Dialogic® PowerMedia™
Media Resource Broker (MRB)

Technology Guide

September 2017 Rev 2.0

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Revision History

Revision	Release Date	Notes
2.0 (Updated)	September 2017	PowerMedia MRB Deployment Models: Updated the section.
2.0	April 2017	Updates for MRB version 3.3. MRB for 1PCC RESTful (SIP Applications): Updated the section.
1.0	November 2016	Initial release of this document.
Last modified: September 2017		

Refer to www.dialogic.com for product updates and for information about support policies, warranty information, and service offerings.

1. Introduction

This document provides an overview of Dialogic® PowerMedia™ Media Resource Broker (also referred to herein as "PowerMedia MRB" or "MRB") solution. The PowerMedia MRB is a media load balancer that provides high availability, scalability and redundancy while managing and monitoring media server resources, such as Dialogic® PowerMedia™ Extended Media Server (also referred to herein as "PowerMedia XMS" or "XMS").

Media Resource Broker

The Media Resource Broker (MRB), including the PowerMedia MRB, is a standardized network element, defined by RFC 6917, that manages media resource availability and reliability, providing improved utilization and reliability of deployed media resources in the network. As defined in MRB specifications, these elements perform critical media resource management functions, including the following:

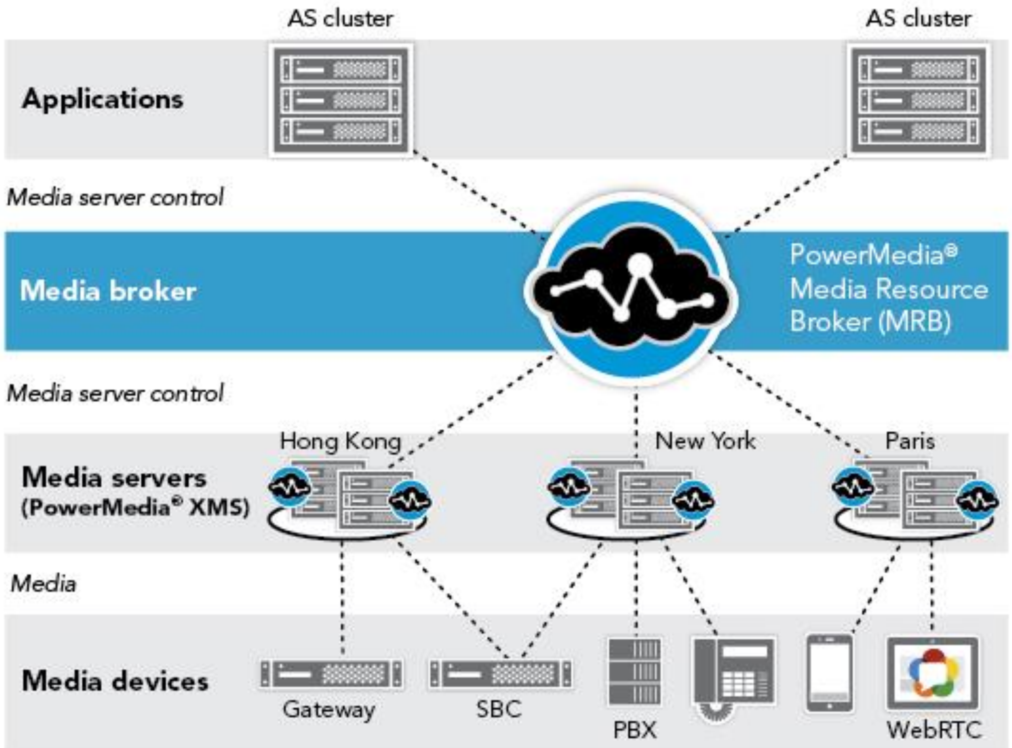
- Balancing requests from multiple application servers or app server clusters
- Efficiently utilizing and allocating the Media Resource Function (MRF) and Media Server (MS) resource pools
- Providing a monitoring mechanism for media server status and capabilities
- Supporting media control payloads such as MSML, JSR 309, NETANN, and RESTful

MRBs are formally defined by the IETF in RFC 6917 - Media Resource Brokering. The MRB has also been incorporated in the 3GPP TS 23.218 IP Multimedia System (IMS) architecture as the functional entity responsible for query and management of MRFs in the IMS network.

In addition to meeting the functional requirements specified in the MRB standards referenced above, the PowerMedia MRB provides many additional capabilities, including the following:

- Stateful call preservation
- Intelligent resource control
- MRB high availability
- Local and geographic redundancy
- Broad range of standard media server interfaces
- Management interfaces

The following diagram illustrates the role of the PowerMedia MRB to manage PowerMedia XMS resources among various geographic sites:



The PowerMedia MRB provides clustering of PowerMedia XMS instances to support higher density, high availability, and scalability requirements of a variety of application services. The PowerMedia MRB is designed to handle large transaction rates and can effectively and efficiently load balance the traffic among available PowerMedia XMS instances (MRFs), even those instances located in different geographic regions. The PowerMedia MRB is implemented to be a stateful load balancer and actively monitors and tracks capacity and availability of individual PowerMedia XMS instances. As the PowerMedia MRB is stateful, it can also support real-time call preservation. In case of failure, the PowerMedia MRB can dynamically restore established media sessions for conferences and bridged calls to an alternate XMS instance, ensuring continuity of service.

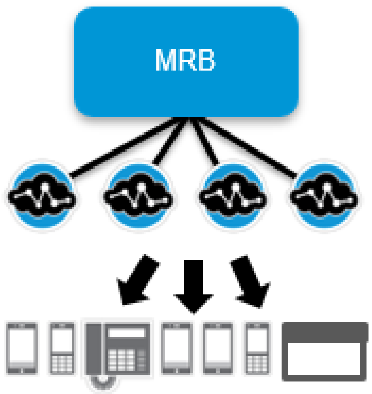
When to Use PowerMedia MRB

The PowerMedia MRB is critical for applications that utilize network media resources. The PowerMedia MRB can provide advantages in the network architecture including the following:

- Scale and Performance
- Redundancy and High Availability

Scale and Performance

The PowerMedia MRB provides software resource management and media load balancing across a cluster of media servers, such as a cluster of PowerMedia XMS systems. The PowerMedia MRB offloads the media load balancing duties from application servers in the network and provides one entry point to the media resources that is used across a variety of networks and devices.

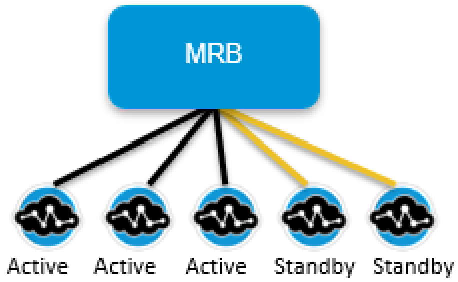


Interacting with the MRB effectively provides an interface that appears and functions like a single media server resource. Providing a single point of entry reduces complexity for media service applications by:

- Shielding applications from managing multiple entry points that would be presented when managing more than a single media server device.
- Providing sophisticated failure detection and reporting without the need for client interaction.
- Providing advanced services such as conference/bridged call preservation and service continuity during failure scenarios.
- Allowing future proof scaling solutions that can be expanded and reduced as required to grow with the surrounding solution.
- Allowing new applications to take advantage of advanced MRB features such as the P-MRB header (as described in SIP P-MRB Header) to increase performance of the overall solution.
- MRB can be easily included in legacy application deployments if required without need for application code changes to accommodate the introduction.

Redundancy and High Availability

The PowerMedia MRB supports both MRB redundancy and media server redundancy. The PowerMedia MRB supports local redundancy and failover between MRB instances by replicating call and conference states for failover. The PowerMedia MRB also handles media server local and geographic redundancy to provide high availability of media servers in case of outages. Additionally, the PowerMedia MRB supports service call continuity by providing call preservation of conferences and joined call sessions.



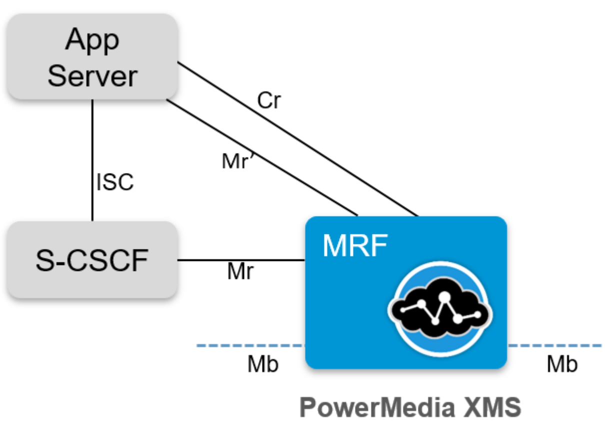
Detailed information about redundancy and high availability can be found in this document:

- For more information about MRB redundancy and high availability, see MRB Redundancy Architecture.
- For more information about media server redundancy, see Media Server Redundancy.

Role of PowerMedia MRB in IMS

The IP Multimedia Subsystem (IMS) architecture is intended to provide a unified framework for deploying and delivering Internet Protocol (IP) based services. The IMS network places a large emphasis on media resources in its network as a major component for deploying IP-based services. Media resources are more generally known as a Media Resource Function (MRF) in the IMS. The Media Resource Broker is a standardized network element that manages resource availability and reliability. The Media Resource Broker made its first appearance in Release 8 of IMS.

The following diagram shows the role of the PowerMedia MRB in the IMS network as defined by 3GPP TS 23.218 for In-Line MRB mode:



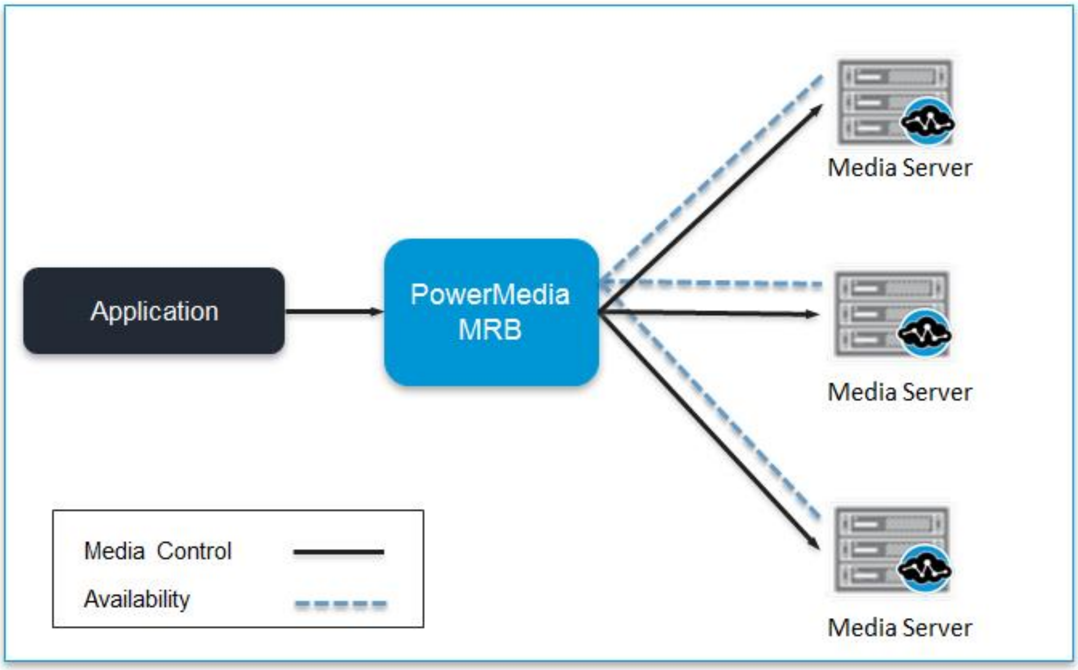
The diagram shows the following interfaces that interact with the PowerMedia MRB and PowerMedia XMS as the MRF:

- Mr - Indirect Media Control (SIP)
- Mr' - Direct AS to MRF Control (SIP)
- Cr - Control Package

The PowerMedia MRB is positioned with the SIP Interface (ISC/Mr) from the S-CSCF and also direct interface from an Application Server (Mr'). These interfaces are used to provide IP-based applications and services deployed in an IMS environment with the ability to request an appropriate MRF depending on the various requirements and characteristics.

In-Line MRB Mode

The In-Line MRB Mode is illustrated in the diagram. In this role, the PowerMedia MRB fronts all the media control protocols and acts as an intermediary back-to-back user agent (B2BUA) to forward the commands to the appropriate media server based on resource needs and availability. It effectively sits in the signaling path between the client and a media server, referred to as "in-line".



In the IMS network, for example, the In-Line MRB uses Session Initiation Protocol (SIP) as the transport protocol between the Application Server and PowerMedia MRB. The Application Server issues requests using SIP to the PowerMedia MRB, which sits directly in the signaling path to act as an intermediary. On receiving a SIP request, the PowerMedia MRB inspects and uses its knowledge of Media Resource Functions (MRF) available in the IMS network to select the most appropriate one to complete the media resource request. The selection decision includes capacity and capability data relating to the MRF as well as any other available external information. Once the PowerMedia MRB has made the media resource selection decision, the SIP request is routed to the appropriate MRF. The Application Server then uses the MRF as it would have without the help of the PowerMedia MRB using the selected control protocol, such as MSML.

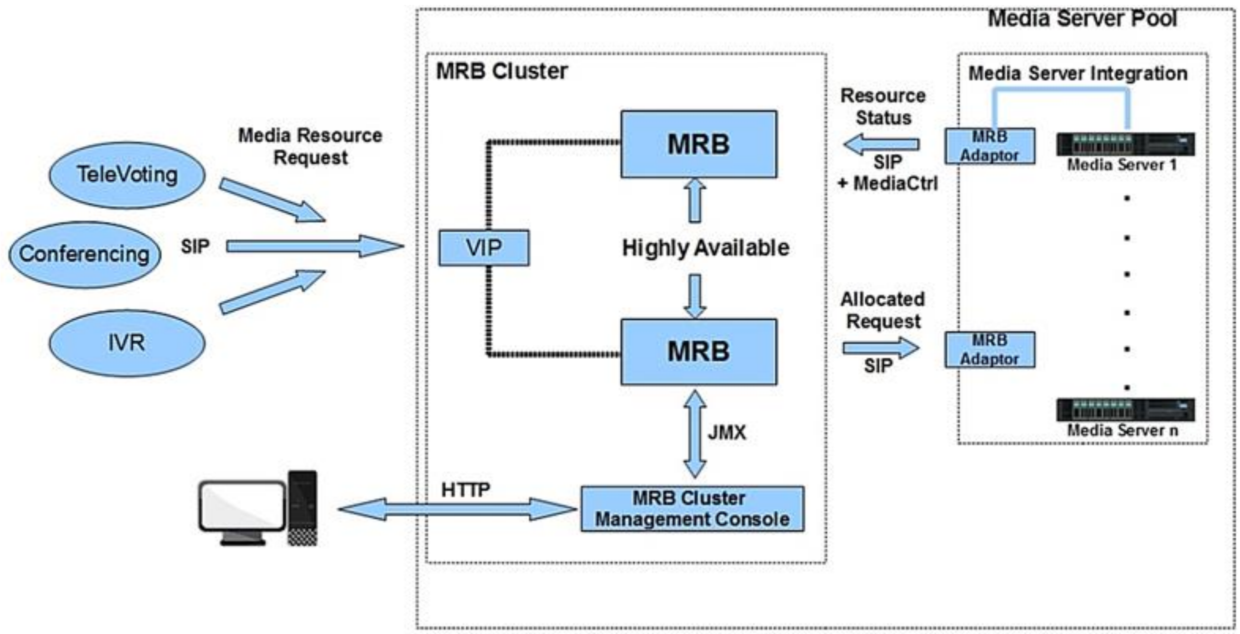
2. PowerMedia MRB

PowerMedia MRB Solution Architecture

The PowerMedia MRB solution has the following components:

- **MRB Pair** is a highly available pair of MRBs fronted by a Virtual IP (VIP). A redundant pair of MRBs working in an active/standby configuration can replicate state and take over in the event of an outage.
- **Media Server Cluster** is a pool or cluster of media server resources, such as PowerMedia XMS, that are managed by PowerMedia MRB. PowerMedia XMS utilizes the media server adaptor component to provide the RFC 6917 MediaCtrl interface. The media server adaptor requests resources and reports resource status of PowerMedia XMS back to the PowerMedia MRB.
- **MRB Cluster Management** is done via the PowerMedia MRB web user interface (WebUI), which provides configuration, status, and monitoring of the MRB cluster and each of the media resources in the pool.

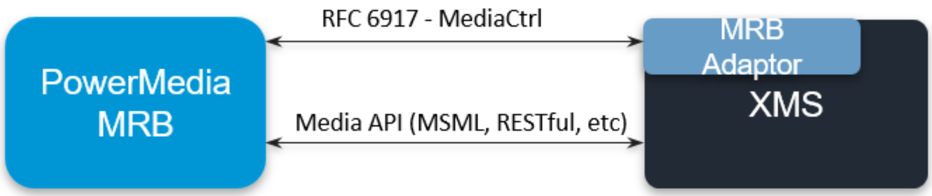
The following diagram shows the overall PowerMedia MRB solution architecture:



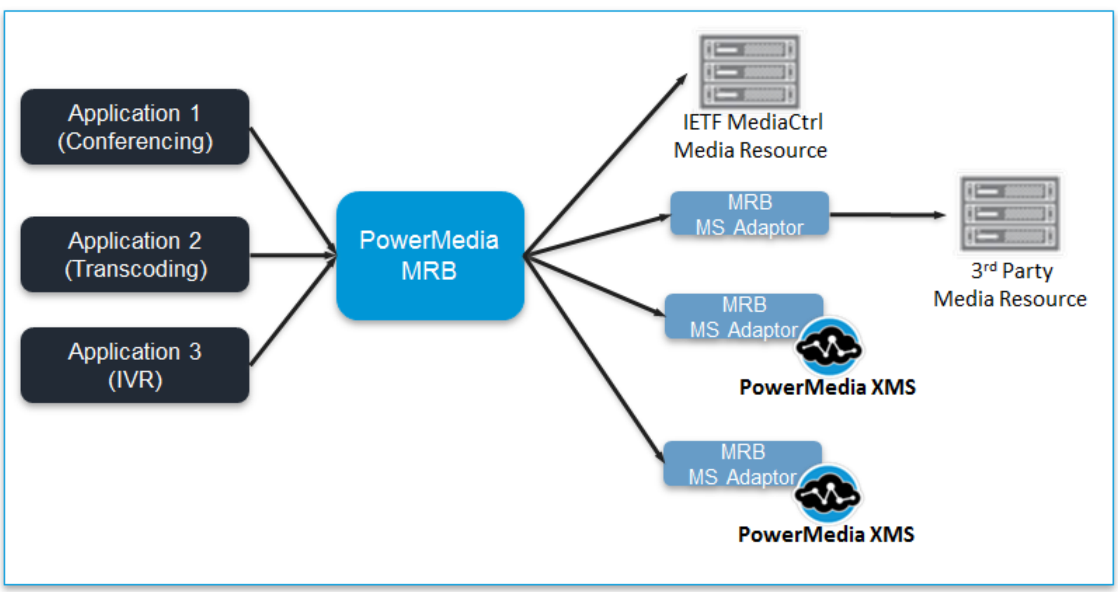
PowerMedia MRB Components

The PowerMedia MRB comprises of the following components:

- **Media Resource Broker (MRB)** - this is the primary MRB application component of the solution providing capacity and capability monitoring of media resources as well as a highly intelligent routing engine. The PowerMedia MRB uses MediaCtrl, as defined by RFC 6917, to monitor and manage media resources of a media server.
- **Media Server Adaptor** - this resides on the PowerMedia XMS and provides an adaptation function for reporting of media resource capability and capacity information. The media server adaptor communicates to the PowerMedia MRB using the latest media control and brokering standards. The PowerMedia XMS is delivered with the latest version of the media server adaptor to communicate with the PowerMedia MRB as shown in the following diagram:



The PowerMedia MRB is positioned in the network between client applications and a varied number of media server resources, such as PowerMedia XMS. Multiple applications and services can interact directly with the PowerMedia MRB to access the cluster of media resources. The PowerMedia MRB matches incoming protocol requests (for example, a SIP INVITE request) from client applications and select an appropriate media server resource based on matching information such as capability, location, and available media server resource capacity information.



To install and configure the PowerMedia MRB for a working MRB test setup, refer to the *Dialogic® PowerMedia™ Media Resource Broker (MRB) Quick Start Guide*.

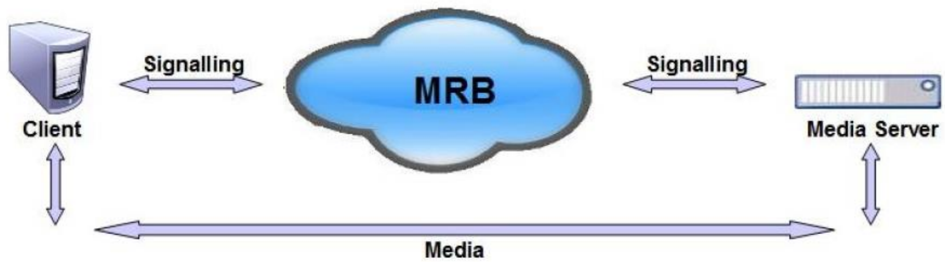
For PowerMedia MRB installation and configuration details, refer to the *Dialogic® PowerMedia™ Media Resource Broker (MRB) Installation and Configuration Guide*.

PowerMedia MRB Media Modes

The PowerMedia MRB can be fundamentally deployed in two distinct media architectural modes of operation: direct without a media (RTP) proxy or with a media (RTP) proxy. The default MRB configuration is direct media mode, where media is sent directly to the media server, which provides a higher solution capacity since media is not routed through the MRB. The media proxy is an option available during installation and can be enabled or disabled via the PowerMedia MRB WebUI. It should be noted that the network deployment, application configuration and media control API will normally dictate the RTP proxy architectural mode that can be configured for the PowerMedia MRB. In both modes, the PowerMedia MRB can be configured to use methods, such as a test RTP stream, for early conference failover detection.

Direct Media

The PowerMedia MRB can be deployed so that it does not act as a media proxy. If this option is chosen during installation, the PowerMedia MRB only inserts itself in the signaling path of traffic being managed for a pool of media servers. Media traffic flows directly between the client and PowerMedia XMS media server without PowerMedia MRB interaction.



Deploying the PowerMedia MRB in this mode of operation, as shown in the diagram, significantly reduces traffic traversing the PowerMedia MRB solution, providing higher capacity. In direct media mode, when SIP signaling is used, SIP re-INVITEs are sent to reestablish media when the MRB moves the session between media servers.

Media RTP Proxy

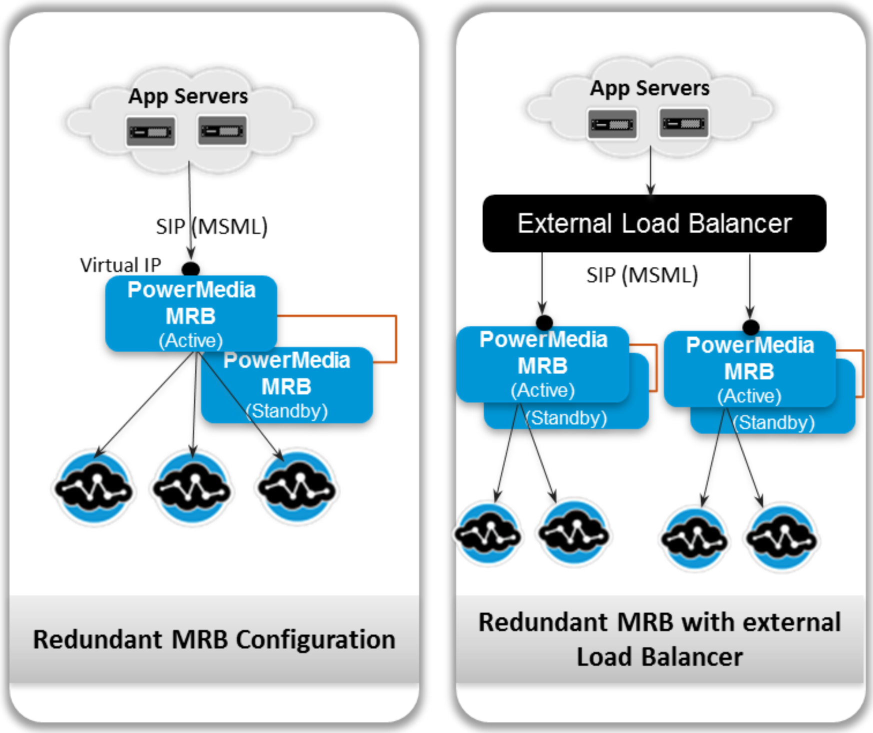
Alternatively, the PowerMedia MRB can be deployed so that it also acts as a media proxy. If this option is chosen during installation, the PowerMedia MRB is inserted in both the signaling and media path of traffic being managed for a pool of media servers. The media proxy diagram below depicts both signaling and media traffic traversing the PowerMedia MRB.

In this mode, the PowerMedia MRB handles the RTP media traffic routing from client to media server through a media Virtual IP (Media VIP). During call setup, the PowerMedia MRB handles SDP exchanges and redirects to the PowerMedia MRB media ports for proper RTP and RTCP forwarding to the active media server. Deploying with an RTP proxy has the advantage of presenting an unchanging RTP port to remote endpoints during media move operations, but at the tradeoff of increased system load through the MRB.

PowerMedia MRB Deployment Models

While the redundant MRB pair is the most typical deployment model for highly available and reliable networks, the different deployment models each have some advantages in different customer situations. All deployment models listed support media server failover, high availability of conferences and joined calls, as well as a single application point of access to all media server resources for high scale applications.

The following diagram provides examples of PowerMedia MRB deployment options:



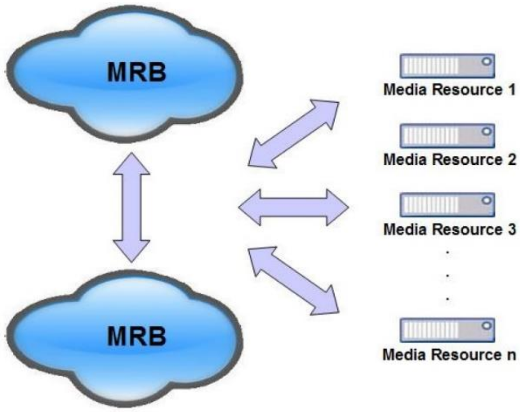
The deployment models shown in the diagram are described below:

- **Redundant MRB Configuration** - In this deployment model, a pair of PowerMedia MRB instances are used in active/standby configurations. The Redundant MRB Configuration is ideal for networks that require high availability and "carrier grade" reliability. This is the most common and recommended deployment model.
- **Redundant MRB Configuration with External Load Balancer** - In this deployment model, an external load balancer can be used to provide redundancy between multiple pairs of PowerMedia MRB instances in active/standby configurations. The external load balancer extends the capacity of the PowerMedia MRB over the Redundant MRB pair.

MRB Redundancy Architecture

Redundant PowerMedia MRB Pair

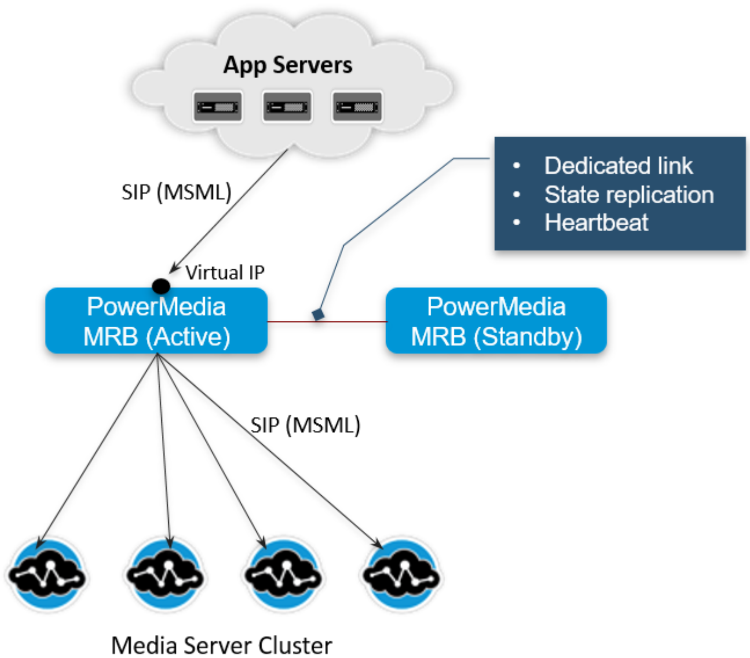
A redundant MRB deployment consists of a pair of MRB nodes, as shown in the diagram. The PowerMedia MRB nodes are configured to work together from both a provisioning and a signaling perspective.



Each MRB instance is configured to manage the same combinations of media server resources. When fail-over occurs all SIP and media control requests and responses are sent to, and received from, the correct destination endpoint to the proper media server resource.

Active/Standby Instances

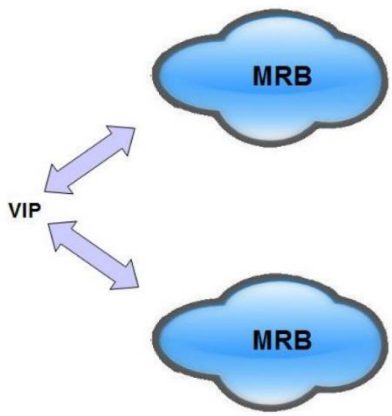
This redundant pair of MRB instances work together in a dual active/standby MRB configuration, as shown in the diagram. The two MRBs communicate with each other over a dedicated link and replicate appropriate provisioning and operational states. An internal heartbeat mechanism is used to monitor the health of MRB instances for active failover. The Active MRB fronts all the media control messages while the standby MRB replicates the call states and is ready to take over on MRB failure.



If the PowerMedia MRB application or machine running the primary MRB becomes inactive, the standby MRB instance in the cluster handles all subsequent service requests. Since the standby MRB maintains the same state as the first MRB, the standby MRB can detect that the primary MRB is down and continue to run where the primary MRB left off. The standby MRB becomes the active MRB and continues media brokering even after the first MRB instance comes back online.

Virtual IP Address

To support the redundant MRB configuration, the PowerMedia MRB directly presents a Virtual IP address (VIP) as the access point into the PowerMedia MRB. The VIP is used by both the active and standby instances so that all media control messages are presented to both MRB instances. It is recommended that a dedicated local Ethernet interface is used between the active and standby instances so that call states can be replicated. Geographical separation of the active and standby MRB instances is not currently supported.



If an external load balancer is not being used, the PowerMedia MRB directly presents a VIP address to the application. If an external Load Balancer is being used, the PowerMedia MRB does not present its own VIP address and relies on the load balancer to allocate traffic. Configuration for using a VIP or external load balancer is covered in the *Dialogic® PowerMedia™ Media Resource Broker (MRB) Installation and Configuration Guide*.

Media VIP

When the MRB is deployed with a media RTP proxy, the MRB presents Media Virtual IP addresses (Media VIP) for media routing through the RTP proxy. The Media VIP works in the same manner as the Signaling VIP, presenting an IP address that is used as an access point for media between the active and standby MRB instances.

Media Server Redundancy

Local MS Redundancy

The PowerMedia MRB solution supports N+1 and N+M media server redundancy architecture. The PowerMedia MRB continuously monitors the health and status of the individual PowerMedia XMS instances in a managed media server resource cluster and can take PowerMedia XMS instances out of service if failure is detected. The PowerMedia MRB will continue to route new calls away from out of service media resources until the instance is back online and reporting healthy status.

The PowerMedia MRB monitors for PowerMedia XMS failure or outages using a number of monitoring methods:

- **MediaCtrl Framework Monitoring** - The PowerMedia MRB monitors the status of the RFC 6917 MediaCtrl and keep alive (TCP session) between MRB and media server adaptor.
- **SIP Call Control Session Monitoring** - The PowerMedia MRB monitors the SIP sessions transitioning through MRB and will cleanup state based on failure conditions.
- **SIP Options Ping Monitoring** - The PowerMedia MRB SIP Options ping between media server adaptor and MRB. This is an optional method configurable through the PowerMedia MRB WebUI.
- **RTP Stream Monitoring** - The PowerMedia MRB samples the status of an RTP stream connection between the PowerMedia MRB and PowerMedia XMS. The test RTP stream can optionally be configured through the PowerMedia MRB WebUI to enable this method of RTP stream watchdog to look for breaks in RTP as an indication of media server failure. The RTP failure detection period is configurable.

To facilitate monitoring and active control of the PowerMedia XMS, each instance of the PowerMedia MRB (both instances of an MRB HA pair deployment) creates a general purpose SIP utility leg that is used for various functions. The SIP utility leg is used to:

- Provide the underlying SIP call for the RTP stream monitoring.
- Manage a subset of MSML call flows where the PowerMedia MRB does not have an active leg to the PowerMedia XMS.

Note: Each MRB will create a utility call to each PowerMedia XMS that it is load balancing. If the MRB configuration is high availability (HA), there will be two utility calls on each PowerMedia XMS (one for each MRB). These utility calls will use one basic audio license each (one signaling and one RTP resource).

An important component of the PowerMedia MRB monitoring of PowerMedia XMS is the tracking of key services. These services are considered critical PowerMedia XMS services that would indicate a media server instance failure:

- hmp (Media Processing Service)
- broker (Message Routing Service)
- xmserver (Signaling and Media Service)
- appmanager (Application Interface Service)
- eventmanager (Event Manager Service)
- perfmanager (Performance Manager Service)
- msml (MSML Service)

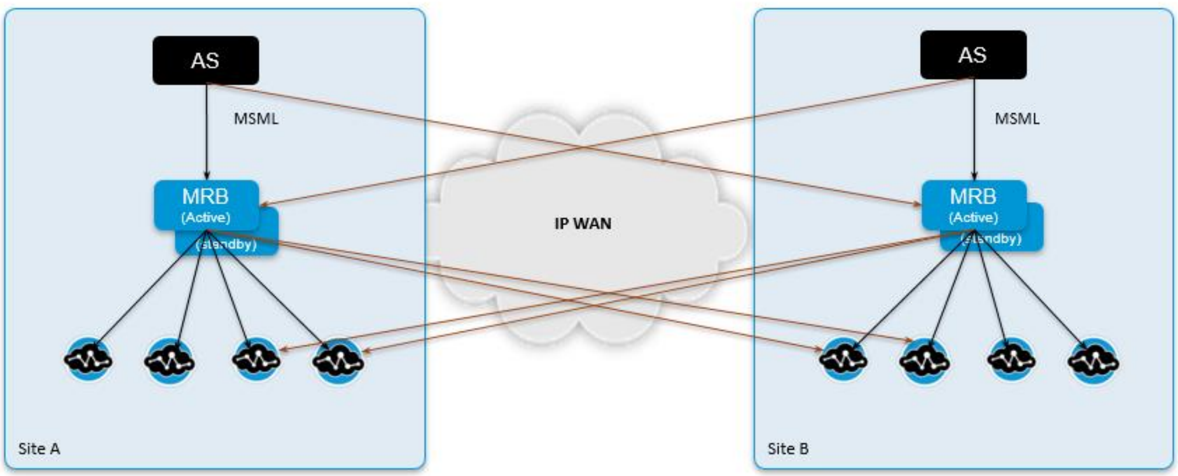
The PowerMedia MRB automatically takes PowerMedia XMS instances offline if it detects a failure condition, as discussed previously in this section. The MRB will continue to monitor the PowerMedia XMS instance that is failed and reintroduce to the active pool of media resources on recovery. Some of the PowerMedia MRB health checks are intentionally throttled to avoid aggressively flooding the network during times of failure and instability.

It should be noted that an administrator of the PowerMedia MRB is also able to manually remove a PowerMedia XMS from the active cluster, take it offline, and preserve conference and joined calls for maintenance reasons. This function, for example, can also be used in conjunction with the "Graceful Shutdown" option provided by the PowerMedia XMS and exposed using the PowerMedia MRB WebUI.

Geo-Redundancy

The PowerMedia MRB Active/Standby nodes must be co-resident in the same network in order to allow the PowerMedia MRB pair to replicate states. However, multiple MRBs can be configured to access the same PowerMedia XMS resources across multiple site locations. The PowerMedia MRB prioritizes traffic to the local media server nodes unless there is a service outage or an incoming media resource request cannot be serviced due to lack of resources (for example, number of available ports or codec type). If there is a site outage, the PowerMedia MRB pair will then be able to steer traffic to the available remote site location.

The following diagram shows an example of a geo-redundant configuration:



PowerMedia MRB configuration consists of an optional location property that determines the locale of the deployment. Each PowerMedia XMS instance is also configured with a locale to enable the MRB to determine if it is local (and so matches the MRB locale) or remote. Taking the previous diagram as an example, the PowerMedia MRB deployed in Site A would have its locale set appropriately to Site A. The PowerMedia XMS instances located in Site A will also be provisioned using the MRB GUI to have the same locale. All incoming requests to the Site A MRB will automatically be routed locally to Site A provisioned PowerMedia XMS instances. Additionally, Site A will also have a number of PowerMedia XMS instances from Site B provisioned. When processing new incoming requests for media resources at Site A, should none be available (for example, due to failure or high utilization), requests would be routed to Site B provisioned PowerMedia XMS instances as a last resort.

In the previous diagram, the reverse is also true with PowerMedia XMS instances from Site A provisioned as additional resources for use by Site B.

It should also be noted that an application can also override the locale set by the MRB for incoming requests using the P-MRB header as described in SIP P-MRB Header.

High Availability: Conference Mixes and Joined Call

The PowerMedia MRB provides preservation of multi-leg sessions, including audio and video conference mixes and joined calls that are established through the PowerMedia MRB. Conference mixes are multi-leg call scenarios that utilize a media server conference resource to provide audio or video mixing. Joined call scenarios are two-party bridged calls on a single media server that may be transcoded or joined for application purposes. The PowerMedia MRB does not provide failover for single-leg IVR calls and these sessions must be re-established.

The PowerMedia MRB keeps track of conference mixes and joined calls that are established through supported API on the media servers it manages. The PowerMedia MRB uses monitoring techniques to detect a media server outage or extended RTP stream breaks and immediately takes action to preserve conferences or joined calls on an available media server.

When a media server outage is detected to go out of service, the PowerMedia MRB quickly works to re-establish the conference on an available standby or backup media server. The PowerMedia MRB uses the stored media control API session information to re-create the call sessions and conference mix or joined-call scenario on an available media server. The PowerMedia MRB does this within a few hundred milliseconds, which provides an active failover of the conference or joined call. The conference or joined call continues as normal.

PowerMedia MRB Supported Media Control Protocol

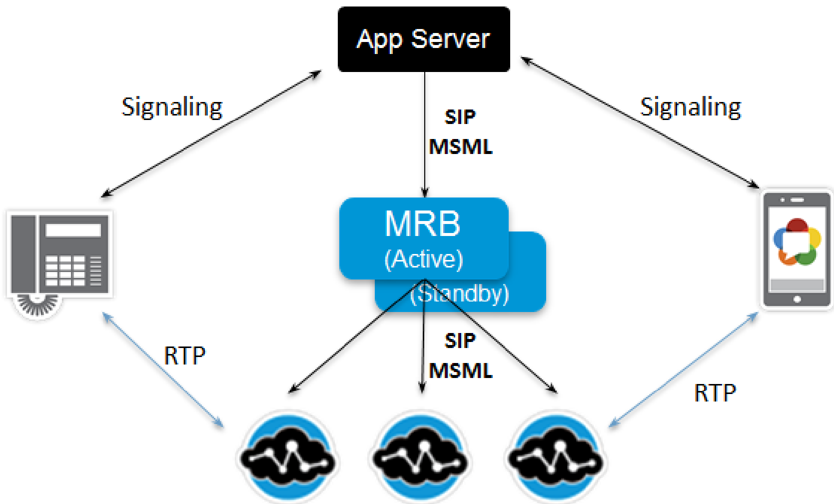
The PowerMedia MRB supports a number of application media control protocols to handle a variety of client applications. The PowerMedia MRB is able to inspect the payload of these media control protocol and forward requests to the appropriate media servers based on capability, capacity, and availability. The PowerMedia MRB is able to manage the associated call sessions and media control sessions to provide high availability and failover.

The application media control protocols listed below are supported by the PowerMedia XMS in combination with the PowerMedia MRB for a powerful example of scalable software media resources for a variety of application types. For more information on PowerMedia MRB and PowerMedia XMS API definitions and details, refer to the Dialogic® documentation page: http://www.dialogic.com/manuals.

MSML Support

The PowerMedia MRB supports the Media Server Markup Language (MSML) protocol, defined by RFC 5707. An application that is written to support MSML can use the PowerMedia MRB to support a highly available cluster of MSML media servers, such as PowerMedia XMS.

A MSML application server handles signaling requests by clients and initiates a SIP call to the PowerMedia MRB to establish the MSML session. The PowerMedia MRB acts as a back-to-back user agent (B2BUA) and inspects the MSML payload to determine the appropriate resources required for the call session. The PowerMedia MRB forwards the MSML call to the appropriate PowerMedia XMS based on capacity, availability, and business logic.



For more information on PowerMedia XMS MSML, refer to the *Dialogic® PowerMedia™ XMS MSML Media Server Software User's Guide*.

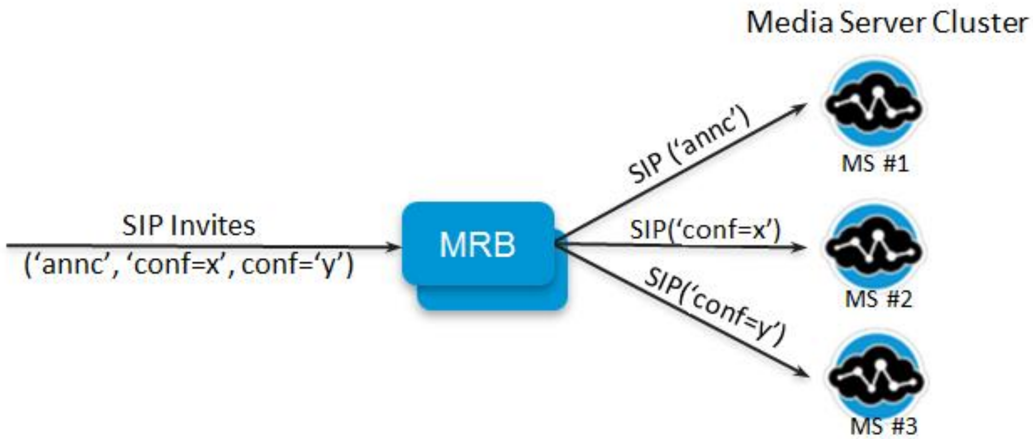
JSR 309 Support

The PowerMedia MRB supports integration with the JSR 309 Connector. The JSR 309 Connector provides the standard Java Specification Request (JSR) 309 Java media control API on the northbound application interface and supports MSML on the southbound media server interface. The PowerMedia MRB works similarly to the MSML example above and acts as a back-to-back user agent (B2BUA) to inspect the JSR 309 Connector southbound MSML payload to determine the appropriate resources required for the call session. The PowerMedia MRB forwards the MSML call requests from JSR 309 Connector to the appropriate PowerMedia XMS based on capacity, availability, and business logic.

For more information on PowerMedia XMS JSR 309 Connector, refer to the *Dialogic® PowerMedia™ XMS JSR 309 Connector Software Developer's Guide* for more information.

NETANN Support

The PowerMedia MRB supports basic network media services for network announcements, also called NETANN, defined by RFC 4240. The NETANN protocol allows application servers to play network announcements or to set up simple conferences using SIP Request URI indications to command media services from a media server, such as PowerMedia XMS. The PowerMedia MRB can provide media resource load balancing for NETANN requests. The routing is provided based on capacity, capability and media server availability.



For more information on PowerMedia XMS NETANN, refer to *Dialogic® PowerMedia™ XMS Basic Network Media Services with SIP User's Guide*.

RESTful Support

The PowerMedia MRB supports the RESTful protocol over HTTP transport to control media and call control resources. In a RESTful application, the HTTP client is the application that contains the business logic and the PowerMedia MRB is the HTTP server that handles the client request and processes the media commands. An application that is written to support the RESTful API can use the PowerMedia MRB to support a highly available cluster of PowerMedia XMS.

There are two RESTful call models:

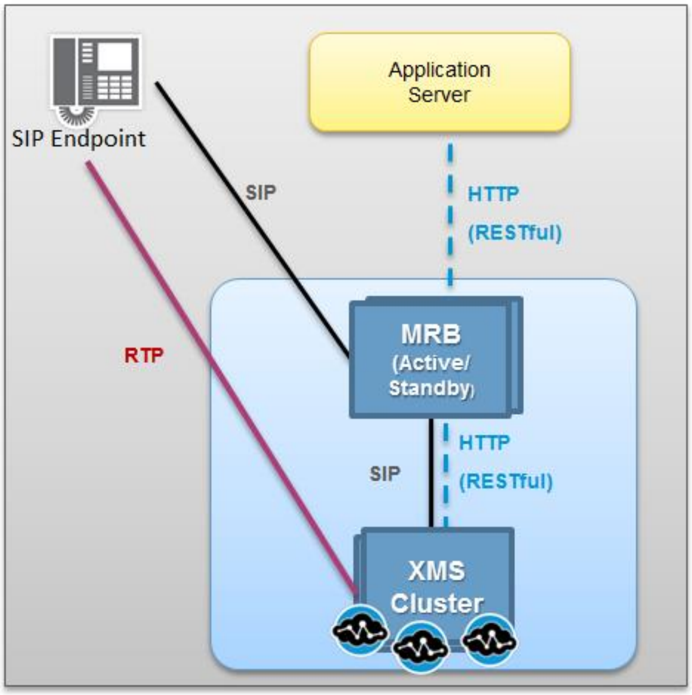
- **First party call control (1PCC)** - The application sends commands to the PowerMedia MRB solution to establish SIP calls on the application's behalf. In this model, the application does not need to be involved in making or receiving SIP calls and related SDP negotiation.
- **Third party call control (3PCC)** - The application handles SIP calls or WebRTC signaling and SDP negotiation, and the PowerMedia MRB solution only performs media processing operations.

The PowerMedia MRB solution with clustered PowerMedia XMS systems supports both of the RESTful call control models with some modifications as described in the following sections.

For more information on PowerMedia XMS RESTful, refer to *Dialogic® PowerMedia™ XMS RESTful API User's Guide*.

MRB for 1PCC RESTful (SIP Applications)

The PowerMedia MRB provides media load balancing, failover, and high availability features for 1PCC RESTful SIP applications. 1PCC RESTful SIP applications are RESTful applications that terminate SIP calls on the PowerMedia MRB. SIP calls can be routed directly to the PowerMedia MRB or can be steered to the PowerMedia MRB via an application server acting as a back-to-back user agent (B2BUA). The PowerMedia MRB provides a single RESTful API entry point to a cluster of PowerMedia XMS instances.



Applications using 1PCC RESTful API route SIP calls directly to the PowerMedia MRB to establish the media session. The PowerMedia MRB routes the SIP call and media to the appropriate PowerMedia XMS resource. SIP sessions are moved via SIP re-INVITE when sessions are moved between PowerMedia XMS systems based on routing or due to media server failover.

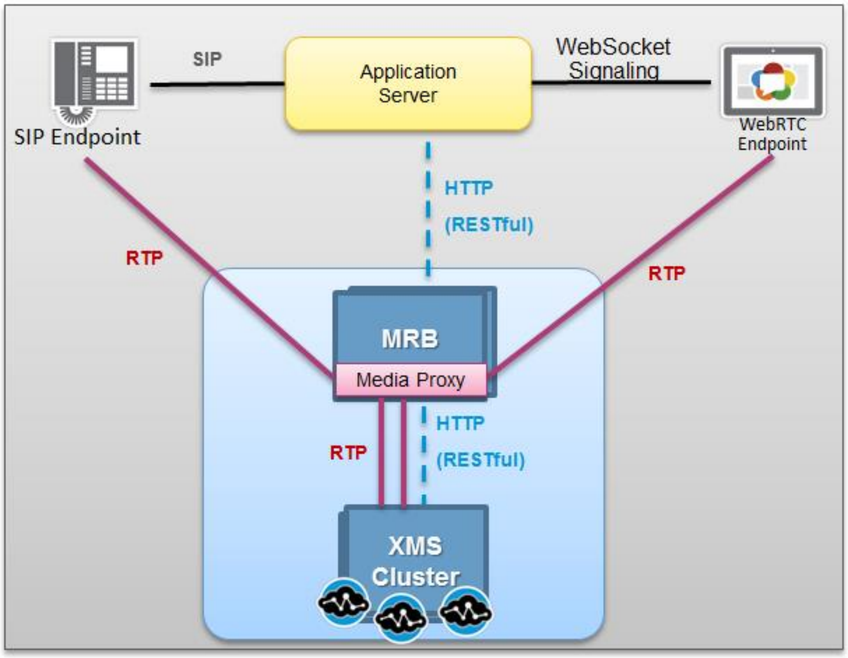
The PowerMedia MRB supports 1PCC RESTful API outbound SIP dialing. With a 1PCC RESTful application, an application server uses the RESTful API (over HTTP transport) to control the call and media functionality and the SIP call control is handled directly by the PowerMedia MRB. 1PCC REST applications support outbound call SIP dialing so both inbound and outbound SIP calls can be managed by PowerMedia MRB for application media resource brokering and load balancing among a pool of PowerMedia XMS media servers.

The application server does not need to have a SIP stack or interface with SIP in any way. Indications of call activity occur through the RESTful HTTP interface, which simplifies the application logic. The RESTful API is sent over HTTP from an application server to the PowerMedia MRB to control the call sessions. The PowerMedia MRB inspects the HTTP Restful payloads and performs the proper media actions on the call. Since the PowerMedia MRB is in the path of both signaling and RESTful media control, the PowerMedia MRB can provide media server failover of conferences or joined calls.

Note: WebRTC calls with 1PCC RESTful are not currently supported.

MRB for 3PCC RESTful API

The PowerMedia MRB provides media load balancing, failover, and high availability features for 3PCC RESTful applications. 3PCC RESTful applications are those that support call signaling for WebRTC or SIP at the application server and only use the PowerMedia XMS for media establishment and media operations. The PowerMedia MRB provides media resource brokering of RESTful API media calls and conferences by handling the RESTful API calls (over HTTP transport) and providing an RTP proxy location for media routing and failover.



Applications using 3PCC RESTful API terminate all signaling: SIP or WebRTC. Call Media (RTP) establishment occurs through the RESTful API using the HTTP transport. Applications using 3PCC RESTful API must enable the media proxy so that media can be routed through the PowerMedia MRB to the appropriate PowerMedia XMS. The media proxy is used to anchor the media providing static RTP ports for the duration of the call and media transactions. The media proxy becomes the RTP entry point to the PowerMedia XMS cluster. The PowerMedia MRB maintains both the RESTful call states and RTP connections to the appropriate PowerMedia XMS.

PowerMedia MRB Traffic Routing Algorithm

The PowerMedia MRB has a default selection algorithm that routes traffic. The algorithm is used to ensure an appropriate media server resource is selected for an incoming service request issued by a PowerMedia MRB client application. The selection algorithm provides the intelligence engine, which closely tracks its managed media server resources and subjects incoming requests from a PowerMedia MRB client application to a number of criteria. This process enables the PowerMedia MRB to determine the most appropriate media server resource, if any are available, to service a request. The selection algorithm is also used on media server failure to determine the best media server to fail-over the session. The default PowerMedia MRB selection algorithm can be generalized as a "least loaded" selection algorithm that matches capability, capacity, and location.

The PowerMedia MRB selection algorithm steps are summarized as follows and discussed in detail in the next sections.

1. Protocol Determination - Classify inbound traffic (for example, MSML, NETANN, RESTful).
2. Online Media Servers - Select active PowerMedia XMS instances for incoming requests.
3. Capabilities Selection - Locate active media servers that can service the type of traffic.
4. Capacity Selection - Locate active media servers with enough capacity to handle the request.
5. Location Selection (Optional) - Identify the geographically closest media server.

Step 1: Protocol Determination

In Step 1, the PowerMedia MRB classifies the inbound traffic as MSML, NETANN, or RESTful. On receiving an incoming request, the PowerMedia MRB evaluates the protocol message content to determine if the MRB can route the call to an existing conference that is already hosted on PowerMedia XMS and if the call can be processed using one of the supported Media control protocols. The type of request being processed is determined using key data present in the message being evaluated. The types of requests supported by the PowerMedia MRB are described in the following list:

- **MSML Conf** - The PowerMedia MRB identifies a request type of MSML Conf if it receives a request that contains a SIP R-URI user part equal to "msml" and the default option for "Unaware Mode" page in the PowerMedia MRB WebUI is set to "Conferencing". The request can also be specified as a Conference request using the P-MRB header (as described in SIP P-MRB Header).
- **MSML IVR** - The PowerMedia MRB identifies a request type of MSML IVR if it receives a request that contains a SIP R-URI user part equal to "msml" and the default options for "Unaware Mode" page in the PowerMedia MRB WebUI is set to "IVR".
- **NETANN Conf** - The PowerMedia MRB identifies a request type of NETANN Conf if it receives a request that contains a SIP Request URI user part equal to "conf=xxxx" where "xxxx" represents the unique conference instance.
- **NETANN IVR** - The PowerMedia MRB identifies a request type of NETANN IVR if it receives a request that contains a SIP R-URI user part equal to "annc".
- **Existing NETANN/MSML Conf** - The PowerMedia MRB monitors all conference instances that are created using the "conf=xxxx" user part that appears in a SIP Request URI. If the conference instance already exists, the request bypasses the remainder of the selection algorithm and route to the previously determined media server. If the request for an existing MSML conference arrives without using the P-MRB header, the PowerMedia MRB ensures it is routed to the correct media resource on receiving the appropriate MSML join message.

If the request type is identified as being targeted to an existing NETANN/MSML/MSML (with P-MRB or appropriate protocol level mechanism) conference instance, it is routed directly to hosting media resource if active and available. Otherwise, the request type does not match any of those specified in Step 1, the request is assumed to be a generic SIP call (such as for RESTful protocol) and the request processing moves to Step 2 in the PowerMedia MRB selection algorithm.

Step 2: Online Media Servers

In Step 2, the PowerMedia MRB selects only an active media server that is prepared to receive service requests. Once the PowerMedia MRB has determined the type of MRB request, the PowerMedia MRB checks to determine all media servers that are currently online (as reported by the MediaCtrl Publish interface). The subset of available media servers is now considered as the algorithm moves onto Step 3. If no media servers are available, an appropriate error is reported.

Step 3: Capabilities Selection

In Step 3, the PowerMedia MRB locates active media server(s) that can service this type of traffic. The PowerMedia MRB examines the subset of media servers supplied from Step 2 and matches the type of request with the capabilities available (as reported by the MediaCtrl Publish interface). The PowerMedia MRB identifies an appropriate media server based on support for MSML, NETANN, or RESTful API, etc. The PowerMedia MRB also compares codec requirements specified in the incoming Session Description (SDP) to a matching media server. The resulting subset list of media servers is then passed to Step 4 in the selection algorithm. If no media servers are available, an appropriate error is reported.

Step 4: Capacity Selection

In Step 4, the PowerMedia MRB identifies a media server with enough capacity to handle the request. The PowerMedia MRB examines the subset of media servers supplied from Step 3 and determines the available capacity in conjunction with the required capabilities (as determined in Step 3). This is achieved by selecting the preferred codec of the request and matching against availability as published by the media resources. If no match is found and multiple codecs are specified in the request, the PowerMedia MRB iterates until a match is found. The resulting ranked order of media servers is then passed to Step 5.

Step 5: Location Selection (Optional)

In Step 5, the PowerMedia MRB identifies the geographically closest media server based on the P-MRB header included in the incoming request. If no P-MRB header is present, the location will be determined from configuration specified in the "Unaware Mode" page in the PowerMedia MRB WebUI. If location is not set for the PowerMedia MRB instance in the "Unaware Mode" page, this step is skipped and a media server is selected from the available list based on Step 4. If the location is set for the PowerMedia MRB, an appropriate media server is selected from the list within the same location. The media server location is provisioned for each media resource being managed by the PowerMedia MRB. If no media servers are available in the same location as the PowerMedia MRB instance, an appropriately provisioned selection is made outside of the location.

3. Application Interaction

SIP P-MRB Header

The PowerMedia MRB supports a custom SIP header named "P-MRB" which allows conferencing (no current support for bridged calls) applications using MSML and NETANN to specify specific mix details in initial SIP requests. The main use of the P-MRB header is to allow applications that have advanced knowledge of conference information to optimize calls flows using the PowerMedia MRB.

This mechanism has the advantage of ensuring that:

- Conference creation requests can be allocated to a media server based on a specified number of estimated media ports required for the conference mix. The PowerMedia MRB will use the figure as an input parameter when stepping though the selection algorithm, as described in PowerMedia MRB Traffic Routing Algorithm.
- Conference join requests (more specifically for MSML) are automatically assigned to the correct media server instance hosting the conference. This optimizes the call flows when using the PowerMedia MRB as it reduces the need for the PowerMedia MRB to subsequently move calls between media server instances on receiving MSML join requests (which occur after the leg has been allocated a media server resource).

The following provides some information on exactly how a P-MRB header can be constructed for conference mix based use cases. An application that generates a P-MRB header instance is effectively requesting media server resources for its conference mix.

The example below describes the construction of the P-MRB header and description of the parameters in P-MRB Header table.

```
P-MRB: Consumer;operation=create;conf-id=1234;mixer-sessions=10;conf-name="conference-
name";location=Cardiff
```

Parameter	Description
hdrtype	Specifies the type of information contained in the P-MRB header. Valid values: • Consumer - signifies that the application is a consumer of media server resources. • Publish - signifies that the resource is publishing information to the PowerMedia MRB acting as a media server resource. **Note:** The "Publish" value is currently not supported in the PowerMedia MRB.
operation	Defines the context of the request from the application to the PowerMedia MRB. Valid values: • create - The associated SIP call intended to be used to create a conference mix. • join - The associated SIP call intended to be used to join to an existing conference mix.

Parameter	Description
conf-id	Contains the unique identifier used to represent the conference in either MSML or NETANN in the PowerMedia MRB.
mixer-sessions	Allows the application to provide an estimated number of ports required for the conference mix in the PowerMedia MRB. This parameter is only used in conjunction with the "create" value of the **operation** parameter.
conf-name	Allows the application to specify a human readable conference name label that will be displayed in certain pages in the PowerMedia MRB WebUI. This parameter is only used in conjunction with the "create" value of the **operation** parameter.
location	Specifies the desired destination location of the media server resource based on locations defined through the PowerMedia MRB configuration. This parameter is then used as input for the desired location covered in Step 5: Location Selection (Optional) of PowerMedia MRB Traffic Routing Algorithm to route to the appropriate media server resource.

The P-MRB Create Example and P-MRB Join Example provide both a P-MRB "create" and "join" header that would be included in an incoming SIP service request.

P-MRB Create Example

An application that has prior knowledge of conference mix information can use the P-MRB in conjunction with the PowerMedia MRB routing algorithm to ensure an appropriate media server resource is selected.

The following is an example of a P-MRB header used to create a conference:

```
P-MRB: Consumer;operation=create;conf-id=1234;mixer-sessions=10;conf-name="conference-
name";location=Cardiff
```

The application that generated this particular P-MRB header instance is requesting the media server resources for its conference mix (as detailed in P-MRB Header table):

- The **hdrtype** parameter is set to "Consumer" as the application is requesting a media server resource.

  Note: "Consumer" is the only value currently supported in conjunction with the P-MRB header.

- The **operation** parameter is set to "create" as the application is intending on using the associated SIP dialog to create a conference.
- The **conf-id** parameter is set to "1234". This value must then be used in the associated protocol level creation of the conference mix in MSML and NETANN.
- The **mixer-sessions** parameter is set to "10" as the application is requesting a media server resource that has at least 10 ports free.
- The **conf-name** parameter is set to "conference-name" which provides a human readable reference if required in the PowerMedia MRB WebUI.
- The **location** parameter is set to "Cardiff" which provides input to the PowerMedia MRB routing algorithm of the desired location for the hosting media server resource.

P-MRB Join Example

An application that has prior knowledge of conference mix information can use the P-MRB in conjunction with the PowerMedia MRB routing algorithm to ensure subsequent parties to be joined to an existing media server mix are routed to the correct media server resource.

The following is an example of a P-MRB header used to join an existing conference mix:

```
P-MRB: Consumer;operation=join;conf-id=1234
```

The application that generated this particular P-MRB header instance is requesting the SIP request be routed to the appropriate media server resource that is hosting the conference mix (as detailed in P-MRB Header table):

- The **hdrtype** parameter is set to "Consumer" as the application is requesting a media server resource.

  Note: "Consumer" is the only value currently supported in conjunction with the P-MRB header.

- The **operation** parameter is set to "join" as the application is intending on using the associated SIP dialog to join a conference.
- The **conf-id** parameter is set to "1234". This value must then be used in the associated protocol level creation of the conference mix in MSML and NETANN.

Global Unique Session ID

PowerMedia MRB supports RFC 7329, which defines a globally unique session identifier for SIP calls, such MSML and NETANN. The Global Unique Session-ID feature is supported at both the PowerMedia MRB and PowerMedia XMS to support call advanced tracing for the life of the call through both the PowerMedia MRB and PowerMedia XMS MRF components.

On receiving an incoming media call request to the PowerMedia MRB an appropriate PowerMedia XMS will be selected as discussed in this document. Once an PowerMedia XMS is selected, if not already present, the PowerMedia MRB will insert a SIP "Session-ID" header into the outgoing request, for example:

```
Session-ID: dc3a1cba7f110bd18fa828dfd900f203@10.221.8.136
```

The SIP Session-ID header is reflected in all transactional responses. It is also reflected in all associated SIP messages within the same dialog (dialog as defined in RFC 3261). If the client supports RFC 7329, the PowerMedia MRB will honor and preserve an incoming SIP "Session-ID" header instead of generating a new one. It should also be noted that the PowerMedia MRB will maintain a consistent "Session-ID" when reestablishing existing SIP/NETANN calls with a new PowerMedia XMS instance due to either failure or administrative intervention. This provides a consistent usage of RFC 7329 throughout the life-cycle of client interaction with PowerMedia MRB which allows for ease of tracing.