Architecting the Network

Part 2

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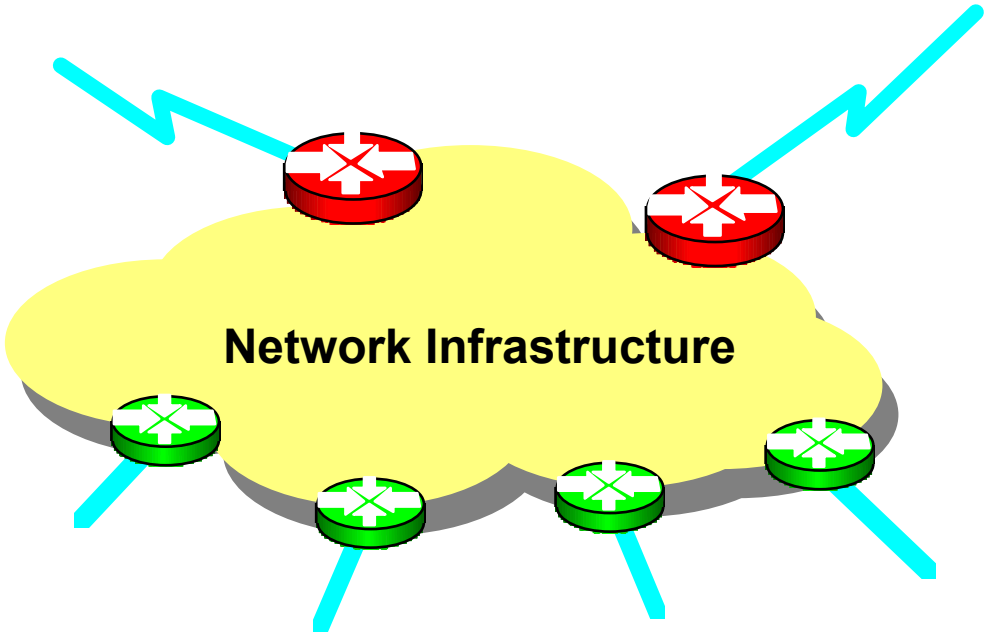
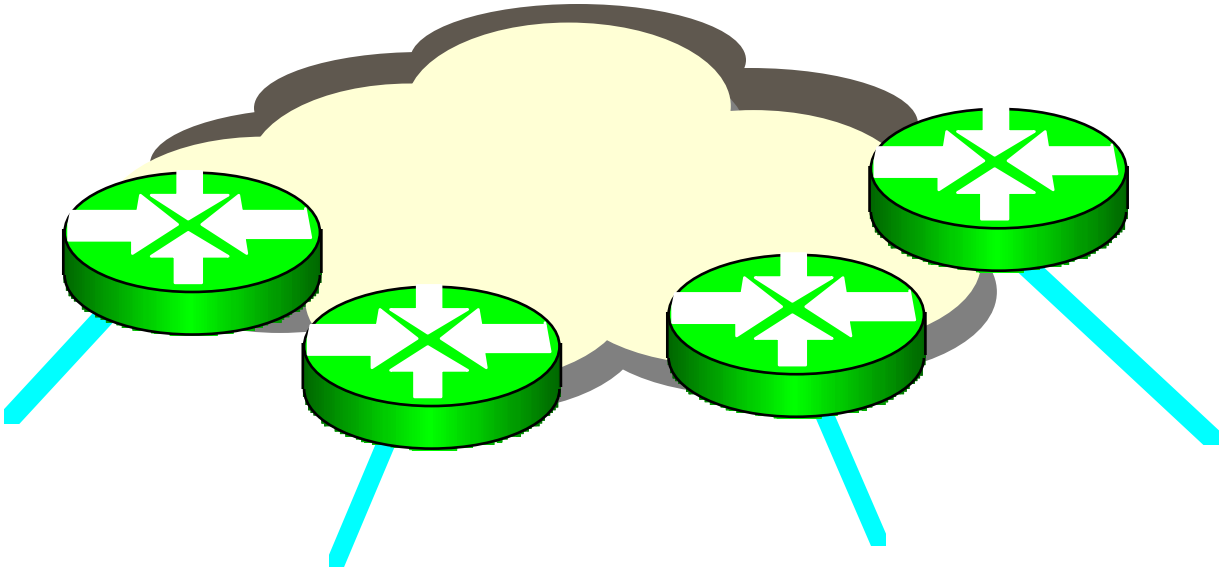
ISOC Workshop

Abstract Design

Router Interface design model



The Client Interface



The Client Interface

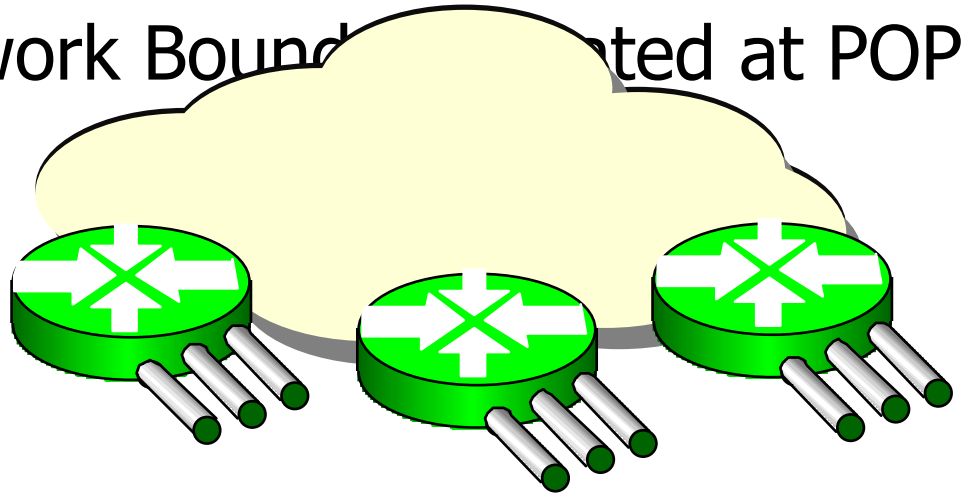
- Single Homed Clients
  - Permanently connected clients using any one of:
    - leased line
    - radio link
    - permanent modem connection
  - Client uses single service provider who offers the client a "default" network service
  - Client's networks are advertised to the Internet exclusively via the provider

The Client Interface

- Clear demarcation of boundary between client and network is required for consistency of service
- Single demarcation model is required for the network to ensure manageability and operability.
- The network service should never transit a client network

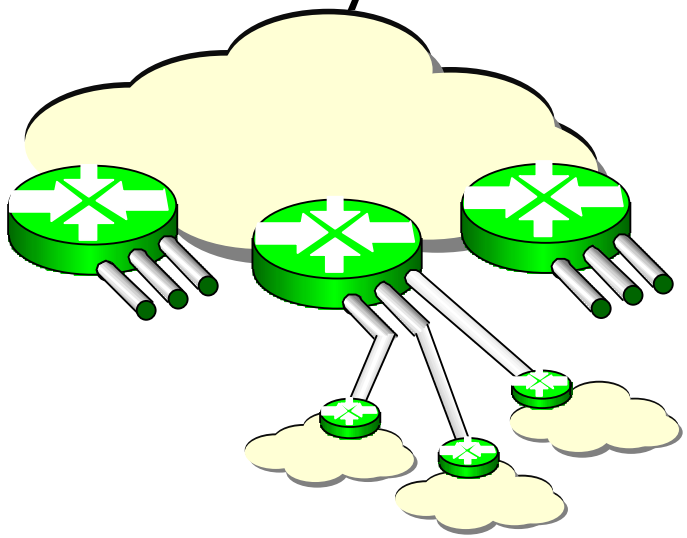
The Client Interface

- The POP Access Model
  - Client is responsible for CPE router and tail loop
  - Network Provider provides router attachment points at a number of locations
  - Network Boun[illegible]ted at POP interface



The Client Interface

- The Comprehensive Service Model
  - Network provider installs and operates CPE router and tail loop
  - Network provider attaches to client LAN
  - Network Boundary located at LAN attachment point



The Client Interface

- The Confused Model
  - Network Provider installs tail loop
  - Network Provider installs router interface card in client router
  - Client and network provider operate client router simultaneously

The Client Interface

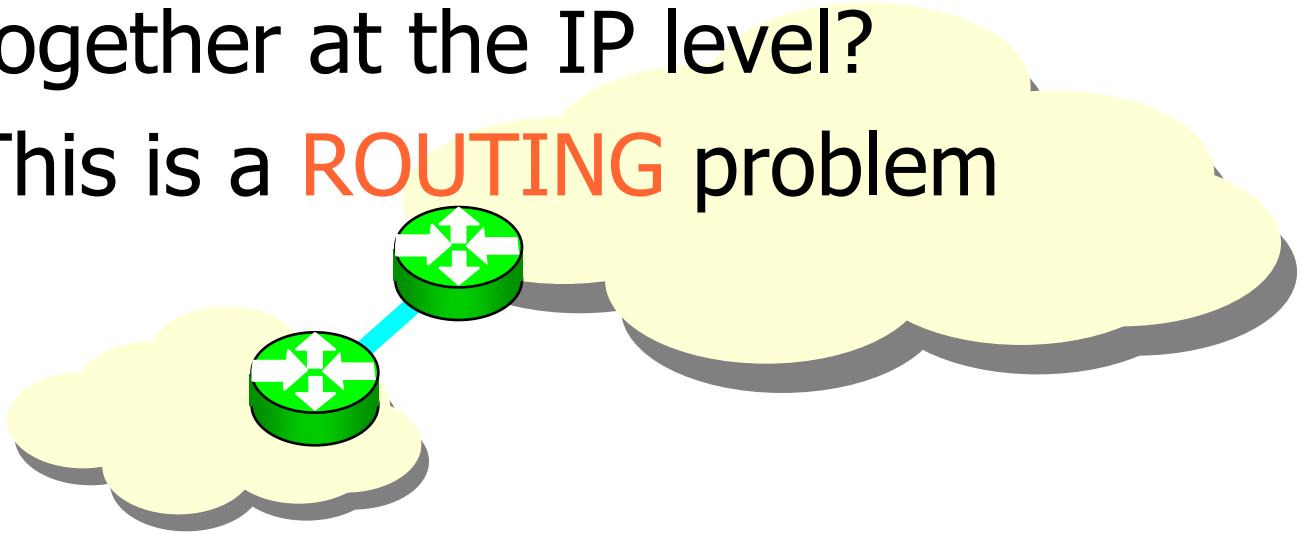
- POP or end-to-end service model depends on:
  - telco bulk purchase tariff discounting
  - router vendor bulk purchase discounting
  - staff availability
  - client expertise levels
  - defined service level
- Client Site service model is preferable from a commercial perspective

The Client Interface

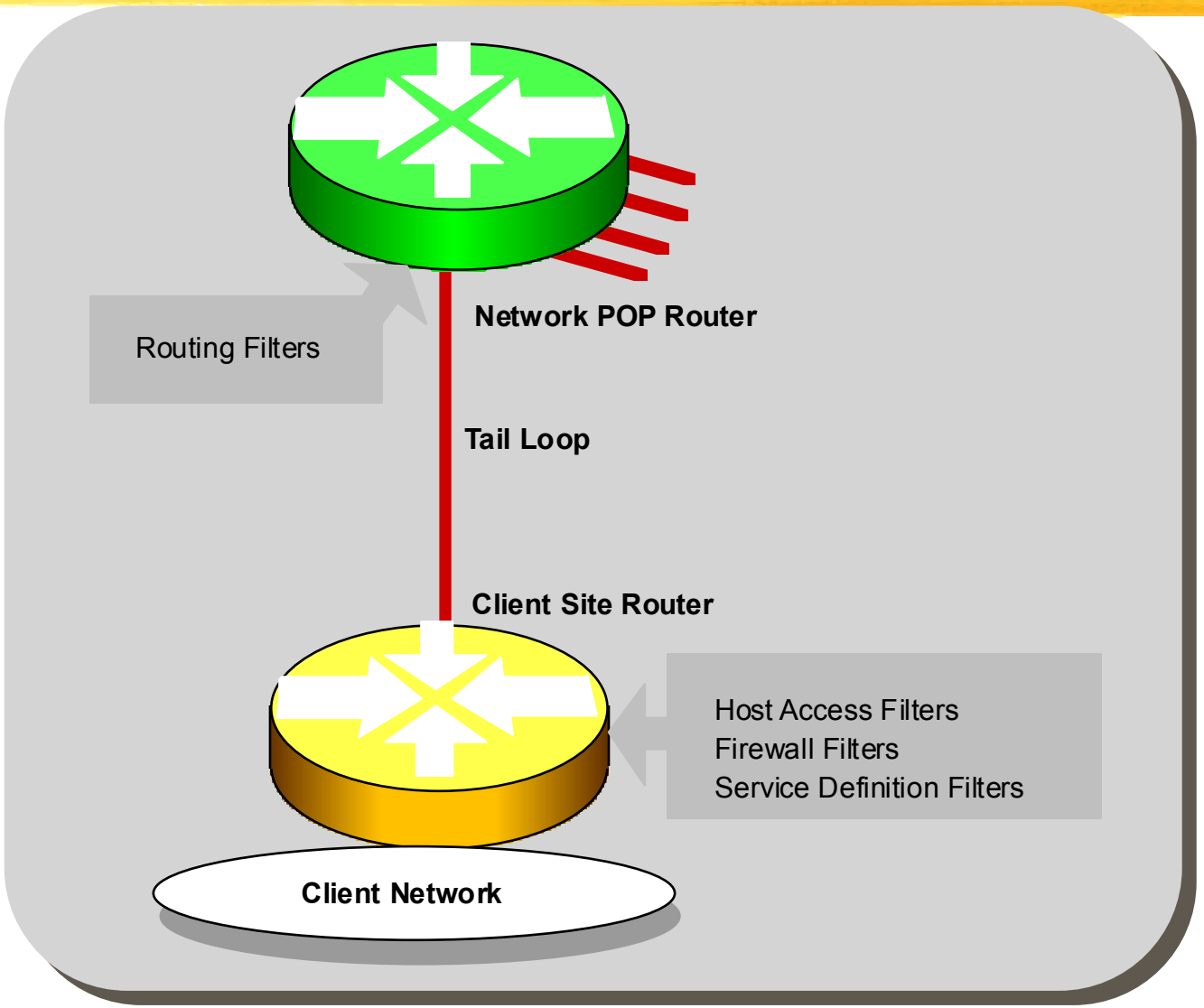
- You can do both POP and end-to-end
  - as long as all routing integrity is maintained within the POP locations for all clients
- The integrity of the system is maintained within a set of "core" routers

The Client Interface

- The client has a network with some IP addresses
- You operate a network with some IP addresses
- How do you join these two networks together at the IP level?
- This is a ROUTING problem



The Client Interface



The Client Interface

Choice of client boundary routing protocol

- Use of RIP as Network / client boundary routing protocol?
  - simple
  - widely implemented
  - **NOT** applicable in all cases
  - no support for classless address exchange

The Client Interface

Choice of client boundary routing protocol

Use of RIPv2 as Network / client boundary routing protocol?

- simple
- not yet widely implemented
- **NOT** applicable in all cases
- no support for classless address exchange

The Client Interface

Choice of client boundary routing protocol

- Use of STATIC ROUTES as Network / client boundary routing protocol?
  - simple
  - widely implemented
  - can support classless address advertisements
  - & requires careful design to scale
  - cannot support dynamic multi-homed connections

The Client Interface

Choice of client boundary routing protocol

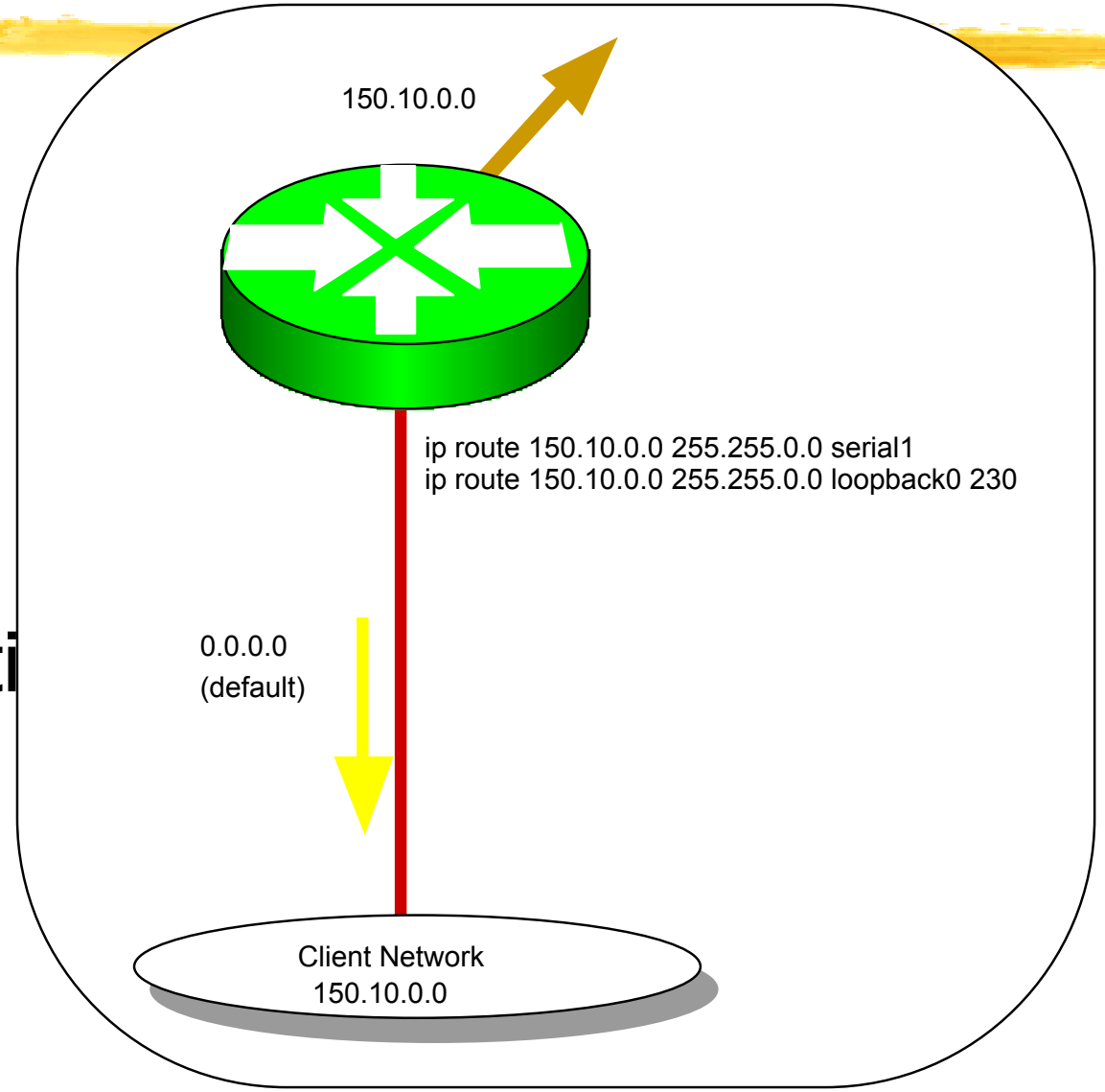
- Use of Classless Client boundary routing protocol?
  - EIGRP - proprietary B-F Distance Vector
  - OSPF - IETF Std Link State
  - RIPV2 - IETF Std B-F Distance Vector
  - BGP4 - IETF Std Inter Domain Routing Protocol
- Issue of clean separation between interior routing environment and client boundary routing environment may dictate use of BGP4

The Client Interface

- A proposed client interface routing architecture
  - use static routes for all singly homed clients
  - use statics of specifics plus aggregates for multiple connections to the same provider
  - use BGP4 for multiply homed clients using multiple providers

The Client Interface

Static routing
(plus sink)
single connecti



The Client Interface

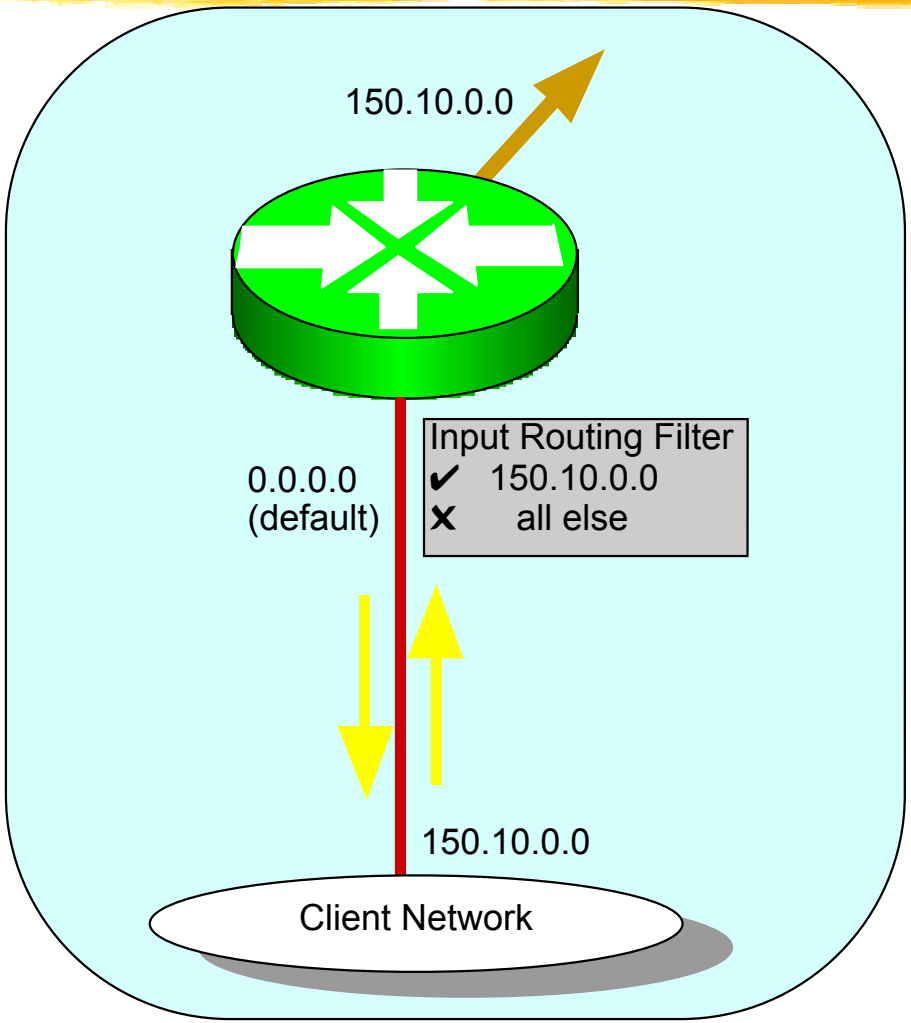
- Dynamic Routing Guidelines
  - Use of inbound routing filters to preserve network integrity
    - prevent client advertising bogus routes
    - preserve integrity of client network

The Client Interface

- Dynamic Routing Guidelines
  - Use of outbound static default route to simplify client routing
    - stability of presented service
    - simplicity of presented service
    - client sees only an external default path

The Client Interface

Dynamic routing
single connection



The Client Connection

- Routers provide:
  - security capability
  - management capability
    - routing management
    - traffic management
    - service management
  - efficiency
  - integration

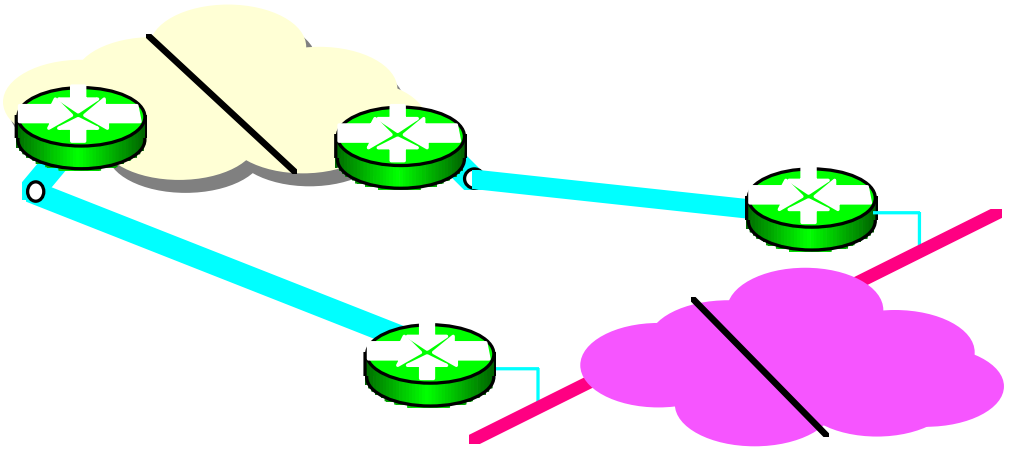
The Client Connection

- SLIP / PPP implementations in hosts
  - cheap!
  - Capital price differential between hosts and router is small
  - Operating cost is higher using hosts as routers
- use as single end host access system

Routing to the Client

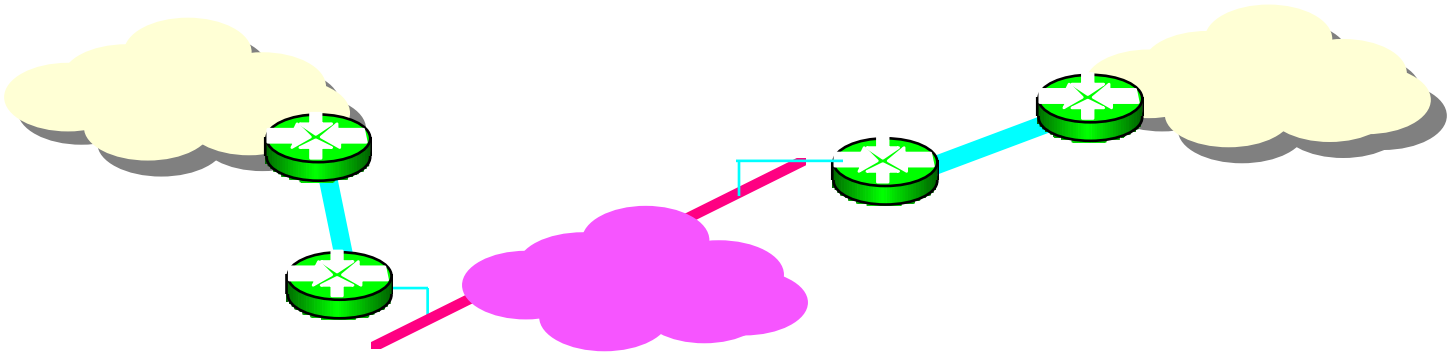
- Multiple client interfaces
  - split of client and provider network - multiple default paths
  - asymmetric routes can be generated
  - client network internal breakage causes black hole routing
- requires careful management and clear understanding of the routing issues
- need to use CIDR routing

  to best advantage!



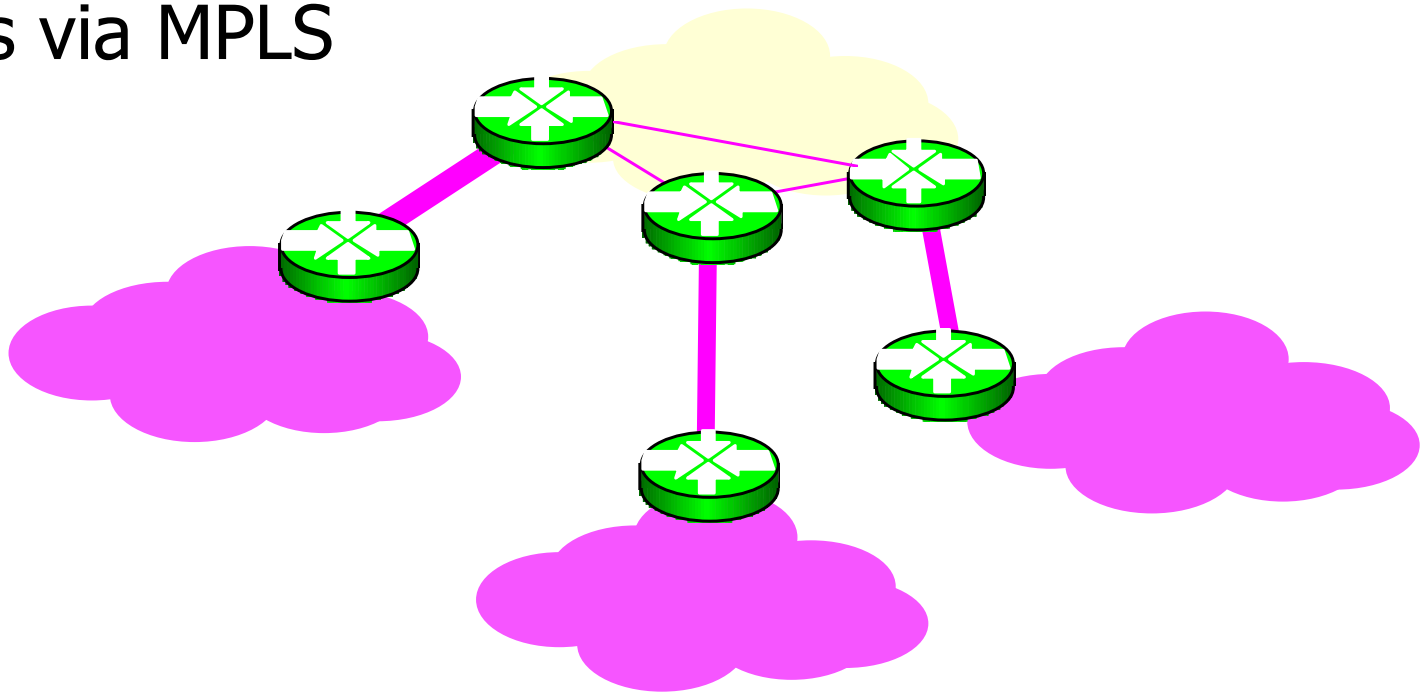
Routing to the Client

- Multiple providers
  - Only one provider can provide "default"
  - other connected providers must resort to explicit provision of routes to enumerated networks
  - All providers must ensure that the client is not used as a transit facility through explicit route management on the part of all providers



Distributed Client support

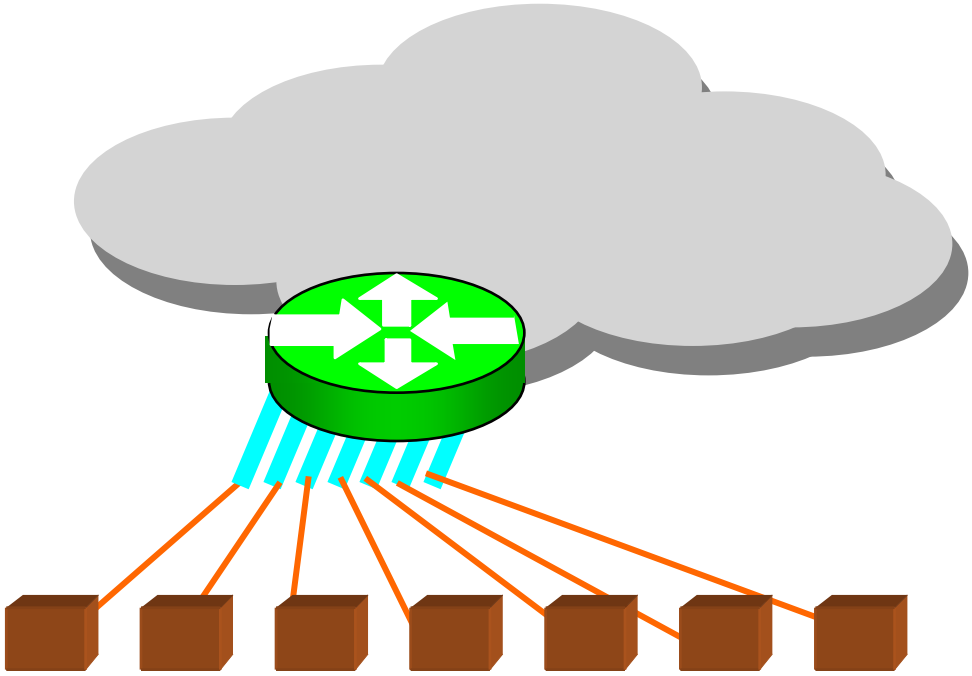
- Virtual Private Network architecture issues
  - VPNs via filtering - unwise!
  - VPNs via tunnelling
  - VPNs via MPLS



Variations

- Address translation technologies at the interface
- Combined firewall / routing interfaces
- Encryption at the interface

Dial Access



Dial Access Management

- PSTN dial access
- ISDN dial access

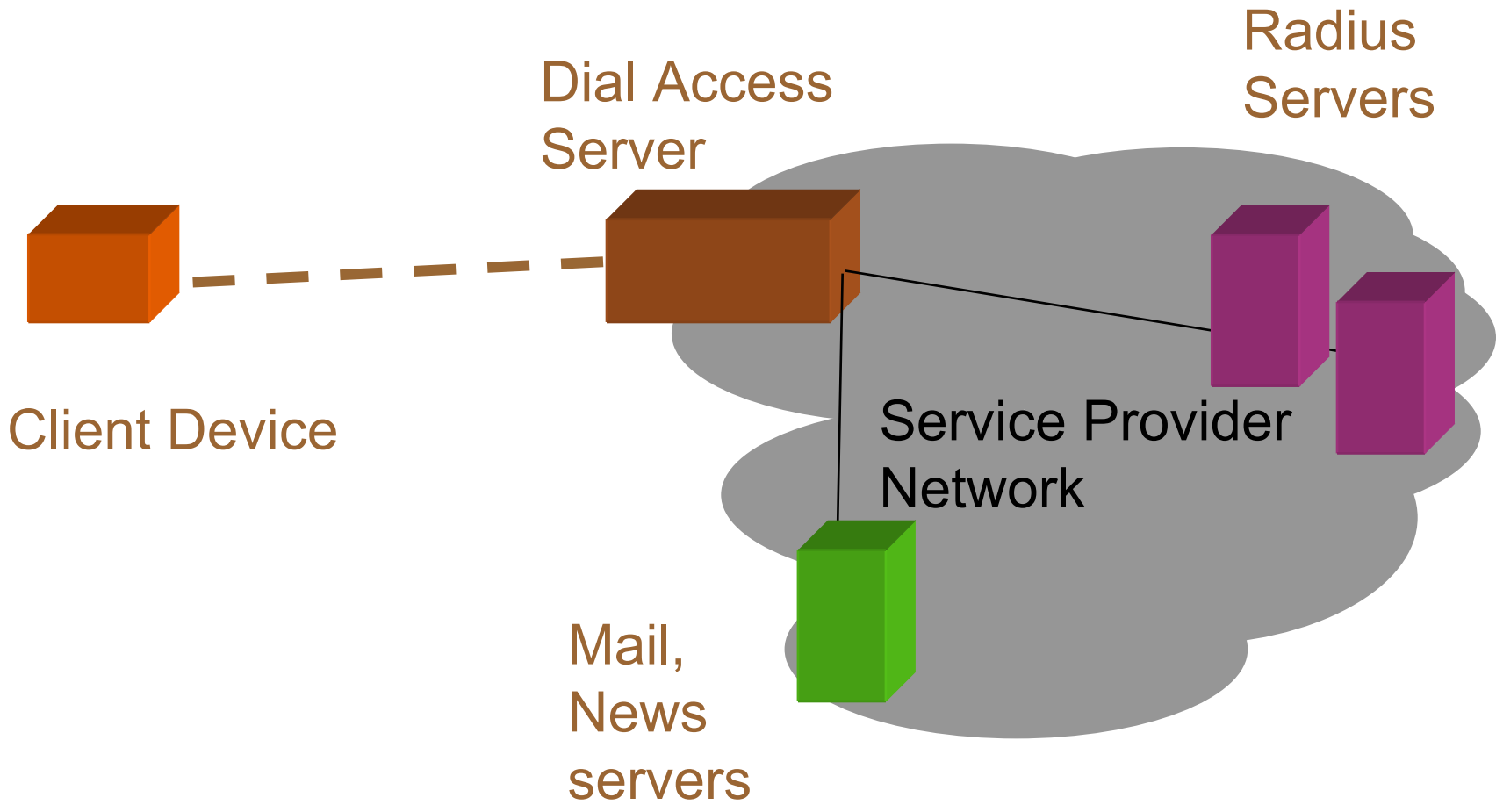
Support issues are similar:

user authentication and user access profile

accounting and billing records

infrastructure support for intermittent access

Dial Access Components



Access Mechanisms

- Modem banks
  - entry level for small ISPs
  - high management cost
- ISDN Primary Rate access
  - higher cost
  - more reliable
  - high manageability
  - smaller size and power budget
  - combine PSTN and ISDN service requirements

Authenticating the User

- PPP component of link setup
  - pass authentication details to access server
  - access server consults Radius servers
  - Radius server providers answer:
    no / yes with profile loaded into access server
  - Session accounting enabled
- Radius Accounting provides per session accounting at session termination

User Accounting

- Collect session accounting record:
  - user identification
  - location of session service (server and port)
  - start time
  - duration
  - session termination reason
  - volume counters
  - IP address assigned for session

Address Management

- Address Pools configured per ISDN PRI port
- Dynamic address assignment per session
  - this has service implications, as the client cannot assume a permanent name / address association
- Client LAN connection is not readily supported
  - dynamic route filter loading is required

Client Services

- Required Services
  - Mail server
  - POP access and account management
  - Proxy Domain name services
  - NEWS browser access
  - WEB server access

Other Services

- Other services
  - WEB proxy systems
  - News servers
  - ftp servers
  - game servers
  - ...

Dial Access Services

- Service Intensive Environment
  - The Helpdesk is the major cost component of a dial access service
- Highly Competitive Environment
  - Small startup capital costs for new players
  - Linking of equipment retail with access service
  - High service margins are now a myth

Dial Access Directions

- commodity low margin market
- virtual dial pops via L2 tunneling from CO telco port banks
- QoS on dial access

Other Access Models

- Cable
  - shared infrastructure
  - speed matching
  - third party ISP access
  - voice / data integration
  - integration with CATV rollout

Other Access Models

- xDSL
  - non-uniform service model
  - speed matching
  - third party ISP access
  - PSTN impact
  - CATV impact
  - IP infrastructure impact
  - use existing copper infrastructure

Other Access Models

- wireless
  - spread spectrum, packet radio, GSM data
  - high utility model
  - limited spectrum availability
  - limited coverage with LOS earth facilities
  - limited available bandwidth
  - But no wires!