

INTERNET DRAFT

IPDC Device Management Protocol

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IPDC
Device Management Protocol
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Abstract

The protocol described in this document is a member of the IP Device Control (IPDC) family of protocols. The IPDC protocols are proposed as a protocol suite, components of which can be used individually or together to perform connection control, media control, and signaling transport for environments where the service control logic is separated from the network access server. Please see the references section for other IPDC documents.

The protocol specification presented here is intended for use between a media gateway controller and a media gateway. The media gateway may be capable of acting as a voice over IP gateway, voice over ATM gateway, dialup modem media gateway, circuit switch, or cross-connect. Using the IP Device Management protocol presented here, the media gateway controller can obtain status and receive notification of management events from the Media Gateway or between Media

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Gateways.

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1.0 Introduction

The protocol specification presented here is intended for use between centralized switch control logic or Media Gateway Controller and a Media Gateway. The Media Gateway may be capable of acting as a circuit switch, voice over IP gateway, dialup modem access server, or other messaging/conference server functions. Using the IP Device Management protocol within this document, the Media Gateway Controller can obtain status and receive notification of management events from the Media Gateway or between Media Gateways.

1.1 Background

This protocol is part of the IP Device Control (IPDC) family of protocols. The IPDC protocols have been proposed as a protocol suite that can be used individually or together to perform connection control, media control, status and signaling transport for environments where the service control logic is separated from the network Media Gateway. Please see the references section for other IPDC documents.

This document describes the commands and attribute value pairs that are necessary within the IPDC protocol to allow the Media Gateway Controller to be notified of status and management functions on the Media Gateway. The intent of the protocol is to leverage and be aware of the functions and service that other management facilities provide. By assuming that there are other management facilities, the protocol can be streamlined and be used for only basic management functions that may impact the Media Gateway Controller functionality. It is also assumed that configuration of the Media Gateway is done through separate means. Although notification of some configuration changes are enabled, full provisioning and configuration requires a separate set of functions and are not a part of this protocol.

This basic management protocol provides the Media Gateway Controller with start-up, configuration notification, status and basic testing facilities. Startup notifications to the Media Gateway Controller include system reboot, initialization and restarting of Media Gateway subsystems. Configuration notifications allow Media Gateway Controller to be notified if any configuration event occurs including those utilizing proprietary means. These configurations can be through SNMP transactions or other configuration methods. The protocol also allows for indication of testing procedures and tools that can be in operation on the Media Gateway. These tests could have an impact on the Media Gateway Controller core functions and are thus taken into account in the protocol.

2 Protocol Definition

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2.1 Specification of Requirements

In this document, several words are used to signify the requirements of the specification. These words are often capitalized.

MUST This word, or the adjective "required", means that the definition is an absolute requirement of the specification.

MUST NOT This phrase means that the definition is an absolute prohibition of the specification.

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

MAY This word, or the adjective "optional", means that this item is one of an allowed set of alternatives. An implementation which does not include this option **MUST** be prepared to interoperate with another implementation which does include the option.

2.2 Messages

This section describes the IP Device Management (IPDM) commands that are described within this document.

2.3 Restart

The media gateway sends a RSIP message to the media gateway controller when a management system directs it to restart. The RSIP message initiates a transaction identified per IPDC base document. The transaction completes when the media gateway controller returns an Acknowledgement message to the media gateway.

On a forced restart, the media gateway controller immediately sends the Acknowledgement message to the media gateway.

On a graceful restart, the media gateway controller releases all resources it is using on the media gateway before responding with the Acknowledgment message.

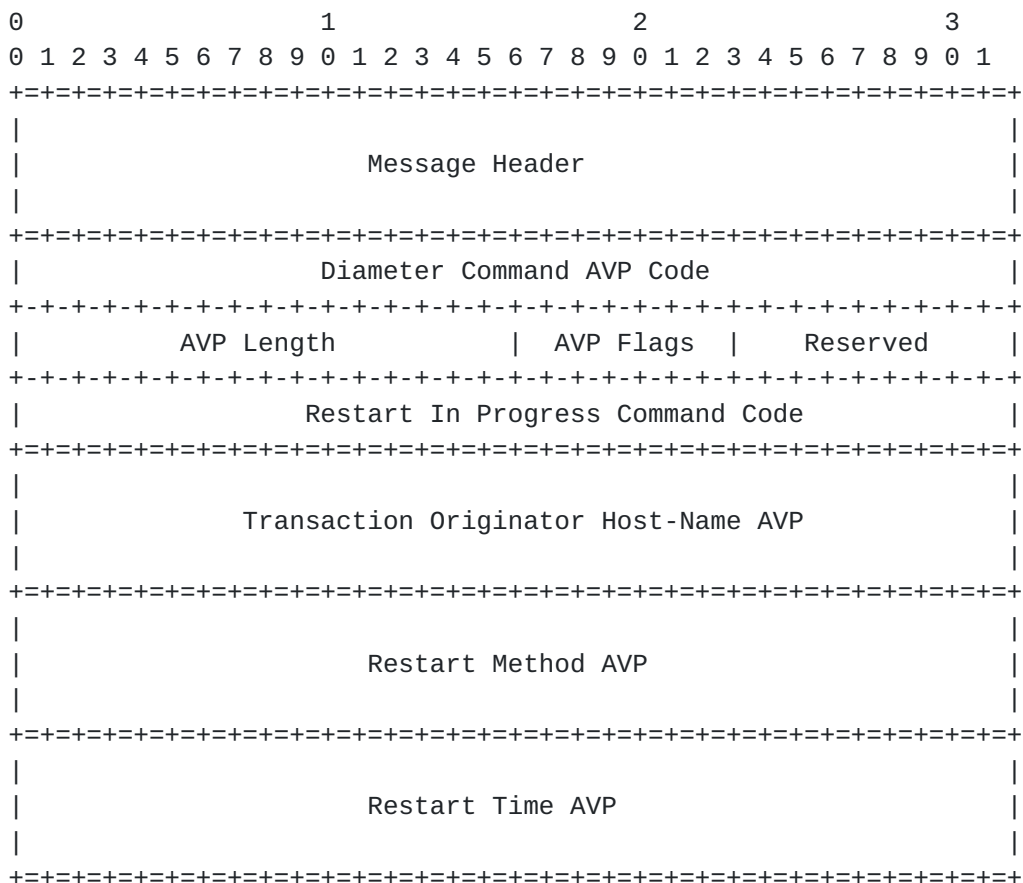
The media gateway can unilaterally complete the restart transaction if it does not receive an Acknowledgement within the specified time.

2.3.1 RSIP - Restart In Progress

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AVP Code

256 DIAMETER-Command

AVP Length

The length of this attribute MUST be at exactly 12.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. Bit two (SS-Encrypted-Data), Bit three (PK-Encrypted-Data) and Bit four (Vendor-Specific-AVP) SHOULD NOT be set.

Reserved

The Reserved field MUST be set to zero (0).

Command Code

1600 Device Management Restart In Progress

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Transaction Originator Host Name AVP

The host name of the initiator of the transaction. This is a required parameter for all IPDC protocol messages.

Restart Method AVP

This field MUST specify one of the following values:

```
00000001  Forced Restart
00000002  Graceful Restart
```

This is a required parameter.

Restart Time AVP

This field specifies number of seconds the media gateway waits for an Acknowledgement from the media gateway controller before restarting. This is a required parameter.

2.4 Configuration and Status

The media gateway controller may send a Request Information (RINF) message to a media gateway, which instructs the media gateway to respond with a Notify Information (NINF) message containing the requested information. The RINF begins a transaction, and the corresponding NINF ends the transaction. The media gateway MUST respond to a RINF message with a NINF or Message Reject message.

The media gateway controller may send a Set Information (SINF) message to the media gateway, which instructs the media gateway to set some limited configuration values. The media gateway MUST respond to a SINF message with an NINF or Message Reject message. The NINF or Message Reject message completes the transaction.

The media gateway can send unsolicited NINF messages to the media gateway controller to inform it of changes made to its system information by other management systems. An unsolicited NINF message initiates a transaction, and the transaction is completed when the media gateway controller returns either a Command Acknowledgement or a Message Reject.

2.4.1 NINF - Notify Information

```

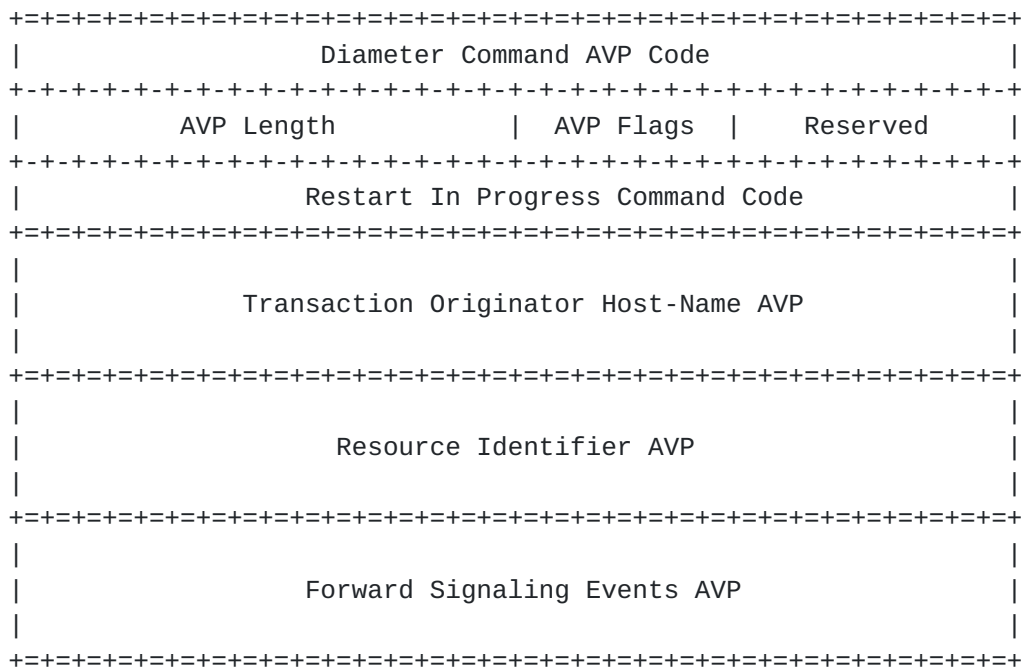
0                               1                               2                               3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+++++
|
|                               Message Header                               |
|
|
|

```

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AVP Code

256 DIAMETER-Command

AVP Length

The length of this attribute MUST be at exactly 12.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. Bit two (SS-Encrypted-Data), Bit three (PK-Encrypted-Data) and Bit four (Vendor-Specific-AVP) SHOULD NOT be set.

Reserved

The Reserved field MUST be set to zero (0).

Command Code

1601 Device Management Notify Information

Transaction Originator Host Name AVP

The host name of the initiator of the transaction. This is a required parameter for all IPDC protocol messages.

Resource Identifier AVP

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The Resource Identifier is the unique identifier for the resource or group of resources on a media gateway to which the NINF command applies. The Resource Identifier is of type IPDC Reference, defined in [3].

Forward Signaling Events AVP

Indicates whether the media gateway should forward signaling events to the media gateway controller

Conditional AVPs when IPDC-Reference specifies gateway

	Maximum Number of Modules AVP	
	Media Gateway Controller In Use AVP	
	List of Media Gateway Controllers AVP	
	Media Gateway Type AVP	

Conditional AVPs when IPDC-Reference specifies equip-holder

	Module Capabilites AVP	
	Number of Lines AVP	
	Number of Failed Lines AVP	
	External Name AVP	

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```
|                                     |  
|                               Line Status Array AVP                       |  
|=====
```

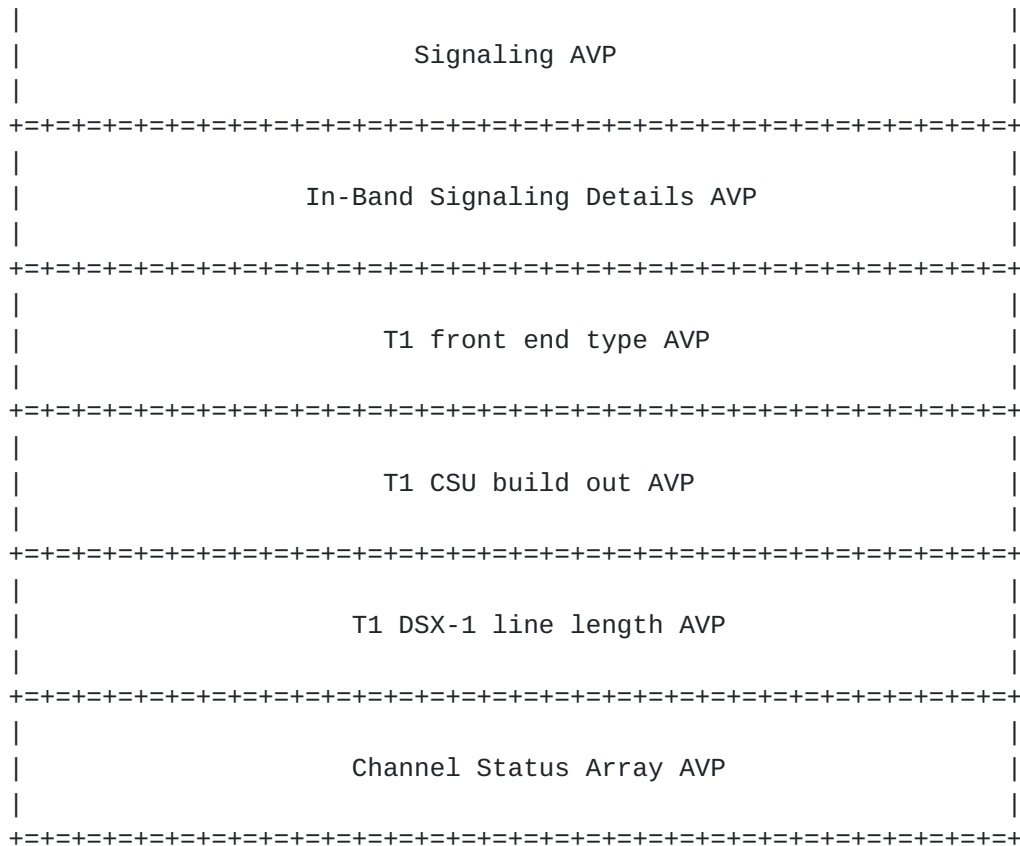
Conditional AVPs when IPDC-Reference specifies trunk-term or access-term

Bearer Capabilities AVP
Calling Party Number AVP
Dialed Phone Number AVP
Timestamp of last channel status transition AVP
Media Gateway Call Identifier AVP

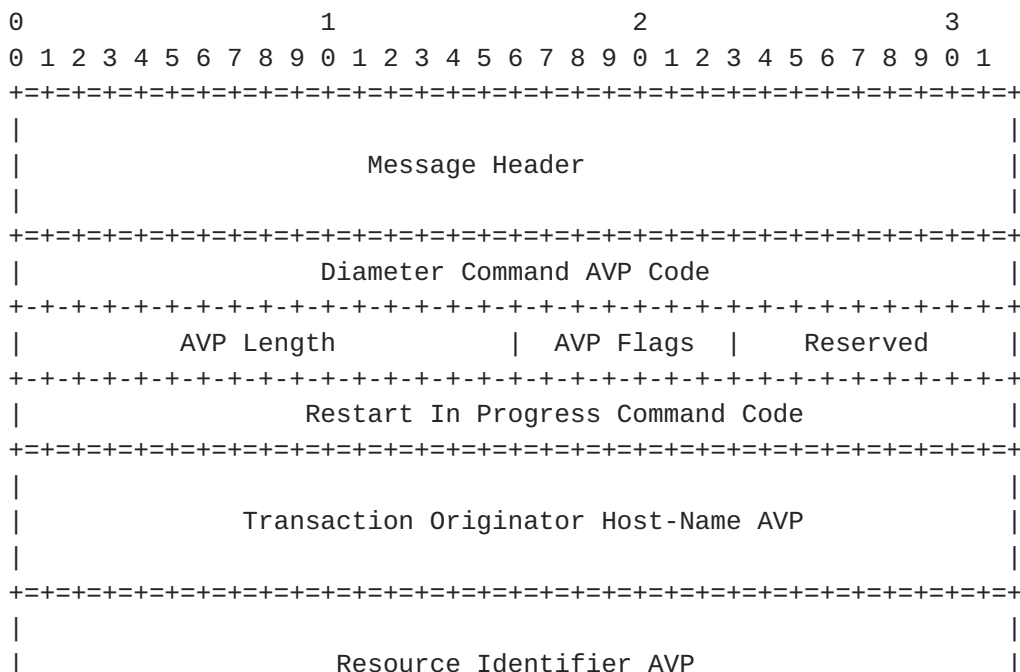
Conditional AVPs when IPDC-Reference specifies trans-term

Number of Channels AVP
External Name AVP
Line Coding AVP
Framing AVP

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[2.4.2](#) RINF - Request Information



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|

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+++++

AVP Code

256 DIAMETER-Command

AVP Length

The length of this attribute MUST be at exactly 12.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. Bit two (SS-Encrypted-Data), Bit three (PK-Encrypted-Data) and Bit four (Vendor-Specific-AVP) SHOULD NOT be set.

Reserved

The Reserved field MUST be set to zero (0).

Command Code

1602 Device Management Request Information

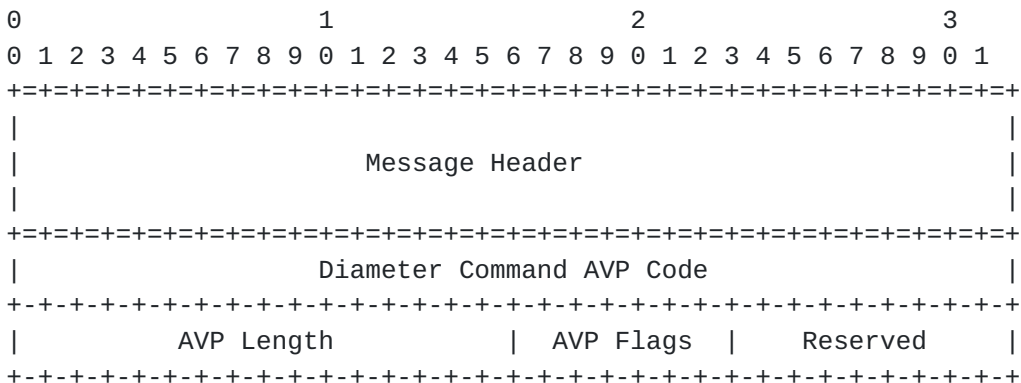
Transaction Originator Host Name AVP

The host name of the initiator of the transaction. This is a required parameter for all IPDC protocol messages.

Resource Identifier AVP

The Resource Identifier is the unique identifier for the resource or group of resources on a media gateway to which the NINF command applies. The Resource Identifier is of type IPDC Reference, defined in [3].

2.4.3 SINF - Set Information



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```

| Restart In Progress Command Code |
|=====|
| Transaction Originator Host-Name AVP |
|=====|
| Forward Signaling Events AVP |
|=====|
| Resource Identifier AVP |
|=====|
| Maximum Number of Modules AVP |
|=====|
| Media Gateway Controller In Use AVP |
|=====|
| List of Media Gateway Controllers AVP |
|=====|

```

AVP Code

256 DIAMETER-Command

AVP Length

The length of this attribute MUST be at exactly 12.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. Bit two (SS-Encrypted-Data), Bit three (PK-Encrypted-Data) and Bit four (Vendor-Specific-AVP) SHOULD NOT be set.

Reserved

The Reserved field MUST be set to zero (0).

Command Code

1603 Device Management Set Information

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Transaction Originator Host Name AVP

The host name of the initiator of the transaction. This is a required parameter for all IPDC protocol messages.

Resource Identifier AVP

The Resource Identifier is the unique identifier for the resource or group of resources on a media gateway to which the NINF command applies. The Resource Identifier is of type IPDC Reference, defined in [3].

3 AVP Values

This section will define the new AVP that are applicable to the commands described within this document. Some of the base AVPs such as Message Code, Transaction ID, Endpoint Address and Connection Type are defined in the IPDC base specification document.

3.1 Media Gateway Type AVP

AVP Code

1700 Media Gateway Type

AVP Length

The length of this attribute MUST be at least 12 to accommodate the AVP header plus 4 bytes of data.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Media Gateway Type

The Media Gateway Type field is of type String.

3.2 Maximum Modules AVP

AVP Code

1701 Maximum Modules

AVP Length

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The length of this attribute MUST be 0x000C (12). The maximum modules field is a 4 byte value.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Maximum Modules

Maximum modules specifies the maximum number of modules (slot cards) supported.

3.3 Media Gateway Controller In Use AVP

AVP Code

1702 Media Gateway Controller In Use

AVP Length

The length of this attribute MUST be 0x000C (12) to accommodate 8 bytes of AVP header information plus a 4 byte data for the index of the Media Gateway Controller currently in use.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Media Gateway Controller In Use

The integer32 Index of the Media Gateway Controller In Use as primary.

3.4 Number of Lines AVP

AVP Code

1703 Number of Lines

AVP Length

The length of this attribute MUST be 0x000C (12) to accommodate 8 bytes of AVP header information plus a 4 byte data for number of

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lines.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Number of Lines

The Number of Lines field specifies the number of physical line interfaces within a module.

3.5 Module Type AVP

AVP Code

1705 Module type

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus 4 byte indication of Module Type.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Module Type

Presently only the following module type values are specified:

0x00000000	not present
0x00000001	unknown Other values are to be defined.

3.6 Module Capabilities AVP

AVP Code

1706 Module Capabilities

AVP Length

The length of this attribute MUST be 0x0012(18) to accommodate 8 bytes of AVP header information plus 4 byte indication of Module

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Capabilities.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Module Capabilities

The Module Capabilities value is a Logical OR of any of the following flags:

0x00000001	Capable of continuity testing
0x00000002	Network Interface module

3.7 Module Status AVP

AVP Code

1707 Module Status

AVP Length

The length of this attribute MUST be 0x0012(18) to accommodate 8 bytes of AVP header information plus 4 byte indication of Module Status.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Module Status

Describes the status of the module. The following values may apply:

0x00000000	not present (empty)
0x00000001	out of service (down)
0x00000002	up
0x00000003	error

3.8 Number of Channels AVP

AVP Code

1709 Number of Channels

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AVP Length

The length of this attribute MUST be at least 0x0012(18) to accommodate 8 bytes of AVP header information plus 4 byte indication of the number of channels within the line.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Number of Channels

Specifies the number of channels within a channelized line interface.

3.9 Resource ID AVP

AVP Code

1710 Resource ID

AVP Length

The length of this attribute MUST be at least 12 to accommodate 8 bytes of AVP header information plus a minimum 4 bytes for the Resource ID.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MAY have bit four (Vendor Specific AVP) set.

Resource ID

The Resource ID field is of type IPDC Reference as defined in [3].
. The Resource ID AVP identifies the resource or resources to which an IPDM command applies.

3.10 Line Coding AVP

AVP Code

1711 Line Coding

AVP Length

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The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus 4 byte Line Coding Data.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Line Coding

The following values apply to the Line Coding field:

0x00000000	Unknown
0x00000001	AMI
0x00000002	B8ZS

3.11 Line Framing AVP

AVP Code

1712 Line Framing

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte Line Framing data field

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Line Framing

Describes the framing used for the line. Valid values are:

0x00000000	Unknown
0x00000001	D4
0x00000002	ESF

3.12 Line Signaling Details AVP

AVP Code

1713 Line Signaling Details

AVP Length

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The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Line Signaling Details

The following values apply to the Line Signaling Details field:

0x00000000	Unknown
0x00000001	In-band
0x00000002	ISDN PRI
0x00000003	NFAS
0x00000004	SS7 gateway

3.13 Line In-Band Signaling Details AVP

AVP Code

1714 Line In-Band Signaling Details

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus 4 byte indication of data.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Line In-Band Signaling Details

The following values apply to the Line Signaling Details field:

0x00000000	Unknown
0x00000001	Wink Start
0x00000002	Idle Start
0x00000003	wink-wink with 200msec wink
0x00000004	wink-wink with 400msec wink
0x00000005	loop start CPE
0x00000006	ground start CPE

3.14 Line Status AVP

AVP Code

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1715 Line Status

AVP Length

The length of this attribute MUST be exactly 0x000C(12) to accommodate 8 bytes of AVP header information plus 4 byte Line Status Data.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Line Status

Describes the Line State. The following Line States apply:

0x00000000	not present
0x00000001	disabled
0x00000002	red alarm (loss of sync)
0x00000003	yellow alarm
0x00000004	other alarms or errors
0x00000005	up
0x00000006	loopback

3.15 Channel Status AVP

AVP Code

1716 Latency Threshold

AVP Length

The length of this attribute MUST be at exactly 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte indication of the latency threshold.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Channel Status

The following are valid values for the channel status field:

0x00000000	not present
0x00000001	out of service
0x00000002	signaling channel (i.e. D Channel on an ISDN PRI

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line)
0x00000003 maintenance (continuity test pending or in progress)
0x00000004 blocked
0x00000005 loopback
0x00000006 idle
0x00000007 in use (dialing, ringing, etc)
0x00000008 connected
0x00000009 in use/DSP output
0x0000000A in use/DSP input
0x0000000B in use/DSP input + output
0x0000000C off hook/idle

3.16 Channel Status Change TimeStamp AVP

AVP Code

1717 Channel Status Changed Timestamp

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data value.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Channel Status Changed Timestamp

The Channel Status Changed Timestamp field is of type Time.

3.17 List of Media Gateway Controllers AVP

AVP Code

1718 List of Media Gateway Controllers

AVP Length

The length of this attribute MUST be at least 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data value.

AVP Flags

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The flag field MUST have bit one (Mandatory Support) set. The flag field MAY have bit four (Vendor Specific AVP) set.

List of Media Gateway Controllers

The list of media gateway controllers is an ordered list of 32-bit IP addresses for the media gateway controllers which can control the media gateway. The number of media gateway controllers in the list is $(\text{AVP Length} - 8) / 4$.

3.18 Number of Lines in Line Status Array AVP

AVP Code

1719 Number of Lines in Line Status Array

AVP Length

The length of this attribute MUST be at exactly 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte value indicating the number of lines specified in a Line Status Array AVP.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Number of Lines in Line Status Array

The Number of Lines in Line Status Array AVP is used to indicate the number of entries in a following Line Status Array AVP.

3.19 Line Status Array AVP

AVP Code

1720 Line Status Array

AVP Length

The length of this attribute MUST be at least 0x000C(12) to accommodate 8 bytes of AVP header information plus a minimum 4 byte value (indicating Line Status for at least one line).

AVP Flags

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The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Line Status Array

Describes an array of Line State values. Each Line State value can be one of the following:

0x00000000	not present
0x00000001	disabled
0x00000002	red alarm (loss of sync)
0x00000003	yellow alarm
0x00000004	other alarms or errors
0x00000005	up
0x00000006	loopback

The Number of entries in this array is reported by the Number of Lines in the Line Status Array AVP.

3.20 Number of channels in the Channel Status Array AVP

AVP Code

1721	Number of channels in the channel status array
------	--

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte value indicating the number of entries in the channel status array.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Number of channels in the channel status array

The Number of channels in the channel status array AVP is used to indicate the number of channel state entries in the Channel State Array AVP

The Number of channels in the channel status array field is of type Integer32.

3.21 Channel Status Array AVP

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AVP Code

1722 Channel Status Array

AVP Length

The length of this attribute MUST be at least 0x000C(12) to accommodate 8 bytes of AVP header information plus a minimum 4 byte value indicating at least one channel state .

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Channel Status Array

Describes an array of channel state values. Each channel state value can be one of the following:

0x00000000	not present
0x00000001	out of service
0x00000002	signaling channel (i.e. D Channel on an ISDN PRI line)
0x00000003	maintenance (continuity test pending or in progress)
0x00000004	blocked
0x00000005	loopback
0x00000006	idle
0x00000007	in use (dialing, ringing, etc)
0x00000008	connected
0x00000009	in use/DSP output
0x0000000A	in use/DSP input
0x0000000B	in use/DSP input + output
0x0000000C	off hook/idle

The number of entries in the channel state array is specified by the Number of channels in the channel status array AVP

3.22 Number of Failed Lines AVP

AVP Code

1723 Number of Failed Lines

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8

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bytes of AVP header information plus a 4 byte data field.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Number of Failed Lines

The Number of Failed Lines AVP is used in a Notify Module information message sent by an Media Gateway

The Number of Failed Lines field is of type Integer32.

3.23 T1 Front End Type AVP

AVP Code

1724 T1 Front End Type

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data field.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

T1 Front End Type

The following are the valid values for T1 Front End Type:

0x00000000	Unknown
0x00000001	CSU (T1 long haul)
0x00000002	DSX-1 (T1 Short Haul)

3.24 T1 CSU Build-out AVP

AVP Code

1725 T1 CSU Build-out

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data field.

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AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

T1 CSU Build-out

The following are the valid values for T1 CSU Build-out:

0x00000000	0 dB
0x00000001	7.5 dB
0x00000002	15 dB
0x00000003	22.5 dB

3.25 T1 DSX Line Length AVP

AVP Code

1726 T1 DSX Line Length

AVP Length

The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data field.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

T1 DSX Line Length

The following are the valid values for T1 DSX Line Length:

0x00000000	1-133 ft
0x00000001	134-266 ft
0x00000002	267-399 ft
0x00000003	400-533 ft
0x00000003	534-655 ft

3.26 Forward Signaling Events to the Media Gateway Controller AVP

AVP Code

1727 Forward Signaling Events to the Media Gateway Controller

AVP Length

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The length of this attribute MUST be 0x000C(12) to accommodate 8 bytes of AVP header information plus a 4 byte data field.

AVP Flags

The flag field MUST have bit one (Mandatory Support) set. The flag field MUST not have bit four (Vendor Specific AVP) set.

Forward Signaling Events to the Media Gateway Controller

Indicates whether the Media Gateway should send signaling events to the Media Gateway Controller. The following are valid values:

0x00000000	Do not send signaling events
0x00000001	Send signaling events IPDC type
0x00000002	Q.931 type
0x00000003	Tunnel type

4 Security Considerations

Security issues are not discussed in this memo. The security mechanisms recommended are those specified in [3].

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6 References

[1] Calhoun, Rubens, "DIAMETER Base Protocol", Internet-Draft, [draft-calhoun-diameter-03.txt](#), May 1998 [2] Calhoun, Zorn, Pan, "DIAMETER Framework", Internet-Draft, [draft-calhoun-diameter-framework-00.txt](#), May 1998 [3] Taylor, "IP Device Control Base Protocol", [4] Dugan, "IP Connection Control Protocol", [5] Skran, "IP Device Control Framework" [6] Elliott, "IP Media Control Protocol" [7] Bell, "IP Signaling Protocol"

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