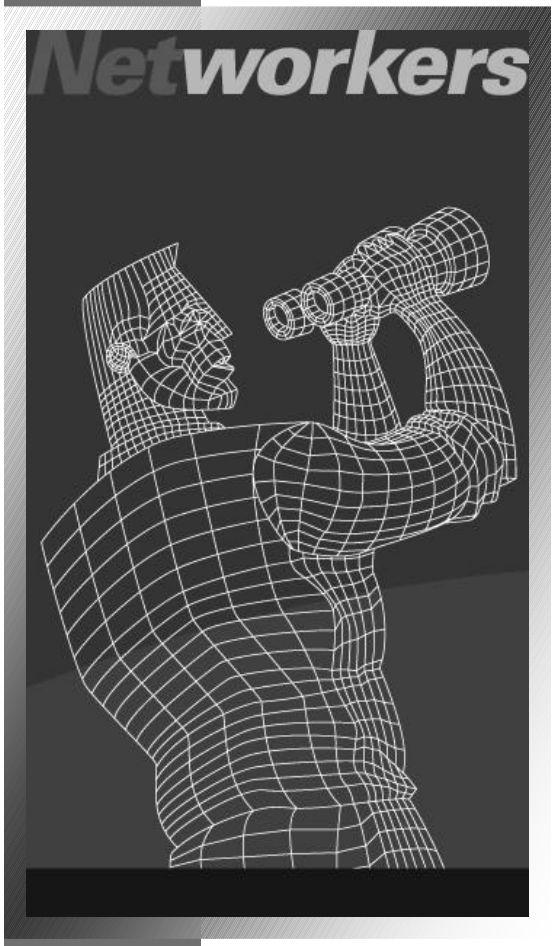


xDSL Architecture

Agenda

- Overview
- Architecture Requirements
- Deployment

Life Beyond 56 K

- **56K is Slow to Provide a Satisfactory Consumer Internet Experience**
- **DSL uses inaudible high-frequency signaling to achieve megabit-transmission speeds**

What is “Broadband”?

- **Broadband = “Megabit” Data Rates**
- **Common unit of measure: “T-1” = 1.544 Mbps**
- **“Fractional” T-1s, starting around 384 kpbs**

Characteristics of xDSL

- Delivers high data rates, within defined radius of the central office or wiring center
- Copper condition, weather, and crosstalk affect performance
- Diverts data traffic off telco voice switch

Benefits of xDSL

- High bandwidth at low cost
- Load on C.O. switch is reduced
- Enables service providers to create new network services
- Facilitates new and better content delivery

Some Implications of xDSL

- Demands larger and more robust backbone data networks
- Deploying today may require use of immature technology
- Effective pricing and service models need to be defined

xDSL Comparisons

	Data Rate Down/Up Links	Distance km	Modulation Scheme
VDSL	25 Mbps/1.6Mbps	.9	QAM
ADSL	8 Mbps/1.Mbps	5.5	DMT/CAP
HDSL	1.5 Mbps/1.5Mbps	4.6	2B1Q
SDSL	784kbp/1784Kbps	6.9	2B1Q
IDSL	144Kbps/144Kbps	5.5	2B1Q

Application Use

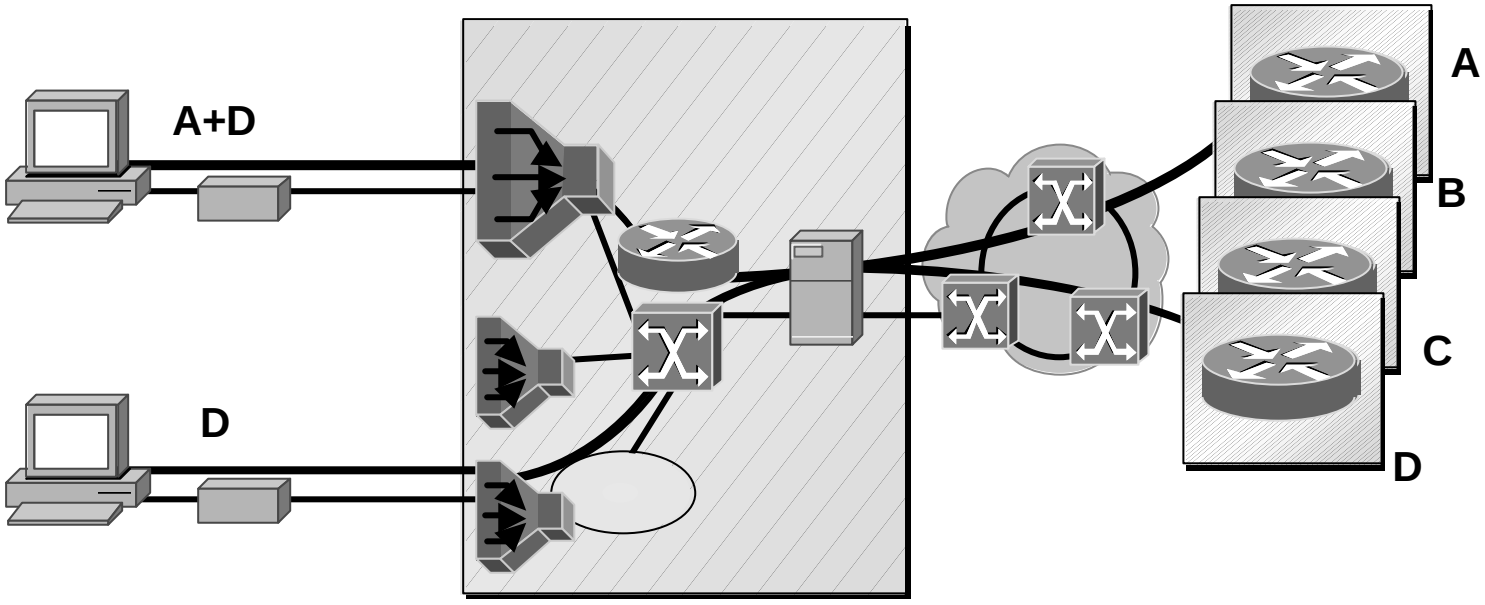
xDSL	Application
ADSL	Telecommuting, Remote Office Connectivity, Intense Web Access
H/SDSL	T1 Replacement, Remote Office Connectivity
IDSL	Telecommuting, Remote Office Connectivity
VDSL	Video, V.R., Multimedia

Multiservice DSL Architecture

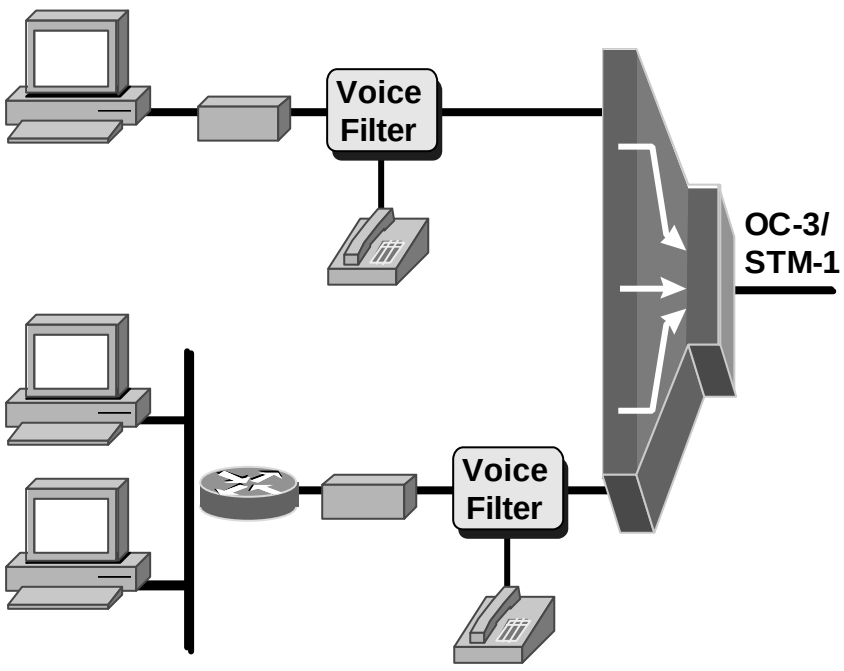
Key Advantages

- Dynamic assignment of IP addresses
- Service differentiation
- Dynamic service selection
- Provisioning flexibility
- Existing operational support

A Multiservice DSL Solution

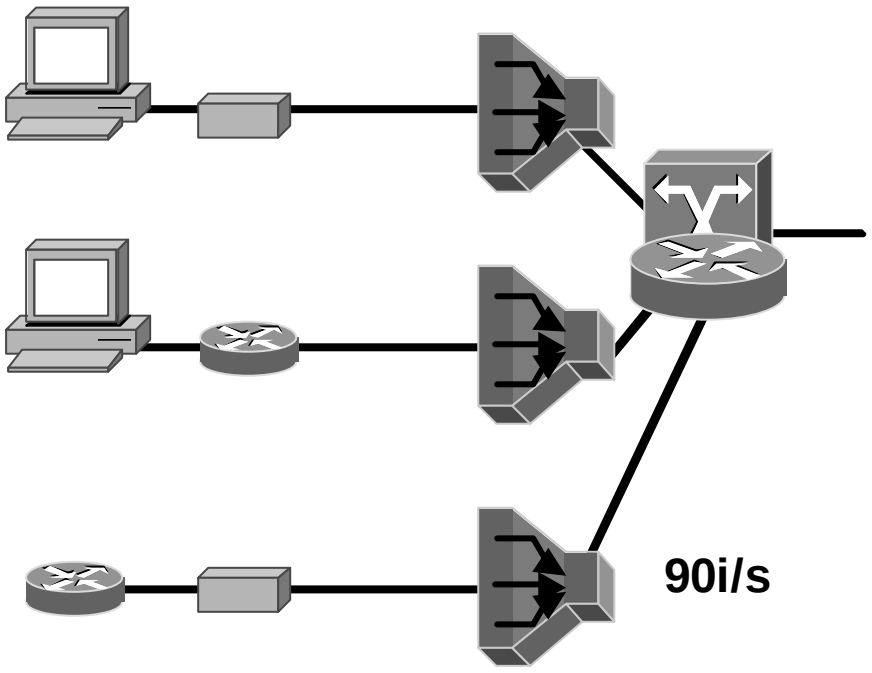


Multiservice DSL Multiplexer



- **Support many subscribers**
  - **ADSL CAP or DMT**
  - **Adaptive or selective**
- **Line rates**
- **ATM architecture**
- **OC-3/STM-1 trunk cards**
- **DS3/E3 trunk cards**
- **External voice filtering**
- **NEBS compliant**
- **WEB-SNMP managed**

Multiservice DSL Aggregator

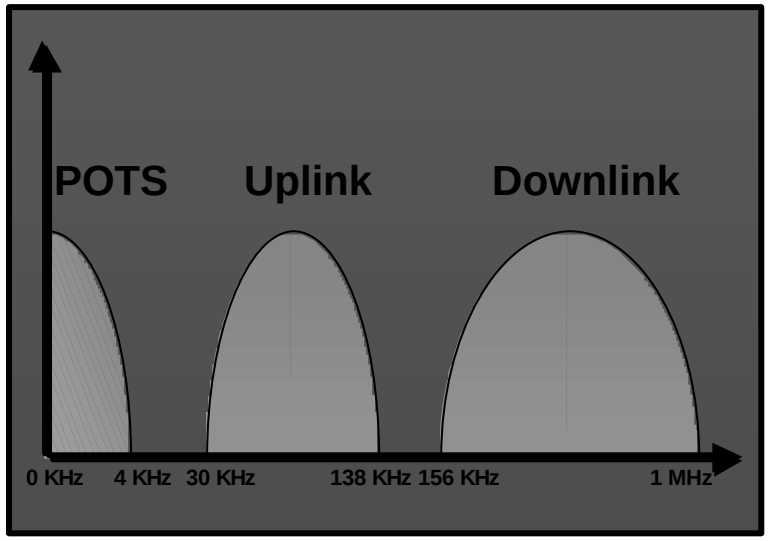


- High-capacity
- NEBS and ETSI compliant
- Fully redundant
- Multi layer ATM-switch
- Optional plug-in routers to add L2/L3 services
- Multiple slots:
- SONET STS3/SDH STM1 ATM OC-3 trunk
- DS3/E3 ATM, DS3/E3 FR

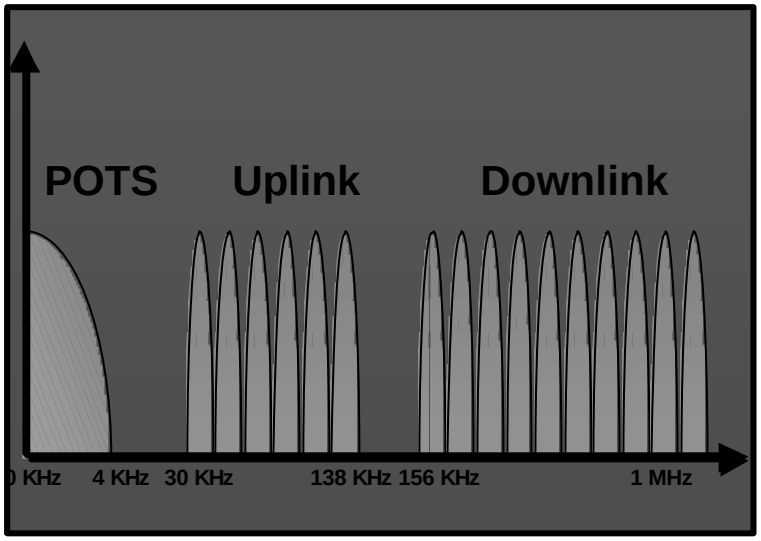
ADSL Terminology

- **ATU-C: ADSL transmission unit, central**
  - **The ADSL point of termination in the central office**
  - **An ADSL modem**
- **ATU-R: ADSL transmission unit, remote**
  - **The remote user sADSL modem**
  - **The CPE**
- **DSLAM: DSL access multiplexer**
  - **Central office device that concentrates many ADSL connections into one**
  - **DSLAM contains ATU-Cs**

CAP and DMT Spectrum



CAP RADSL Frequency Range



DMT Frequency Range

ADSL Rates

Downstream	Upstream
7 Mbps	1 Mbps
2.5 Mbps	950 Kbps
640 kbps	680 Kbps

CAP RADSL

Symmetric Rates Possible

Downstream	Upstream
8 Mbps	640 Kbps
4 Mbps	160 Kbps
2 Mbps	64 Kbps

ETSI Annex T1.413

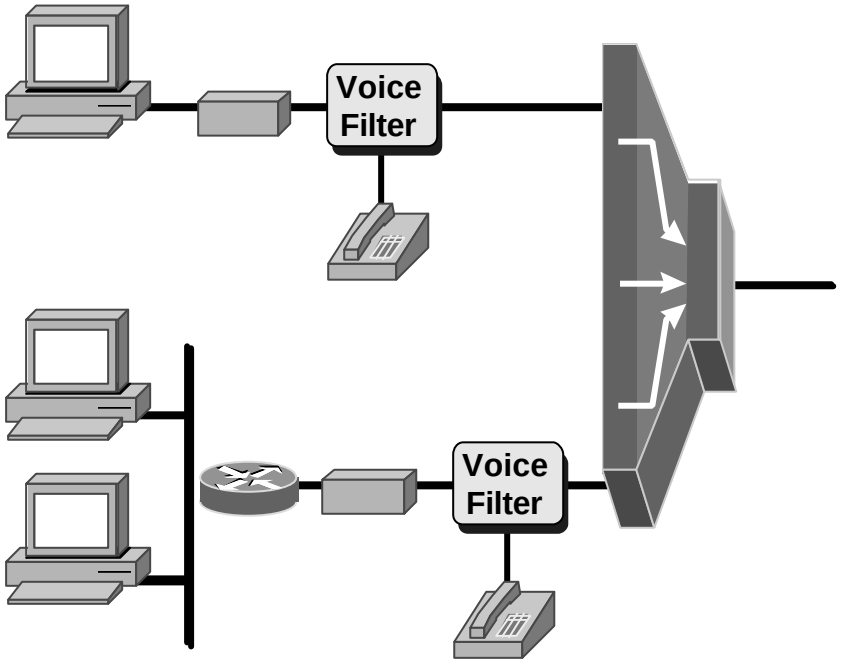
ADSL Deployment Considerations

- **Compatibility**
  - **DMT v1, v2, v3**
  - **Bundle co-existance**
    - **ISDN, DMT, HDSL**
- **Service definition**
  - **Data, VoD, Voice**
  - **Data convergency layer**
- **CAP in the standard track**
  - **Large industry support**
  - **Performances**
  - **Low dissipation**

Design Considerations

- Twisted pair bundle issue
- Throughput expectations
- Traffic shaping and policing
- L3 Breakout at the edge
  - Scalability and value-add services
- Network/content design

ADSL CPE Requirements



Features Needed

- RADSL CAP (DMT Phase II)
- 7 Mbps downstream
- 1 Mbps Upstream
- RFC 1483
- External passive voice filter
- Auto-configuration

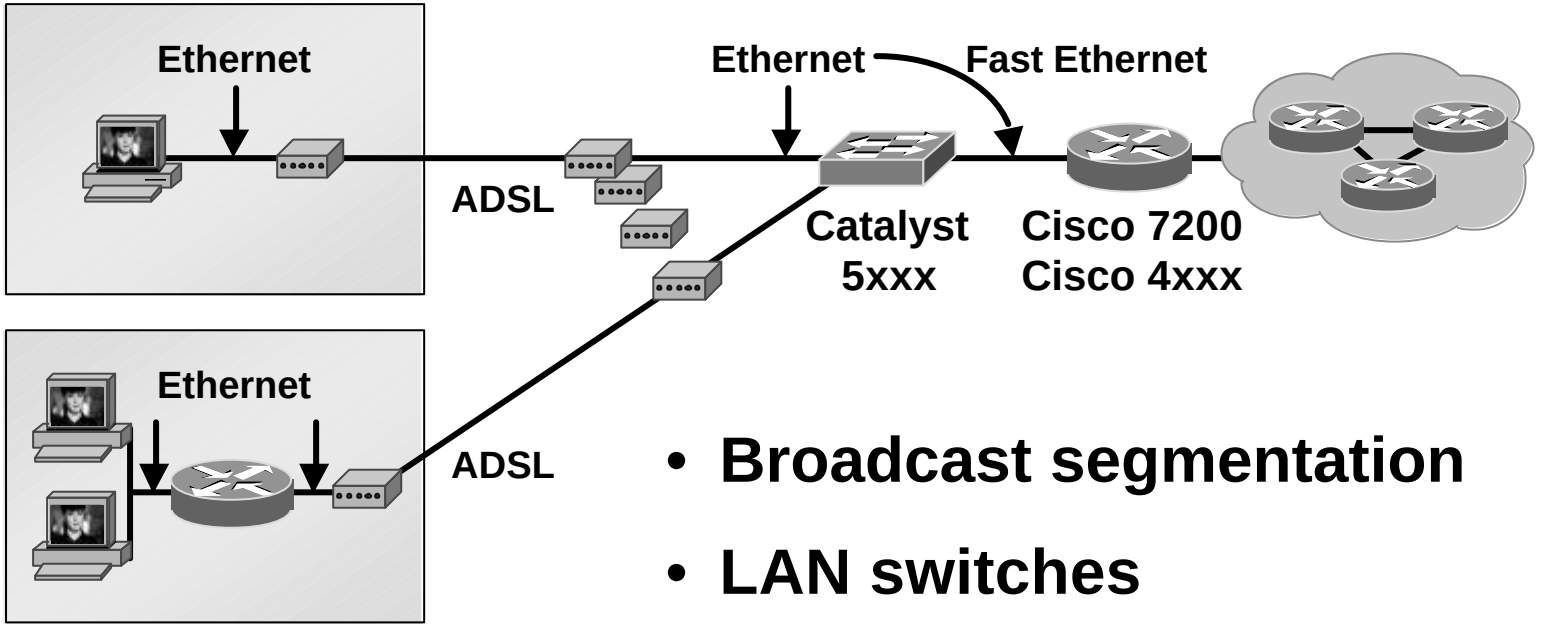
ADSL CPE Requirements

- IP routing
- Multicast support
- Traffic shaping
- Network address translation
- Data and voice integration
- IP over ATM support
- Management

Ethernet to the User

- **Massive market penetration, low cost, already available**
- **Value add via L3 functions**
- **Easy-of-use**
- **ATM transport on ADSL line**
- **IP over ATM options available**

ADSL Pilots: Ethernet

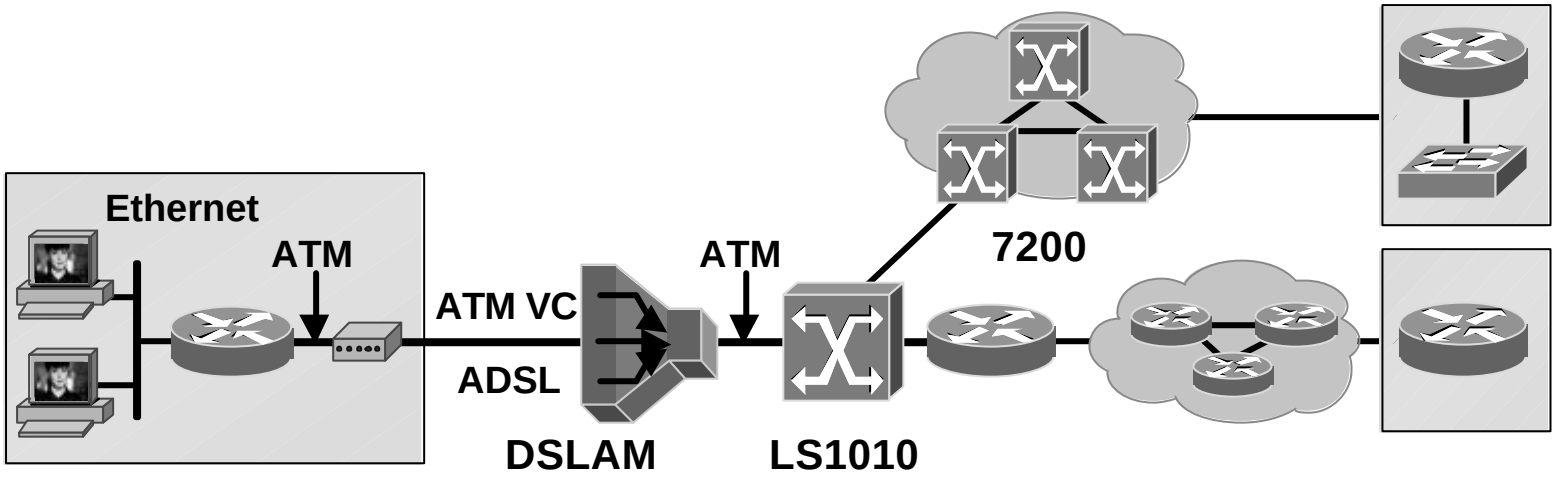


- **Broadcast segmentation**
- **LAN switches**
  - **Port fanout**
  - **VLAN**
- **L3 POP breakout**

ATM to the User

- **Multiservice capability**
- **ATM QoS**
- **PPP over ATM for single user solution**
- **ATM shaping required**

ADSL Pilots: ATM

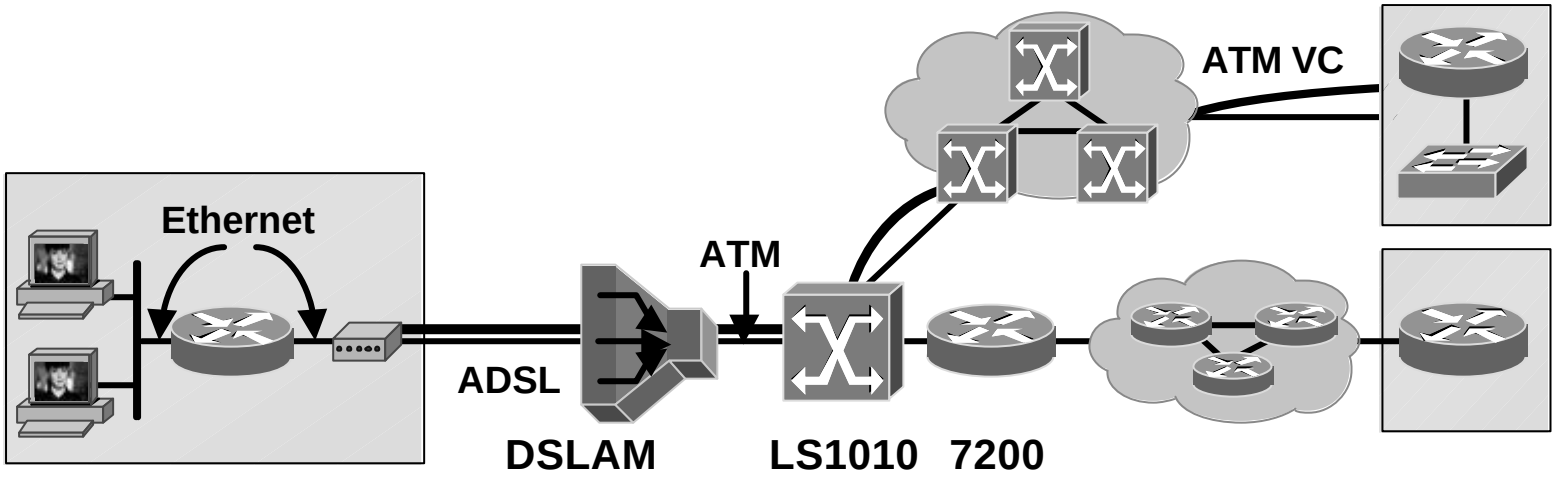


- **ATM service locally terminated**
- **Shaping and policing at ATM layer**
- **IP over ATM**

  RFC1483, Classical IP over ATM

  L3 Breakout at the ADSL POP

ADSL Pilots: Ethernet ATM



- **RFC1483 based service**
- **L2 service provisioning at ADSL POP**
- **L3 function**

  CPE

  Corporate site or ISP

Service Architecture

For ADSL Systems

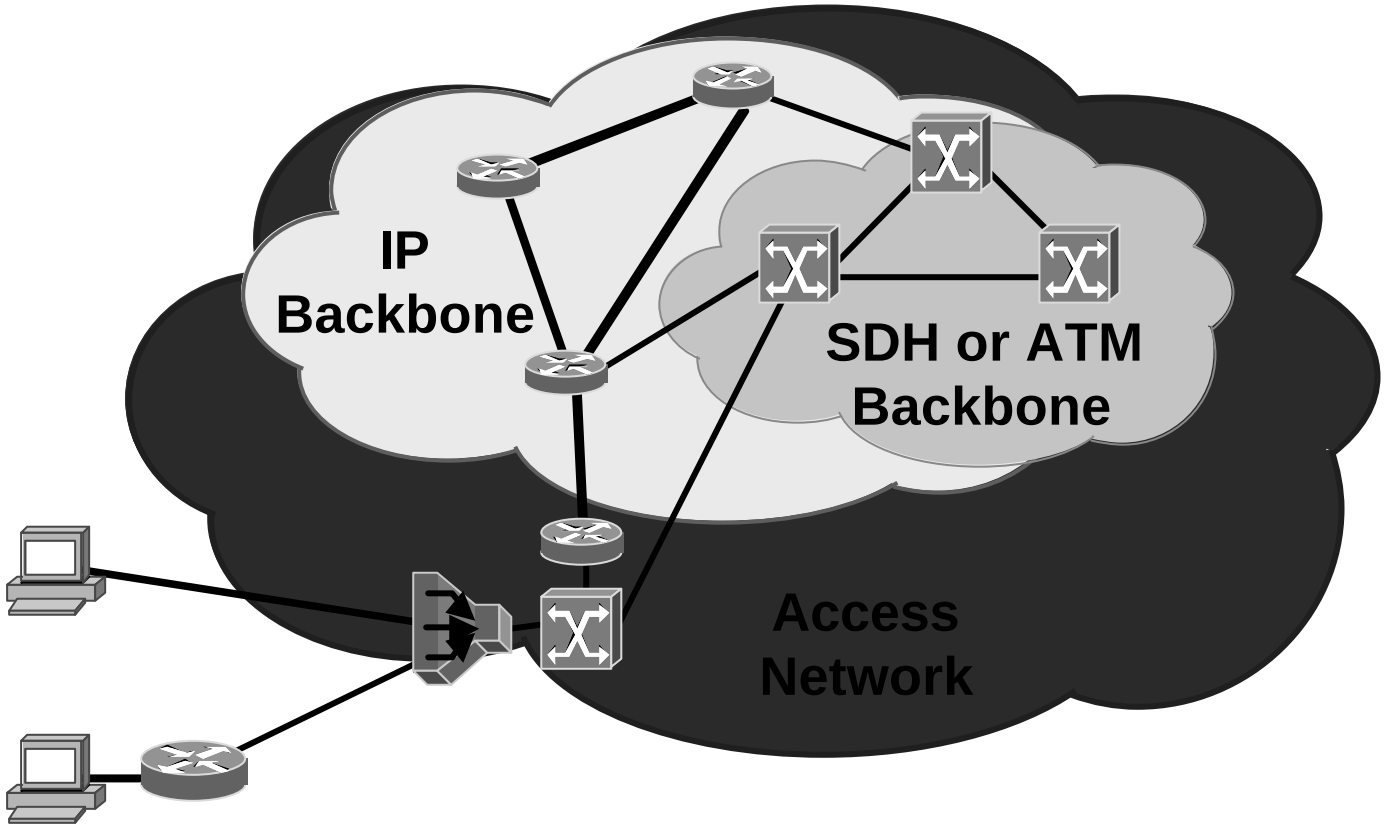
Classic VPN

- Leverages existing L2 protocols
  - Frame Relay
  - ATM
- Multiprotocol support
- Shaping and policy
- VC budget

PPP over ATM over ADSL

- Leverages standard dial features
  - Authentication (PAP, CHAP, etc)
  - Layer 3 autoconfig (DHCP, DNS, etc)
  - Multiple sessions
  - Encryption
  - Billing, etc via RADIUS

ADSL Based Architecture

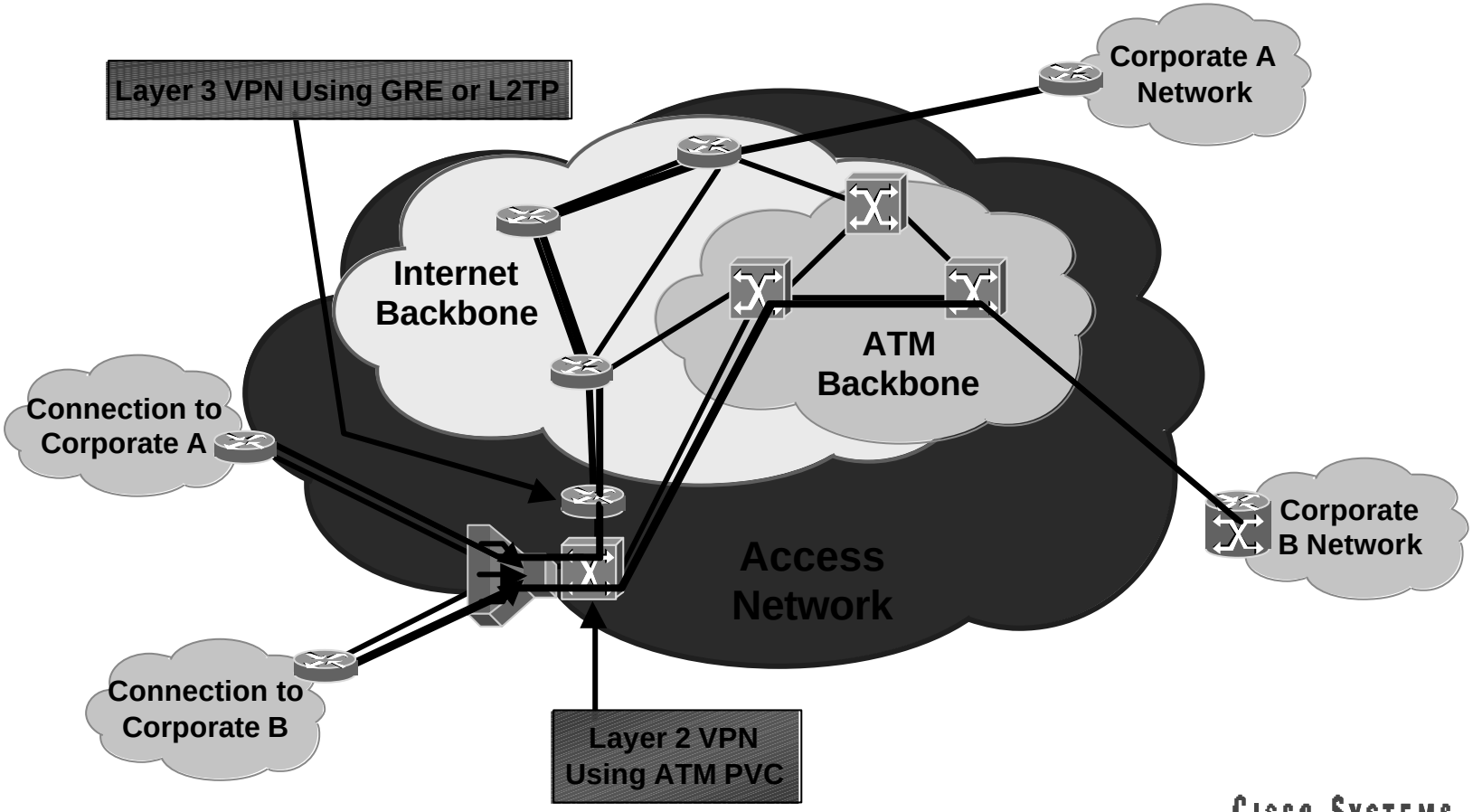


- **Service delivery network**

ADSL Design

- **VC management**
- **Bandwidth management**
  - **Architecture: L2 vs. L3**
  - **Value add: Content management**
- **CPE requirements**

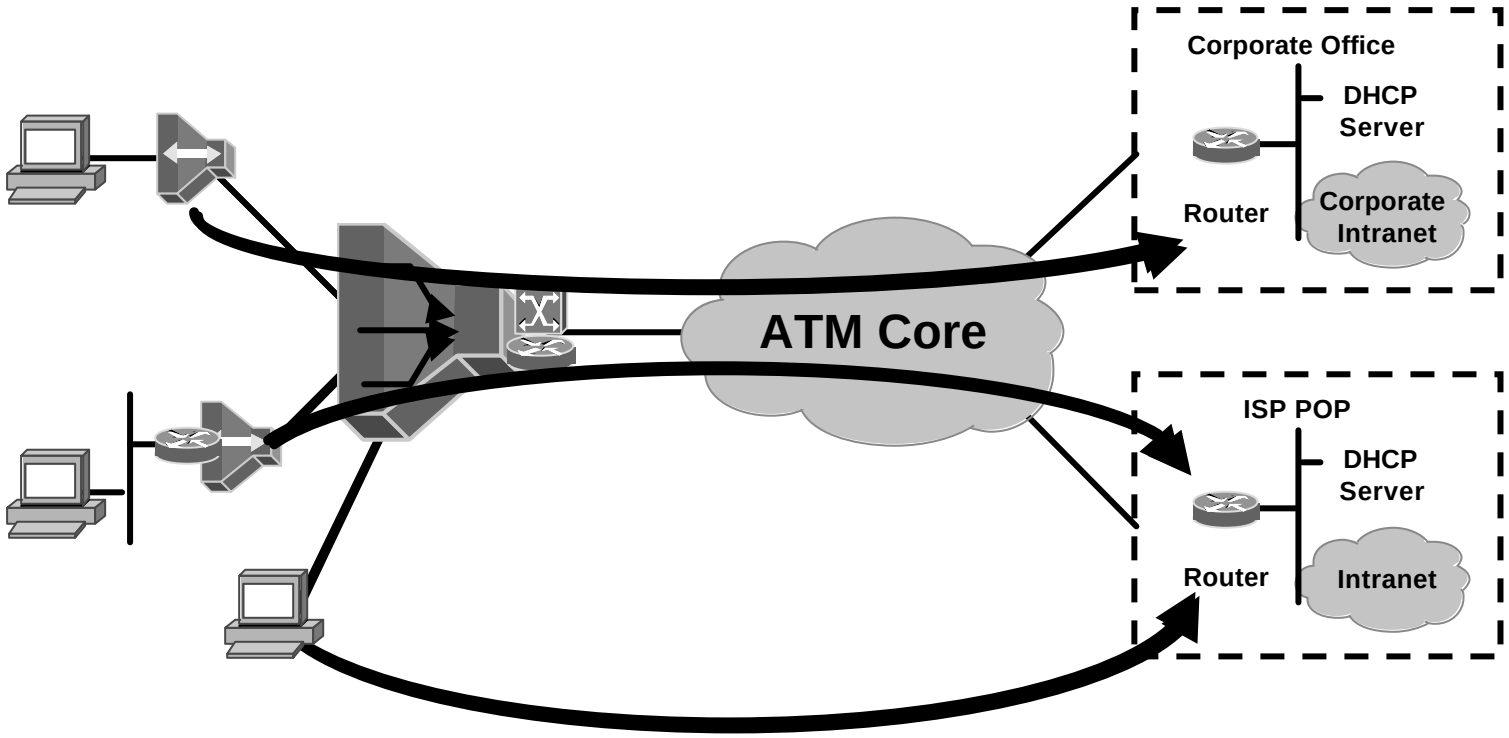
VPN Service: L2 and L3



Bandwidth Management: Architecture

- L2 end-to-end issue
- L3 local termination
- Broadcasts segmentation
- Bandwidth misused due to bridging architecture
- No access content/caching

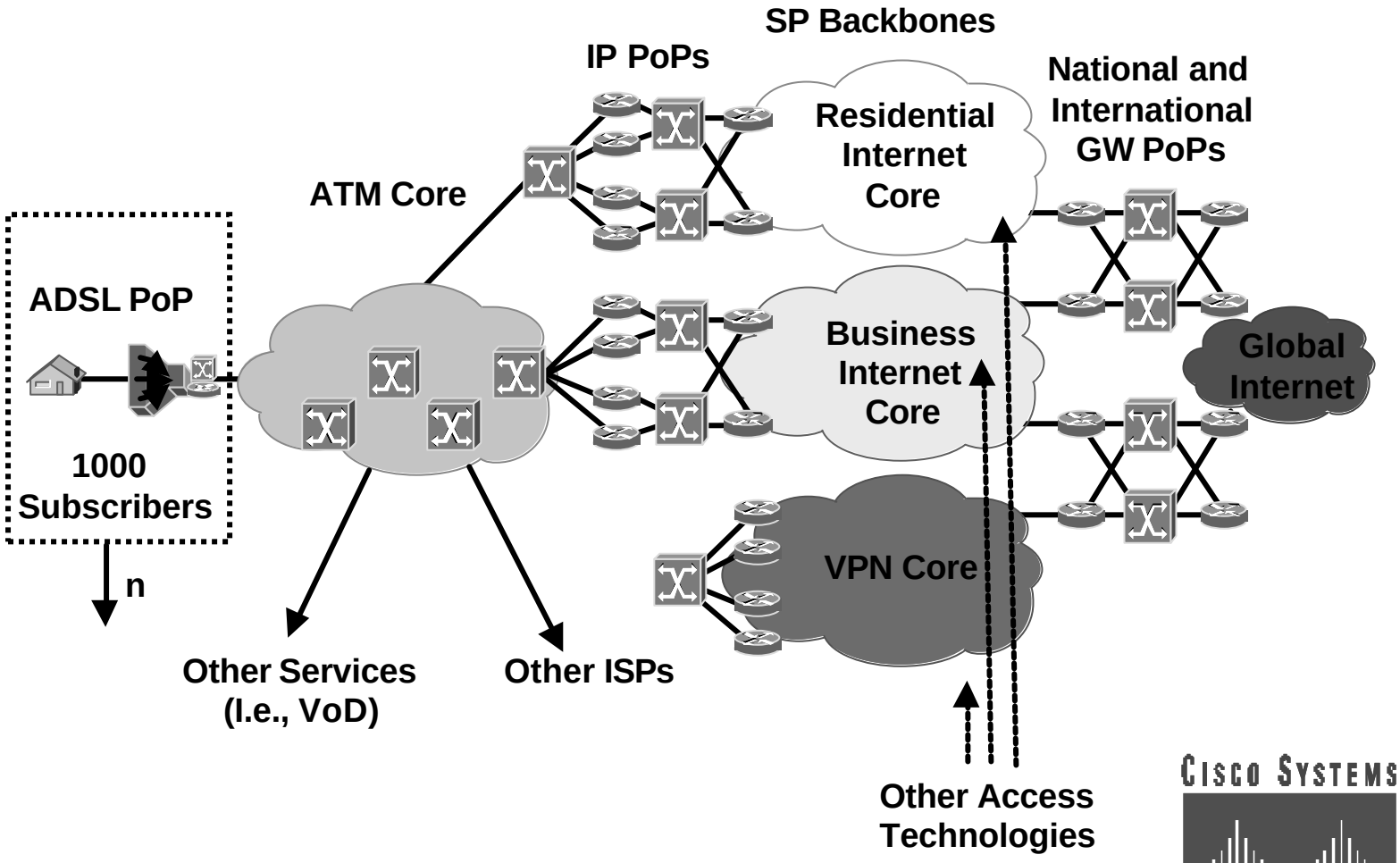
L2 Passthrough Mode



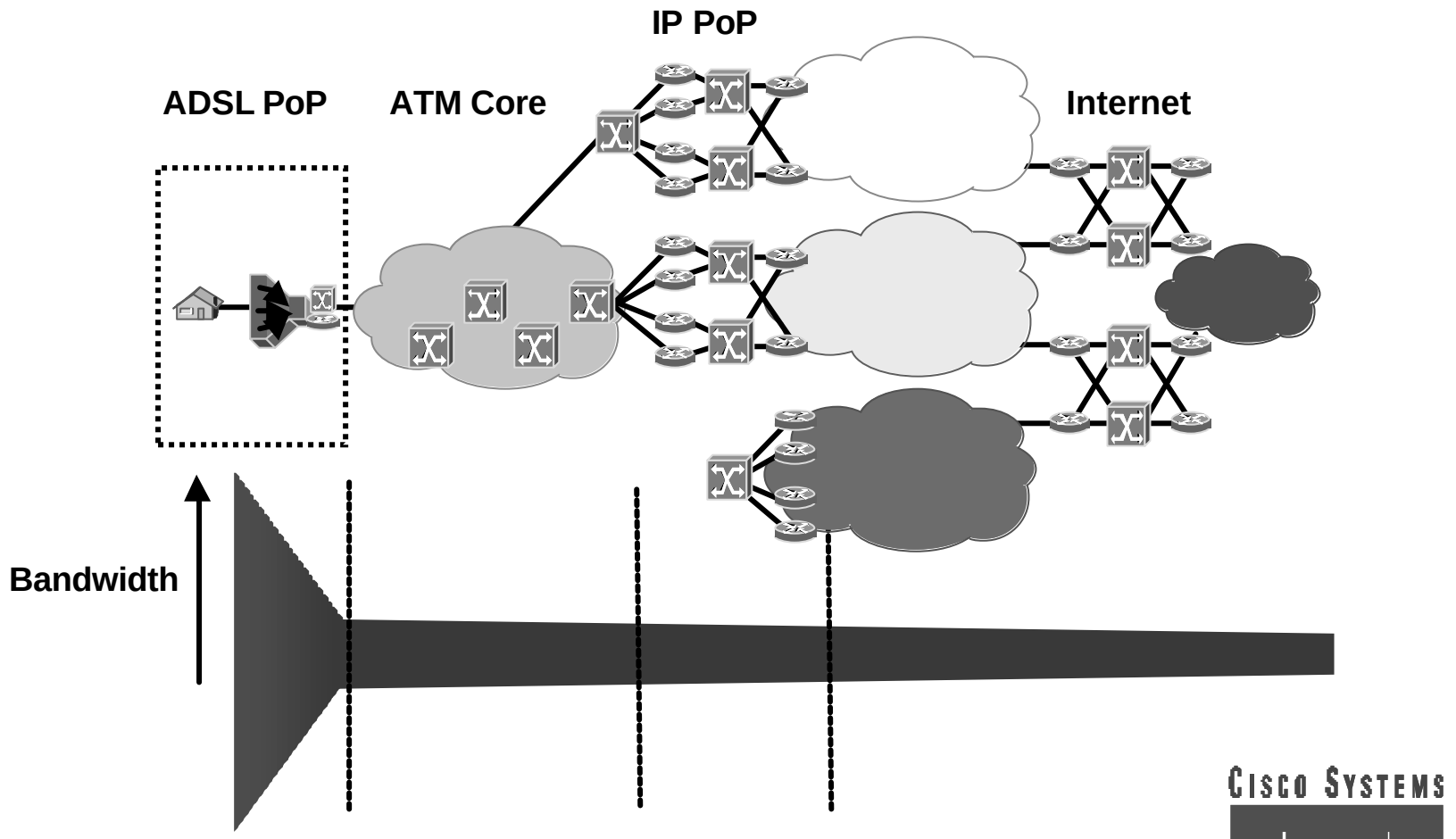
Bandwidth Management: Value-Add

- L3 Breakout
- VC and Broadcast management
- Caching and content management and delivery
- Optimized multicast service
  - IP multicast
  - IPmc and ATM p-mpt integration

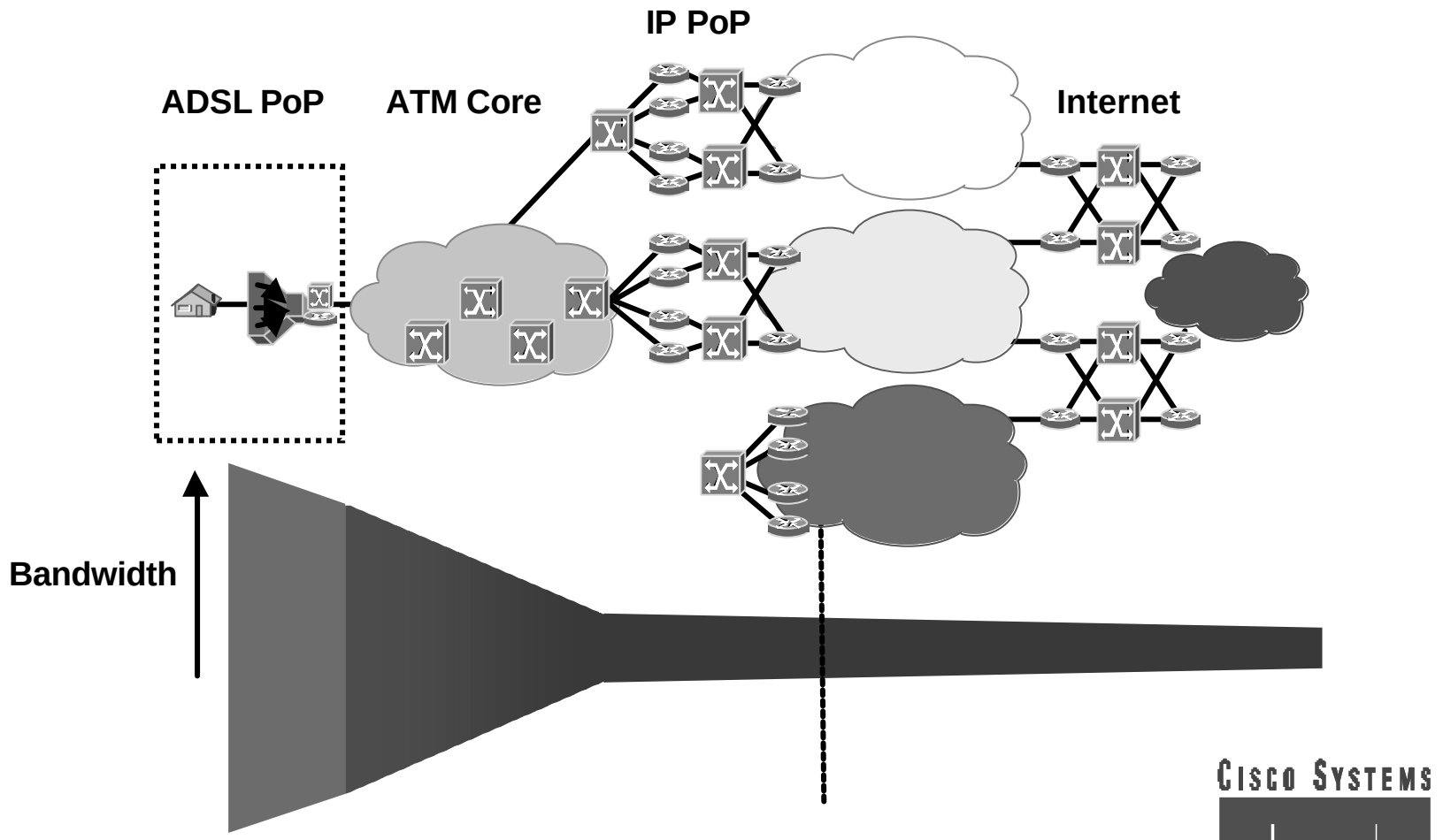
System Architecture



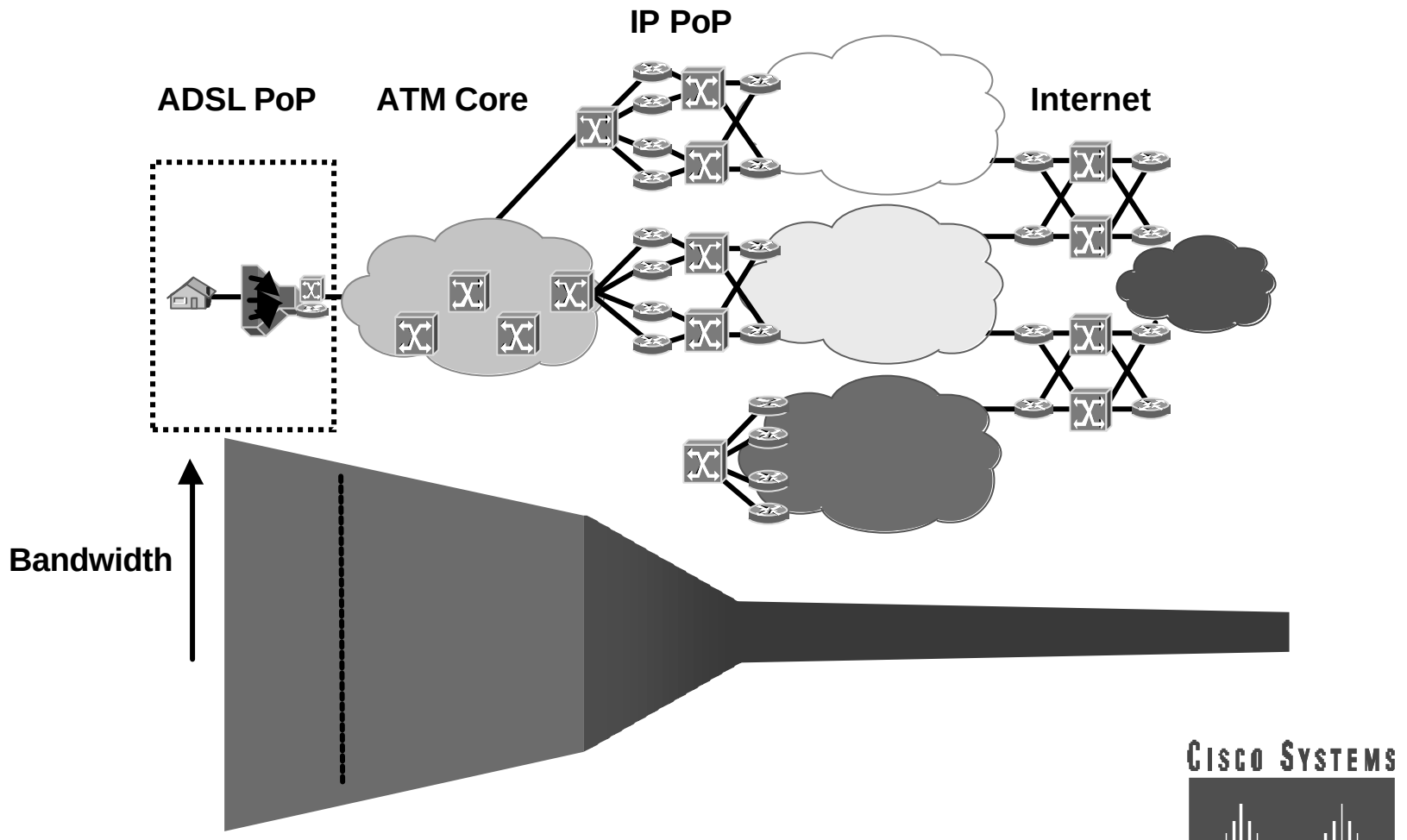
ADSL PoP Contention



ATM Core Contention

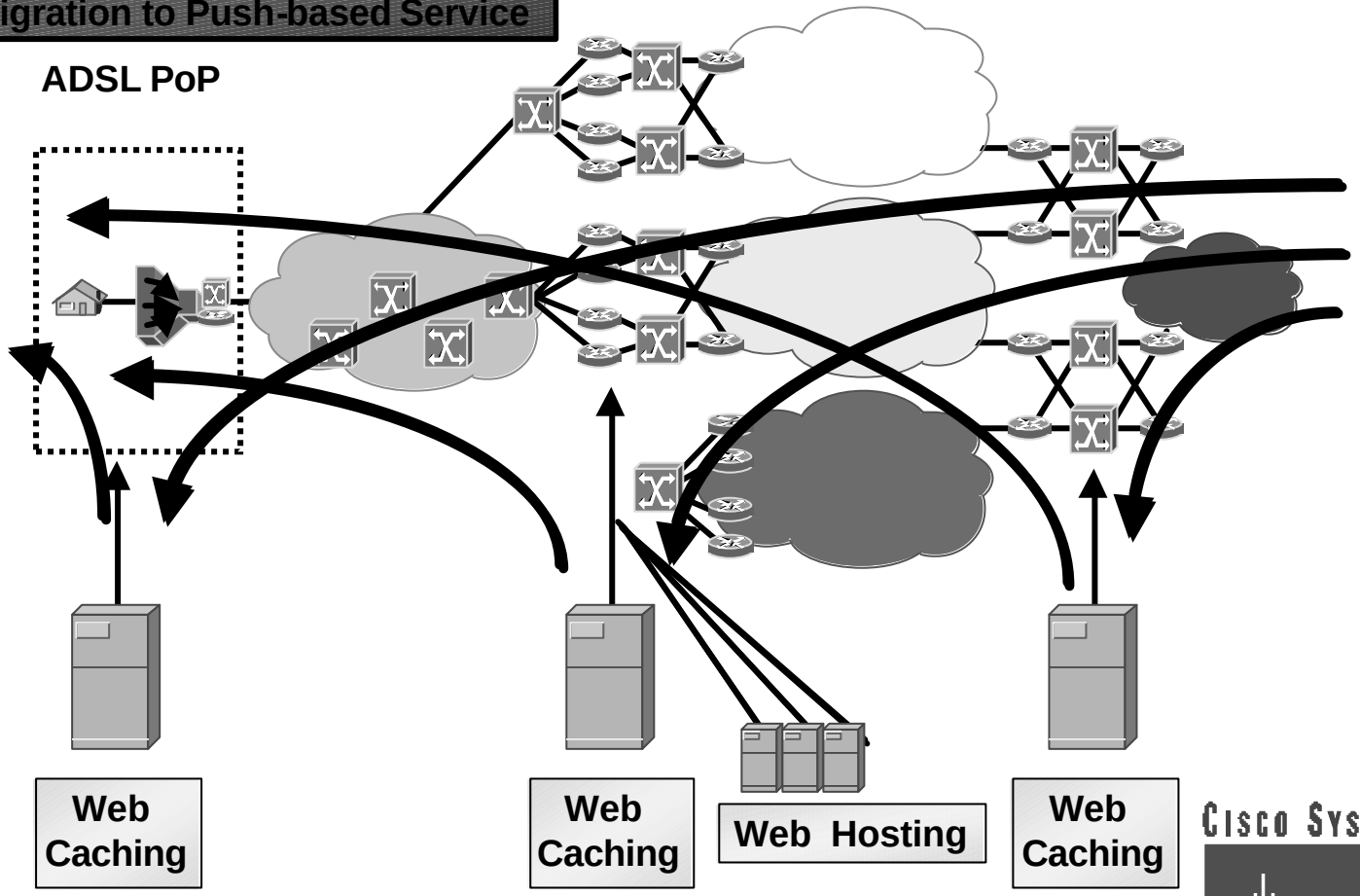


IP PoP Contention



Content Networking Architecture

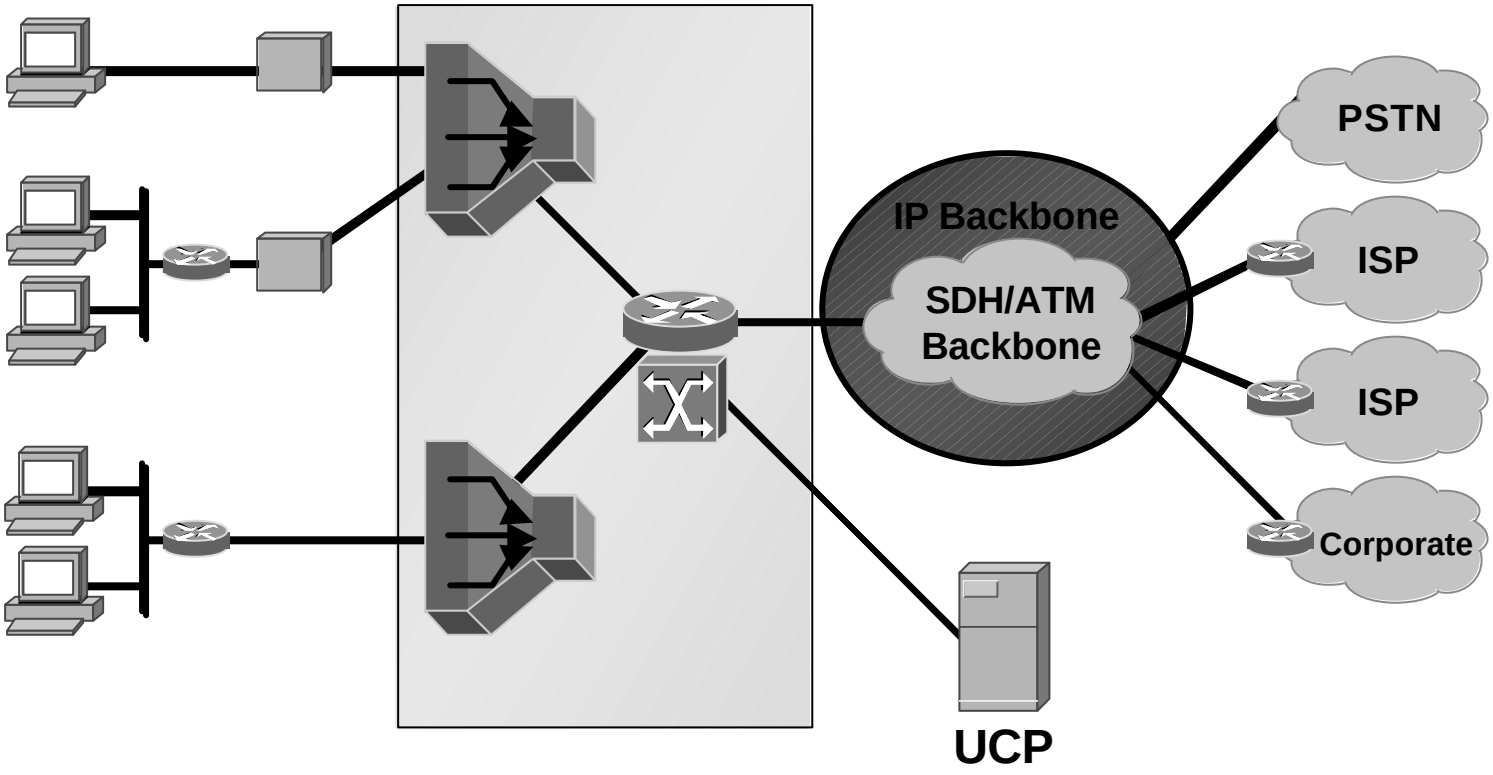
Efficient Pull-based Network Migration to Push-based Service



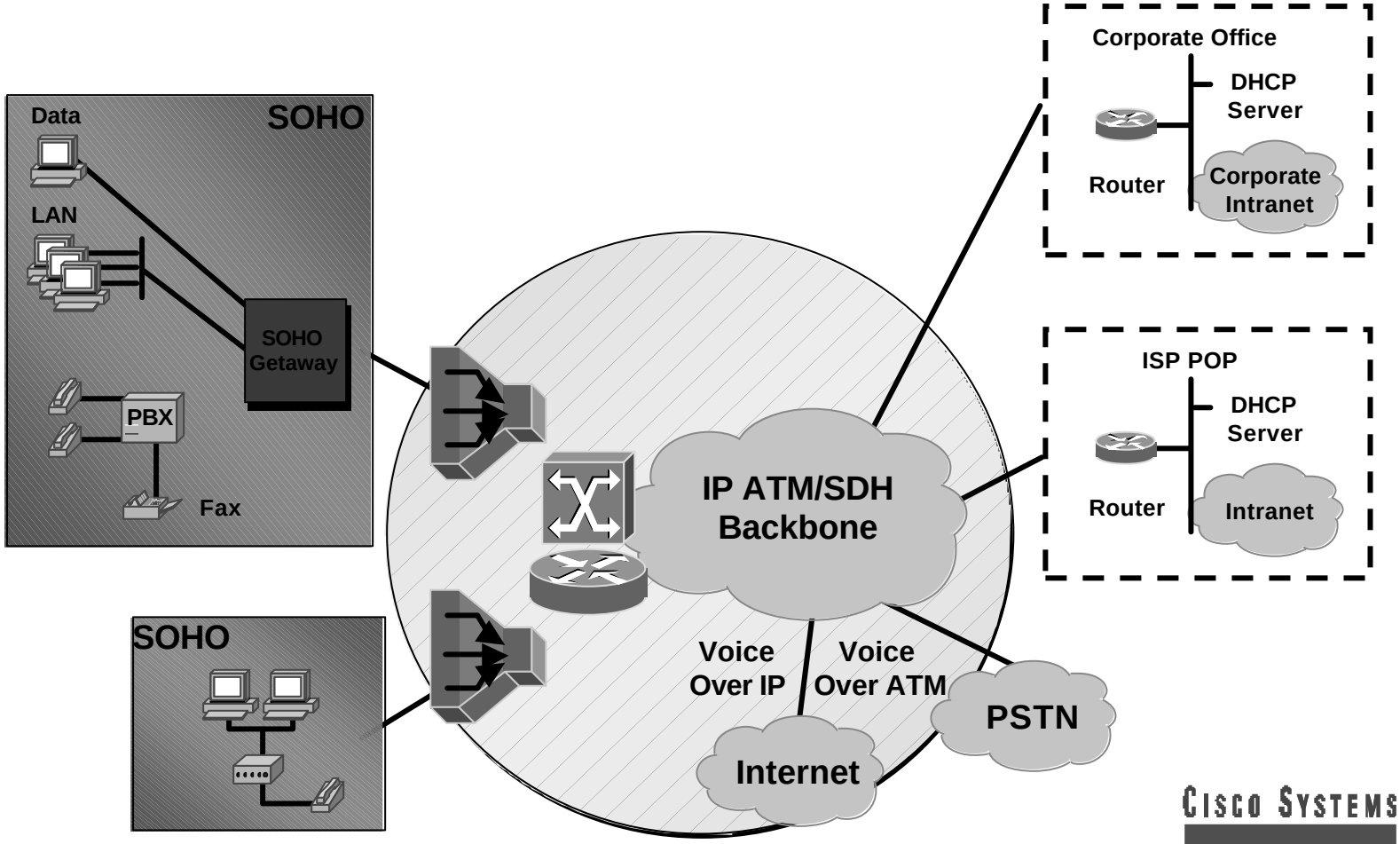
Content Management Benefits

- **Optimization bandwidth use**
- **Insertion of local content/ads**
- **Value-add services**
  - **To end-users, perceived better service**
  - **To content providers**
- **Traffic shaping and policing required**
  - **ATM or IP QoS**

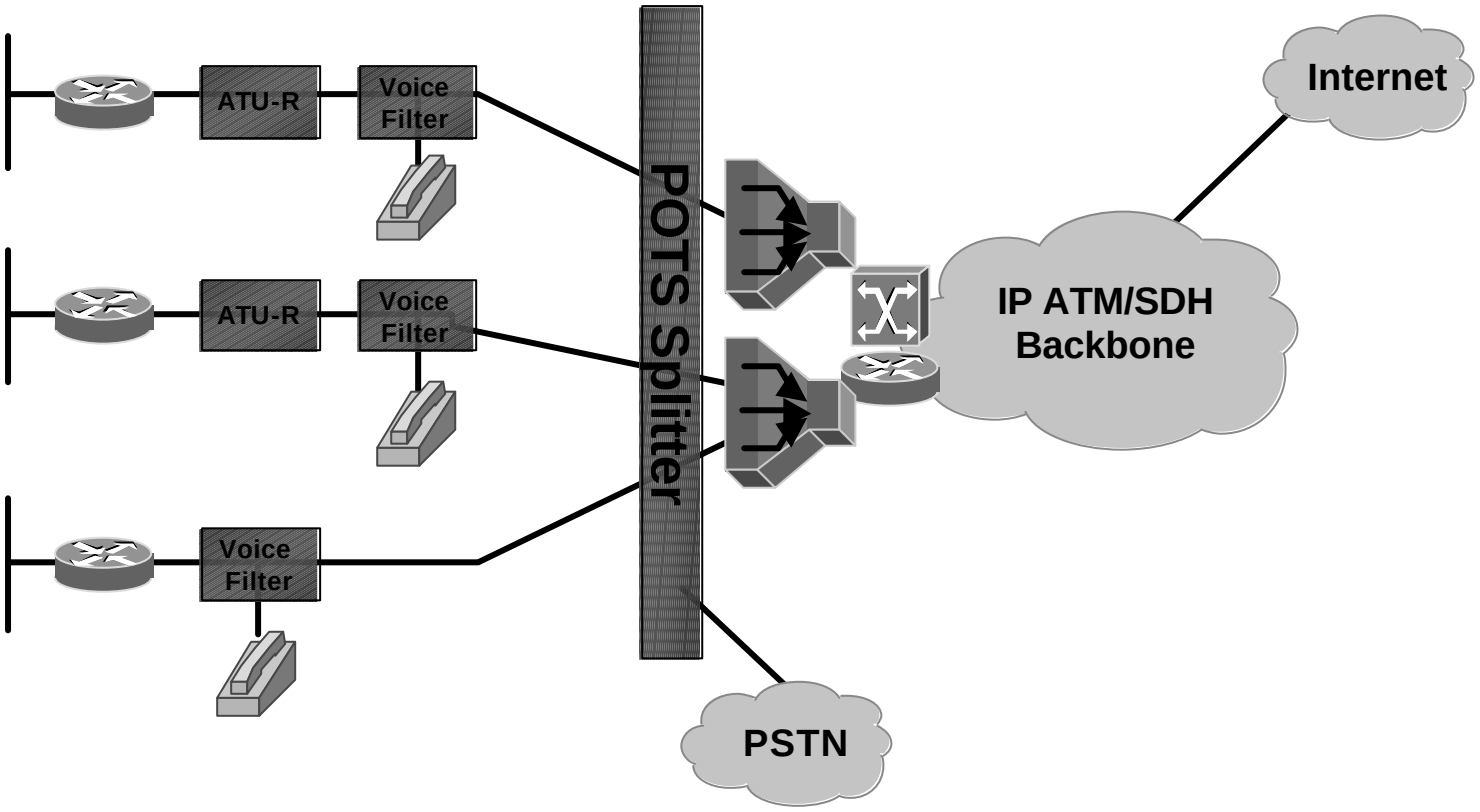
End-to-End ADSL Architecture



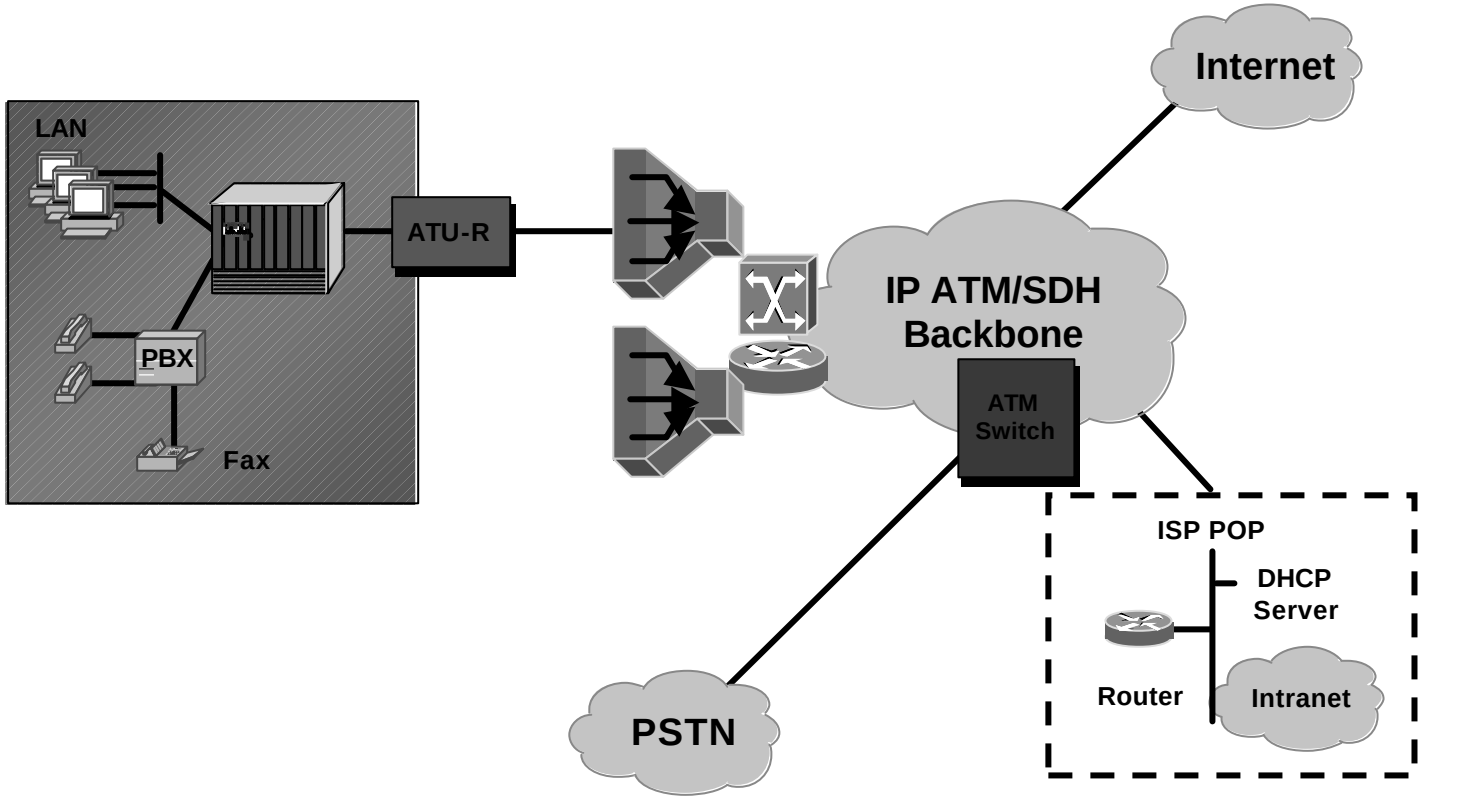
ADSL and Voice Integration



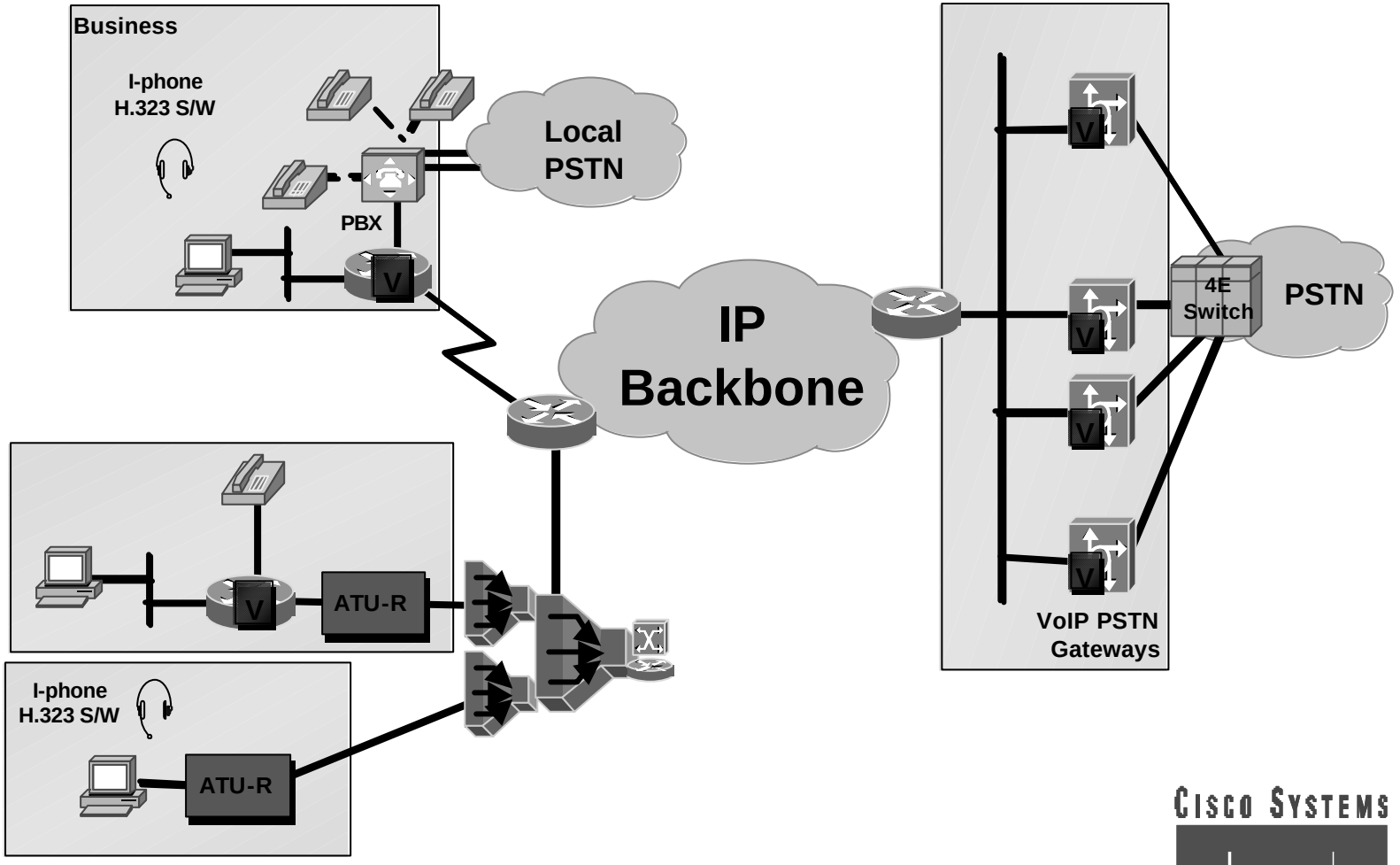
POTS Splitter



VoATM Breakout



VoIP Breakout



Network Deployment

- L3 Breakout point
- Bandwidth management
  - Bottleneck is not the local loop
- Content/caching management
- Caching and telephony probability of refused or not terminated call
- Differentiated IP services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