Cisco Remote PHY Out of Band

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.

Hardware Compatibility Matrix for Cisco Remote PHY Device

Note The hardware components introduced in a given Cisco Remote PHY Device Software Release are supported in all subsequent releases unless otherwise specified.

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

Cisco HFC Plaform	Remote PHY Device
Cisco GS7000 Node	**Cisco 1x2 RPD Software 1.1 and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= • RPD-1X2-PKEY=

Cisco HFC Plaform	Remote PHY Device
Intelligent NODE (iNODE)	**Cisco 1x2 RPD Software 3.1 and Later Releases** Cisco Remote PHY Device 1x2 • IRPD-1X2= • IRPD-1X2-PKEY=

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Note   The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

Information About Out of Band

Out of Band (OOB) data is used by set-top boxes on the cable plant for the delivery of data streams that support set-top box operation in the downstream and to convey responses and commands from the STB in the upstream.

The two OOB systems are OOB 55-1 and OOB 55-2. The OOB 55-2 system has a scheduled TDMA upstream, which is intolerant of packet network latency. The SCTE 55-1 system does not include such upstream scheduling capabilities, however requires multiple upstream frequencies to operate.

OOB 55-1

To facilitate the delivery of OOB streams from the headend to the customer-facing CPE via the Remote PHY (R-PHY) architecture, a solution is needed that delivers the OOB streams to the RPD via the same Ethernet carriers that the rest of the services traverse. The following sections describe 55-1 OOB approaches to this transport:

For downstream:

- Ethernet from the OM device: The OM processes OOB source streams per SCTE-55-1 and outputs datagrams via IP multicast.

- CCAP-Core forward as virtrual OM: The CCAP joins and processes streams from OM device per SCTE-55-1 and forwards them downstream to the RPD.

For upstream:

- ATM from STB: The STB send augment ATM upstream packet to RPD per SCTE-55-1, RPD build up upstream packet per ARPD protocol (version 2) and forward it to CCAP core.

- CCAP-Core forward as virtrual ARPD: The CCAP receive 55-1 packet via UEPI and forwards them upstream to the NC.

The Out-of-Band Modulator (OM) handles the receiving of OOB source data streams and creating a multiplexed signal in accordance with OOB 55-1. The MPEG transport stream, containing the OOB is IP multicast using the UDP to the CCAP Core over an Ethernet link.

Each OM can output only a single OOB multiplex. Hence, a CCAP Core may receive OOB streams from multiple OMs. Each of these streams is intended for a different set of RPDs.

OM2000 does not include null frames in its Ethernet output stream. The OM provides an output of non-null packets in its Ethernet output transport streams. Hence, the downstream QPSK modulator should insert nulls when necessary. The Remote PHY device inserts null packets as necessary to maintain the required module rate of the OOB 55-1 downstream QPSK channel. The downstream modulator need not maintain precise inter-packet timing. The modulator can effectively insert null packets wherever necessary without checking for excessive data packet displacement.

Each virtual ARPD uses a unique source IP address and a unique destination UDP port in packets that are sent to the NC. The NC relies on IP address and UDP port to identify the ARPD from which the traffic is arriving.

Using GCP, the CCAP Core configures the attached RPDs with the appropriate ARPD source ID, RF port ID, and demodulator ID corresponding to each UEPI tunnel. The RPD uses this information when forming the ARPD datagram.

The RPD aggregates multiple physical demodulators into a single virtual ARPD demodulator ID.

The RPD also supports power level setting of the OOB 55-1 FDC in a range of -7 dBc to 0 dBc relative to the 256-QAM level, in 0.2 dB steps.

Forward Channels

To support the orderly transition of set-top boxes to a higher frequency, the SCTE 55-1 forward data can be carried on two forward channels with distinct frequencies. The data content sent on both channels is identical.

The RPD can support two SCTE 55-1 forward channels on any of its downstream RF port.

OOB 55-2

In the video headend, the OOB 55-2 Controller maintains all interfaces with the existing applications and services but contains only a subset of the functions available with the existing 55-2 Modulator/Demodulator. The remaining functions are moved to the RPD.

The OOB 55-2 Remote PHY solution places components necessary for performing ATM slot receipt acknowledgement within the RPD, and all other components of the OOB 55-2 MAC located in the 55-2 Controller where feasible. The OOB 55-2 Controller handles the configuration and monitoring of 55-2 specific functions within the RPD. Some monitoring is also included in the upstream data packets sent by the RPD to the 55-2 Controller.

The current 55-2 Digital Home Communication Terminal (DHCT) service group sizes are more than 10,000 DHCTs, versus the expected RPD DHCT counts which can be 1000 or lower. For compatibility with existing infrastructure, RPDs are grouped with a single 55-2 Controller as follows:

- Multiple RPDs are bound by operator configuration to a single 55-2 Controller which can service >10,000 DHCTs.

- RPD demodulators are assigned an Upstream Group ID between 0 and 7. All demodulators in the same Upstream Group logically-share the same upstream slot assignments for 55-2 compatibility. Upstream Group ID is equivalent to SCTE 55-2 Demodulator Number, but is zero indexed instead of 1 indexed. Upstream Group ID 0 corresponds to SCTE 55-2 Demodulator Number 1 (R1), Upstream Group ID 7 corresponds to SCTE 55-2Demodulator Number 8 (R8).

• All RPDs bound to a single 55-2 Controller share a single L2TPv3 multicast tunnel for downstream data.

An RPD can incorporate a number of SCTE 55-2 modules, each represented by Oob55d2Module object. The number of SCTE 55-2 Modules is communicated using RPD capabilities. Common parameters for all 55-2 modules are grouped into an Oob55-2Config object.

Each SCTE55-2 module consists of one modulator and one to eight demodulators. The Oob55-2Modulator can be associated with one or more downstream RF ports, and the Oob55-2Demodulator can be associated with zero or one upstream RF ports.

The RPD reports these associations to the CCAP Core.

Prerequisites

The RPD must support the following:

• RPD connects to only one 55-2 controller.

• OOB 55-2 specific L2TPv3 multicast packets containing downstream ATM cells and metadata.

• OOB 55-2 specific IP and L2TPv3 encapsulation of upstream ATM cells and metadata.

• Sending at least one L2TPv3 upstream tunnel per RPD to the 55-2 Controller.

• Forwarding the IP unicast packets to the 55-2 Controller.

• GCP configuration by the 55-2 Controller using authenticated and secured connections.

• An authenticated and secured L2TPv3 control connection with the 55-2 Controller.

How to Configure 55-1 OOB

This section describes how to configure OOB on Cisco cBR-8.

Configuring Global 55-1 OOB

To configure OOB, complete the following procedure:

configure terminal
cable oob
virtual-om *o-id*
ip *ip subnet_mask*
join-group *ip* **source-ip** *ip* **out-group** *ip*
virtual-arpd *id*
ip *ip subnet_mask*
nc *ip* **udp-port** *number*
source-id *s-id*

Configuring Profile for 55-1 OOB

To configure profile to use OOB, complete the following procedure:

configure terminal
controller downstream-oob 55d1-profile *dp-id*
no ds-channel 0 rf-mute
no ds-channel 0 shutdown
ds-channel 0 frequency *f-value*
ds-channel 0 poweradjust *p-value*
controller upstream-oob 55d1-profile *up-id*
no us-channel 0 shutdown
us-channel 0 frequency *f-value*
us-channel 0 varpd-portid *va-id* **varpd-demodid** *vd-id*
no us-channel 1 shutdown
us-channel 1 frequency *f-value*
us-channel 1 varpd-portid *va-id* **varpd-demodid** *vd-id*
no us-channel 2 shutdown
us-channel 2 frequency *f-value*
us-channel 2 varpd-portid *va-id* **varpd-demodid** *vd-id*

Configuring Remote PHY Device for 55-1 OOB

To configure the RPD to use OOB, complete the following procedure:

configure terminal
cable rpd *name*
identifier *id*
no sbfd enable
core-interface TenGigabitEthernet *slot/subslot/port*
principal
rpd-ds 0 downstream-oob-vom *o-id* **profile** *dp-id*
rpd-us 0 upstream-oob-varpd *a-id* **profile** *up-id*
rpd-us 1 upstream-oob-varpd *a-id* **profile** *up-id*
r-dti *value*
rpd-event profile *id*

Configuring OOB with VRF

The following example shows how to configure the OOB with VRF:

```
cable oob
  virtual-om 1
    ip 100.100.100.100 255.255.255.0 vrf xxx
    join-group 235.1.1.1 source-ip 2.3.4.5 out-group 239.2.2.2
  virtual-arpd 1
    ip 20.20.20.20 255.255.255.0 vrf xxx
    source-id 1
    nc 200.1.1.100 udp-port 100
```

Configuring Two Forward Channels

The following example shows how to configure two forward channels. This configuration is OOB DS profile: (1 port per RPD, 1 channel per port, 2 output RF frequency per channel):

```
controller downstream-oob 55d1-profile 100
    no ds-channel 0 rf-mute
    no ds-channel 0 shutdown
    ds-channel 0 frequency 70000000
    ds-channel 0 poweradjust 0
    no ds-channel 0 sf-mute
    no ds-channel 0 sf-shutdown
    ds-channel 0 second-frequency 130000000
    ds-channel 0 sf-poweradjust  -10
```

Verifying OOB DS Details

Use the following commands to verify the DS details.
```
show platform software cable F0 oob-ds

show platform software cable F0 oob-ds statistics
clear platform software cable F0 oob-ds statistics

show platform software cable F0 oob-ds group <G2 address>
```

Verifying OOB US Details

Use the following commands to verify the US details.
```
show platform software cable F0 oob-us
show platform software cable F0 oob-us statistics
clear platform software cable F0 oob-us statistics
show platform software cable F0 oob-us source-id <RPD source id>
```

Verifying OOB Channel Details

Use the following commands to view the OOB channel details.
```
show cable rpd db-dump rpd-oob-ds-chan (all)
show cable rpd db-dump rpd-oob-us-chan (all)
```

Debugging OOB

Use the following commands to view the OOB channel details.
```
debug cable rphy-oob
```

Example: OOB Configuration

The following example shows how to configure OOB:

```
Router#configure terminal
Router(config)# cable oob
Router(config-oob)# virtual-om 1
Router(config-oob-vom)# ip 100.100.100.100 255.255.255.0
Router(config-oob-vom)# join-group 235.1.1.1 source-ip 2.3.4.5 out-group 239.2.2.2
Router(config-oob-vom)# exit
```

```
Router(config-oob)# virtual-arpd 1
Router(config-oob-varpd)# ip 32.32.32.32 255.255.255.0
Router(config-oob-varpd)# nc 3.3.3.3 udp-port 100
Router(config-oob-varpd)# source-id 1
Router(config-oob-varpd)# exit
Router(config-oob)# exit

Router(config)# controller downstream-OOB 55d1-profile 1
Router(config-profile)# no ds-channel 0 rf-mute
Router(config-profile)# no ds-channel 0 shutdown
Router(config-profile)# ds-channel 0 frequency 70000000
Router(config-profile)# ds-channel 0 poweradjust 1
Router(config-profile)# exit

Router(config)# controller upstream-OOB 55d1-profile 1
Router(config-profile)# no us-channel 0 shutdown
Router(config-profile)# us-channel 0 frequency 5216000
Router(config-profile)# us-channel 0 varpd-portid 3 varpd-demodid 2
Router(config-profile)# no us-channel 1 shutdown
Router(config-profile)# us-channel 1 frequency 6000000
Router(config-profile)# us-channel 1 varpd-portid 3 varpd-demodid 4
Router(config-profile)# no us-channel 2 shutdown
Router(config-profile)# us-channel 2 frequency 8000000
Router(config-profile)# us-channel 2 varpd-portid 3 varpd-demodid 6
Router(config-profile)# exit

Router(config)# cable rpd node1
Router(config-rpd)# identifier 0004.9f00.0685
Router(config-rpd)# no sbfd enable
Router(config-rpd)# core-interface Te7/1/0
Router(config-rpd-core)# principal
Router(config-rpd-core)# rpd-ds 0 downstream-cable 7/0/0 profile 3
Router(config-rpd-core)# rpd-ds 0 downstream-oob-vom 1 profile 1
Router(config-rpd-core)# rpd-us 0 upstream-cable 7/0/0 profile 3
Router(config-rpd-core)# rpd-us 0 upstream-oob-varpd 1 profile 1
Router(config-rpd-core)# exit

Router(config-rpd)# r-dti 1
Router(config-rpd)# rpd-event profile 0
```
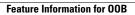
Feature Information for OOB

The following table provides release information about the feature or features described in this module. This 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.

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Table 2: Feature Information for OOB

Feature Name	Releases	Feature Information
Out of Band	Cisco 1x2 / Compact Shelf RPD Software 3.1	This feature was integrated into the Cisco Remote PHY Device.
Support for OOB 55-2	Cisco 1x2 / Compact Shelf RPD Software 3.1	This feature was integrated into the Cisco Remote PHY Device.