Lab 13c. Multilink PPP

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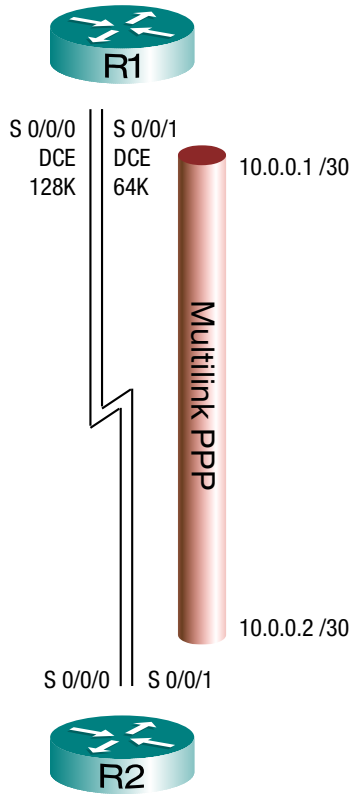
TOPOLOGY & GOAL



Create a multilink PPP connection between R1 and R2, combining the two serial connections shown. You'll need two routers of almost any vintage (I'm using a 2951 and a 2911) with whatever serial cards they support (HWIC-2A/S in my case) and serial crossover cables (or DCE-DTE cable pairs).

Configure bandwidth information on the individual serial lines so MLPPP can calculate the combined bandwidth. Issue "show" commands to verify the multilink interface is "open" and which serial lines are successfully participating.

CONFIGURATION AND VERIFICATION

First, get your boilerplate configurations out of the way—hostname, domain-lookup, and console settings.

Next, create and configure the multilink PPP interface.

Next, get your serial lines up and running at OSI layer 2, at the speeds indicated in the diagram, and with matching bandwidth designations. Now, tell both serial lines to participate in the multilink interface.

Finally, verify the multilink PPP connection and ensure that both serial lines are participating.

WALKTHROUGH

Starting from a fresh, unconfigured state, give your routers their boilerplate configurations.

```
Router> en
Router# conf t
Router(config)# hostname R1
R1(config)# no ip domain-lookup
R1(config)# line console 0
R1(config-line)# exec-timeout 0 0
R1(config-line)# logging synchronous
```

The Multilink Interface

Now, we can create a multilink interface on each of the two routers. It's a virtual interface (no physical jack on the router) but we'll soon tell the "real" serial interfaces to work with it. Once everything is working, these multilink interfaces are what you'll use for everything from IP addresses to routing protocols. You'll be able to ignore the individual serial interfaces once they're participating in the multilink interface.

	R1	R2
1	`R1(config)# interface multilink 42`	`interface Multilink12`
2	`R1(config)# description TO R2`	` description TO R1`
3	`R1(config-if)# ppp multilink`	` ppp multilink`
4	`R1(config-if)# ppp multilink group 42`	` ppp multilink group 12`
5	`R1(config-if)# ip address 10.0.0.1 255.255.255.252`	` ip address 10.0.0.2 255.255.255.252`

IOS will automatically add the "ppp multilink" instruction [Line 3] once you type line 4. I include it in case you encounter a router (or exam simulation) that doesn't automatically add it.

We haven't told the individual serial interfaces to participate in the multilink yet, so it's "inactive."

```
1  R1# show ppp multilink
2  No active bundles
3
4  Multilink42 (inactive)
5    Member links: 0
```

The Individual Serial Interfaces

Now, let's tell the individual serial interfaces to participate in the multilink. We'll do this on both interfaces on both routers (total of 4).

	R1	R2
1	R1(config)# **interface s0/0/0**	interface Serial0/0/0
2	R1(config-if)# **description TO R2 FAST**	description TO R1 FAST
3	R1(config-if)# **encapsulation ppp**	encapsulation ppp
4	R1(config-if)#	ppp multilink
5	R1(config-if)# **ppp multilink group 42**	ppp multilink group 12
6	R1(config-if)# **bandwidth 128**	bandwidth 128
7	R1(config-if)# **clock rate 128000**	no ip address
8	R1(config-if)# **no shutdown**	!
9	R1(config-if)#	!
10	R1(config-if)# **interf s0/0/1**	interface Serial0/0/1
11	R1(config-if)# **description TO R2 SLOW**	description TO R1 SLOW
12	R1(config-if)# **encapsulation ppp**	encapsulation ppp
13	R1(config-if)# **ppp multilink**	ppp multilink
14	R1(config-if)# **ppp multilink group 42**	ppp multilink group 12
15	R1(config-if)# **bandwidth 64**	bandwidth 64
16	R1(config-if)# **clock rate 64000**	no ip address
17	R1(config-if)# **no shutdown**	

As before, the line "ppp multilink" [Lines 4, 13] is optional on real routers because the line "ppp multilink group <number>" makes it obvious. You *do* need "no shutdown" commands [Lines 9, 17] on the individual serial lines, since they start out shutdown, prior to configuration. The multilink, like all virtual interfaces, defaults to "up," but you can shut it down if you want.

Verification

```
1  R1# show ppp multilink
2
3  Multilink42
4    Bundle name: R2
5    Remote Endpoint Discriminator: [1] R2
6    Local Endpoint Discriminator: [1] R1
7    Bundle up for 00:07:48, total bandwidth 192, load 1/255
8    Receive buffer limit 24000 bytes, frag timeout 1000 ms
9      0/0 fragments/bytes in reassembly list
10     0 lost fragments, 8 reordered
11     0/0 discarded fragments/bytes, 0 lost received
12     0x1C received sequence, 0x1C sent sequence
13   Member links: 2 active, 0 inactive (max 255, min not set)
14     Se0/0/0, since 00:07:48, 480 weight, 472 frag size
15     Se0/0/1, since 00:07:48, 240 weight, 232 frag size
16 No inactive multilink interfaces
```

The individual serial lines are listed [Lines 13-15].

If we shut down s0/0/0, we would see

```
                    <stuff omitted>
  Member links: 1 active, 1 inactive (max 255, min not set)
    Se0/0/1, since 01:14:51
    Se0/0/0 (inactive)
```

We would also see the bandwidth of the multilink automatically adjust, since it's calculated from the individual bandwidth statements we entered on the serial lines. (It's back on for what follows.)

```
1  R1# show interfaces multilink 42
2  Multilink42 is up, line protocol is up
3    Hardware is multilink group interface
4    Description: TO R2
5    Internet address is 10.0.0.1/30
6    MTU 1500 bytes, BW 192 Kbit/sec, DLY 20000 usec,
7       reliability 255/255, txload 1/255, rxload 1/255
8    Encapsulation PPP, LCP Open, multilink Open
9    Open: IPCP, CDPCP, loopback not set
10   Keepalive set (10 sec)
11   DTR is pulsed for 2 seconds on reset
12   Last input 00:00:07, output never, output hang never
13   Last clearing of "show interface" counters 01:55:24
14   Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
15   Queueing strategy: fifo
16   Output queue: 0/40 (size/max)
17   5 minute input rate 0 bits/sec, 0 packets/sec
18   5 minute output rate 0 bits/sec, 0 packets/sec
19      40 packets input, 10916 bytes, 0 no buffer
20      Received 0 broadcasts (0 IP multicasts)
21      0 runts, 0 giants, 0 throttles
22      0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
23      39 packets output, 10848 bytes, 0 underruns
24      0 output errors, 0 collisions, 2 interface resets
25      0 unknown protocol drops
26      0 output buffer failures, 0 output buffers swapped out
27      0 carrier transitions
```

The "show interfaces" command treats the multilink like any other interface running PPP, complete with the NCPs (Network Control Protocols) that are running on it [Line 9]. The NCPs don't run on the individual serial lines. "Multilink" [Line 8] is simply another protocol added to LCP and PPP. Once again, the bandwidth [Line 6] is the calculated sum of the serial line bandwidths.

CONFIGURATION RECAP

R1	R2
interface Multilink42 ip address 10.0.0.1 255.255.255.252 ppp multilink group 42 ! interface Serial0/0/0 bandwidth 128 encapsulation ppp ppp multilink group 42 clock rate 128000 ! interface Serial0/0/1 bandwidth 64 encapsulation ppp ppp multilink group 42 clock rate 64000	interface Multilink12 ip address 10.0.0.2 255.255.255.252 ppp multilink group 12 ! interface Serial0/0/0 bandwidth 128 encapsulation ppp ppp multilink group 12 ! interface Serial0/0/1 bandwidth 64 encapsulation ppp ppp multilink group 12

Multilink interface numbers and multilink group numbers all need to match within a router, but not on different routers.