Data-Over-Cable Service Interface Specifications
Resource Management Interface

Edge Resource Manager – Edge Device Interface Specification

CM-SP-RMI-ERM-EDGE-I02-150528

ISSUED

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Key to Document Status Codes

Work in Progress	An incomplete document, designed to guide discussion and generate feedback that may include several alternative requirements for consideration.
Draft	A document in specification format considered largely complete, but lacking review by Members and vendors. Drafts are susceptible to substantial change during the review process.
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Closed	A static document, reviewed, tested, validated, and closed to further engineering change requests to the specification through CableLabs.

Trademarks

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1 SCOPE

1.1 Overview

This specification is part of the DOCSIS family of specifications developed by Cable Television, Inc. Laboratories (CableLabs). The Resource Management Interface (RMI) architecture is an evolution of the Edge Resource Manager Interface (ERMI) architecture which is intended to improve scalability, performance, and service velocity. The architecture adopts web services as the standard communications mechanism between components.

1.2 Purpose

This document specifies the interface between the Edge Resource Manager (ERM) and the Edge Device in the RMI architecture. It uses web services to transmit this information.

The ERM to Edge Device Resource Interface (ERM-EDGE) defines interaction between an ERM and an Edge Device for the purpose of specifying, enabling and disabling the flow of data traffic through an Edge Device.

Interface ERM-EDGE is used to provision QAMs within an Edge Device and it can be used to request that the Edge Device inspect and/or inject session specific data. Edge Devices in RMI architectures are required to support the ERM-EDGE interface.

Support by an Edge Device of the SDR-EDGE interface is required. The SDR-EDGE discovery message contains information about the configuration of the QAMs on the Edge Device, including use of static and dynamic port mapping. It is also used to provide operational status to the ERM, which can convey that status information to the Session Manager via the SM-ERM interface.

1.3 Scope

This specification details the web service interfaces between Edge Resource Managers and their associated Edge Devices in order to interoperate.

1.4 Reference Architecture

The RMI architecture defines the following interfaces:

- Service Discovery and Registration (SDR) interface: An SDR-ERM interface between a Session Manager and an Edge Resource Manager (ERM), and an SDR-EDGE interface between an ERM and an Edge Device. This interface is used to provide resource status information to the ERM and Session Managers in order to effectively administer available QAM resources.
- Session Manager – ERM interface (SM-ERM): This interface allows a Session Manager/M-CMTS Core to make resource requests on Edge Devices from the ERM that manage those devices.
- ERM – Edge Device interface (ERM-EDGE): This interface allows an ERM to provision QAMs within an Edge Device and can be used to request that the Edge Device inspect and/or inject session-specific data.

The interfaces specified in the RMI documentation set are shown in Figure 1. This specification details the ERM-EDGE interface.

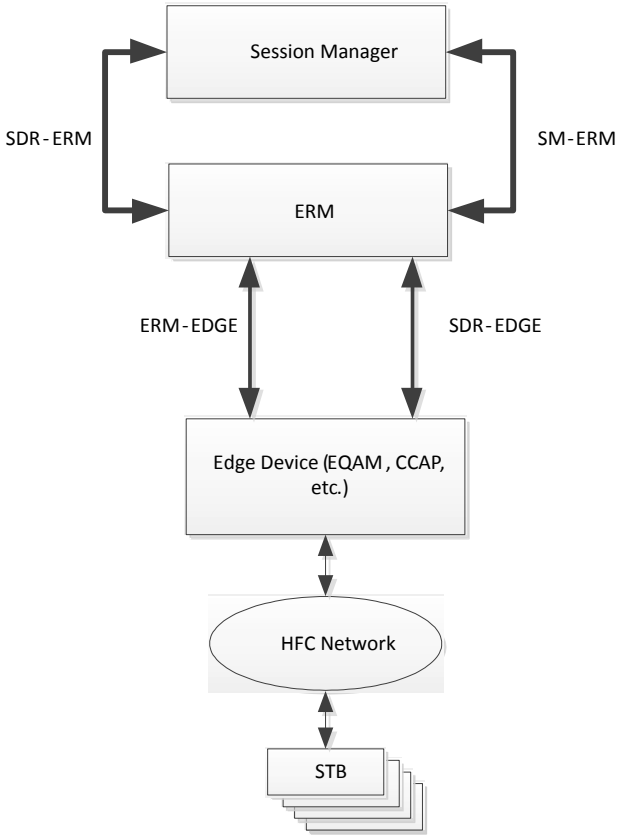

Figure 1 – Resource Management Interface Reference Architecture [1]

1.5 Requirements

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

"MUST"	This word means that the item is an absolute requirement of this specification.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this specification.
"SHOULD"	This word 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 behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
"MAY"	This word means that this item is truly optional. For example, one vendor may choose to include the item because a particular marketplace requires it or because it enhances the product; another vendor may omit the same item.

[1] Table replaced per RMI-ERM-EDGE-15.1287-1 by JB on 4/23/15.

This document defines many features and parameters, and a valid range for each parameter is usually specified. Equipment (CM and CMTS) requirements are always explicitly stated. Equipment must comply with all mandatory (MUST and MUST NOT) requirements to be considered compliant with this specification. Support of non-mandatory features and parameter values is optional.

1.6 Organization of Document

This specification is organized into the following sections:

Sections 1 – 4 contain the introduction, references, terms and abbreviations.

Section 5 specifies the general operation and requirements for the ERM-EDGE Interface.

Section 6 provides details about linear broadcast video and SDV support.

Section 7 specifies the XML messages for the ERM-EDGE interface.

2 REFERENCES

2.1 Normative References

In order to claim compliance with this specification, it is necessary to conform to the following standards and other works as indicated, in addition to the other requirements of this specification. Notwithstanding, intellectual property rights may be required to use or implement such normative references.

[RMI-SM-ERM]	Session Manager – Edge Resource Manager Interface Specification, CM-SP-RMI-SM-ERM-I02-150528, May 28, 2015, Cable Television Laboratories, Inc.
[RMI-HTTP]	Resource Management Architecture and HTTP Specification, CM-SP-RMI-HTTP-I02-150528, May 28, 2015, Cable Television Laboratories, Inc.
[RMI-SDR]	Service Discovery and Registration Specification, CM-SP-RMI-SDR-I02-150528, May 28, 2015, Cable Television Laboratories, Inc.

2.2 Reference Acquisition

- Cable Television Laboratories, Inc., 858 Coal Creek Circle, Louisville, CO 80027;
  Phone +1-303-661-9100, Fax +1-303-661-9199; http://www.cablelabs.com/

3 TERMS AND DEFINITIONS

This specification uses the following terms:

Edge Device	A head-end or hub device that receives packets of digital video or data from the operator network. It re-packetizes the video or data into an MPEG transport stream and digitally modulates the transport stream onto a downstream RF carrier using QAM.
Edge Input Group	A set of Edge Device input interfaces that has equivalent connectivity in the operator's Ethernet network.
Edge Resource Manager	A network element that manages the input and output resources of an Edge Device via the protocols defined in this specification.
Session Manager	A network element that manages the life cycle of video service sessions delivered to a subscriber.

4 ABBREVIATIONS AND ACRONYMS

This specification uses the following terms:

EIG	Edge Input Group
ERM	Edge Resource Manager
ERMI	Edge Resource Manager Interface
HTTP	HyperText Transfer Protocol
IGMP	Internet Group Management Protocol
IP	Internet Protocol
MPTS	Multi-Program Transport Stream
PAT	Program Association Table
PID	Packet Identifier
PMT	Program Mapping Table
QAM	Quadrature Amplitude Modulation
RMI	Resource Management Interface
SDR	Service Discovery and Registration
SDV	Switched Digital Video
SM	Session Manager
SOP	Streaming Output Port
SPTS	Single-Program Transport Stream
TSID	Transport Stream ID
UDP	User Datagram Protocol
URL	Uniform Resource Locator
VOD	Video on Demand
XML	Extensible Markup Language

5 OVERVIEW AND THEORY OF OPERATIONS

5.1 ERM-Edge Device Architecture

In order for an ERM to control the resources of an Edge Device, two logical functions are required. The first function, called service discovery, allows an ERM to dynamically discover Edge Devices as well as the resources of each Edge Device. The second function, called resource management, allows the Edge Resource Manager to specify the resource allocation within the Edge Device, as well as inject session data and check session stream status asynchronously. Messages associated with the discovery function are originated from the Edge Device, while messages that specify the resources allocated for a video session (resource management messages) originate from the ERM.

The interface and protocol associated with the discovery function is separate from the interface and protocol associated with the resource management function. Interface ERM-EDGE implements the resource management function between the Edge Resource Manager and Edge Device, while interface SDR-EDGE implements the discovery function between these two components. This document describes the architecture and protocol used for interface ERM-EDGE, while [RMI-SDR] describes the architecture and protocol used for interface SDR-EDGE.

The overall architecture of the ERM-EDGE interactions as specified in this document is characterized by the following:

- When the ERM is requested to set up a session, it allocates available resources on the Edge Device. If the Edge Device is configured for dynamic port mapping or is handling a linear broadcast video or switched digital video (SDV) service, the ERM sends a SetupSession request to the Edge Device to establish the data flow. The Edge Device passes all data arriving on the input port to the QAM.
- When a stream is no longer required, the ERM sends a TeardownSession request to the Edge Device. Upon receipt, the Edge Device is required to stop the flow of data through the QAM and release resources allocated to that session.
- The Edge Device can be contacted by an ERM outside of the context of a session to obtain configuration information from the Edge Device that is relevant to resource allocation. For example, the ERM can request an Edge Device to provide information about the User Datagram Protocol (UDP) port mapping associated with a particular QAM. This information is obtained through the SDR-EDGE interface, rather than the ERM-EDGE interface.
- Edge Devices report status or errors within the context of a particular session to the ERM using interface ERM-EDGE. However, changes in the state of an Edge Device outside the context of a particular session are conveyed using interface SDR-EDGE.

Note that the functions of interfaces SDR-EDGE and ERM-EDGE are closely related. Edge Devices are required to advertise the resources associated with each QAM under their control to the Edge Resource Manager using interface SDR-EDGE; once those resources have been discovered, the ERM can allocate any of those resources using interface ERM-EDGE.

The content of the traffic present on the incoming UDP/IP interface can be a Single Program Transport Stream (an SPTS, typically used for a Video on Demand [VOD] stream), a Multiple Program Transport Stream (an MPTS, typically used for a broadcast video source), or just a collection of ancillary Packet Identifier (PID streams). A valid Program Association Table (PAT) and Program Mapping Table (PMT) have to be present when there is an underlying MPEG-2 transport stream.

For the incoming SPTS, the ERM remaps the program number on the outgoing channel and signals this remapped value through the ERM-EDGE interface. Note: For implementations that use a non-ERM-EDGE, legacy static-mapping mechanism, the ERM remaps the program number through the appropriate selection and allocation of UDP port numbers. The Edge Device is required to re-label the program number, remap the PID values to values guaranteed to be unique in the output multiplex, and update the PMT and PAT to reflect the new program number / PID associations. Program numbers are a resource managed by the ERM, and therefore the ERM ensures the uniqueness of program numbers in an outgoing multiplex.

For an incoming SPTS, the Session Manager can request in the session setup request that the ERM suppress PID remapping. This function could be required to deliver data carousels on known program numbers or PIDs.

5.2 ERM-EDGE Functional Components

The components that use the ERM-EDGE interface and their respective roles are as follows:

- ERM – Maintains global inventory and controls the allocation of input bandwidth, UDP port numbers, QAM bandwidth, and MPEG program numbers for Edge Devices.
- Edge Device – Decapsulates a MPEG-2 transport from a UDP/IP transport and routes data to one or more designated MPTS channels for MPEG-2 remultiplexing, QAM modulation, and RF up conversion.

An Edge Device is managed by a single logical ERM. An ERM manages one or more logical Edge Devices.

Avoidance of conflicting program number assignment is the responsibility of the ERM, while avoidance of a conflicting PID is the responsibility of the Edge Device. When an Edge Device registers with an ERM, the ERM ascertains all of the Edge Device's physical downstream channels and corresponding bandwidth inventory. Since the resources of an Edge Device are registered to a single ERM through interface SDR-EDGE, the ERM has or can acquire all necessary information to avoid program number conflicts. Any observed conflicts in program numbering is considered as an error exception.

5.3 Provisioning Considerations

It is assumed that the Edge Device is already provisioned with general and physical device settings before the commencement of communication with an ERM. As part of the provisioning process, an Edge Device is provisioned with the Uniform Resource Locator (URL) or IP address of the ERM to be contacted by the Edge Device using interface SDR-EDGE. Using this address, the Edge Device initiates a connection to the ERM. The ERM MUST successfully process the resource inventory and HTTP signaling address for the Edge Device via interface SDR-EDGE before it can initiate a transport connection using interface ERM-EDGE.

The Edge Device publishes its control plane interface using SDR-EDGE. See [RMI-SDR] for details on this interface.

The ERM is assumed to have full dominion and allocation authority for all program numbers used on all associated Edge Device outputs.

5.4 Inventory Management

5.4.1 Device Inventory Discovery

The Edge Device communicates its edge inputs, QAM outputs, and operational status information to the ERM using the SDR-EDGE interface, as described in [RMI-SDR]. This ensures that the ERM is aware of the resources configured on the Edge Device.

5.4.2 Inventory Impacting Events

Changes to the functional or configuration state on the Edge Device that impact the operation or availability of bandwidth inventory are communicated to the ERM via interface SDR-EDGE. For example, if a QAM brick or QAM blade is removed from an Edge Device, this will have an obvious impact on bandwidth inventory, and quite possibly on active streaming sessions. The Edge Device notifies the ERM via SDR-EDGE messaging of all events caused by operational status or configuration changes.

Note that events that impact individual sessions are handled by sending an Event Notification to the ERM, as described in Section 7.5 in this specification.

SDR-EDGE includes an explicit keep-alive heartbeat mechanism that is used from the Edge Device to the ERM. If the ERM detects a timeout in the keep-alive messages from the Edge Device, the ERM MAY consider that Edge Device to be in the Shut Down state. The ERM SHOULD NOT use the resources of that Edge Device for new

session requests. The ERM MAY notify the Session Manager that the Edge Device is in a Shut Down state via the SM-ERM interface, detailed in [RMI-SM-ERM].

5.5 Control Plane URLs

An Edge Device is managed by a single logical ERM. In order to send service discovery and registration information to the ERM, the Edge Device is configured with the control plane URL or IP address of the ERM that manages it. The Edge Device uses this URL or IP address as the destination of EventNotify messages. If multiple instances of the ERM exist, it is suggested that the ERM use a load balancer to select an available instance for communications or assign a virtual IP address to an active instance in order to receive the Edge Device messages.

The ERM discovers the control plane interface of the Edge Device using the Service Discovery and Registration interface. The format is detailed in [RMI-SDR].

6 ERM-EDGE SUPPORT FOR LINEAR BROADCAST VIDEO AND SDV SESSIONS

6.1 Synchronous versus Asynchronous Mode[2]

Linear broadcast video and SDV session setup flow and a high level operational description is provided in the Overview and Theory of Operations section of [RMI-SM-ERM]. Refer to that document for details.

When the ERM directs an Edge Device to setup a session for linear broadcast video or SDV, the Edge Device allocates resources for the stream and issues an Internet Group Management Protocol (IGMP) Join request for the multicast that carries the desired channel. When the system operates in synchronous mode, the tune parameters are not returned to the Session Manager until the Edge Device begins outputting PAT/PMT packets that carry the requested channel. When a system operates in asynchronous mode, the tune parameters are returned to the Session Manager without verifying that the channel is being output by the Edge Device.

The Edge Device returns a setup session response (SetupSessionResult) to the ERM as soon as it has allocated resources for the stream; it does not wait until the IGMP Join succeeds or fails. However, when the IGMP Join succeeds or fails, the Edge Device MUST send an Event Notify message to the ERM communicating the status of the Join.

The ERM is responsible for applying the synchronous/asynchronous mode policy. This is accomplished by using an EventNotify message from the Edge Device to determine when the Edge Device is outputting a stream or when an IGMP Join failed. When operating in synchronous mode, the ERM MUST delay delivery of a SetupSessionResult message to the Session Manager until an EventNotify from the Edge Device indicating the status of the multicast stream has been received. When operating in asynchronous mode, the ERM MUST immediately return the SetupSession response to the Session Manager when it receives the SetupSession response from the Edge Device.

Figure 2 provides the message flow for synchronous mode.

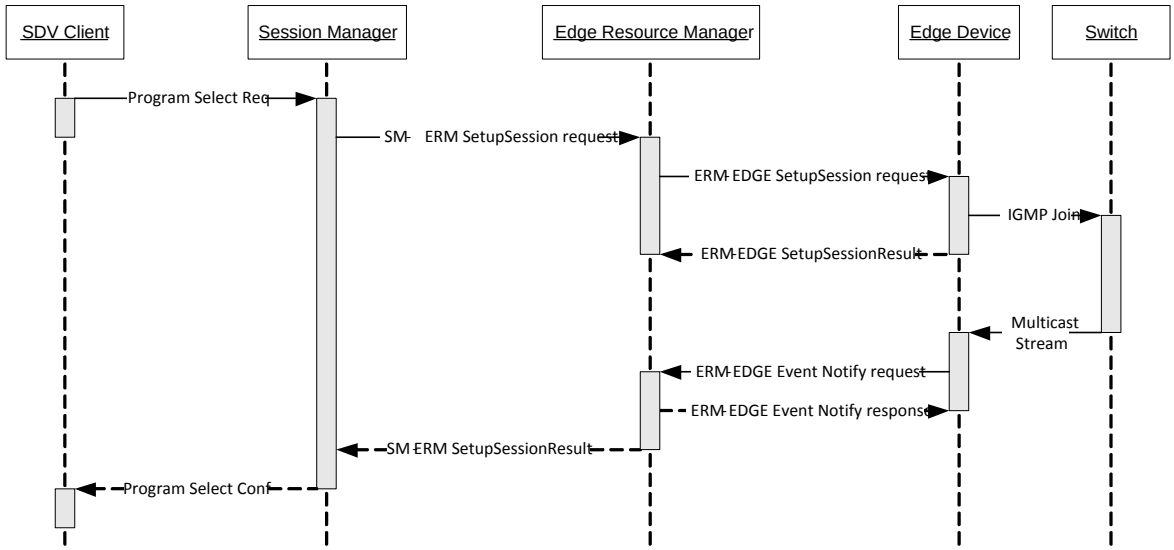

Figure 2 – Message Flow for Synchronous Mode[3]

[2] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.
[3] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

Figure 3 provides the message flow for asynchronous mode.

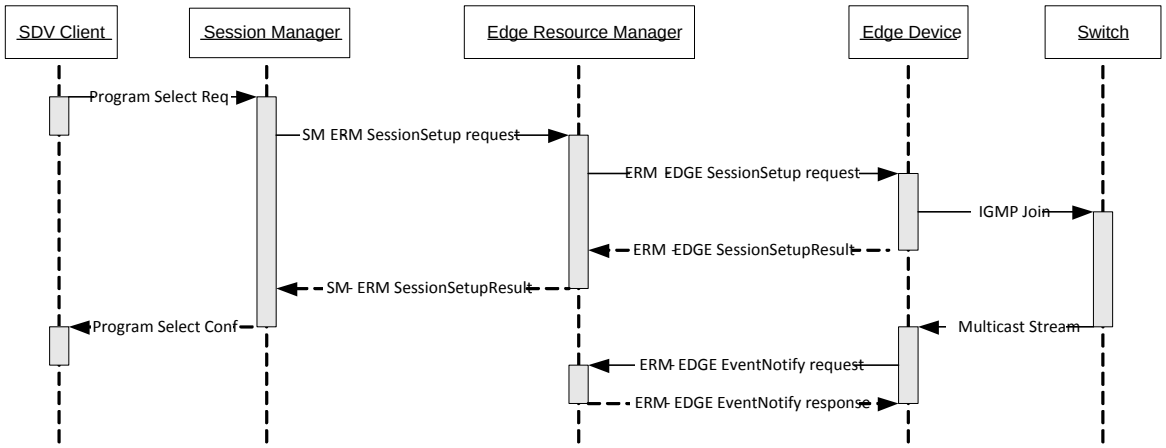

Figure 3 – Message Flow for Asynchronous Mode[4]

6.2 Edge Input Groups

An Edge Input Group (EIG) specifies a group of Edge Device input interfaces that have the same connectivity to streaming output port (SOP) groups. Since the EIG needs to be used to specify edge inputs connected to the same router for network connectivity, it is recommended that the EIG is named such that the router is part of the EIG name. The ERM can use the network connectivity information embedded in the EIG name to route redundant multicast streams through different routers to increase the reliability of the system.

The following EIG naming convention is suggested:

<RouterLocalname> + "/" + <EDSlotNumber> + "/" + <PortNumber>

Example: UR01/12/2

6.3 MPEG Program Numbers

When an MPEG transport stream carries multiple programs, it is termed a multi-program transport stream (MPTS). When an MPEG transport stream carries only a single program, it is termed a single-program transport stream (SPTS). When an ERM needs to identify which service within an MPTS the Edge Device needs to output on a QAM, the ERM has to provide the correct MPEG program number for the MPTS in the SetupSession request.

In the case of an SPTS, it is not necessary to provide the MPEG program number to identify the stream since there is only one program in an SPTS. A "wild card" MPEG program number value of zero (0) can be used to signal the Edge Device to pass the lone program in the SPTS to the output.

If an ERM needs to indicate to an Edge Device that an MPEG transport stream is an SPTS and that the Edge Device is to pass the only program in the program association table (PAT) for that transport stream, then the ERM SHOULD send a value of zero (0) for the MPEG program number in the ERM-EDGE SetupSession request. The ERM MAY choose to specify the actual value of the MPEG program number in the SetupSession request.

If an Edge Device receives a value of zero (0) for the MPEG program number in a SetupSession request, the Edge Device assumes that the transport stream is an SPTS and MUST pass the first program in the PAT. If an Edge Device receives a value other than zero for the MPEG program number in a SetupSession request, the Edge Device

[4] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

MUST only pass the program with that value in the PAT. If no program is found with that value, the Edge Device MUST fail the stream in order to avoid passing an incorrect program.

If the ERM does not provide a program number in the SetupSession request, the system assumes a passthrough MPTS stream.

6.4 Multicast Redundancy

6.4.1 Setup Session Parameters

When executing a SetupSession request, the ERM supplies one or more MulticastTransport elements carrying the details of multicast source streams. Multiple MulticastTransport elements are used to specify redundant copies of the stream. The MulticastTransport element is defined in [RMI-HTTP].

For IGMPv3, the redundant multicasts can be configured with the same multicast group address and different source addresses. Thus, for redundant multicast streams joined via IGMPv3, the ERM MUST supply the sourceAddress attribute of the MulticastTransport element for efficient bandwidth control.

In case of IGMPv2, IP traffic cannot be filtered using source address. Therefore, the multicast group address for all multicasts (whether or not redundant) are required to be unique. If the ERM does not require inspection of a multicast source IP address, the ERM MUST omit the sourceAddress attribute or set it to "0.0.0.0".

6.4.2 Redundancy Models

The Edge Device will be configured for a particular source redundancy model, such as cold backup or hot backup. If the Edge Device joins multiple multicasts to support the configured redundancy model, the Edge Device MUST return all joined multicasts in the SetupSession response message to the ERM.

Two redundancy models are described in the following sub-sections. Note that other redundancy models may exist.

6.4.2.1 Hot Backup

In this case the ERM provisions the Edge Device with multiple MulticastTransport elements; the hot-hot redundant streams are configured with the same value in the priority attribute. The Edge Device joins those multicasts. If a multicast ingest failure occurs, the Edge Device switches to the redundant source and sends an EventNotify message to the ERM to signal to fail over to the alternate multicast.

If the Edge Device does not support hot-hot redundancy, the SetupSession request will be denied.

A benefit of this model is that switch over time is minimal, since the redundant multicast is already being ingested. A negative is larger bandwidth consumption.

6.4.2.2 Cold Backup

In this case the ERM provisions the Edge Device with multiple multicast options. The Edge Device joins the multicast transport with the highest value in the priority attribute. It saves the other multicasts' data for redundancy purposes. If a multicast ingest failure occurs, the Edge Device switches to the redundant source and sends an EventNotify message to the ERM to signal to fail over to the alternate multicast.

A benefit of this model is it has lower IP bandwidth usage, since only one multicast is actively ingested. A negative is the switch over time is longer.

6.5 Event Notifications

6.5.1 IGMP Join Success

The Edge Device MUST send an EventNotify request with event code 2105 "Stream Delivery Success" to the ERM when the Edge Device begins outputting a multicast stream. This indicates that an IGMP Join succeeded and the Edge Device is able to process the stream and deliver it to the set-tops.

6.5.1.1 No Redundancy

If the SetupSession request contains a single MulticastTransport element and the Edge Device successfully joins that stream, the Edge Device MAY include a MulticastTransport element in the EventNotify message to indicate that the stream was successfully delivered. The Edge Device can also omit this element, since the SetupSession response specifies the MulticastTransport element that was joined.

6.5.1.2 Hot Backup Redundancy

If the Edge Device is using hot backup multicast redundancy, the Edge Device MUST include a MulticastTransport element in the EventNotify request to indicate the multicast that is actually being output, since the SetupSession response will provide all joined multicast streams.

6.5.2 IGMP Join Failure

The Edge Device MUST send an Event Notify request with event code 5404, "Unable to join multicast group", to the ERM when an IGMP Join fails. If multiple source addresses were specified by the ERM in the Setup Session request, then an IGMP Join failure means that all sources failed.

Even if one or more IGMP Join operations fails, if at least one IGMP Join succeeds, then the Edge Device is able to output content on its QAM. Thus, this situation is not considered an IGMP Join failure.

6.5.3 Fail Over to Redundant Source

The Edge Device MUST send an EventNotify request with event code 5406, "Switch over to redundant multicast source", to the ERM when it detects a loss of input of the source stream from the current multicast source and it fails over to a redundant multicast source. The Edge Device MUST include a MulticastTransport element with the EventNotify request that specifies the new multicast that is being output.

6.5.4 Source Stream Loss

The Edge Device MUST send an EventNotify request with event code 5403, "Network delivery failure", to the ERM when a source stream is lost and the Edge Device cannot fail over to an alternate stream source.

7 XML MESSAGES FOR THE ERM-EDGE INTERFACE

7.1 SetupSession

The ERM sends a SetupSession request to the Edge Device to route a VOD, SDV, linear broadcast video stream, or ancillary PID stream to a particular QAM and MPEG program number for delivery to the client. The ERM selects the edge input and QAM resources and supplies this information to the Edge Device. For VOD, the ERM supplies the unicast receive address and interface the Edge Device will use to ingest the VOD server stream. For SDV, the ERM supplies a list of multicasts for the Edge Device to ingest. For linear broadcast video, the ERM either provides a unicast stream or a primary, and possibly, a secondary multicast stream for the Edge Device to ingest. The Edge Device can also be configured with either a unicast or multicast connection to receive ancillary PID streams to route.

Request Direction: ERM to Edge Device

Method: HTTP POST

Location: `http://<device-url>/edge/SetupSession`

Children: QamTransport (1)

TargetClient (0..1)

UnicastTransport (0..1)

MulticastTransport (0..N)

EncryptControl (0..1)

RightsMetadata (0..1)

CASInfo (0..1)

The SetupSession element is the root element of the request message. Depending on the type of session being set up, different child elements are required. Table 1 indicates which elements are required to be included for VOD, SDV, linear broadcast video, and ancillary PID stream sessions, respectively.

Table 1 – SetupSession Child Element Inclusion Requirements

Element	VOD	SDV	Linear Broadcast	PID Stream
QamTransport	Yes – Mandatory	Yes – Mandatory	Yes – Mandatory	Yes – Mandatory
TargetClient	Yes – Optional	Yes – Optional	No	No
UnicastTransport	Yes – Mandatory	No	Yes – Optional	Yes – Optional
MulticastTransport	No	Yes – Mandatory	Yes – Optional	Yes – Optional
EncryptControl	Yes – Optional	Yes – Optional	Yes – Optional	No
RightsMetadata	Yes – Optional	Yes – Optional	Yes – Optional	No
CASInfo	Yes – Optional	Yes – Optional	Yes – Optional	No

Table 2 – SetupSession Request Attribute Definitions

Attribute	Use	Data Type	Description
sessionId	Required	xs:string	Session Manager assigned ID for the session.
clientSessionId	Optional	xs:string	Client specified session ID.
sessionGroup	Required	xs:string	This value defines a token that is used to identify a group of sessions.

Attribute	Use	Data Type	Description
bandwidth	Optional	xs:integer	Bandwidth of the content in bits per second. The ERM passes this value to the Edge Device when it is provided in the SetupSession request from the Session Manger. When provided, the Edge Device can use this value to determine if there is enough bandwidth available on the output QAM for the new session.
jitterBuffer	Optional	xs:integer	Specifies the amount of dejittering buffer in milliseconds to budget for the flow. If the specified value exceeds the capability of the Edge Device, the Edge Device MUST set and indicate its maximum dejittering capability in this attribute in the SetupSession response message. If the value is set to zero, then the stream is assumed to be a data stream, and the Edge Device remultiplexer MAY ignore stream delay variation for this program in order to optimize the remultiplexing of data for the entire downstream MPTS. If omitted, the Edge Device MUST appliy a default dejittering buffer size to the stream.
noPidRemapping	Optional	xs:boolean	Indicates whether the Edge Device should remap PIDs. The default is false (remap PIDs).
sessionDeliveryTimeout	Optional	xs:integer	This value identifies the amount of time the Edge Device should wait for a unicast VOD stream to be delivered, in seconds, before marking the delivery a failure. If included, this attribute is enforced for VOD sessions only.

7.1.1 QamTransport

The QamTransport element is specified in [RMI-HTTP]. This element directs the Edge Device to route the stream to the specified RF output. The ERM MUST provide the values of the frequency, qamName, mpegProgram (or pid and pidType), and tsid attributes. The Edge Device MUST validate that:

- the specified QAM has sufficient bandwidth for the stream
- the specified MPEG program number or PID is available for use
- the specified frequency and TSID match that configured for the selected QAM

If these parameters cannot be validated, the ERM MUST reject the SetupSession request.

7.1.2 TargetClient

The TargetClient element is specified in [RMI-HTTP]. This element is only included for VOD and SDV sessions. When provided, the Edge Device makes this data available to the CA system via the proprietary CA license protocol.

7.1.3 UnicastTransport

The UnicastTransport element is specified in [RMI-HTTP]. This element is required for VOD sessions; for linear broadcast video and ancillary PID stream sessions, either a UnicastTransport or MulticastTransport element is required in the SessionSetup message. This element directs the Edge Device to route the unicast stream on the specified Edge Device input and UDP port number to the QAM and MPEG program number specified in the QamTransport element. The ERM MUST supply the destinationAddress and destinationPort attributes.

7.1.4 MulticastTransport

The MulticastTransport element is specified in [RMI-HTTP]. This element is required for SDV sessions; for linear broadcast video and ancillary PID stream sessions, either a UnicastTransport or MulticastTransport element is required in the SessionSetup message. This element specifies the multicast streams that are carrying the video for the switched or linear broadcast channel or, alternately, carrying an ancillary PID stream. The Session Manager may provide more than one mulicast source for redundancy purposes. If the SessionSetup request calls for hot-hot redundancy but the Edge Device does not support hot-hot redundancy, then the Edge Device MUST reject the SetupSession request and return response code 480.

7.1.5 EncryptControl

The EncryptControl element is specified in [RMI-HTTP]. This element is only required if the ERM is setting up an encrypted session on an Edge Device with an embedded encryptor. Note that the encrypted session could be pre-encrypted.

7.1.6 CASInfo

The CASInfo element is specified in [RMI-HTTP]. This element is only required if the ERM is setting up an encrypted session on an Edge Device with an embedded encryptor.

7.1.7 RightsMetadata

The RightsMetadata element is specified in [RMI-HTTP]. This element is provided for some encrypted sessions The Edge Device may make the data in this element available to other interfaces as needed.

7.1.8 SetupSession Request Message Examples

7.1.8.1 SetupSession Request Example for VOD Session with Encryption Data

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP4"
       bandwidth="3750000">
       <TargetClient deviceId="C0A011223344"/>
       <QamTransport
              qamName="Philly.117"
              frequency="303000"
              mpegProgram="101"
              modulationMode="QAM256"
              tsid="117" >
       </QamTransport>
       <UnicastTransport
              destinationAddress="10.200.1.23"
              destinationPort="5101">
       </UnicastTransport>
       <EncryptControl
              encryptionType="ON-DEMAND"
              encryptionScheme="3DES"
              keyLength="56"
encryptorOpaque="a4a5d2f52g255c26g41d1ee651d2236f4f5g51a1b2b3c4d5
e6f7g8f9e213658745235aabd4e56f23">
       </EncryptControl>
       <CASInfo
```

```
casId="47A0"
              casBlob=be074250cc5a11d98cd50800200c9a66>
</CASInfo>
       <RightsMetadata
              providerId="Warner Bros"
              assetId="abcd1234567890123456"
              updateNumber="1"
              copyControl="NEVER"
              aps="OFF"
              cit="ON">
       </RightsMetadata>
</SetupSession>
```

7.1.8.2 SetupSession Request Example for Multiplexing Linear Transport Stream with Encryption Data[5]

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP5">
       <QamTransport
              qamName="Philly.210"
              mpegProgram="101"
              frequency="693000"
              modulationMode="QAM256"
              tsid="210">
       </QamTransport>
       <MulticastTransport
              sourceAddress="10.30.1.24"
              groupAddress="224.2.1.103"
              recvAddress="10.40.1.21"
              groupPort="1901"
              program="5"
priority="1" >
       </MulticastTransport>
       <MulticastTransport
              sourceAddress="10.32.2.17"
              groupAddress="224.2.1.103"
              recvAddress="10.40.1.23"
              groupPort="1901"
              program="5"
priority="2" >
       </MulticastTransport>
       <EncryptControl
              encryptionType="BROADCAST"
              encryptionScheme="3DES"
              keyLength="56"
encryptorOpaque="a4a5d2f52g255c26g41d1ee651d2236f4f5g51a1b2b3c4d5
e6f7g8f9e213658745235aabd4e56f23">
       </EncryptControl>
       <CASInfo
casId="47A0"
              casBlob=be074250cc5a11d98cd50800200c9a66>
```

[5] Title update per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
</CASInfo>
       <RightsMetadata
providerId="ESPN"
              assetId="CCDN1234567890000001"
              updateNumber="1"
              copyControl="NEVER"
              aps="OFF"
              cit="ON">
       </RightsMetadata>
</SetupSession>
```

7.1.8.3 SetupSession Request Example for Pass-Through Linear MPTS

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...

<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP5"
       noPidRemapping = TRUE >
       <QamTransport
              qamName="Philly.210"
              frequency="693000"
              modulationMode="QAM256"
              tsid="210">
       </QamTransport>
       <MulticastTransport
              sourceAddress="10.30.1.24"
              groupAddress="224.2.1.105"
              recvAddress="10.40.1.21"
              groupPort="1901"
priority="1" >
       </MulticastTransport>
       <MulticastTransport
              sourceAddress="10.32.2.17"
              groupAddress="224.2.1.105"
              recvAddress="10.40.1.23"
              groupPort="1901"
priority="2" >
       </MulticastTransport>
</SetupSession>
```

7.1.8.4 SetupSession Request Example for Multicast Ancillary PID Stream

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP5">
       <QamTransport
              qamName="Philly.210"
              frequency="693000"
```

```
              modulationMode="QAM256"
              tsid="210"
              pid="8188"
              pidType="NET" >
       </QamTransport>
       <MulticastTransport
              sourceAddress="10.30.1.30"
              groupAddress="224.2.1.10"
              recvAddress="10.40.1.20"
              groupPort="1900"
              pid="8188" >
       </MulticastTransport>
</SetupSession>
```

7.1.8.5 SetupSession Request Example for Unicast Ancillary PID Stream

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP5">
       <QamTransport
              qamName="Philly.210"
              frequency="693000"
              modulationMode="QAM256"
              tsid="210"
              pid="8188"
              pidType="NET" >
       </QamTransport>
       <UnicastTransport
              destinationAddress="10.40.1.24"
              destinationPort="5100"
              pid="8188">
       </UnicastTransport>
</SetupSession>
```

7.1.8.6 SetupSession Request Example for SDV with Optional Encryption

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP4"
       bandwidth="3750000" >
       <QamTransport
              qamName="Philly.122"
              frequency="333000"
              mpegProgram="101"
              modulationMode="QAM256"
              tsid="122" >
       </QamTransport>
       <MulticastTransport
```

```
              sourceAddress="10.30.1.20"
              groupAddress="224.2.1.100"
              recvAddress="10.40.1.21"
              groupPort="1901"
              program="10"
priority="1" >
       </MulticastTransport>
       <MulticastTransport
              sourceAddress="10.32.2.30"
              groupAddress="224.2.1.100"
              recvAddress="10.40.1.23"
              groupPort="1901"
              program="10"
priority="2" >
       </MulticastTransport>
       <EncryptControl>
              encryptionType="BROADCAST"
              encryptionScheme="3DES"
              keyLength="56">
       </EncryptControl>
       <CASInfo
casId="47A0"
              casBlob="be074250cc5a11d98cd50800200c9a66" >
</CASInfo>
       <RightsMetadata
              providerId="Golf"
              assetId="CCDN1234567890000002"
              updateNumber="1"
              copyControl="NEVER"
              aps="OFF"
              cit="ON" >
       </RightsMetadata>
</SetupSession>
```

7.1.8.7 SetupSession Request Example for Network Encrypted SDV

```
POST /edge/SetupSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<SetupSession
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66"
       sessionGroup="ERM1.GROUP4"
       bandwidth="3750000" >
       <QamTransport
              qamName="Philly.122"
              frequency="333000"
              mpegProgram="101"
              modulationMode="QAM256"
              tsid="122" >
       </QamTransport>
       <MulticastTransport
              sourceAddress="10.30.1.20"
              groupAddress="224.2.1.100"
              recvAddress="10.40.1.21"
              groupPort="1901"
              program="10"
priority="1" >
```

```
      </MulticastTransport>
      <MulticastTransport
            sourceAddress="10.32.2.30"
            groupAddress="224.2.1.100"
            recvAddress="10.40.1.23"
            groupPort="1901"
            program="10"
priority="2" >
      </MulticastTransport>
</SetupSession>
```

7.1.9 SetupSession Response

On successful completion of a SessionSetup request, the Edge Device MUST return 200 OK with an XML response carrying the SetupSessionResult element, detailing selected IP and QAM information. The SetupSessionResult element is defined in Section 7.1.9.1.

On failure of a SetupSession request on the Edge Device, the Edge Device MUST return 500 Internal Server Error and provide a SetupSessionResult element with details about the failure in its Response element.

On standard HTTP protocol errors, the Edge Device MUST return the appropriate HTTP status code and status text.

Table 3– SetupSession HTTP Status Codes

Status Code	Meaning
200	OK
400	Bad Request
403	Forbidden
500	Internal Server Error
503	Service Unavailable

7.1.9.1 SetupSessionResult

The SetupSessionResult element is returned with the XML response to a SetupSession request from the ERM. It provides the status of the response, details of any errors that occurred, and the resulting impact of the request on the Edge Device.

Children: Response (1)

EdgeResourceDetails (0..1)

Table 4 – SetupSessionResult Request Attribute Definitions

Attribute	Use	Data Type	Description
sessionId	Required	xs:string	Session Manager assigned ID for the session.

7.1.9.1.1 Response

The Response element is detailed in [RMI-HTTP]. The Edge Device MUST specify a responseCode value of 200 on successful completion of the SetpSession request. Standard SetupSession failure response codes are detailed in the Response Codes section of [RMI-HTTP].

7.1.9.1.2 EdgeResourceDetails

The Edge Device MUST provide the EdgeResourceDetails element in the SetupSessionResult element if the SetupSession request was successful.

Children: QamTransport (1)

UnicastTransport (0..1)

MulticastTransport (0..N)

EncryptControl (0..1)

CASInfo (0..1)

RightsMetadata (0..1)

Table 5 indicates which child elements need to be included for VOD, SDV, linear broadcast video, and ancillary PID streams, respectively.

Table 5 – EdgeResourceDetails Child Element Inclusion Requirements

Element	VOD	SDV	Linear Broadcast	PID Stream
QamTransport	Yes – Mandatory	Yes – Mandattory	Yes – Mandatory	Yes - Mandatory
UnicastTransport	Yes – Mandatory	No	Yes – Optional	Yes – Optional
MulticastTransport	No	Yes – Mandatory	Yes – Optional	Yes – Optional
EncryptControl	Yes – Optional	Yes – Optional	Yes – Optional	No
CASInfo	Yes – Optional	Yes – Optional	Yes - Optional	No
RightsMetadata	Yes – Optional	Yes – Optional	Yes – Optional	No

Table 6 – EdgeResourceDetails Attribute Definitions

Attribute	Use	Data Type	Description
jitterBuffer	Optional	xs:integer	If an unsupported jitter buffer value was specified in the SetupSession request, the Edge Device returns the jitter buffer value that it applied to the session, in ms.

7.1.9.1.2.1 QamTransport

The QamTransport element is detailed in [RMI-HTTP]. It specifies the selected QAM and RF tuning parameters. Note that these parameters were originally specified by the ERM; the Edge Device is simply confirming use of the specified resources.

7.1.9.1.2.2 UnicastTransport

The UnicastTransport element is defined in [RMI-HTTP]. The UnicastTransport element is required for VOD sessions; for linear broadcast video and ancillary PID stream sessions, either a UnicastTransport or MulticastTransport element will be provided in the EdgeResourceDetails message. Note that these parameters were originally specified by the ERM; the Edge Device is simply confirming use of the specified resources.

7.1.9.1.2.3 MulticastTransport

The MulticastTransport element is defined in [RMI-HTTP]. This element must be provided for SDV; for linear broadcast video and ancillary PID stream sessions, either a UnicastTransport or MulticastTransport element will be provided in the EdgeResourceDetails message. There is one MulticastTransport element for each multicast that is actively being ingested by the Edge Device. Thus, when the Edge Device is using hot-hot redundancy (two actively ingested multicasts), the Edge Device MUST return both multicasts that are being ingested. If the Edge Device is using hot-warm redundancy (one active ingest, one standby), the Edge Device MUST return a single multicast that

is being actively ingested. The Edge Device SHOULD populate the recvAddress attribute to indicate the edge input interface on which the multicast is received.

7.1.9.1.2.4 EncryptControl

The EncryptControl element is defined in [RMI-HTTP]. This element is provided when an encrypted session has been set up.

7.1.9.1.2.5 CASInfo

The CASInfo element is defined in [RMI-HTTP]. This element is provided when an encrypted session has been set up.

7.1.9.1.2.6 RightsMetadata

The RightsMetadata element is defined in [RMI-HTTP]. This element is provided when an encrypted session has been set up.

7.1.9.2 SetupSession Response Examples

7.1.9.2.1 SetupSession Response Example: VOD with Optional Encryption Data[6]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SetupSessionResult
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66">
       <Response responseCode="200"/>
       <EdgeResourceDetails>
              <QamTransport
                     qamName="Philly.117"
                     frequency="303000"
                     mpegProgram="101"
                     modulationMode="QAM256"
                     tsid="117" >
              </QamTransport>
              <UnicastTransport
                     destinationAddress="10.190.1.23"
                     destinationPort="709">
              </UnicastTransport>
              <EncryptControl
                     encryptionType="ON-DEMAND"
                     encryptionScheme="3DES"
                     keyLength="56"
                     encryptorOpaque="a4a5d2f52g255c26g41d1ee651d2236f4f5g51a1b2
                     b3c4d5e6f7g8f9e213658745235aabd4e56f23">
              </EncryptControl>
              <CASInfo
                     casId="47A0"
                     casBlob=be074250cc5a11d98cd50800200c9a66>
                     </CASInfo>
              <RightsMetadata
                     providerId="Warner Bros"
                     assetId="abcd1234567890123456"
                     updateNumber="1"
                     copyControl="NEVER"
                     aps="OFF"
```

[6] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
                    cit="ON">
              </RightsMetadata>
       </EdgeResourceDetails>
</SetupSessionResult>
```

7.1.9.2.2 SetupSession Response Example: Multiplex Linear Transport Stream[7]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SetupSessionResult
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66">
       <Response responseCode="200"/>
       <EdgeResourceDetails>
              <QamTransport
                    qamName="Philly.210"
                    mpegProgram="101"
                    frequency="693000"
                    modulationMode="QAM256"
                    tsid="210" >
              </QamTransport>
              <MulticastTransport
                    sourceAddress="10.32.2.17"
                    groupAddress="224.2.1.103"
                    recvAddress="10.40.1.23"
                    groupPort="1901"
                    program="5" >
              </MulticastTransport>
       </EdgeResourceDetails>
</SetupSessionResult>
```

7.1.9.2.3 SetupSession Response Example: Pass-Through Linear MPTS[8]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SetupSessionResult
       xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
       sessionId="be074250cc5a11d98cd50800200c9a66">
       <Response responseCode="200"/>
       <EdgeResourceDetails>
              <QamTransport
                    qamName="Philly.210"
                    frequency="693000"
                    modulationMode="QAM256"
                    tsid="210" >
              </QamTransport>
              <MulticastTransport
                    sourceAddress="10.32.2.17"
                    groupAddress="224.2.1.105"
                    recvAddress="10.40.1.23"
                    groupPort="1901" >
```

[7] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.
[8] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
            </MulticastTransport>
      </EdgeResourceDetails>
</SetupSessionResult>
```

7.1.9.2.4 SetupSession Response Example: Multicast Ancillary PID Stream[9]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SetupSessionResult
      xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
      sessionId="be074250cc5a11d98cd50800200c9a66">
      <Response responseCode="200"/>
      <EdgeResourceDetails>
            <QamTransport
                  qamName="Philly.210"
                  pid="8188"
                  pidType="NET"
                  frequency="693000"
                  modulationMode="QAM256"
                  tsid="210">
            </QamTransport>
            <MulticastTransport
                  sourceAddress="10.30.1.30"
                  groupAddress="224.2.1.10"
                  recvAddress="10.40.1.20"
                  groupPort="1900"
                  pid="8188" >
            </MulticastTransport>
      </EdgeResourceDetails>
</SetupSessionResult>
```

7.1.9.2.5 SetupSession Response Example: Unicast Ancillary PID Stream[10]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SetupSessionResult
      xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:18"
      sessionId="be074250cc5a11d98cd50800200c9a66">
      <Response responseCode="200"/>
      <EdgeResourceDetails>
            <QamTransport
                  qamName="Philly.210"
                  pid="8188"
                  pidType="NET"
                  frequency="693000"
                  modulationMode="QAM256"
                  tsid="210">
            </QamTransport>
            <UnicastTransport
                  destinationAddress="10.40.1.24"
                  destinationPort="5100"
```

[9] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.
[10] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
                pid="8188">
            </UnicastTransport>
      </EdgeResourceDetails>
</SetupSessionResult>
```

7.1.9.2.6 SetupSession Response Example: SDV [11]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SetupSessionResult
      xmlns="urn:com:cablelabs:rmi:erm-edge:2013:01:03">
      sessionId="be074250cc5a11d98cd50800200c9a66">
      <Response responseCode="200"/>
      <EdgeResourceDetails>
            <QamTransport
                  qamName="Philly.122"
                  mpegProgram="101"
                  frequency="303000"
                  modulationMode="QAM256"
                  tsid="122" >
            </QamTransport>
            <MulticastTransport
                  sourceAddress="10.30.2.30"
                  groupAddress="224.2.1.100"
                  recvAddress="10.40.1.23"
                  groupPort="1901"
                  program="10"
            </MulticastTransport>
      </EdgeResourceDetails>
</SetupSessionResult>
```

7.2 TeardownSession

The ERM sends a TeardownSession request to the Edge Device to terminate an existing session. When the Edge Device receives a TeardownSession request, the Edge Device MUST verify that the session is active, stop routing the stream to the RF output, and release the edge resources allocated to the session.

Request Direction: ERM to Edge Device

Method: HTTP POST

Location: `http://<device-url>/edge/TeardownSession`

Children: None

Table 7 – TeardownSession Attribute Definitions

Attribute	Use	Data Type	Description
sessionId	Required	xs:string	Session Manager assigned ID for the session.
reasonCode	Required	xs:integer	A numeric value indicating the reason that the session was terminated. Codes are specified in the Teardown Reason Codes section of [RMI-HTTP].
reasonText	Optional	xs:string	Optional description of the reason for session termination.

[11] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

7.2.1 TeardownSession Request Message Example

```
POST /edge/TeardownSession HTTP/1.1
Host: edge
User-Agent: ERM
Content-Type: application/xml
Content-Length: ...
<TeardownSession
      xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03"
      sessionId="be074250cc5a11d98cd50800200c9a66"
      reasonCode="200"
      reasonText="User Stop">
</TeardownSession>
```

7.2.2 TeardownSession Response

On successful completion of the request, the Edge Device MUST return a status code of 204 No Content without an XML body.

If the ERM specifies an unknown sessionId, the Edge Device MUST return a status code of 404 Not Found.

On failure, the Edge Device MUST return a status code of 500 Internal Server Error and provide the TeardownSessionResult element in the XML body with details about the failure in the Response element.

On standard HTTP protocol errors, the Edge Device MUST return the appropriate HTTP status code and status text.

Table 8 – TeardownSession HTTP Status Codes

Status Code	Meaning
204	No Content
400	Bad Request
403	Forbidden
404	Not Found
500	Internal Server Error
503	Service Unavailable

7.2.2.1 TeardownSessionResult

The TeardownSessionResult element is returned with the XML response to a TeardownSession request from the Edge Device when an error occurs. It provides, in the Response element, the details of the errors that occurred. The TeardownSessionResult element has no attributes.

Children: Response (1)

7.2.2.1.1 Response

The Response element is detailed in [RMI-HTTP]. Valid response codes are detailed in the Response Codes section of [RMI-HTTP].

7.2.2.2 TeardownSession Response Examples

7.2.2.2.1 TeardownSession Response Example: Success

```
HTTP/1.1 204 NO Content
```

```
Server: CCAP 1.1
Cache-Control: no-cache
```

7.2.2.2.2 TeardownSession Response Example: Error

```
HTTP/1.1 500 Internal Server Error
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<TeardownSessionResult
      xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03">
      <Response responseCode="404"
            responseText="Not Found" />
</TeardownSessionResult>
```

7.3 GET SessionList

The ERM uses this request to obtain a list of all sessions managed by the Edge Device. The ERM can supply the sessionGroup parameter in the request URL to obtain a subset of the session list matching the specified session group.

Request Direction: ERM to Edge Device

Method: HTTP GET

Location: `http://<device-url>/edge/SessionList[?sessionGroup="<session-group-name>"]`

Children: None

Table 9 – GET SessionList Request Parameter Definitions

Parameter	Use	Data Type	Description
sessionGroup	Optional	xs:string	Session group name specified in the SetupSession request. Only returns sessions that belong to that session group.

7.3.1 GET SessionList Request Example

```
GET /edge/SessionList?sessionGroup="ERM1.GROUP4" HTTP/1.1
```

7.3.2 GET SessionList Response

On success, the Edge Device MUST return 200 OK with the SessionList element in the XML body.

On standard HTTP protocol errors, the Edge Device MUST return the appropriate HTTP status code and status text without an XML body.

Table 10 – GET SessionList HTTP Status Codes

Status Code	Meaning
200	OK
400	Bad Request
403	Forbidden
500	Internal Server Error
503	Service Unavailable

7.3.2.1 SessionList

The SessionList element is defined in [RMI-HTTP]. A successful response to the GET SessionList request provides a list of session IDs that match the parameters of the request.

7.3.2.2 GET SessionList Response Example

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SessionList
       xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:032013:01:18">
       <SessionId>be074250cc5a11d98cd50800200c9a66</SessionId>
       <SessionId>c8ba47402f494a6d9037fdda7746ca29</SessionId>
       <SessionId>1301b42a229149909611c9584f833fe8</SessionId>
       <SessionId>78c5d9cefe0d45d5871e812a294caf05</SessionId>
</SessionList>
```

7.4 GET SessionStatus[12]

This request is used by the ERM to determine the current status of a session on the Edge Device. If a session exists on the Edge Device that matches the sessionId in the request parameters, the Edge Device MUST return an event code and event text describing the current state of the session. The sessionId parameter is required in the GET SessionStatus request. The Edge Device returns all data known about the specified session, including the QamTransport, MulticastTransport, UnicastTransport, and EncryptControl elements as appropriate.

Request Direction: ERM to Edge Device

Method: HTTP GET

Location: `http://<device-url>/edge/SessionStatus?sessionId="<session-id>`

Table 11 – GET SessionStatus Request Parameter Definitions

Parameter	Use	Data Type	Description
sessionId	Required	xs:string	Session Manager assigned ID for the session.

7.4.1 GET SessionStatus Request Example

```
GET /edge/SessionStatus?sessionId="be074250cc5a11d98cd50800200c9a66" HTTP/1.1
```

7.4.2 GET SessionStatus Response

On success, the Edge Device MUST return 200 OK with a SessionStatus element containing the session status information in the XML body.

If the ERM specifies an unknown sessionId, the Edge Device MUST return a 404 Not Found response.

If the ERM does not specify a Session ID, the Edge Device MUST return a 400 Bad Request response.

On standard HTTP protocol errors, the Edge Device MUST return the appropriate HTTP status code and status text.

[12] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

Table 12 – GET SessionStatus HTTP Status Codes

Status Code	Meaning
200	OK
400	Bad Request
403	Forbidden
500	Internal Server Error
503	Service Unavailable

7.4.2.1 SessionStatus

The SessionStatus element is defined in [RMI-HTTP]. The SessionStatus element specifies the current status for an active session.

7.4.2.2 GET SessionStatus Response Examples

7.4.2.2.1 GET SessionStatus Response: No Error Condition[13]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SessionStatus xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03">
      eventCode="0" >
      <QamTransport
            qamName="Philly.210"
            frequency="693000"
            mpegProgram="101"
            modulationMode="QAM256"
            tsid="210">
      </QamTransport>
      <MulticastTransport
            sourceAddress="10.30.1.24"
            groupAddress="224.2.1.103"
            recvAddress="10.40.1.21"
            groupPort="1901">
      </MulticastTransport>
      <EncryptControl
            casId="47A0"
            encryptionType="BROADCAST"
            encryptionScheme="AES"
            keyLength="128">
      </EncryptControl>
</SessionStatus>
```

7.4.2.2.2 GET SessionStatus Response: Session-Related Error Condition[14]

```
HTTP/1.1 200 OK
Server: CCAP 1.1
Cache-Control: no-cache
Content-Type: application/xml
Content-Length: ...
<SessionStatus xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03"
```

[13] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.
[14] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
        eventCode="5401"
        eventText=" Downstream Failure"
                eventDate="2010-10-23T16:04:37Z" >
        <QamTransport
                qamName="Philly.210"
                frequency="693000"
                mpegProgram="101"
                modulationMode="QAM256"
                tsid="210">
        </QamTransport>
        <MulticastTransport
                sourceAddress="10.30.1.24"
                groupAddress="224.2.1.103"
                recvAddress="10.40.1.21"
                groupPort="1901">
        </MulticastTransport>
        <EncryptControl
                casId="47A0"
                encryptionType="BROADCAST"
                encryptionScheme="AES"
                keyLength="128">
        </EncryptControl>
</SessionStatus>
```

7.5 POST EventNotify

The Edge Device sends an EventNotify request to the ERM to notify the Session Manager of an important session-related event. For SDV session-related events can include notifications of stream delivery, as specified in Section 6.5, Event Notifications.

The ERM handles event notifications by updating its resource management information. The ERM passes session-impacting events to the Session Manager to allow it to determine whether to terminate the session, as detailed in [RMI-SM-ERM].

Request Direction: Edge Device to ERM

Method: HTTP POST

Location: `http://<device-url>/erm/EventNotify`

The EventNotify element is the root element of this message and is defined in [RMI-HTTP].

If the event is related to one or more sessions, the Edge Device MUST provide a list of impacted sessions in the SessionList element. This allows efficient notification of events that impact many sessions, such as QAM failure.

The EventNotify element can include a MulticastTransport child element. This element is only specified for SDV, linear broadcast video, and ancillary PID stream sessions. The MulticastTransport element indicates which multicast stream is being delivered to the clients and is used when a session is established and when a fail over to a redundant source occurs. See Section 6.4, Multicast Redundancy, for multicast fail over use cases.

7.5.1 POST EventNotify Message Examples

7.5.1.1 POST EventNotify Message Example: VOD Session Event[15]

```
POST /erm/EventNotify HTTP/1.1
Host: erm
User-Agent: EDGE
Content-Type: application/xml
Content-Length: ...
```

[15] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
<EventNotify xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03"
       eventCode="5401"
       eventText="Downstream Failure"
       eventDate="2010-10-23T16:04:37Z" >
       <SessionList>
              <SessionId>be074250cc5a11d98cd50800200c9a66</SessionId>
       </SessionList>
       <QamTransport
              qamName="Philly.210"
              mpegProgram="101">
       </QamTransport>
</EventNotify>
```

7.5.1.2 POST EventNotify Message Example: IGMP Join Success[16]

```
POST /erm/EventNotify HTTP/1.1
Host: erm
User-Agent: EDGE
Content-Type: application/xml
Content-Length: ...
<EventNotify
       xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03"
       eventCode="2105"
       eventText="Stream Delivery Success"
       eventDate="2010-10-23T16:04:37Z" >
       <SessionList>
              <SessionId>be074250cc5a11d98cd50800200c9a66</SessionId>
       </SessionList>
       <QamTransport
              qamName="Philly.210"
              mpegProgram="101">
       </QamTransport>
       <MulticastTransport
              sourceAddress="10.32.2.17"
              groupAddress="224.2.1.103"
              recvAddress="10.40.1.23"
              groupPort="1901" >
       </MulticastTransport>
</EventNotify>
```

7.5.1.3 POST EventNotify Message Example: IGMP Join Failure[17]

```
POST /erm/EventNotify HTTP/1.1
Host: erm
User-Agent: EDGE
Content-Type: application/xml
Content-Length: ...
<EventNotify
       xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:03"
       eventCode="5404"
       eventText="Unable to Join Multicast Group"
       eventDate="2010-10-23T16:04:37Z" >
       <SessionList>
              <SessionId>be074250cc5a11d98cd50800200c9a66</SessionId>
       </SessionList>
       <MulticastTransport
              sourceAddress="10.32.2.17"
```

[16] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.
[17] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
            groupAddress="224.2.1.103"
            recvAddress="10.40.1.23"
            groupPort="1901" >
      </MulticastTransport>
</EventNotify>
```

7.5.1.4 POST EventNotify Message Example: Failover to Redundant SDV Source[18]

```
POST /erm/EventNotify HTTP/1.1
Host: erm
User-Agent: EDGE
Content-Type: application/xml
Content-Length: ...
<EventNotify
      xmlns="urn:com:cablelabs:rmi:erm-edge:2010:12:032013:01:18"
      eventCode="5406"
      eventText="Switch Over to Reundant Multicast Source"
      eventDate="2010-10-23T16:04:37Z" >
      <SessionList>
            <SessionId>be074250cc5a11d98cd50800200c9a66</SessionId>
            <SessionId>c8ba47402f494a6d9037fdda7746ca29</SessionId>
            <SessionId>1301b42a229149909611c9584f833fe8</SessionId>
            <SessionId>78c5d9cefe0d45d5871e812a294caf05</SessionId>
      </SessionList>
      <MulticastTransport
            sourceAddress="10.32.2.17"
            groupAddress="224.2.1.103"
            recvAddress="10.40.1.23"
            groupPort="1901"
            priority="1" >
      </MulticastTransport>
</EventNotify>
```

7.5.2 POST EventNotify Message Response

On successful receipt of the message, the ERM MUST return a status code of 204 No Content without an XML body.

On all failure responses, the ERM MUST return the HTTP status code and status text that specifies the error without an XML body.

Table 13 – POST EventNotify HTTP Status Codes

Status Code	Meaning
204	No Content
400	Bad Request
403	Forbidden
404	Not Found
500	Internal Server Error

7.5.2.1 EventNotify Response Examples

7.5.2.1.1 EventNotify Response Example: Success

```
HTTP/1.1 204 NO Content
```

[18] Revised per RMI-ERM-EDGE-N-15.1287-1 on 4/24/15 by JB.

```
Server: ERM 1.1
Cache-Control: no-cache
```

7.5.2.1.2 EventNotify Response Example: Failure

```
HTTP/1.1 404 Not Found
Server: ERM 1.1
Cache-Control: no-cache
```

Appendix I Acknowledgements

On behalf of the cable industry and our member companies, CableLabs would like to thank the following individuals for their contributions to the development of this specification.

Contributor	Company Affiliation
Glenn Babecki	CCAD
Weidong Mao	Comcast
Doug Will	Comcast
Ty Pearman	Comcast
Joe Solomon	Comcast
Niem Dang	Time Warner Cable
Brian Floyd	Time Warner Cable

Appendix II Revision History

II.1 Engineering Change for CM-SP-ERM-EDGE-I02-150528

ECN	Date Accepted	Summary	Author
RMI-ERM-EDGE-15.1287-1	04/22/2015	Simplifications to RMI in RMI-ERM-EDGE	Solomon