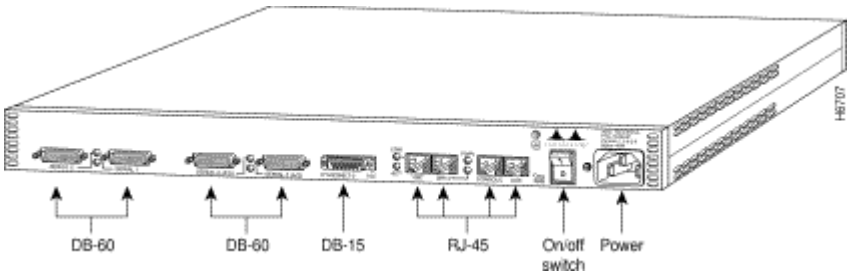
RESOURCE GUIDE FOR BUILDING A CCIE LAB

This document has been prepared in an effort to provide answers to the most frequently asked questions about setting up a lab. These recommendations are not set in stone. These are just some guidelines to point candidates in the right direction. You'll need a minimum of three routers but no more than 6. A minimal CCIE lab can be built with three 2500 series routers. The following router models can be used and provide 85% of the interface types needed for various lab scenarios.

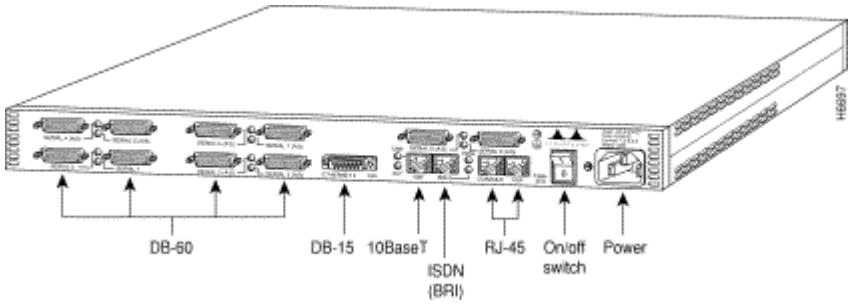
3 ROUTER LABS

LAB OPTION 1

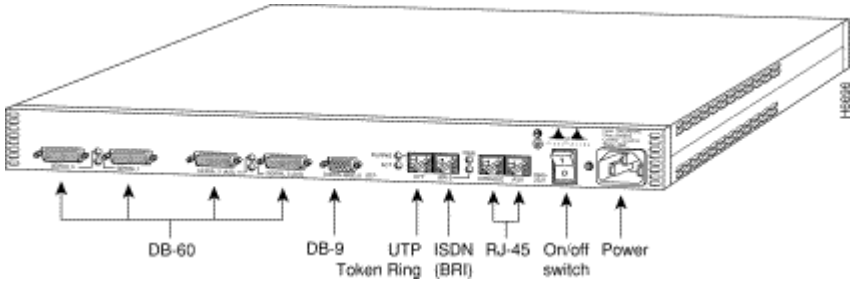
- A Cisco 2520 (Ethernet, 2 Synchronous Serial, 2 Asynchronous Serial and 1 ISDN BRI S/T)



or 2522 (Ethernet, 2 Synchronous Serial, 8 Asynchronous Serial and 1 BRI S/T)

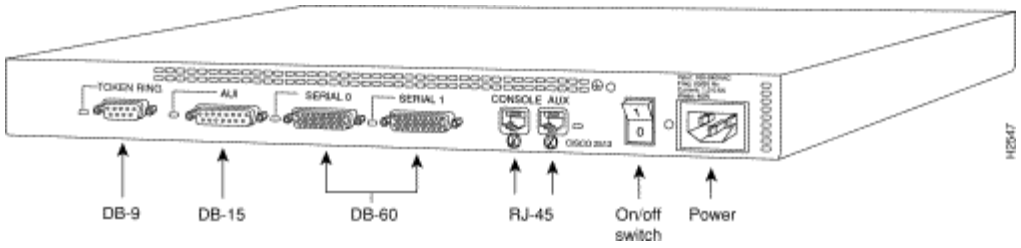


- A Cisco 2521 (Token ring, 2 Synchronous Serial, 2 Asynchronous Serial and 1 ISDN BRI S/T)



or 2523 (Token ring, 2 Synchronous Serial, 8 Asynchronous Serial and 1 ISDN BRI S/T)

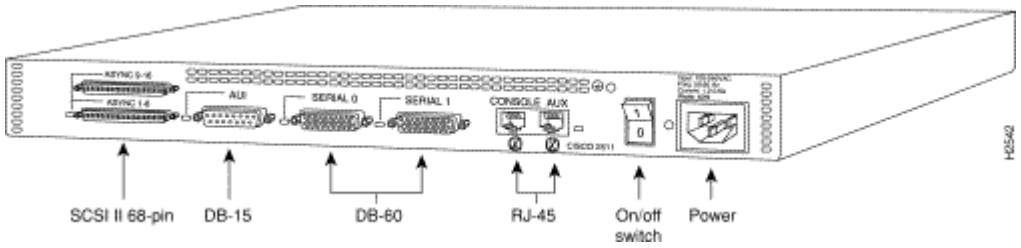
- A Cisco 2513 (1 Ethernet, 1 Token ring, and 2 Synchronous Serial)



LAB OPTION 2

- A Cisco 2520 (Ethernet, 2 Synchronous Serial, 2 Asynchronous Serial and 1 ISDNBRI S/T)
  or 2522 (Ethernet, 2 Synchronous Serial, 8 Asynchronous Serial and 1 ISDN BRI S/T)

- A Cisco 2509 (1 Ethernet, 2 Synchronous Serial, 1 SCSI for 1 octal cable 8 Asynchronous Serial)
  Or a Cisco 2511 (1 Ethernet, 2 Synchronous Serial, 2 SCSI for 2 octal cables 16 Asynchronous Serial)



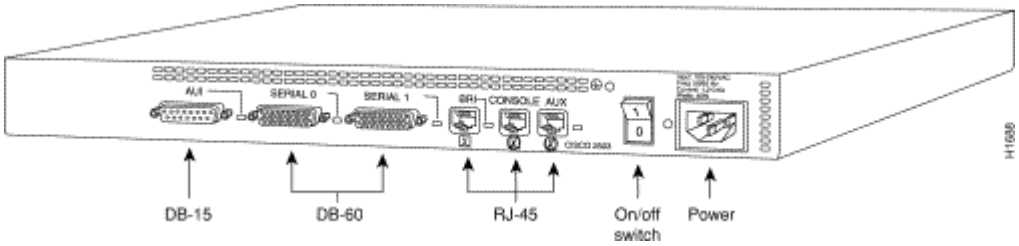
- A Cisco 2504 (1 Token ring, 2 Synchronous Serial, 1 ISDN BRI S/T)

LAB OPTION 3

- A Cisco 2521 (Token ring, 2 Synchronous Serial, 2 Asynchronous Serial and 1 ISDN BRI S/T)
  or 2523 (Token ring, 2 Synchronous Serial, 8 Asynchronous Serial and 1 ISDN BRI S/T)

- A Cisco 2509 (1 Ethernet, 2 Synchronous Serial, 1 SCSI for 1 octal cable 8 Asynchronous Serial)
  Or a Cisco 2511 (1 Ethernet, 2 Synchronous Serial, 2 SCSI for 2 octal cables 16 Asynchronous Serial)

- A Cisco 2503 (1 Ethernet, 2 Synchronous Serial, 1 ISDN BRI S/T)



While the three router lab options can keep the amount of equipment needed to a minimum. The reality is that the 2520's and 2521's (especially the 2521's) can be hard to find pre-owned.

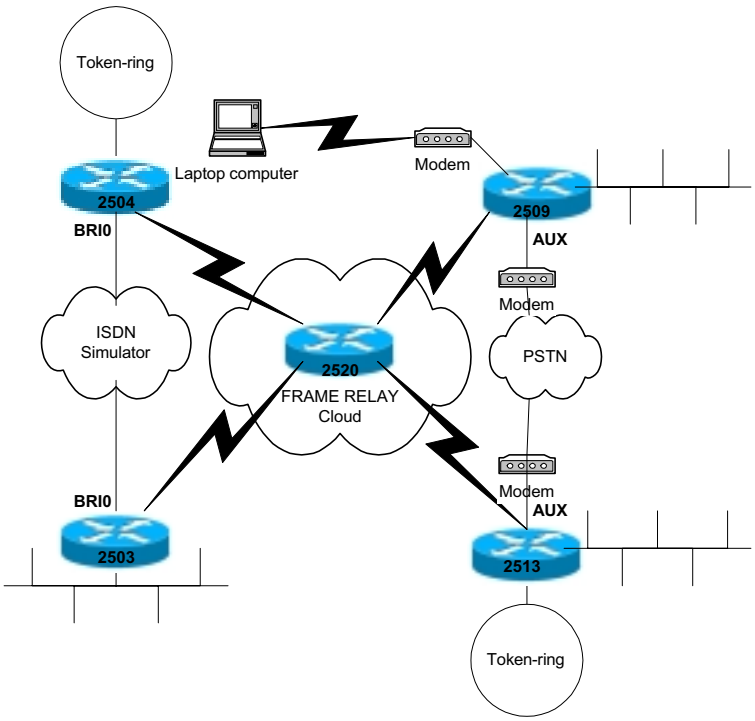
FOUR ROUTER LAB

A forth router can be added to the previous three router labs to give you the equipment needed to do full mesh or multi-point frame relay, or X.25 scenarios. For lab option 1 you can add an access server for

reverse telnet such as a 2509 or 2511. For lab option 2 and 3 you can add a 2513 to give you another token ring interface for Remote Source Route Bridging and Ethernet for Source Route Transnational Bridging.

FIVE ROUTER LAB

The five router lab could consist of a 2504 and 2503 combined with an ISDN simulator for ISDN scenarios. A 2513 for RSRB and SR/TLB with 2504. A 2520 for a frame relay/X.25 switch. A 2509 for reverse telnet, Dial up, and Dial On Demand with both AUX ports and or the async lines on the 2520.



Other equipment:
ISDN Demonstrator (available from TELTONE) $1600.00
2 External NT1 adapters (available from Adtran) http://www.adtran.com/cpe
(needed to plug an ISDN S/T interface into the U interface on the ISDN Demonstrator)
6 CAB-V35MT and 6 CAB-V35FC or 6 CAB-H60MTC (available from Network Hardware Resale)
2 RS232 DTE cables (needed for 2520 series to connect to a modem for Dial on Demand or dial up)
CAB-232MT= (part number 72-0793-01)
2 modems
3 Cisco rollover cable (console cable)
3 MMOD AS2500 adapters
2 phone lines or an Analog Line Simulator (available from TELTONE) $500.00
2 Token Ring MAUs
3 Ethernet hubs and transceivers

SIX ROUTER LAB

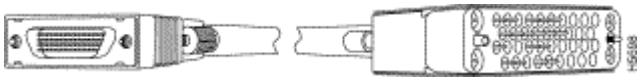
At this point you could add any other router to the lab setup above such as a 2501 to give you six routers for more complex scenarios like Route Redistribution, OSPF, External BGP and Internal BGP, etc.

CONNECTING SERIAL PORTS BACK TO BACK

The Cisco 2500 series routers have 2 serial ports. These can be connected in one of two ways. You can take a Male V.35 DTE cable from Cisco and plug it into a Female V.35 DCE cable, or use a single V.35 DTE/DCE crossover cable. This is a custom made cable that can be purchased from third party companies list in the appendix

CABLES FOR 2500's

CAB-V35MT=

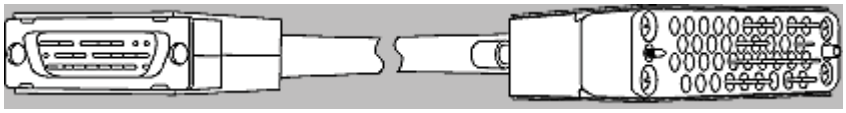


CAB-V35FC=

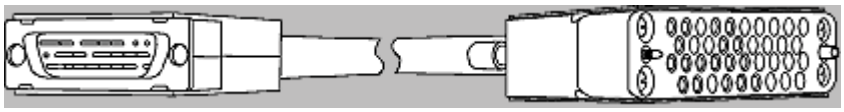
Single V35 DTE/DCE Cross-Over Cable CAB-H60MTC (available from Network Hardware Resale)

CABLES FOR AGS+

CAB-VMT= DTE



CAB-VFC= DCE



CONNECTING AUX PORTS BACK TO BACK

A Null modem cable is needed or 1 Cisco rollover cable

```
Router 1
version 11.3
!
service udp-small-servers
service tcp-small-servers
!
hostname Router1
!
enable secret cisco
!
no ip domain-lookup
!
interface Ethernet0
 ip address 172.16.1.1 255.255.0.0
!
interface Async1
 ip address 192.168.10.1 255.255.255.0
 encapsulation ppp
 async dynamic routing
 async mode dedicated
 dialer-group 1
 no cdp enable
!
ip route 0.0.0.0 0.0.0.0 Async1
```

```
!
dialer-list 1 protocol ip permit
!
line con 0
 exec-timeout 0 0
line aux 0
 modem InOut
 transport input all
 rxspeed 38400
 txspeed 38400
 flowcontrol hardware
line vty 0 4
 exec-timeout 0 0
 password cisco
 login
!
end
```

```
ROUTER 2
!
version 11.3
service udp-small-servers
service tcp-small-servers
!
hostname Router2
!
enable secret cisco
!
no ip domain-lookup
!
interface Ethernet0
 ip address 10.0.3.4 255.255.255.0
!
interface Async1
 ip address 198.162.10.2 255.255.255.0
 encapsulation ppp
 async dynamic routing
 async mode dedicated
 no cdp enable
!
ip route 0.0.0.0 0.0.0.0 async1
!
snmp-server community public RO
dialer-list 1 protocol ip permit
!
line con 0
 exec-timeout 0 0
line aux 0
 modem InOut
 transport input all
 rxspeed 38400
 txspeed 38400
 flowcontrol hardware
line vty 0 4
 exec-timeout 0 0
 password cisco
 login
!
end
```

FRAME RELAY/X.25 SWITCH

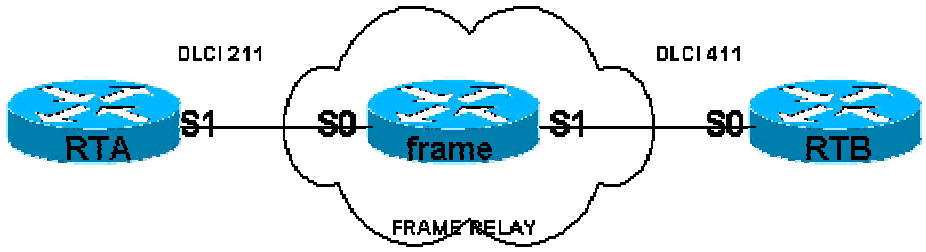
The following routers can be configured as a frame relay or X.25 switch. Cisco 2520, 2521, 2522, or 2523 The modular 4000 or 4000 M with 4 port serial module. As well as an AGS+

A note about the AGS+

Lots of AGS+ ‘s can be found at www.ebay.com. Be aware, that the AGS+ chassis was not designed to make it easy to upgrade. You need a CSC/4 processor to run IOS 11.0. Serial cables are not the same as a

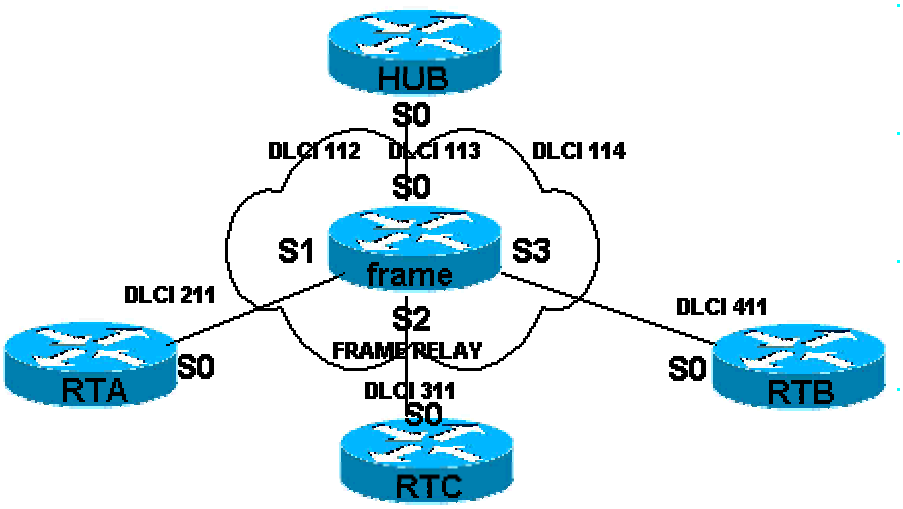
2500 or 4000 and may be hard to find. They are noisy, heavy, and may require more power requirements than expected. A 2520 or 2522 will serve perfectly as a frame-relay switch.

SETTING UP A 2501 AS FRAME RELAY SWITCH




```
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname frame
!
!
frame-relay switching
!
interface Ethernet0
 no ip address
 shutdown
!
interface Serial0
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 211 interface Serial1 411
!
interface Serial1
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 411 interface Serial0 211
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

SETTING UP A 2520 AS A FRAME RELAY SWITCH

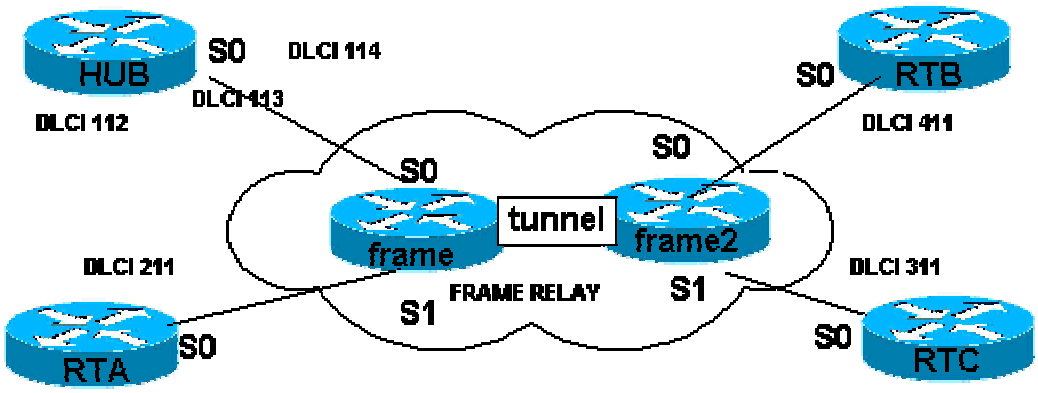



```
Cisco 2520
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname frame-switch
!
!
frame-relay switching
!
interface Ethernet0
 no ip address
 shutdown
!
interface Serial0
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 112 interface Serial1 211
 frame-relay route 113 interface Serial2 311
 frame-relay route 114 interface Serial3 411
!
interface Serial1
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 211 interface Serial0 112
!
interface Serial2
 no ip address
 encapsulation frame-relay
 clockrate 64000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 311 interface Serial0 113
!
interface Serial3
 no ip address
 encapsulation frame-relay
 clockrate 64000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 411 interface Serial0 114
```

```
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

SETTING UP 2 2501's AS A FRAME RELAY SWITCH

Some may not have the luxury of having a 2520 or a single router with more than 2 serial interfaces to be able to do full mesh frame relay scenarios. You can combine two combine 2 2501's to act as a single frame relay switch to give you 4 serial port to use for frame relay simulations using a tunnel interface

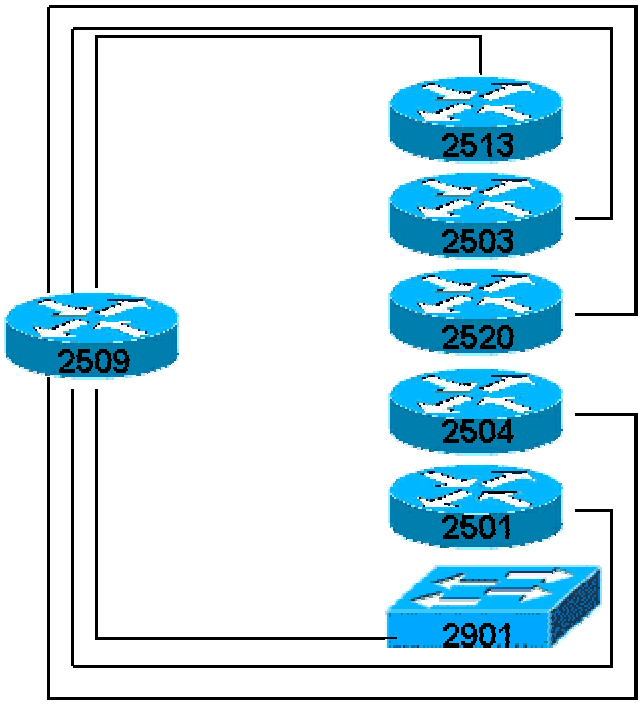



```
Cisco 2501 # 1
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname frame
!
!
frame-relay switching
!
interface Tunnel0
 no ip address
 tunnel source Ethernet0
 tunnel destination 192.168.1.1
!
interface Ethernet0
 ip address 192.168.1.2 255.255.255.0
!
interface Serial0
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 112 interface Serial1 211
 frame-relay route 113 interface Tunnel0 311
 frame-relay route 114 interface Tunnel0 411
!
interface Serial1
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
```

```
 frame-relay intf-type dce
 frame-relay route 211 interface Serial0 112
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
 login
!
end


Cisco 2501 # 2
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname frame2
!
!
frame-relay switching
!
interface Tunnel0
 no ip address
 tunnel source Ethernet0
 tunnel destination 192.168.1.2
!
interface Ethernet0
 ip address 192.168.1.1 255.255.255.0
!
interface Serial0
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 311 interface Tunnel0 113
!
interface Serial1
 no ip address
 encapsulation frame-relay
 clockrate 1000000
 frame-relay lmi-type ansi
 frame-relay intf-type dce
 frame-relay route 411 interface Tunnel0 114
!
no ip classless
!
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

SETTING UP ACCESS SERVER FOR REVERSE TELNET




```
version 11.3
!
service udp-small-servers
service tcp-small-servers
!
hostname R2509
!
enable secret cisco
!
no ip domain-lookup
!
ip host r2513 2001 10.1.1.1
ip host r2503 2002 10.1.1.1
ip host r2520 2003 10.1.1.1
ip host r2504 2004 10.1.1.1
ip host r2501 2005 10.1.1.1
ip host Cat2901 2006 10.1.1.1
!
interface Loopback0
ip address 10.1.1.1 255.255.255.255
!
ip classless
!
line con 0
!
line 1 8
 transport input all
 no exec
line aux 0
line vty 0 4
 login
!
end
```

SETTING UP BACK TO BACK CSU/DSU

This is for those working with the modular routers with the WIC-DSU-T1 cards installed.

The original document is now available at the Cisco web site. It was originally available only to internal Cisco SE's

http://www.cisco.com/warp/public/471/75.html#command

You can connect 2 WIC1-T1-DSU Back to Back by using a Cross-Over cable between the CSU/DSUs. Back-to-back configuration of the 4-wire CSU/DSU has the following restrictions:

You cannot use a clock rate of auto on either side of the back-to-back setup.
You cannot use a clock rate of 64.
You cannot use switched-56 operation.

Constructing a Cross-Over Cable

A 4 wire T-1 cross-over cable uses (1->4, 2->5, 4->1, 5->2)
A 4 wire 56k cross-over cable uses (1->7, 2->8, 7->1, 8->1)

T1 CSU/DSU Configuration

Set one CSU/DSU to clock source internal, and the other CSU/DSU to clock source line. The linecode, framing, data-coding, and timeslots must be set the same on both CSU/DSUs.

Four-Wire 56k CSU/DSU Configuration

Set one CSU/DSU to clock source internal, and the other CSU/DSU to clock source line. On the CSU/DSU with internal clock, the clock rate must not be auto. Both CSU/DSUs must be set for service-module 56k network-type dds.

SETTING UP DIAL ON DEMAND ROUTING USING AUX PORTS


```
RTA
version 11.3
!
service udp-small-servers
service tcp-small-servers
!
hostname RTA
!
enable secret cisco
!
no ip domain-lookup
!
username RTB password cisco
chat-scritpt ddr-test "" "ATDT\T" TIMEOUT 30 CONNECT \C
!
interface Ethernet0
 ip address 172.16.2.1 255.255.0.0
```

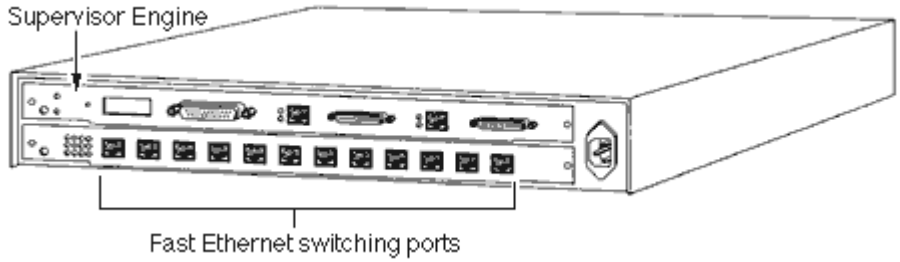
```
!
interface Async1
 ip unnunmbered Ethernet 0
 encapsulation ppp
 async mode interactive
 no peer default ip address pool
 dialer-group 1
 dialer idle-timeout 120
 pulse-time 3
 dialer in-band
 dialer hold-queue 20
 dialer map ip 172.16.1.1 modem-script ddr-test name RTB broadcast 5555555
 no cdp enable
 ppp authentication chap
!
ip classless
ip route 172.16.1.0 255.255.255.0 172.16.1.1
ip route 172.16.1.1 255.255.255.255 Async 1
!
dialer-list 1 protocol ip permit
!
line con 0
 exec-timeout 0 0
line aux 0
 modem InOut
 modem autoconfigure discovery
 autoselect ppp
 rxspeed 38400
 txspeed 38400
 flowcontrol hardware
line vty 0 4
 exec-timeout 0 0
 password bar
 login
!
end

RTB
 version 11.3
 !
 service udp-small-servers
 service tcp-small-servers
 !
 hostname RTB
 !
 enable secret cisco
 !
 no ip domain-lookup
 !
 username RTA password cisco
 chat-scritpt ddr-test “” “ATDT\T” TIMEOUT 30 CONNECT \C
 !
 interface Ethernet0
  ip address 172.16.1.1 255.255.0.0
!
 interface Async1
  ip unnunmbered Ethernet 0
  encapsulation ppp
  async mode interactive
  no peer default ip address pool
  dialer-group 1
  dialer idle-timeout 120
  pulse-time 3
  dialer in-band
  dialer hold-queue 20
  dialer map ip 172.16.2.1 modem-script ddr-test name RTB broadcast 5556666
  no cdp enable
  ppp authentication chap
 !
 ip classless
 ip route 172.16.2.0 255.255.255.0 172.16.2.1
```

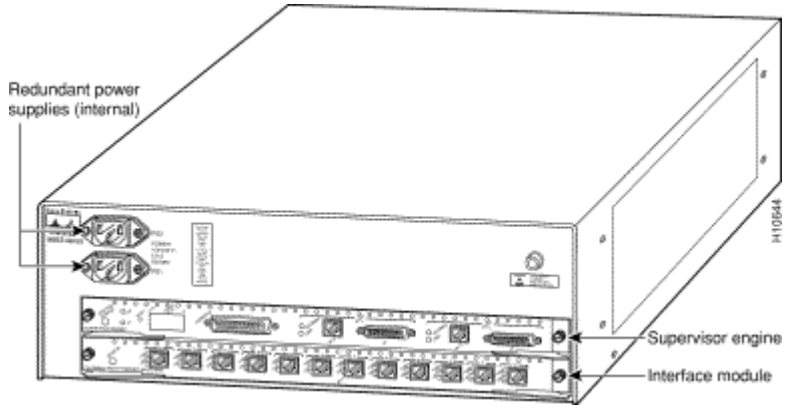
```
ip route 172.16.2.1 255.255.255.255 Async 1
!
dialer-list 1 protocol ip permit
!
line con 0
 exec-timeout 0 0
line aux 0
 modem InOut
 modem autoconfigure discovery
 autoselect ppp
 rxspeed 38400
 txspeed 38400
 flowcontrol hardware
line vty 0 4
 exec-timeout 0 0
 password bar
 login
!
end
```

CATALYST SWITCHES

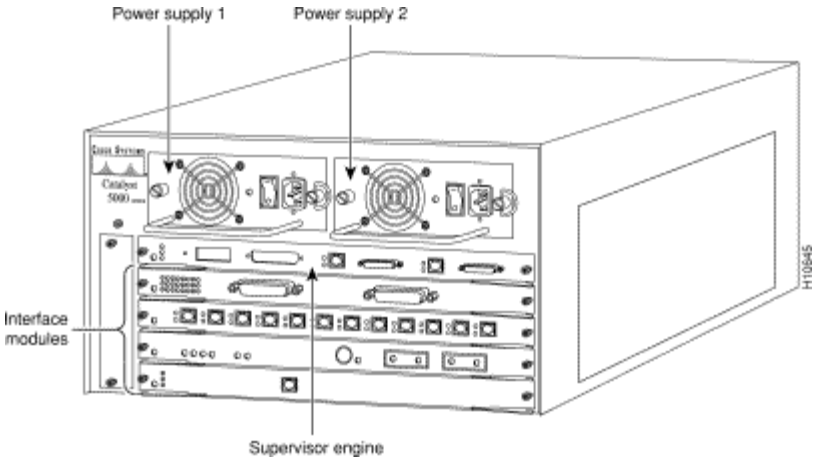
Adding a Catalyst can be very costly for a home lab. The 2900's (Not to be confused with the 2900 XL series) can run between $2500-$5000 used depending on the company you get it from and there availability. The least expensive would be a 2901 shown below.



A Catalyst 5002 is next model up



A Catalyst 5000 chassis with 1 AC power supply and a Supervisor Engine will run somewhere in the neighborhood of $3500 plus $2000 for a 12 port 10/100 Ethernet module for it depending on the company and there availability.



An option for learning about the Catalyst switches would be to attend the Cisco LAN Switch Configuration Class available from any of the Cisco Training partners. This 5-day course takes you through configuring the Catalyst 5000 series and other Catalyst products. You'll also have the opportunity in the hands-on lab to configure FDDI, the Route Switch Module, and ATM LANE. Which would not be possible if you were to by 2900. You may want to contact some of the practice labs in the appendix to get some experience on the Catalyst 5000 and ATM

Q. Do I need to have a router with a 100 megabit interface to do VLAN routing?

A. Yes, and no. If you plan to do intra VLAN routing using the ISL encapsulation or using a trunk, then the answer is yes. If you just want to route between two VLANS on the same switch then you just need a router with two Ethernet interfaces.

In short, you need a router with the same number of physical interface as the number of VLAN you plan to implement on a single switch (4 VLANS = 4 Ethernet interfaces) or you have a router with one fast Ethernet and use ISL trunking.

The following models support ISL trunking:

- Cisco 2620
- Cisco 2621
- Cisco 3620 (requires FastEthenet module)
- Cisco 3640 (requires FastEthenet module)
- Cisco 4500 (requires FastEthenet module)
- Cisco 4700 (requires FastEthenet module)

Note: The 4000 and 4000-M do **NOT** support Fastethernet or ISL

The new 2620 chassis (1 10/100 ethernet 2 WIC slots 1 Network Module Slot) will most likely be the most cost effective for VLAN ISL routing unless you already have a 3600 or 4500 with 100 megabit interface.

APPENDIX

RECOMMENDED READING

CCIEPREP.COM Study Guide Volume one by Louis D Rossi, Louis R Rossi and Thomas Rossi
ISBN# 1-890911-08-9

McGraw Hill (CISCO TECHNICAL EXPERT SERIES)

Cisco TCP/IP reference Second Edition by Chris Lewis
ISBN# 0-07-041130-1

Advanced IP Routing in Cisco Networks by Terry Slattery and Bill Burton
ISBN# 0-07-0058144-4

Cisco OSPF DESIGN Guide by William Parkhurst
ISBN# 0-07-048626-3

Configuring Cisco Routers for ISDN by Paul Fischer
ISBN# 0-07-022073-5

Prentice Hall PTR

Cisco Certification, Bridges, Routers, and Switches for CCIEs by Andrew Bruce Caslow
ISBN# 0-13-082537-9

Cisco Press

IP Routing Primer by Robert Wright
ISBN# 1-57870-108-2

Cisco Router Configuration by Allan Leinwand, Bruce Pinsky, and Mark Culpepper
ISBN# 1-57870-022-1

Introduction to Cisco Router Configuration by Laura Chappell
ISBN: 1-57870-076-0

Advanced Cisco Router Configuration by Laura Chappell
ISBN: 1-57870-074-4

CCIE Professional Development: Routing TCP/IP volume one by Jeff Doyle
ISBN# 1-57870-041-8

Internet Routing Architectures by Bassam Halabi
ISBN# 1-56205-652-2

ISDN DEMONSTRATOR
Teltone Corporation
22121-20th Avenue SE
Bothell, WA 98021-4408
http://www.teltone.com/
1-800-426-3926 (U.S. and Canada only)

PLACES TO PURCHASE USED EQUIPMENT

Network Hardware Resale INC.
6445 Calle Real Suite
Santa Barbra, CA
http://www.networkhardware.com

Talk to Glen Fasset (888) 277-4025

Try InterLink at 800-832-6539.
http://www.interlinkcom.com/

Millennium Solutions Group, Inc
916-797-9998

National LAN Exchange
801-377-0074

MSI Communications INC.
973-347-3349

CISCO MEMORY

Comstar INC.
5250 West 74th Street
Minneapolis, MN 55439

http://www.comstarinc.com

CISCO CABLES

LoDan West, Inc.
1050 Commercial Street
San Carlos, CA 94070
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http://www.cs.umn.edu/labs/CCIE

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http://ccie.engr.iupui.edu/

University of Colorado
Boulder, Colorado, USA
http://itp.colorado.edu/~itplab/ccie.html

Wichita State University
Wichita, Kansas, USA
http://www.engr.twsu.edu/cisco

University of California Extension, Santa Cruz
Santa Clara, California, USA
http://www.ucsc-extension.edu/internetworking/

http://www.cciebootcamp.com

http://www.virtualrack.com

http://www.mentorlabs.com