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## Introduction

This document describes configuration steps required to implement a back-to-back Multirate Symmetric High-Speed Digital Subscriber Line (G.SHDSL) connection between two EHWIC-4SHDSL-EA modules.

You must configure one end of the connection in Central Office (CO) mode and the other end in Customer Premises Equipment (CPE) mode to bring up the SHDSL connection. This kind of a back-to-back SHDSL connection set-up is commonly implemented within a campus network to provide connectivity between two buildings without the need for a DSLAM in between the two DSL Routers.

## Prerequisites

### Requirements

Cisco recommends that you have knowledge of these topics:

- EHWIC-4SHDSL-EA module
- Fixed ISR G2 routers like C888EA-K9 work in both CO and CPE modes with Cisco IOS Software 15.2(2)T2 and later releases.

### Components Used

This document is not restricted to specific software and hardware versions.

However, this set-up is built using the following devices

- Two ISR Generation-2 routers (CISCO2901/K9) loaded with IOS 15.4.3M2.
- Two EHWIC-4SHDSL-EA modules installed on both ISR G2 routers.
- ANSI/TIA/EIA-568-B cable with RJ-45 connectors at either ends.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

## Configure

## Configurations

In this set-up, we are using identical routers with EHWIC-4SHDSL-EA modules installed on them. The device named **CO\_Router** has the SHDSL controller configured to operate in CO mode, while the device named **CPE\_Router** has the SHDSL controller configured to operate in CPE mode.

The EHWIC-4SHDSL-EA module can be configured for both Ethernet in the first mile (EFM) and Asynchronous Transfer Mode (ATM). This document explains how to set-up back-to-back SHDSL connection in both EFM and ATM modes.

Below example shows how to set-up back-to-back SHDSL connection in ATM mode,

### ATM mode

We can implement either IP over ATM (IPoA) or PPP over ATM (PPPoA) solution while configuring back-to-back SHDSL connection.

#### 1. IP over ATM Solution

CO Router:

```
CO_Router#show running-config
Building configuration...

Current configuration : 1624 bytes
!
!
version 15.4
service config
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CO_Router
!
boot-start-marker
boot system flash:c2900-universalk9-mz.SPA.154-3.M2.bin
boot-end-marker
!
!
!
no aaa new-model
!
!
!
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
!
!
cts logging verbose
!
!
license udi pid CISCO2901/K9 sn FGL1622241N
license boot module c2900 technology-package securityk9
```

```
license boot module c2900 technology-package datak9
!
redundancy
!
!
!
controller SHDSL 0/1/0
  termination co
  dsl-group 0 pairs 0, 1, 2, 3 m-pair
  !
!
!
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  ip address dhcp
  duplex auto
  speed auto
!
interface GigabitEthernet0/1
  no ip address
  shutdown
  duplex auto
  speed auto
!
interface ATM0/1/0
  ip address 1.1.1.1 255.255.255.0
  no atm ilmi-keepalive
  pvc 1/10
  !
!
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!

control-plane
!
!
line con 0
line aux 0
line vty 0 4
  login
  transport input all
!
!
end
```

**CO\_Router#**

CPE Router:

**CPE\_Router#show running-config**

Building configuration...

Current configuration : 1538 bytes

!

```
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CPE_Router
!
boot-start-marker
boot-end-marker
!
!
!
no aaa new-model
!
ip cef
!
!
!
no ipv6 cef
!
multilink bundle-name authenticated
!
!
!
voice-card 0
!
!
!
license udi pid CISCO2901/K9 sn FGL151625KN
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
!
!
!
redundancy

!
controller SHDSL 0/1/0
  dsl-group 0 pairs 0, 1, 2, 3 m-pair
  !

!
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  no ip address
  shutdown
  duplex auto
  speed auto
!
interface GigabitEthernet0/1
  ip address dhcp
  duplex auto
  speed auto
!
interface ATM0/1/0
```

```
ip address 1.1.1.2 255.255.255.0
no atm ilmi-keepalive
pvc 1/10
!
!
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
control-plane
!
!
gatekeeper
 shutdown
!
!
!
line con 0
line aux 0
line vty 0 4
 login
 transport input all

!
end
```

**CPE\_Router#**

## 2. PPP over ATM Solution

CO Router:

**CO\_Router#show running-config**

Building configuration...

Current configuration : 1779 bytes

```
!
!
version 15.4
service config
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CO_Router
!
boot-start-marker
boot system flash:c2900-universalk9-mz.SPA.154-3.M2.bin
boot-end-marker
!
!
!
no aaa new-model
!
!
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
```

```
!  
!  
!  
cts logging verbose  
!  
!  
license udi pid CISCO2901/K9 sn FGL1622241N  
license boot module c2900 technology-package securityk9  
license boot module c2900 technology-package datak9  
!  
  
!  
redundancy  
!  
!  
controller SHDSL 0/1/0  
  termination co  
  dsl-group 0 pairs 0, 1, 2, 3 m-pair  
  !  
interface Embedded-Service-Engine0/0  
  no ip address  
  shutdown  
!  
interface GigabitEthernet0/0  
  ip address dhcp  
  duplex auto  
  speed auto  
!  
interface GigabitEthernet0/1  
  no ip address  
  shutdown  
  duplex auto  
  speed auto  
!  
interface ATM0/1/0  
  no ip address  
  no atm ilmi-keepalive  
  pvc 1/10  
    encapsulation aal5snap  
    protocol ppp dialer  
    dialer pool-member 1  
  !  
!  
interface Dialer1  
  ip address 1.1.1.1 255.255.255.0  
  encapsulation ppp  
  dialer pool 1  
  dialer-group 1  
!  
!  
ip forward-protocol nd  
!  
no ip http server  
no ip http secure-server  
!  
  
!  
!  
control-plane  
!  
!  
!  
line con 0  
line aux 0
```

```
line vty 0 4
  login
  transport input all

!
```

**CO\_Router#**

**CPE Router:**

**CPE\_Router#show running-config**

Building configuration...

Current configuration : 1693 bytes

!

```
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CPE_Router
!
boot-start-marker
boot-end-marker
!
!
!
no aaa new-model
!
ip cef
!
!
no ipv6 cef
!
multilink bundle-name authenticated
!
!
!
license udi pid CISCO2901/K9 sn FGL151625KN
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
!
!
!
redundancy
!
!controller SHDSL 0/1/0
  dsl-group 0 pairs 0, 1, 2, 3 m-pair
  !
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  no ip address
  shutdown
```

```

duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address dhcp
duplex auto
speed auto
!
interface ATM0/1/0
no ip address
no atm ilmi-keepalive
pvc 1/10
  encapsulation aal5snap
  protocol ppp dialer
  dialer pool-member 1
!
!
interface Dialer1
ip address 1.1.1.2 255.255.255.0
encapsulation ppp
dialer pool 1
dialer-group 1
!
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
control-plane
!
gatekeeper
shutdown
!
line con 0
line aux 0
line vty 0 4
login
transport input all

!
end

```

**CPE\_Router#**

### 3. PPPOE over ATM Solution

CO Router:

```

CO_Router#show running-configuration
Building configuration...

```

```

Current configuration : 2299 bytes
!

```

```

version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CO_Router
!
boot-start-marker

```



```
boot-end-marker
!

no aaa new-model
!

username cisco password 0 cisco
!

redundancy
!
!

controller SHDSL 0/1/0
termination co dsl-group 0 pairs 0, 1, 2, 3 m-pair
!
!

bba-group pppoe global
virtual-template 1
!
!

interface Loopback0
ip address 10.1.1.1 255.255.255.255
!

interface Embedded-Service-Engine0/0
no ip address
shutdown
!

interface GigabitEthernet0/0
no ip address
shutdown
duplex auto
speed auto

!

interface GigabitEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!

!

interface ATM0/1/0
no ip address
no atm ilmi-keepalive
!

interface ATM0/1/0.1 point-to-point
pvc 1/100
protocol pppoe group global
!
!

interface Virtual-Template1
ip unnumbered Loopback0
ip mtu 1492
peer default ip address pool PPPOE
!
!

ip local pool PPPOE 10.1.1.2 10.1.1.254

!

line con 0
line aux 0
line vty 0 4
login
```

```
transport input all
```

```
end
```

```
CO_Router#
```

### Verification:

```
CO_Router#show caller ip
```

Line	User	IP Address	Local Number	Remote Number	<->
<b>Vi1.1</b>	-	<b>10.1.1.2</b>	-	-	in

```
CO_Router#
```

CPE Router:

```
CPE_Router#show running-config
```

```
Building configuration...
```

```
Current configuration : 2554 bytes
```

```
!  
!
```

```
version 15.4
```

```
service timestamps debug datetime msec
```

```
service timestamps log datetime msec
```

```
no service password-encryption
```

```
!
```

```
hostname CPE_Router
```

```
!
```

```
boot-start-marker
```

```
boot-end-marker
```

```
!
```

```
!
```

```
!
```

```
no aaa new-model
```

```
!
```

```
ip cef
```

```
no ipv6 cef
```

```
!
```

```
multilink bundle-name authenticated
```

```
!
```

```
controller SHDSL 0/1/0
```

```
dsl-group 0 pairs 0, 1, 2, 3 m-pair
```

```
!
```

```
!
```

```
!
```

```
interface Embedded-Service-Engine0/0
```

```
no ip address
```

```
shutdown
```

```
!
```

```
interface GigabitEthernet0/0
```

```
ip address dhcp
```

```
duplex auto
```

```
speed auto
```

```
!
```

```
interface GigabitEthernet0/1
```

```
no ip address
```

```
duplex auto
```

```
speed auto
```

```
!
```

```
interface GigabitEthernet0/2
```

```
ip address dhcp
```

```

duplex auto
speed auto
!
interface ATM0/1/0
  no ip address
  no atm ilmi-keepalive
!
interface ATM0/1/0.1 point-to-point
  pvc 1/100
    pppoe-client dial-pool-number 1
!
!
interface Dialer1
  ip address negotiated
  encapsulation ppp
  dialer pool 1
  ppp chap hostname cisco
  ppp chap password 0 cisco
!
!

control-plane
!
!

line con 0
line aux 0
line vty 0 4
  login
  transport input all
!
!
end

```

**CPE\_Router#**

### Verification:

**CPE\_Router#show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
Embedded-Service-Engine0/0	unassigned	YES	NVRAM	administratively down	down
ATM0/1/0	unassigned	YES	unset	up	up
ATM0/1/0.1	unassigned	YES	unset	up	up
<b>Dialer1</b>	<b>10.1.1.2</b>	<b>YES</b>	<b>IPCP</b>	<b>up</b>	<b>up</b>
Virtual-Access1	unassigned	YES	unset	up	up

**CPE\_Router#**

### EFM mode

We can implement either IP over Ethernet (IPoE) or PPP over Ethernet (PPPoE) solution while configuring back-to-back SHDSL connection.

#### 1. IP over Ethernet Solution

CO Router:

**CO\_Router#show running-config**

Building configuration...

```
Current configuration : 2194 bytes
!
! Last configuration change at 14:56:53 UTC Thu Mar 10 2016
!
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname CO_Router
!
boot-start-marker
boot system flash:c2900-universalk9-mz.SPA.154-3.M2.bin
boot-end-marker
!

!
ip cef
no ipv6 cef
multilink bundle-name authenticated
!

!
cts logging verbose
!

!
redundancy
!

!
controller SHDSL 0/3/0
  termination co
  mode efm
  dsl-group 0 pairs 0, 1, 2, 3 efm-bond
!

!
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  no ip address
  duplex auto
  speed auto
!
interface GigabitEthernet0/1
  no ip address
  duplex auto
  speed auto
!
!
interface Ethernet0/3/0
  ip address 1.1.1.1 255.255.255.252
!
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
```

```
!  
control-plane  
!  
gatekeeper  
  shutdown  
!  
line con 0  
line aux 0  
line vty 0 4  
  login  
  transport input all  
!  
scheduler allocate 20000 1000  
!  
end
```

```
CO_Router#  
CPE Router:
```

```
CPE_Router#show running-config  
Building configuration...
```

```
Current configuration : 1646 bytes  
!  
! Last configuration change at 14:50:55 UTC Thu Mar 10 2016  
!  
version 15.4  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname CPE_Router  
!  
boot-start-marker  
boot system flash:c2900-universalk9-mz.SPA.154-3.M2.bin  
boot-end-marker  
!  
!  
no aaa new-model  
!  
  
ip cef  
no ipv6 cef  
!  
multilink bundle-name authenticated  
!  
  
cts logging verbose  
!  
  
redundancy  
!  
  
controller SHDSL 0/3/0  
  mode efm  
  dsl-group 0 pairs 0, 1, 2, 3 efm-bond  
!  
!  
!
```

```
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  ip address dhcp
  duplex auto
  speed auto
!
interface GigabitEthernet0/1
  no ip address
  duplex auto
  speed auto
!
interface Ethernet0/3/0
  ip address 1.1.1.2 255.255.255.252
!
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!

control-plane
!

line con 0
line aux 0
line vty 0 4
  login
  transport input all
!
scheduler allocate 20000 1000
!
end
```

**CPE\_Router#**

## 2. PPP over Ethernet Solution

CO Router:

**CO\_Router#show running-config**

Building configuration...

Current configuration : 1851 bytes

!

! Last configuration change at 15:00:06 UTC Thu Mar 10 2016

!

version 15.4

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname CO\_Router

!

boot-start-marker

boot system flash:c2900-universalk9-mz.SPA.154-3.M2.bin

boot-end-marker

!

ip cef

no ipv6 cef

```
!  
multilink bundle-name authenticated  
!  
cts logging verbose  
!  
controller SHDSL 0/3/0  
  mode efm  
  dsl-group 0 pairs 0, 1, 2, 3 efm-bond  
  !  
  
bba-group pppoe global  
  virtual-template 1  
  !  
  !  
  interface Embedded-Service-Engine0/0  
    no ip address  
    shutdown  
  !  
  interface GigabitEthernet0/0  
    ip address dhcp  
    duplex auto  
    speed auto  
  !  
  interface GigabitEthernet0/1  
    no ip address  
    duplex auto  
    speed auto  
  !  
  interface Ethernet0/3/0  
    ip address 1.1.1.2 255.255.255.252  
    pppoe enable group global  
  !  
  interface Virtual-Template1  
    mtu 1492  
    ip unnumbered Ethernet0/3/0  
    peer default ip address pool PPPOE  
  !  
  !  
  ip local pool PPPOE 1.1.1.1  
  
  !  
  no ip http server  
  no ip http secure-server  
  !  
  
  control-plane  
  !  
  
  line con 0  
  line aux 0  
  line vty 0 4  
    login  
    transport input all  
  !  
  scheduler allocate 20000 1000  
  !  
end
```

```
CO_Router#  
CPE Router:
```

**CPE\_Router#show running-config**

Building configuration...

Current configuration : 2310 bytes

```
!  
! Last configuration change at 15:10:04 UTC Thu Mar 10 2016  
!  
version 15.4  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname CPE_Router  
!  
boot-start-marker  
boot system flash:c2900-universalk9-mz.SPA.154-3.M2.bin  
boot-end-marker  
!  
!  
ip cef  
no ipv6 cef  
multilink bundle-name authenticated  
!  
!  
!  
!  
!  
cts logging verbose  
!  
!  
voice-card 0  
!  
!  
!  
!  
redundancy  
!  
controller SHDSL 0/3/0  
termination co  
mode efm  
dsl-group 0 pairs 0, 1, 2, 3 efm-bond  
!  
!  
!  
!  
!  
interface Embedded-Service-Engine0/0  
no ip address  
shutdown  
!  
interface GigabitEthernet0/0  
no ip address  
duplex auto  
speed auto  
!  
interface GigabitEthernet0/1  
no ip address  
duplex auto  
speed auto  
!
```



```

!
interface Ethernet0/3/0
  no ip address
  pppoe enable group global
  pppoe-client dial-pool-number 1
!
interface Dialer1
  ip address negotiated
  encapsulation ppp
  dialer pool 1
!
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
!
control-plane
!
!
!
!
gatekeeper
  shutdown
!
!
!
line con 0
line aux 0
line vty 0 4
  login
  transport input all
!
scheduler allocate 20000 1000
!
end

```

**CPE\_Router#**

## **Verify**

1.To verify that the router is in central office (CO) mode, use the following **show** command. The "CO termination" line in the output (**bold** in the example below) indicates that the router is in CO mode. The default mode would be CPE. Some of the output does not appear here, for brevity.

**CO# show controllers shdSL 0/1/0**

Controller SHDSL 0/1/0 is UP

Hardware is EHWIC-4SHDSL-EA, rev 0 on slot 0, hwic slot 1

Capabilities: EFM: 2-wire, EFM-Bond, Annex A, B, F & G

ATM: 2-wire, Mpair, IMA, Annex A, B, F & G

## CO termination

cdb=0x3CF085F0, plugin=0x21C33C1C, ds=0x21C33C68 base=0x10200000

FPGA Version is A14

NPU Source: System

NPU Firmware version: SHDSL\_EA\_FW\_20130116053038

Vendor: Infineon, Chipset: SOCRATES-4e

PHY Source: System

IDC Firmware version: 1.7.5.0

DFE Firmware version: 1.1-1.7.5\_\_002

Firmware reload mode: Auto

<Output abbreviated due to space constraints>

2. For EFM mode, use **show controllers ethernet** command for verification.
3. For ATM mode, use **show controllers atm** command for verification.
4. For detailed information on troubleshooting SHDSL connections, refer to [Configuring Cisco G.SHDSL EFM/ATM EHWICs in Cisco Routers](#).
5. For PPP related troubleshooting, refer to [PPP Troubleshooting Flowchart](#).