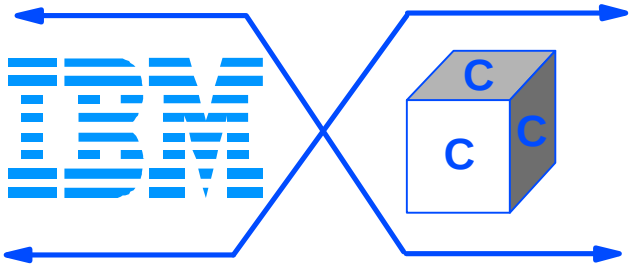

ELANs , VLANs
Layer 2/3 Switching
MSS Migration Scenario

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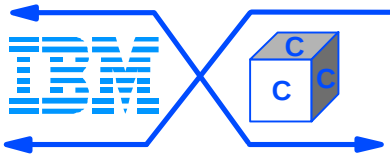
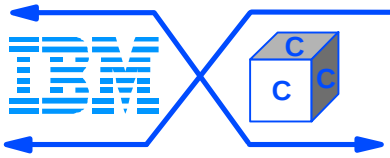


Agenda

- Virtual LANs (VLANs) vs. LAN Emulation (LANE)
  - Emergence of Layer 2/3 Switching
    - Migrating to MSS



ELANs, VLANs?

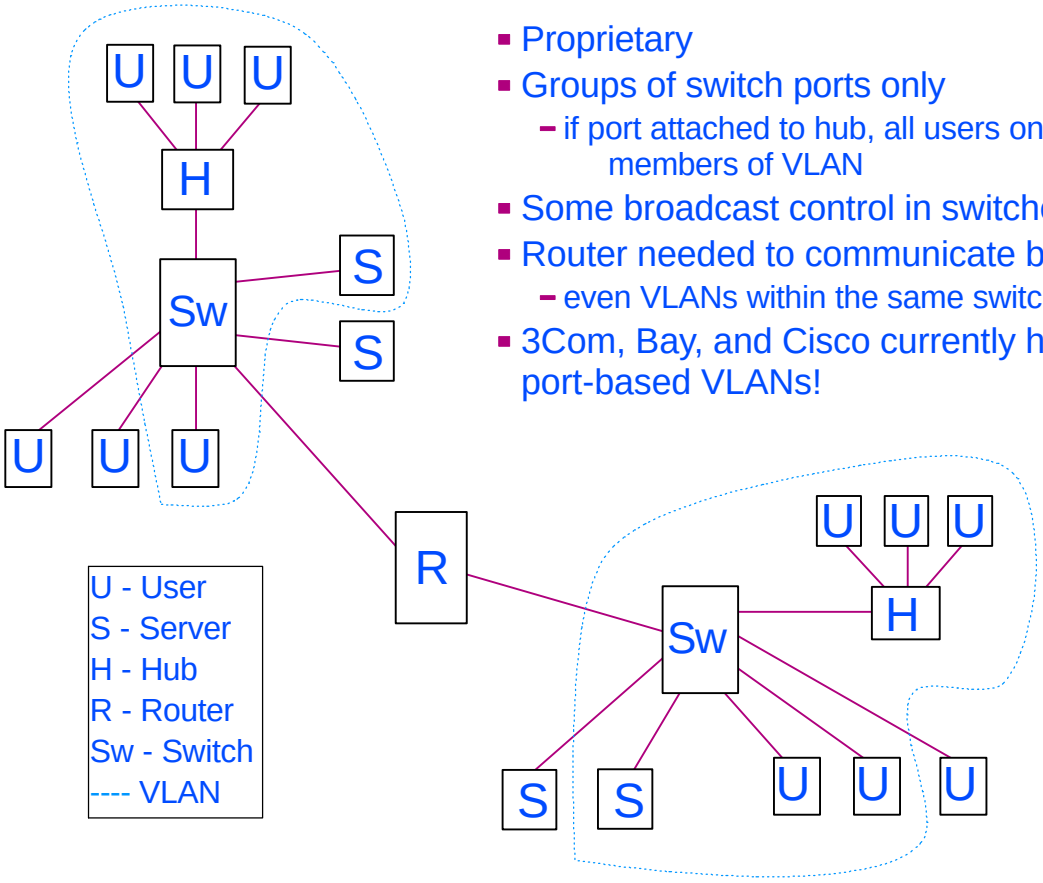
VLAN ... Virtual LAN

- a "GROUPING" of workstations, end-stations, hosts that are in the SAME BROADCAST DOMAIN.
  - i.e. a broadcast frame is received by ALL members of the VLAN
- Member stations administratively grouped by various criteria
  - ports , addresses , protocols , etc.
  - and *capabilities of vendors' products.* (proprietary pending 802.1q)
- Broadcast containment typically managed by creating smaller domains of "like , resource-sharing, or collaborating" users.
- Does not scale to large networks.

ELAN ... Emulated LAN

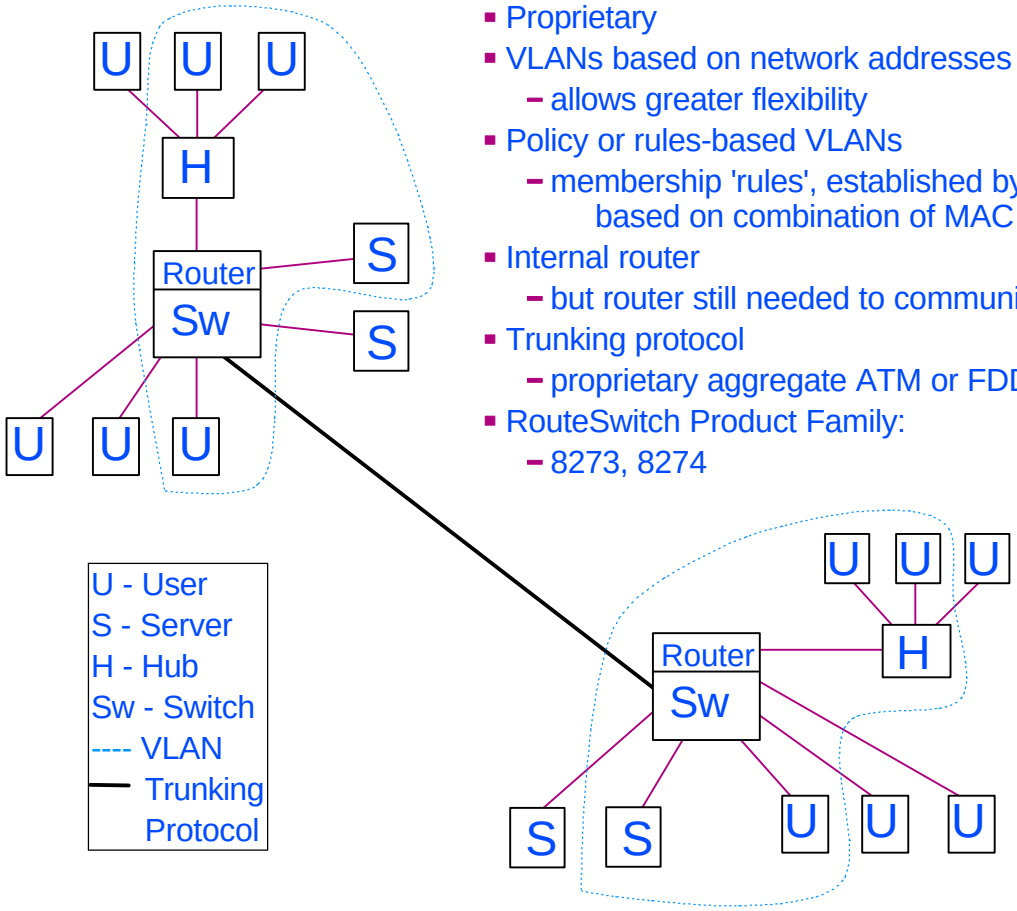
- also a "GROUPING" of workstations, end-stations, hosts that are in the SAME BROADCAST DOMAIN.
- BUT, because of the "one to one" connection orientation of the sessions set up by LANE, (and Classic IP)
  - the broadcasts can be intercepted, and directed to target devices
- Eliminates disruption to all other devices in the Emulated LAN.

Today's port-based VLANs...GOOD!



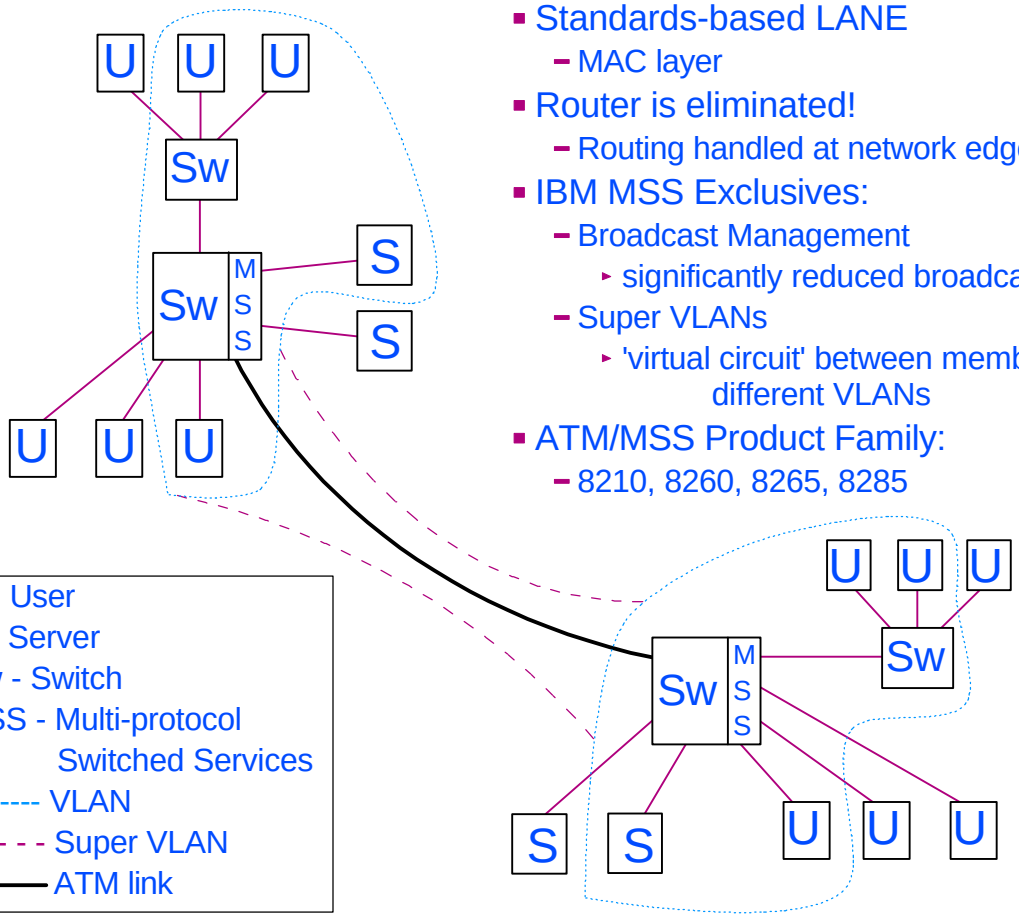
- Proprietary
- Groups of switch ports only
  - if port attached to hub, all users on that hub are members of VLAN
- Some broadcast control in switched environment
- Router needed to communicate between VLANs
  - even VLANs within the same switch
- 3Com, Bay, and Cisco currently have *only* port-based VLANs!

RouteSwitch VLANs...BETTER!



- Proprietary
- VLANs based on network addresses (MAC & Layer 3)
  - allows greater flexibility
- Policy or rules-based VLANs
  - membership 'rules', established by network management, based on combination of MAC and Layer 3 protocols
- Internal router
  - but router still needed to communicate between VLANs
- Trunking protocol
  - proprietary aggregate ATM or FDDI links between switches
- RouteSwitch Product Family:
  - 8273, 8274

MSS & Emulated LANs (LANE)...BEST!



- Standards-based LANE
  - MAC layer
- Router is eliminated!
  - Routing handled at network edge by MSS
- IBM MSS Exclusives:
  - Broadcast Management
    - significantly reduced broadcast traffic
  - Super VLANs
    - 'virtual circuit' between members of different VLANs
- ATM/MSS Product Family:
  - 8210, 8260, 8265, 8285

Competitive Positioning

- First, win the technology decision...
  - ATM
    - The SVN Philosophy
    - MSS Implementation

vs.

  - LAN switches *and* routers
    - Fast Ethernet backbones
    - Gigabit Ethernet?
    - Stand-alone routers

- If ATM...
  - 8260
    - MSS
    - One platform

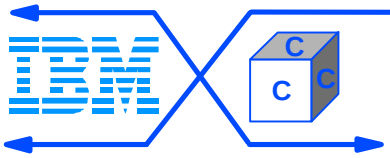
vs.

  - ATM switches *and* routers from
    - Cisco
    - Bay
    - 3Com

- If ~~ATM~~... (i.e.. Fast Ethernet or FDDI)
  - 8274
    - RouteSwitch VLANs
  - 8260
    - Switch Module series

vs.

  - LAN switches from
    - Cisco
    - Bay
    - 3Com



VLANs or MSS?

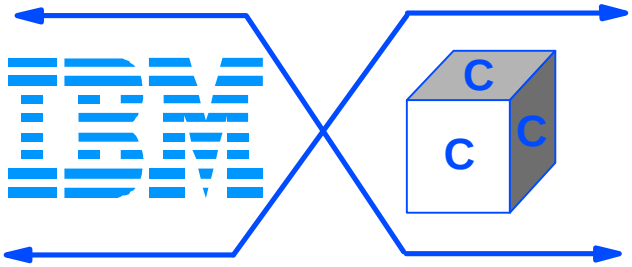
Proprietary VLANs

1. Switched VLANs
   - proprietary methods to group users based on network layers
     - physical, MAC, & Layer 3
2. Restrict & control broadcasts
   - not within VLANs, however
3. Administration
   - adds, moves and changes simplified
     - *but*, VLAN membership must still be tracked and maintained
4. Provides means of restricting access to parts of network
5. Router still needed
   - for communication between VLANs

Standard LANE with MSS

1. ATM VLANs with MSS
   - groups of users based on ATM standards
     - LAN Emulation (LANE)
2. *Eliminate* broadcasts w/BCM
   - even within Emulated LANs!
3. The 'flat' network
   - same administrative advantages
     - *and* the need for VLANs largely reduced due to BCM
4. Deploy ELANs *only* when access must be restricted
5. Super VLAN
   - ATM 'Virtual Circuit' between ELANs

Why implement proprietary VLANs ???



LAYER 2/3 Switching
An Introduction

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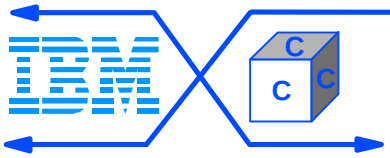
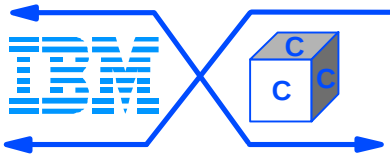


Layer 2/3 Switching: Agenda

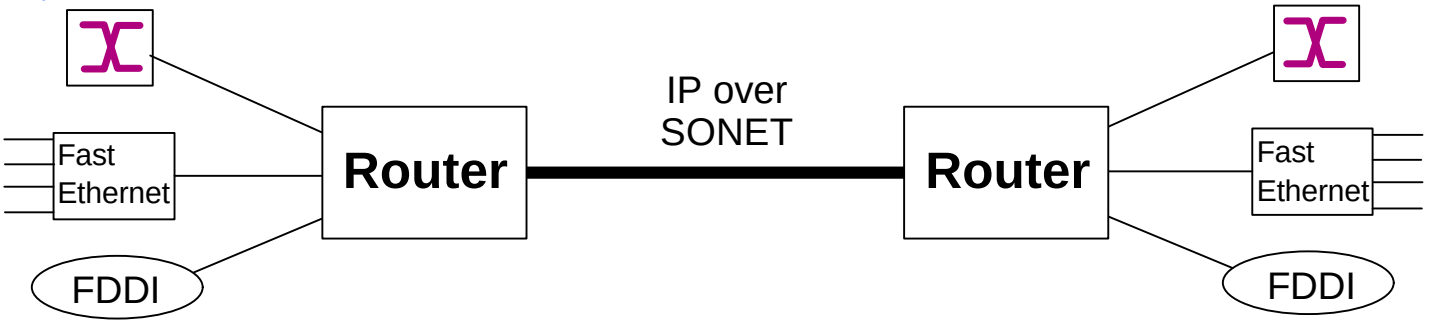
- Introduction
  - The Requirement
- Types of Route Switches
  - Big Fast Routers
  - Virtual Routers
  - Integrated Cell/Switch Routers
- Vendor Offerings
  - Campus
    - IBM: MSS
    - Cisco: NetFlow Switching
    - Bay: Switch Node
  - Enterprise
    - IBM: ARIS
    - Cisco: Tag Switching
    - Ipsilon: IP Switching



Layer 3 Switching: The Requirement

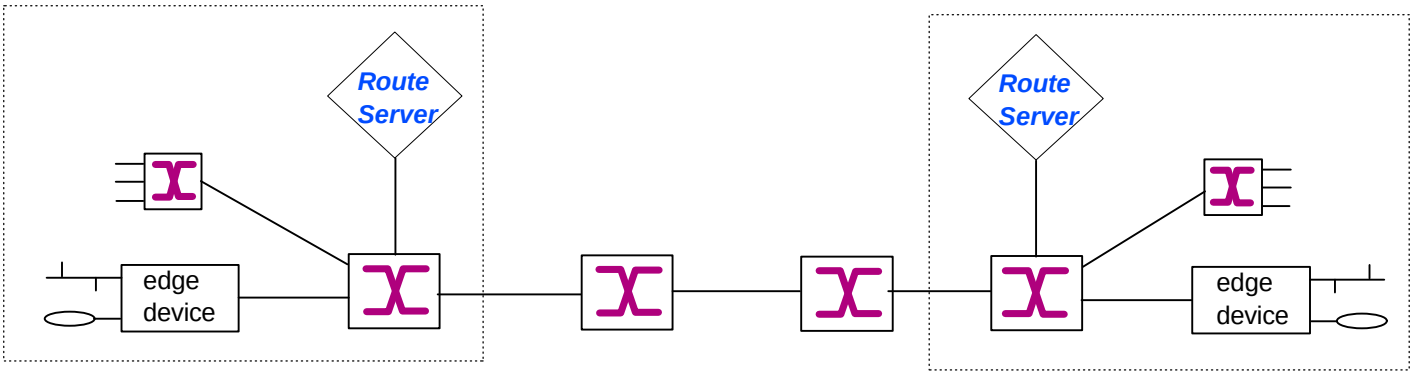
- Internet and intranets are faced with the following issues:
  - large increase in data traffic - TCP/IP
  - presence of "killer app" - the Web
  - requirement to support real-time traffic flows with end-to-end QoS without impacting best-effort
  - requirement to prioritize traffic flows for optimal bandwidth utilization
- Three Router Models have begun to emerge:
  - Big Fast Routers
  - Virtual Routers
  - Integrated Cell/Switch Routers

Big Fast Routers (BFR's)



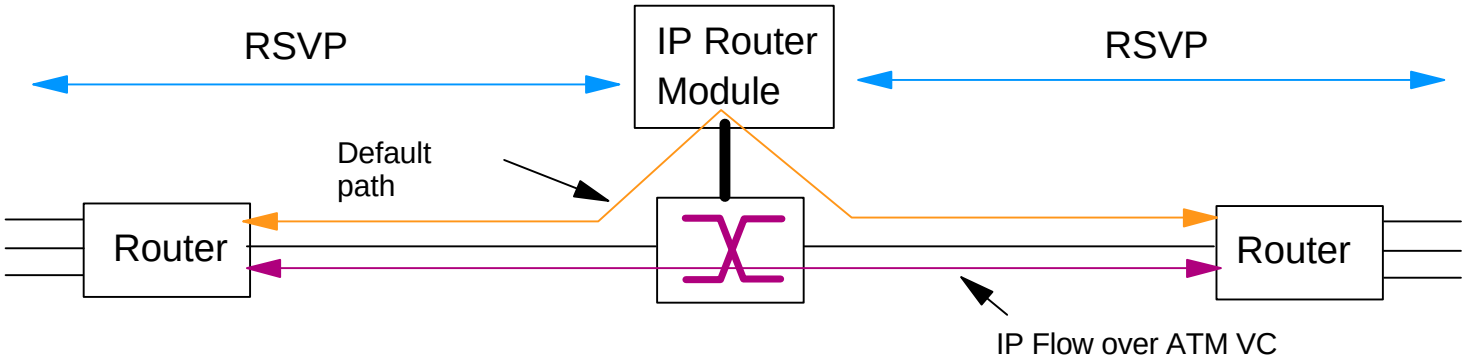
- Big Fast Router
  - outfitted with high-speed LAN interfaces including ATM, Fast Ethernet, GB Ethernet and FDDI
  - WAN interfaces might include IP over SONET
  - End-to-End QoS dependent on all network elements (including Fast Ethernet) supporting RSVP/IntServ
- Advantages
  - No change to existing, workable, scaleable IP networking model
  - Familiar technology
  - No overhead associated with ATM Signaling
  - IP Multicast
- Disadvantages
  - Cost
  - RSVP/IntServ not fully understood or defined
  - no end-to-end QoS
  - Overhead associated with packet translation and routing
  - VLAN support is localized

Virtual Routers

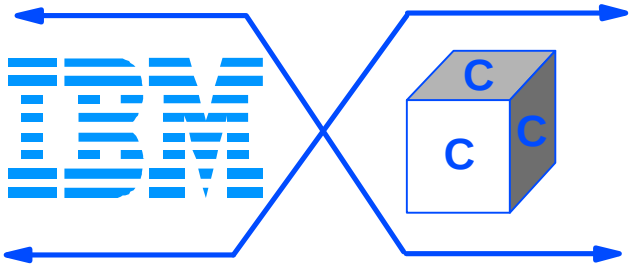


- Virtual Router
  - Consolidates Routing Function into Route Server and distributes packet forwarding to inexpensive high-performance edge devices and ATM-attached hosts
- Advantages
  - leverages low latency and high-bandwidth of ATM cell switching
  - Cut-thru Routes can bypass layer-3 hops
  - ATM workgroups can support end-to-end QoS
  - Best Price and Performance for routing - added bonus of QoS-enabled network
  - Presence of ATM switch fabric offers QoS-enabled network for native ATM applications
- Disadvantages
  - Complexity and overhead of IP (e.g. OSPF) and ATM (e.g. PNNI) routing protocols
  - Incomplete Standards at this time
  - No exploitation of QoS at this time

Integrated Cell/Switch Router



- Integrated Cell Switch/Router
  - Ipsilon IP Switch is shipping and Toshiba has a prototype
  - Routes packets over default path and can map IP flow to ATM VC
  - no Q.2931/PNNI signaling - ATM is just used as a cell switching transport
- Advantages
  - exploits low latency and high performance of ATM switching
  - no overhead from ATM signaling/routing
  - flexibility and robustness of IP routing
  - RSVP could become signaling protocol so that QoS state could be dynamically installed
- Disadvantages
  - IP only
  - Complexity associated with mapping IP flow to ATM VC - optimal implementation uses RSVP signaling
  - Proprietary



Layer 2/3 Switching: Campus

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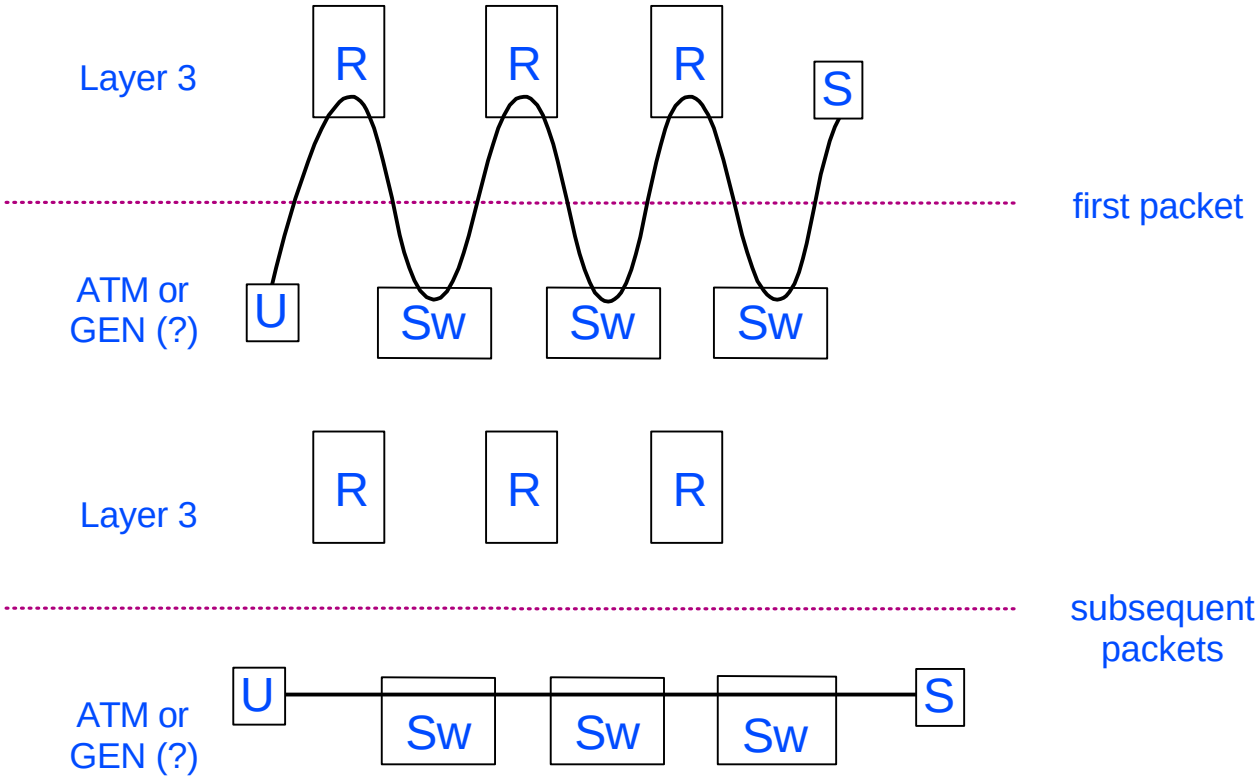
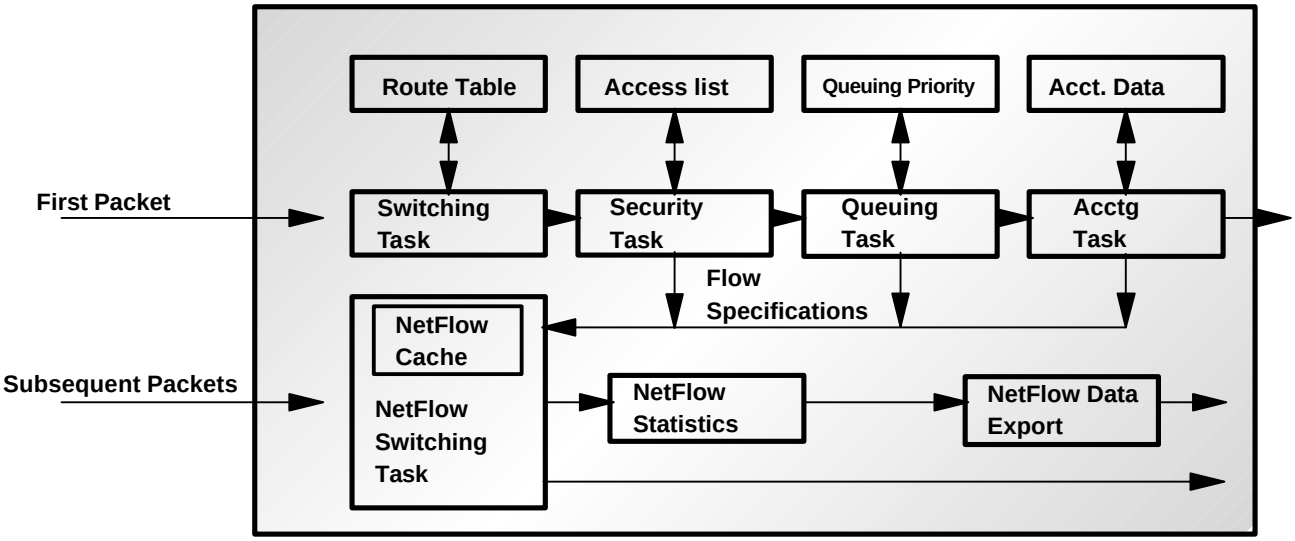
Cisco: NetFlow Switching



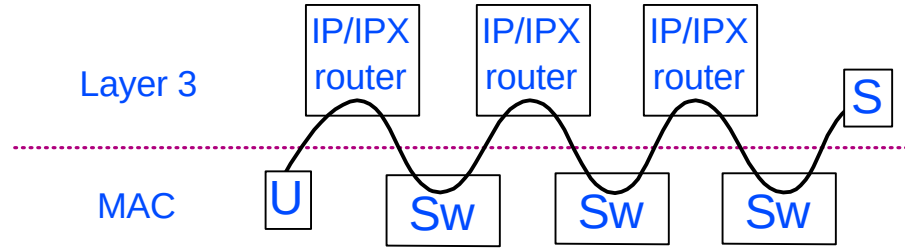
Defined as a series of either route
or switch related 'tasks'

NetFlow Switching Overview

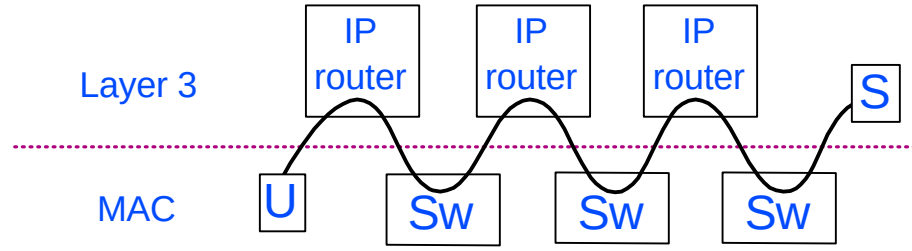


- NetFlow Switching
  - Proprietary!
  - Currently only IP supported
  - True switching... or 'distributed route processing'?
- Where do the NetFlow cache and switching tasks reside?
  - Versatile Interface Processors for 75xx routers
  - Feature card for supervisor module on Catalyst 5500 (delayed until early '98!)
- Statistics on 'expired' flows'
  - Can be forwarded to management applications

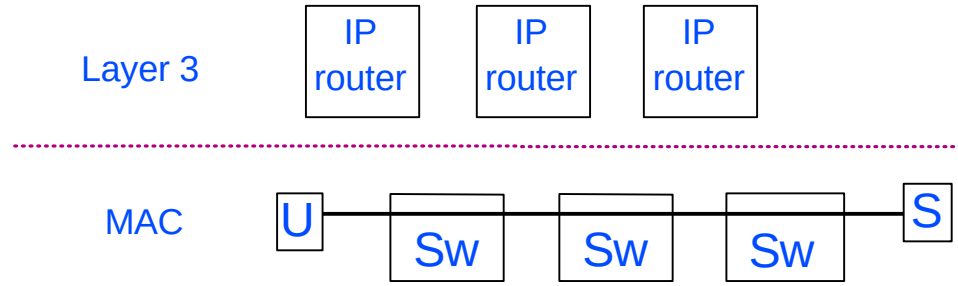
Bay Networks: Switch Node



routing mode (acts as fast low latency router)

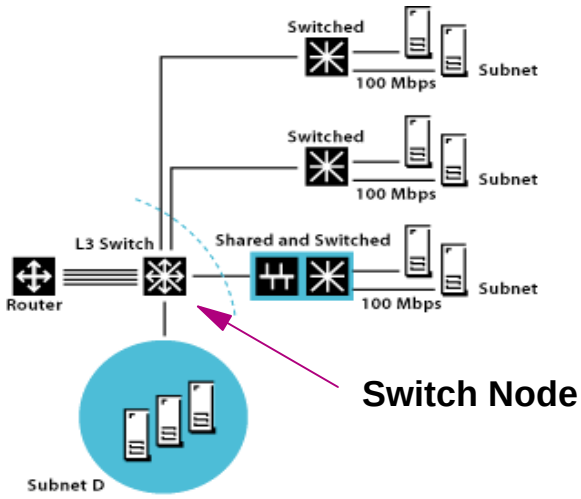


'IP AutoLearn' mode ('learns' IP addresses)



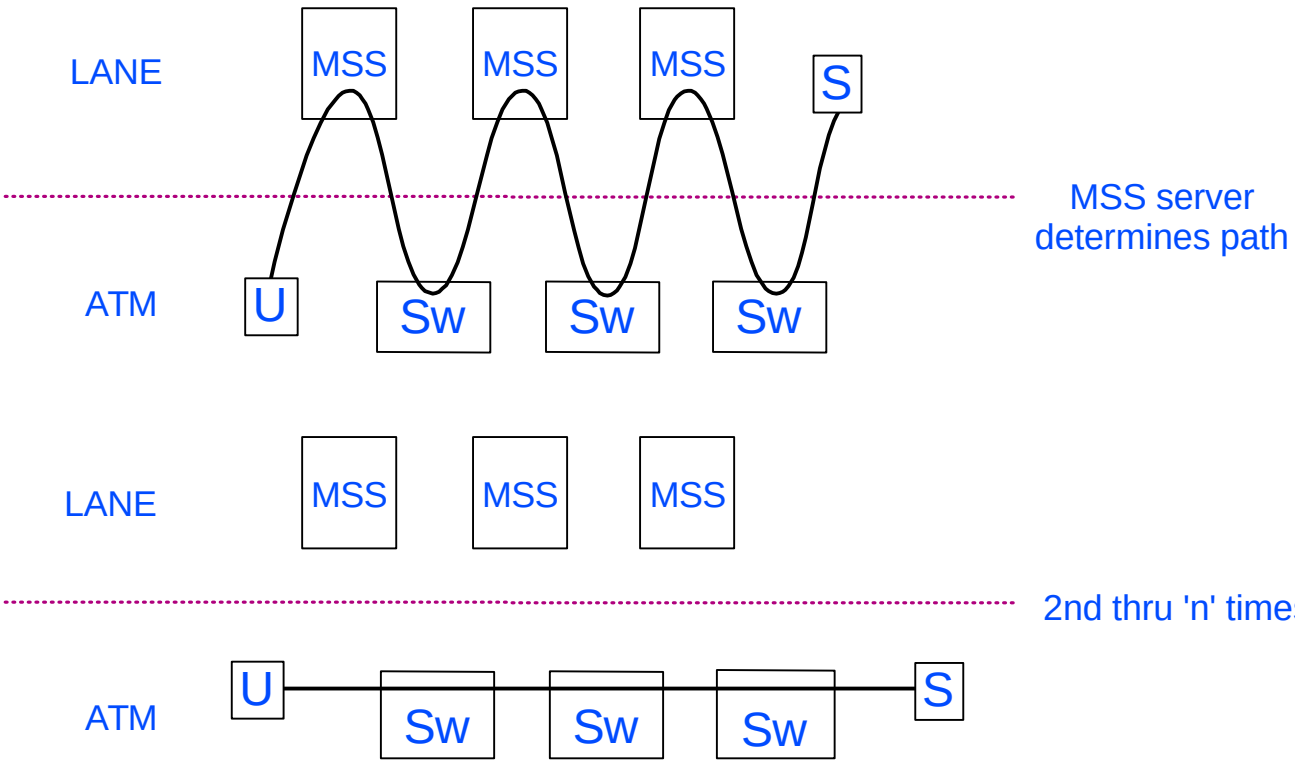
Very fast IP routing based on learned addresses

Switch Node Overview

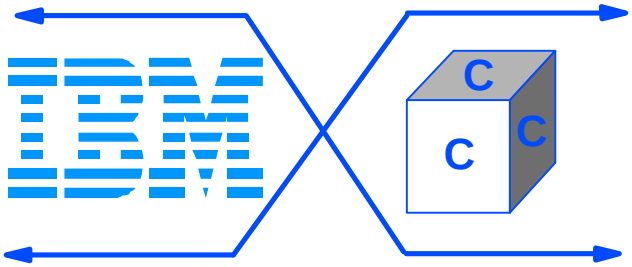


- Very Fast Routing
  - Dedicated CPU for learning addresses
  - Distributed processors (on blades) for data forwarding
    - router forwarding code written into micro-code
- Lacks Scaleability
  - Dependent on existing routers for discovery
  - 'AutoLearn' (IP only) for adjacent router
    - locally attached subnets only

IBM: Next Hop Resolution Protocol (NHRP)



LANE and NHRP are building blocks for Multi-Protocol Over ATM (MPOA)



Layer 2/3 Switching: Enterprise

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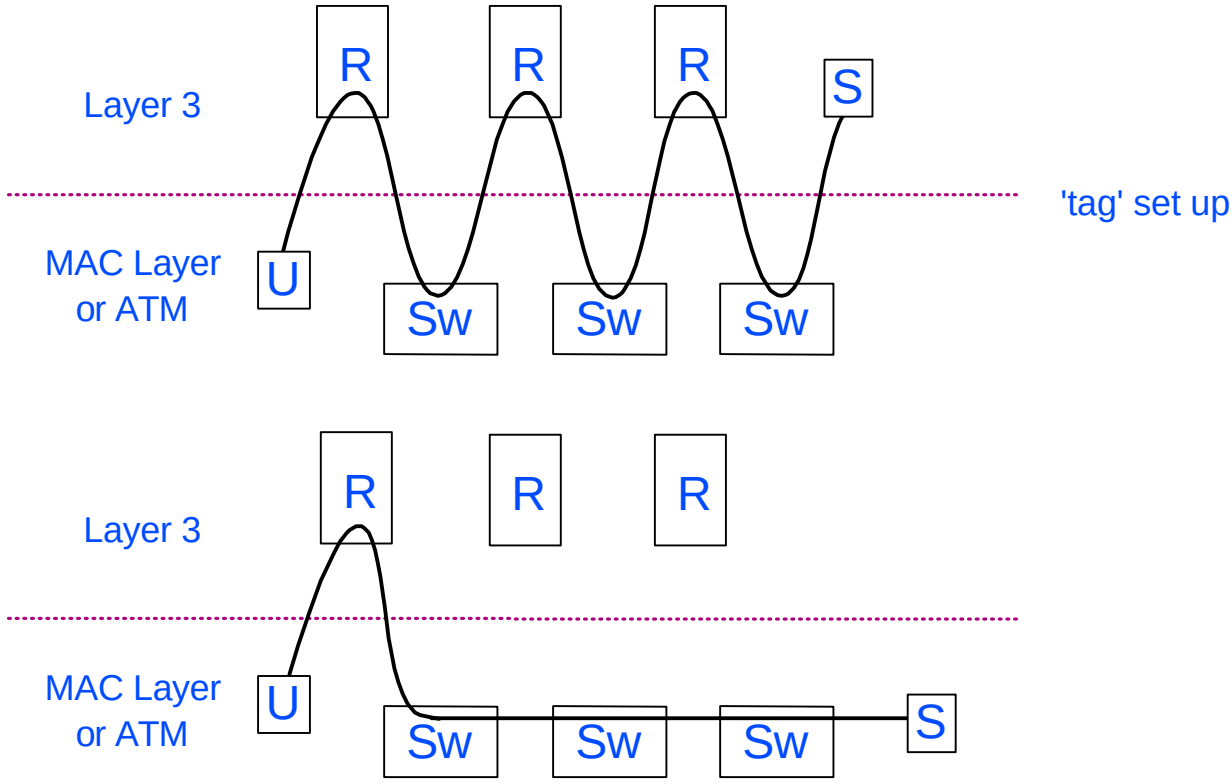
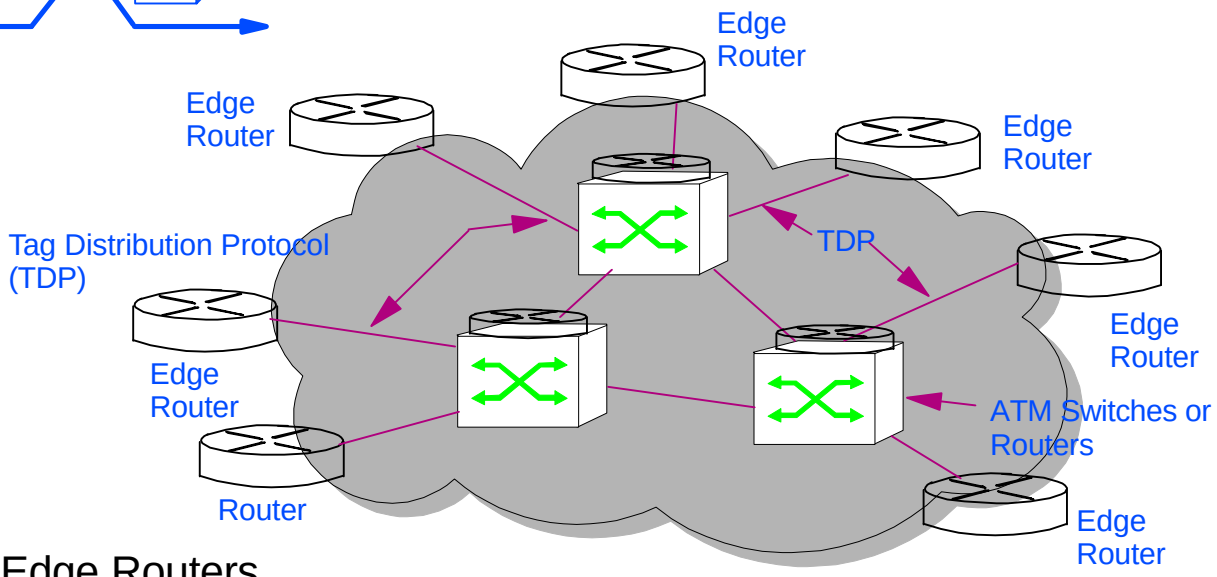
Cisco: Tag Switching



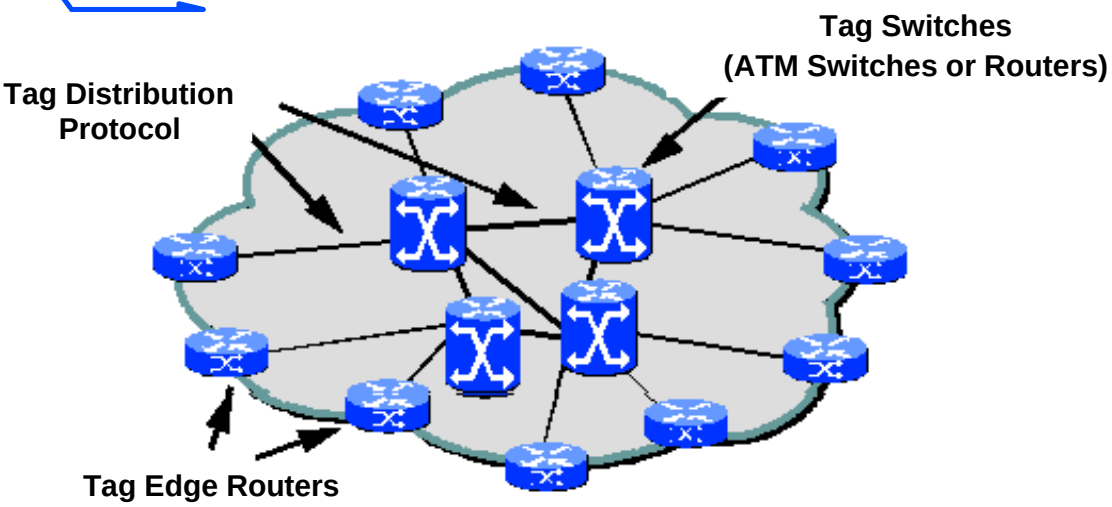
Tag Distribution Protocol (TDP), a broadcast-like mechanism, is used to set up above environment, still dependent on stand alone router

Tag Switching Overview

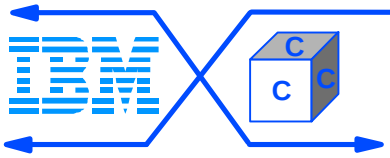


- Tag Edge Routers
  - Located at the boundary of the Internet, perform value added network layer services and apply tags to packets
- Tag Switches
  - Switch tagged packets or cells based on tags
  - May support Layer 3 routing or layer 2 switching
- Tag distribution protocol
  - Distribute tag info between devices in the tag switched network.
  - Works in conjunction with OSPF, BGP ...,

Tag Switching Process



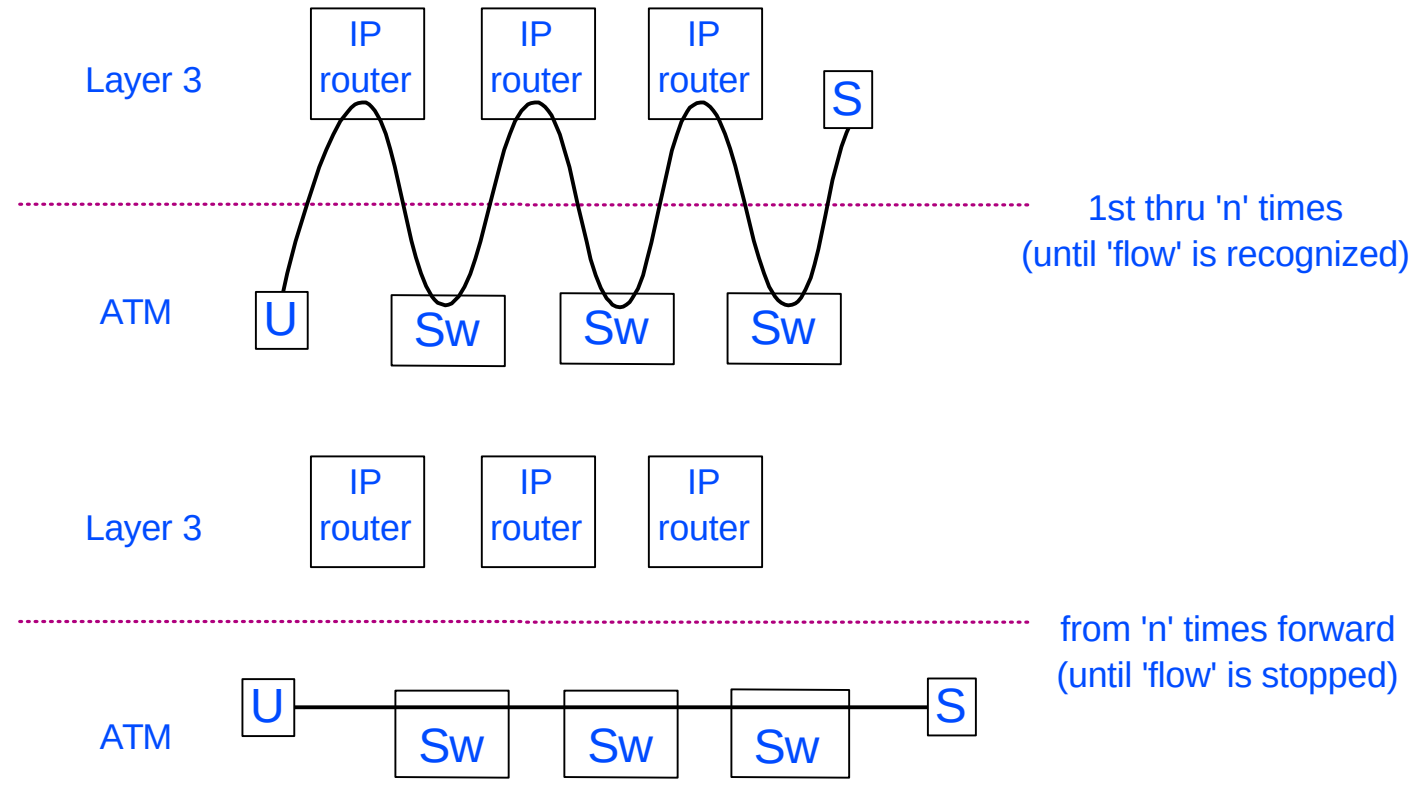
- Tag Switching process
  - Network devices exchange reachability info using routing protocols like OSPF, IGRP
  - New Cisco Tag Distribution Protocol establish tag-to-destination network mappings
  - Ingress edge routers in tag switching network perform Layer 3 services (NetFlow services) and adds tag to packet
  - Packets switched based on tags using tag swapping
  - Egress edge routers removes the tags and deliver the packets
- Cisco plans for tag switching
  - Standardize portions of Tag Switching via IETF
  - Deliver products starting in 1H97



Tag Switching: Strengths/Issues

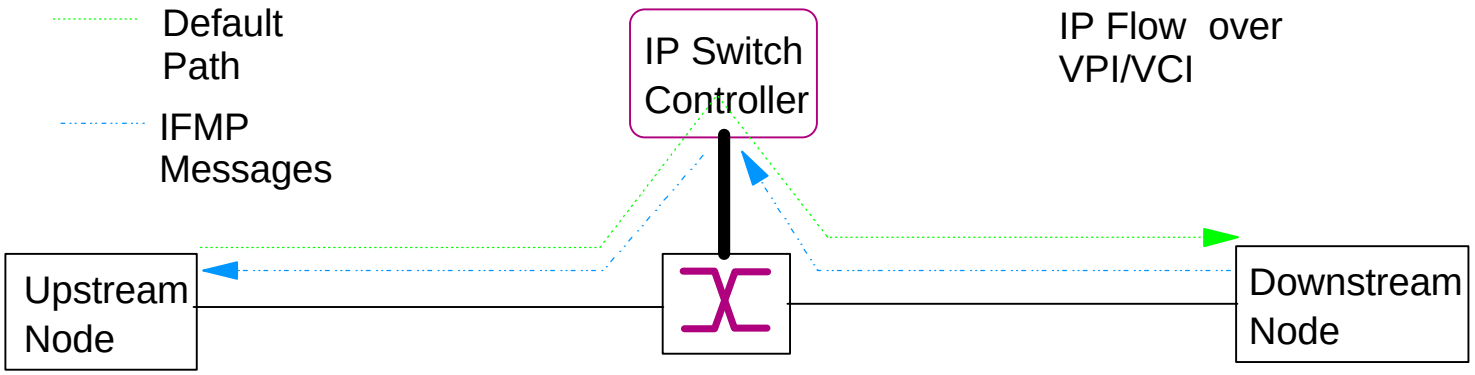
- Tag Switching Strengths
  - Comprehensive, allowing coexistence of ATM and Non-ATM services
  - Cisco router market share in ISP networks may give an edge to Cisco in pushing their agenda
  - Claimed to provide multi-protocol support
  - Protect router technology investment
  - Reduce 'routing table lookup' time > latency
  - Label swapping > switching appearance on routers
- Tag Switching Limitations
  - Currently Cisco proprietary, though Cisco is trying to standardize parts of it
  - Results in higher overhead that the IBM proposed ARIS (Aggregate Route based IP Switching) protocol
    - ARIS allows for VC aggregation/conservation
    - Loop prevention even in the presence of transient conditions
  - Does not provide the level of aggregation proposed in ARIS, resulting in limited scalability
  - Does not address explicit multi-path support

Ipsilon: IP Switching

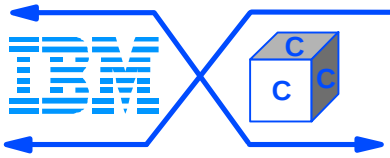


An ATM 'virtual circuit' is needed for each user-to-server connection...not scaleable

IP Switching Overview



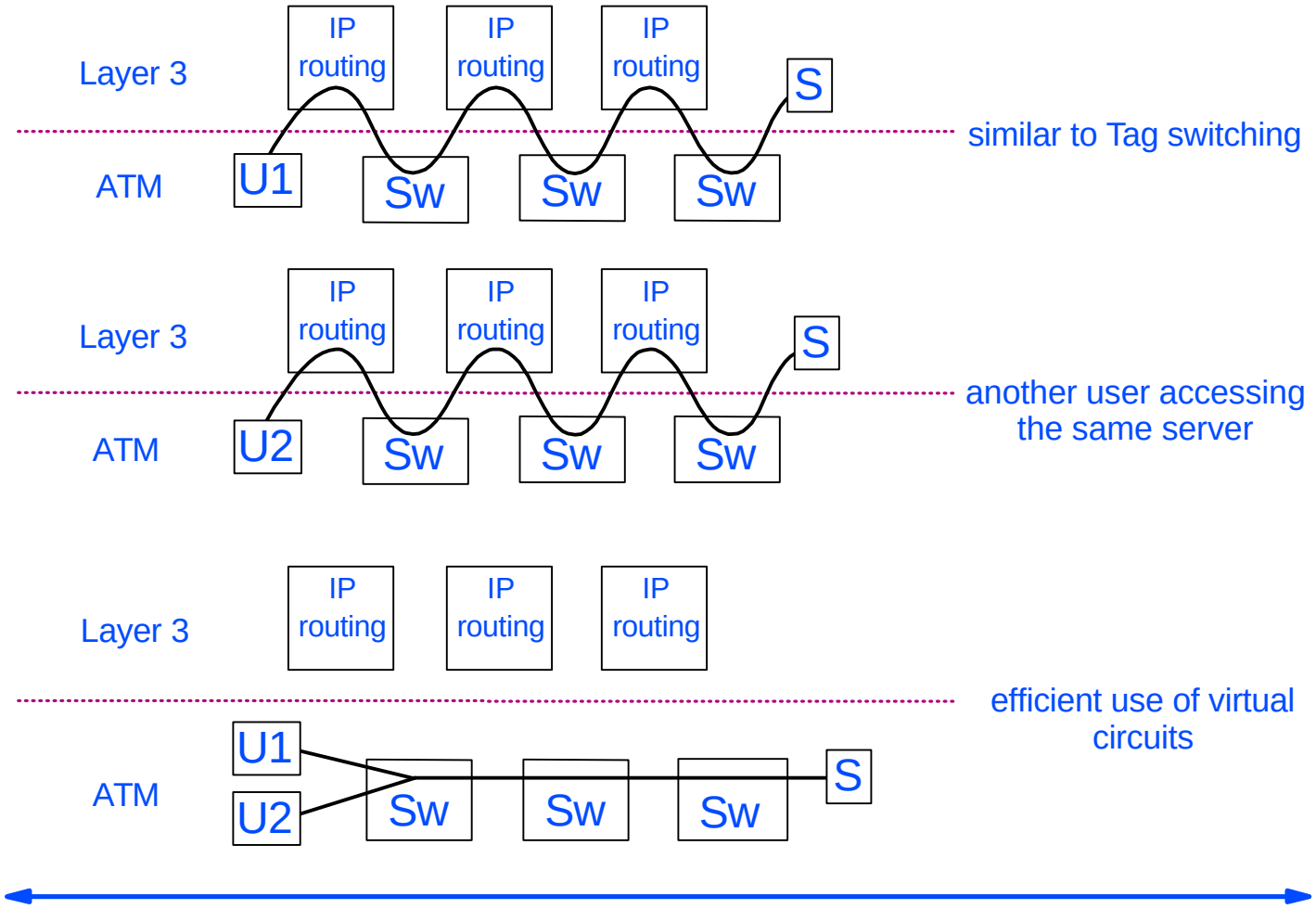
- Ipsilon Networks has developed unique solution for mapping IP flows to ATM VCs that is implemented in their IP Switch
- IP Switch Components
  - IP Switch Controller - perform normal IP Routing, flow identification and flow mapping
  - ATM Switch - switches ATM cells
  - IFMP - Ipsilon Flow Management Protocol, instructs upstream node to label IP Flow with new VPI/VCI
  - GSMP - Generic Switch Management Protocol, enables IP Switch Controller to instruct ATM Switch to establish/release ATM connections (updates ATM cell routing table with VPI/VCI/port info)
- Purpose is to bypass latency/delay of IP Routing function and leverage ATM cell transport while maintaining the flexibility and simplicity of IP networking
- IP Routing only - there is NO UNI 3.1/PNNI Signaling taking place



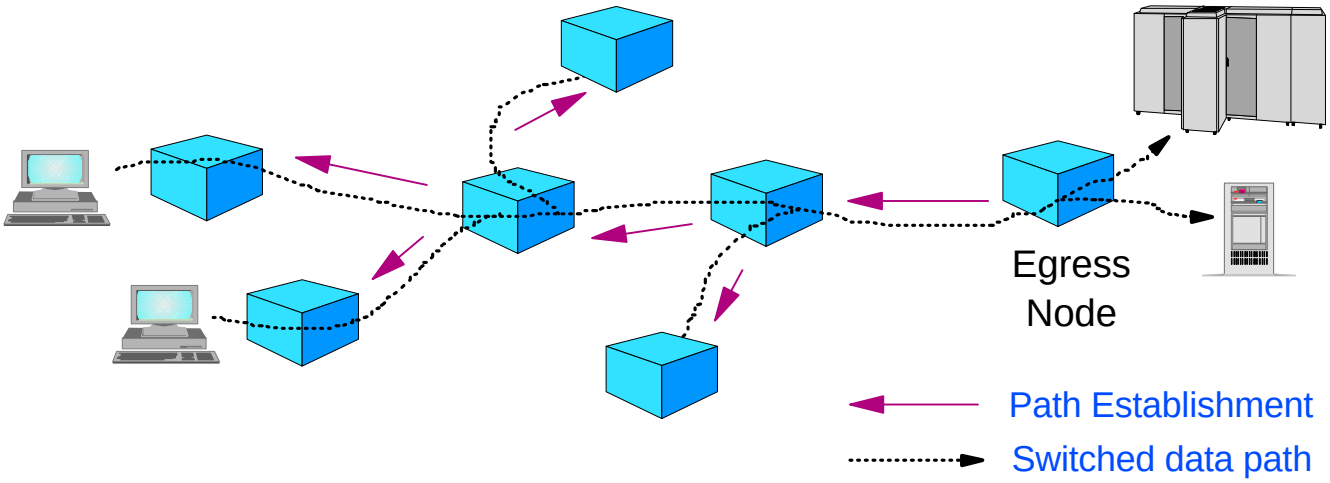
Ipsilon's IP Switching

- IP Switch Operation
  - cells flow over default path thru IP Switch Controller on a hop-by-hop basis
  - IP Switch Controller determines that IP flow should be switched based on number of packets and other heuristics
  - IP Switch Controller sends IFMP redirect message to upstream node instructing it to label cells of IP flow with new VPI/VCI. Same action repeated by downstream node.
  - IP Switch Controller used GSMP to update ATM Switch VPI/VCI/Port information
  - IP Flow is now forwarded over dedicated ATM cell transport
- Advantages
  - leverages low latency and high bandwidth of ATM without ATM complexity
  - performs traditional IP Routing - business as usual
  - dynamic mapping of IP Flows to ATM connections
- Disadvantages
  - relies on TCP for congestion control - no ABR or UBR/EPD
  - no QoS
  - Proprietary Solution
  - IP Routing performance is marginal and one IP Flow per ATM VC may not scale
  - IP only

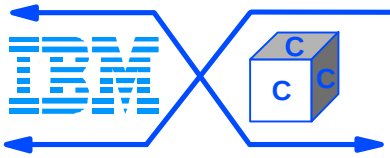
IBM: Aggregate Route-based IP Switching (ARIS)



ARIS
Aggregate Route-based IP Switching



- Switched path established to each egress node
- Switched paths follow IP forwarding path
- Single path for all destinations behind common egress
- One tree rooted at egress

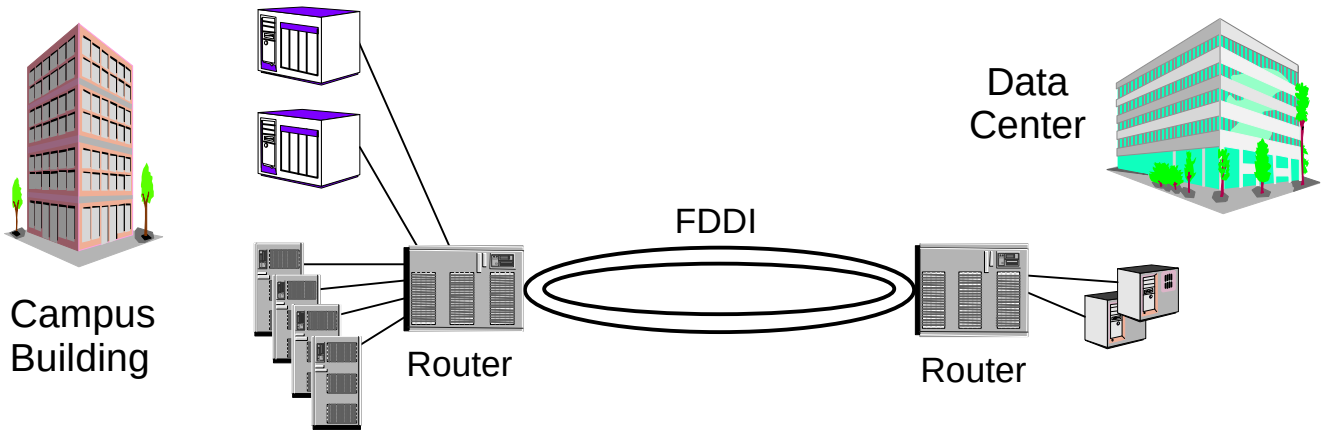


ARIS: Building Switched Paths

- A node determines that it is an egress
  - e.g. if it has a non-ARIS neighbor downstream
- It sends an Establish message (with a VP/VC) to each upstream neighbor
- The Establish messages includes the "path" to the egress
- An upstream neighbor determines if the Establish provides a "useful" path
  - from the appropriate next hop
  - path is loop-free
- If path is useful, it is propagated further upstream
- On a route change, a node deletes its downstream VP/VC
  - requests a new Establish from the new downstream neighbor and propagates that upstream

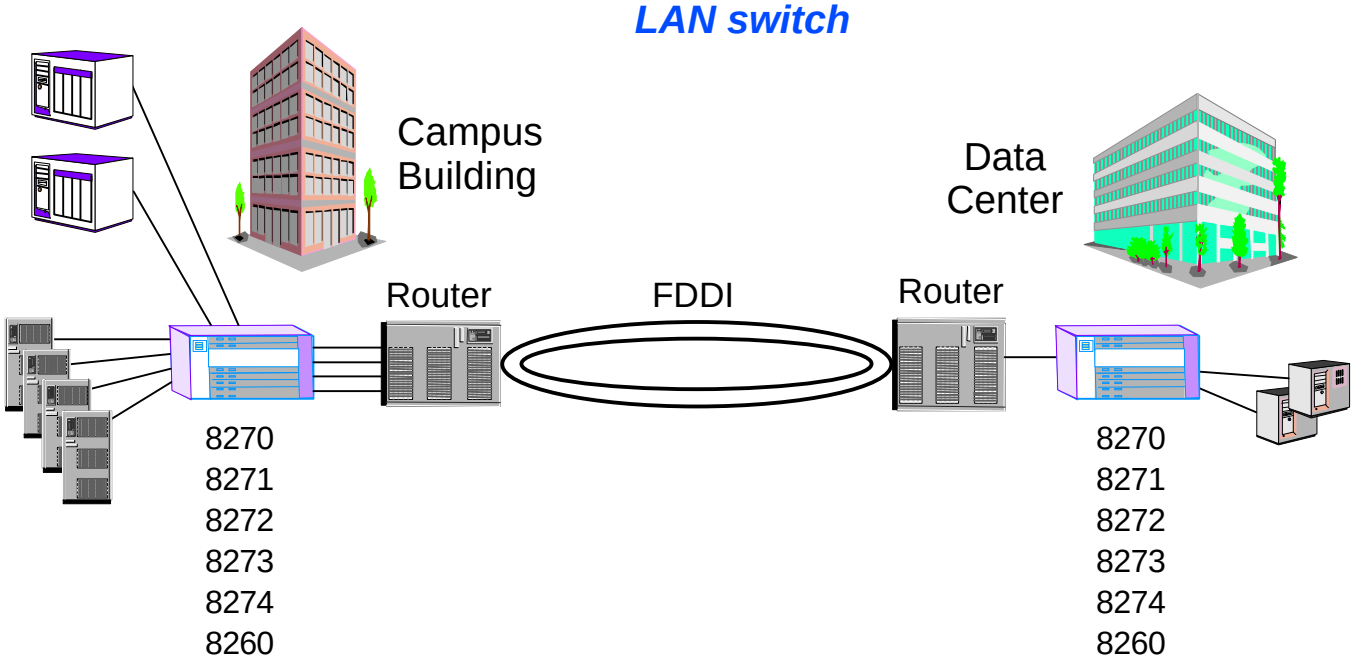
Migrating to MSS: Current Router Network

Migration goals:
Coexistence with current router backbone
Migration to ATM backbone & MSS by incremental steps



Migrating to MSS: Step 1

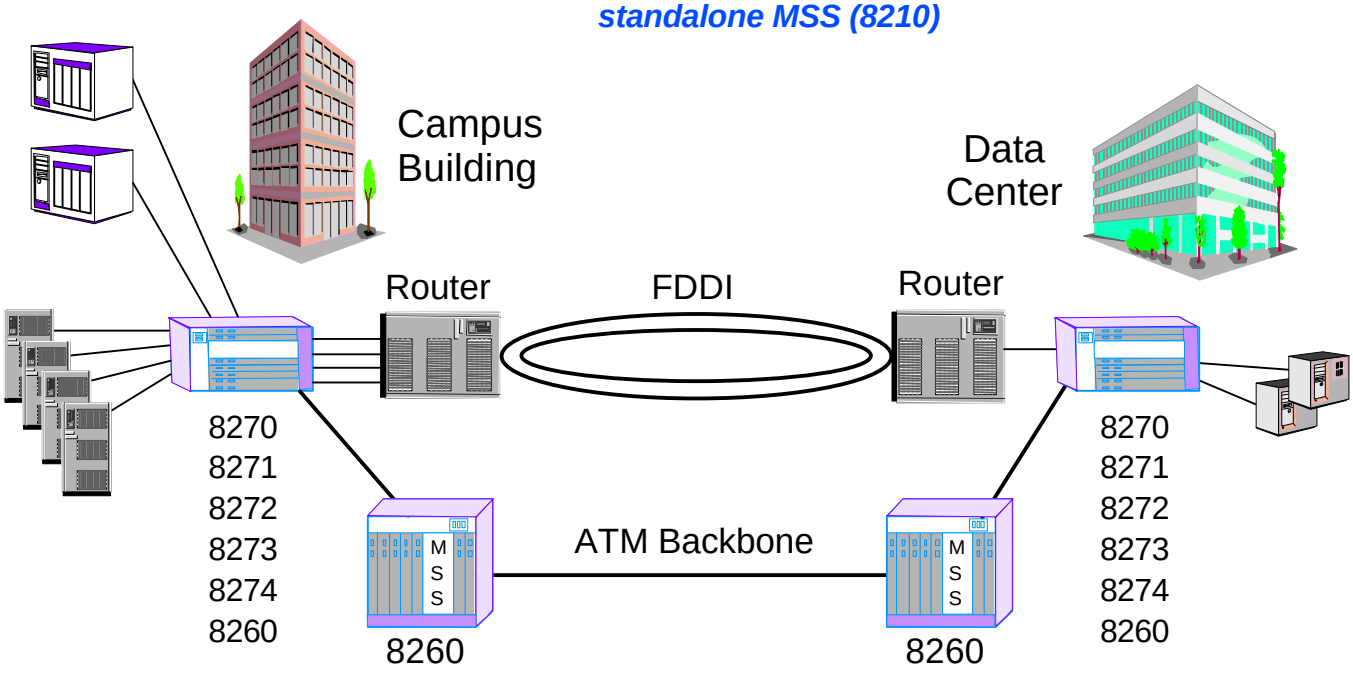
Alleviate sever and desktop congestion with ATM capable LAN switch



Migrating to MSS: Step 2

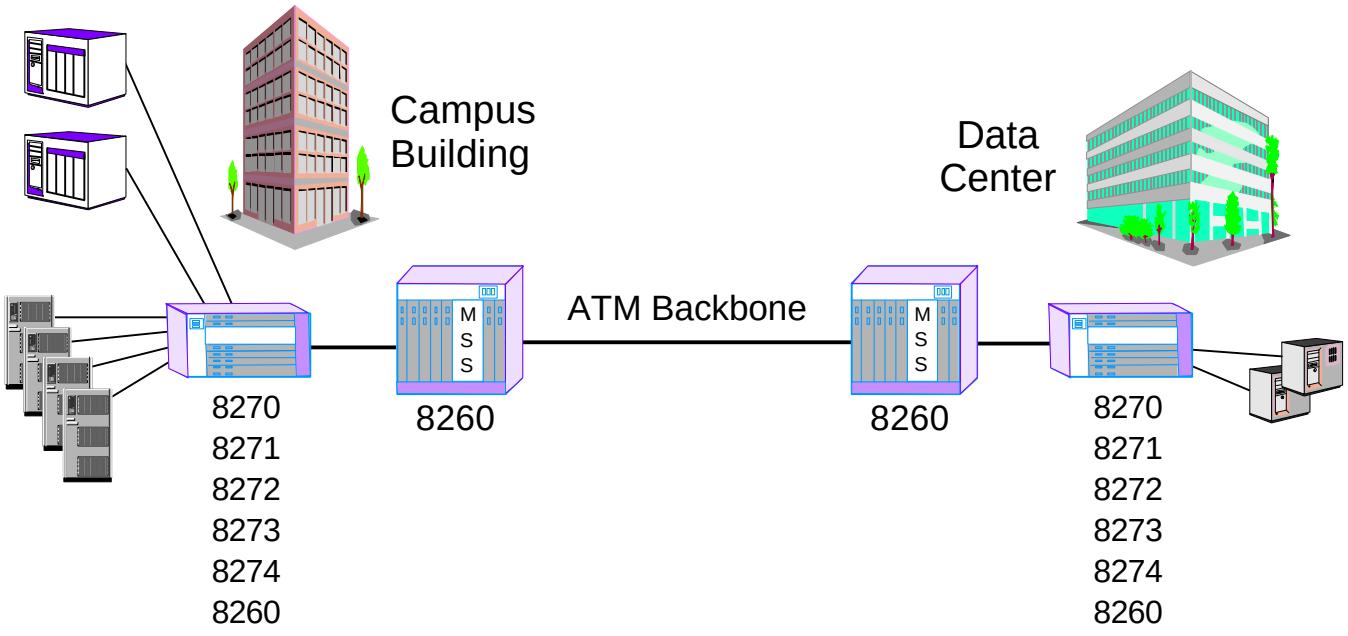
Add ATM backbone for capacity
Begin staged migration to ATM:

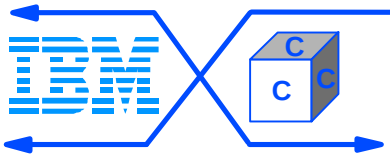
1. ***Switch Bridged Traffic over ATM Backbone***
2. ***Introduce VLANs and deploy Broadcast Manager to reduce reliance on router***
3. ***NOTE: FDDI interface also available on standalone MSS (8210)***



Migrating to MSS: Step 3

Completed migration to ATM backbone w/MSS
Re-deploy routers to remaining legacy subnets





Conclusion

- MSS from IBM...
  - The 'flat' network
    - largely reduced broadcasts with BCM
- VLANs
  - RouteSwitch
    - VLANs beyond port-based
  - LANE & Super VLAN
    - no standalone router needed!
- Route Switching
  - NHRP
    - standards-based...available today
  - ARIS
    - efficient IP switching solution