AS/400 TCP/IP Wide Area Networking

Frank Gruber

Server Development AS/400

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AS/400 WAN Focus Areas

Planning Your WAN Networking

Steps to getting an operational WAN

- Getting Connected
- Address Management
- Name Resolution
- Security

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AS/400 TCP/IP V4R2+ WAN Offering

PPP offering includes switched and dedicated links
(async analog thru sync T1/E1)

Extensions - Address management, Routing
(PPP and Frame Relay)

Security and Names Services features

Position the AS/400

- AS/400 Serve As Office Gateway
  - Lan-to-Lan Access
  - Access Corporate home network
- AS/400 Serve as Remote Access Server
  - Remote Mobile Client Access
  - Remote Lan Access

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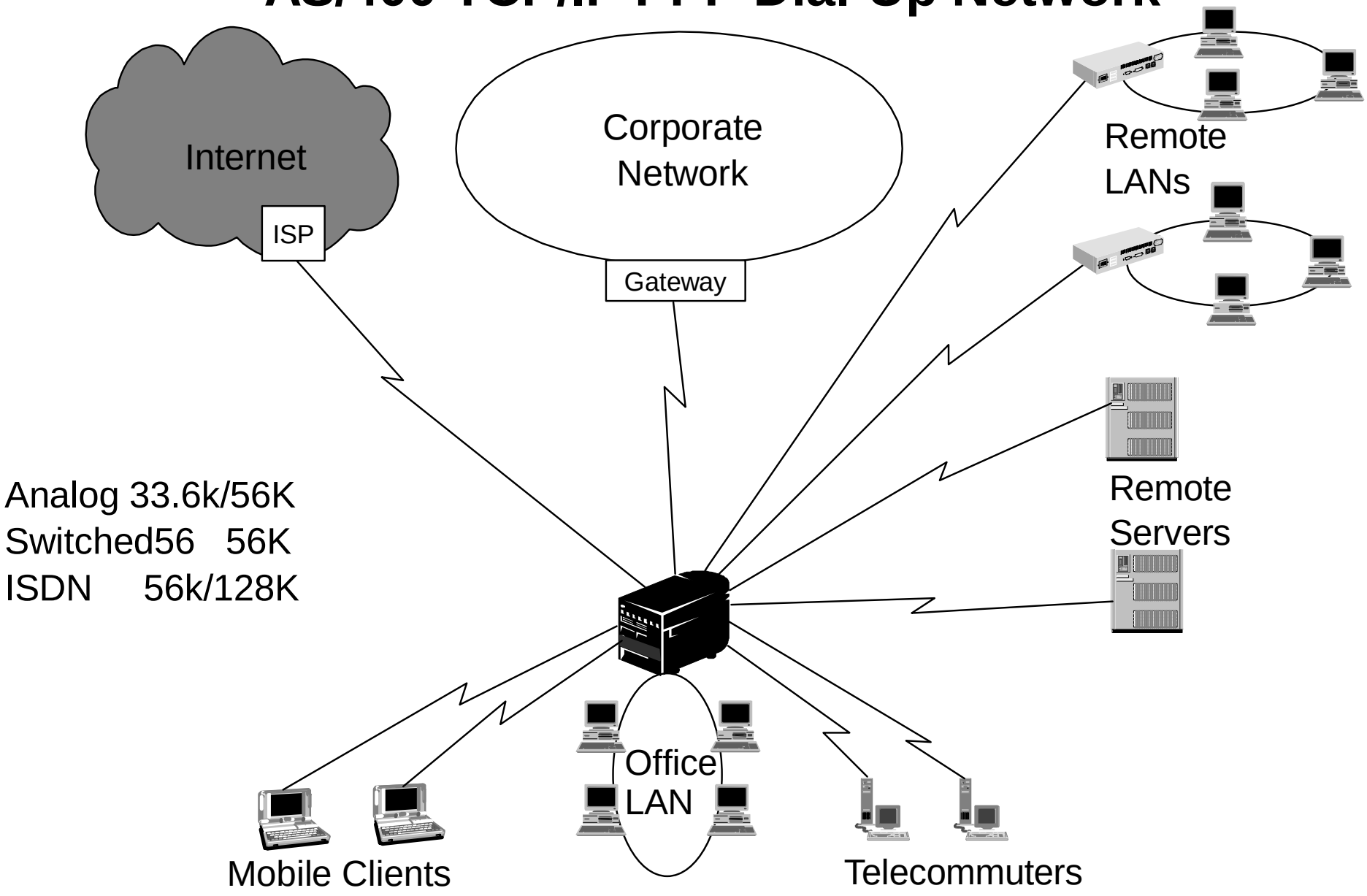
AS/400 TCP/IP PPP Dial-Up Network



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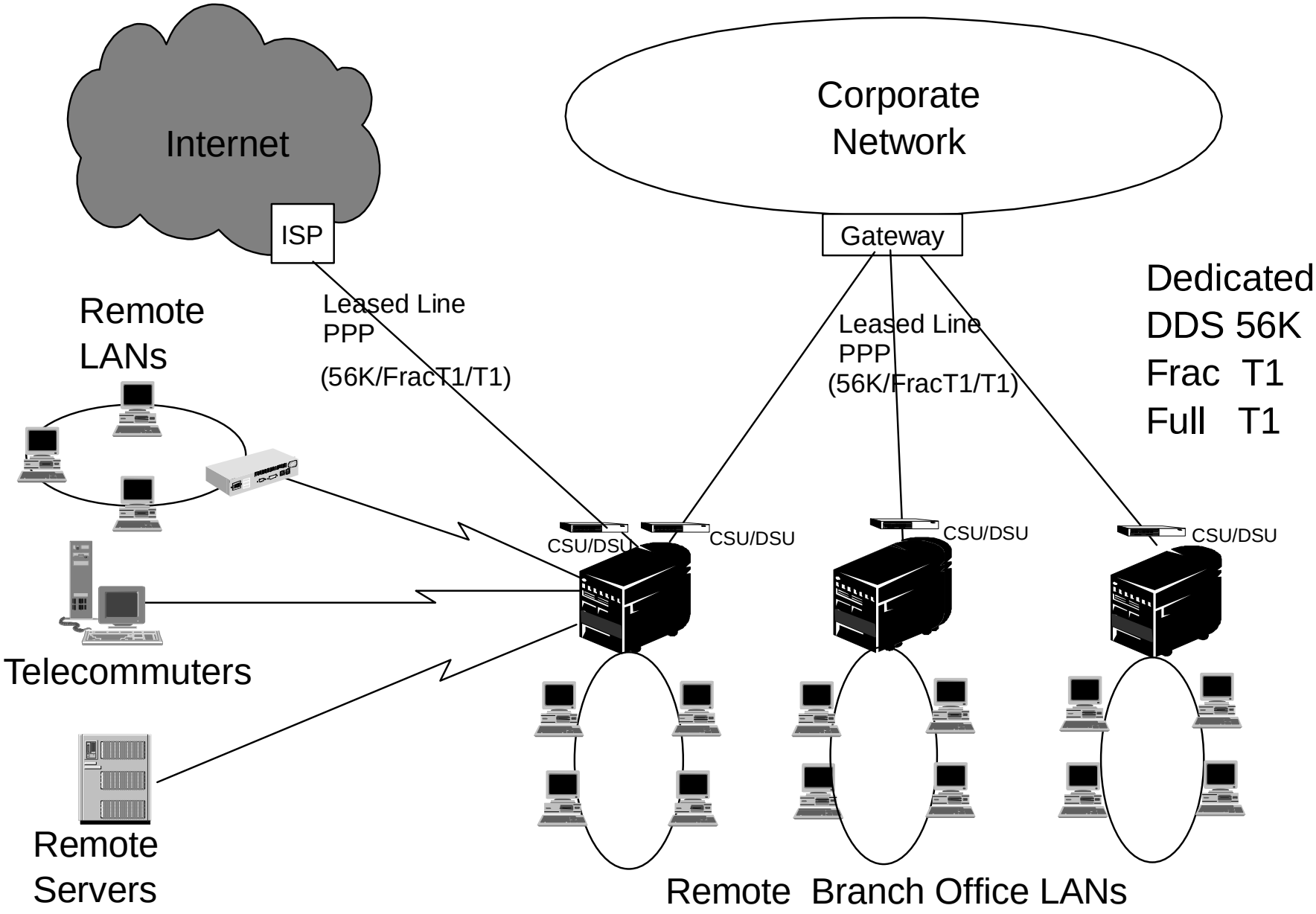
AS/400 TCP/IP Dedicated PPP Link



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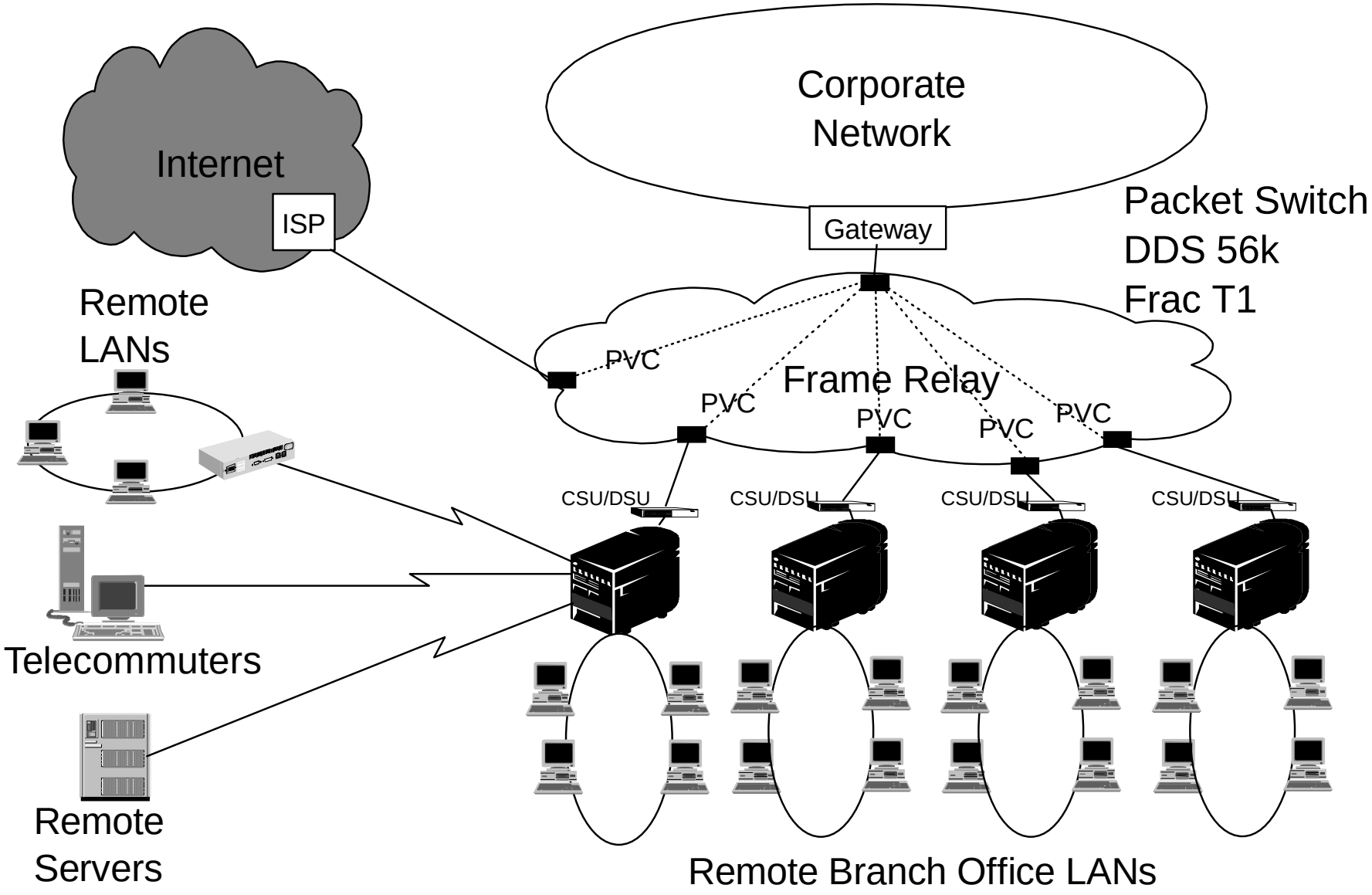
AS/400 TCP/IP Frame Relay Network



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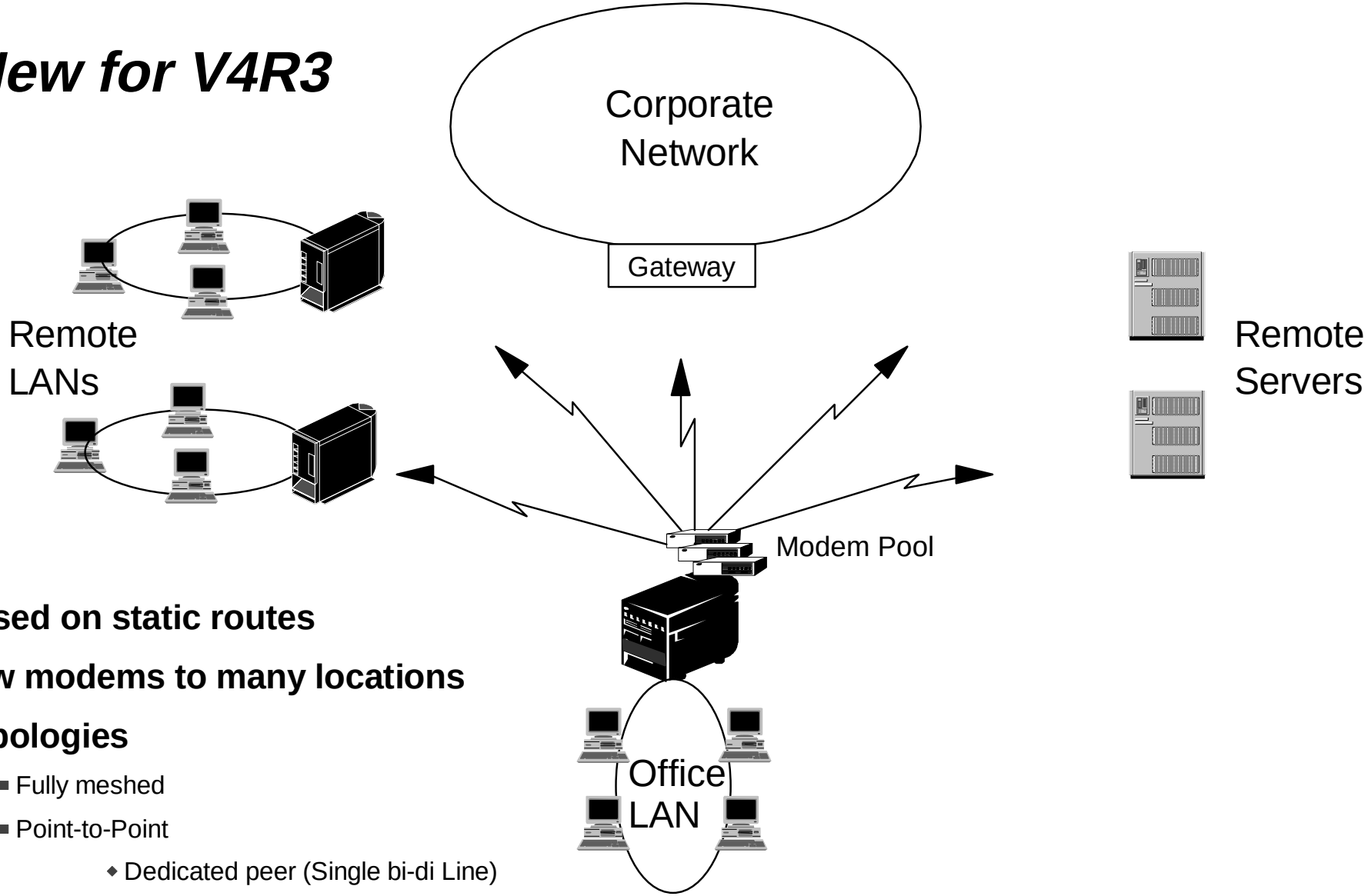
AS/400 TCP/IP PPP Dial-on-Demand

***New for V4R3**



Based on static routes

Few modems to many locations

Topologies

- Fully meshed
- Point-to-Point
  - Dedicated peer (Single bi-di Line)

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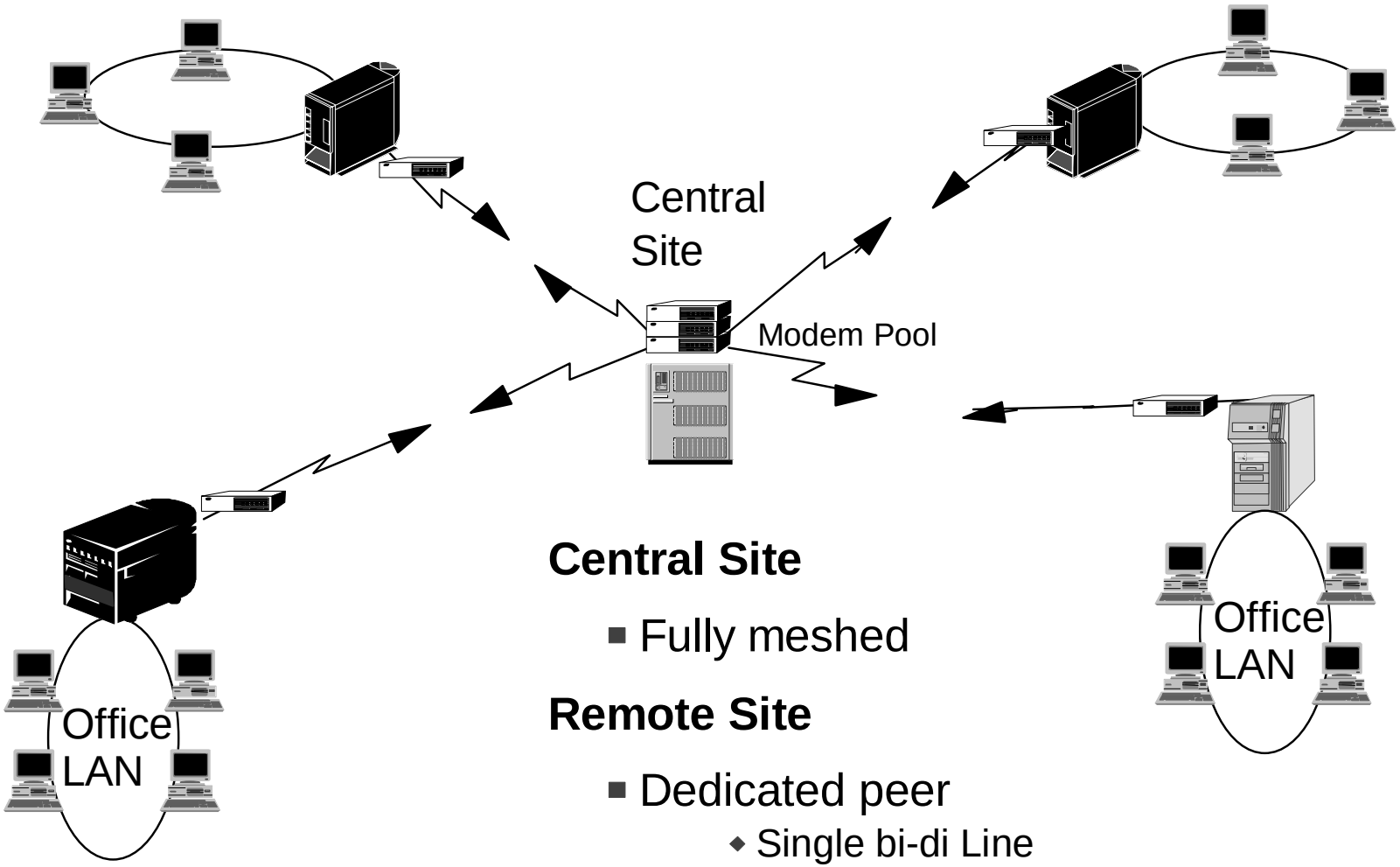
PPP Dial-on-Demand Hub and Spoke

***New for V4R3**



Central Site

- Fully meshed

Remote Site

- Dedicated peer
  - Single bi-di Line

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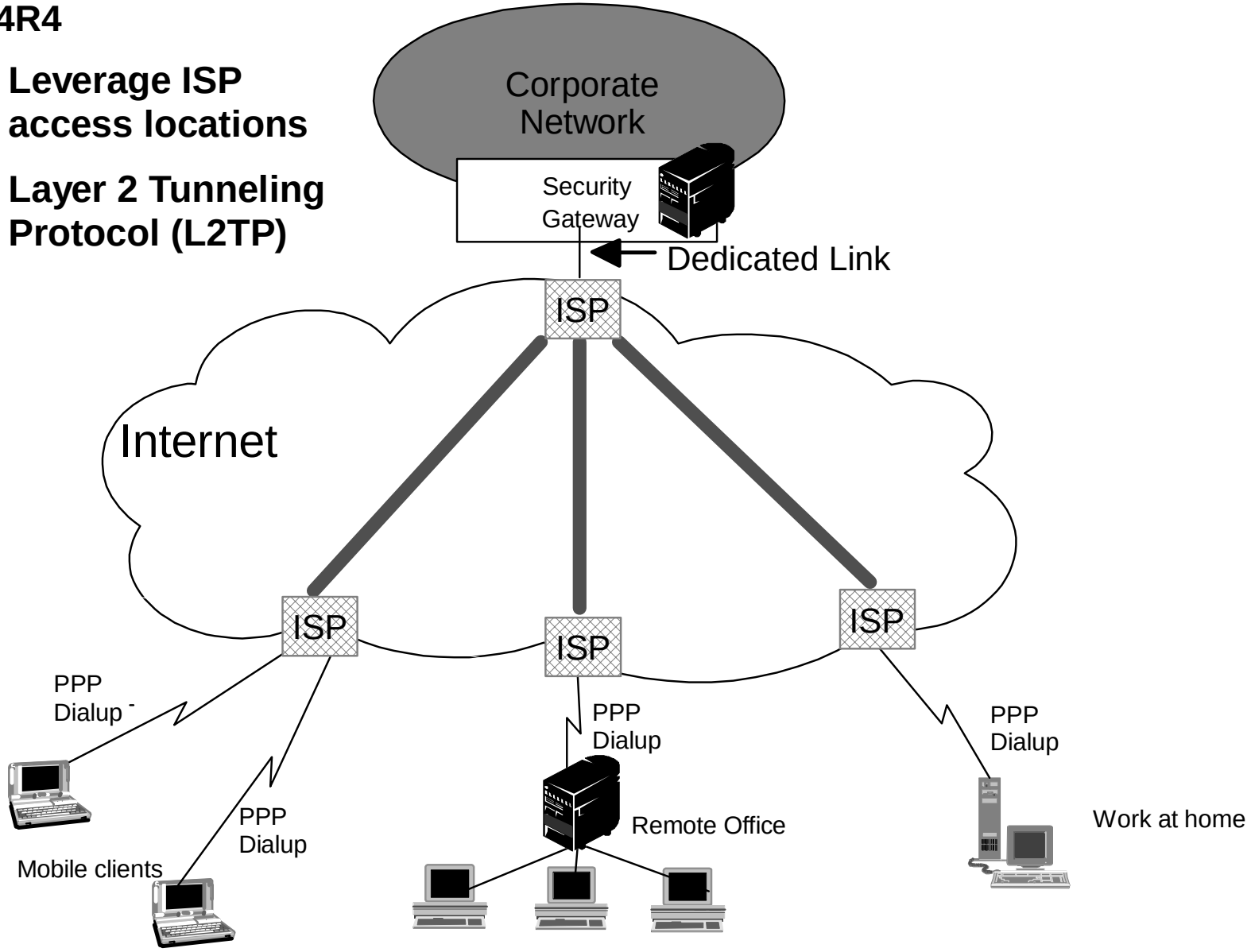
VPN Dial-up Remote Access

***New for V4R4**

Leverage ISP access locations

Layer 2 Tunneling Protocol (L2TP)



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AS/400 TCP/IP WAN Hardware Requirements

Support for PPP and Frame Relay

New AS/400 PPP Line Descriptor Object

- Supports both SLIP(async) and PPP(async/sync)
- PPP supported IOA's (#2720,#2721,#2745,#2699,#2750,#2751,#2761)
  - RS232, X.21, V.35, and RS449

AS/400 Operations Navigator required(Win95/98/NT™) for PPP

- Easy to use graphical interface
- Supports both SLIP and PPP

PPP/SLIP Analog - requires external v.24 modem

PPP ISDN - requires external Terminal Adapter or new #2750,#2751

- ISDN adapter #2605 is not supported

PPP Sync - requires CSU/DSU (Channel Service Unit/Data Service Unit)

Frame Relay is supported on #2666,#2720,#2721,#2745,#2699 and requires CSU/DSU

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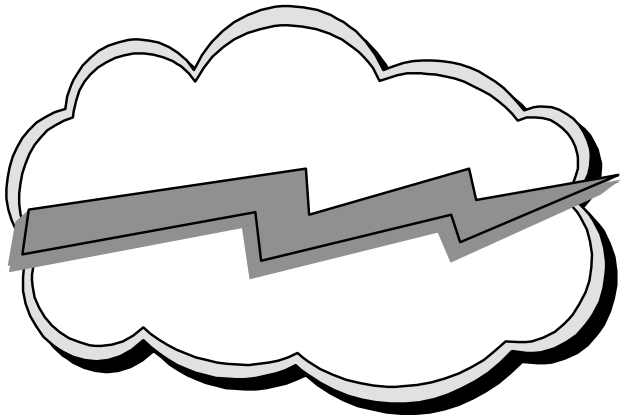
New V4R4+ 08/99 Announce
ISDN and Integrated Modem Support



ISDN:
- **2750**
- **2751**

Integrated Analog Modem
- **2761**

Scheduled availability for 2750/2751/2761 is December, 1999.

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Notes: *ISDN Communication Adapters (#2750 and #2751)*

New

ISDN adapters consolidate a wide variety of connectivity needs for remote devices attached to the AS/400e servers including:

- **Remote computers/devices connected to a phone network via an ISDN connection.**
- **Remote computers/devices connected to a normal analog telephone system with a modem.**

The #2750 and the #2751 support full-duplex mode and are both 4-port (8-channel) ISDN BRI (basic rate interface) PCI. The #2750 is the U-bus (2-wire) version IOA whereas #2751 is the S/T-bus (4-wire) version IOA.

Based on the latest Digital Signal Protocol (DSP) technology, #2750 and #2751 allow connections to data modems connected to the telephone network with analog phone lines as well as to other ISDN devices. Each port consists of 2B+D configuration.

For data mode support, B-channel supports digital data at 64 Kbps. For modem mode support, B-channel supports V.90 and lesser modulations.

SLIP, PPP, FAX, and IDLC (connected to remote ISDN devices, synchronous or asynchronous modems) protocols are supported. Dial on demand is supported over ISDN with PPP protocol. This enables dynamically starting and stopping communications with different "end systems/devices."

Prerequisites:

- **PCI slot C03 in Model 170 (Base System Unit or System Expansion Units - slot E03 in #7101 or slots E03, E08, E09 in #7102. A #2824 IOP is required or,**
- **Storage/PCI Expansion Tower (#5065) on Models 620, 640, 650, S20, S30, S40, SB1, 730, and 740, or,**
- **One PCI slot and PCI LAN/WAN Workstation IOA (#2824) on Models 600, 620, S10, S20, and 720, or,**
- **Base PCI Integrated Expansion Unit (#9330) on Models 620, S20, or 720.**

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Notes: *08/99 PCI Integrated Analog Modem (#2761)*

The #2761 simplifies the attachment of remote devices to the AS/400e servers.. A combination of eight of any of the following remote devices can be connected simultaneously:

- **Remote computers/devices connected to a normal analog telephone system with a modem. Example: a laptop PC with an integrated modem.**
- **Remotely attached fax machines. This adapter can replace the Integrated Fax Adapter (#2664)**

Based on the latest Digital Signal Processor technology, #2761 support full-duplex mode and allows the modem function to be integrated into the IOA and supports multiple analog modem ports (8-phone lines). #2761 will run the following protocols without the need of an external modem:

- **SLIP/PPP**
- **SDLC**
- **Fax**

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Notes: *08/99 PCI Integrated Analog Modem (#2761)* -2

New

A wrap cable/plug and eight cables are shipped with each #2761. An ASYNC line description is required for Fax, and can only be used for Fax.

Prerequisites:

- **PCI slot C03 in Model 170 (Base System Unit), or System Expansion Units - in slot E03 in #7101 or slots E03, E08, E09 in #7102 or,**
- **Storage/PCI Expansion Tower (#5065) on Models 620, 640, 650, S20, S30, S40, SB1, 730, and 740, or,**
- **one PCI slot and PCI LAN/WAN Workstation IOA (#2824) on Models 600, 620, S10, S20, and 720, or,**
- **Base PCI Integrated Expansion Unit (#9330) on Models 620, S20, or 720.**

Only one PCI #2761 Remote Access IOA can be attached to an IOP, such as the #2824 PCI LAN/WAN/Workstation IOP

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V4R2 PPP Overview

PPP - Industry standard for networking over point-to-point links.

Comprised of three main components

- Method encapsulating multi-protocol datagrams
  (Only TCP/IP is supported by AS/400).
- Link Control Protocol (LCP) for establishing & configuring the data-link connection
- Family of Network Control Protocols (NCPs) for establishing & configuring different network-layer protocols (ie IP)

PPP standardizes link connection process

- Eliminates need for connection script files

Supports both async and sync link types

PPP provides stronger security for authentication of peers

Prioritize inter-active data over batch data(AS/400 implementation)

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V4R2 PPP LCP/NCP Overview

Supported RFCs 1661,1662,1334,1332,1877,1321,1144,1055

Link Control Protocol(LCP)

- Maintains link states(Opened, Up, Closing, Down)
- Negotiates Maximum Receive Unit (MRU)
- Authentication Protocol
  - Password Authentication Protocol(PAP) "clear text"
  - Challenge Handshake Authentication(CHAP) "MD5 hash"
  - Can periodically re-challenge
  - Bi-directional challenge

IP Network Control Protocol(IPCP)

- Exchange/Assign Local and/or Remote IP address(s)
- Negotiate Van Jacobsen TCP header compression
- Assign Domain Name Server(DNS) address(s)

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AS/400 Physical Interface Protocol Support

PPP supported IOA's #2699, #2720, #2721,#2745,#2750,#2751,#2761
Frame Relay supported IOA's #2699, #2720, #2721,#2745, #2666

Async

- RS232 - max rate 115.2kbps
- V.35 - max rate 230.4kbps

Sync

- RS232 - max rate 64kbps
- X.21, V.35, and RS449 - max rate 2.048mbps

Async Switched call setup

- AT command (RS232/V.35 only)

Sync Switched call setup

- V.25bis (V.35/RS449 only)

PPP ISDN supported via external Terminal Adapter or new #2750-1

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Media Selection Process

Guidelines for selecting type of service

Switched (Analog/ISDN/SW56)

- Requires infrequent service <30 min/day
- Requires dedicated bandwidth
- Cost of dedicated /packet switch service prohibitive

Point-to-Point Dedicated

- Requires high bandwidth utilization >30%
- Requires frequent/dedicated service
- Small number of locations

Packet Switch (Frame Relay)

- Multi-protocol support (eg mixed SNA & TCP/IP traffic)
- Large number locations >3 or 4
- Requires frequent/dedicated service
- Bursty, non-delay sensitive traffic

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WAN Interconnection Technologies

Telco Services using existing facilities between customer and central office

Switched Service	Line Speed	Equipment Required	DTE/DCE interface	Approx line cost/month*
Analog	33.6kps up 56kbps dwn	Modem	RS232 Async	$20 - $150
Switched 56	56kbps	CSU/DSU V.25bis dial	V.35/RS449 Sync	$50 - $250
ISDN	56/128kbps	Terminal Adapter	RS232/V.35 Async/Sync	$50 - $250

Dedicated Service	Line Speed	Equipment Required	DTE/DCE interface	Approx line* cost/month
Digital Data ServiceDDS	56kbps	CSU/DSU	V.35/RS449 Sync	$50 - $500
Fractional T1	64kbps to 1.544Mbps	CSU/DSU or T1 mux	V.35/RS449 Sync	$100-$2000
T1	1.544Mbps	CSU/DSU	V.35/RS449	$350-$2000
Frame Relay	56kbps to 1.544Mbps	CSU/DSU or T1 mux	V.35/RS449	$350 - up CIR,#PVC

***Costs shown are not intended to reflect current pricing, but to show relative differences between services. Actual costs can vary tremendously based on distance and/or time utilization(switched). Also, pricing may vary significantly amoung telcos.**

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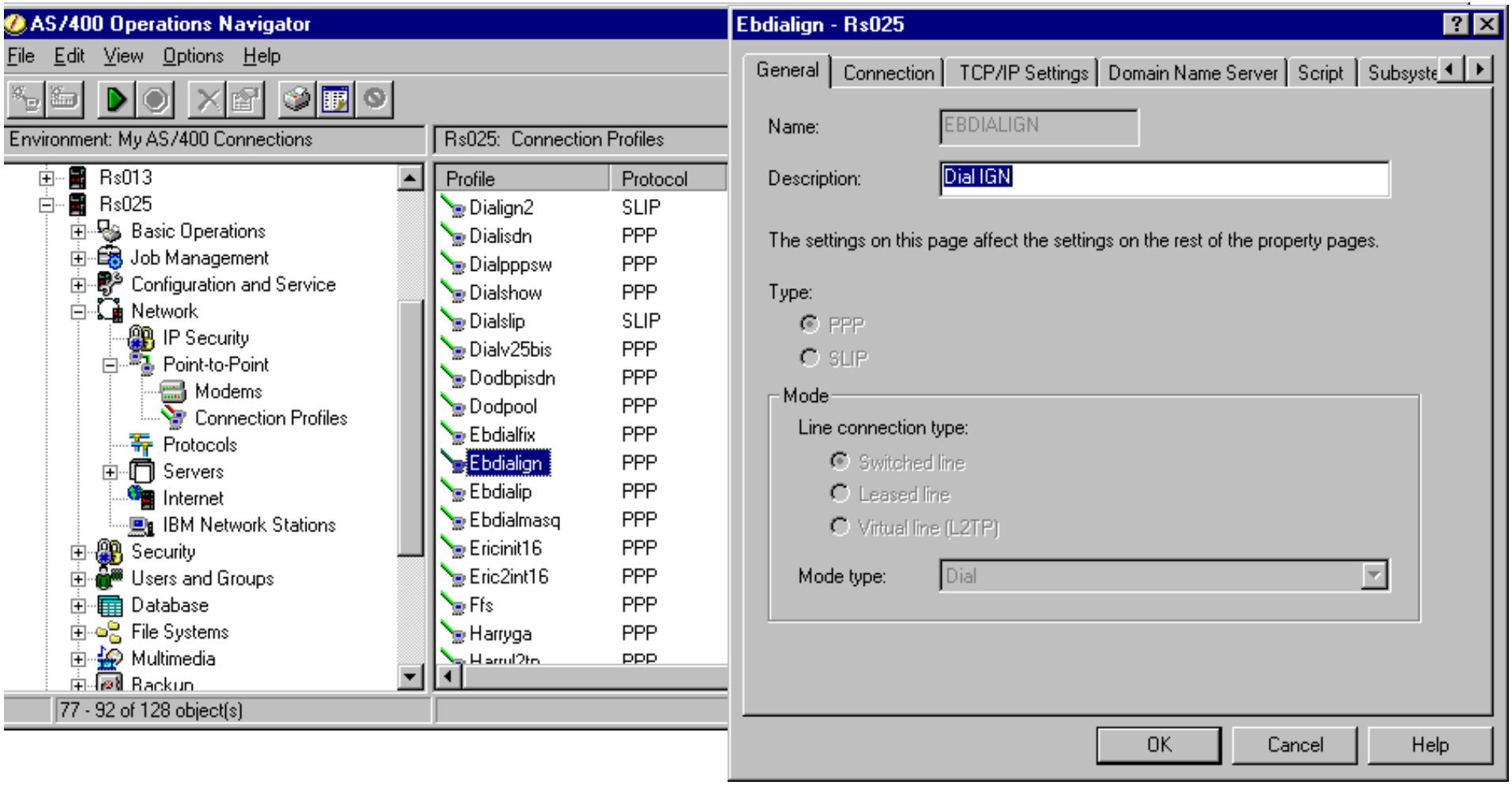
Configuring AS/400 as Dial-up Internet Gateway



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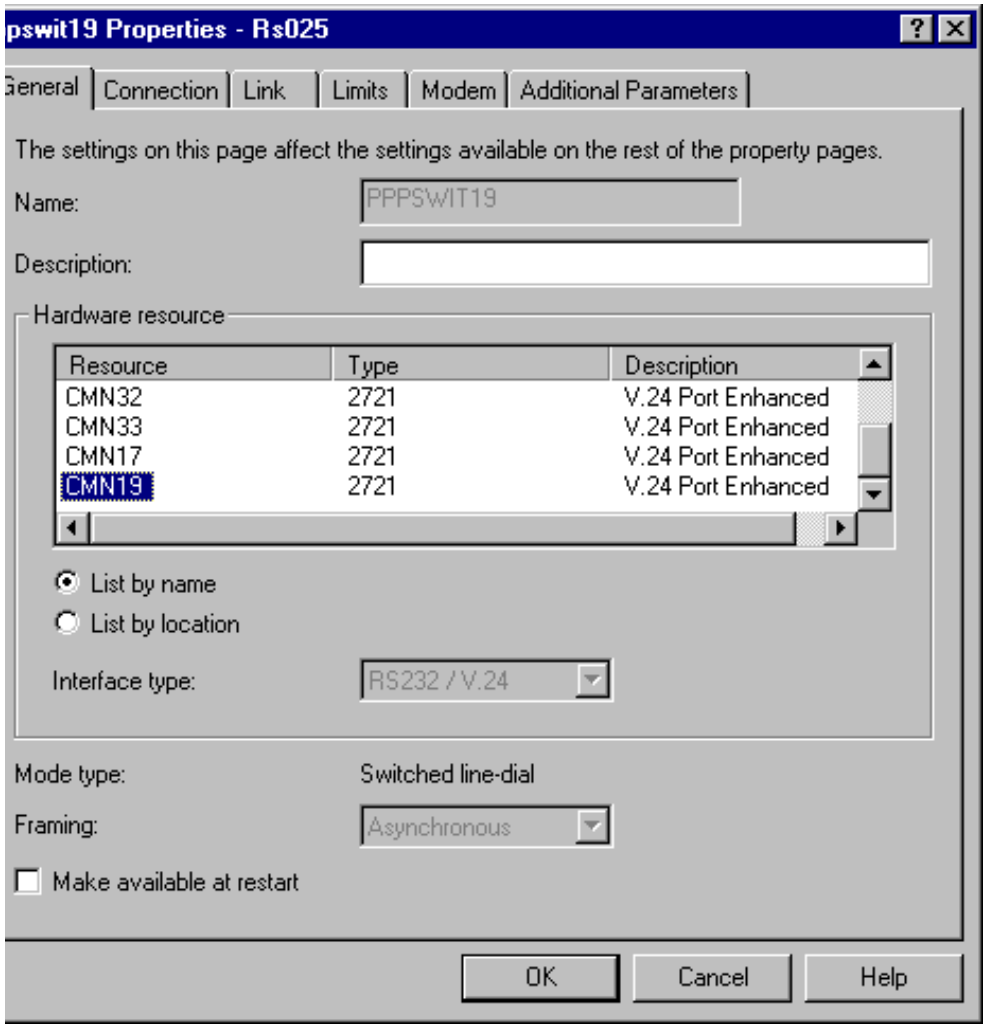
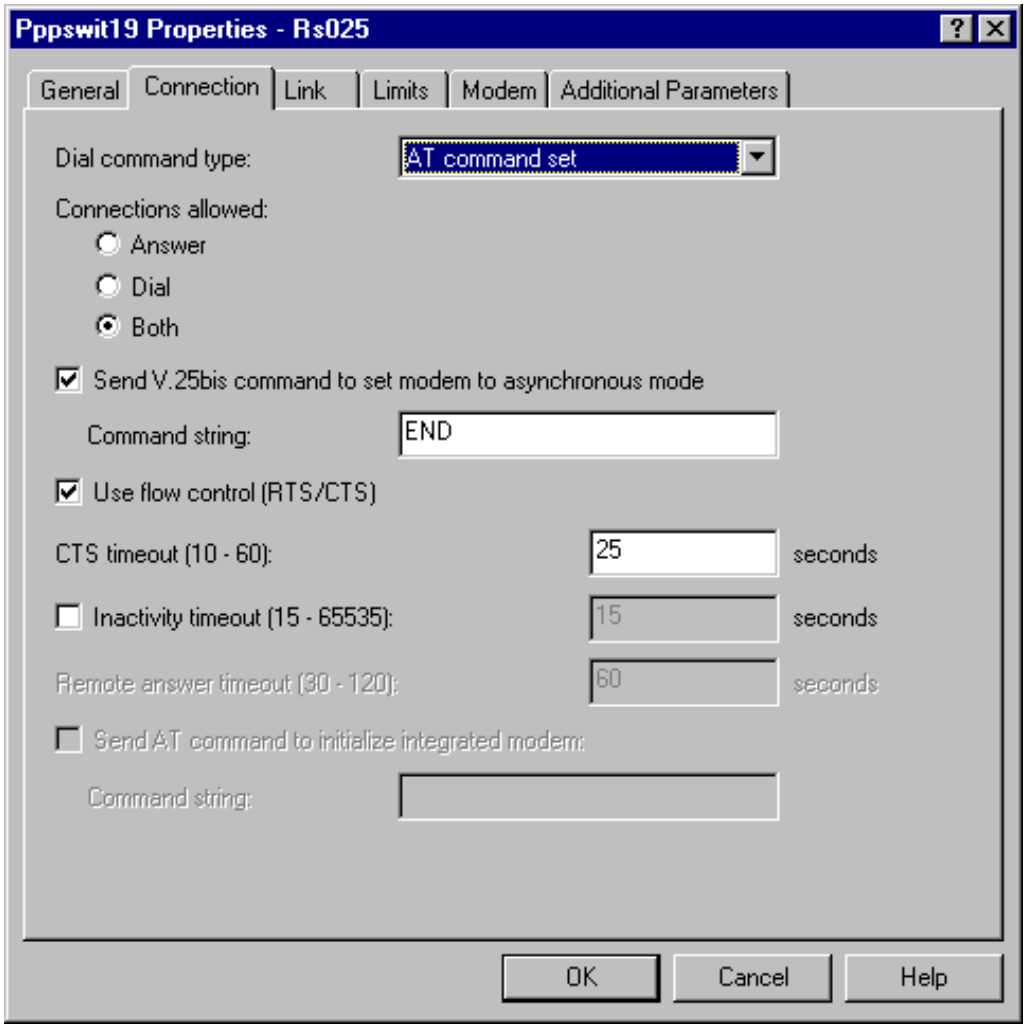
Configuring Connection Properties





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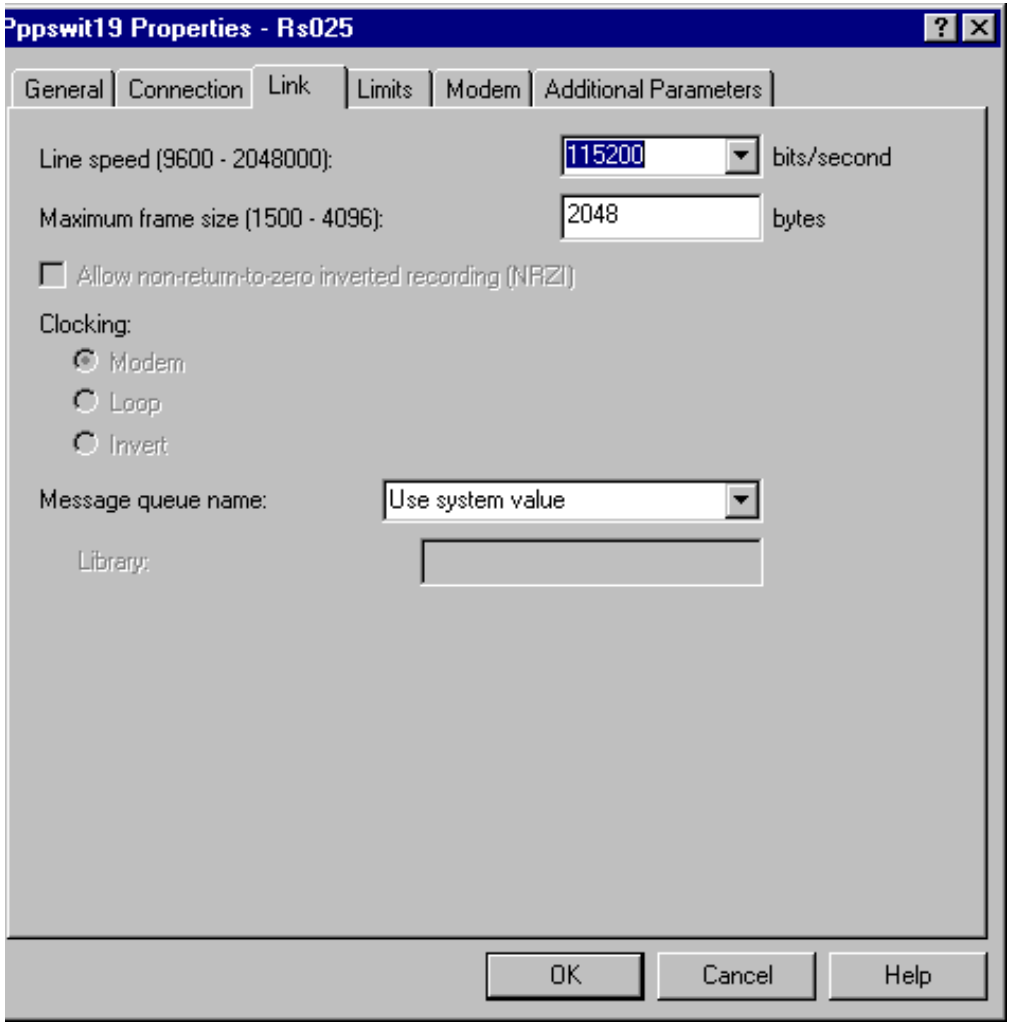
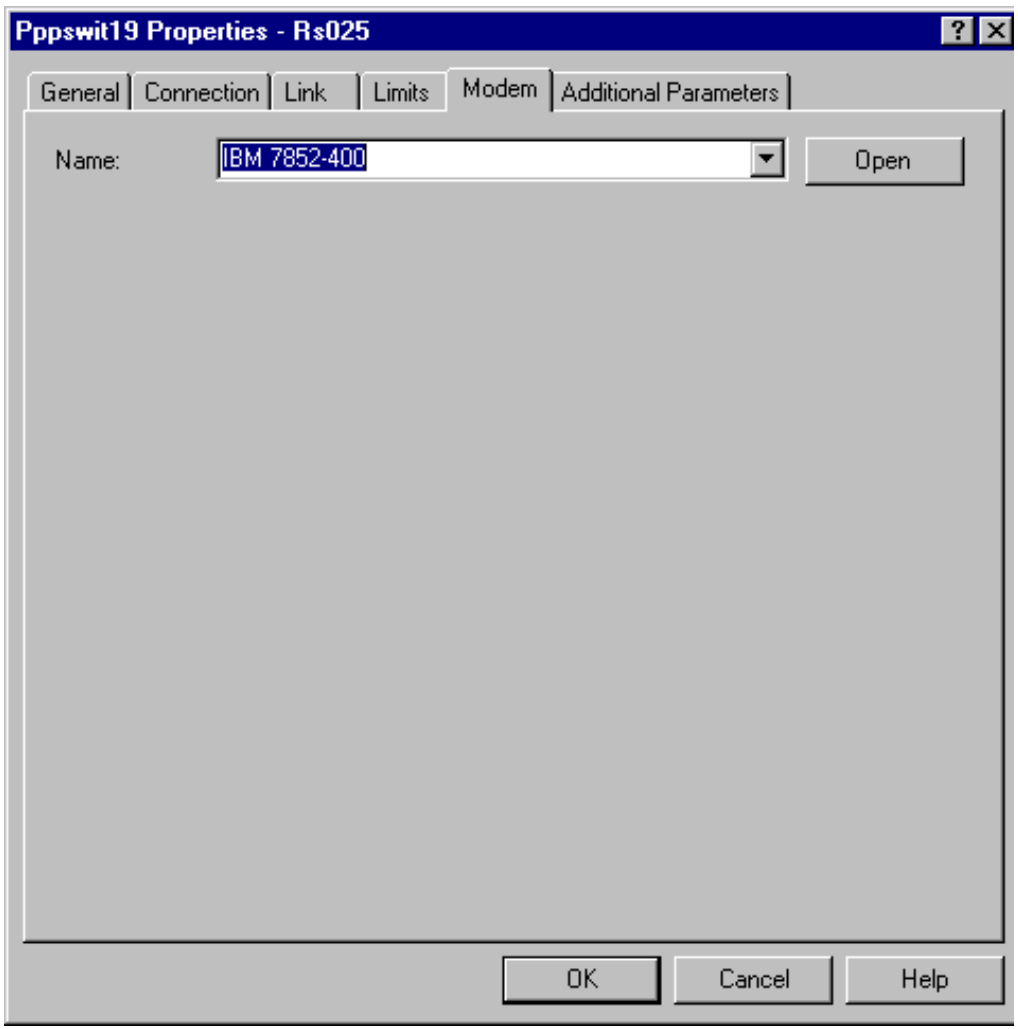
Configuring Connection Properties cont





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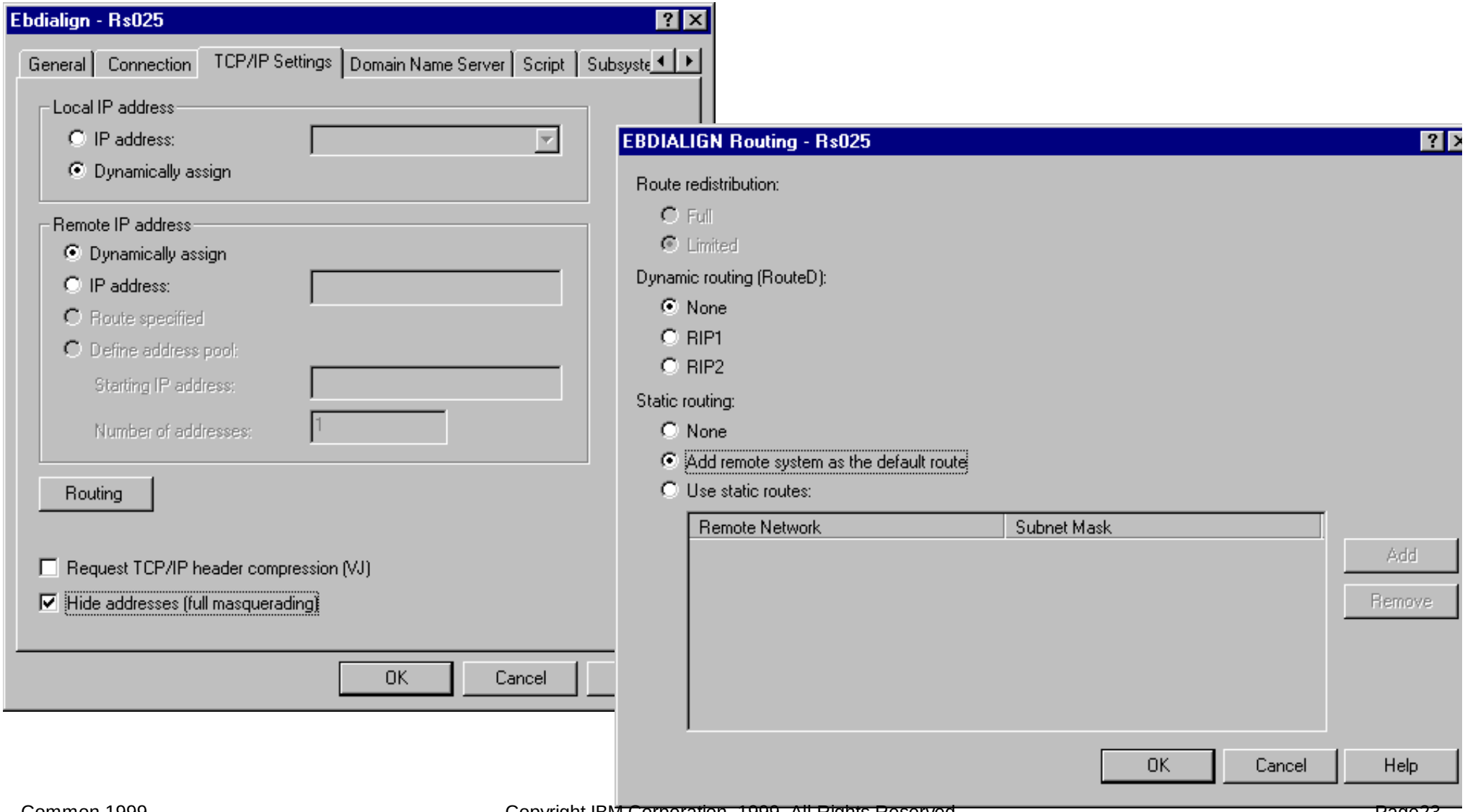
Configuring TCP/IP settings



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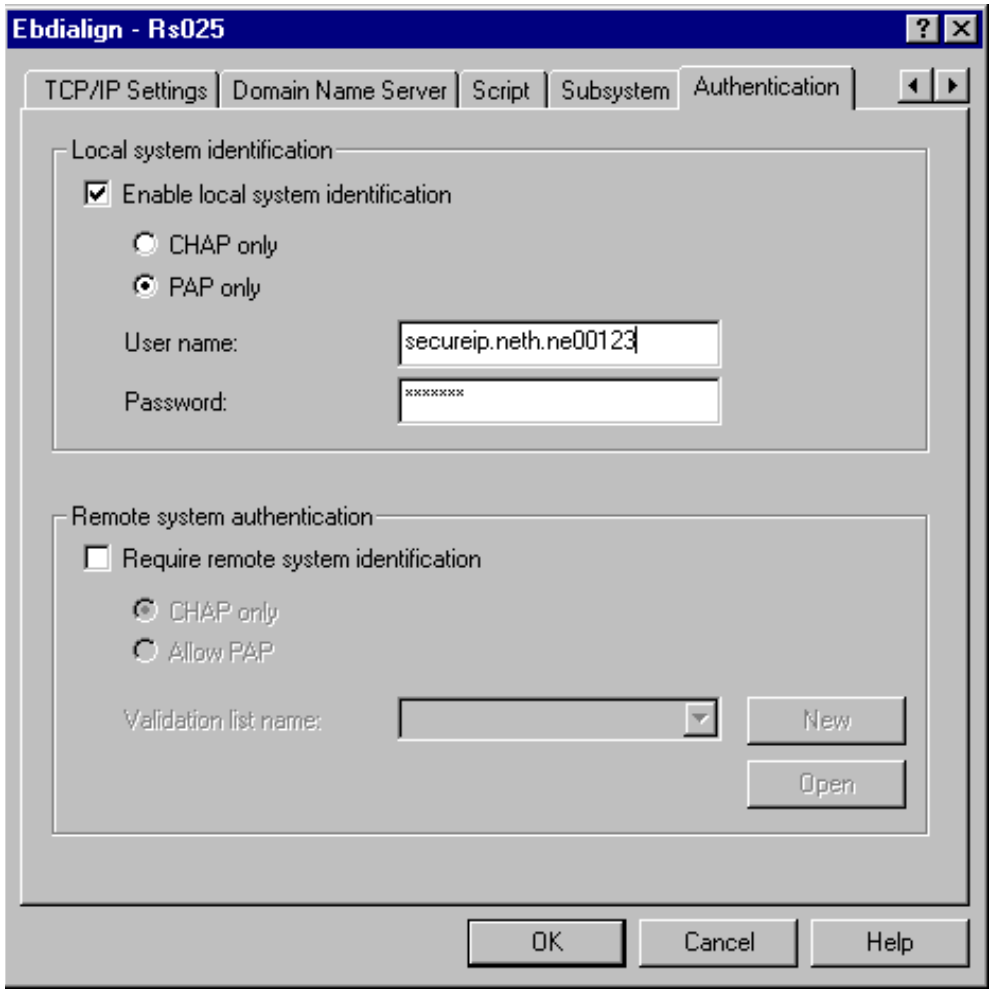
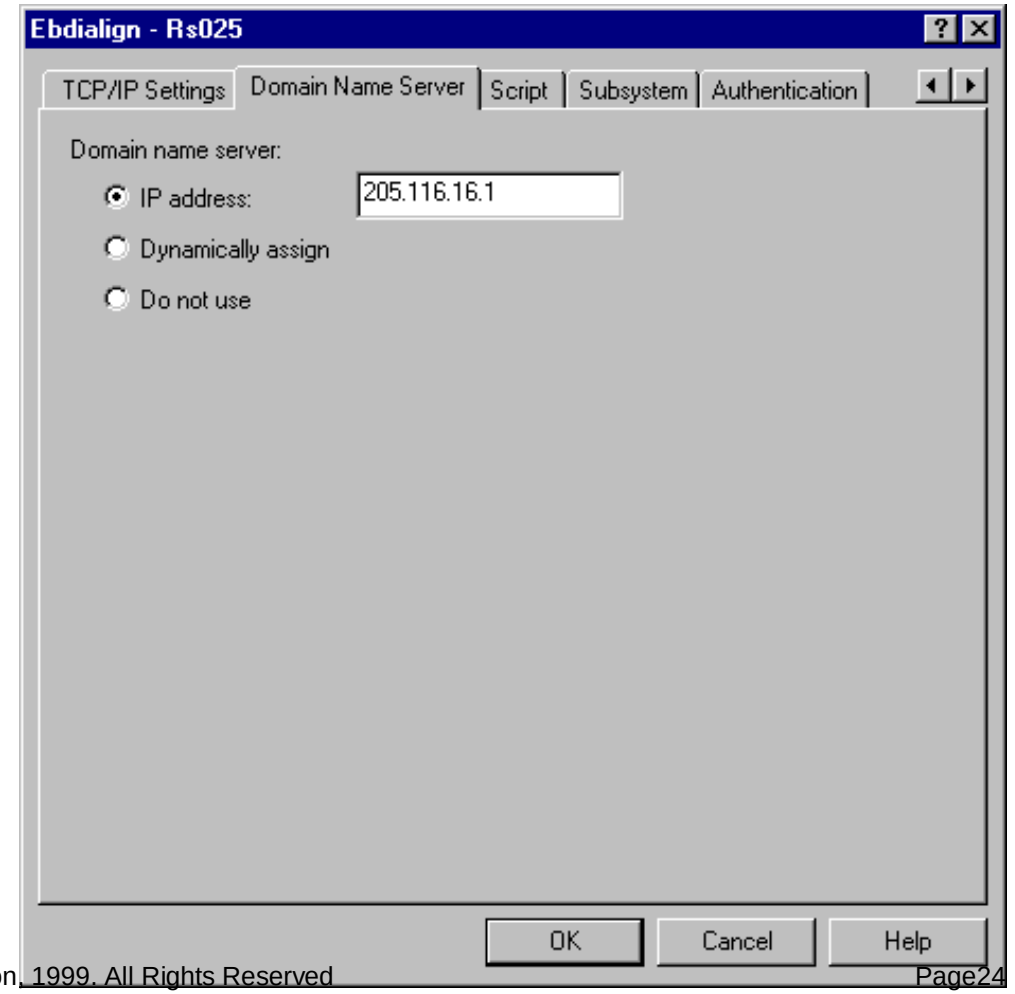
Configuring Authentication Properties



Configuring DNS Server



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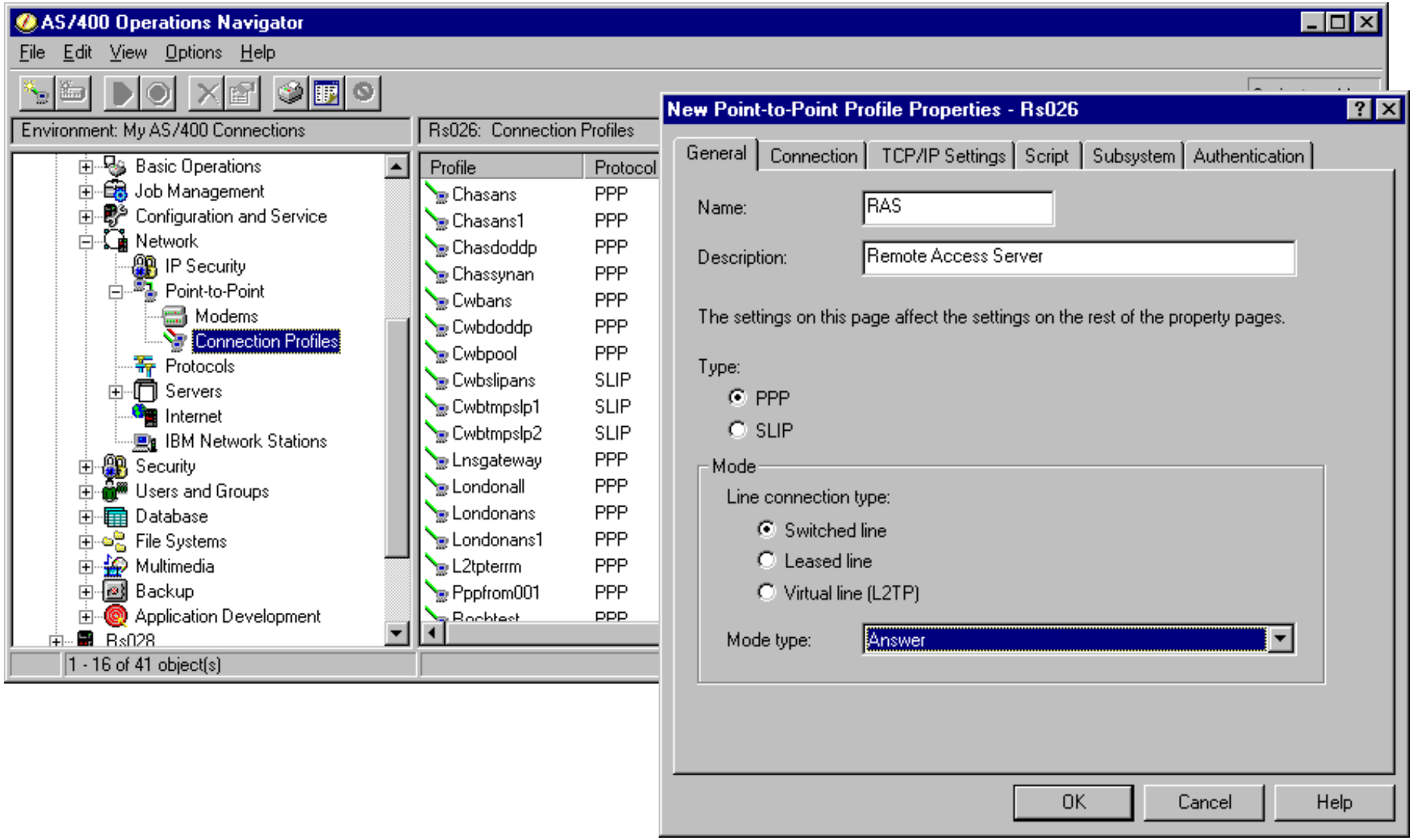
Configuring AS/400 as Remote Access Server



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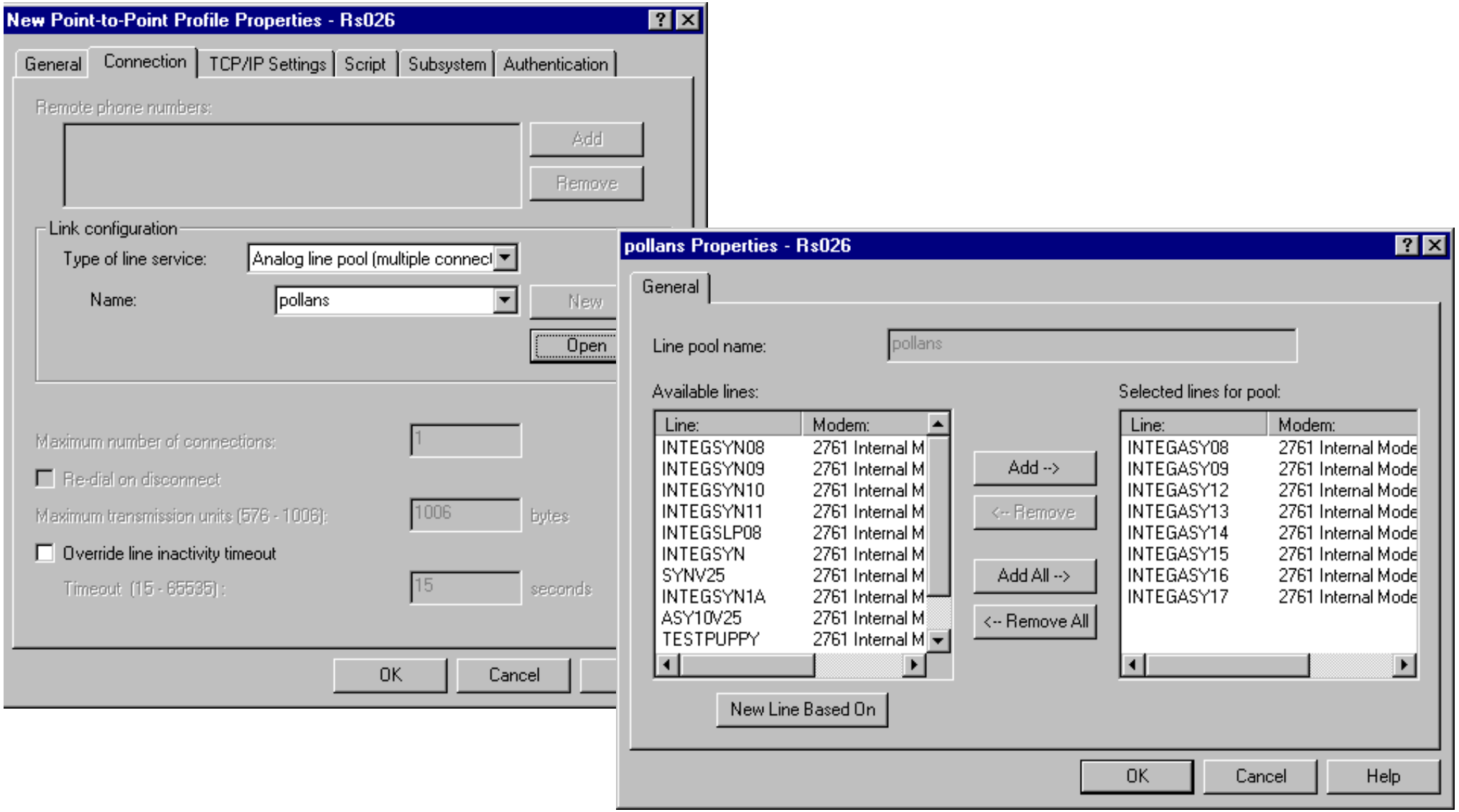
Configuring Connection Properties



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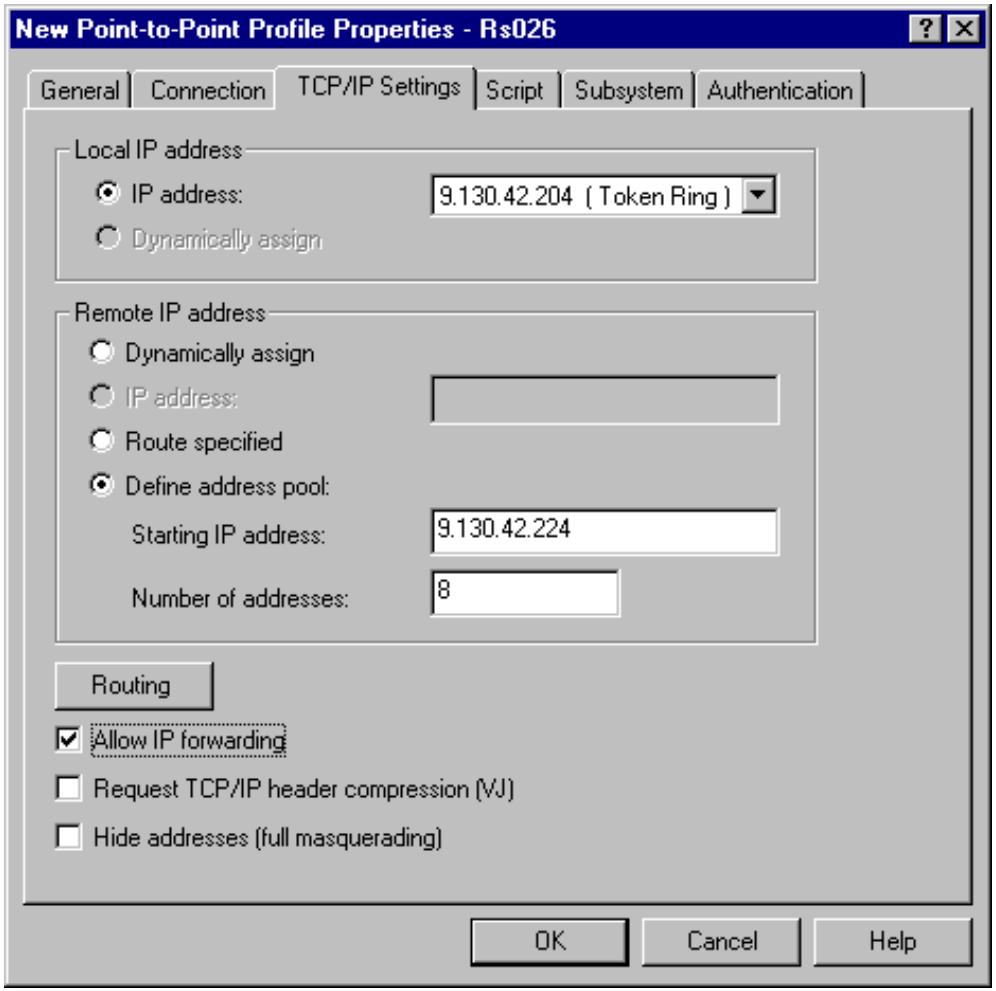
Configuring TCP/IP settings



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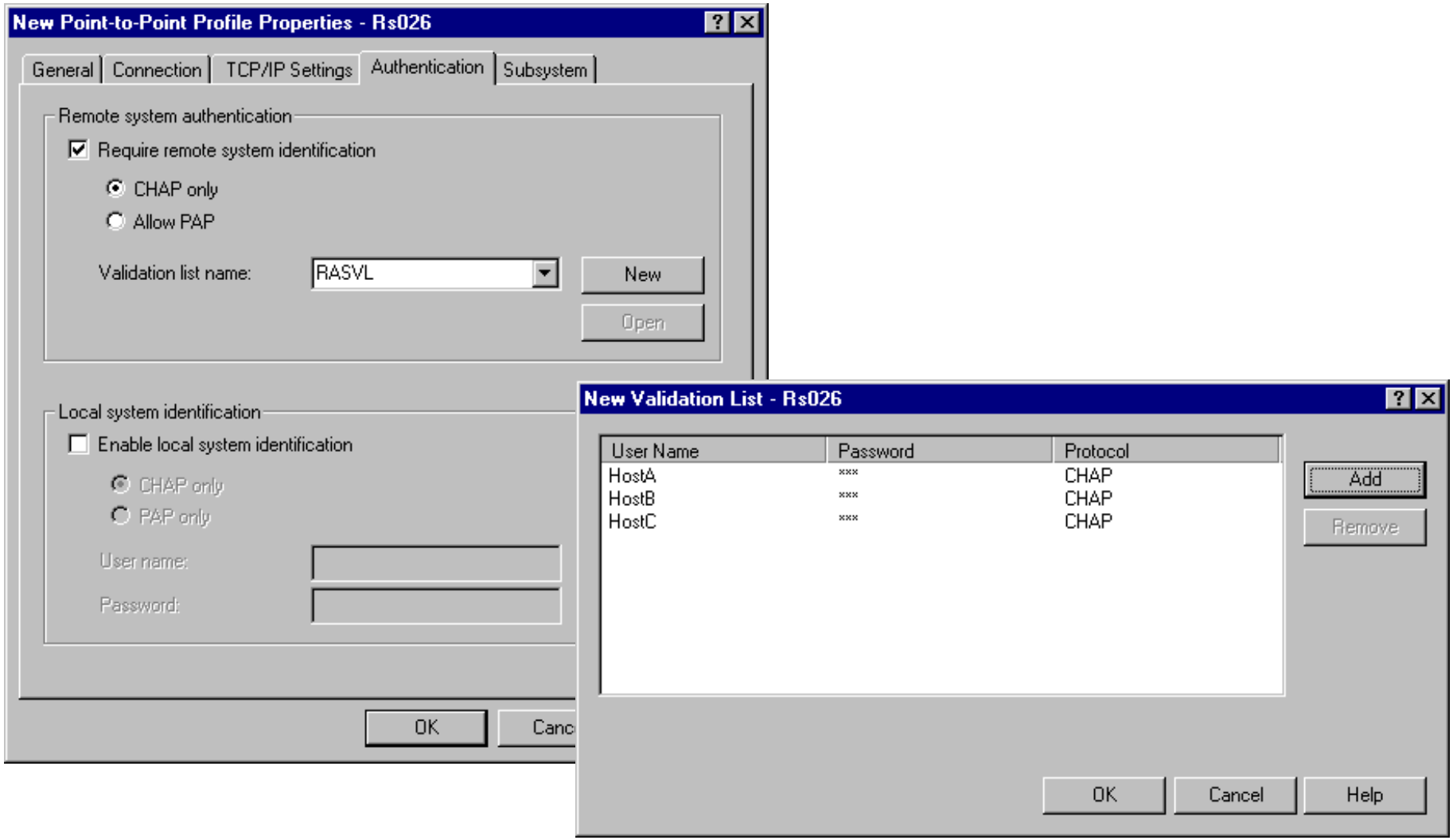
Configuring Authentication Properties



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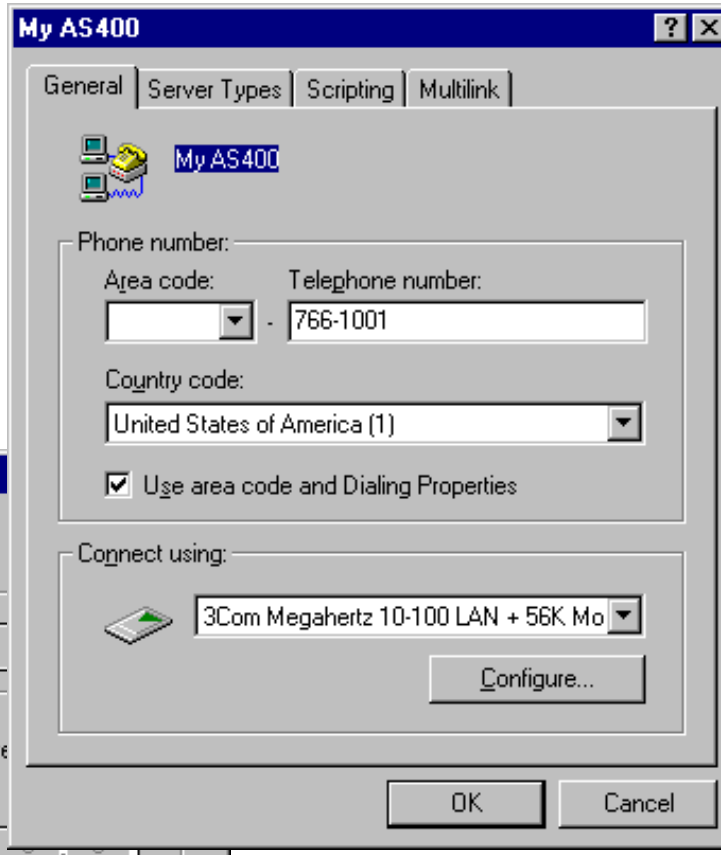
Configuring Win95/98/NT to Dial-Up AS/400 via PPP

1)

2)



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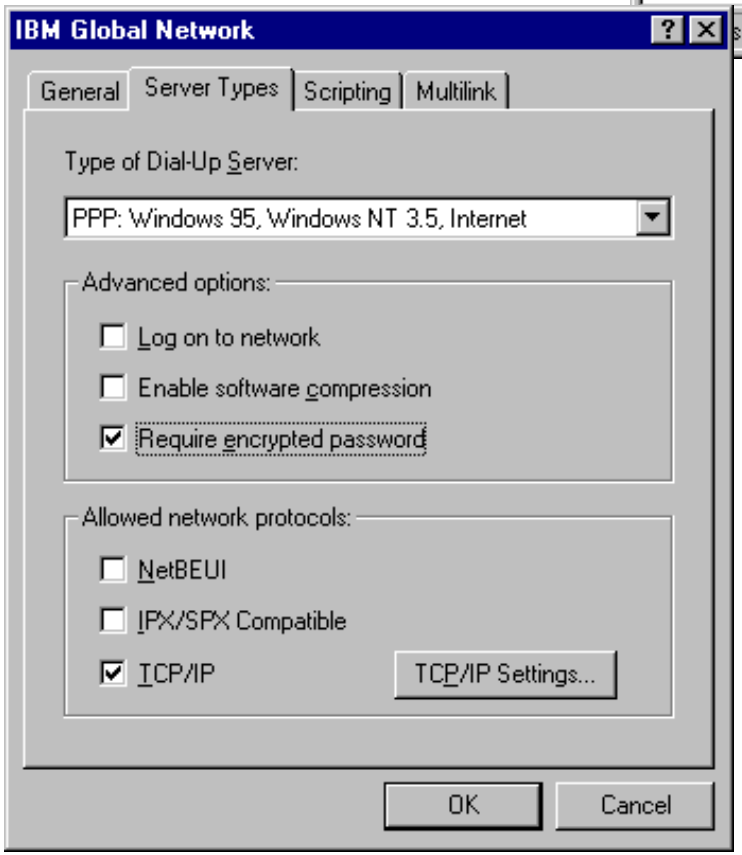

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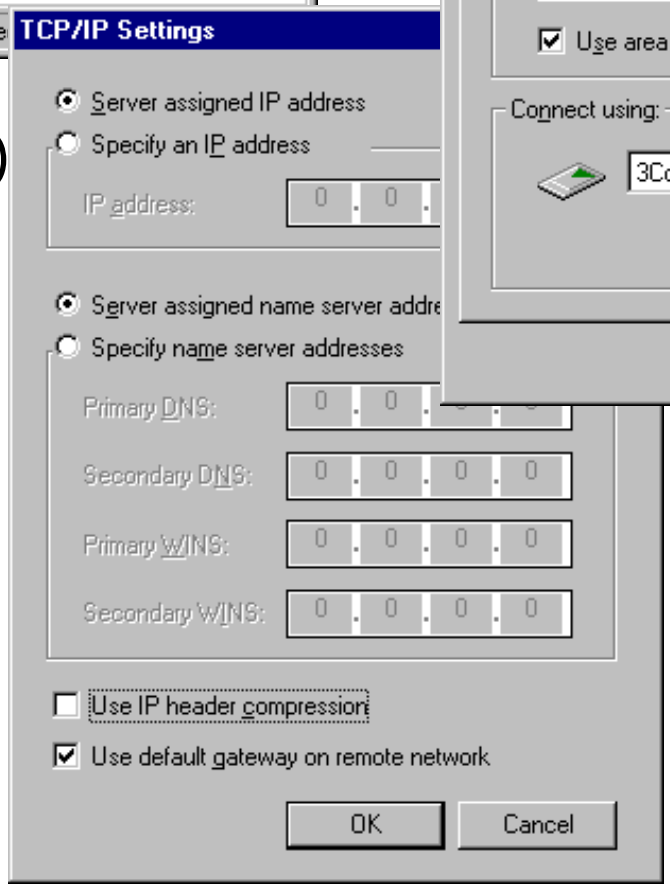

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Address Management

- **Unnumbered networks**
- **Proxy Arp Routing**
- **Ip Masquerading**
- **Dynamic Routing**
  - Static route redistribution
- **Frame Relay Address Topologies**

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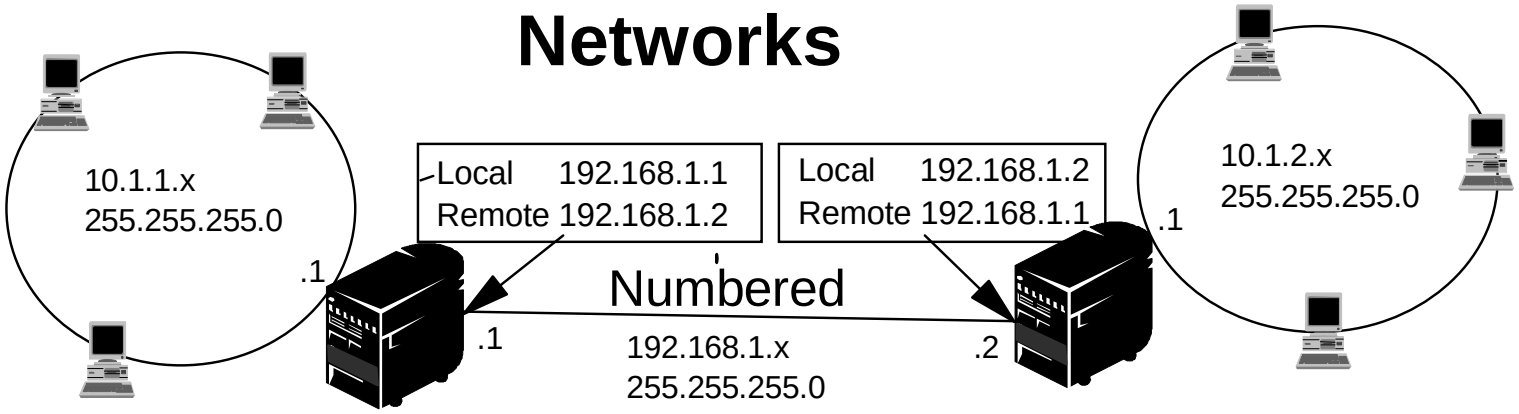
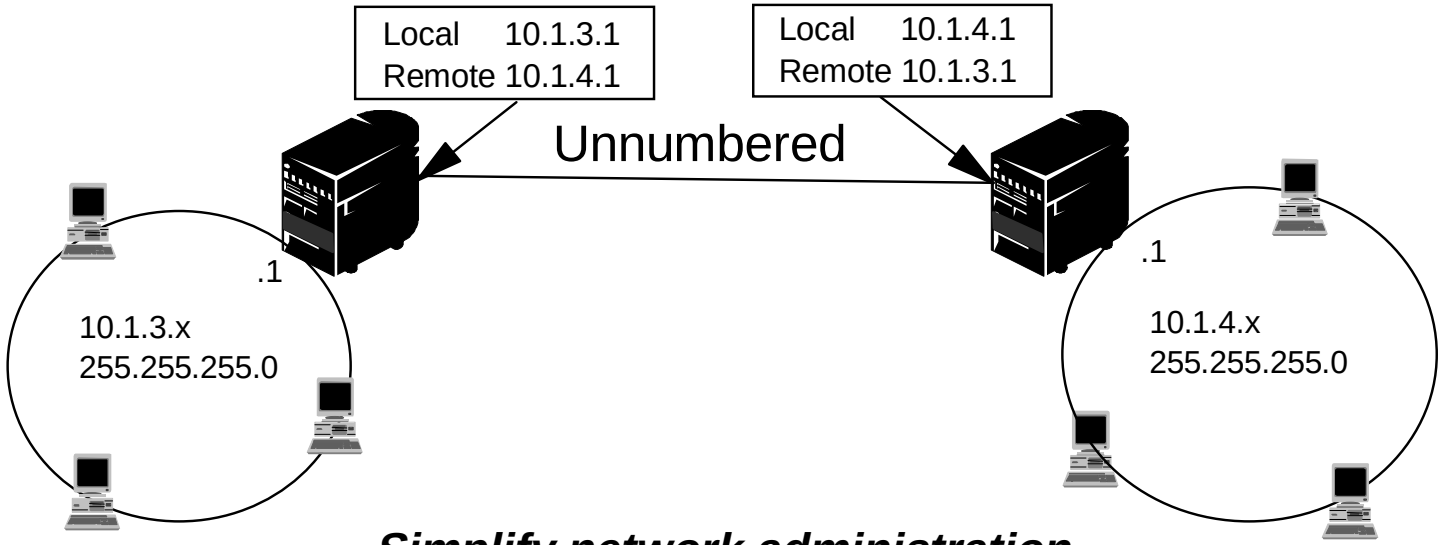
Point-to-Point Numbered vs Unnumbered Networks





Simplify network administration
Can save on precious addresses

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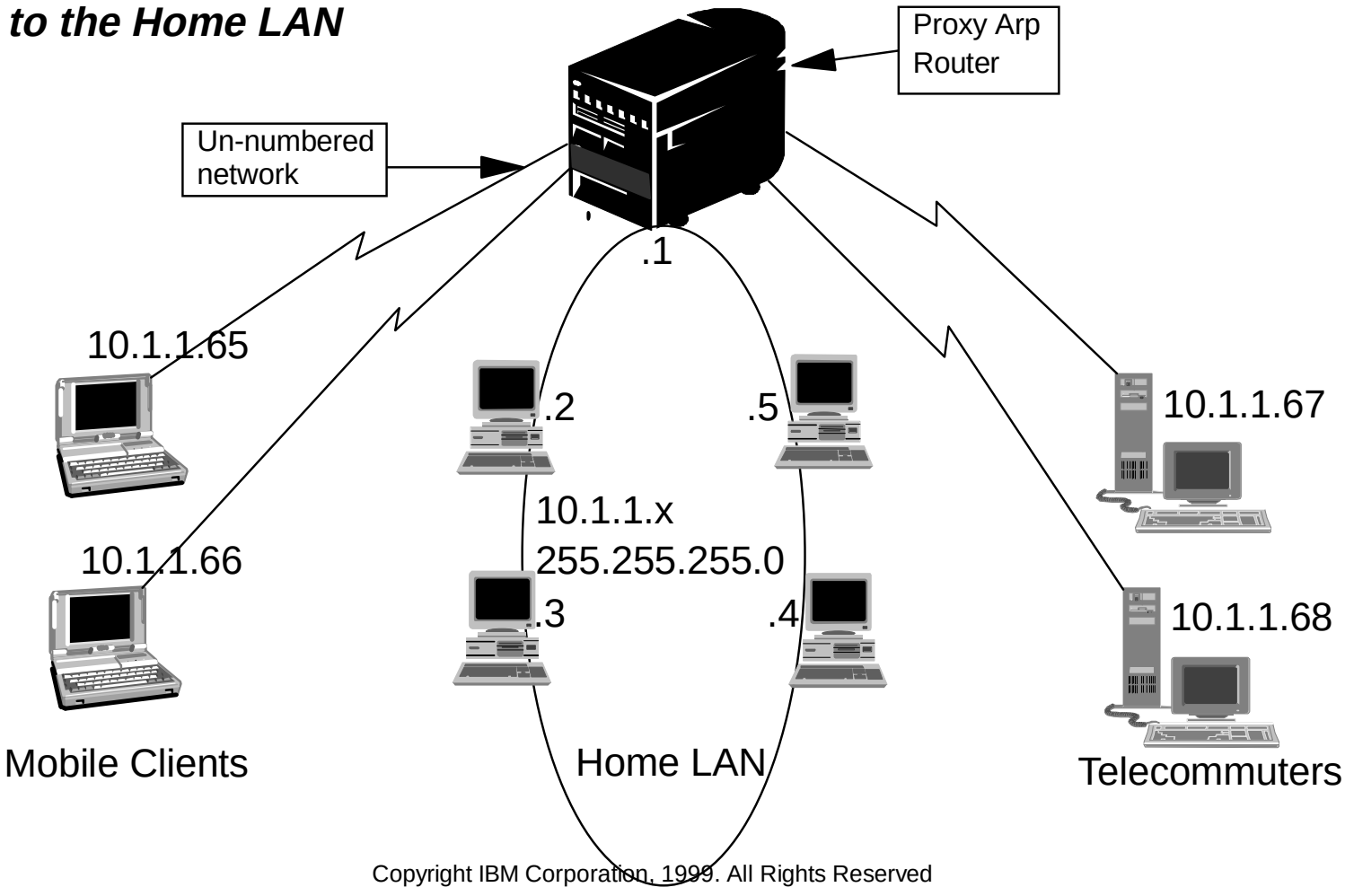
Proxy Arp Routing

Remote clients appear to be connected to the Home LAN



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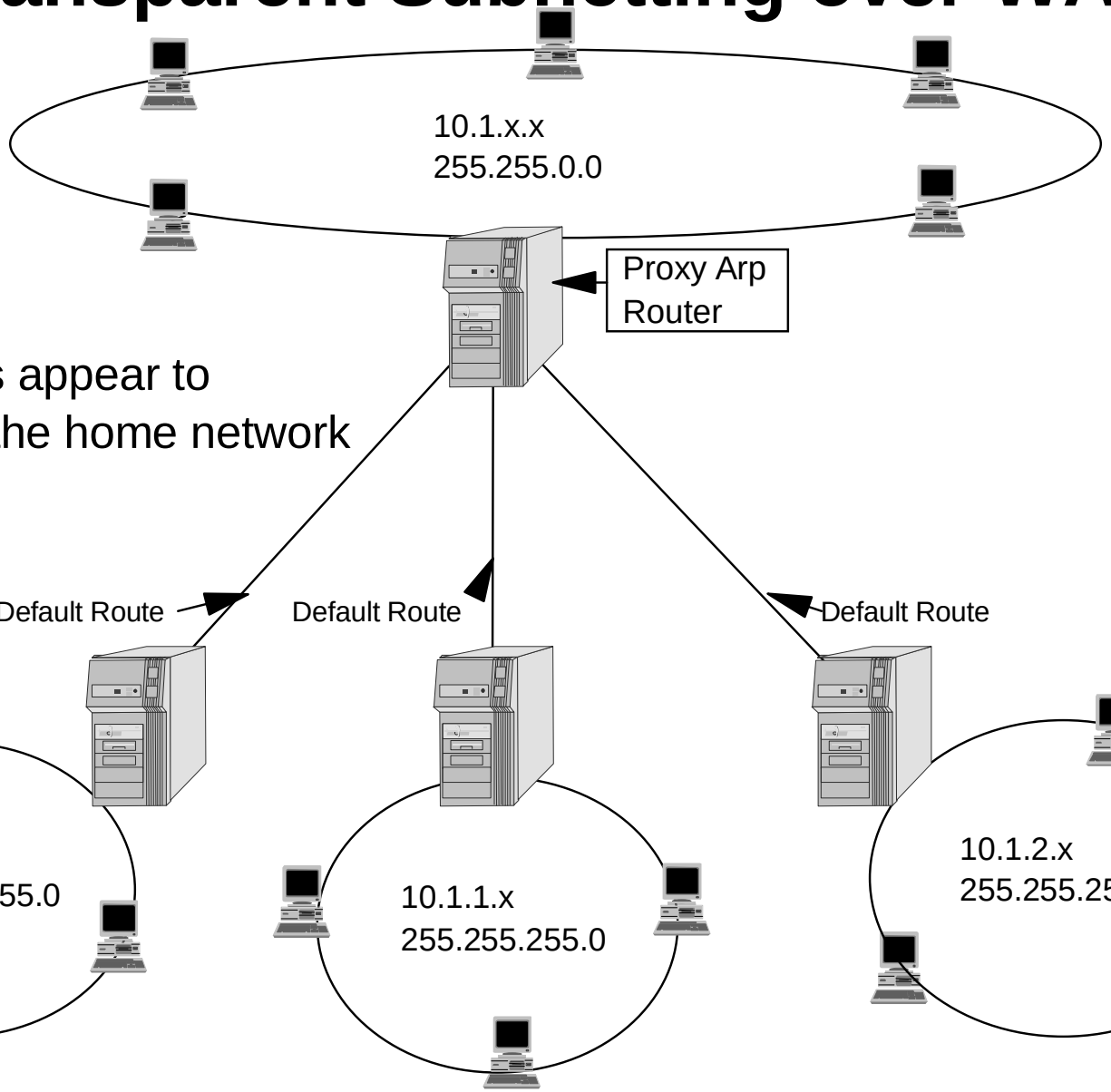
Transparent Subnetting over WAN



Stub Remote networks are assigned address out of the home network address space

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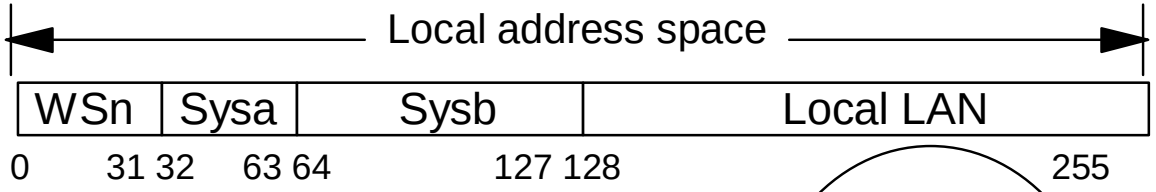
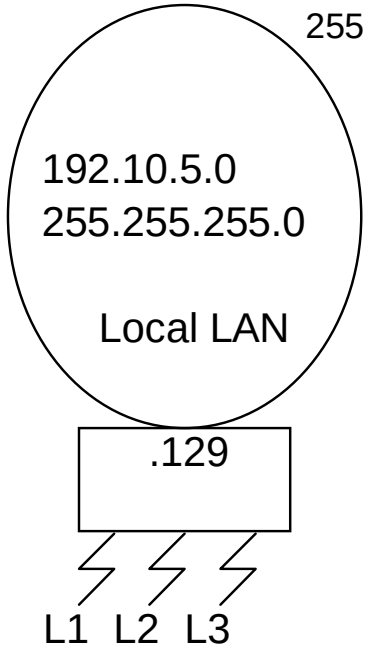
Remote Access Server Scenarios

Access Server (*ANS)

Local IP
192.10.5.129

Remote IP
Address Pool
192.10.5.16-192.10.5.31

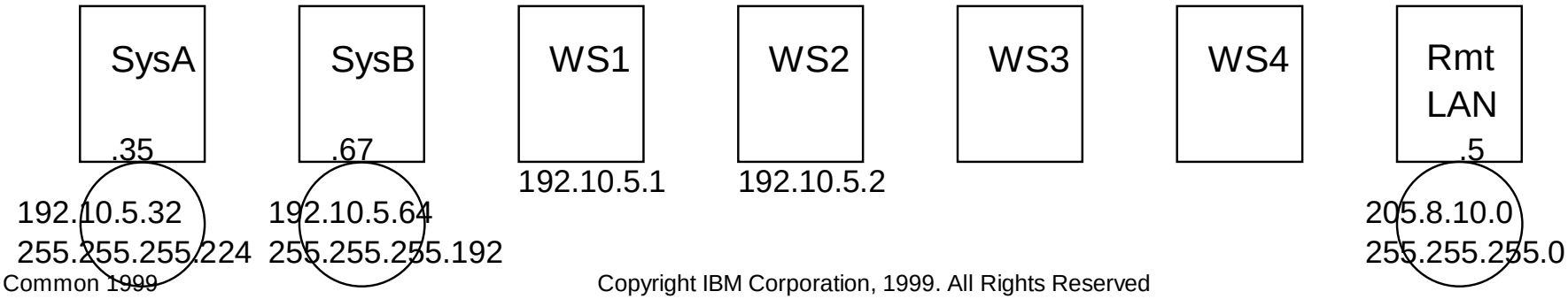




Route Specified

User	IP Addr	Remote NW	Mask
SysA	192.10.5.35	192.10.5.32	255.255.255.224
SysB	192.10.5.67	192.10.5.64	255.255.255.192
WS1	192.10.5.1		HOST
WS2	192.10.5.2		HOST
RmtLAN	205.8.10.5	205.8.10.0	255.255.255.0

Fixed LanAddr | Fixed IPaddr | Dynamic IPaddr



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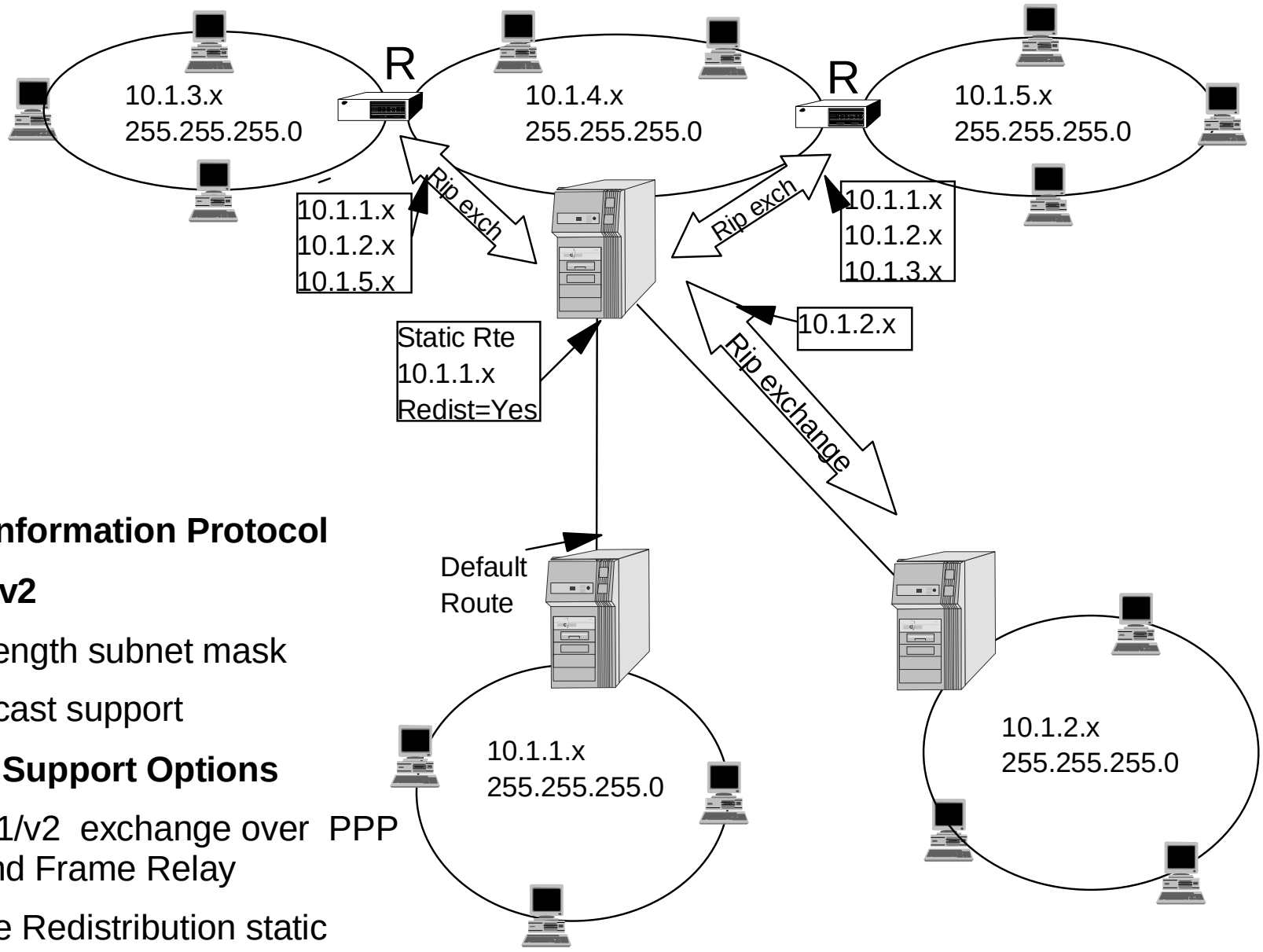
Dynamic Routing with/over WANs



Routing Information Protocol

V4R2 RIPv2

- Var length subnet mask
- Multicast support

RIP WAN Support Options

- RIPv1/v2 exchange over PPP and Frame Relay
- Route Redistribution static Route

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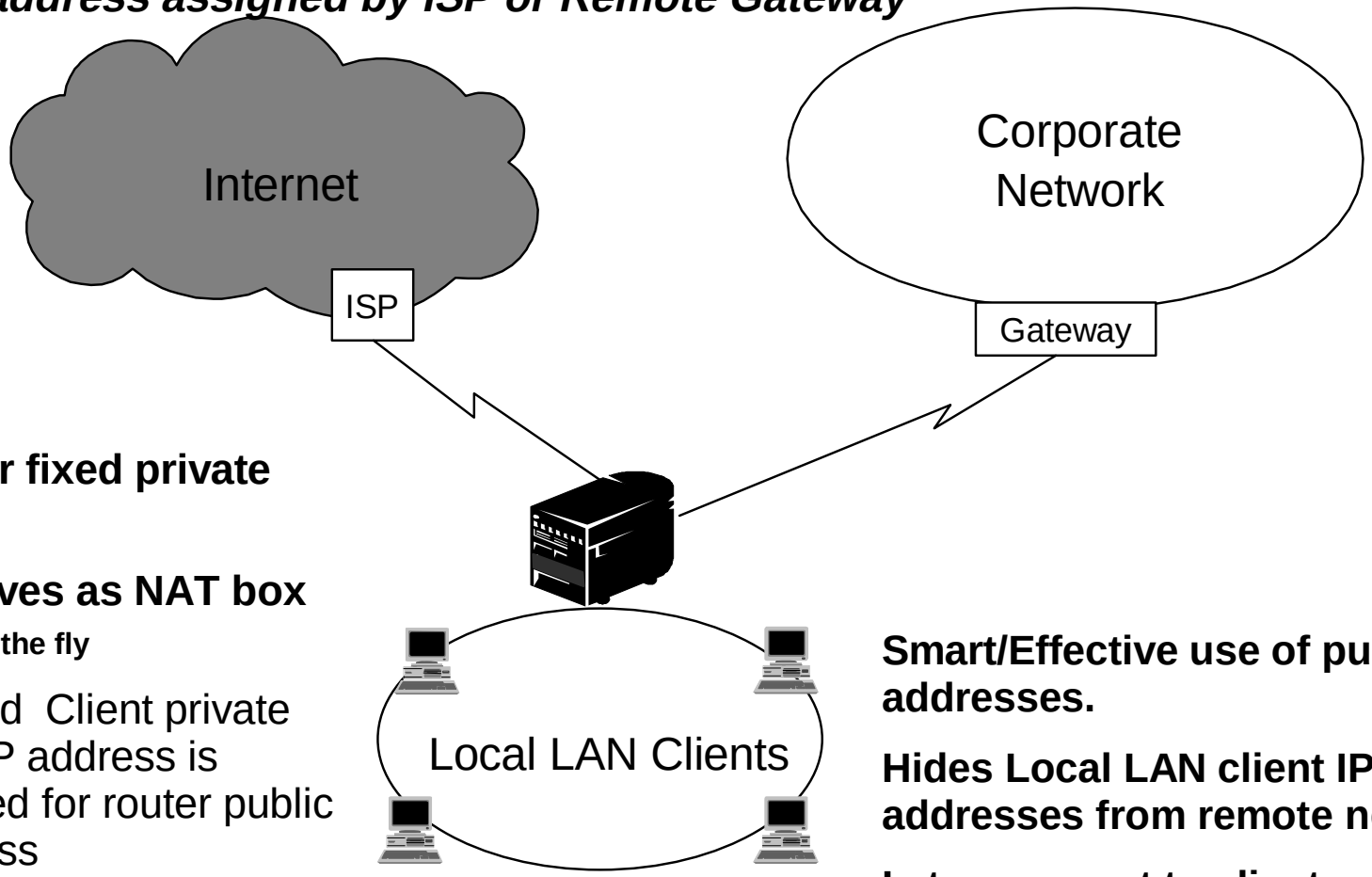
Address Masquerading

Allows multiple clients in a local network to simultaneously access remote networks using single IP address assigned by ISP or Remote Gateway



Clients use their fixed private addresses.

LAN Router serves as NAT box

-modifies packets on the fly

- On outbound Client private source IP address is subsituted for router public IP address
- On inbound destination IP address is replaced with Client private address

Smart/Effective use of public IP addresses.

Hides Local LAN client IP addresses from remote network

Is transparent to clients -providing client IP address isn't buried in data -requires special handling

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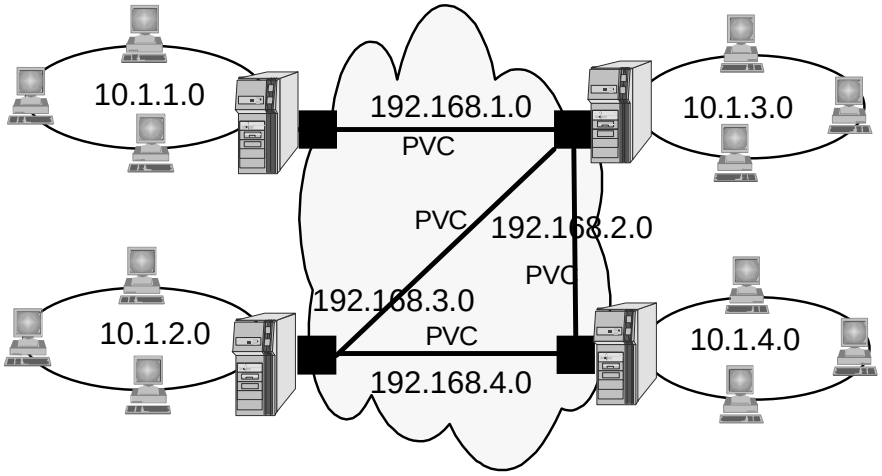
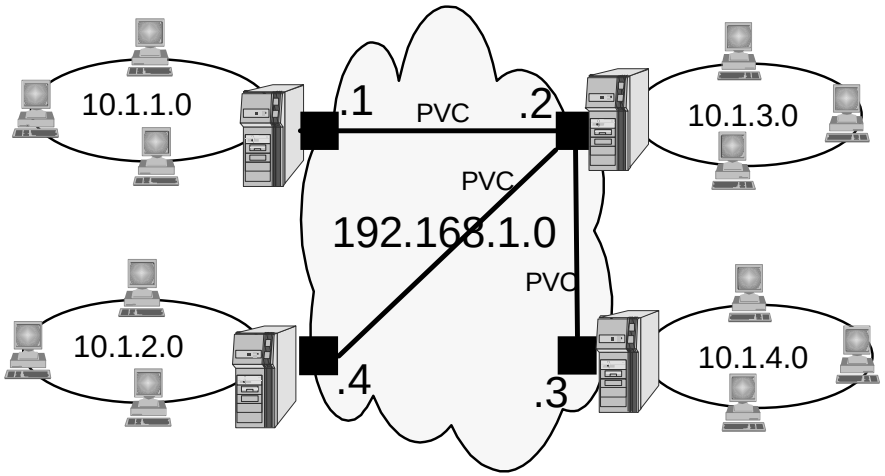
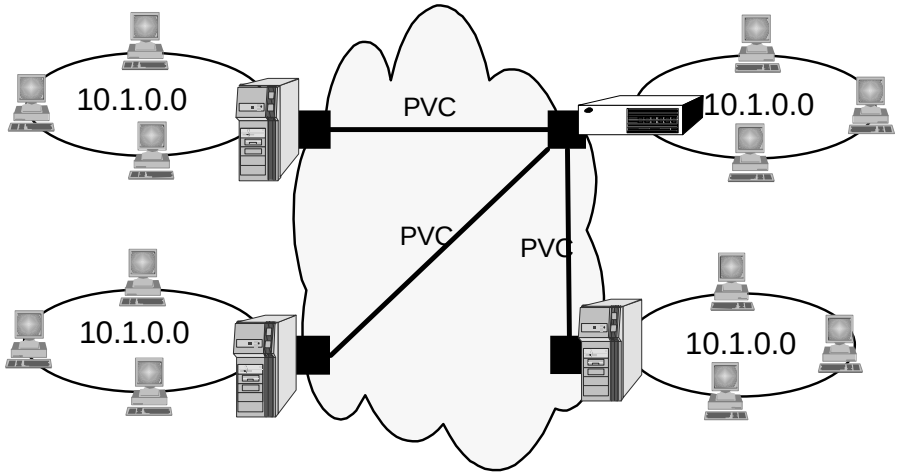
AS/400 Frame Relay Address Topologies



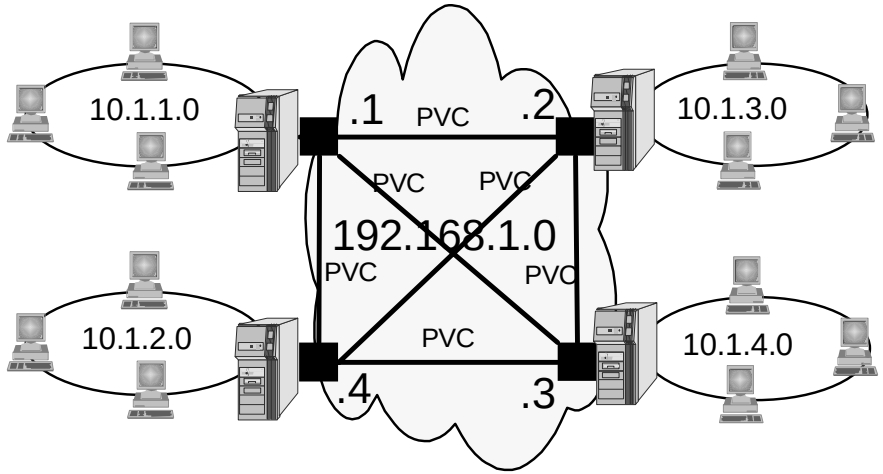
P-P Numbered Network



Non-Broadcast Multi-Access
Partially-meshed



Bridged LAN Network



Non-Broadcast Multi-Access
Fully-meshed

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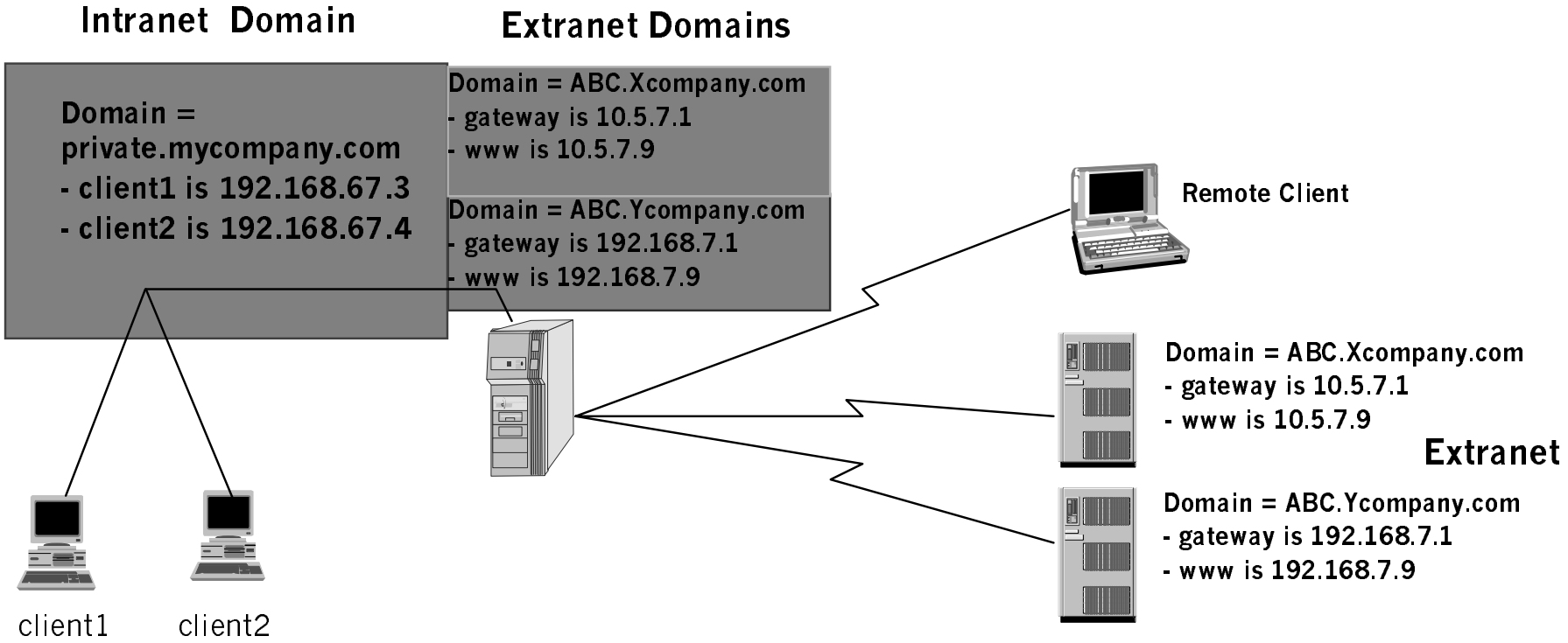
Domain Name Services Basic

Simplistic Multiple Domain Methodology

Use Primary Directive

- To define local domain and also each remote domain
  - Reasonable approach for small number remote hosts

PPP AS/400 dynamically assigns remote client its DNS address(RFC 1877)



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Domain Name Services Advanced

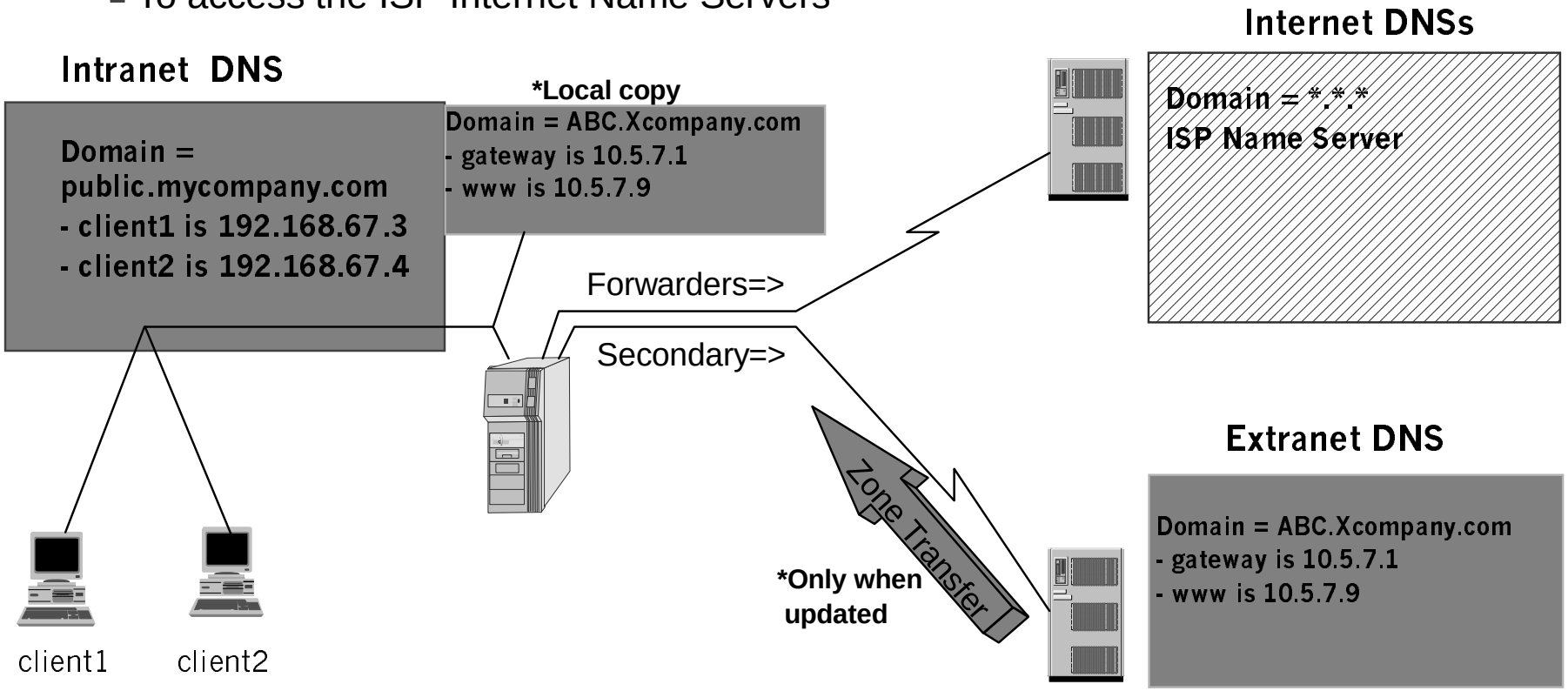
Adding Remote Domains dynamically with WAN Links

Use Secondary Directive(s)

- To transfer remote Extranet domain info from each remote name server
- For co-located DNS & RAS. AS/400 will send HUP signal to DNS to force secondary load when PPP link comes up

Use Forwarders Directive

- To access the ISP Internet Name Servers



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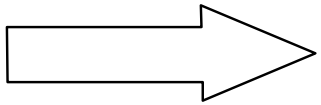
Security Policy Enforcement

Security Gateway

Firewall Technology

- IP packet filtering
- Proxy servers
- SOCKS server
- Domain name services
- Encrypted IP tunnels
- VPN(L2F,PPTP,L2TP)



Firewall systems

- Packet filtering router
- Dual-homed gateway firewall
- Screened host firewall
- Screened subnet firewall

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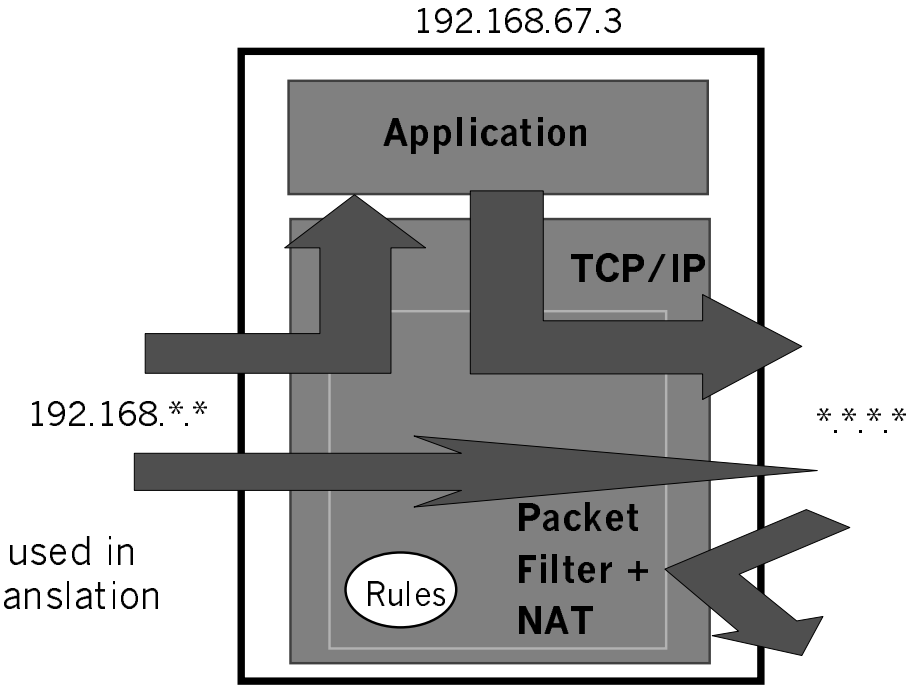
IP Packet Filtering

Screens Internet packets (TCP,UDP,ICMP)

- Controlled by filter rules
- Unwanted packets are discarded
- Variety of levels of discrimination

Characteristics

- Seamless, transparent access
- Trust based on IP address
- Can hide internal IP addresses when used in conjunction with Network Address Translation



Example rules

Permit any telnet packets from 192.168.*.* to *.*.*.* to be routed through
Permit any telnet response packets from *.*.*.* to 192.168.*.* to be routed through

Permit inbound http packets from 192.168.*.* to local applications at 192.168.67.3
Permit outbound http response packets from local applications at 192.168.67.3 to 192.168.*.*
Permit outbound http packets from local applications at 192.168.67.3 to *.*.*.*
Permit inbound http response packets from *.*.*.* to the local application at 192.168.67.3

Deny all other traffic

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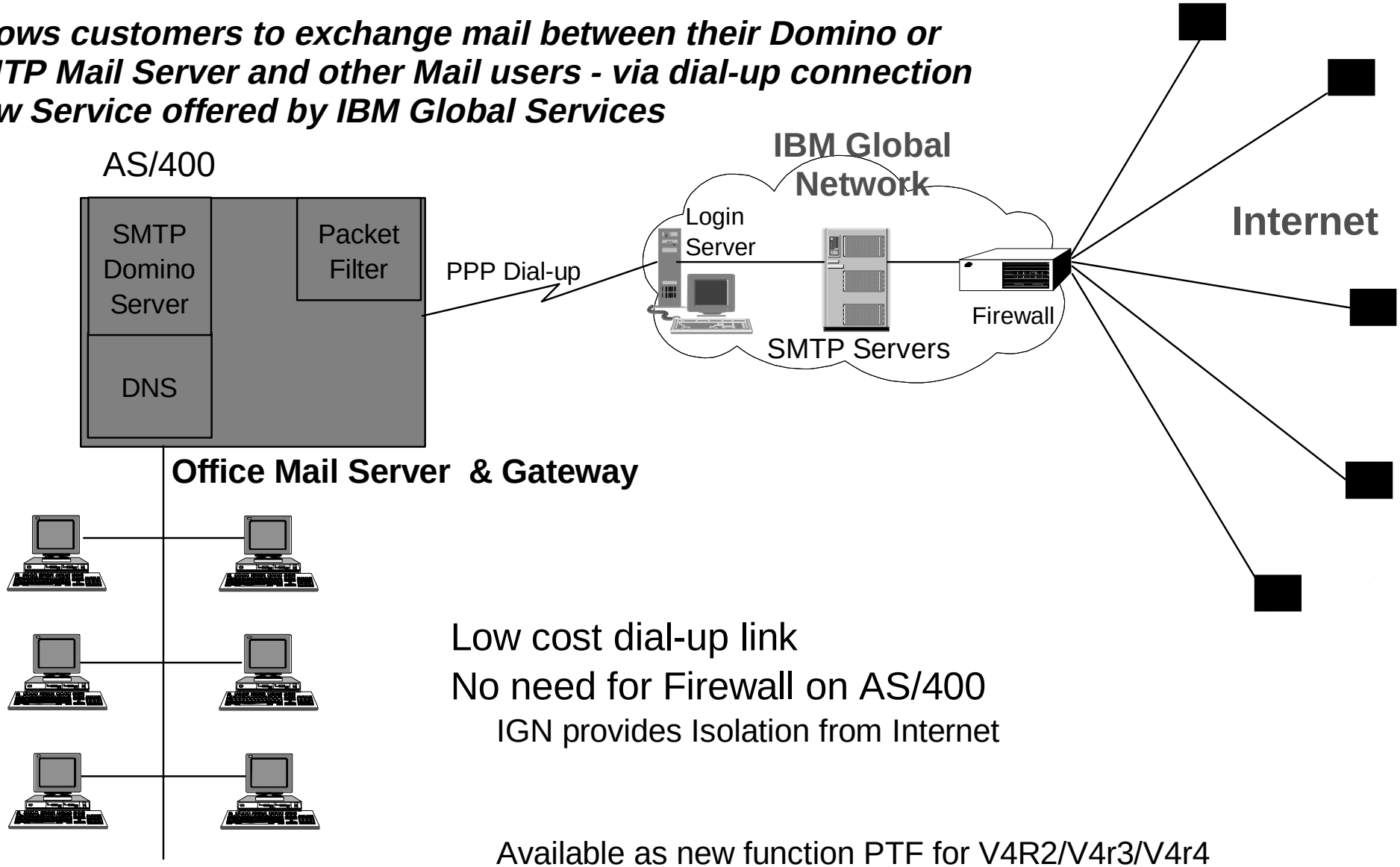
Dial SMTP for AS/400

Allows customers to exchange mail between their Domino or SMTP Mail Server and other Mail users - via dial-up connection
New Service offered by IBM Global Services



Low cost dial-up link

No need for Firewall on AS/400

IGN provides Isolation from Internet

Available as new function PTF for V4R2/V4r3/V4r4

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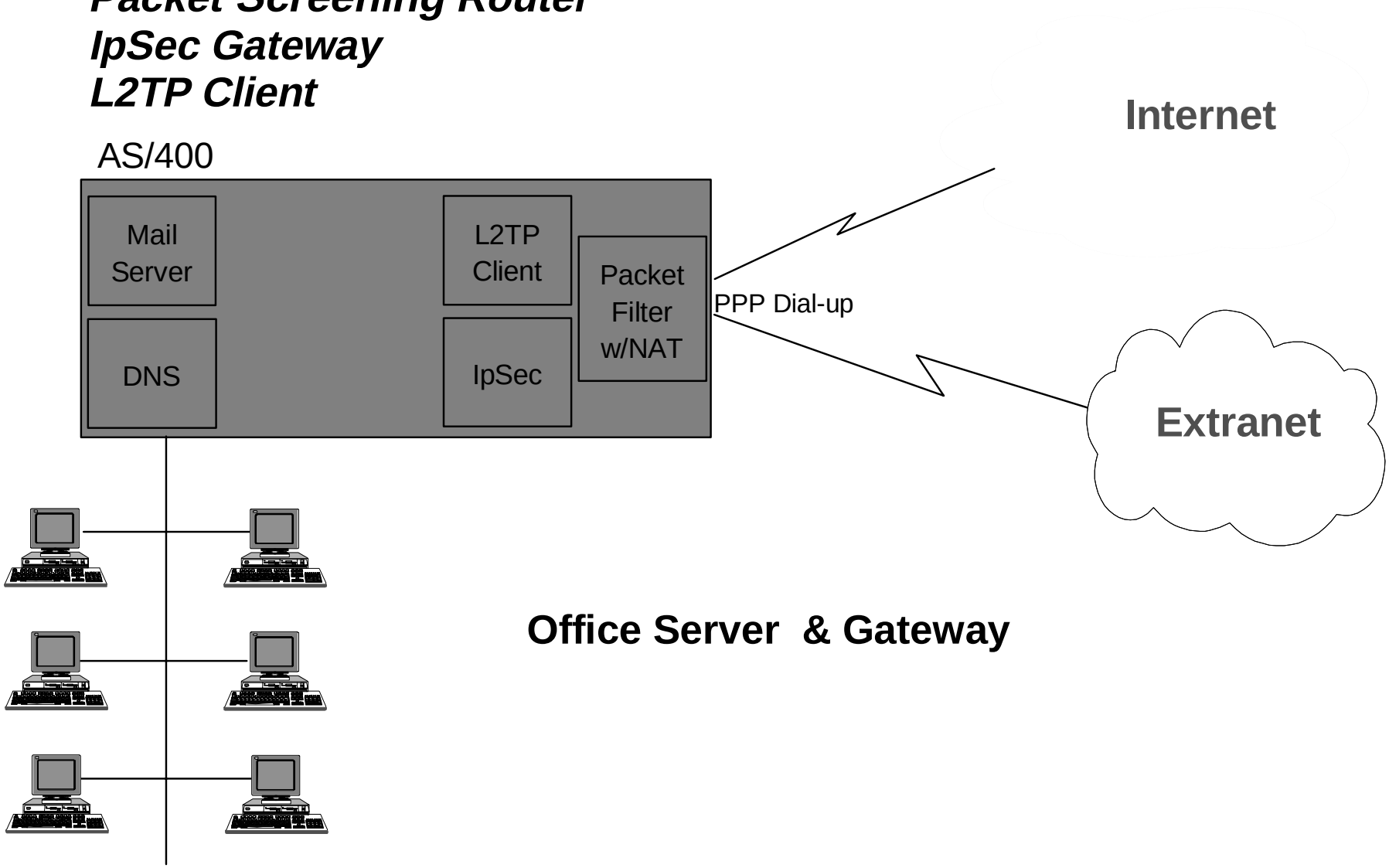
AS/400 Entry Level Security Gateway

Packet Screening Router
IpSec Gateway
L2TP Client



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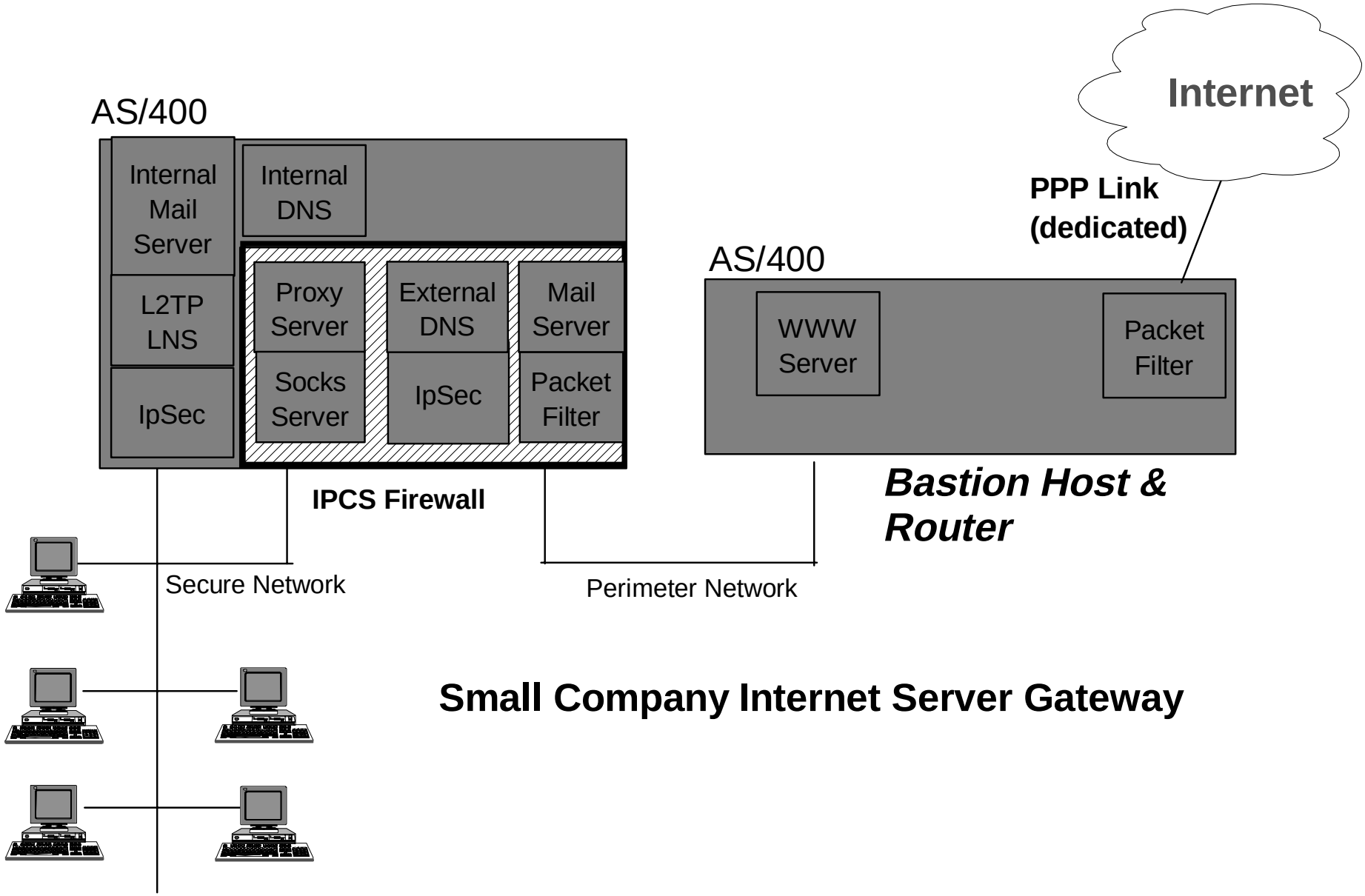
AS/400 as Merged Bastion Host & Exterior Router



Small Company Internet Server Gateway

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AS/400 TCP/IP WAN History

Pre-V4R1

- X.25, X.25 over ISDN, Frame Relay, SLIP

V4R1

- Dynamic Routing Information Protocol Ver 1 (RIPv1)
- New COM hardware (IOA's #2699, #2720, #2721 providing async at 115.2kbps)

V4R2

- Point-to-Point Protocol(PPP) -analog and high speed links
- Dynamic Routing Information Protocol Ver II (RIPv2)
- Proxy Arp Routing
- Domain Name Server(DNS)

V4R3

- PPP Dial-on-Demand
- Network Address Translation (NAT)
- Packet Filtering

V4R4

- PPP extensions - Remote Access Layer 2 Tunneling Protocol
- Native IpSec
- **New V4R4+ COM hardware #2750,#2751,#2752**

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AS/400 TCP/IP WAN Positioning

Position AS/400 As "Edge Server"

Multifunctional box that sits between LANs and WANs with integrated server functions, routing and remote-access capabilities

- **Exploit AS/400 Inherent Strengths**
  - Security (Program Objects, User Profiles, Access limitations, etc)
  - Robust Multi-User Operating System
  - High Availability
- **Easier to implement and manage**
  - Simpilify network management
  - Reduce overall cost

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