Ascend

IP Navigator

Multiservice QoS for IP Wide Area Networks

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ASCEND

Ascend Builds Carrier-Class Multiservice QoS IP Networks

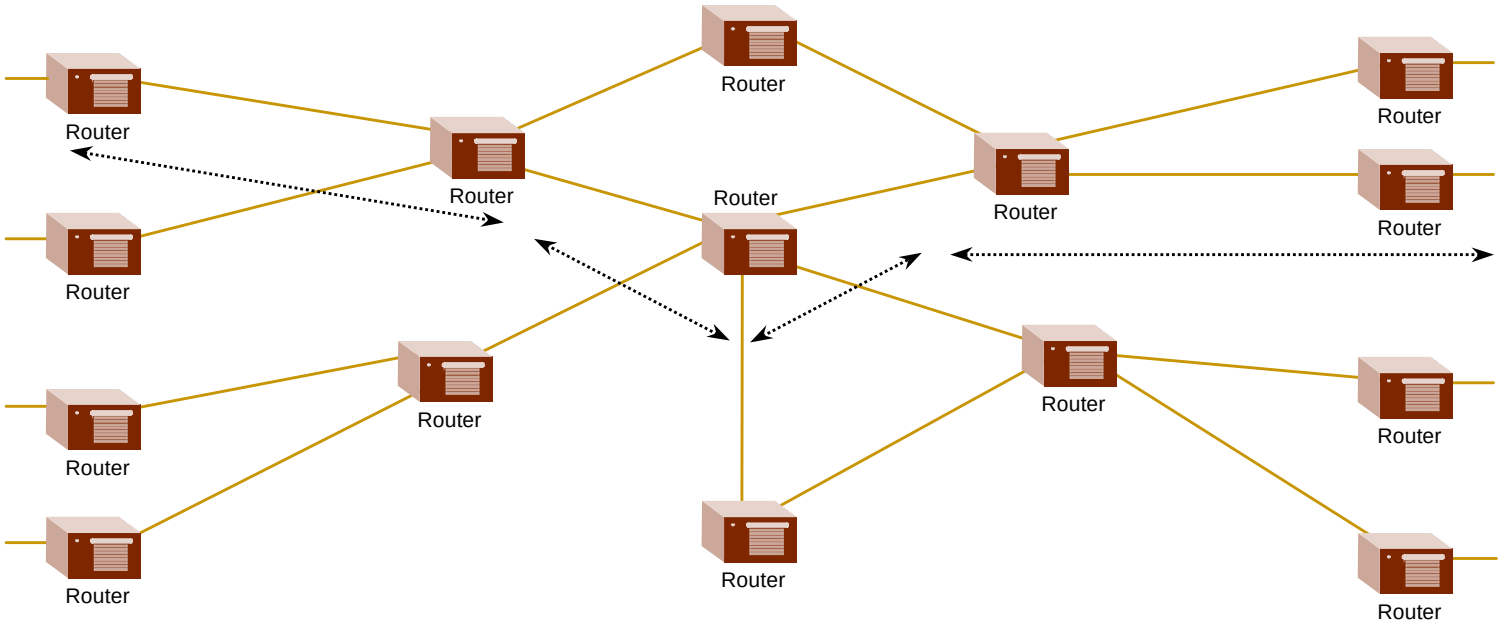
- True multiservice QoS capability
- End-to-end QoS
- Scalability
- Carrier-class availability
- Navis network service management architecture
- Delivering next-generation IP services

IP Navigator Harnesses the Strengths of the Ascend Switch Architecture

The Problem with Current Model

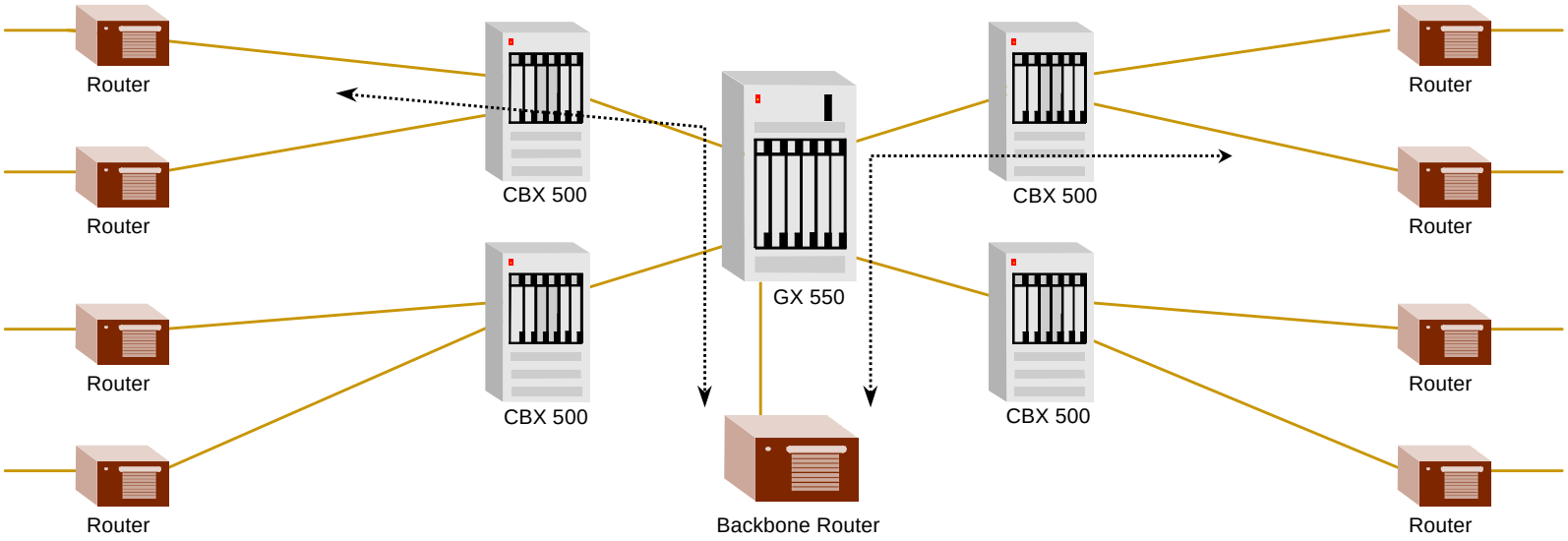
- **Too complex**
- **Doesn’t scale**
- **Only “Best efforts”**
  - Shared QoS = no QoS
  - Router-based RSVP not scalable
- **Current best-efforts router solution has too much latency to provide real time data delivery**
- **No guarantees**

Network Evolution: Pure Routed Network



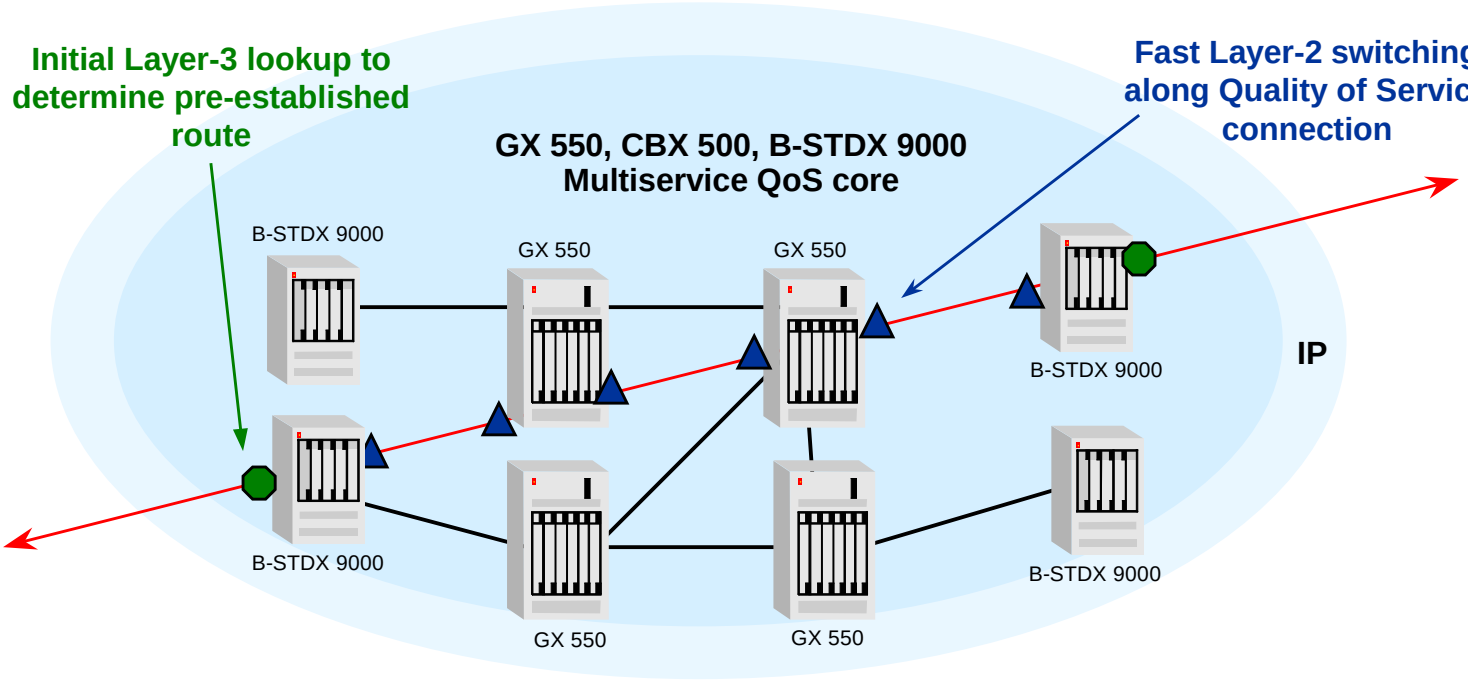
- Slow hop-by-hop, fully-routed network
- Scalability and complexity problems

Network Evolution: Routing and Switching



- Hybrid switching and routing increases performance.
- Switching provides multiservice capabilities, bandwidth management, traffic prioritization.
- A shortcoming is the number of PVCs required as the network grows. The backbone router is also a bottleneck.

Next Generation: IP Navigator



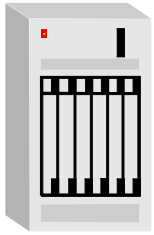
- Edge routing determines best path to destination
- Switched core provides multiservice QoS and bandwidth guarantees
- Multiservice IP, Frame Relay or ATM
- Based on MPLS (multiprotocol label switching) – the pending IETF standard for switched IP in the WAN

IP Navigator

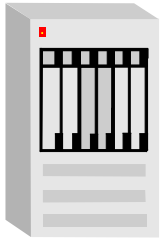
- **Multiservice QoS Architecture**
  - Natural evolution of Ascend's core switching architecture
  - Support for standard IP protocols – OSPF, BGP-4, RIP-2
  - Greater than 200,000 IP routes supported
  - Multiservice networks – simultaneous IP via PPP, ATM and Frame Relay in same network
  - Support for new value-added services
  - Highly scalable for large networks
  - Unified network management for all services (IP, Frame Relay, ATM) under Navis™
  - Type of Service (ToS) extensions

Platforms Supported

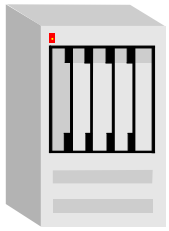
- **Edge Routing**
  - B-STDX 8000/9000
  - CBX 500
- **Core Trunking/Switching**
  - B-STDX 8000/9000
  - CBX 500
  - GX 550



GX 550



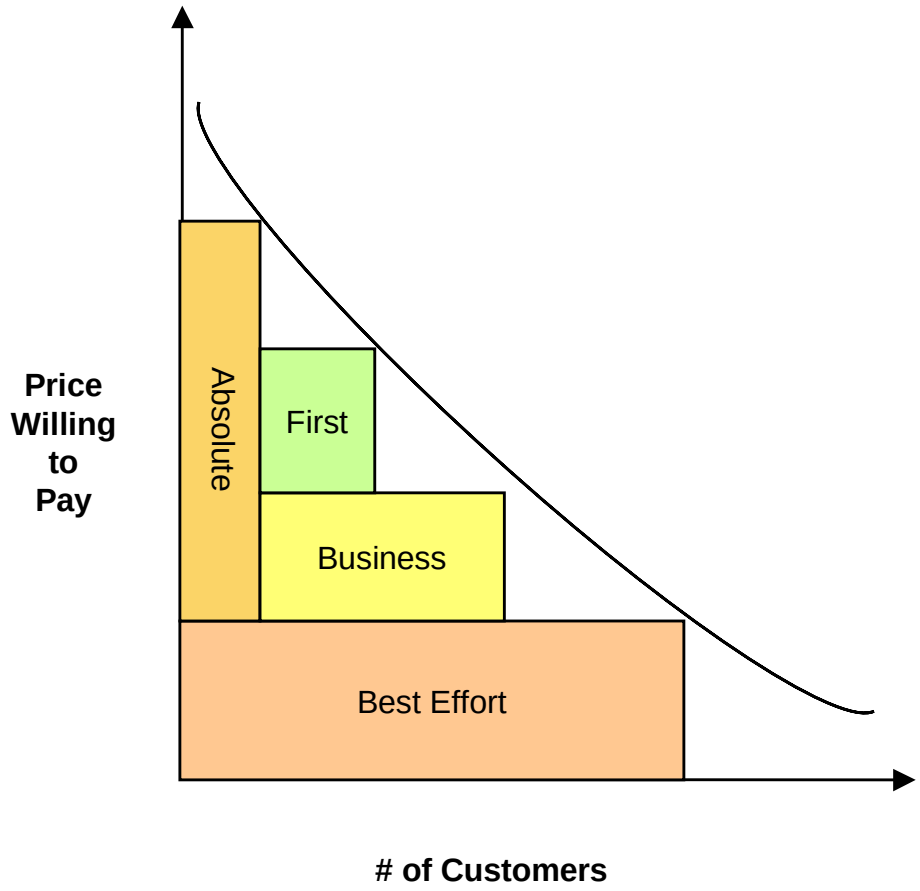
CBX 500



B-STDX 9000

Why is Quality of Service Important?

Revenue Opportunities from QoS/CoS Differentiation

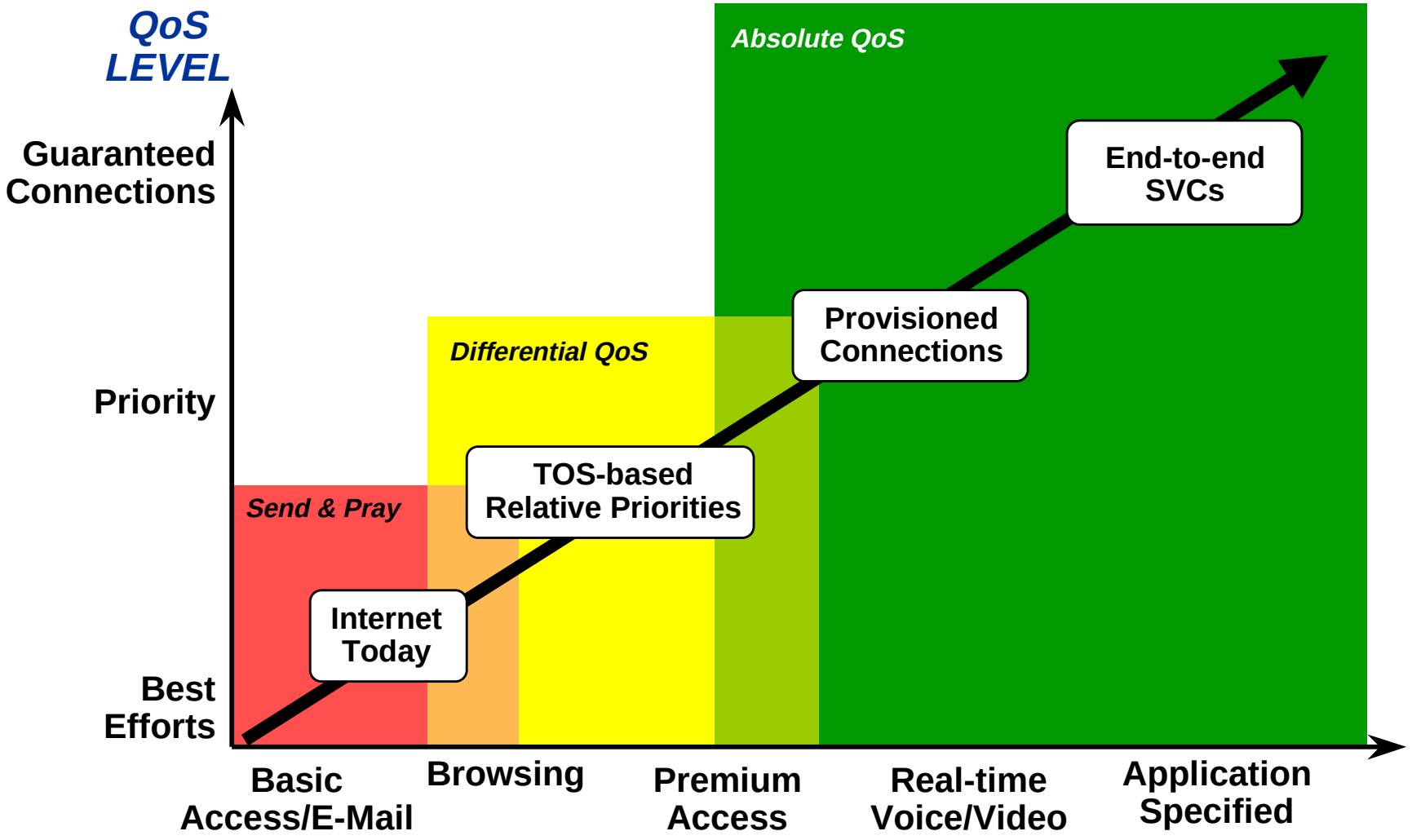


- **NSP can resell bandwidth in many different ways.**
- **“Best effort” service yields many customers, but low revenue/customer.**
- **As level of service increases, revenue/customer increases.**
- **Multiservice QoS examples:**
  - Absolute – real time voice and video
  - First – SNA
  - Business – Lan-to-Lan VPNS
  - Best efforts – consumer internet access

Market Drivers

- **Phase II of the Internet will require multiservice QoS for network differentiation**
  - "Best Efforts" will remain for background tasks (e-mail, file transfer) and low-cost access ($9.95/month internet)
  - "Priority" for "business class" (Premium service)
  - "Absolute" for real-time access, voice, video
- **Service providers must be able to provide value-added services in addition to basic Internet connectivity**
  - Basic connectivity to the Internet isn't enough anymore to meet end-user demands
- **Service providers must integrate voice and data networks in a common backbone infrastructure**
  - In the new deregulated world, service providers must provide services today only available through the PSTN over data backbones

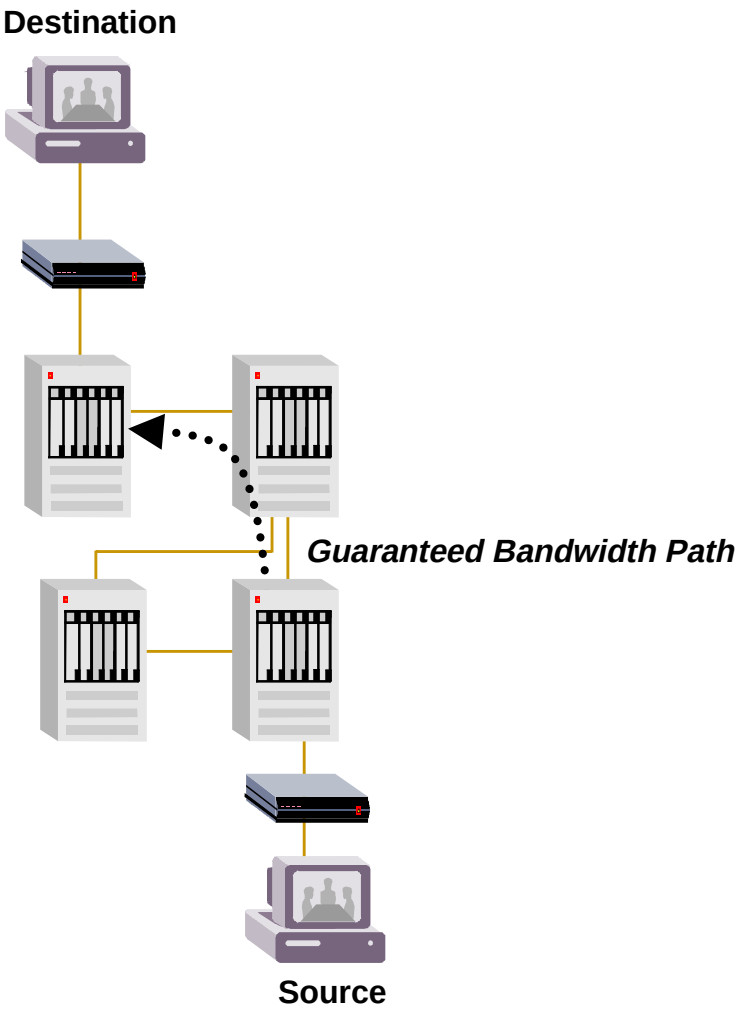
Multiservice QoS for Differentiated Networks



Industry's Only Absolute QoS for IP

- **Ascend is the only carrier-class equipment vendor today that provides "Absolute QoS" for IP**
  - Internet today is best-effort only – no QoS
  - Other schemes only provide simple "Relative" QoS without necessary guarantees for voice and video applications
- **Ascend's multiservice QoS will provide the full range of QoS capabilities from basic, best-effort through guaranteed QoS on demand for IP backbone**

Absolute QoS on Demand

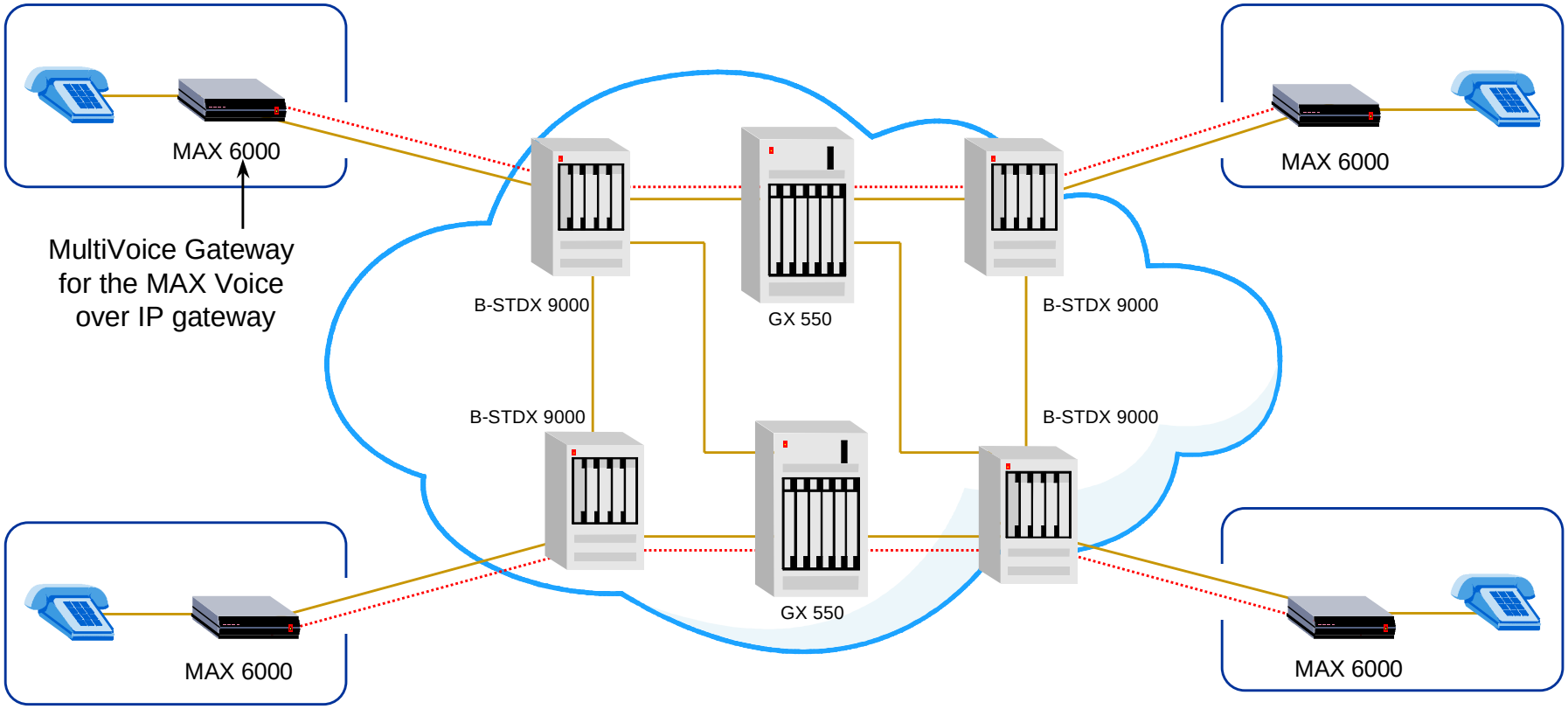


- **Harness the strength of Ascend switch architecture**
- **Excellent ATM SVC setup performance and scalability**
- **Process:**
  1. **QoS is demanded based on a profile:**
     - Source/destination IP addresses
     - Source/destination port numbers
     - TOS values
     - IP protocol ID (in IP headers)
  2. **QoS attributes can also be requested by destination**
  3. **Guaranteed bandwidth path is established**

Customer Benefits

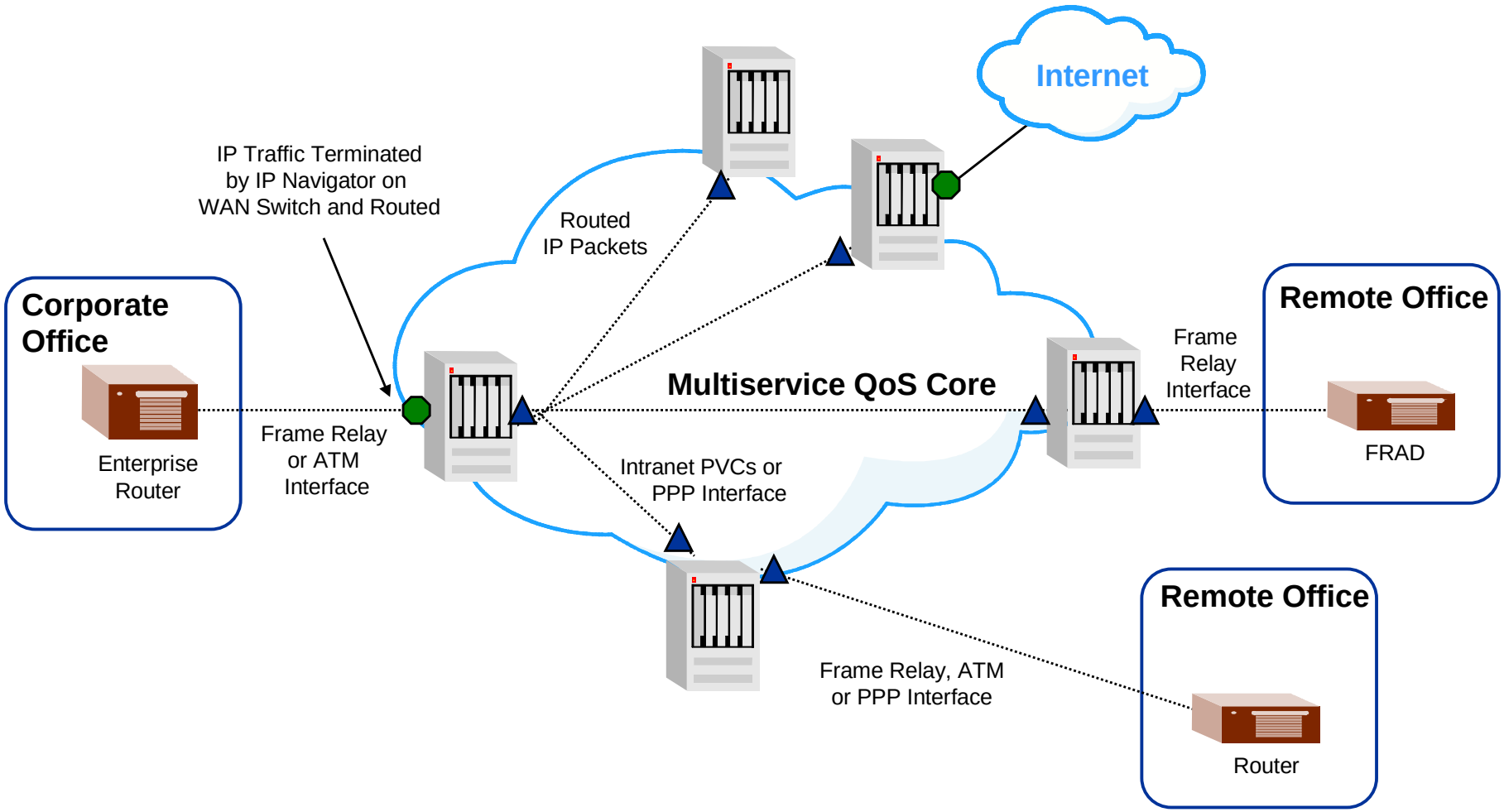
- Lowers service provider costs by having a single network architecture providing multiple service types
- Allows service providers to optimize revenue by offering differentiated service levels to different customers
- Allows WAN infrastructure to support IP applications that demand guaranteed QoS such as voice and video

Application: End-to-End "Toll-Quality" Voice over IP (VoIP)



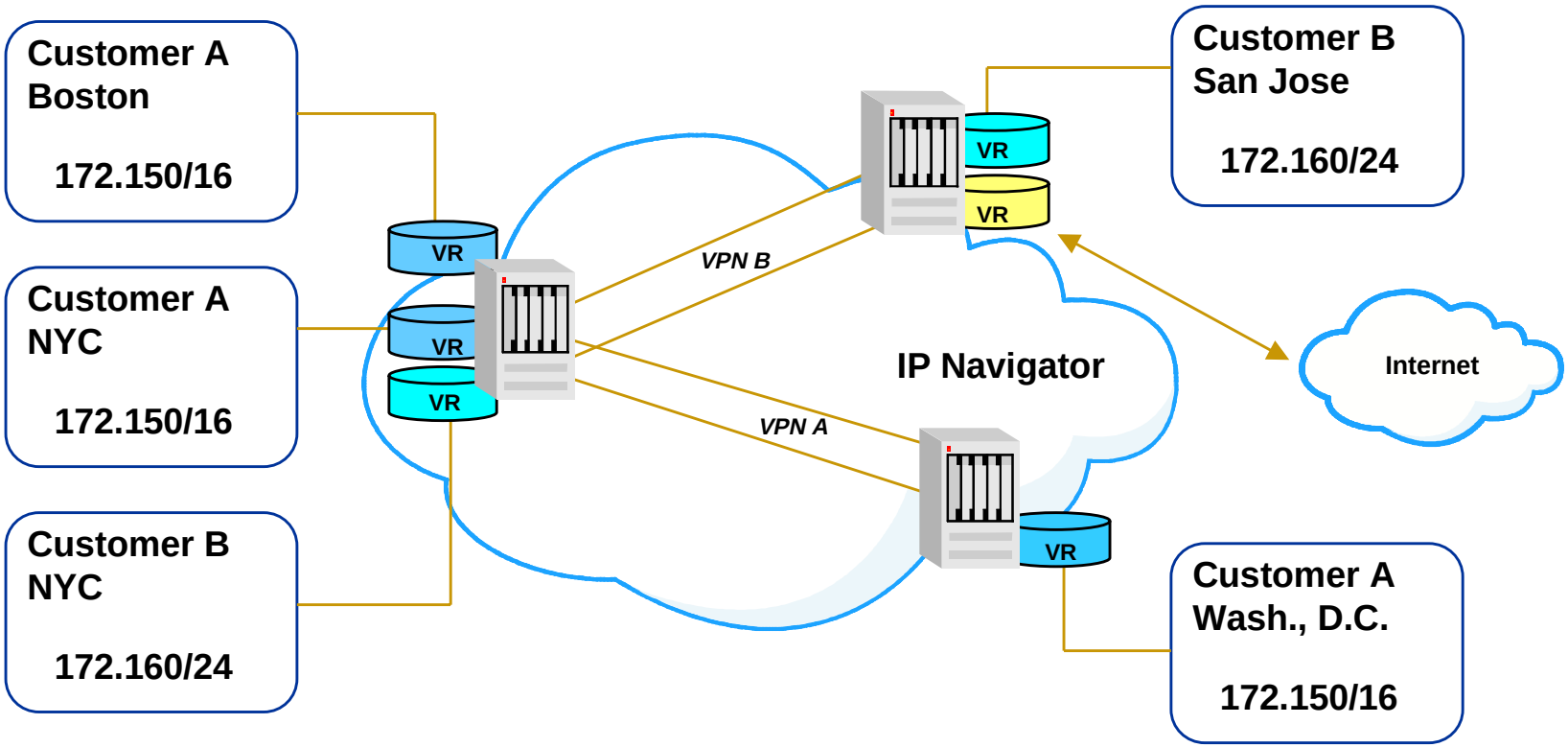
- IP Navigator maintains toll-quality voice over scalable backbone
- Service management via Navis network management

Application: Multiple Services



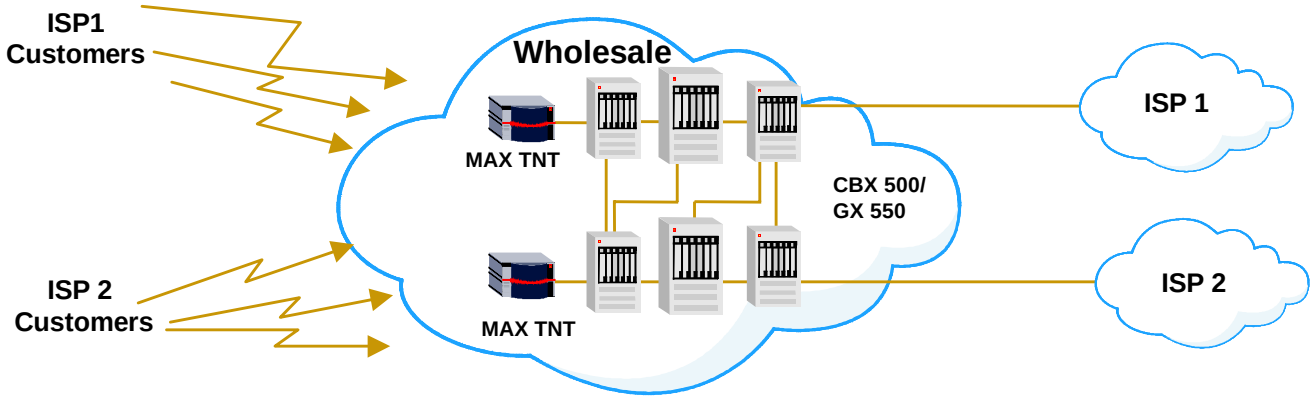
- **Single customer connection allows both Internet and intranet connectivity**

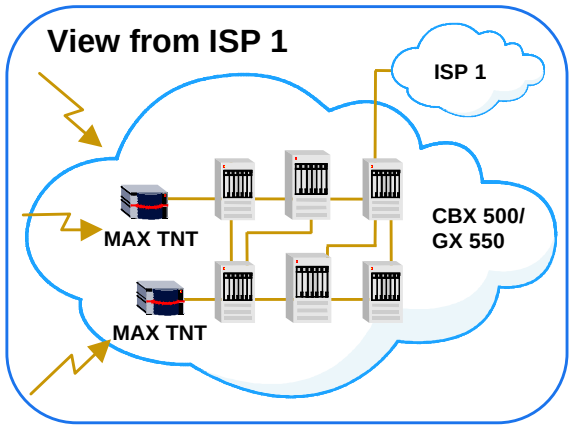
Application: IP VPNs

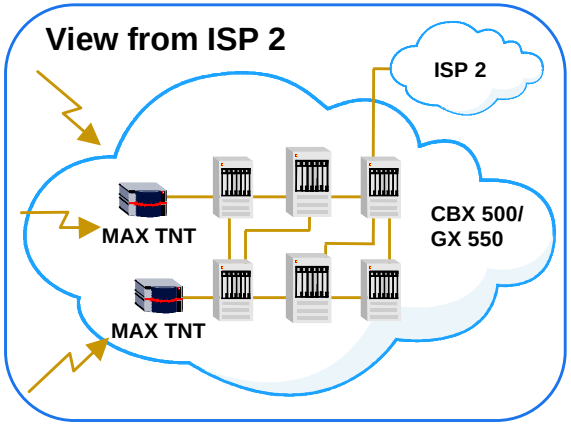


- Separate route tables per VPN at edge of network
- QoS and bandwidth guarantees per VPN
- Allows use of valuable private IP address space

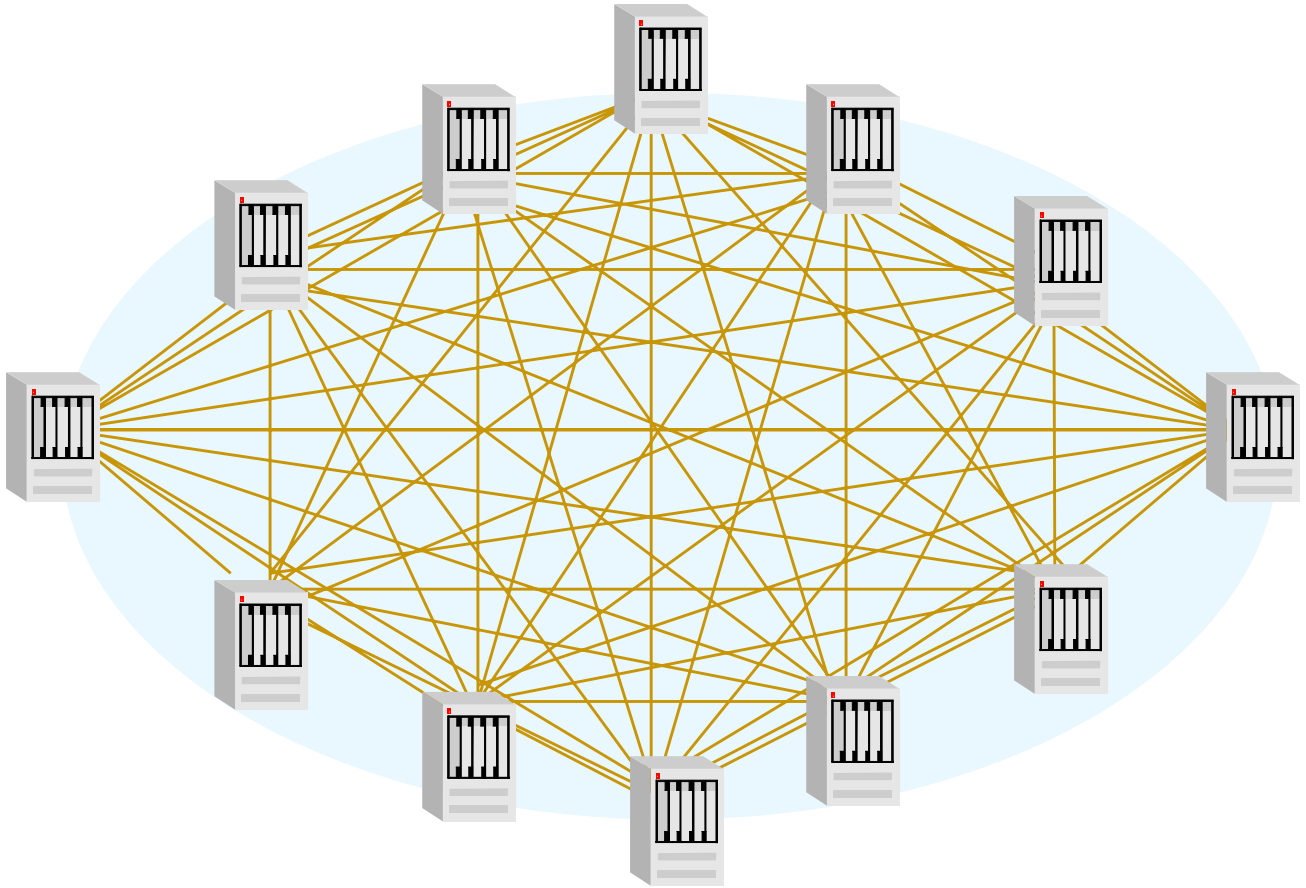
Application: Port Wholesaling





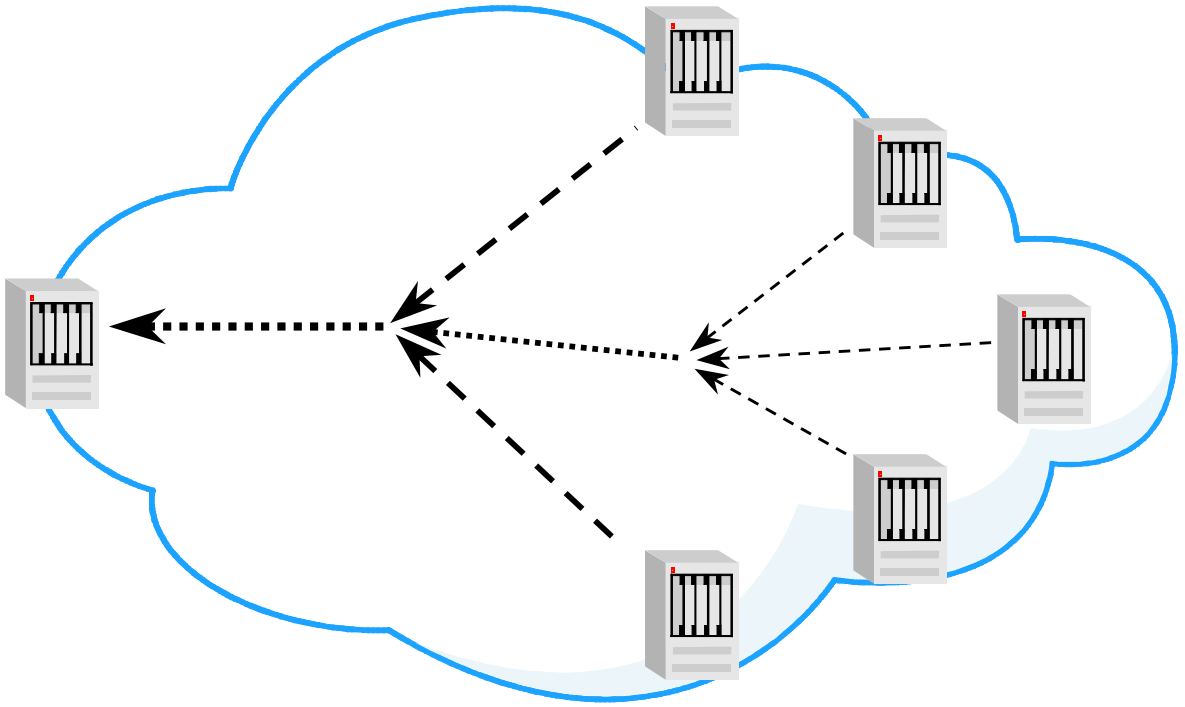


IP Navigator Architecture Solves the N2 Scaling Problem



- The number of virtual circuits grows as a square of the number of switches
- This causes scaling problems to arise when building a large switched networks

Multipoint-to-Point Trees (MPTs)

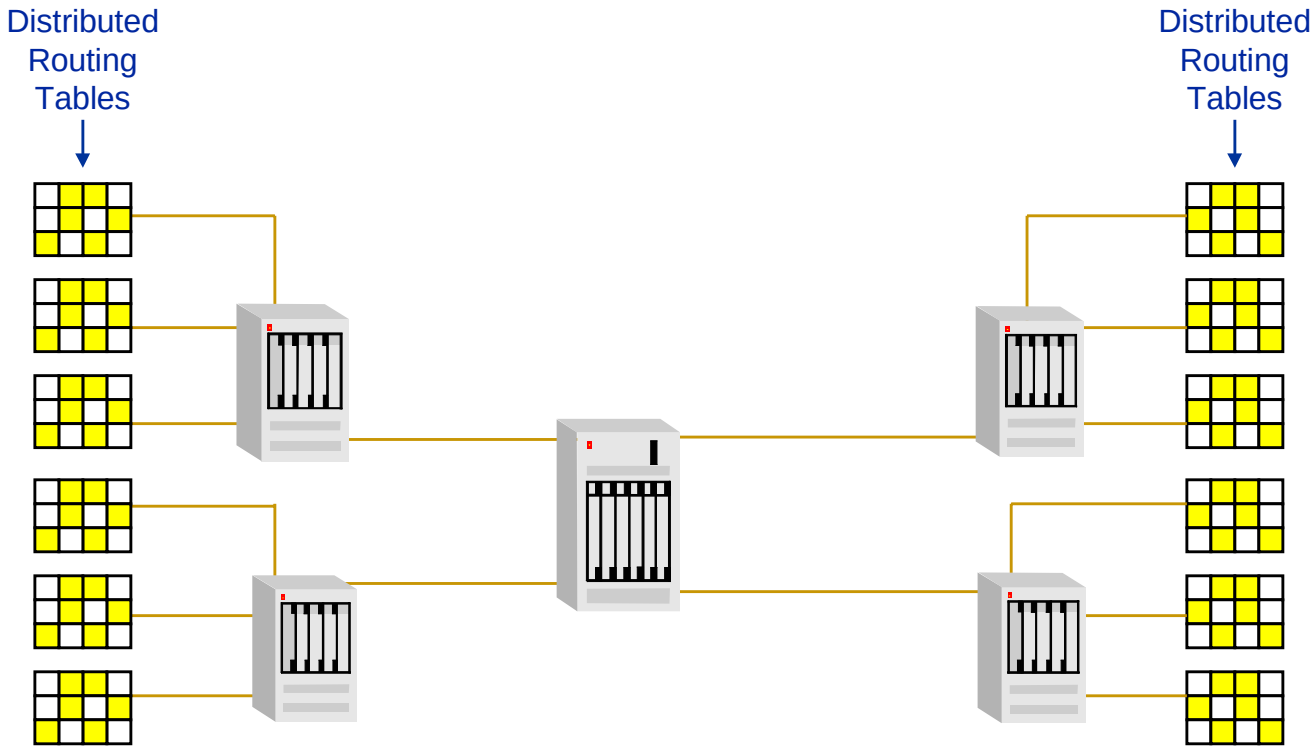


- **MPTs are essential for scalability**
  - Allow O(n) Scaling
  - Simplify packet forwarding

Multipoint-to-Point Trees

- **Virtual paths automatically set up between all switches in the network**
  - Can be configured to use multiple VPs, for load sharing
- **N virtual paths interconnect N switches**
  - VPI specifies the root of the tree (destination)
  - VCI within each path specifies the leaf (source)
  - VCIs allows cells from different packets to be interleaved, differentiated by standard SAR at root

Performance Scalability



- IP Navigator distributes routing tables to each line card
- No centralized packet forwarding or caching is used
- One route lookup, then cut-through switching to edge

IP Navigator for Multiservice QoS

- **Integrated routing and switching**
  - Open, standards-based architecture using existing protocols
  - Relative to Absolute QoS
- **Optimal design for large service providers**
  - Carrier-class reliability, scalability and availability
- **Allows flexible service offering based on application**
- **Multiservice – ATM, Frame Relay, IP**
- **Investment protection**
- **Service management for multiple services**