Next Generation On Demand (NGOD)

Streaming Server Resource Interface (R2) 1.1

June 15, 2005

Document Status Sheet

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Key to Document Status Codes:

Work in Progress (W)	An incomplete document, designed to guide discussion and generate feedback that may include several alternative requirements for consideration.
Draft (D)	A document in specification format considered largely complete, but lacking review by other VE and PE vendors. Drafts are susceptible to substantial change during the review process.
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Released (R)	A stable document, reviewed, tested and validated, suitable to enable

cross-vendor interoperability.

Contents

List of Figures

List of Tables

1 SCOPE

1.1 Introduction and Overview

As part of the Comcast Next Generation On Demand (NGOD) Architecture initiative, the Streaming Server Resource Interface (R2) defines interaction between the ODRM component and the Streaming Server component.

1.2 Purpose of document

The purpose of this document is to define the syntax and semantics for the R2 interface.

1.3 Scope

The following information will be included in this document:

Interface overview including protocol options and design considerations

Overview of messages and purpose of each message

Detail for each message request/response – sequence diagrams, message parameter details, syntax details and scenario explanations

Please note that the interaction scenarios described in this document are intended to be illustrative and not normative.

1.4 Requirements (Conformance Notation)

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

"MUST"	This word or the adjective "REQUIRED" means that the item is an absolute requirement of this specification. The word "MANDATORY" may be used in lieu of "MUST" in certain circumstances.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this specification.
"SHOULD"	This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
"SHOULD NOT"	This phrase means that there may exist valid reasons in particular circumstances when the listed 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 or the adjective “OPTIONAL” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

2 REFERENCES

2.1 Normative References

The following documents may be of use in understanding this interface.

[N-1] NGOD RTSP Usage Specification

[N-2] H. Schulzrinne; et al, Real Time Streaming Protocol (RTSP), RFC 2326, April 1998

[N-3] R. Fielding; et al, Hypertext Transfer Protocol -- HTTP/1.1, RFC 2068, January 1997

[N-4] Berners-Lee, T., and D. Connolly, "HyperText Markup Language Specification - 2.0", RFC 1866, November 1995

[N-5] M. Handley; et al, SDP: Session Description Protocol, RFC 2327, April 1998

[N-6] H. Schulzrinne; et al, Real Time Streaming Protocol (RTSP), RFC 2326bis-07, July 19, 2004

[N-7] NGOD Data Warehouse Interface Specification

3 TERMS AND DEFINITIONS

This specification defines the following terms:

N/A

4 ABBREVIATIONS AND ACRONYMS

This specification uses the following abbreviations and acronyms:

Table 1 - Abbreviations and Acronyms

MPEG	Motion Picture Experts Group
NGOD	Next Generation On Demand
NPT	Normal Play Time – format as defined in the RTSP RFC 2326
ODRM	On Demand Resource Manager
RTSP	Real-time Streaming Protocol
SOP	Server Output Port
SOPG	Server Output Port Group
SSL	Secure Socket Layer
URL	Universal Resource Locator

5 R2 - INTERFACE SPECIFICATION

5.1 Key Decision Drivers, Scope, and Constraints

The following key decisions and constraints bound the architecture and associated interfaces.

5.2 Interface Requirements Phasing

This document describes the establishment of sessions and interaction with sessions that utilize a single set of resources determined at the time of session setup.

Future requirements:

- The ability for a client to request additional or different resources after the establishment of the initial session. For example, perhaps a client would like to play a different MPEG file in the course of the session. The R2 specification would need to be extended to change/add the asset being requested.
- The ability for a session to start up multiple streams. For example a football game play-out could start up multiple streams and the client could choose between different camera angles (streams). The session setup request interface would need to be able to convey the desired play-out. The session setup response would need to encompass the tuning parameters for multiple streams.
- The ability for the client to send messages in a more secure manner. For example, one could implement an SSL socket layer on top of which RTSP messages would be sent. Note that SSL may not be possible for legacy set tops that do not support TCP sockets. Another option is to add on addition authentication mechanisms on top of the standard RTSP protocol.
- The ability for the client to setup a session for a real-time feed. The RTSP Play Request will need to have an option of specifying a start position of “now.”

5.3 Overall Architecture

The overall architecture of the R2 interactions as specified in this document is characterized by the following.

- Sessions are established and torn down via interactions over R2 between the ODRM and the Streaming Server.
- The Streaming Server may inform the ODRM regarding session state changes.

5.4 Description of Functional Components

The components that are involved with interface R2 are as follows.

ODRM – Manages resources with regards to Streaming Servers.

Streaming Server - Outputs video streams and manages stream control.

5.5 Protocol Interfaces

The protocol chosen for R2 for this specification is based on the Real-time Streaming Protocol (RTSP). The RTSP protocol has various options that, if not implemented uniformly, could lead to a lack of interoperability. This specification along with the NGOD RTSP Usage Specification will define a minimal subset of RTSP messaging in order to be compliant with the Comcast Next Generation On Demand Architecture.

The architecture shall support TCP transport for interface R2. It will be the requirement of the components to establish the TCP socket and to re-establish it if the socket is ever disconnected.

5.6 Security Considerations

Please see “Interface Requirements Phasing.”

5.7 Future Considerations

Protocol extensions. When defining the syntax of the RTSP messages included in R2, we will define a paradigm of extensibility for use in the future when adding new messages and fields to the protocol.

5.8 Future functionality

Please see “Interface Requirements Phasing” for a discussion of future functionality.

6 PHYSICAL TO LOGICAL SOP MAPPING

The NGOD architecture is designed such that the ODRM selects the SOP from the server based on criteria such as load, content connectivity, and network connectivity (inferred by the SOPG associated with the SOP), etc. The R2 and D5 specifications refer to a SOP as a logical entity. There is often a one to one mapping of a physical SOP to a logical SOP, but multiple physical SOPs may also be represented as a single logical SOP. In the latter case, such a logical SOP must behave like any other as described below.

6.1.1 Requirements

6.1.1.1 Bandwidth Reporting

D5 available BW and consumed BW reports must contain the aggregate BW of all physical ports in the logical SOP. All BW advertised must be able to be satisfied by streams with BW requirements described in the MPEG over IP NGOD specification. The SS can not sum the remainder of BW on all physical ports if a stream of the size described can not be delivered.

6.1.1.2 Network Connectivity

All physical SOPs that are included in a logical SOP must have the same network connectivity i.e. they all belong to the same SOPG.

6.1.1.3 Grouping

The physical SOPs must all be managed by the same controllers i.e. the NextHopServer (and alternates) exposed in D5 must be capable of controlling all physical SOPs within the logical SOP.

6.1.1.4 Volume Access

All physical SOPs must have access to the Volumes exposed in the D5 message.

6.1.2 Examples

6.1.2.1 N+1 Redundancy

If a logical SOP is built for N+1 redundancy i.e. a hot backup port, then the total BW reported for the logical SOP would only include the BW for N ports.

6.1.2.2 Reporting At Capacity

If a logical SOP is comprised of 10 1-Gbps physical SOPS and each SOP has a remainder of 1 Mbps of BW available, it should not report the available BW such that available minus consumed BW is equal to 10 mbps if it can not deliver a single stream of 10 mbps. The Streaming Server could have anticipated this and held back some BW in its initial capacity report or it could send an update.

6.1.2.3 Loss of Physical SOP

If a physical port is lost, a D5 announcement could be sent indicating the total BW for the SOP has decreased.

7 SESSION SETUP MESSAGES

7.1 Introduction

The ODRM interacts with the Streaming Server with RTSP Setup Request and Response messages to establish new sessions.

7.2 Interaction Diagram

The below diagram depicts the interaction between the ODRM and the Streaming Server to set up a session.

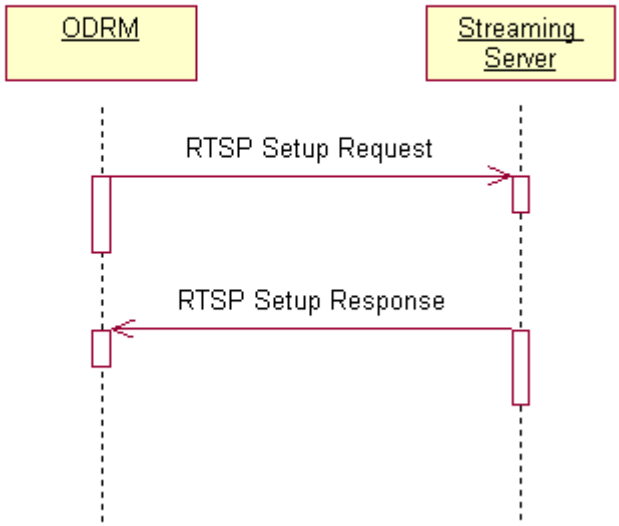

Figure 1. Session Setup Interaction Between ODRM and Streaming Server

7.3 RTSP Setup Request

7.3.1 RTSP URL

The RTSP URL shall have the following syntax.

```
rtsp://<streaming-server-path>:<streaming-server-port>/<sop> RTSP/1.0
```

Where

- <streaming-server-path> is the DNS name or IP address of the streaming server
- <streaming-server-port> is the signaling port for the streaming server

- <sop> is an optional abs_path field indicating the logical SOP that the ODRM wishes to use

7.3.2 RTSP Transport Header

The RTSP Transport header will have the following additional syntax definition.

```
Transport:
  MP2T/DVBC/UDP;
  unicast;
  client=<client-id>;
  destination=<destination>;
  client_port=<client-port>;
  source=<source>;
  server_port=<server-port>;
  bandwidth=<bandwidth>
```

where

- <client-id> is a unique identifier of the client. Note that although this information is not needed to establish the session, the information is still required per the NGOD specifications for the operational use of the solution. E.g. tracking behavior across the system.
- <destination> describes the IP/host address to which data is streamed. E.g. IP of EdgeQAM device.
- <client-port> describes the port to which the data is streamed. E.g. a input port for a EdgeQAM device
- <source> is the IP/host address from which the data is streamed. E.g. the IP address of a streaming server
- <server_port> is the port from which the data is streamed. E.g. the output port of a streaming server
- <bandwidth> is the bandwidth requirement in bits per second.

7.3.3 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 SETUP request:

- **Require**
- **OnDemandSessionId**
- **SessionGroup**
- **InBandMarker**
- **Policy**

- **StreamControlProto**
- **SDP Extensions**

In addition, the following Extension Header is also used:

- **Volume:** The name of the Volume that the requested asset(s) reside. This information can be retrieved from APM to ODRM via Interface R1.

7.3.4 Example

Following is an example SETUP request. For a detailed description of the headers and the SDP text, please refer to the NGOD RTSP Specification. For specifics on the usage of the "SessionGroup" header, please see the NGOD RTSP Specification.

```
SETUP rtsp://streamingserver32.comcast.com:554 RTSP/1.0
CSeq: 896
Require: com.comcast.ngod.r2
OnDemandSessionId: be074250-cc5a-11d9-8cd5-0800200c9a66
Volume: boston.v1
Transport:
  MP2T/DVBC/UDP;unicast;client=00AF123456DE;
  bandwidth=2920263;destination=2.2.2.2;client_port=45;
  source=1.2.3.4;server_port=123
SessionGroup: SM1
InbandMarker:type=4;pidType=A;pidValue=01EE;dataType=T;
   insertDuration=10000;data=4002003030
Content-type: application/sdp
Content-length: 168

v=0
o=- be074250-cc5a-11d9-8cd5-0800200c9a662890842807
  IN IP4 10.47.16.5
s=
t=0 0
a=X-playlist-item: comcast.com abcd1234567890123456
1000-6000
c=IN IP4 0.0.0.0
m=video 0 udp MP2T
```

7.4 RTSP Setup Response

7.4.1 RTSP Transport Header

The RTSP Transport header will have the following additional syntax definition.

```
Transport:
  MP2T/DVBC/UDP;
  unicast;
  client=<client-id>;
```

```
destination=<destination>;
client_port=<client-port>;
source=<source>;
server_port=<server-port>;
bandwidth=<bandwidth>
```

where

- <client-id> is a unique identifier of the client. Note that although this information is not needed to establish the session, the information is still required per the NGOD specifications for the operational use of the solution. E.g. tracking behavior across the system.
- <destination> describes the IP/host address to which data is streamed. E.g. IP of EdgeQAM device.
- <client-port> describes the port to which the data is streamed. E.g. a input port for a EdgeQAM device
- <source> is the IP/host address from which the data is streamed. E.g. the IP address of a streaming server
- <server_port> is the port from which the data is streamed. E.g. the output port of a streaming server
- <bandwidth> is the bandwidth requirement in bits per second.

7.4.2 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 SETUP response:

- **OnDemandSessionId**
- **SDP Extensions**

7.4.3 Example

```
RTSP/1.0 200 OK
CSeq: 896
Session: 777
OnDemandSessionId: be074250-cc5a-11d9-8cd5-0800200c9a66
Transport:
  MP2T/DVBC/UDP;unicast;client=00AF123456DE;
  bandwidth=2920263;destination=2.2.2.2;client_port=45;
  source=1.2.3.4;server_port=123
Content-type: application/sdp
Content-length: 149

v=0
o=- 777 2890842817 IN IP4 1.2.3.4
s=
t=0 0
a=control:lscp://videoserver234.comcast.com:554/9876
```

```
c=IN IP4 2.2.2.2
m=video 45 udp MP2T
```

8 SESSION TEARDOWN MESSAGES

8.1 Introduction

The ODRM interacts with the Streaming Server with RTSP Teardown Request and Response messages to teardown existing sessions.

8.2 Interaction Diagram

The below diagram depicts the interaction between the ODRM and the Streaming Server to tear down a session.

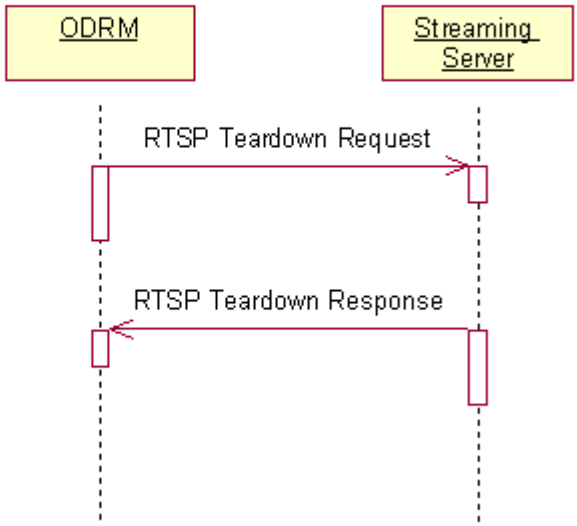

Figure 2. Session Tear Down Interaction Between ODRM and Streaming Server

8.3 Teardown Request

8.3.1 RTSP URL

The RTSP URL shall have the following syntax.

```
rtsp://<streaming-server-path>:<streaming-server-port>/
```

where

- < streaming-server -path> is the DNS name or IP address of the Streaming Server
- < streaming-server -port> is the signaling port for the Streaming Server

8.3.2 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 TEARDOWN request:

- **OnDemandSessionId**
- **Reason**
- **Require**

8.3.3 Example

```
TEARDOWN rtsp://sserver32.comcast.com:554  RTSP/1.0
CSeq: 789
Require: com.comcast.ngod.r2
Reason: 200 "user pressed stop"
Session: 999
OnDemandSessionId: be074250-cc5a-11d9-8cd5-0800200c9a66
```

8.4 Teardown Response

8.4.1 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 TEARDOWN response:

- **OnDemandSessionId**

8.4.2 Message Body

The body of the TEARDOWN response message SHALL contain XML data with the root level element <ResponseData>. The following table describes the sub elements that may appear.

XML Elements Supported	Description	Mandatory/Optional
ODRMSessionHistory	See N-7	Mandatory

8.4.3 Example

```
RTSP/1.0 200 OK
CSeq: 789
Session: 999
OnDemandSessionId: be074250-cc5a-11d9-8cd5-0800200c9a66
Content-Type: text/xml
Content-Length: 1234
```

```
<ResponseData>
  <ODRMSessionHistory>
     (see N-7)
  </ODRMSessionHistory>
</ResponseData>
```

9 ANNOUNCE MESSAGES

9.1 Introduction

On some occasions the Streaming Server will send unsolicited messages to the ODRM regarding active sessions. These messages shall be sent via RTSP Announce Request and Response messages as detailed below.

9.2 Interaction Diagram

The below diagram depicts the interaction between the ODRM and the Streaming Server to notify the ODRM of information relating to the session.

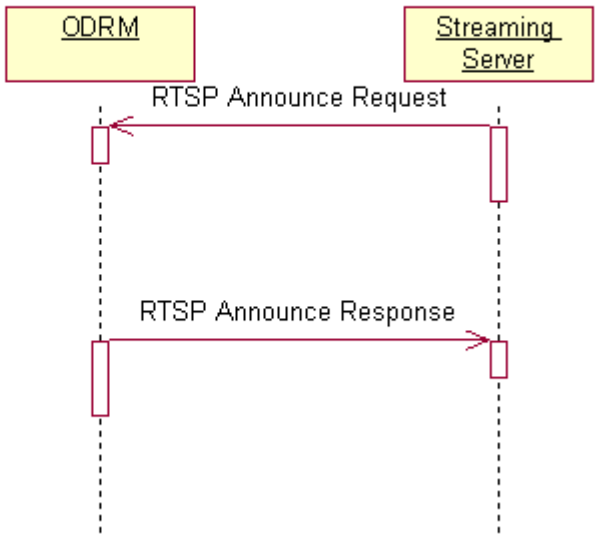

Figure 3. Session Information Interaction Between Streaming Server and ODRM

9.3 Announce Request

9.3.1 RTSP URL

The RTSP URL shall have the following syntax.

```
rtsp://<odrm-path>:<odrm-port>/
```

where

- <odrm-path> is the DNS name or IP address of the ODRM
- <odrm-port> is the port of the ODRM

9.3.2 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 ANNOUNCE request:

- **Require**
- **Notice**
- **OnDemandSessionId**

Additional extension headers are used for collecting play mode statistics using R2 ANNOUNCE request within the session, these headers have the same definitions as those defined for GET_PARAMETER in the NGOD RTSP Usage specification:

- Additional ANNOUNCE Extension headers:
  - presentation_state
  - position
  - scale

9.3.3 Example

```
ANNOUNCE rtsp://odrm32.comcast.com:554  RTSP/1.0
CSeq: 3
Require: com.comcast.ngod.r2
Session: 94155497
Notice: 5402 "Client Session Terminated"
  event-date=19930310T023735.013Z npt=342554
OnDemandSessionId: be074250-cc5a-11d9-8cd5-0800200c9a66
```

9.4 Announce Response

9.4.1 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 ANNOUNCE response:

- **OnDemandSessionId**

9.4.2 Example

```
RTSP/1.0 200 OK
CSeq: 3
Session: 94155497
OnDemandSessionId: be074250-cc5a-11d9-8cd5-0800200c9a66
```

10 GET_PARAMETER MESSAGES

10.1 Introduction

The ODRM interacts with the Streaming Server via the RTSP Get_Parameter Request and Response messages to retrieve information about the sessions.

10.2 Interaction Diagram

The below diagram depicts the interaction between the ODRM and the Streaming Server for a Get_Parameter interaction.

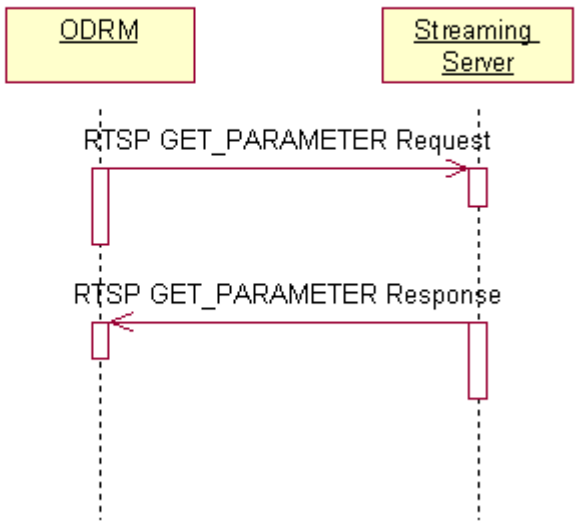

Figure 4. Get_Parameter Interaction between ODRM and Streaming Server

10.3 Get_Parameter Request

10.3.1 RTSP URL

The RTSP URL shall have the following syntax.

```
rtsp://<streaming-server-path>:<streaming-server-port>/
```

where

<streaming-server-path> is the DNS name or IP address of the streaming server

<streaming-server-port> is the signaling port for the streaming server

10.3.2 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 GET_PARAMETER request:

- **Require**
- **SessionGroup**
- **GET_PARAMETER Extensions:**
  - **presentation_state**
  - **position**
  - **scale**
  - **connection_timeout**
  - **session_list**

10.3.3 Example

```
GET_PARAMETER
rtsp://streamingserver32.comcast.com:554/98765 RTSP/1.0
CSeq: 36393
Require: com.comcast.ngod.r2
Content-Type: text/parameters
Session: 1231796058
Content-Length: 19

presentation_state
```

10.4 Get_Parameter Response

10.4.1 RTSP Extension Headers

The syntax for the RTSP Extension Header is as defined in the NGOD RTSP Usage specification. The following Extension Headers can be used in R2 GET_PARAMETER response:

- **GET_PARAMETER Extensions:**
  - **presentation_state**
  - **position**
  - **scale**
  - **connection_timeout**
  - **session_list**

10.4.2 Example

```
RTSP/1.0 200 OK
```

```
CSeq: 36393
Session: 1231796058
Content-Type: text/parameters
Content-Length: 23

presentation_state: play
```