IP Navigator

Multiservice QoS for IP Wide Area Networks

Ascend

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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
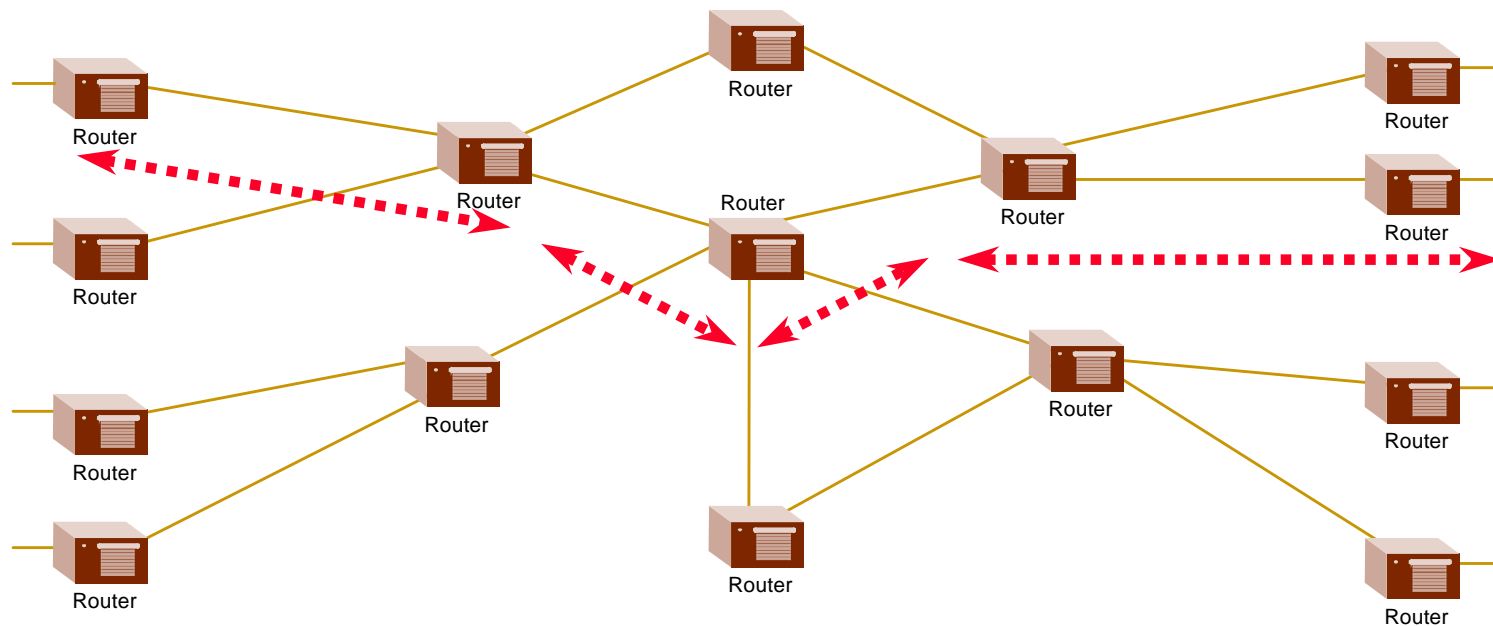
The Problem with Current Model

- **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**
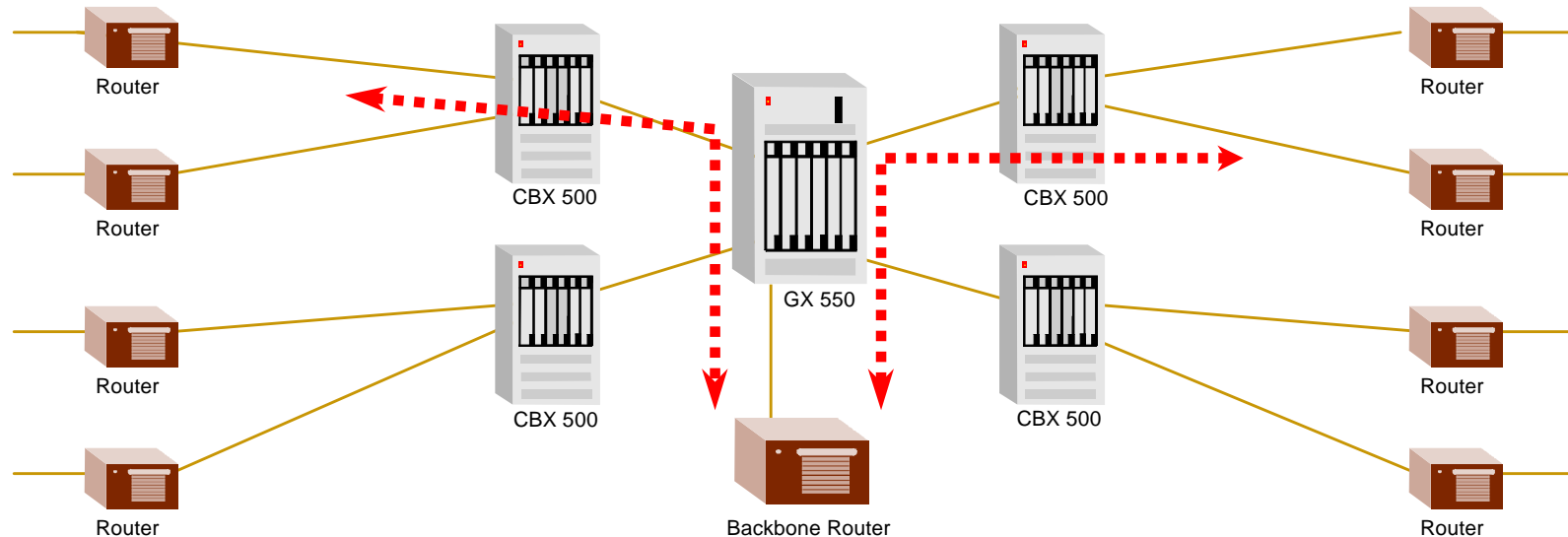
- **No guarantees**

Network Evolution:
Pure Routed Network

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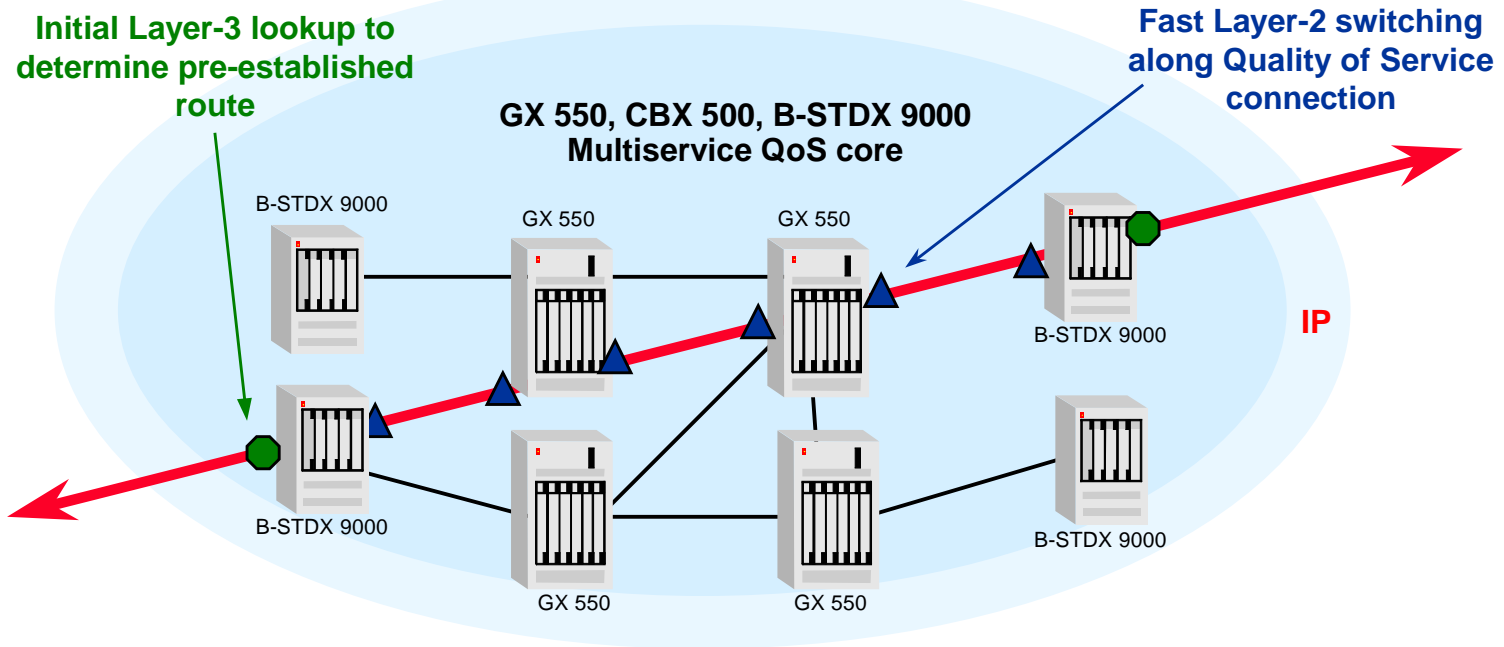- **Scalability and complexity problems**

Network Evolution:
Routing and Switching

Router

Router

Router

Router

CBX 500

CBX 500

GX 550

Backbone Router

Router

Router

Router

Router

CBX 500

CBX 500

- **Hybrid switching + 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

Initial Layer-3 lookup to determine pre-established route

Fast Layer-2 switching along Quality of Service connection

GX 550, CBX 500, B-STDX 9000 Multiservice QoS core

B-STDX 9000

GX 550

GX 550

B-STDX 9000

IP

B-STDX 9000

GX 550

GX 550

B-STDX 9000

- ■ **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
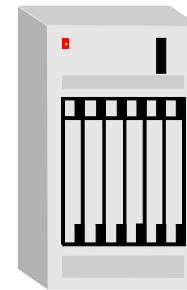
Platforms Supported

- **Edge Routing**
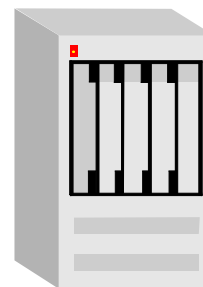 - B-STDX 8000/9000
  - CBX 500

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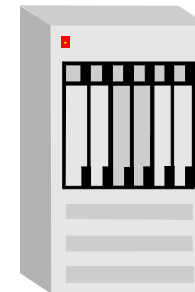
GX 550
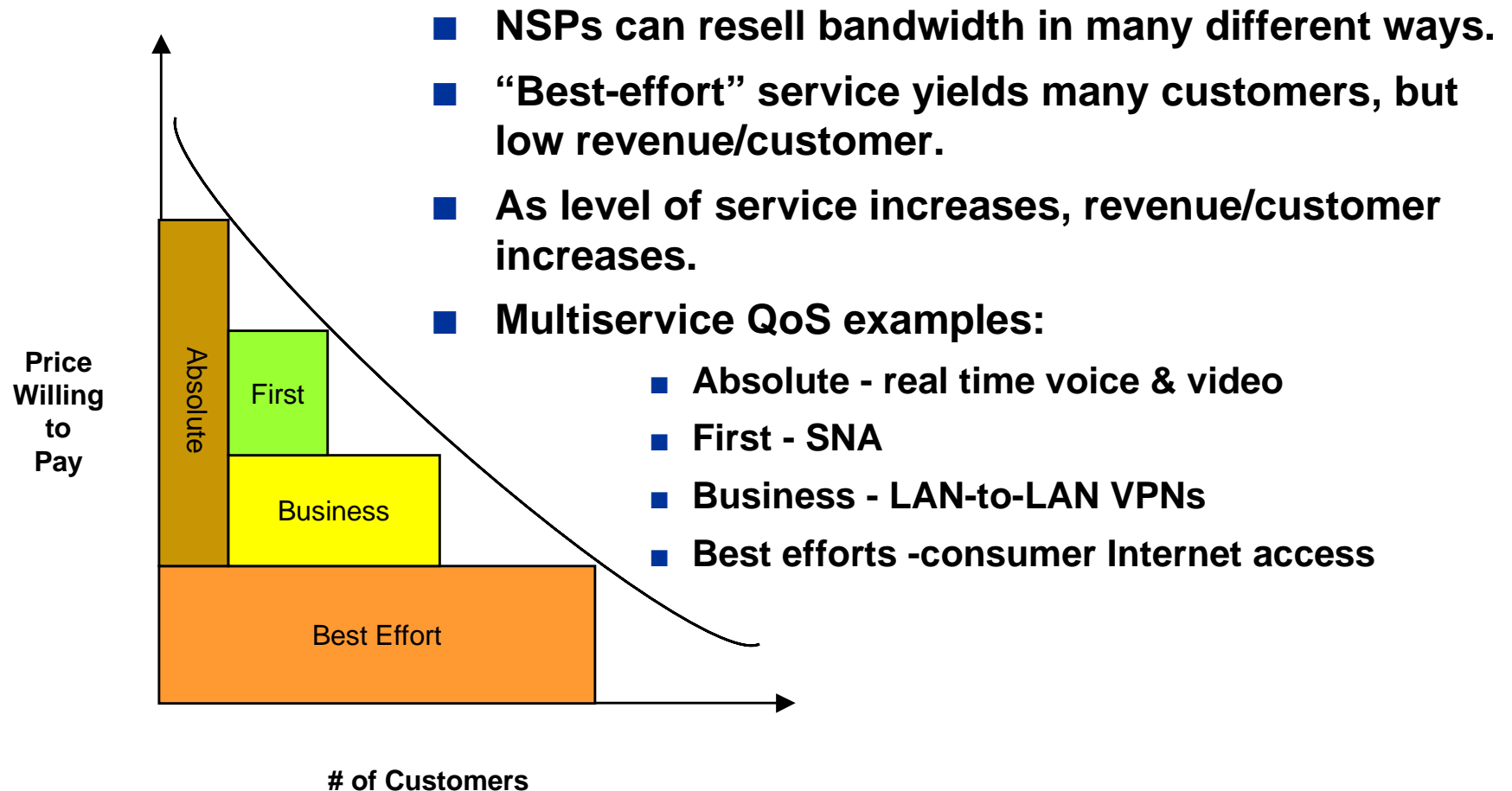
B-STDX 9000   **CBX 500**

Why is Quality of Service Important?
Revenue Opportunities from QoS/CoS Differentiation

- NSPs 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 & video
    - First - SNA
    - Business - LAN-to-LAN VPNs
    - Best efforts -consumer Internet access

Price Willing to Pay

Absolute

First

Business

Best Effort

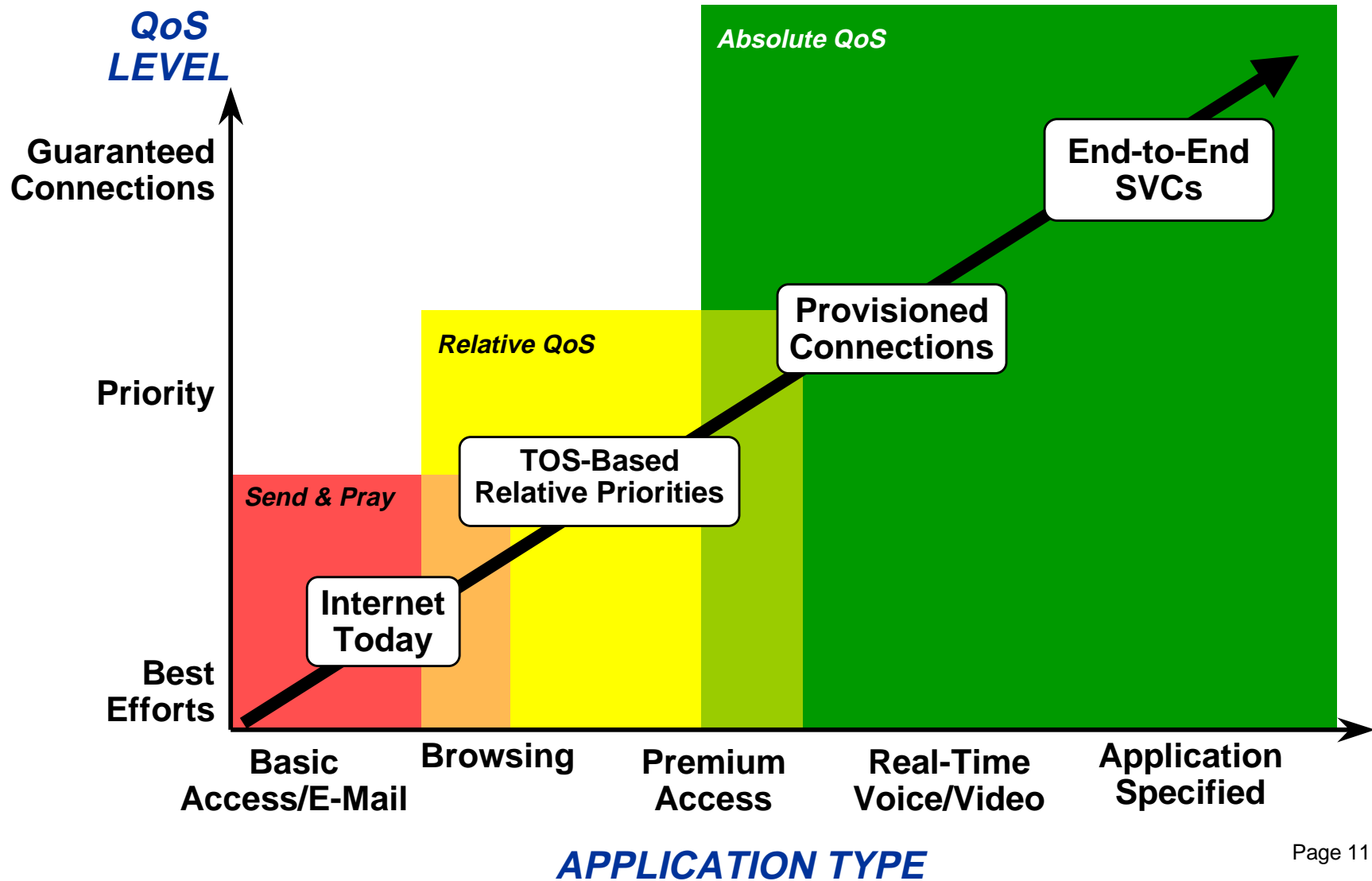**# of Customers**

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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
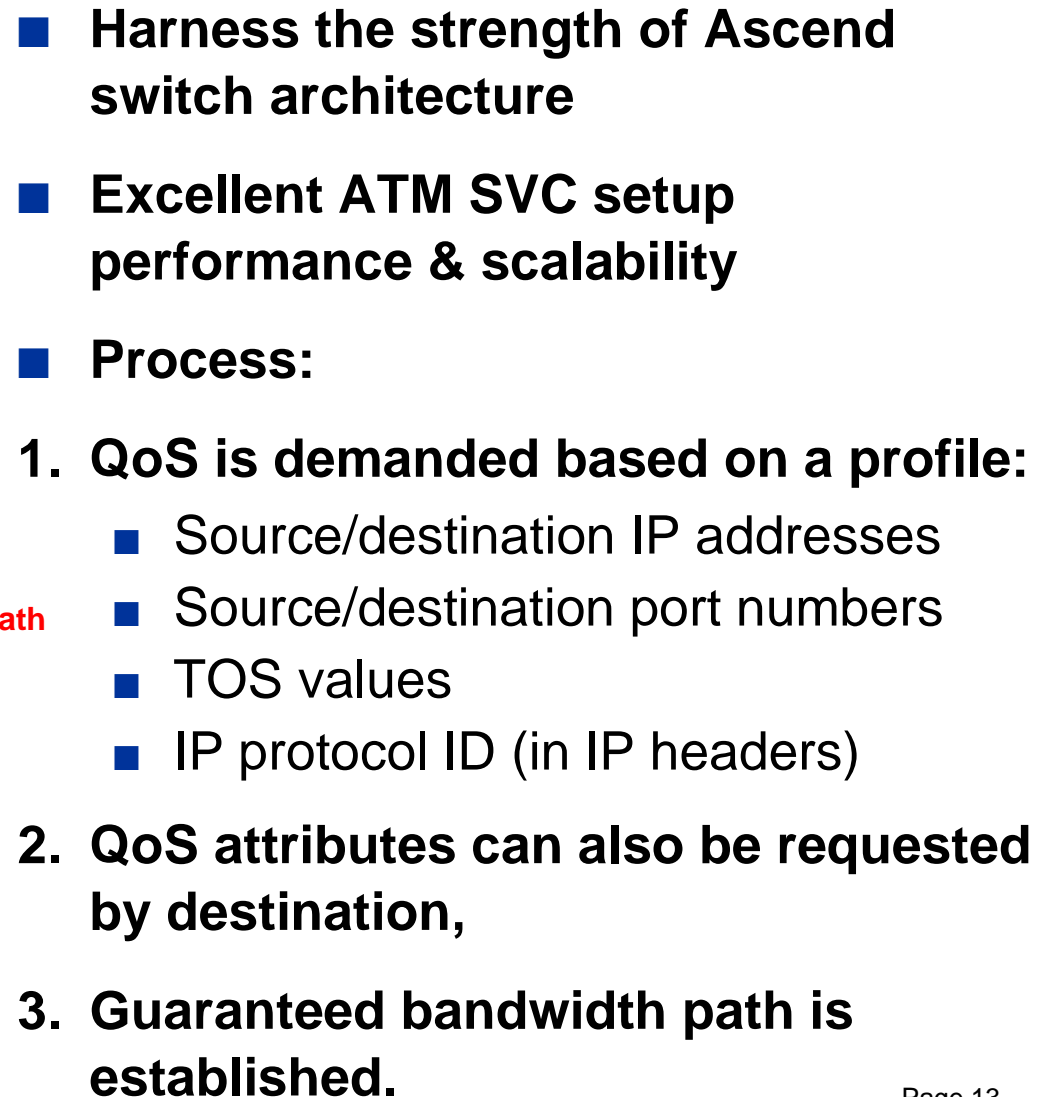
Multiservice QoS for Differentiated Networks

QoS LEVEL

Guaranteed Connections

Priority

Best Efforts

Absolute QoS

End-to-End SVCs

Provisioned Connections

Relative QoS

TOS-Based Relative Priorities

Send & Pray

Internet Today

Basic Access/E-Mail   **Browsing**   **Premium Access**   **Real-Time Voice/Video**   **Application Specified**

APPLICATION TYPE

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

Destination

Guaranteed Bandwidth Path

Source

- **Harness the strength of Ascend switch architecture**

- **Excellent ATM SVC setup performance & 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,**

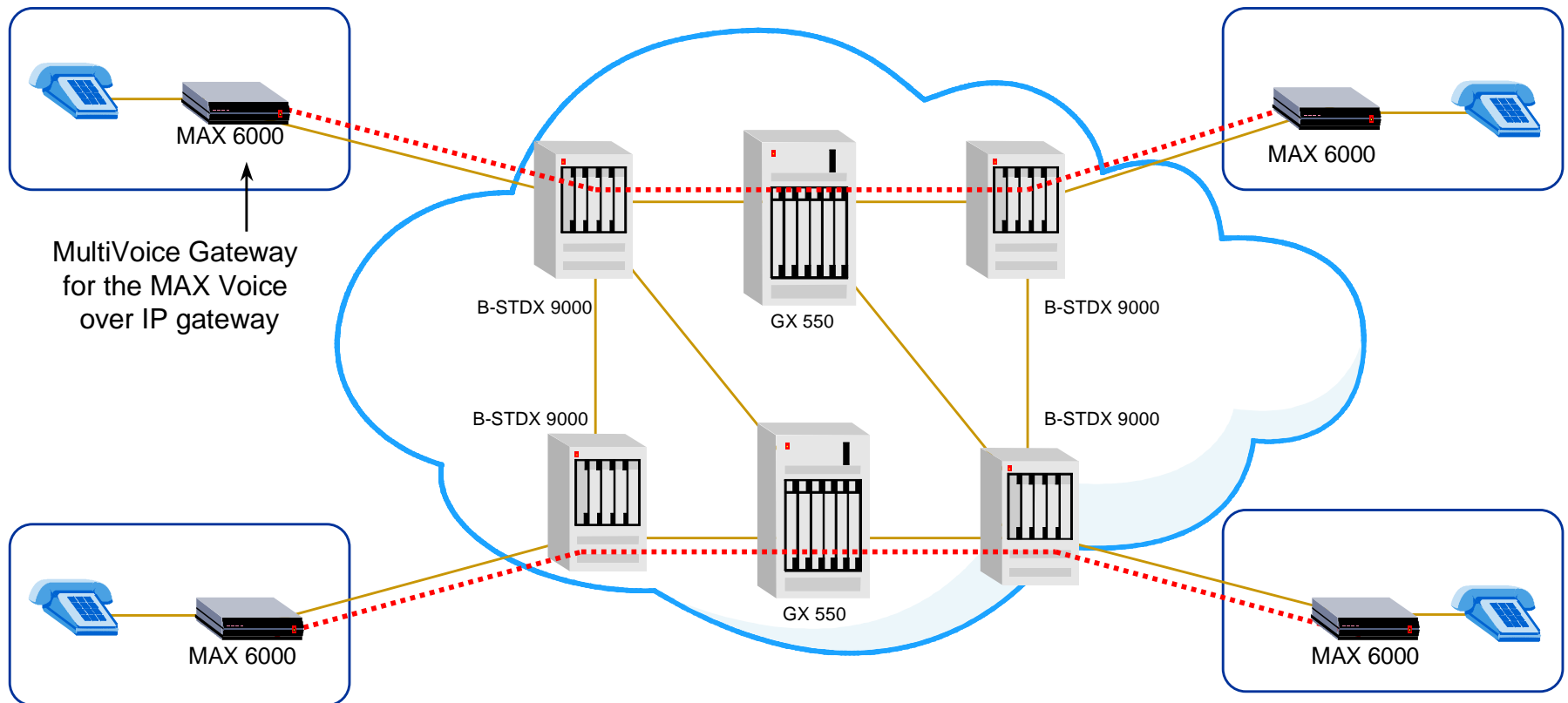3. **Guaranteed bandwidth path is established.**

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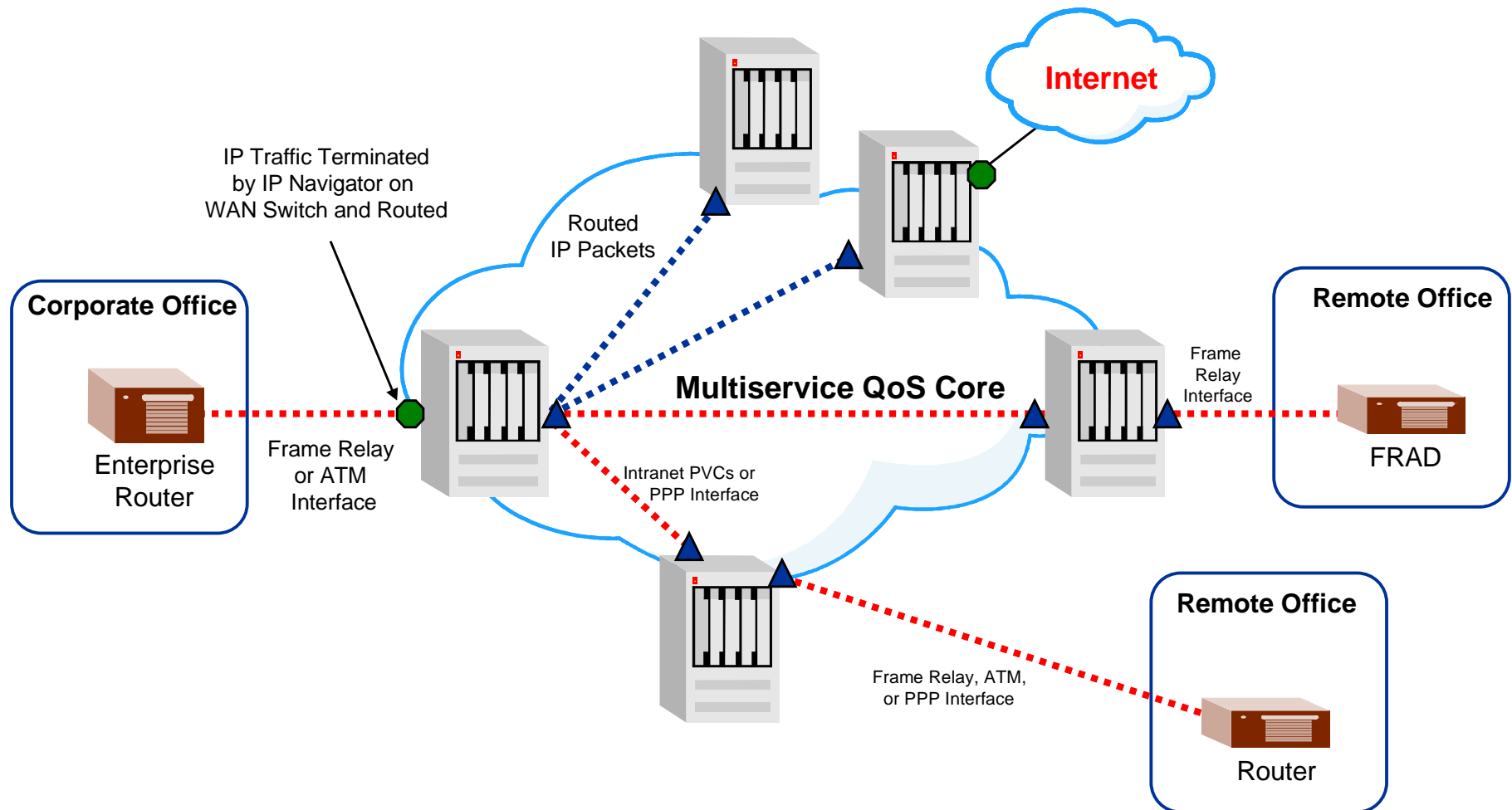
Application: End-to-End "Toll-Quality" Voice over IP (VoIP)

MAX 6000

MultiVoice Gateway
for the MAX Voice
over IP gateway

B-STDX 9000

GX 550

B-STDX 9000

MAX 6000

B-STDX 9000

B-STDX 9000

GX 550

MAX 6000

MAX 6000

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

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Application: Multiple Services

Internet

IP Traffic Terminated
by IP Navigator on
WAN Switch and Routed

Routed
IP Packets

Corporate Office

Remote Office

Frame
Relay
Interface

Enterprise
Router

Frame Relay
or ATM
Interface

Multiservice QoS Core

Intranet PVCs or
PPP Interface

FRAD

Remote Office

Frame Relay, ATM,
or PPP Interface

Router

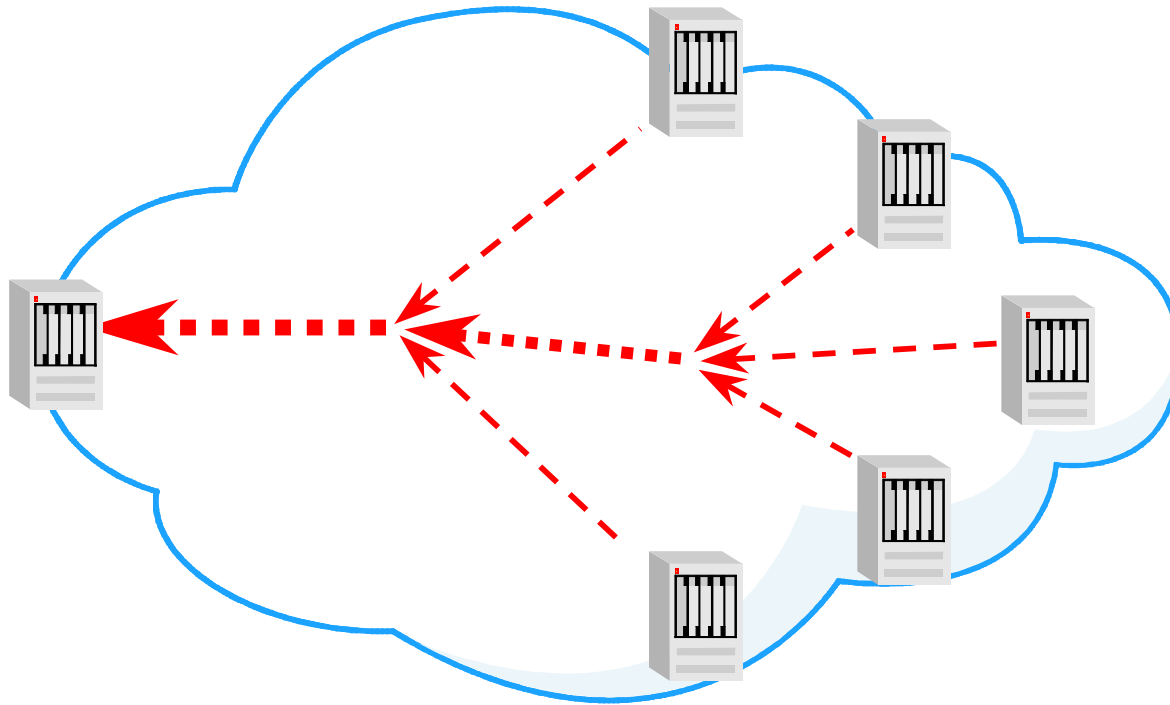- **Single customer connection allows both Internet and intranet connectivity.**

IP Navigator Architecture Solves the N² Scaling Problem
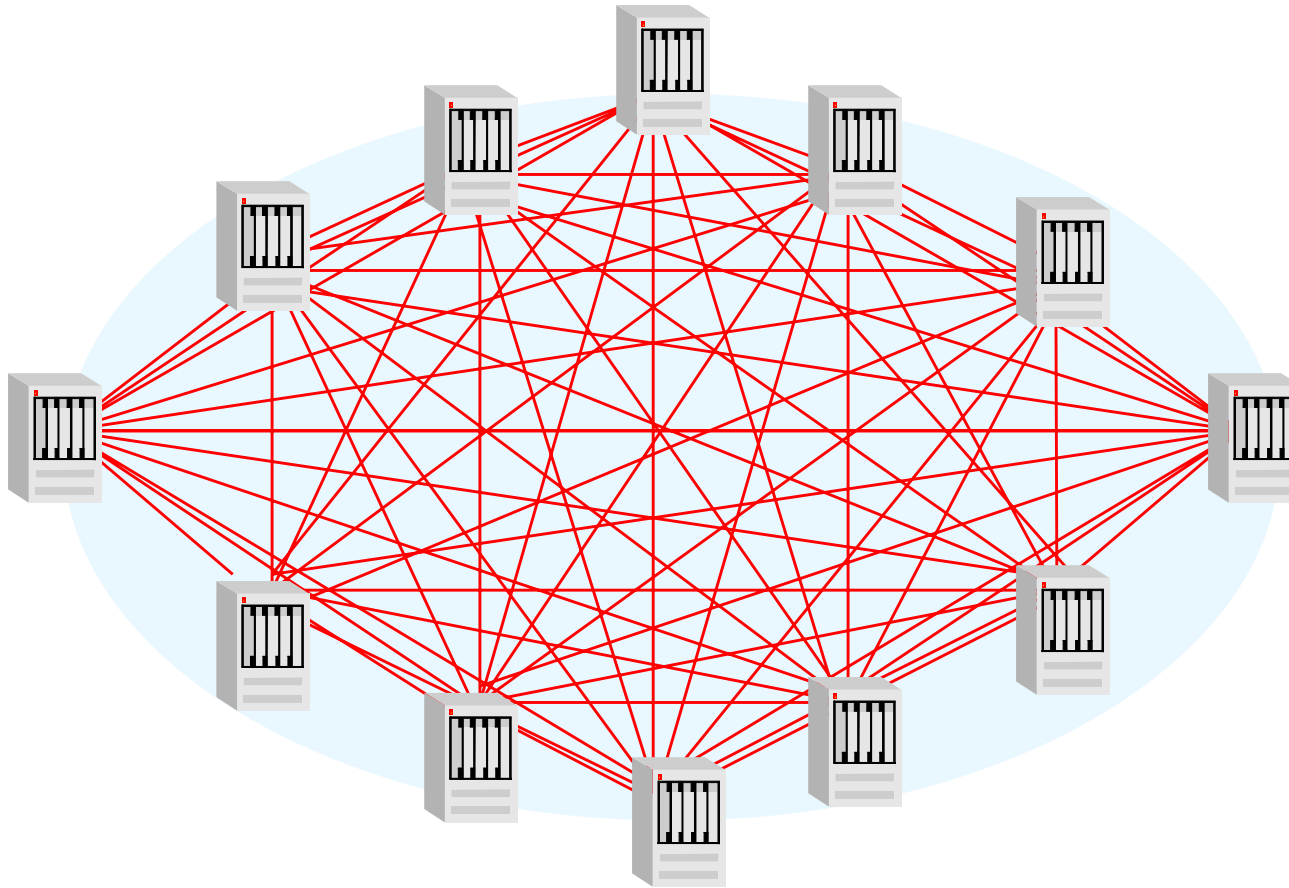
- **The number of virtual circuits grows as a square of the number of switches**
- **This causes scaling problems to arise when building a large switched networks**

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

Distributed Routing Tables

Distributed Routing Tables
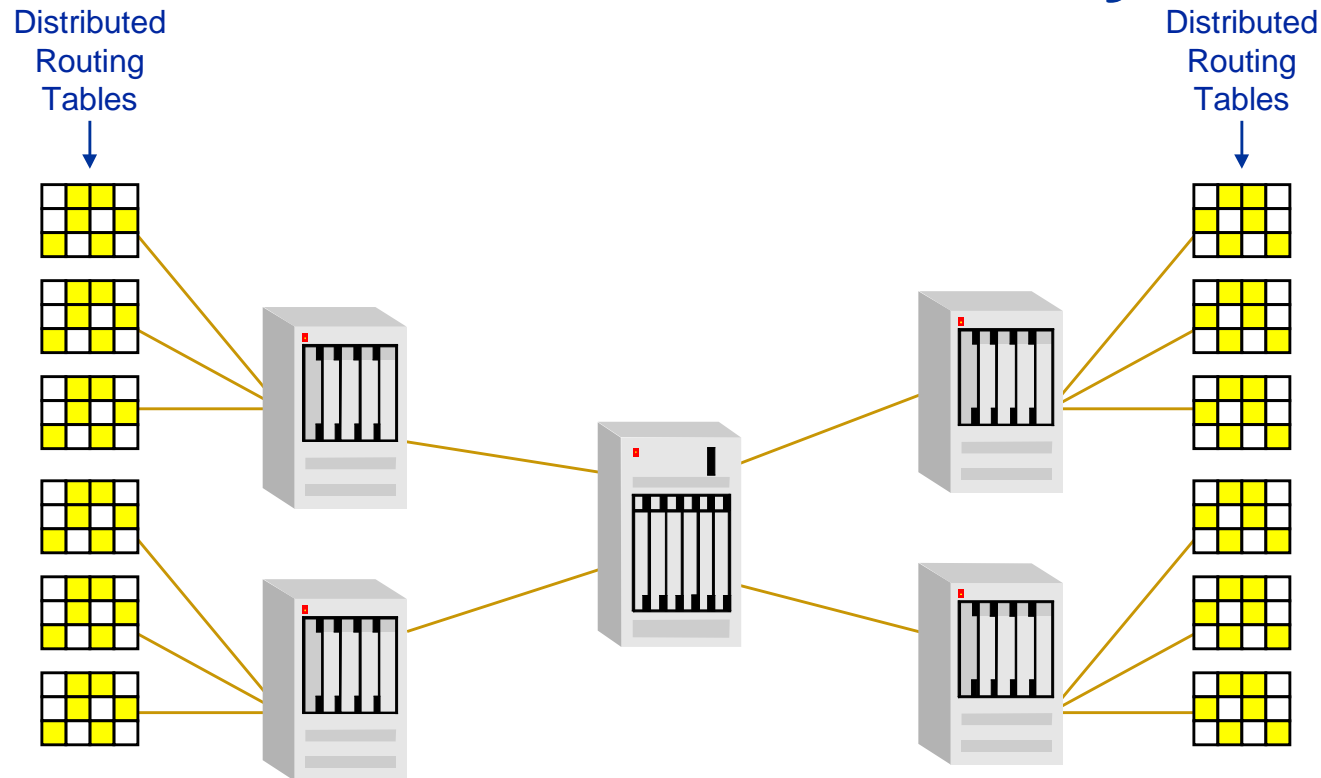
■ **IP Navigator distributes routing tables to each line card.**

■ **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**