



## Remote PHY Switched Digital Video

This document provides information on how to configure Switched Digital Video for Cisco Remote PHY Device.

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

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## Hardware Compatibility Matrix for Cisco Remote PHY Device



**Note** Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Device Software Release are supported in all subsequent releases.

**Table 1: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device**

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

# Switched Digital Video Services

The Switched Digital Video (SDV) services are supported for the MPEG video subsystem on the Cisco Remote PHY Device. It consists of Multicast IP Packet based video streams that are managed as "Video Sessions". The Cisco Remote PHY Device supports both Any Source Multicast (ASM) and Source Specific Multicast (SSM) sessions.

- For ASM, the input is identified by the group IP address.
- For SSM, the input is identified by the source and group IP address pair.

In both cases, the UDP ports are ignored. Both ASM and SSM can co-exist but cannot overlap in a group IP address. Hence, for a group IP address, either a single ASM, or one or more SSM can be used.

## Session Cloning

Session cloning refers to the ability of forwarding an input to multiple output QAM channels. Only multicast sessions can be cloned. The output QAM channels are located on the same or different line cards. However, an input cannot be cloned on the same QAM channel. Cloning is available on session-based GQIv2 or Table-based sessions. It is applicable to re-mapped, pass-through, and data piping sessions. All cloned sessions must have the same processing type, bitrate and jitter value. For re-mapped sessions, each output copy will have a different output program number.

## Redundant Multicast Sources

The redundant multicast sources feature supports up to four SSM/ASM multicast address pairs per video session. However, only multicast traffic from one source is forwarded to the output QAMs. When the active source fails, another source is chosen automatically. Multicast sources must be unique within a redundant group and cannot overlap across redundant groups.

The order of the sources is critical when multicast sessions are configured via GQI or VSRM. For a given group IP address, the source IP addresses must be specified in the same order.

For example: The group IP address 232.1.2.3 used with two sessions must have the source IP addresses specified in the same order.

Session A configured with group IP 232.1.2.3 source 174.2.3.4 source2 174.4.5.6 source3 174.7.8.9 and session B or any session created after session A configured using group IP 232.1.2.3, must have the source IP addresses in this same order as specified for session A. That is, source 174.2.3.4 source2 174.4.5.6 source3 174.7.8.9.

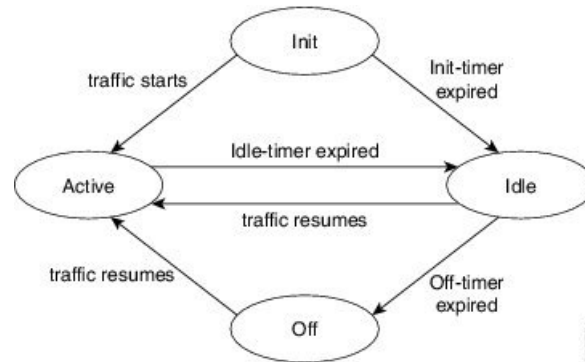
This ensures that all sessions switch to the same source IP address when a source switch occurs. Additionally, sessions configured via GQI have up to three sources available for redundancy, whereas multicast labels configured for table-based sessions have up to four sources available for redundancy.

Multicast labels must use unique groups and S/G pairs. These pairs cannot be used by other multicast labels or by multicast sessions that use S/G pairs. For example, when one multicast session uses {[S1, G], [S2, G] and [S3, G]}, another session cannot use {[S1, G], [S4, G]}.

Multicast source change is based on the session state; INIT, IDLE, ACTIVE or OFF. A session configured for the first time is in INIT state and stays in this state for a brief time. If traffic starts before the INIT timer expires, it moves to the ACTIVE state, otherwise to the IDLE state.

When traffic starts, the session remains in ACTIVE state as long as traffic continues to flow. When traffic stops for a time longer than the IDLE timer, the session moves to IDLE state. During IDLE state, PAT and PMT of the session is retained as the output. If traffic resumes in this state, the session moves to ACTIVE state again with all its previous PSI and remapping information unaltered.

In IDLE state, if traffic does not start or resume before the OFF timer expires, the session transitions to OFF state. When traffic resumes for a session in OFF state, it is treated as a new session.



Sessions that transition from ACTIVE to IDLE have higher priority and will be moved to the backup source than those that were newly created and have changed from INIT to IDLE.

## Benefits of Switched Digital Video

Switched Digital Video provides the following benefits:

- Saves space, maintenance and cost.
- Allows customers to oversubscribe bandwidth.

## Prerequisites for Switched Digital Video

- To access multicast capability, configure multicast routing.
- To switch sources for table-based sessions, configure at least two sources for a multicast label and then associate with the desired session.

## Restrictions for Switched Digital Video

- While creating a multicast label, up to four sources can be associated with one group IP address.
- Labels are used with table-based video sessions only.
- Sessions created with GQI Tools do not use labels. However, they can have up to three sources associated with one group IP address.

# Information About Switched Digital Video

## QAM Sharing

Unicast and multicast video sessions can co-exist on the same QAM channel for VOD, SDV or Gaming sessions. QAM sharing requires a common Edge Resource Manager to avoid oversubscription of QAM resources between services.



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**Note** QAM sharing with MPTS pass-thru sessions is not supported.

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## QAM Replication

Multicast sessions can be replicated from one port to other ports on the same line card and/or across line cards.

The difference between a cloned session and replicated sessions is:

- Cloned sessions are initiated by a user on session creation. Each session has a unique session id and may have different output configuration.
- Replicated sessions have the same output configuration attributes. For sessions that are replicated across line cards, session on each line card will have its own unique session id.

## MPTS Pass-through Session

Switched digital video (SDV) sessions are typically multicast SPTS remap type. The Cisco Remote PHY Device also supports multicast MPTS pass-through and data-piping session types.

The MPTS session is assumed to have no collision in the PID space and program number space with other sessions that already exist within a QAM. Hence, SPTS remap and MPTS pass-through sessions cannot co-exist on the same QAM. Otherwise, there might be conflict when the PID and program numbers in the MPTS and SPTS remuxing are not unique on the output QAM channel.

For a pass-through session:

- The PAT is snooped and regenerated with the correct TSID.
- The PMT and other program data are not changed.
- PID remapping is not performed.
- Input NULL packets are dropped.
- Oversubscription results in random TP dropping, and all ghost PIDs are preserved in the output.

# How to Configure the Switched Digital Video Services

## Configuring Multicast Routing

You can enable IP Multicast Distributed Switching (MDS) to provide distributed switching of multicast packets received at the line cards.

```
enable
configure terminal
ip multicast-routing distributed
ip pim ssm range all-multicasts
ip pim rp-address ip-address
interface type number
ip pim sparse-dense-mode
ip igmp version 3
cable video
multicast-uplink interface-name access-list access-list-name
```

When more than one physical or logical interfaces are used for reverse path forwarding (RPF) lookup, use loopback interface in **multicast-uplink** command and make sure that the loopback interface is routable/reachable on your network. Loopback interface of the cBR-8 can be enabled with **ip pim sparse-mode** command and it is reachable to multicast source or reverse path.

Below is an example of configuration:

```
Router> enable
Router# configure terminal
Router(config)# cable video
Router(config-video)# multicast-uplink 'Loopback0' access-list "acl_name1" access-list-global
"acl_name2" rp "rp-address"

Router(config)# interface Loopback0
Router(config-if)# ip address <ipaddress> <mask>
Router(config-if)# ip pim sparse-mode
Router(config-if)# end

Router(config)# ip access-list standard acl_name2
Router(config-std-nacl)# 10 permit 232.0.0.0 0.255.255.255
Router(config-std-nacl)#20 permit 227.0.0.0 0.255.255.255
Router(config-std-nacl)#30 permit 228.0.0.0 0.255.255.255
Router(config-std-nacl)#40 permit 231.0.0.0 0.255.255.255
Router(config-std-nacl)#50 permit 230.0.0.0 0.255.255.255

Router(config)# ip access-list standard acl_name1
Router(config-std-nacl)#10 permit 232.0.0.0 0.255.255.255
Router(config-std-nacl)#20 permit 231.0.0.0 0.255.255.255
```

`acl_name1` is a named-access-list to provisioned by user which provides multicast prefix belong to SSM range. Default is 232.\*.\*

`acl_name2` is a named-access-list to provisioned by user which provides multicast prefix belong to both SSM/ASM range.

`rp-address` is the actual IP address of the RP if ASM used.

## Configuring Multicast Label

The Cisco Remote PHY Device supports up to four multicast address pairs per multicast session for backup purpose. To specify additional sources for a multicast session for table-based, a label needs to be configured and attached to the session configuration. A maximum of 2000 multicast labels can be created but only 2048 multicast addresses can be active at a time.

Multicast label is used for table-based session configuration when more than one multicast source [S, G] is used as backup for the sessions. A multicast label can only be created or deleted; it cannot be modified. The multicast label cannot be deleted before the sessions using it are removed.

Groups used by multicast labels must be unique like the multicast S/G pairs. However, sources may be used by more than one label as long as the group is unique. A maximum of 4 multicast sources is allowed in one label. If the label is used in multiple sessions, the sessions are considered as cloned sessions.

```
enable
configure terminal
cable video
table-based
multicast-label label group group-ip source source-ip source2 source-ip source3
source-ip source4 source-ip
```

## Configuring Multicast Table-based Sessions

Similar to table-based unicast session configuration, sessions can be configured as individual sessions under each QAM carrier that is assigned to a table-based LED.

A multicast session can be configured with a single input multicast input source or multiple input sources for backup purpose. For multiple backup sources, a label is required to be associated with the session configuration. Same label can be applied to multiple sessions on different QAM channel. These sessions are considered as cloned sessions.

For session cloning on multiple QAMs within the same line card, only one copy of the traffic is forwarded to the line card. The line card replicates the input packets and forwards them to multiple QAMs. Each cloned copy of a remapped session will have the same or different output program number.

```
enable
configure terminal
cable video
table-based
vcg vcg-name
rf-channel channel
session session-name group group-ip source source-ip processing-type {remap
| passthru | data} start-program program-num [bit-rate bit-rate-number] [jitter
jitter-number] [cbr | vbr]
```

## Configuring Source Switching

Source switching happens automatically when the current source goes down. If more than one source IP is configured, the software will automatically switch to the next valid source IP, if it is available. However, to force switch from one valid source to another valid source, use the following commands:

```
Router(config)# cable video source-switch from-group group-ip from-source
source-ip
```

or

```
Router(config)# cable video source-switch to-group group-ip to-source source-ip
```

## Verifying Switched Digital Video Configuration

```
Router#show cable video session logical-edge-device id 2
Total Sessions = 4
```

Session Input Id State	Output Port State	Streaming Input Type Bitrate	Output Type Bitrate	Session Encrypt Type	Session Encrypt Ucast Dest Status	Source IP/Mcast Name	Session IP (S,G)	UDP Port	Output Program
2097152	142 ON 0	Remap 0	SSM CLEAR	175.2.5.6,232.5.6.7 -	SESS_PME2.1.7.338	0	1	OFF	
2097153 INIT	163 ON 0	Remap 0	SSM CLEAR	175.6.1.13,232.2.1.6 -	SESS_PME3.1.7.497	0	2		
2097154	184 ON 0	Passthru 0	SSM CLEAR	175.2.6.7,232.5.6.15 -	SESS_PME4.1.7.656	0	-	OFF	
2097155	230 ON 0	Data-Piping 0	SSM CLEAR	175.7.2.2,232.2.6.7 -	SESS_PME6.1.7.978	0	-	OFF	

```
Router#show cable video session logical-edge-device id 2 session-id 2097152
Session Name      : SESS_PME2.1.7.338
Session Id       : 2097152
Creation Time    : Fri Jun 24 16:30:45 2016
```

```
Output Port      : 142
TSID             : 142
ONID            : 0
Number of Sources : 1
  Source IP      : 175.2.5.6
  Group IP       : 232.5.6.7
  UDP Port       : 0
Config Bitrate   : not specified
Jitter          : 100 ms
Processing Type   : Remap
Stream Rate      : VBR
Program Number   : 1
Idle Timeout     : 2000 msec
Init Timeout     : 2000 msec
Off Timeout      : 60 sec
Encryption Type   : CLEAR
Encryption Status : -
```

```
Input Session Stats:
```

```
=====
```

```
State: OFF, Uptime: 0 days 00:26:35
IP Packets: In 0, RTP 0, Drop 0
TP Packets: In 0, PCR 0, PSI 0, Null 0
             Unreference 0, Discontinuity 0
Errors: Sync loss 0, CC error 0, PCR Jump 0,
        Underflow 0, Overflow 0, Block 0
Bitrate: Measured 0 bps, PCR 0 bps
```

Output Session Stats:

=====

```
State: ON, Uptime: 0 days 00:26:35
TP Packets: In 0, PCR 0, PSI 0,
            Drop 0, Forward 0, Insert 0
Errors: Info Overrun 0, Info Error 0, Block 0, Overdue 0,
        Invalid Rate 0, Underflow 0, Overflow 0
Bitrate: Measured 0 bps
```

## Troubleshooting Switched Digital Video Configuration

Problem	Possible Causes	Recommended Solution
%ERROR: Duplicate multicast source 175.2.5.6 group 232.5.6.7 not allowed for use in label groupDuplicate.	Group and Source are already used in an existing label.	Assign unique group and source IPs across multicast labels.
%ERROR: Duplicate multicast source 178.3.3.3 group 232.222.222.222 not allowed within label DuplicateSourceHere.	Source has been repeated within a label.	Assign unique source IP within a multicast label.
%ERROR: Duplicate multicast source 175.2.5.6 group 232.5.6.7 not allowed for use in this session.	Session has been created with a duplicate group IP. This group IP has been used in an existing multicast label.	Create the session with a unique group IP.
%ERROR Only one multicast session can be created per multicast session command; rf-channel range values, such as rf-channel 20-30, not allowed.	Session has been created on a range of RF channels.	RF channel range is not allowed. Create the session on an RF channel.

## Configuration Examples for Switched Digital Video

### Example 1: Table-based Multicast Session Configuration

```
enable
configure terminal
ip pim rp-address 9.1.1.1
ip pim ssm range all-multicasts
ip access-list standard all-multicasts
permit 233.0.0.0 0.255.255.255
permit 234.0.0.0 0.255.255.255
permit 235.0.0.0 0.255.255.255
permit 236.0.0.0 0.255.255.255
permit 237.0.0.0 0.255.255.255
permit 238.0.0.0 0.255.255.255
permit 232.0.0.0 0.255.255.255
```



```

permit 224.0.0.0 0.255.255.255
permit 239.0.0.0 0.255.255.255
interface TenGigabitEthernet4/1/2
 ip address 2.33.1.1 255.255.255.252
 ip pim sparse-mode
 ip igmp version 3
 ip ospf 64512 area 9
 load-interval 30
cable video
 multicast-uplink TenGigabitEthernet4/1/2 access-list all-multicasts
 service-distribution-group sdg-1 id 1
   rf-port downstream-cable 7/0/0
 virtual-carrier-group vcg-1 id 1
   service-type narrowcast
   rf-channel 0-55 tsid 1-56 output-port-number 1-56
 bind-vcg
   vcg vcg-1 sdg sdg-1
 logical-edge-device led_multicast id 1
 protocol table-based
   virtual-edge-input-ip 174.102.1.1 input-port-number 1
   vcg vcg-1
   active
 table-based
   multicast-label labell group 232.2.1.1 source 175.2.2.2
   vcg vcg-1
     rf-channel 0
     session mcast1 multicast-label labell processing-type remap start-program 1 jitter
100 vbr
     session mcast2 group 236.0.1.1 source 175.10.5.2 processing-type passthru jitter
100 cbr

```

### Example 2: Table-based Configuration for Replicated Multicast Pass-through Sessions

Below is a table-based configuration for multicast pass-through sessions replicated to all QAM ports on the same line card.

```

enable
configure terminal
cable video
 multicast-uplink TenGigabitEthernet4/1/2 access-list all-multicasts
 service-distribution-group sdg1 id 1
   rf-port downstream-cable 7/0/0
   rf-port downstream-cable 7/0/1
   rf-port downstream-cable 7/0/2
   rf-port downstream-cable 7/0/3
   rf-port downstream-cable 7/0/4
   rf-port downstream-cable 7/0/5
   rf-port downstream-cable 7/0/6
   rf-port downstream-cable 7/0/7
 virtual-carrier-group vcg1 id 1
   rf-channel 0-95 tsid 0-95 output-port-number 1-96
 bind-vcg
   vcg vcg1 sdg sdg1
 logical-edge-device led1 id 1
 protocol table-based
   virtual-edge-input-ip 174.102.1.1 input-port-number 1
   vcg vcg1
   active
 table-based
   multicast-label mlabell group 236.0.1.1 source 175.10.5.2 source2 175.10.6.20 source3
175.10.7.2

```

```

vcg vcg1
  rf-channel 0
    session mcast1 multicast-label mlabel1 processing-type passthru vbr
  rf-channel 5
    session mcast2 group 237.0.1.1 source 175.10.6.2 processing-type passthru vbr

```

### Example 3: QAM Sharing Configuration

Below is an example of how to create a PMT encrypted table-based session for both VOD and SDV on the same QAM channel on 7/0/0 RF port.

```

cable video
  multicast-uplink TenGigabitEthernet4/1/2 access-list all-multicasts
  mgmt-intf VirtualPortGroup 0
  encryption
    linecard 7/0 ca-system pme scrambler dvs042
    pme vodsid 111
    pme cem 1.200.1.163 5000
    pme mgmt-ip 1.33.2.6
  service-distribution-group sdg1 id 1
    rf-port downstream-cable 7/0/0
  virtual-carrier-group vcg1 id 1
    virtual-edge-input-ip 174.102.1.1 input-port-number 1
    encrypt
      service-type narrowcast
      rf-channel 20-34 tsid 20-34 output-port-number 20-34
  bind-vcg
    vcg vcg1 sdg sdg1
  logical-edge-device led1 id 1
    protocol table-based
      vcg vcg1
      active
  table-based
    multicast-label mlabel1 group 236.0.1.1 source 175.10.5.2 source2 175.10.6.2 source3
175.10.7.2
    vcg vcg1
      rf-channel 20
        session VOD input-port 1 start-udp-port 49152 processing-type remap start-program
1 jitter 100 vbr
        session SDV multicast-label mlabel1 processing-type remap start-program 1000 jitter
100 vbr
    !

```

### Example 4: QAM Replication Configuration

Below is an example of how to configure multicast sessions with four backup sources and replicated on multiple line cards and multiple RF ports within the same line card.

```

cable video
  multicast-uplink TenGigabitEthernet4/1/2 access-list all-multicasts
  service-distribution-group sdg-1 id 1
    rf-port downstream-cable 7/0/0
    rf-port downstream-cable 7/0/1
    rf-port downstream-cable 8/0/0
    rf-port downstream-cable 8/0/1
  virtual-carrier-group vcg-1 id 1
    service-type broadcast
    rf-channel 0-55 tsid 1-56 output-port-number 1-56

```

```

bind-vcg
  vcg vcg-1 sdg sdg-1
  logical-edge-device led_multicast id 1
  protocol table-based
    virtual-edge-input-ip 174.102.1.1 input-port-number 1
    vcg vcg-1
  active
  table-based
    multicast-label label1 group 232.2.1.1 source 175.2.2.2 source2 175.2.3.2 source3
175.2.4.2 source4 175.5.1.12
    vcg vcg-1
    rf-channel 0
      session mcast1 multicast-label label1 processing-type remap start-program 1 jitter
100 vbr

```

### Example 5: SSM Session Configuration

The following examples show how to configure SSM sessions on a range of QAM channels with three multicast sources.

```

table-based
  multicast-label label110_1 group 232.2.1.35 source 175.2.2.2 source2 175.6.1.12 source3
175.2.9.2
  multicast-label label103_1 group 232.2.1.30 source 175.2.2.2 source2 175.6.1.12 source3
175.2.9.2
  vcg vcg-uni-multi0
  rf-channel 0
    session mcast multicast-label label110_1 processing-type remap start-program 1
jitter 100 cbr
  rf-channel 6
    session mcast multicast-label label103_1 processing-type remap start-program 1
jitter 100 cbr

```

### Example 6: Multicast Session with Virtual Carrier Group as Service Type Broadcast Configuration

```

virtual-carrier-group VCG_PME0 id 1
  service-type broadcast
  rf-channel 20-35 tsid 100-115 output-port-number 100-115

table-based
  multicast-label a2 group 232.5.6.7 source 175.2.5.6
  multicast-label exampleLabel group 232.2.1.6 source 175.6.1.13 source2 175.6.1.12 source3
180.1.1.1 source4 175.6.1.14
  vcg VCG_PME2
  rf-channel 22
    session SESS_PME2 multicast-label a2 processing-type remap start-program 1
  vcg VCG_PME3
  rf-channel 23
    session SESS_PME3 multicast-label exampleLabel processing-type remap start-program
2

```

### Example 7: Sessions with Passthru and Data Processing Type

```

table-based
  multicast-label a2 group 232.5.6.7 source 175.2.5.6
  multicast-label exampleLabel group 232.2.1.6 source 175.6.1.13 source2 175.6.1.12 source3
180.1.1.1 source4 175.6.1.14

```

```

vcg VCG_PME2
  rf-channel 22
  session SESS_PME2 multicast-label a2 processing-type remap start-program 1
vcg VCG_PME3
  rf-channel 23
  session SESS_PME3 multicast-label exampleLabel processing-type remap start-program
2
vcg VCG_PME4
  rf-channel 24
  session SESS_PME4 group 232.5.6.15 source 175.2.6.7 processing-type passthru
vcg VCG_PME6
  rf-channel 30
  session SESS_PME6 group 232.2.6.7 source 175.7.2.2 processing-type data

```

## Feature Information for Switched Digital Video

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.



**Note** The below table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Feature Name	Releases	Feature Information
Switched Digital Video	Cisco 2x2 RPD Software 2.x	This feature was introduced on the Cisco 2x2 Remote PHY Device.