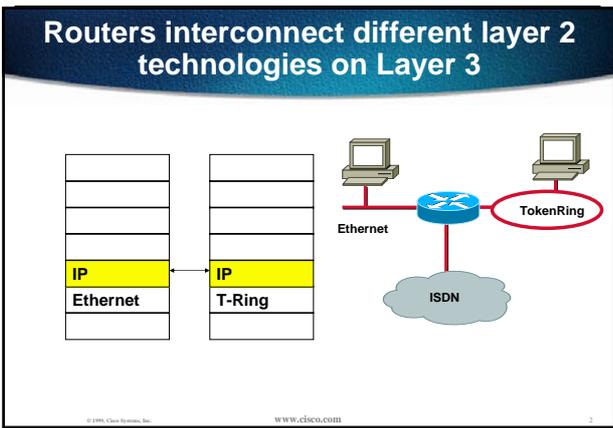
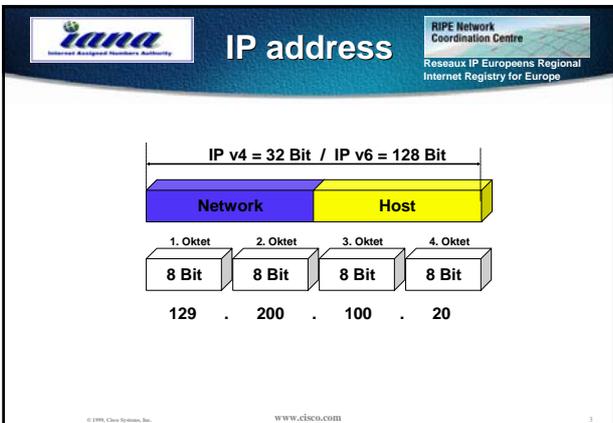


HomeRun Training

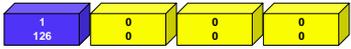
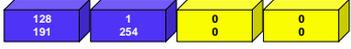






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Networking ranges

Class	Address range	Subnet mask
A		255.0.0.0
B		255.255.0.0
C		255.255.255.0
D	224.0.0.0 to 239.255.255.254	

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Network and Hosts per Class

Class	Network	Hosts
A		
B		
C		

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Private range address

The RFC 1918 definition private range address

Class A = **10.0.0.0**
(1 Class A Network)

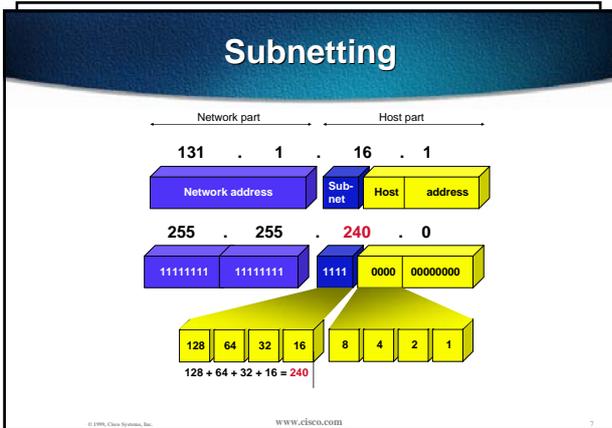
Class B = **172.16.0.0 - 172.32.0.0**
(16 Class B Networks)

Class C = **192.168.0.0 - 192.168.255.0**
(256 Class C Networks)

 **All these addresses will be dropping in the Internet** 

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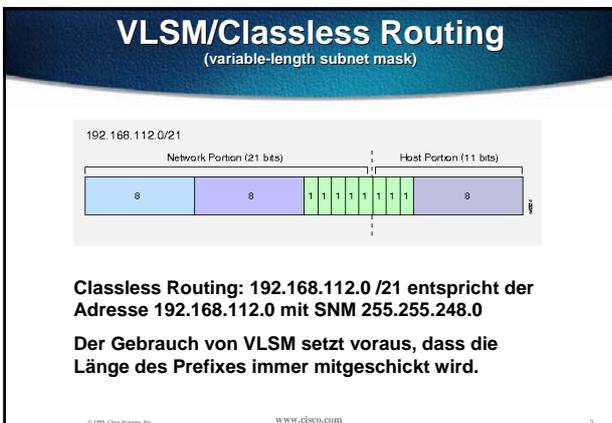
HomeRun Training



Subnetting

Class B				Class C			
# bits	Mask	Effective Subnets	Effective Hosts	# bits	Mask	Effective Subnets	Effective Hosts
2	255.255.192.0	2	16382	2	255.255.255.192	2	62
3	255.255.224.0	6	8190	3	255.255.255.224	6	30
4	255.255.240.0	14	4094	4	255.255.255.240	14	14
5	255.255.248.0	30	2046	5	255.255.255.248	30	6
6	255.255.252.0	62	1022	6	255.255.255.252	62	2
7	255.255.254.0	126	510				
8	255.255.255.0	254	254				
9	255.255.255.128	510	126				
10	255.255.255.192	1022	62				
11	255.255.255.224	2046	30				
12	255.255.255.240	4094	14				
13	255.255.255.248	8190	6				
14	255.255.255.252	16382	2				

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HomeRun Training



Routed versus Routing Protocol

Routed Protocol use between routers to direct user traffic	Examples •TCP/IP •IPX •etc.
Routing Protocol use only between routers to maintain tables	Examples •RIP •IGRP •E-IGRP •OSPF •BGP •IPX-RIP

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Different Routing Protocols use different metrics to calculate the Routing Table

- Reliability
- Delay
- Bandwidth
- Load
- Cost
- Hops

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Routing Types

- **Static routing**
 - **Manually** defined by the system administrator as the only path to the destination
- **Default routing**
 - **Manually** defined by the system administrator as the path to take when no route to destination is known
- **Dynamic routing**
 - Router learns of paths to destinations by receiving periodic updates from other routers

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Routing Protocols Overview

Protocol	Metric	Algorithm IG/EG	Usage
RIP Routing Information Protocol	Hops	DistanceVector Interior Gateway	Smaller Networks (15hops limit) LAN
IGRP Interior Gateway Routing Protocol	Bandbreite Reliability Load...	DistanceVector Interior Gateway	Large Networks
OSPF Open Shortest Path First	Combination	LinkState Interior Gateway	Large Networks within AS
E-IGRP Enhanced Interior Gateway Routing Protocol	Combination	LinkState/DV Interior Gateway	Large Networks within AS
BGP Border Gateway Protocol	AS System Count State of Link Delay, Cost ...	Exterioir Gateway	Very Large, Internet Nachfolger von EGP

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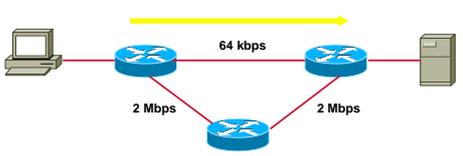
Routing Protocol RIP

- Uses hop count as the only metric
- little to configure
- periodical updates every 30 seconds
- no VLSM Support

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Which route would RIP choose?



The diagram shows a network topology with three routers. A laptop is connected to the leftmost router, and a server is connected to the rightmost router. The top two routers are connected to each other with a link speed of 64 kbps. Both the leftmost and rightmost routers are connected to the bottom router with link speeds of 2 Mbps. A yellow arrow points from the laptop to the server, indicating the path of traffic.

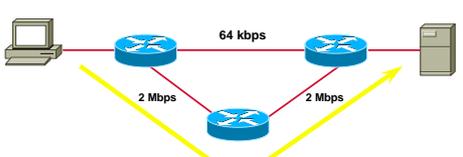
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Routing Protocol E-IGRP

- Converges quickly. An EIGRP router has the routing tables of its neighbours in the memory and is able to choose alternative routes quickly.
- No periodical updates
- Multiple network layer support - AppleTalk, IP, Novell NetWare
- Load Sharing

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Which route would E-IGRP choose?



The diagram shows the same network topology as the first slide. A yellow arrow points from the laptop to the server, following the path through the bottom router (2 Mbps link to the bottom router, and 2 Mbps link from the bottom router to the rightmost router).

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HomeRun Training



WAN-Technologies

Packet Switched	Circuit Switched
<ul style="list-style-type: none">• X.25• HDLC• Frame Relay• ATM	<ul style="list-style-type: none">• ISDN• PSTN (POTS)* <p><small>* Public Switched Telephone Network Plain Old Telephone Service</small></p>

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Wide-Area Network (WAN) Transmission Options

Leased Line

X.25

Frame Relay

Circuit Switched (ISDN)

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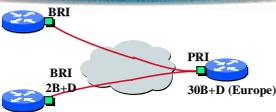
Leased Lines



- One connection per physical interface
- Bandwidth: 64 kbps–2 Mbps
- Cost effective at 4–6 hours daily usage
- Dedicated connections with predictable throughput

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ISDN



- Digital dial-up connection
- Fast setup time
- Up to 128 kbps per basic rate interface
- Monthly rate plus usage

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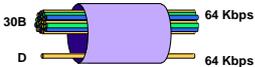
ISDN

Basic Rate Interface (BRI)



2B } 128 Kbps
D }
64 Kbps
64 Kbps
16 Kbps

Primary Rate Interface (PRI)



30B } 2 Mbps
D }
64 Kbps
64 Kbps

- Digital dial-up connection
- Fast set-up time
- 64 Kbps per B channel

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Frame Relay

Traffic

What You Pay for

Time

Peak

CIR

Free if Available

- Committed Information Rate (CIR)
- Port speed
- Permanent Virtual Circuits (PVCs)
- “Burst” mode or MSTR

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Frame Relay

DLCI = Data Link Connection Identifier
LMI = Local Management Interface

```

interface Serial 0
no shutdown
no description
no ip address
encapsulation frame-relay
frame-relay lmi-type q933a
!
interface Serial 0.1 point-to-point
no shutdown
description connected to basel
ip address 192.144.144.144 255.255.255.0
frame-relay interface-dlci 17
!
interface Serial 0.2 point-to-point
no shutdown
description connected to zurich
ip address 192.15.15.15 255.255.255.0
frame-relay interface-dlci 10
    
```

DTE **DLCI #17** **DCE** **DLCI #10**

Virtual Circuit

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WAN Cost Analysis

Monthly Cost (\$)

Usage (Hours/Day)

ISDN

X.25

Leased Lines

4 **6**

Use ISDN **Use X.25 or Frame Relay** **Use Leased Lines**

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HomeRun Training

Broadband Access Technologies

- (A)DSL (Copper)
- Cable (Coax) CAT-TV
- Sky-DSL
- Powerline / PDT

Weitere Übersicht unter:
www.burger-inf.ch/prod05_adsl.htm

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“DSL 101”

End-User — Enet — DSL “Modem” — Copper Loop — DSL “Modem” — ATM — Value-Added Packet Network

- DSL is a pair of “modems” on either end of a copper wire pair
- DSL converts ordinary phone lines into high-speed data conduits
- Like dial, cable, wireless, and T1, DSL by itself is a **transmission technology**, not a complete end-to-end solution
- End-users don’t “buy” DSL, they “buy” services, such as high-speed Internet access, intranet, leased line, voice, VPN, and video on demand

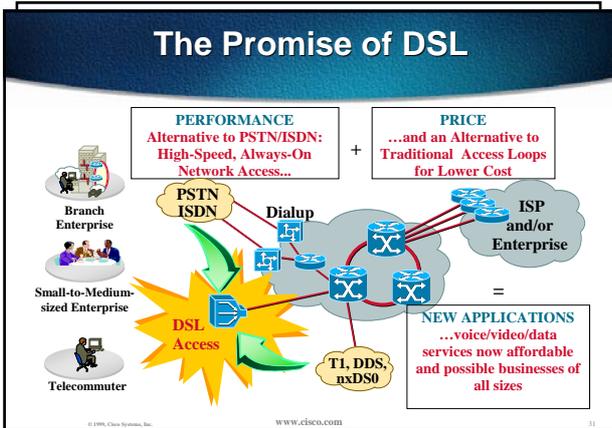
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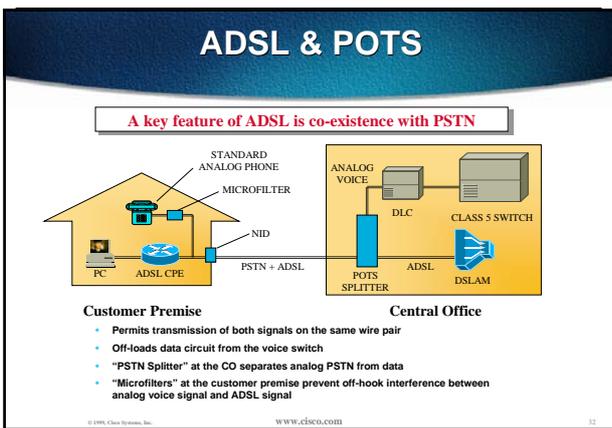
Terms & Acronyms xDSL Technologies

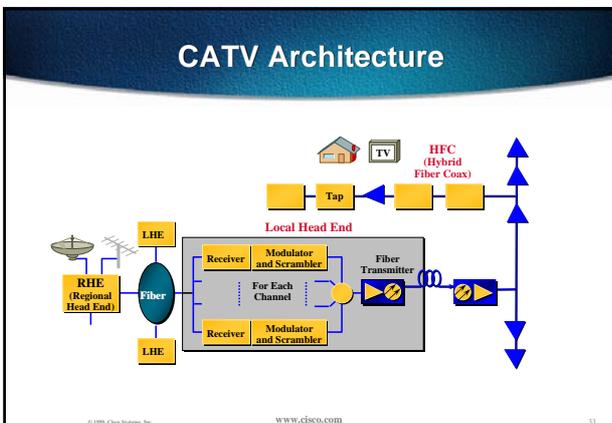
- ADSL asymmetric digital subscriber line 1.5 to 9 Mbps downstream, 16-640 Kbps upstream over single copper twisted pair (5844 m)
- HDSL high-level-data-rate subscriber line 1.544 Mbps Bandwidth each way over two copper twisted pairs (3658m)
- SDSL single-line digital subscriber line 1.544 Mbps down & upstream over single copper twisted pair (3048m)
- VDSL very-high-data-rate digital subscriber line 13 to 54 Mbps down & 1.5 to 2.3 Mbps upstream over single twisted copper pair (300-1372m)

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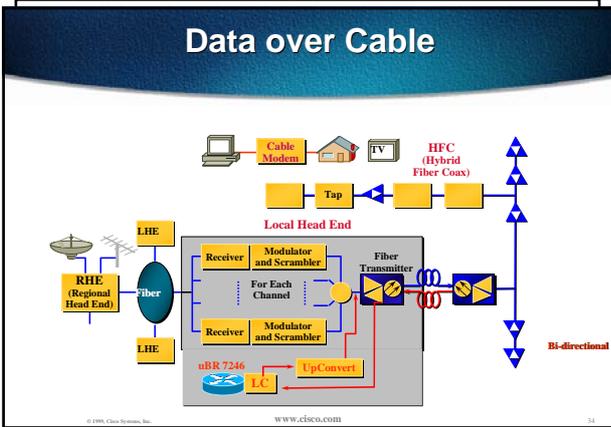
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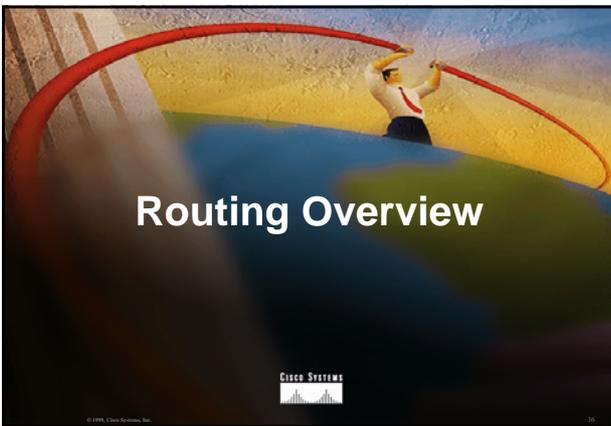
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DSL vs. Cable Bake-Off

	<i>DSL</i>	<i>Cable</i>
Dedicated vs. Shared	DSL is a dedicated connection: <ul style="list-style-type: none"> No bandwidth contention Secure 	Cable is a shared wire: <ul style="list-style-type: none"> Noticeable speed impairment during "rush hour" Near-term security issues
Availability	Telephone wires are universally available to nearly every business & residence	Existing cable is almost exclusively residential
Accessibility	Approx. 15% of current customers are inaccessible (out-of-reach, bad copper, etc.)	Cable head-end equipment must be upgraded or replaced for 2-way communication
Impairment Susceptibility	Telephone wires are susceptible to high-frequency cross-talk and external impairment	Cable is shielded – signal impairment is not a problem
Customer Support	Established customer support models & systems for data services & per subscriber outages	Data service is new and operations model is broadcast oriented
Consumer Awareness	Telcos are the incumbent for voice & data	Cable companies are moving aggressively

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HomeRun Training

Interoperability

- Support of all Routing Protocols: RIP, RIPv2, OSPF, IGRP, BGP, EGP ...
- Support of all Routed Protocols TCP/IP, SPX/IPX, AppleTalk, DecNet ...

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Performance

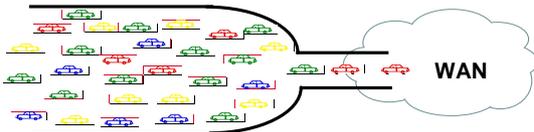
- Hardware features (Memory, RISC-Processor)
- Support of all Layer 2 Technologies
- Queuing

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Traffic Prioritisation



- Priority queuing
- Custom queuing
- Fair queuing

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HomeRun Training

Security

- VPN
- Encryption
- Call-back
- Access Lists
- PacketFiltering
- Firewall Feature Set

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IOS Firewall Feature Set

Integrated on routers
Context-Based Access Control (CBAC)
Dynamic per-application filtering
Support for advanced protocols
(H.323, SQLnet, RealAudio, etc.)

Control downloading of Java applets
Denial-of-service detection and prevention
Real-time alerts
TCP/UDP transaction log
Configuration and management



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Lowering the Costs of Ownership:

- Compression
- Dial-on-Demand
- Bandwidth-on-Demand
- Snapshot Routing
- NAT & PAT

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HomeRun Training

Manageability

- Cisco View, Cisco Works, NMS like HP OpenView
- over Open Standards like SNMP and RMON

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Usability

- GUI's (ConfigMaker, ConfigBuilder)
- CLI (Same Interface on all platforms)

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Windows NT and Cisco Routers

- NetBEUI Dial-in mit Cisco Access Server: netbios nbf
- DHCP Server Unterstützung bei Dial-in: Cisco Access Server als Proxy konfigurieren: ip dhcp-server n.n.n.n
- Router als DHCP Relay: ip helper-address n.n.n.n

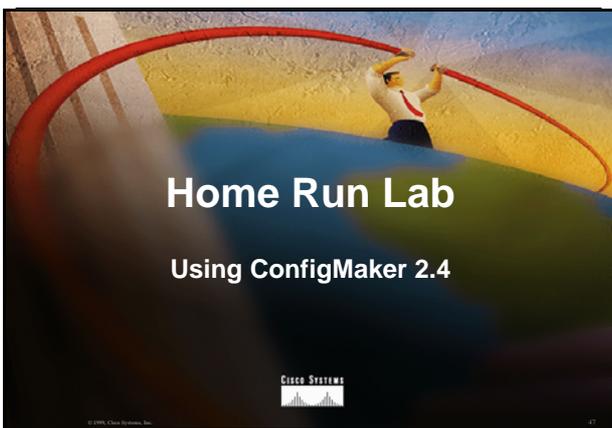
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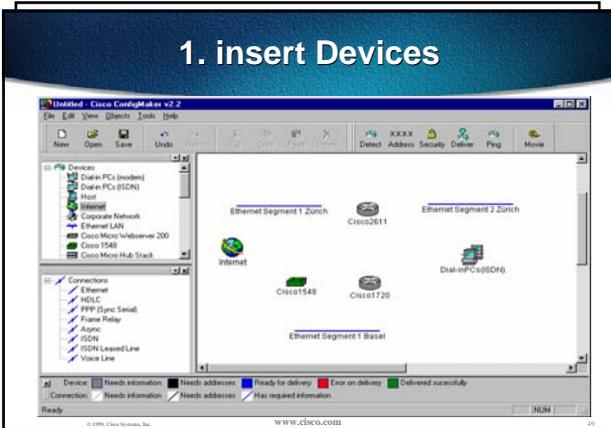




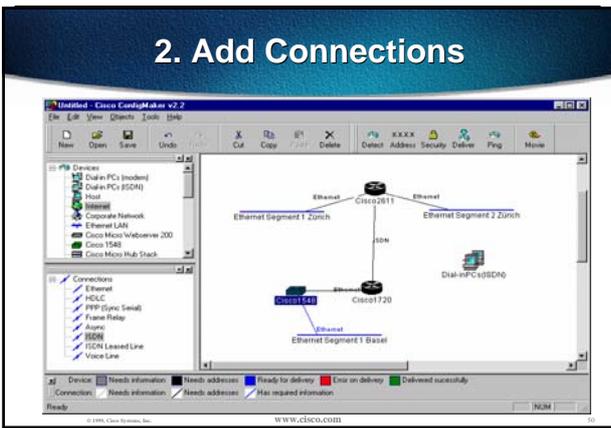


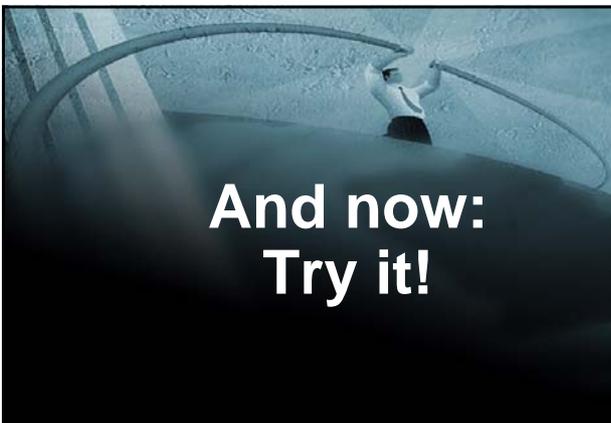
HomeRun Training

1. insert Devices



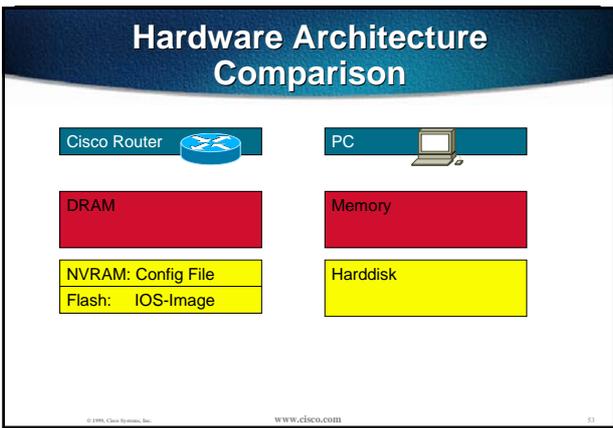
2. Add Connections

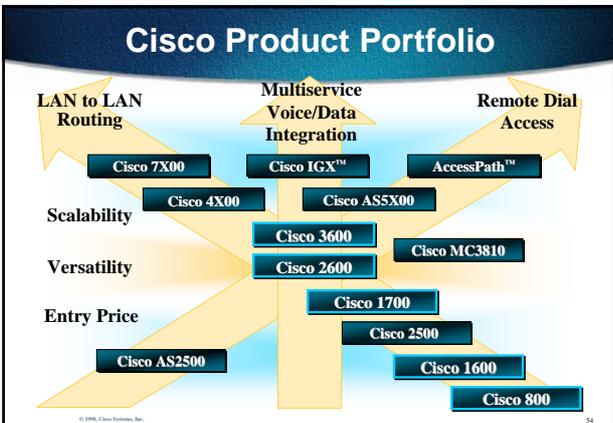




HomeRun Training







HomeRun Training

Cisco Access Router Portfolio

Residential

- Cisco 700**
 - Lowest acquisition cost
 - Residential ISDN (ISDN or serial)
 - Internet access

Small Office/Professional Office

- Cisco 800**
 - Entry-level Cisco IOS® solution
 - One fixed WAN (ISDN or serial)
 - ISDN teleworker
- Cisco 1400**
 - ATM, ADSL enabled
 - Desktop
 - One fixed WAN

Small-Medium Business/Small Branch

- Cisco 1600**
 - Flexible, secure Internet access
 - Desktop
 - Entry-level modularity
 - One fixed WAN - one WIC slot

Enterprise Branch Office

- Cisco 1720 (data)**
- Cisco 1750 (data/voice)**
 - 1600 features plus:
 - Additional flexibility of 1 WIC, 2 WIC/WICs
 - 25 fixed-port configurations
 - Accelerated encryption for VPN
 - Fast Ethernet LAN
 - 2 ISDN BRI support
 - Up to 5 serial ports for serial aggregation
 - Future integrated DSL capability
- Cisco 2500**
 - Industry standard data router
 - Rackmount
 - Enterprise software features
- Cisco 2600**
 - Data, voice, and dial
 - Rackmount
 - Enterprise software features
 - Two WIC + one NM slot
 - AIM expansion
 - RISC processor

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Cisco 700 and 800 Series Routers



Cisco 700 for Small Offices and Home Offices

- Lowest cost router
- Recommended for small offices with 1-5 users
- 1 fixed ISDN port
- Optional 2 analog POTS and 4 port hub

Cisco 800 for Small Offices and Teleworkers

- Recommended for small offices with up to 20 users
- Cisco IOS for enhanced security (firewall and IPSec) and reliability (QoS)
- Upgradeable memory
- 1 fixed ISDN (801/803) or 1 fixed serial up to 512Kbps (805) port
- Optional 2 POTS and 4 port hub (not on 805)



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FastStep 700/800 - 3 Simple Steps to Get Connected

1

Connect the colour-coded cables



2

Insert the CD-ROM into a PC on the LAN



3

Select service and enter account info



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HomeRun Training

Cisco 1600 Series

- **Ideal solution for**
 - Small-medium businesses
 - Remote small offices
- **Part of Cisco networked office solutions for small offices**
- **Hardware modularity + Cisco IOS™ technologies enable:**
 - Flexible networks
 - Secure Internet/intranet access
 - Extranet communications
 - Secure and reliable VPNs



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Cisco 1700 series extends Leadership of Cisco 1600



Cisco 1600
User Requirements:

- Entry-level modularity
- Internet/Intranet access
- Second WAN option for backup
- Security/firewall capability



Cisco 1700 series
User Requirements:

- All capabilities of 1600 plus:
- Full Modularity
- Voice and Data Integration (Cisco 1750)
- VPN Access Now or Later
- Optional H/W Encryption slot
- Fast Ethernet LAN
- Additional flexibility of one VIC and two VIC / WIC slots for fast growing or changing environment (Cisco 1750)
- Dual ISDN BRI support
- Up to five serial ports
- Future Integrated DSL capability
- SDSL access with Cisco 633 today

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Cisco 1720 Architecture

Chassis

- RISC processor for encryption performance
- One autosensing 10/100 Fast Ethernet
- Console and auxiliary ports up to 115 kbps
- Cisco Networked Office stack enclosure
- Locking connector on power socket
- Kensington compatible locking slot

Memory

- Runs from DRAM
- DRAM onboard/default: 16 MB
- DRAM max: 48 MB
- Flash onboard/default: 4 MB
- Flash max : 16 MB.



Two WAN Interface Card Slots

- Any combination of WAN interface cards
- Over 25 WAN interface combinations
- Serial, ISDN BRI, and CSU/DSU options
- Shared with Cisco 1600, 2600, 3600 series

Internal Expansion Slot

- Future hardware-assisted data encryption up to TI/E1, data compression

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HomeRun Training

Cisco 1750 Architecture

Chassis

- RISC processor for encryption performance
- One autosensing 10/100 Fast Ethernet
- Console and auxiliary ports up to 115 kbps
- Cisco Networked Office stack enclosure
- Locking connector on power socket
- Kensington compatible locking slot

Memory

- Runs from DRAM
- DRAM onboard/default: 16 MB
- DRAM max: 48 MB
- Flash onboard/default: 4 MB
- Flash max : 16 MB.



One Voice & Two Voice / WAN Interface Card Slots

- Any combination of WAN interface cards
- Over 25 WAN interface combinations
- Serial, ISDN BRI, and CSU/DSU options
- Shared with Cisco 1600, 2600, 3600 series

Internal Expansion Slot

- Future hardware-assisted data encryption up to T1/E1, data compression

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Cisco Networked Office Stack

Small Business Products Deliver Secure Internet / VPN Access, Flexibility, and Integration

- Cisco 1750 router
- Cisco 1720 router
- Cisco 1600 series routers
- Cisco 1548 Micro Switch 10/100
- Cisco 1528 Micro Hub 10/100
- Cisco 1503 Micro Hub
- Cisco IOS™ Firewall
- Cisco ConfigMaker



Cisco IOS® Technology

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Cisco 26xx and 36xx Series Modular Access Routers



- Key element of Cisco's data/voice/video integration strategy
- Ethernet and Token Ring models
- WAN interface cards and network modules shared with Cisco 1600 through 3600 series

- Full range of Cisco IOS® software feature sets
- Field-upgradable: Two WAN interface slots, one network module slot, one AIM slot
- Cost effective: \$2700-\$7500 average list price

CISCO SYSTEMS

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HomeRun Training

Cisco 2600 Series Versatility, Integration, Power



- Ethernet and Token Ring models
- Field-upgradable interfaces shared with Cisco 1600 through 3600 series
- Up to 25-kpps fast switching performance
- Data/voice/fax integration, dial and VPN access

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The Cisco 3600 Series Multifunction Platform

- RISC base architecture
- 50-70 Kpps fast switching
- 3-4 Kpps process switching
- Four network module slots
- Up to 128Mb DRAM

Versatility
↕
Integration
↕
Performance

- RISC base architecture
- 20-40 Kpps fast switching
- 1.5-2 Kpps process switching
- Two network module slots
- Up to 64Mb DRAM



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Cisco 3600 Family Interfaces Versatility, Integration, Performance

- Multiple LAN/WAN combinations
Ethernet, Token Ring, Fast Ethernet, Serial, ISDN, CSU/DSU
- Broad range of network services
Dial—ISDN, async, modems
Multiservice—Voice and Fax over IP™
packet gateways (BR/PRI digital interfaces)
Emerging technologies—ATM, xDSL in the future
RPS option
NMs shared with Cisco 2600
- Simplified solutions
Integrated T1 and 56K CSU/DSU
Integrated compression
WICs shared with Cisco 1600 and 2600 series



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ISDN Network Modules



- **4- or 8-port ISDN BRI**
With or without NT1 (U or S/T)
- **PRI and BRI in the same chassis**
Cisco IOS software release version 11.3(3)T and later



- **1- or 2-port ISDN PRI**
With or without CSU
E1 balanced or unbalanced

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WAN Interface Cards (WICs)

Cisco 1600, 1700, 2600, and 3600



- **One-port serial**
- **ISDN BRI (S/T or U interface)**



- **Two-port serial**
- **Two-port async/sync**

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Analog and Digital Modem Network Modules



Cisco 3600 only
Hybrid ISDN/analog dial via ISDN PRI network modules
Up to 60 modems in a Cisco 3640 or 30 modems in a Cisco 3620
Up to 56 kbps (K.56 flex); software upgradable to V.90



- Cisco 2600 and 3600
- Eight or 16 manageable analog modems
- Up to 33.6 kbps (V.34)
- Rockwell technology

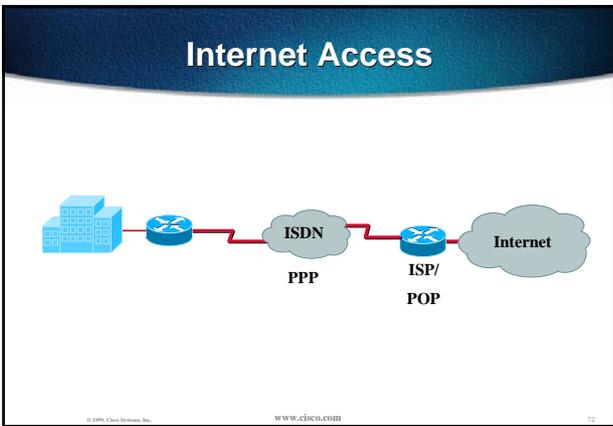


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HomeRun Training







HomeRun Training

Simple Internet Access Solution

- Target customers
 - Telecommuters / home offices
 - Small standalone offices
- Provides your customer with:
 - Low cost internet connectivity

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Simple Internet Access Solution

Cisco 300 Internet & PSTN

- Recommended for small offices with up to 20 users
- Recommended for critical applications (with IPSec) and reliability (QoS)
- 1 fixed ISDN port
- Optional 2 analog PSTN and 4 ports
- Now supports Catalyst 240

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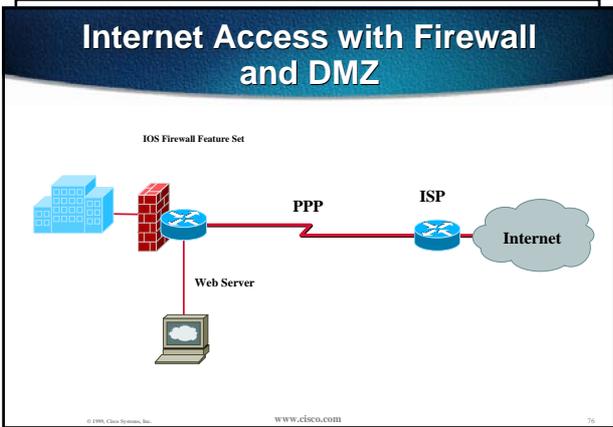
Internet Access with Firewall

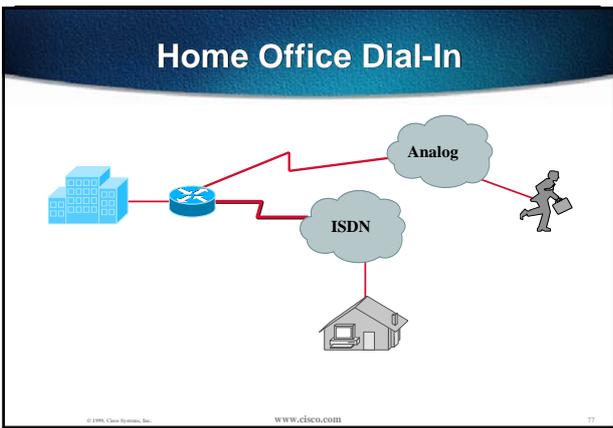
IOS Firewall Feature Set

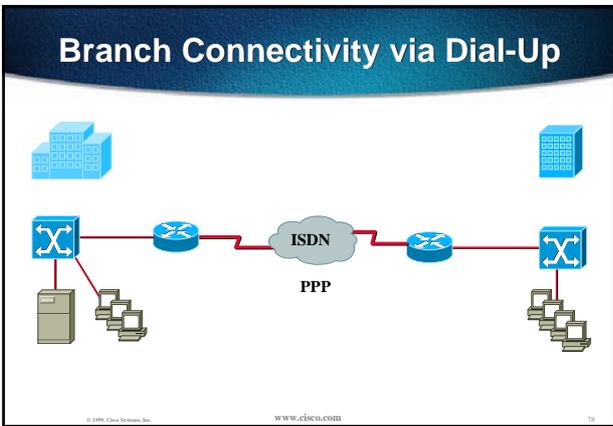
PPP
ISDN
ISP
Internet

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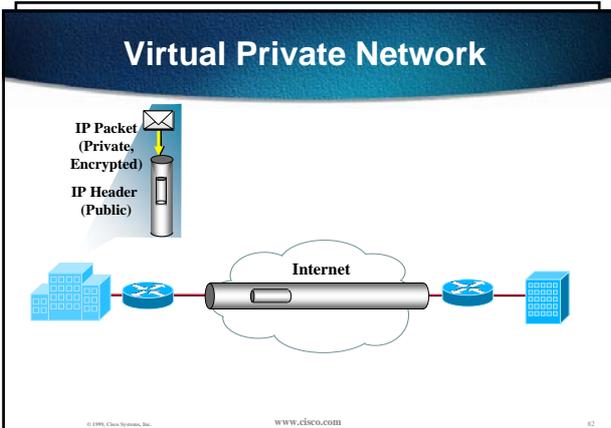
HomeRun Training

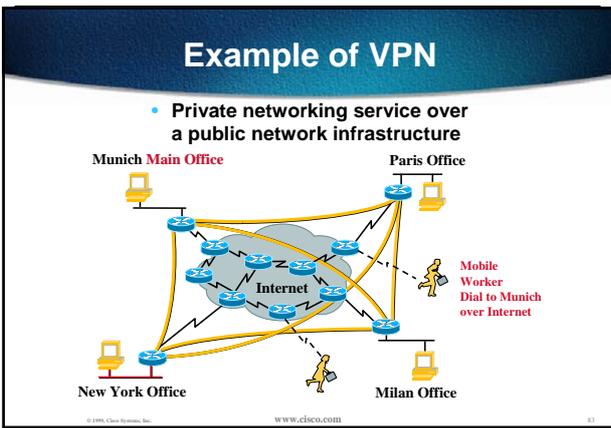






HomeRun Training



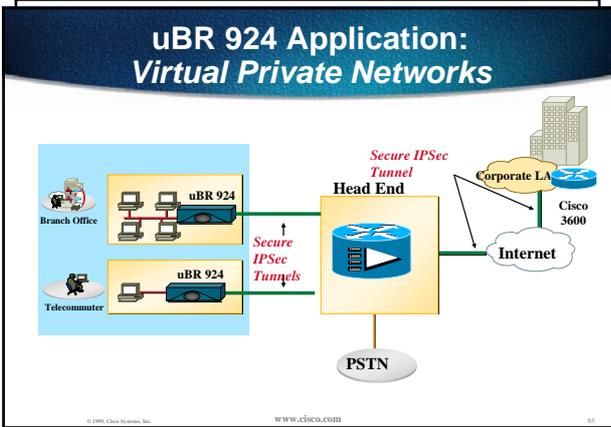


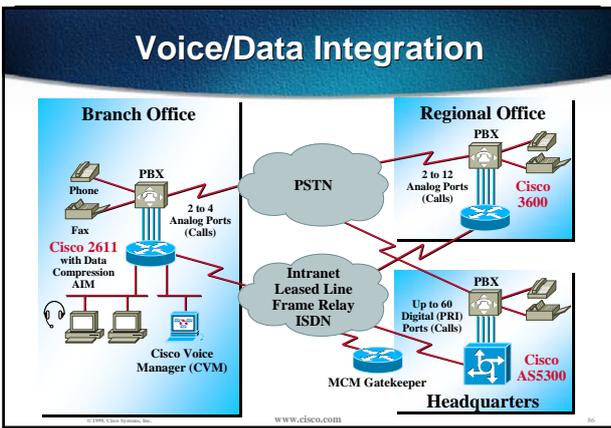
Secure Internet Access Solution

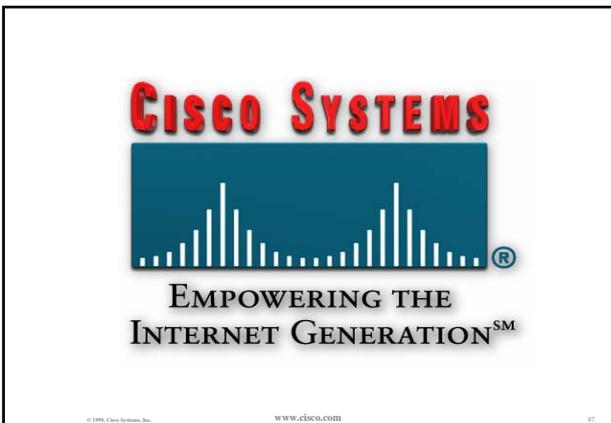
- Target customers:
 - Branch offices
 - Growing stand alone offices (>20 users)
- Provides your customer:
 - Managed, expandable LAN/WAN connectivity
 - High security (firewalls, encryption etc)
 - Reduced costs (local call charges)
 - Quality of Service per application and user

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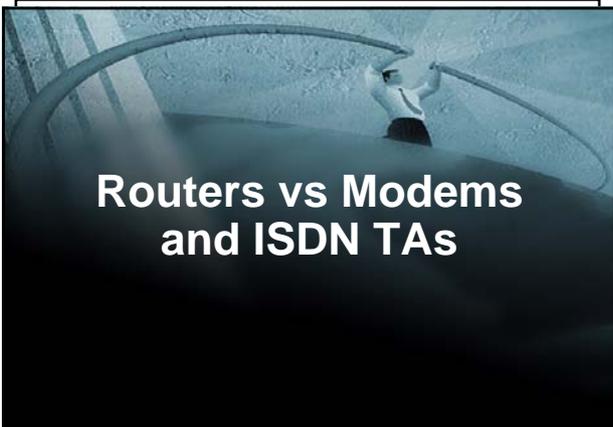
HomeRun Training







HomeRun Training



Management Benefits

- **Simple to Use**
Same connections remotely as on office LAN
- **Manageable**
Software updates and maintenance on remote routers as part of extended intranet

“For remote users working from fixed locations (home or satellite office), dial-up routers are also simpler to use than standard modems. They are Ethernet devices, so users connect to them using their NIC, just as they do in the office LAN, eliminating support and maintenance of the dial-up network client.”

Source: GartnerGroup
Will Dial-Up Routers Slash Modem Connection Costs? J. Girard, K. Dulaney July 99

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Lower Line Costs for Remote Users

- **Example**
User online for 6 hours per day at \$2 /hour, using intermittent access to network
Modem/TA costs \$12/day, Router (50% on) \$6/day
\$6/day saving eg \$300 dial-up router pays for itself in 10 weeks (NB shorter if line costs higher)

“Dial modems are easy to use but easy to leave online for hours and hours. For certain work styles, dial-up routers may offer compelling cost reductions and other benefits for modem users. Replacing modems with small, dedicated dial-up routers costing \$200 to \$500 can potentially reduce user connection time and costs by more than half.”

Source: GartnerGroup
Will Dial-Up Routers Slash Modem Connection Costs? J. Girard, K. Dulaney July 99

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Lower line Costs for Remote Offices

Figure 1:

Default server timeout = 120 min.
Total cost: 490 min. at \$5/hr. = \$40.83

Figure 2:

Default router timeout = 5 min.
Total cost: 165 min. at \$5/hr. = \$13.75

Figure 1 and Figure 2, based on a real case study, show a 65 percent reduction in daily access charges for a highly intermittent user with a "toll free" access that costs the enterprise 8.3 cents per minute. In small satellite offices, connection costs may be further reduced because one router can be shared by several users.

Source: Gartner Group
Will Dial-Up Routers Slash Modem Connection Costs? J. Girard, K. Dulaney July 99

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Speeds of Access Technologies

Remote Access Connections	Speed
Analog Modem	56 Kbps
ISDN	128 Kbps
XDSL	128 Kbps to 1.5 Mbps
Cable Modem	256 Kbps to 10 Mbps

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Router Advantages over TAs

- No need to use a dial-up utility
- Initial connection delay shorter
- Router drops connection when inactive
- More than one user can share the router

Source: Gartner Group
ISDN in the SOHO: Should Users Select a TA or Router? J. Girard Nov. 98

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