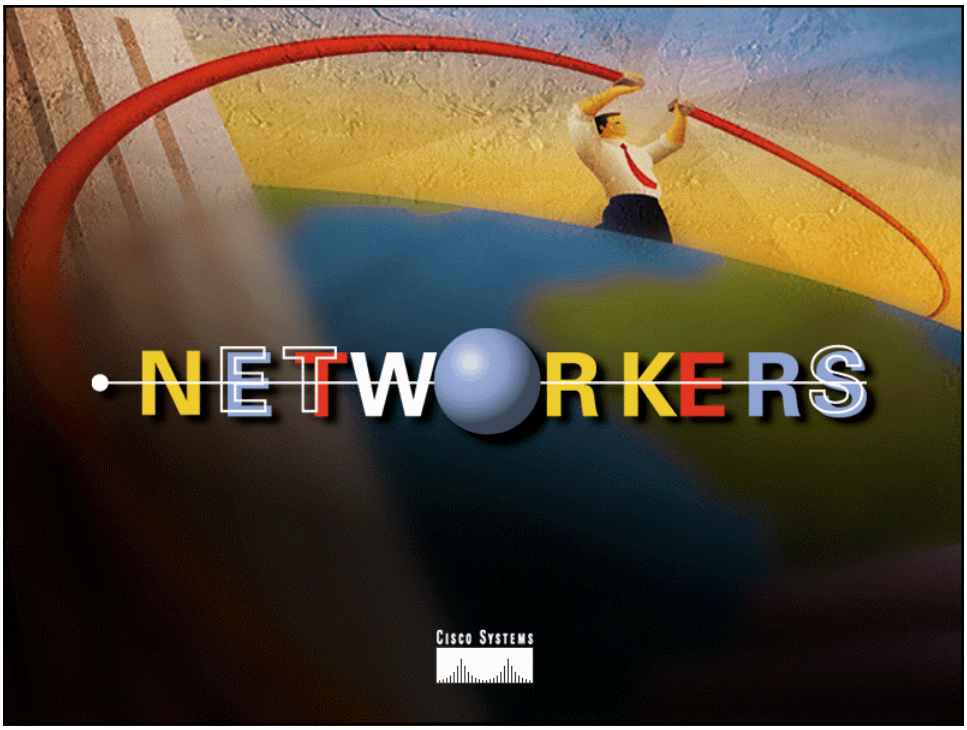

Agenda

- Dial Design Principles and Product Base
- Core Dial Technology
  - AAA, IP Routing, Virtual Private Networking, Service Level Agreements
- Putting It All Together
  - Wholesale Dial and Corporate Dial Outsource
- Miscellaneous Tips and Tricks
- SS7/C7 for Dial Access
- Summary

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Core Dial Design Principles

- Centralize administration
- Distribute implementation
- Minimize IP routing complexity
- Maximize dial server performance
- Design for resiliency

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At-a-Glance Dial Product Selector

	Capacity (T1/E1)	2xBellcore Reliability	Redundancy Features	Main Processor	Interface Options	List Price per Port
AS5200	48/60	98.5%	None	20Mhz MC68030	T1/E1, 10BaseT, T1/E1 Serial	US$360
3640	48/60	99.83%	Redundant DC/AC Power	100Mhz R4700	T1/E1, 7000 Combinations	US$500
AS5300	192/240	99.98%	Redundant DC/AC Power	150Mhz R4700	T1/E1, 10/100BaseT, T1/E1 Serial	US$418
AS5800	1344/1440	99.999%	Redundant Modems, Controllers, Power	266Mhz R7000	T1/E1/CT3, Any 7200/7500 PA	US$437
AP-TS3	2496/3120	99.9999%	Redundant Shelves, Switch, Power	150Mhz R4700	T1/E1, Any 7200/7500 PA	US$457

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Authentication, Authorization and Accounting (AAA)

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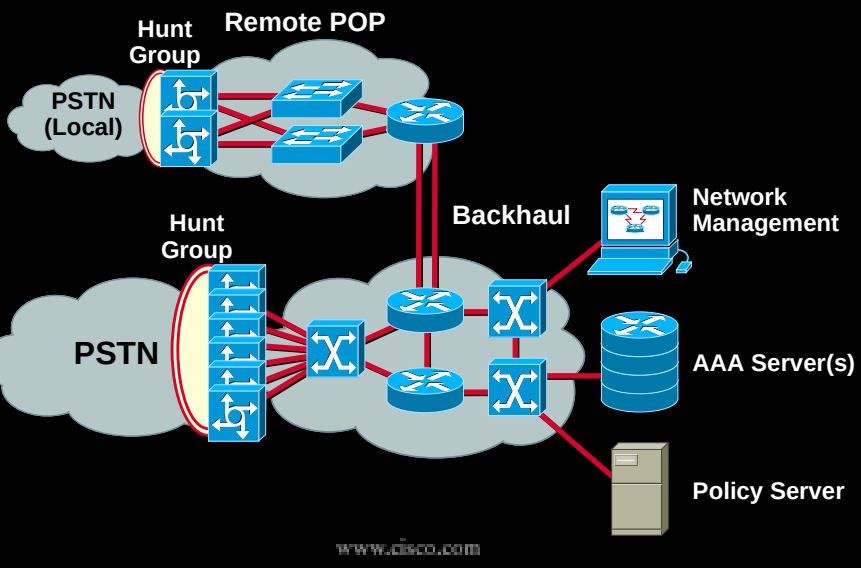
Dial POP Reference Model



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Centralize Administration: AAA Servers

- Provide centralized authentication, authorization, accounting
- AAA protocol choices
  - RADIUS
  - TACACS+
- AAA redundancy is critical
  - No AAA, no dial-in…no job!

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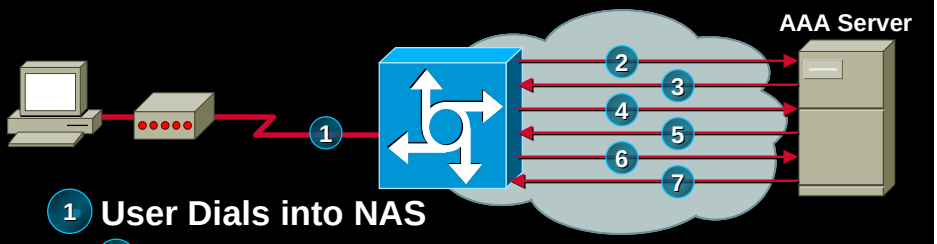
NAS and AAA Interaction



1. User Dials into NAS
2. Access Request Message
3. Access Accept/Reject Response
4. Accounting Request (START)
5. Accounting Request Accept
6. Accounting Request (STOP)
7. Accounting Request Accept

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AAA Server Benefits

- Configure dial port on per-user basis
  - Applied when user connected
  - Discarded when user disconnects
- Centralized IP address admin
  - Configure address pools for NAS's
- Centralized accounting data
  - Feed into rating/billing application

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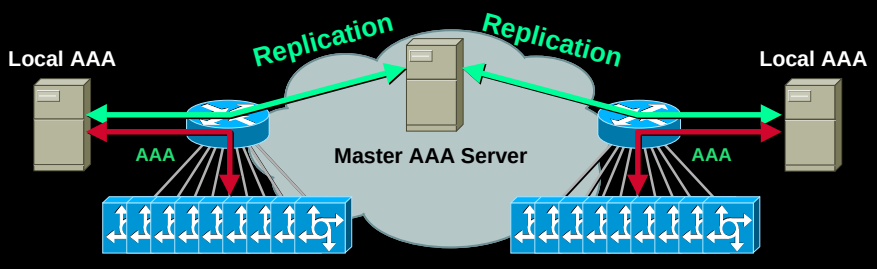
Local AAA Servers



- Reduces delay, improves resiliency
- Balances load
- Failover to multiple AAA servers
- Requires server synchronization

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Access Server AAA Scalability

- Increases number of AAA processes on access server
- Improves AAA throughput

```
aaa new-model
 radius-server host alcatraz
 radius-server key myRaDiUSpassWoRd
 radius-server configure-nas
 aaa authentication ppp dialins radius local
 aaa authentication login admins local
 aaa authorization network radius local
 aaa accounting network start-stop radius
 aaa processes 10
```

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How Dial IP Routing Works in Cisco IOS®

- PPP assigns IP address to end user
  - Part of IPCP negotiation
- Host route installed for every dial user
  - Relatively large number of /32 routes
  - Frequent NAS route table changes
- IP addresses assignment alternatives
  - Server-defined IP address pool
  - RADIUS-defined IP address pool
  - Per-user according to AAA profile

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Dial IP Routing Guidelines

- Summarize and advertise routing prefix to backbone
  - Minimize backbone route recalculations
- Use classless routing protocol
  - E.g., OSPF, EIGRP, IS-IS
  - Minimizes advertised routing prefixes
- Don’t propagate /32s to backbone unless absolutely necessary

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OSPF Summarization Example

```
router ospf 1
 redistribute static metric 100 subnets
 network 10.21.102.0 0.0.0.255 area 0
!
ip local pool default 10.21.231.33 10.21.231.254
!
ip route 10.21.231.0 255.255.255.0 Null0
```

"Dust Magnet" Route

- Summarize host routes
- Drop rogue packets with "dust magnet"

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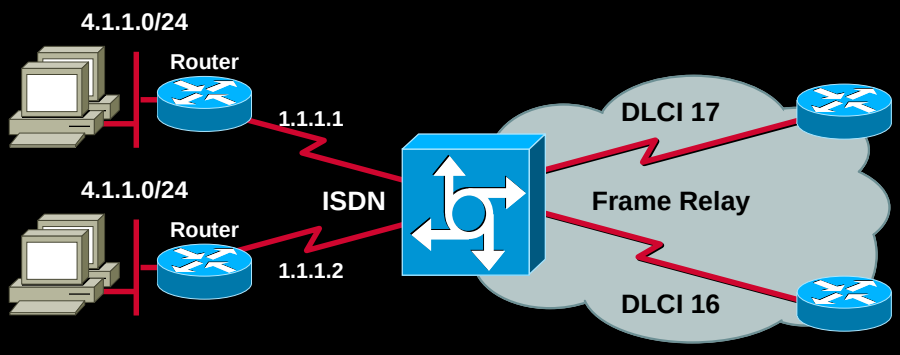
Special Case: Remote LAN with Static Route



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Static Remote LAN Routing via RADIUS

- Use Framed-IP-Address to set calling router IP address
- Use Framed-Route to install route for duration of call
- Classless routing protocol will advertise route to backbone

```
Framed-IP-Address = 1.1.1.1
Framed-Route = "4.1.1.0 255.255.255.0"
```


Dynamic Routing Updates from Remote Clients?

- **Don't do it!...**but if you really must
  - Set per-client flag in AAA profile to permit routing
  - Use route filtering—permit only default route
  - Consider passive-interface for asymmetric routing
  - Consider snapshot routing (RIP or IGRP) or on-demand OSPF
  - Consider route update authentication (MD5 hash)
  - NB: AS5800 only supports dynamic routing on 10% of interfaces at any one time

VPDN Protocol History

- **PPTP** (Point-to-Point Tunneling protocol) Microsoft/Ascend/3COM **Proprietary**
- **L2F** (Layer 2 Forwarding) Cisco **Proprietary (in Cisco IOS 11.2+)**
- **L2TP** (Layer 2 Tunneling Protocol)
  - IETF draft combining the best of PPTP
  - L2F industry standard track
- **IPSec** (IP Security)
  - AH mode (payload encryption)
  - Tunnel mode (entire packet encryption)

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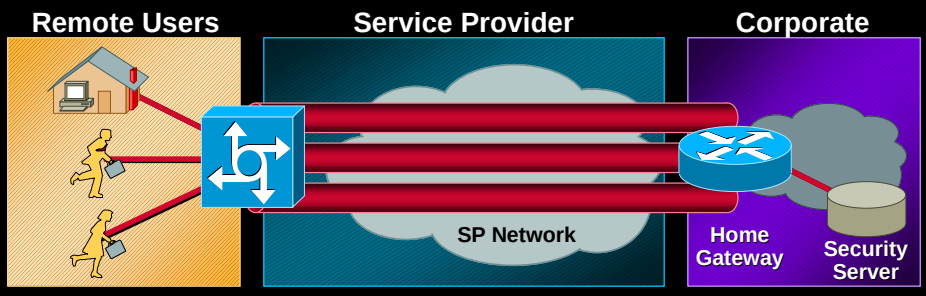
Point-to-Point Tunneling Protocol (PPTP)



Pros

- No agreement with SP required
- Software included with Windows 98
- Completely under corporate control

Cons

- Software and config on remote PCs
- No QoS possible without SP
- Doesn't scale (one tunnel per user)

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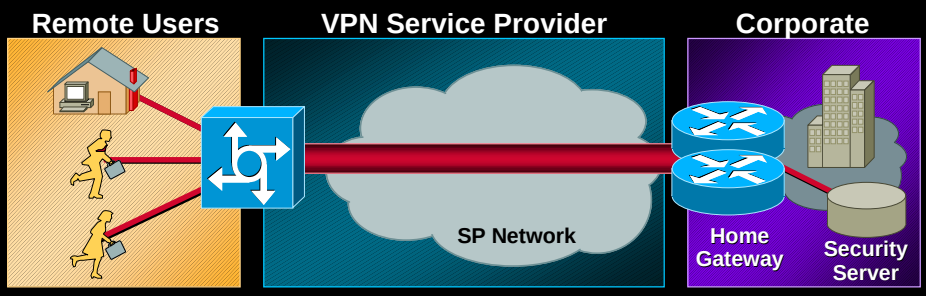
Layer 2 Tunneling Protocol (L2TP)



Pros

- No software changes on remote PCs
- Scales well, tunnel per NAS
- QoS techniques available
- Multiple home gateways for load balancing and redundancy

Cons

- Requires SP participation

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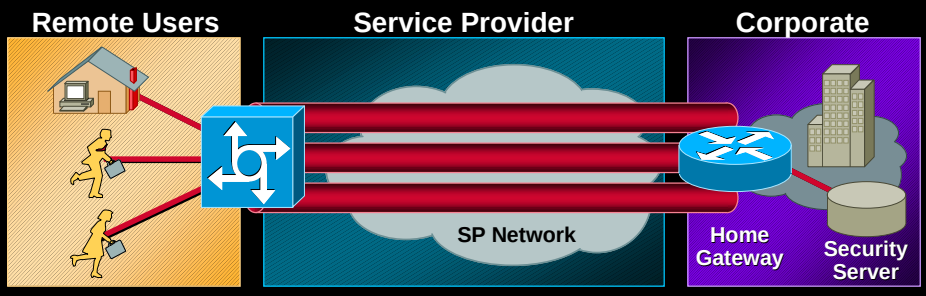
Encryption (IPSec)



Pros

- No agreement with SP required
- Encryption for extra security
- Completely under corporate control

Cons

- Software and config on remote PCs
- No QoS possible without SP
- Export restrictions

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VPN Technology Support in Cisco Dial Products

- **L2F**
  Release 11.2F onwards
- **L2TP**
  Release 11.3AA and 12.0, 12.0T
- **IPSec**
  Release 11.3T, 11.3AA, 12.0, 12.0T
- **PPTP**
  Not applicable—client initiated

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Cisco Resource Pooling

- Enables dial service level agreements
  - Guaranteed port availability
  - Restricted/unrestricted overflow
  - Data-over-speech-bearer capability
- Flagging of overflow CDRs for billing and sales purposes
- Full HTML reporting capabilities

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What Is a Resource?

- Anything in an access server that can terminate or originate a call
- Resource groups today:

Modems	ISDN (HDLC) Controllers	V.110	V.120

- Future resource groups:

VoIP	Dial Out

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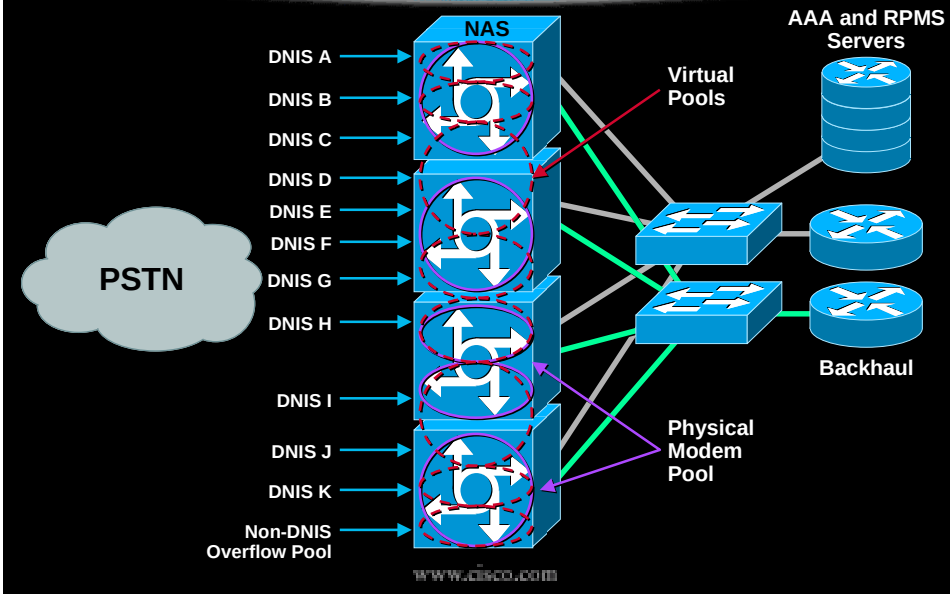
Resource Pooling Example



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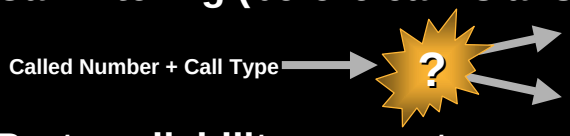
Resource Pooling Capabilities

- Call filtering (before call is answered)



- Port availability guarantees

- Data-over-Speech-Bearer Service (DOSBS)

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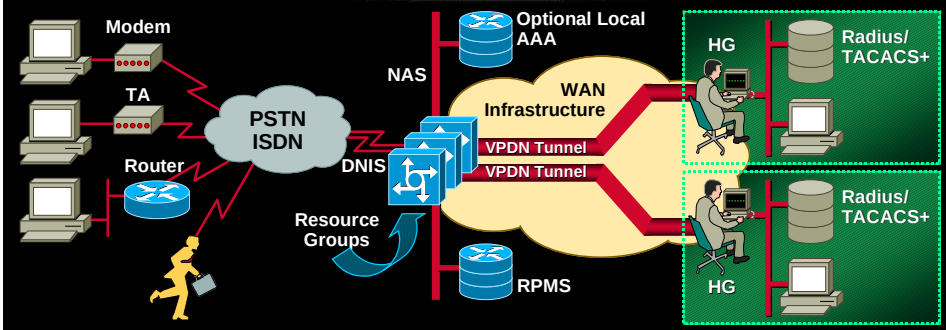
Example Resource Pooling Network



- Information captured at call setup
  - Called number (DNIS), call type, caller's number (ANI)
- All public network interfaces supported
  - PRI, CT1, CE1, SS7
- Resource pool management may be located
  - In the NAS (trivial case) or in a Resource Pool Manager Server

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Resource Pool Manager Server

The Resource Pool Manager Server (RPMS) is a sophisticated resource manager that applies wholesale policies on a per-call basis. RPMS works alongside existing RADIUS or TACACS+ servers to apply wholesale customer profiles (policies) with high scalability.

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Customer Profile

A customer profile is a record in the NAS or in the server that identifies a customer configuration. Fields in the record include the types of resources used by the customer's dial service plan and specify the maximum number of allowable sessions.

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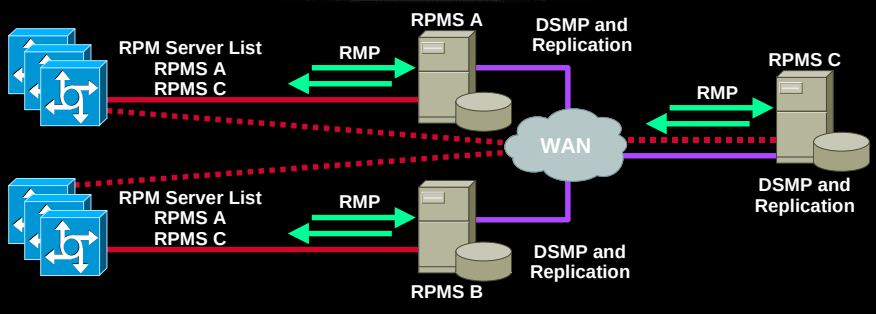
Fault Tolerance and Resiliency

- No RPMS, no calls answered…no job!
- Database replication
  - Synchronizes back-end database records
- Multiple RPMS servers (primary/secondary)
  - Distributed session management protocol
  - Synchronizes state of primary and secondary RPM servers
- Call context reconstruction
  - NAS retains enough information to reconstruct correct counters on secondary after failure

Fault Tolerance and Resiliency Example



- Each NAS has a list of primary and backup RPMS IP addresses
- Resilient RMP is a peer-to-peer protocol between RPMS and NAS
- RPMS Distributed Session Management Protocol (DSMP) keeps synchronized resource pool data on primaries and the backup server
- Oracle database replication manager and RPMS cache update mechanism insures data is updated to all RPMSes
- Call context reconstruction between NAS and RPMS insures integrity of the call data between primary and backup RPMS

Putting It All Together
Service Examples

Wholesale Dial
Corporate Dial Outsource

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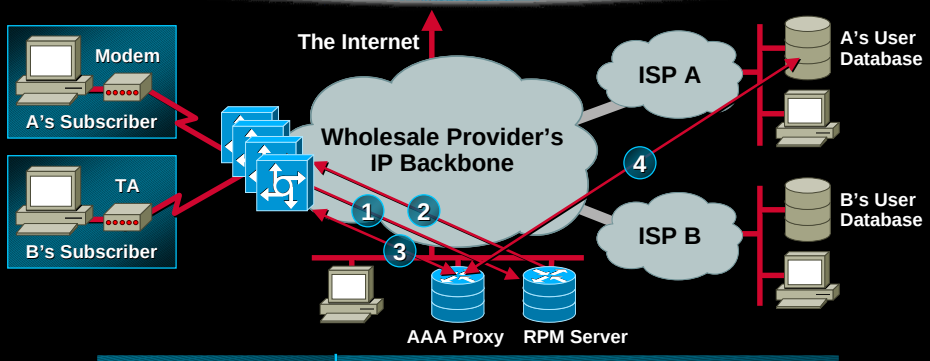
Wholesale Dial



Service Attribute	Dial Technology
SLAs	Cisco Resource Pooling
Customer AAA Integration	GRS, Multivendor RADIUS Attributes
SS7 Connectivity	Signaling Controller 2200, COT Capability

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Wholesale Dial Benefits

- Customer (ISP) benefits
  - Outsource expensive activity
  - Reduce costs
  - Focus on differentiation
- Wholesaler benefits
  - Additional revenue opportunity
  - Leverage existing infrastructure
  - Reduce cost of sales per subscriber

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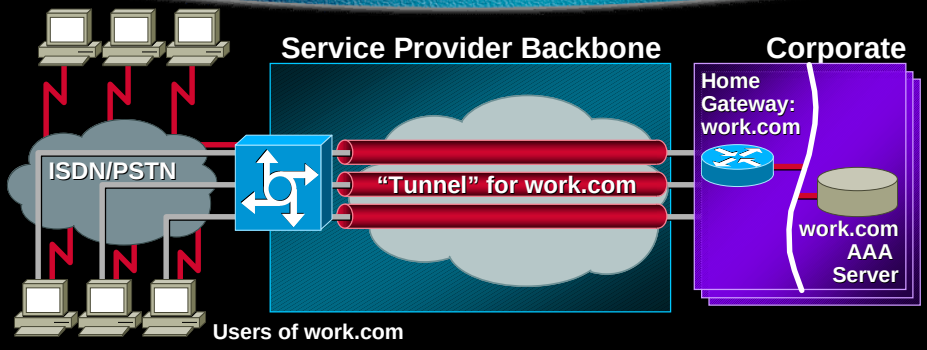
Corporate Dial Outsourcing



Service Attribute	Dial Technology
Dial VPN	L2F, L2TP Tunneling
SLAs	Resource Pooling
Billing	RADIUS, TACACS+, RPMS

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Corporate Dial Outsourcing

- Customer benefits
  - Outsource non-strategic activities
  - Maintain security and control
  - Reduce costs
- Service provider benefits
  - Additional revenue opportunity
  - Leverage existing infrastructure
  - Closer relationship with customers

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Troubleshooting Essentials

Four Commands to Run on Any Dial Access Server

```
no logging console
service timestamps debug datetime msec
service timestamps log datetime msec
modem call-record terse
```

- Ensures debugging is non-service affecting
- Enhances value of debug information
- Allows establishment of call failure patterns (Cisco IOS 11.3AA and 12.0T only)

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Conditional Debug
(Cisco IOS 11.3AA and 12.0T Only)

- **Essential** for larger access servers
- Allows debug to be turned on and off based on
  - Username
  - Calling number/called number
  - Interface

```
debug condition {username username | called
                                    dial-string | caller dial-string}
debug condition interface  "interface"
```

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Debugs Affected by Conditions

```
debug aaa {accounting | authorization | authentication}

debug dialer {events | packets}

debug isdn {q921 | q931}

debug modem {oob | trace}

debug ppp {all | authentication | chap | error | negotiation |
           multilink events | packet}
```

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Active User Information

```
Show caller  ( {     interface name [full]
                     username name [detailed] |
                     line range [full] |
                     ip } )
```

```
5300# show caller username mary
User: mary, line Vi1, service PPP Bundle, active 00:00:18
  PPP: LCP Open, multilink Open, IPCP
  Dialer: Connected 00:00:25 to 60222, inbound
        Idle timer 120 secs, idle 19 secs
        Type is IN-BAND SYNC, group Dialer0
  IP: Local 1.0.0.3/8, remote 10.1.1.1
  Bundle: First link of mary, 1 link, last input 00:00:19
  Counts: 3 packets input, 36 bytes, 0 no buffer
        0 input errors, 0 CRC, 0 frame, 0 overrun
        3 packets output, 36 bytes, 0 underruns
        0 output errors, 0 collisions, 0 interface resets
```

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Modem Troubleshooting

- Factor out Layer 3/PPP issues
- Verify connectivity from Layer 1 upwards
  - Check the T1/E1 before assuming modem problems
- Fix individual client modem problems through upgrades
  - http://www.56k.com/

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Performance Optimization for Dial Access Servers

- For best performance
  - Don’t log to console
  - At least 10 AAA processes on Cisco AS5800
  - Switch off virtual profiles
  - Switch off VJ header compression
  - Always use conditional debug
  - Minimize dynamic routing
  - Minimize use of ACLs

IP Address Pool Configuration Using RADIUS

- On the access server

```
aaa configuration config-username nas01
radius-server configure-nas
```

- In the RADIUS “user” file

```
pools-nas01     Password = "ascend"
        Service-Type = Outbound,
        Ascend:Ascend-IP-Pool-Definition = "1 192.168.0.32 8",
        Ascend:Ascend-IP-Pool-Definition = "2 10.12.0.32 8"
```

Assigning Users to IP Address Pools

- Select address pool within user's RADIUS profile
- Use for differentiated services

```
mary    Password = "contrary", NAS-Port-Type = Async
        Service-Type = Framed,
        Cisco:Ascend-Assign-IP-Pool = 2,
        Framed-Protocol = PPP,
        Framed-MTU = 1500
```

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Controlling "Special" Users…

- ACL configured on the access server

```
ip access-list extended NoSPAM
  permit tcp any 192.168.55.0 0.0.0.255 eq smtp
  deny tcp any any eq smtp log
  permit ip any any
```

- In the RADIUS "user" file

```
spamford Password = "wallace"
        Service-Type = Framed,
        Filter-Id = "NoSPAM.in",
        Framed-Protocol = PPP,
        Framed-MTU = 1500
```

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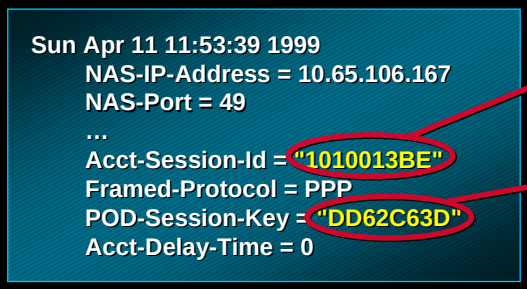
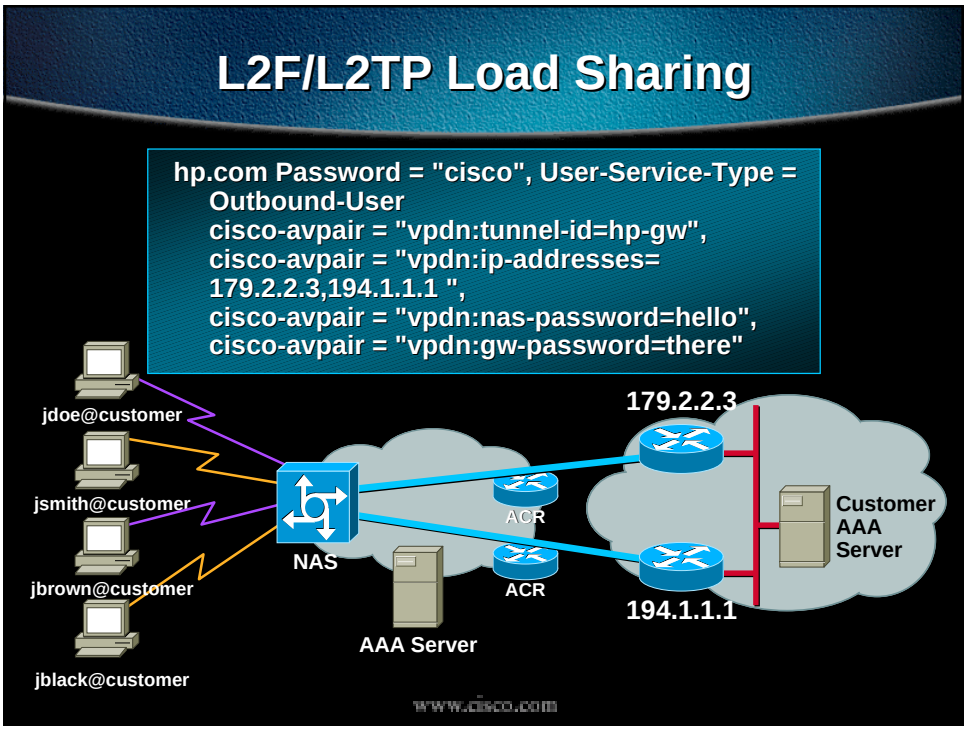
“Packet of Death” (POD)

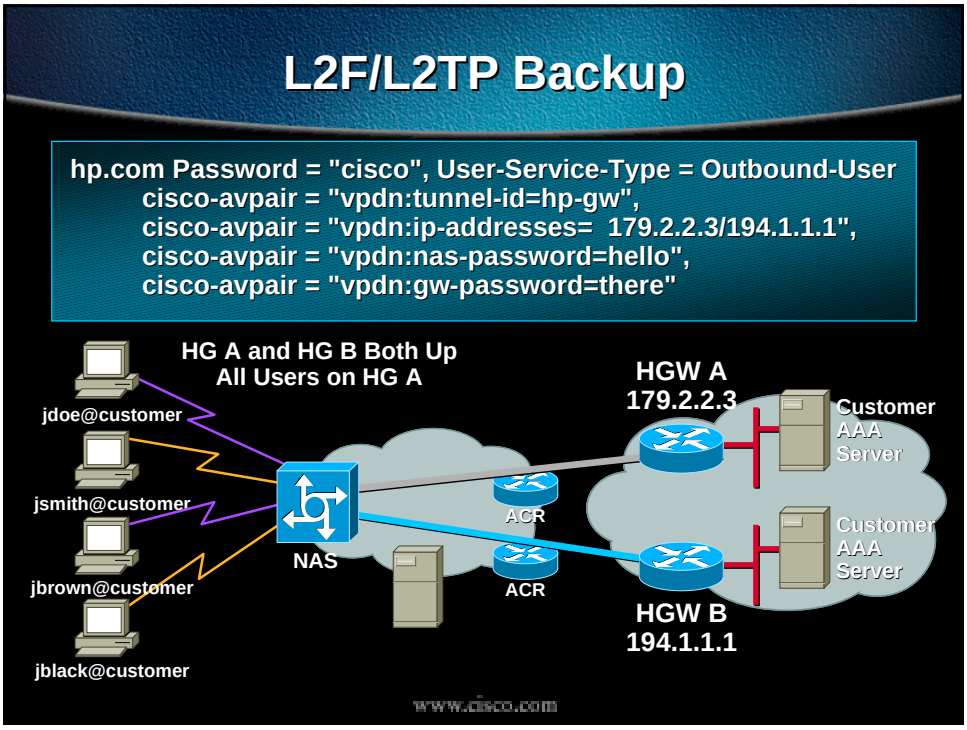
- Enables remote disconnect of problem users
- Send NAS a RADIUS packet on port 1700
- Uses IDs from RADIUS accounting file

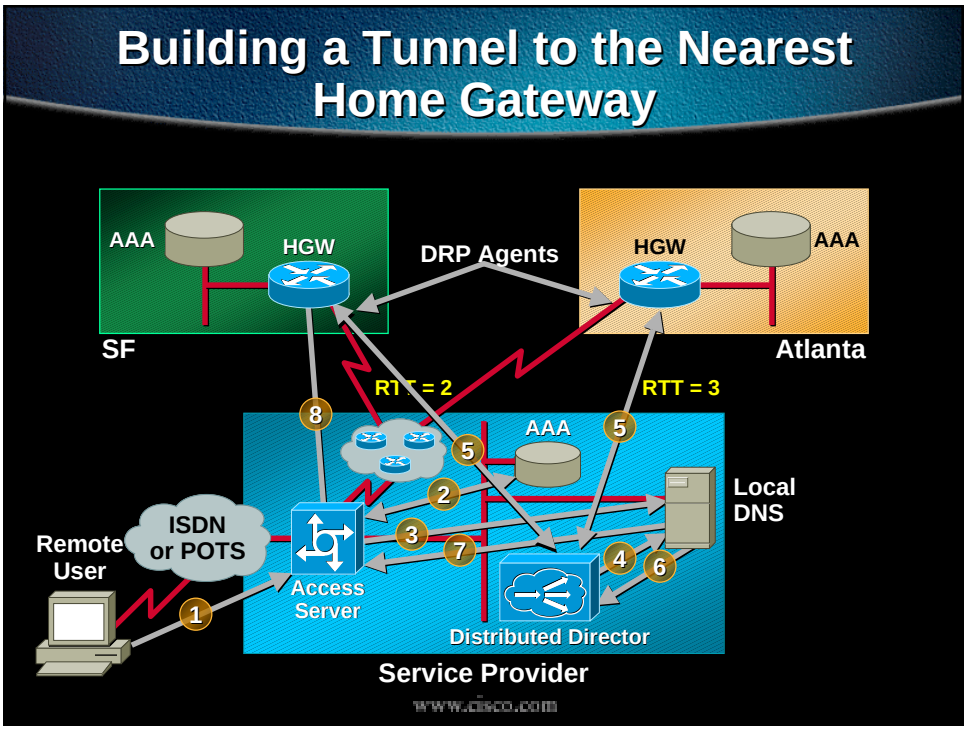


“Packet of Death” (Cont.)

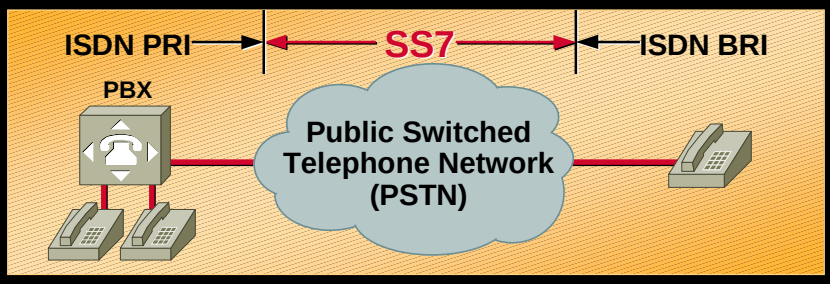
- Enable on NAS with command
  - aaa pod server key <*key*>
- RADIUS packet must contain
  - User ID
  - POD key
  - MD5 hash (computed using RADIUS shared secret key)
- Optionally contains
  - Accounting session ID
  - IP address







What Is SS7/C7?



- Chosen PSTN signaling protocol—used worldwide
- Provides look ahead and circuit reservation
- Sets up calls and tracks call status
- Accesses databases (800, local number portability) and intelligent network services (e.g., voice VPN)
- Highly scalable—designed for telephony scale

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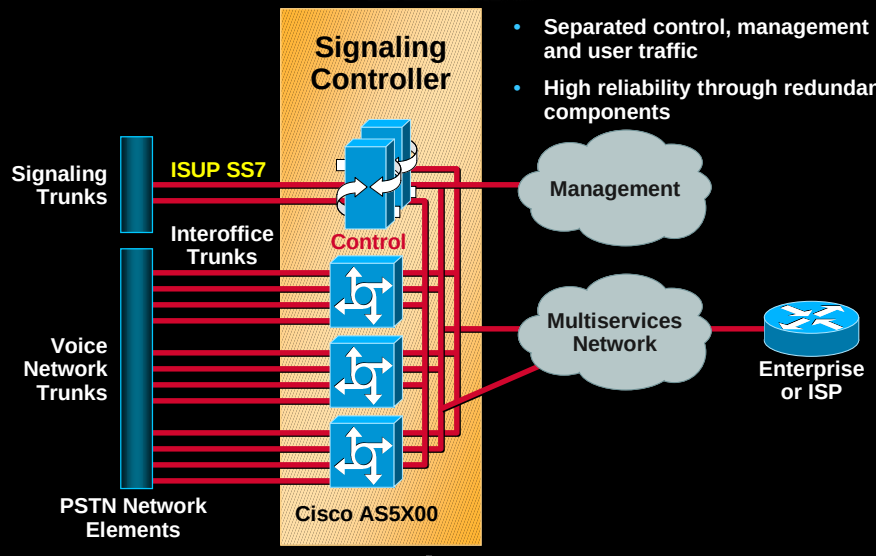
Cisco SC2200 Signaling Controller Architecture



- Separated control, management and user traffic
- High reliability through redundant components

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Service Provider Benefits of SS7/C7

- Lower network costs
- Improve network efficiency
- Implement the new dial access service model (wholesale dial)
- Lower carrier interconnect costs
- Improve the end user's experience

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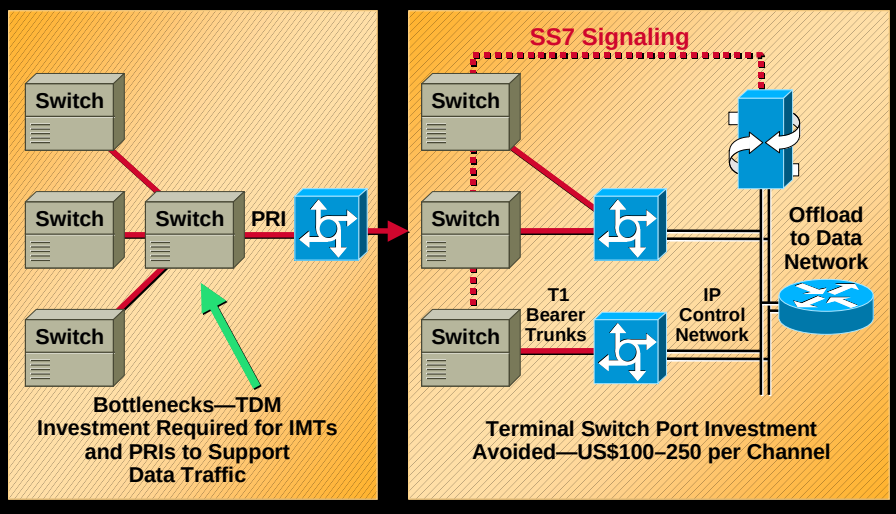
Cisco SC2200 Reduces Costs and Switch Congestion



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SC2200 Benefits the ISP

- Improved customer experience
- "Reciprocal compensation" available in some countries
- ISPs getting much better PSTN charges with SS7 (10–75% lower)
  - Carriers benefit because they relieve congestion and free up PRIs
  - Regulations may dictate lower SS7 interconnect rates

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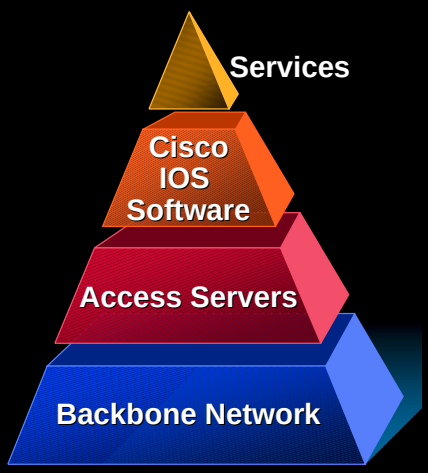
Summary

- Centralize administration
- Distribute implementation
- Minimize IP routing complexity
- Maximize dial server performance
- Design for resiliency



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