412].

7.2 Requirements using option 2

In option 2, the SIP UA issues an indication in the session set-up (SIP-INVITE) message that this session requires priority treatment. This information may include using specific access numbers, a feature code (a special prefix assigned by the service provider or the national authority), specific destination numbers, or a combination of these.

7.2.1 Requirements for the SIP UA and CM

Additional requirements beyond those included in existing Recommendations of the ITU-T J.300 series do not exist.

7.2.2 Requirements for the CMTS

There are no signalling requirements for the CMTS to recognize the R-P header.

7.2.3 Requirements for the P-CSCF

The P-CSCF shall recognize the request for priority treatment based on the information in the SIP INVITE from the SIP UA and add the R-P header with the appropriate namespace and priority level, prior to transmitting the request to the core network.

8 Requirements for the priority enabling mechanism in IPCablecom2

8.1 SIP UA and CM

Based on the configuration during registration, service flows must be supported by the CM for preferential treatment services in option 1.

For option 2, the access layer does not impact the SIP UA or the CM when preferential telecommunication services are invoked in the network.

8.2 CMTS

These requirements are for both option 1 and option 2**.**

The CMTS is the key to providing priority for preferential telecommunication services in the cable access network. There are two areas that need to be addressed: the CMTS needs to give priority to requests for assignment of cable resources for these services, and it needs to give priority to transmission of contention requests to send packets for these services.

When the CMTS sees a request from the policy server to create or activate service flows, it needs to recognize the preferential telecommunication service related requests and process them with priority.

The CMTS shall use the SessionClassID as the basis for determining which requests for resources to process and honour, and the CMTS shall process the highest priority requests first.

A new priority SessionClassID value shall be defined according to the definition given in [ANSI/SCTE 159-1] and in Appendix II of [b-ITU-T J.360] for these services. The SessionClassID value shall have a higher priority than any other SessionClassID value with the possible exception of network maintenance values. The values should be assigned by the service provider or the appropriate authority.

The CMTS shall be able to reserve a predetermined percentage of assignable resources for preferential telecommunication service flows. When not assigned to priority service flows, these resources should be available for normal best effort service flows.

When the CMTS receives a request to assign resources for a request with a SessionClassID value for preferential services, it shall honour that request if the CMTS has not reached the resource limit for these priority service flows. If it has reached the limit, it shall do one of the following:

- If the CMTS has not reached other limits for assigning resources, the CMTS may allocate resources as if this were a normal priority request.
- If the CMTS chooses not to assign resources, the CMTS shall fail the request and send the normal failure response when resources are not available.

When the CMTS is processing upstream traffic requests, the CMTS needs to recognize the Traffic Priority in the best effort and non-real time polling traffic flows and may use the Traffic Priority value for best effort flows to provide additional contention request opportunities as needed for preferential telecommunication services. The CMTS needs to honour priority request to send preferential telecommunications related messages first.

The CMTS shall give priority to upstream traffic requests based on the Traffic Priority value assigned to the service flow.

A new Traffic Priority value shall be defined for preferential telecommunication services. This Traffic Priority value shall have a higher priority than any other Traffic Priority value with the possible exception of network maintenance values.

The CMTS may grant periodic special contention request opportunities to best effort service flows that are assigned a preferential telecommunications Traffic Priority value.

When the CMTS receives IP packets destined for a CM, the CMTS needs to recognize the assigned Traffic Priority and give priority to these downstream packets.

The CMTS shall give priority to received IP packets destined for a CM based on the Traffic Priority value assigned to the service flow.

8.3 PCRF

Within the IPCablecom2 multimedia architecture, the PCRF functionality is equivalent to two separate functional entities: an application manager and the policy server. Application managers provide a standard way for applications to interface with the IPCablecom2 multimedia policy server. The application manager is specifically designed to interface with the IPCablecom2 elements using the Diameter Rx reference point as defined in Appendix II of [b-ITU-T J.360]. This clause provides detailed requirements for each functional element.

8.3.1 IPCablecom application manager

The IPCablecom application manager (IPAM) needs to recognize the preferential telecommunication service Reservation-Priority AVP values in Diameter requests on the Rx reference point and use this information in communicating with the policy server.

The IPAM shall recognize the Reservation-Priority AVP in request messages received over the Diameter Rx reference point and shall use the values to give priority in processing requests.

The Reservation-Priority values for preferential telecommunication services shall be defined to be higher priority than other Reservation-Priority values with the possible exception of network maintenance values.

The IPAM shall use the Reservation-Priority AVP value in creating the SessionClassID and shall convert the Reservation-Priority value to the SessionClassID value assigned for preferential telecommunication services.

The IPAM shall use the Reservation-Priority AVP value in creating the Traffic Priority and shall convert the Reservation-Priority value to the preferential telecommunications Traffic Priority value.

8.3.2 Policy server

In general terms, the policy server receives Gate-Set and Gate-Delete messages from the application manager in COPS decision messages, forwards them to the CMTS in COPS decision messages, and passes responses back to the application manager.

The policy server shall recognize the SessionClassID in Gate-Set messages and the policy server shall use the values to give priority in processing requests.

8.4 P-CSCF

When the P-CSCF detects a request for preferential telecommunications (either directly as in option 1 or indirectly as in option 2), special actions are performed in processing the request before transmitting to the core network. For IPCablecom2 applications, the following specific cable access requirements are included.

When the P-CSCF detects a request (e.g., INVITE, SUBSCRIBE) to or from the SIP UA to establish a new preferential treatment service SIP dialogue with the SIP UA, the P-CSCF shall send a message to the PCRF to create priority signalling service flows (upstream and downstream) for option 2 and it shall include the Reservation-Priority AVP value assigned for the service. For both options, the P-CSCF shall send a message to the PCRF to create bearer service flows and it shall include the Reservation-Priority AVP value assigned for the service.

8.5 Preferential Treatment-AS (PrefTreat-AS)

When the PrefTreat-AS detects a request to or from the SIP UA to establish a new preferential treatment data service with the SIP UA, the PrefTreat-AS shall send a message to the PCRF over the Diameter Rx reference point to create priority signalling service flows (upstream and downstream) for option 2. The PrefTreat-AS may do this when it receives the initial request, prior to completion of the authentication and authorization sequence.

The PrefTreat-AS shall include the Reservation-Priority AVP with the value specified for these services in all messages sent to the PCRF over the Rx interface.

Annex A

Namespace used for ITU Region A

(This annex forms an integral part of this Standard)

This annex will provide the namespace to be used in the R-P header for ITU Region A. If ITU Region A needs this namespace, then it needs to request it from IANA. The relevant instructions are found in [IETF RFC 4412].

Annex B

Namespace used for ITU Region B

(This annex forms an integral part of this Standard)

[IETF RFC 4412]-defined "ETS" namespace must be used within ITU Region B for emergency services.

For emergency services using wireless access, the "WPS" namespace defined in [IETF RFC 4412] must be used.

Annex C

Namespace used for ITU Region C

(This annex forms an integral part of this Standard)

This annex will provide the namespace to be used in the R-P header for ITU Region C. If ITU Region C needs this namespace, then it needs to request it from IANA. The relevant instructions are found in [IETF RFC 4412].

Annex D

Namespace used for ITU Region D

(This annex forms an integral part of this Standard)

This annex will provide the namespace to be used in the R-P header for ITU Region D. If ITU Region D needs this namespace, then it needs to request it from IANA. The relevant instructions are found in [IETF RFC 4412].

Annex E

Namespace used for ITU Region E

(This annex forms an integral part of this Standard)

This annex will provide the namespace to be used in the R-P header for ITU Region E. If ITU Region E needs this namespace, then it needs to request it from IANA. The relevant instructions are found in [IETF RFC 4412].

Appendix I

Example of use of the R-P header

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

The following is an example of the elements required in defining the namespace for the R-P header.

[IETF RFC 4412] suggests several schemes for providing priority, including preemption and priority.

A suggested namespace definition for cable is as follows:

> The Cable preferential treatment is used in the Ipcablecom2 network when requesting priority treatment for a session by the authorized users or systems. The "CablePrefTreatment" defines the following resource values listed from lowest to highest priority:
>
> (lowest) CablePrefTreatment.4
>
> CablePrefTreatment.3
>
> CablePrefTreatment.2
>
> CablePrefTreatment.1
>
> (highest) CablePrefTreatment.0
>
> The CablePrefTreatment namespace operates according to the priority queuing algorithm (see section 4.5.2 of [IETF RFC 4412]).

The priority levels defined are applicable within IPCablecom2 networks. Mapping of these levels may be required at the different gateways when the end-to-end session is set up passing through different network technologies and architectures to support end-to-end priority for the preferential telecommunication services.

Bibliography

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