

CCIE Routing & Switching Lab Guide

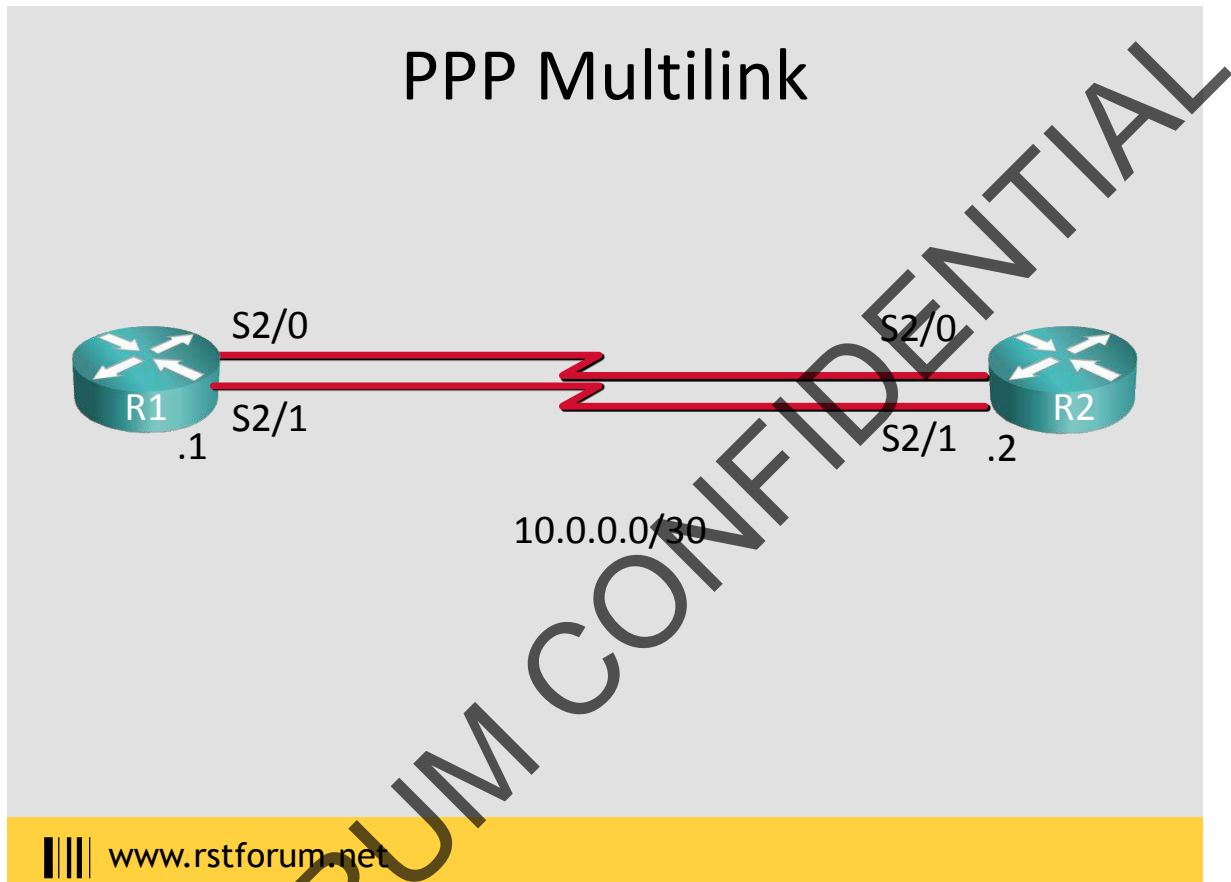
Disclaimer

This CCIE Routing & Switching Lab Guide is designed to assist candidates in the preparation for Cisco Systems' CCIE Routing & Switching Lab exam. While every effort has been made to ensure that all material is as complete and accurate as possible, the enclosed material is presented on an "as is" basis. Neither the authors nor Forum assume any liability or responsibility to any person or entity with respect to loss or damages incurred from the information contained in this workbook. This workbook was developed by Forum. Any similarities between material presented in this workbook and actual CCIE TM lab material or any other material is completely coincidental.



PPP

PPP Multilink Configuration



Configuration:

```
R1:
hostname R1
!
interface Serial2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp multilink  
ppp multilink group 1
```

R2:

```
Hostname R2
```

```
!  
interface Serial2/0  
no ip address  
encapsulation ppp  
ppp multilink  
ppp multilink group 1  
no shut
```

```
!  
interface Serial2/1  
no ip address  
encapsulation ppp  
ppp multilink  
ppp multilink group 1  
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.2 255.255.255.252  
ppp multilink  
ppp multilink group 1
```

Verification:

```
R1# Show ppp multilink  
Multilink1  
Bundle name: R2  
Remote Endpoint Discriminator: [1] R2  
Local Endpoint Discriminator: [1] R1  
Bundle up for 00:01:15, total bandwidth 3088, load 1/255  
Receive buffer limit 24000 bytes, frag timeout 1000 ms  
0/0 fragments/bytes in reassembly list  
0 lost fragments, 0 reordered  
0/0 discarded fragments/bytes, 0 lost received  
0x14 received sequence, 0x1C sent sequence  
Member links: 2 active, 0 inactive (max 255, min not set)  
Se2/0, since 00:01:15  
Se2/1, since 00:01:15  
No inactive multilink interfaces
```

Verification:

R1#Ping 10.0.0.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

Observation:

PPP uses CDPCP network control protocol if CDP is enabled between the two devices

PPP uses IPCP network control protocol if IPv4 address is set on the Multilink

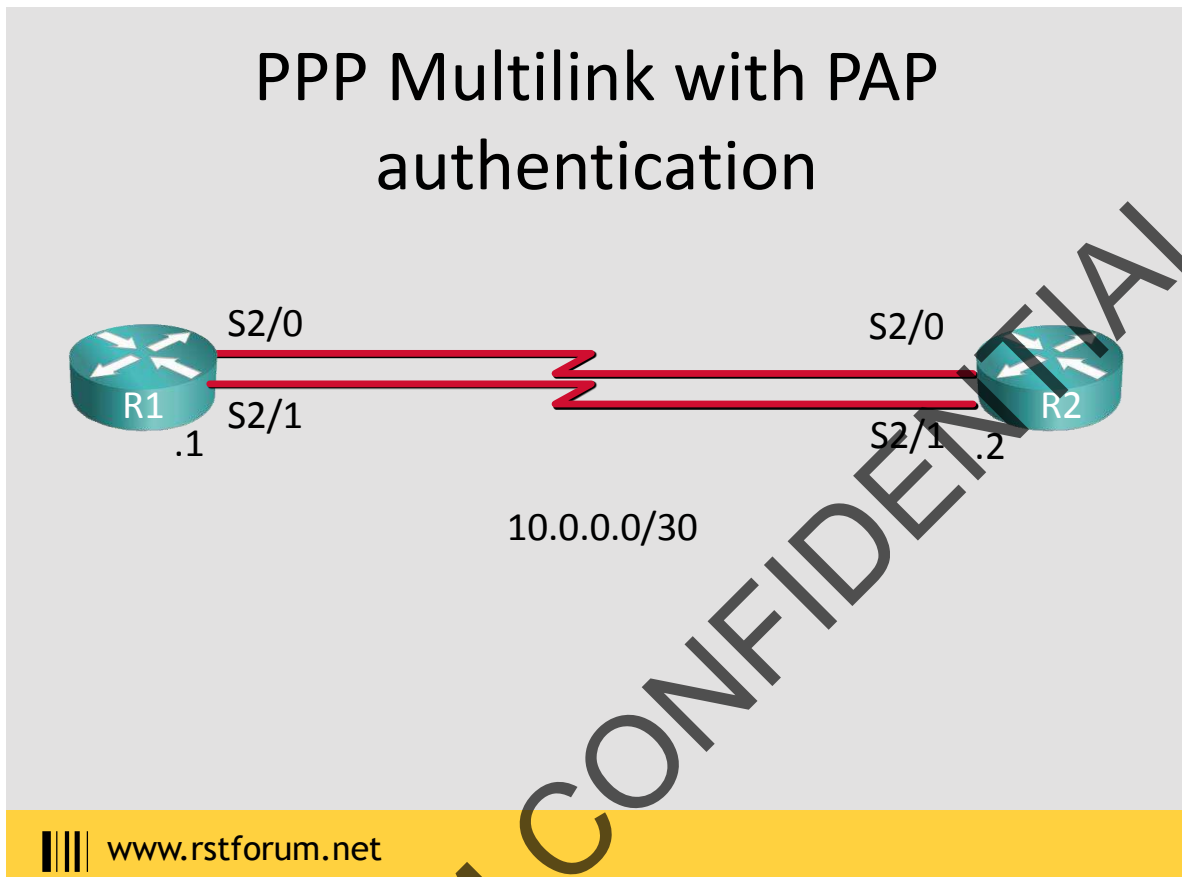
```
*Mar  1 01:13:38.615: Mu1 IPCP: Received AAA AUTHOR Response PASS
*Mar  1 01:13:38.615: Mu1 CDPCP: Received AAA AUTHOR Response PASS
```

```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID      Local Intrfce  Holdtme  Capability  Platform  Port ID
R2             Multilink1    174     R S I      3725     Multilink1
```

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PPP Multilink Configuration with PAP authentication



Configuration:

```
R1:
hostname R1
!
username R2 password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp authentication pap  
ppp pap sent-username R1 password 0 cisco  
ppp multilink  
ppp multilink group 1
```

R2:

```
Hostname R2
```

```
!
```

```
username R1 password cisco
```

```
!
```

```
interface Serial2/0
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Serial2/1
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Multilink1
```

```
ip address 10.0.0.2 255.255.255.252
```

```
ppp pap sent-username R2 password 0 cisco
```

```
ppp multilink
```

```
ppp multilink group 1
```

Verification:

```
R1# Show ppp multilink
```

```
Multilink1
```

```
Bundle name: R2
```

```
Remote Endpoint Discriminator: [1] R2
```

```
Local Endpoint Discriminator: [1] R1
```

```
Bundle up for 00:01:15, total bandwidth 3088, load 1/255
```

```
Receive buffer limit 24000 bytes, frag timeout 1000 ms
```

```
0/0 fragments/bytes in reassembly list
```

```
0 lost fragments. 0 reordered
```

0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

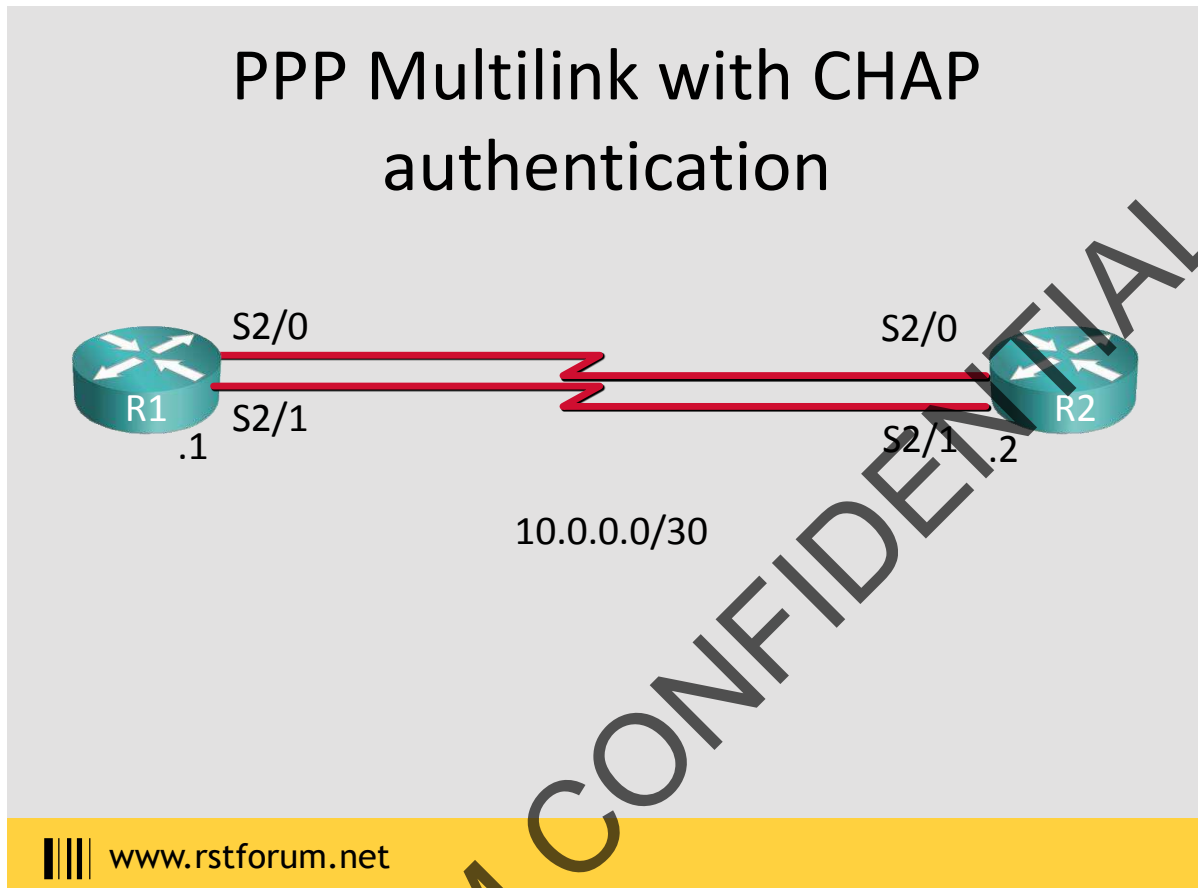
```
*Mar  1 01:13:38.615: Mul1 IPCP: Received AAA AUTHOR Response PASS
*Mar  1 01:13:38.615: Mul1 CDPCP: Received AAA AUTHOR Response PASS
```

```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID      Local Intrfce  Holdtime  Capability  Platform  Port ID
R2             Multilink1    174      R S I       3725      Multilink1
```

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PPP Multilink Configuration with CHAP authentication



Configuration:

```
R1:
hostname R1
!
username R2 password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```



```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp authentication chap  
ppp multilink  
ppp multilink group 1
```

R2:

```
Hostname R2
```

```
!
```

```
username R1 password cisco
```

```
!
```

```
interface Serial2/0
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Serial2/1
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Multilink1
```

```
ip address 10.0.0.2 255.255.255.252
```

```
ppp multilink
```

```
ppp multilink group 1
```

Verification:

```
R1# Show ppp multilink
```

```
Multilink1
```

```
Bundle name: R2
```

```
Remote Endpoint Discriminator: [1] R2
```

```
Local Endpoint Discriminator: [1] R1
```

```
Bundle up for 00:01:15, total bandwidth 3088, load 1/255
```

```
Receive buffer limit 24000 bytes, frag timeout 1000 ms
```

```
0/0 fragments/bytes in reassembly list
```

```
0 lost fragments, 0 reordered
```

```
0/0 discarded fragments/bytes, 0 lost received
```

0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

debug ppp negotiation

debug ppp authentication

```
*Mar  1 01:13:38.615: Mu1 IPCP: Received AAA AUTHOR Response PASS
*Mar  1 01:13:38.615: Mu1 CDPCP: Received AAA AUTHOR Response PASS
```

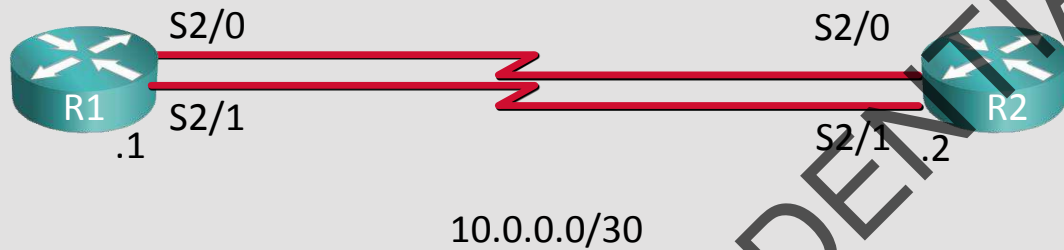
```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H  Host, I - IGMP, r - Repeater

Device ID         Local Interface   Holdtme   Capability Platform  Port ID
R2                Multilink1        174       R S I     3725     Multilink1
```

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PPP Multilink Configuration with CHAP Callin

PPP Multilink with CHAP Callin authentication



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Configuration:

```
R1:
hostname R1
!
username R2 password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp authentication chap callin  
ppp multilink  
ppp multilink group 1
```

R2:

```
hostname R2
```

```
!
```

```
username R1 password cisco
```

```
!
```

```
interface Serial2/0
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Serial2/1
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Multilink1
```

```
ip address 10.0.0.2 255.255.255.252
```

```
ppp chap hostname R2
```

```
ppp chap password 0 cisco
```

```
ppp multilink
```

```
ppp multilink group 1
```

Verification:

```
R1# Show ppp multilink
```

```
Multilink1
```

```
Bundle name: R2
```

```
Remote Endpoint Discriminator: [1] R2
```

```
Local Endpoint Discriminator: [1] R1
```

```
Bundle up for 00:01:15, total bandwidth 3088, load 1/255
```

```
Receive buffer limit 24000 bytes, frag timeout 1000 ms
```

```
0/0 fragments/bytes in reassembly list
```

0 lost fragments, 0 reordered
0/0 discarded fragments/bytes, 0 lost received
0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

debug ppp negotiation

debug ppp authentication

```
*Mar 1 01:13:38.615: Mu1 IPCP: Received AAA AUTHOR Response PASS
*Mar 1 01:13:38.615: Mu1 CDPCP: Received AAA AUTHOR Response PASS
```

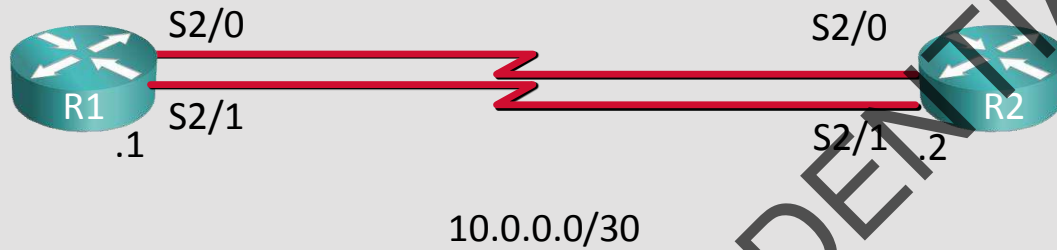
```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID         Local Intrfce   Holdtme    Capability Platform  Port ID
R2                 Multilink1     174        R S I      3725     Multilink1
```

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PPP Multilink Configuration with PAP Callin

PPP Multilink with PAP Callin authentication



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Configuration:

```
R1:
hostname R1
!
username R2 password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp authentication pap callin  
ppp multilink  
ppp multilink group 1  
  
R2:  
hostname R2  
!  
username R1 password cisco  
!  
interface Serial2/0  
no ip address  
encapsulation ppp  
ppp multilink  
ppp multilink group 1  
no shut  
!  
interface Serial2/1  
no ip address  
encapsulation ppp  
ppp multilink  
ppp multilink group 1  
no shut  
!  
interface Multilink1  
ip address 10.0.0.2 255.255.255.252  
ppp pap sent-username R2 password 0 cisco  
ppp multilink  
ppp multilink group 1
```

Verification

```
R1# Show ppp multilink
```

```
Multilink1  
Bundle name: R2  
Remote Endpoint Discriminator: [1] R2  
Local Endpoint Discriminator: [1] R1  
Bundle up for 00:01:15, total bandwidth 3088, load 1/255  
Receive buffer limit 24000 bytes, frag timeout 1000 ms  
0/0 fragments/bytes in reassembly list
```

0 lost fragments, 0 reordered
0/0 discarded fragments/bytes, 0 lost received
0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

debug ppp negotiation

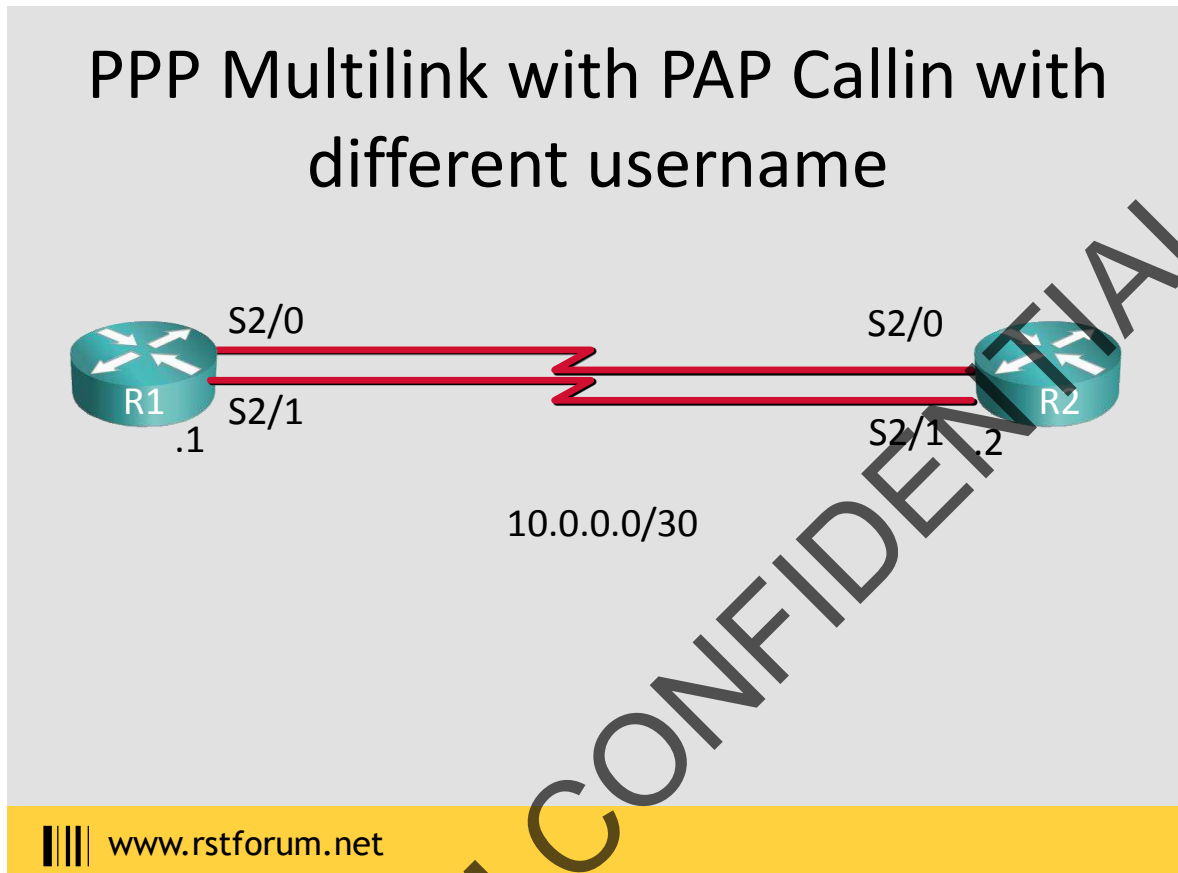
debug ppp authentication

```
*Mar 1 01:13:38.615: Mul1 IPCP: Received AAA AUTHOR Response PASS
*Mar 1 01:13:38.615: Mul1 CDPCP: Received AAA AUTHOR Response PASS
```

```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID         Local Intrfce   Holdtme    Capability Platform  Port ID
R2                 Multilink1     174        R S I      3725     Multilink1
```


PPP Multilink Configuration with PAP Callin with different username



Configuration:

```
R1:
hostname R1
!
username hello password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp authentication pap callin  
ppp multilink  
ppp multilink group 1  
  
R2:  
hostname R2  
!  
username R1 password cisco  
!  
interface Serial2/0  
no ip address  
encapsulation ppp  
ppp multilink  
ppp multilink group 1  
no shut  
!  
interface Serial2/1  
no ip address  
encapsulation ppp  
ppp multilink  
ppp multilink group 1  
no shut  
!  
interface Multilink1  
ip address 10.0.0.2 255.255.255.252  
ppp pap sent-username hello password 0 cisco  
ppp multilink  
ppp multilink group 1
```

Verification

```
R1# Show ppp multilink
```

```
Multilink1  
Bundle name: R2  
Remote Endpoint Discriminator: [1] R2  
Local Endpoint Discriminator: [1] R1  
Bundle up for 00:01:15, total bandwidth 3088, load 1/255  
Receive buffer limit 24000 bytes, frag timeout 1000 ms  
0/0 fragments/bytes in reassembly list
```

0 lost fragments, 0 reordered
0/0 discarded fragments/bytes, 0 lost received
0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

debug ppp negotiation

debug ppp authentication

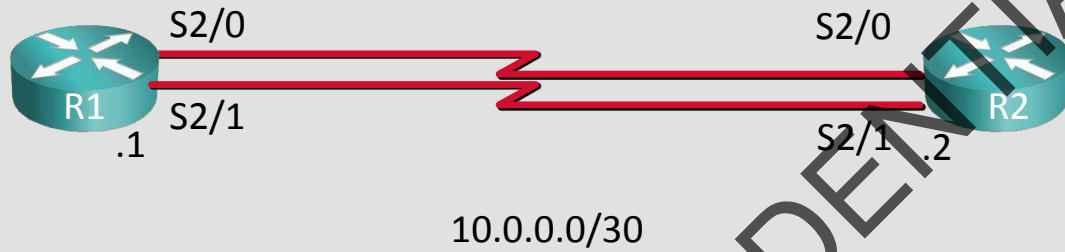
```
*Mar 1 01:13:38.615: Mu1 IPCP: Received AAA AUTHOR Response PASS
*Mar 1 01:13:38.615: Mu1 CDPCP: Received AAA AUTHOR Response PASS
```

```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID         Local Intrfce   Holdtme    Capability Platform  Port ID
R2                 Multilink1     174        R S I      3725     Multilink1
```

PPP Multilink Configuration with CHAP Callin with different username

PPP Multilink with CHAP Callin with different username



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Configuration:

```
R1:
hostname R1
!
username hello password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
ip address 10.0.0.1 255.255.255.252  
ppp authentication chap callin  
ppp multilink  
ppp multilink group 1
```

R2:

```
hostname R2
```

```
!
```

```
username R1 password cisco
```

```
!
```

```
interface Serial2/0
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Serial2/1
```

```
no ip address
```

```
encapsulation ppp
```

```
ppp multilink
```

```
ppp multilink group 1
```

```
no shut
```

```
!
```

```
interface Multilink1
```

```
ip address 10.0.0.2 255.255.255.252
```

```
ppp chap hostname hello
```

```
ppp chap password 0 cisco
```

```
ppp multilink
```

```
ppp multilink group 1
```

Verification:

```
R1# Show ppp multilink
```

```
Multilink1
```

```
Bundle name: R2
```

```
Remote Endpoint Discriminator: [1] R2
```

```
Local Endpoint Discriminator: [1] R1
```

```
Bundle up for 00:01:15, total bandwidth 3088, load 1/255
```

```
Receive buffer limit 24000 bytes, frag timeout 1000 ms
```

```
0/0 fragments/bytes in reassembly list
```

0 lost fragments, 0 reordered
0/0 discarded fragments/bytes, 0 lost received
0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

```
debug ppp negotiation
```

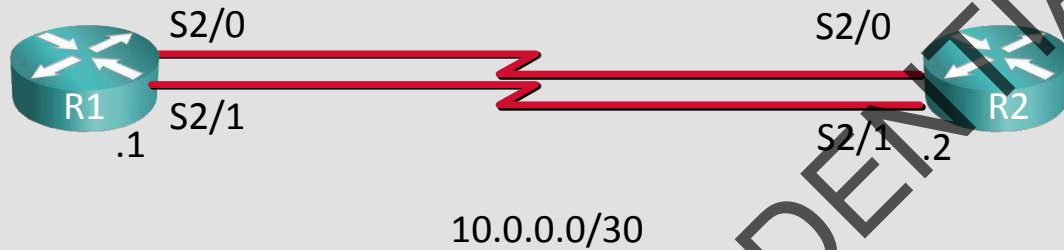
```
debug ppp authentication
```

```
*Mar  1 01:13:38.615: Mu1 IPCP: Received AAA AUTHOR Response PASS  
*Mar  1 01:13:38.615: Mu1 CDPDP: Received AAA AUTHOR Response PASS
```

```
R1#sh cdp nei  
R1#sh cdp neighbors  
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge  
                  S - Switch, H - Host, I - IGMP, r - Repeater  
  
Device ID         Local Intrfce    Holdtme    Capability  Platform  Port ID  
R2                 Multilink1      174        R S I      3725      Multilink1
```

PPP Multilink Configuration with IPv6 using PAP Callin

PPP Multilink with IPv6 using PAP Callin



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Configuration:

```
R1:
hostname R1
!
username R2 password cisco
!
interface Serial 2/0
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
!
interface Serial 2/1
no ip address
encapsulation ppp
ppp multilink
ppp multilink group 1
no shut
```

```
!  
interface Multilink1  
  ipv6 address 2001:1234:ABCD:1::/64 eui-64  
  ipv6 enable  
  ppp authentication pap callin  
  ppp multilink  
  ppp multilink group 1
```

```
R2:  
hostname R2  
!  
username R1 password cisco  
!  
interface Serial2/0  
  no ip address  
  encapsulation ppp  
  ppp multilink  
  ppp multilink group 1  
  no shut  
!  
interface Serial2/1  
  no ip address  
  encapsulation ppp  
  ppp multilink  
  ppp multilink group 1  
  no shut  
!  
interface Multilink1  
  ipv6 address 2001:1234:ABCD:1::/64 eui-64  
  ipv6 enable  
  ppp pap sent-username R2 password 0 cisco  
  ppp multilink  
  ppp multilink group 1
```

Verification:

```
R1# Show ppp multilink
```

```
Multilink1  
  Bundle name: R2  
  Remote Endpoint Discriminator: [1] R2  
  Local Endpoint Discriminator: [1] R1  
  Bundle up for 00:01:15, total bandwidth 3088, load 1/255  
  Receive buffer limit 24000 bytes, frag timeout 1000 ms  
  0/0 fragments/bytes in reassembly list
```


0 lost fragments, 0 reordered
0/0 discarded fragments/bytes, 0 lost received
0x14 received sequence, 0x1C sent sequence
Member links: 2 active, 0 inactive (max 255, min not set)
Se2/0, since 00:01:15
Se2/1, since 00:01:15
No inactive multilink interfaces

Verification:

R1#Ping 10.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/140/152 ms

debug ppp negotiation

debug ppp authentication

```
*Mar  1 01:22:57.459: Mu1 CDPCP: Received AAA AUTHOR Response PASS
*Mar  1 01:22:57.463: Mu1 IPV6CP: Received AAA AUTHOR Response PASS
```

```
R1#sh cdp nei
R1#sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H  - Host, I - IGMP, r - Repeater

Device ID         Local Interface   Holdtme   Capability  Platform  Port ID
R2                 Multilink1        174       R S I       3725      Multilink1
```

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