



# High-Speed Networking and Applications in Research & Education Networks

**CUDI Meeting**  
**Reunión de Otoño - 2002**

***Roosevelt Ferreira***  
***roosevelt@juniper.net***



# Company Profile

- ◆ **Service Provider Market Focus**
  - ❖ **Purpose-built IP Infrastructure**
- ◆ **Worldwide Presence**
  - ❖ **60 offices worldwide**
- ◆ **Excellence**
  - ❖ **#1 BRAS**
  - ❖ **#1 Broadband Access & IP Services**
  - ❖ **#2 Core Router**
  - ❖ **#2 Edge Router**

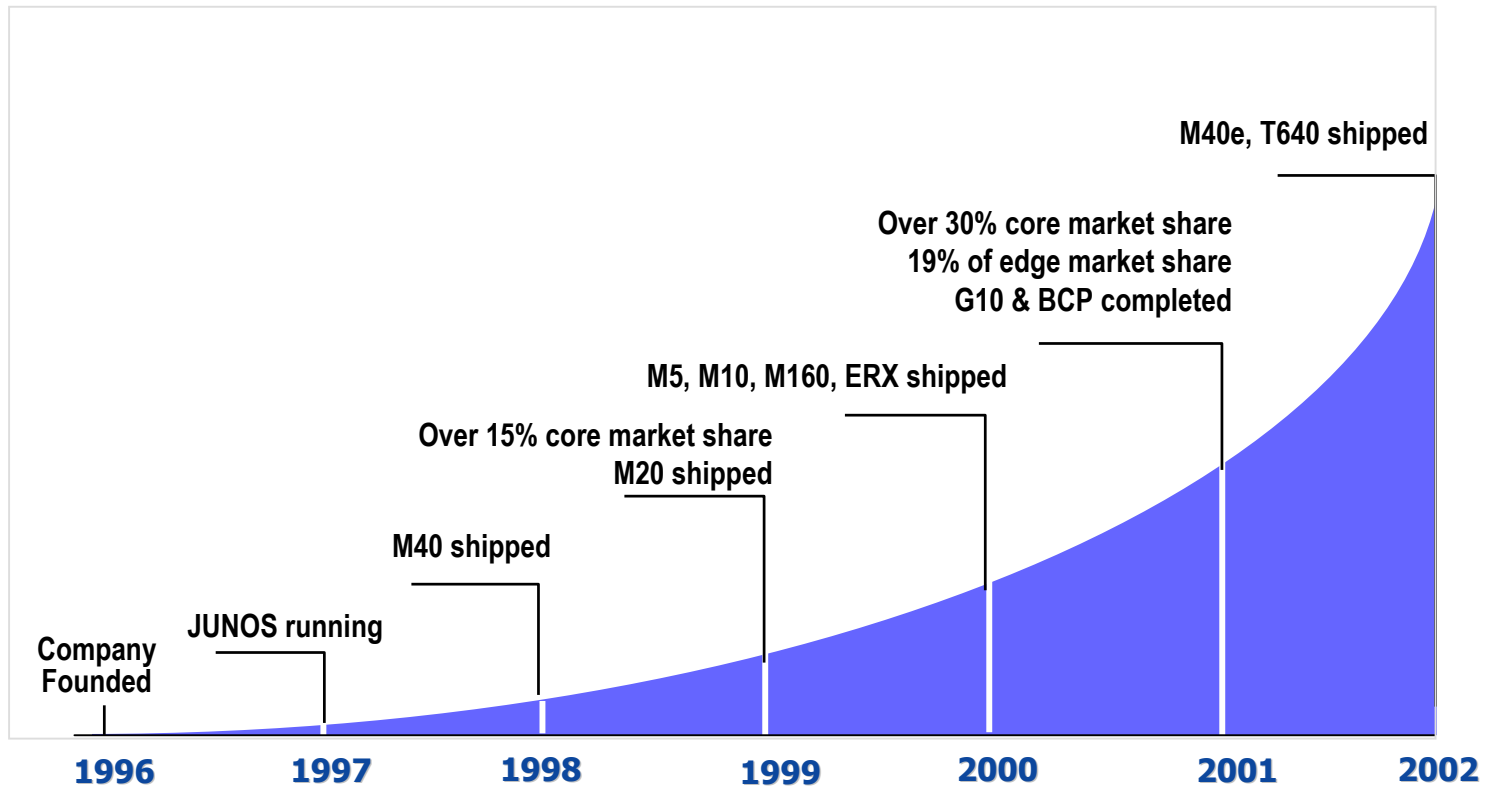


Source: Infonetics, Synergy, Dell'Oro



# Company Milestones

**Trusted Partner for State of the Art IP Systems  
and Services for the New Public Network**





# Global Base of over 600 Leading SPs

## Americas



## Europe Middle East Africa



## Asia Pacific





# Agenda

- ◆ **Juniper in R&E Networks**
  - ❖ **Application Examples**
  - ❖ **R&E References**
- ◆ **Juniper Product Technical Overview**
  - ❖ **Architecture & Platforms**



# Agenda

- ◆ **Juniper in R&E Networks**
  - ❖ **Application Examples**
  - ❖ **R&E References**
- ◆ **Juniper Product Technical Overview**
  - ❖ **Architecture & Platforms**



# Juniper Applications in R&E Nets

- ◆ **HDTV over IP**
- ◆ **Passive Monitoring via Port Mirroring**
- ◆ **Wire speed filtering for firewalls**



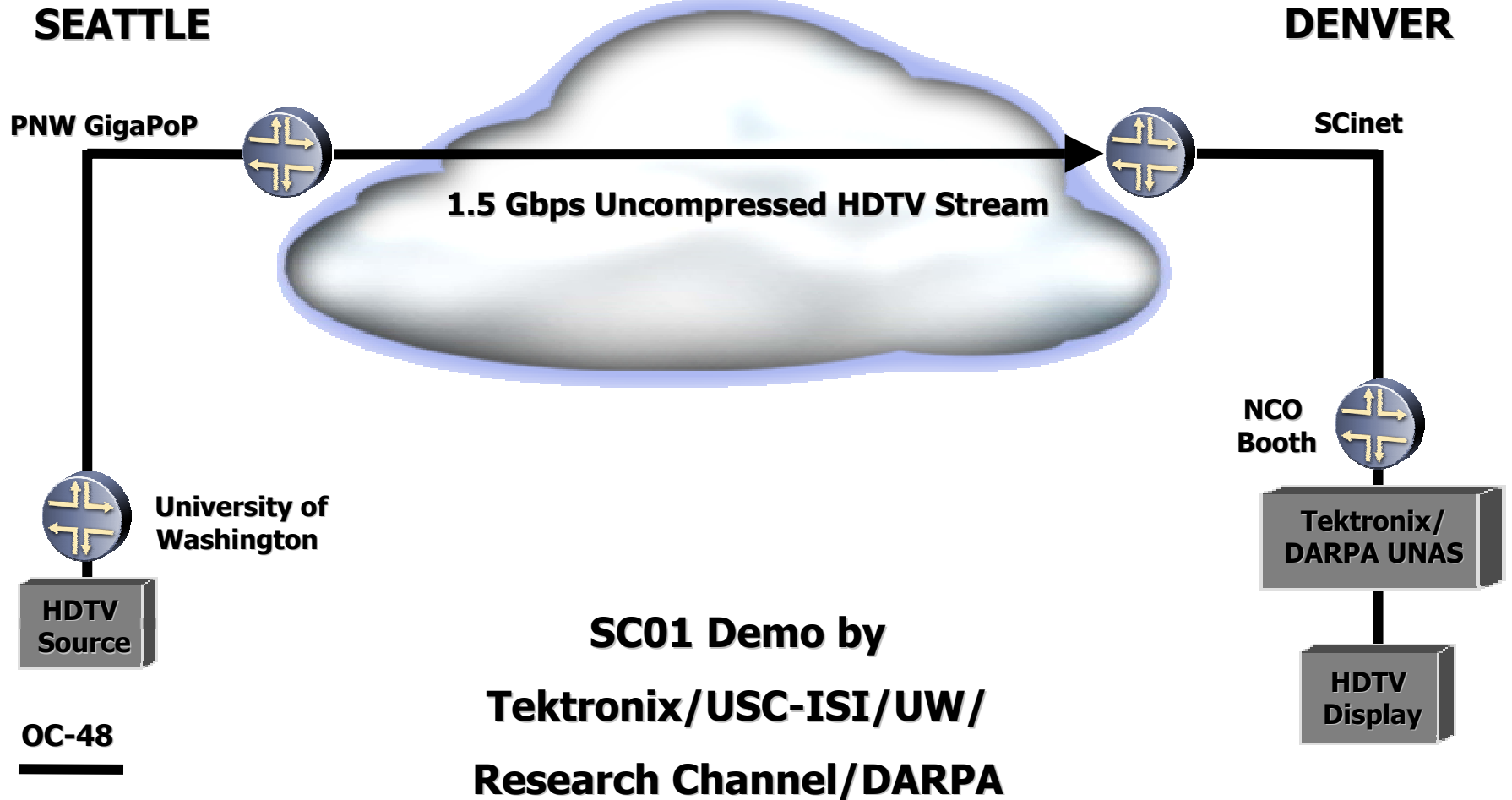
# HDTV Over IP at the University of Washington

- ◆ **The University of Washington is a leading innovator in HDTV over IP applications**
- ◆ **At the Supercomputing 2001 show, UW demonstrated for the first time that it was possible to run uncompressed, broadcast quality HDTV that required a 1.5 Gbps stream of data across a wide area Internet backbone**
- ◆ **By using Juniper Networks routers, UW engineers concentrate on their applications instead of tracking down network bottlenecks and troubleshooting network problems**





# 1.5 Gbps Uncompressed HDTV over IP



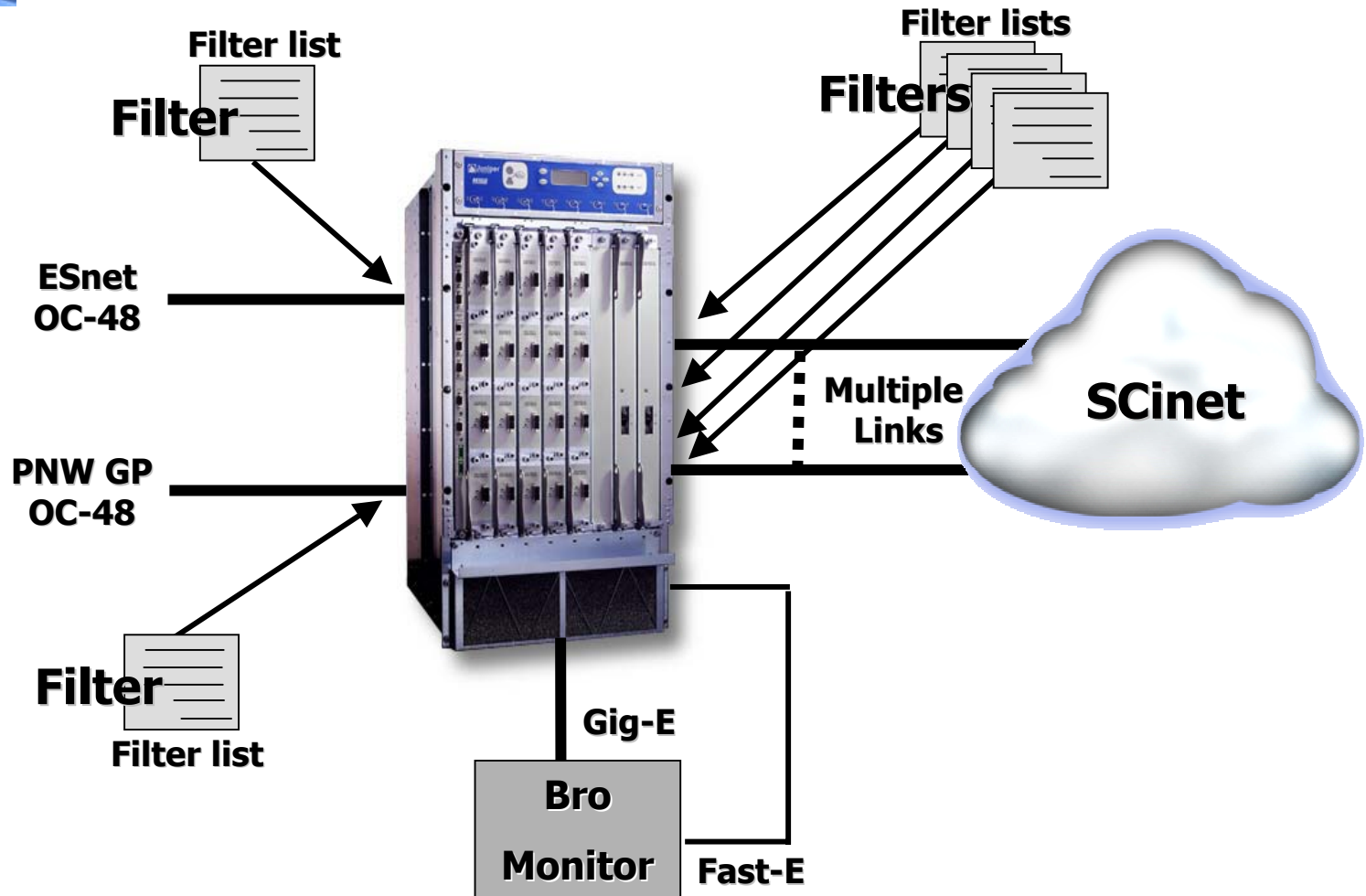


# Passive Monitoring via Port Mirroring

- ◆ **LBNL set up Bro (its security monitor) on a Gig-E link attached to the Juniper M160 at SCinet**
- ◆ **Filters were set up on all links to mirror all TCP: SYN, FIN, and Reset packets to Bro**
- ◆ **Bro modified the filters on the fly to block attack traffic**
  - ❖ For example FTP traffic for which there was no session set up was blocked
- ◆ **Port Mirroring can also be used with OCXMONs and other passive monitoring devices**
  - ❖ Monitors do not have to be upgraded with bandwidth increases
  - ❖ A passive monitor can watch more than one link at a time



# Port Mirroring and Bro at SC01



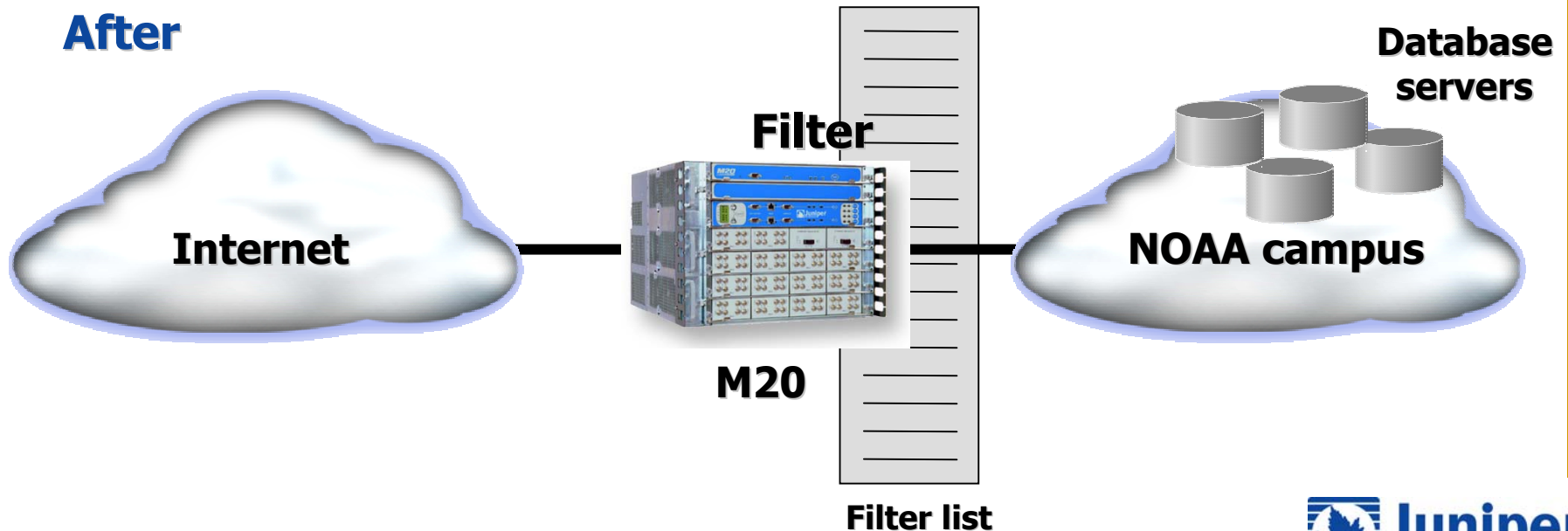
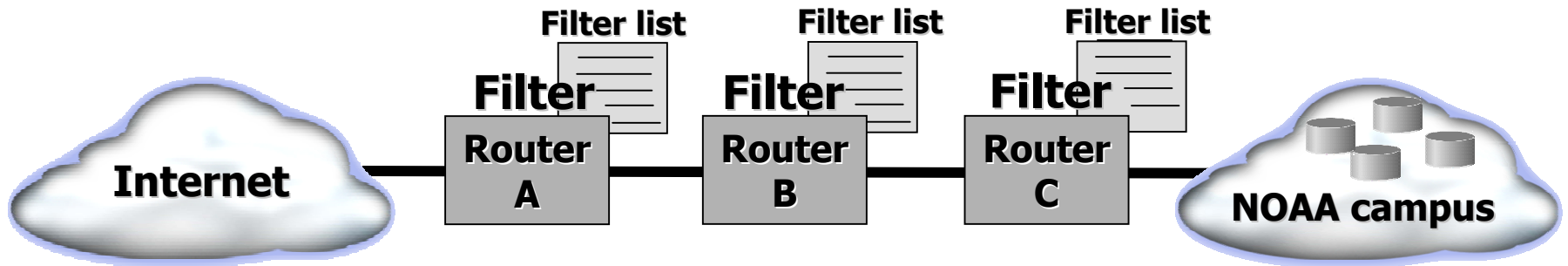


# Wire Speed Filtering for Firewalls

- ◆ **NOAA uses Juniper's line speed filtering capability to do all of their security filtering on one router**
- ◆ **As part of NOAA's acceptance process Juniper ran lab demonstrations using filters with up to 40,000 terms implemented on an OC-48 interface running at line speed with no performance loss**
- ◆ **Several R&E customers have been able to replace a firewall made up of two or more routers linked serially with a single Juniper router**



# Improving Network Efficiency at NOAA

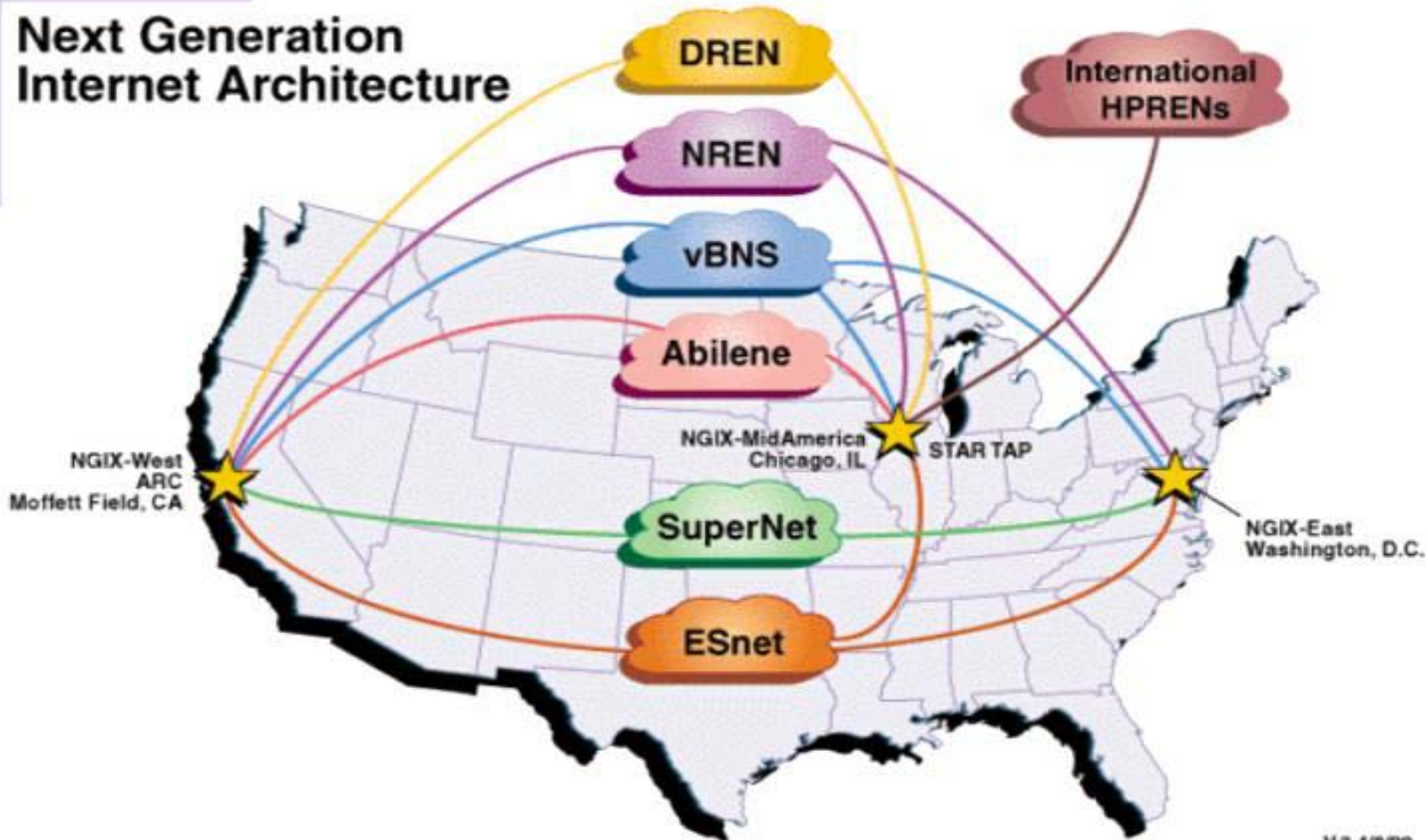




# Agenda

- ◆ **Juniper in R&E Networks**
  - ❖ Application Examples
  - ❖ **R&E References**
- ◆ **Juniper Product Technical Overview**
  - ❖ Architecture & Platforms

# Next Generation Internet Architecture



V.3 4/8/99

**DREN** - Defense Research & Engineering Network  
**NREN** - NASA Research and Education Network  
**vBNS** - Very High Performance Backbone Network Service (NSF)

**Abilene** - University Corporation for Advanced Internet Development (UCAID)  
**SuperNet** - Terabit Research Network (DARPA)  
**ESnet** - Energy Sciences Network (DOE)



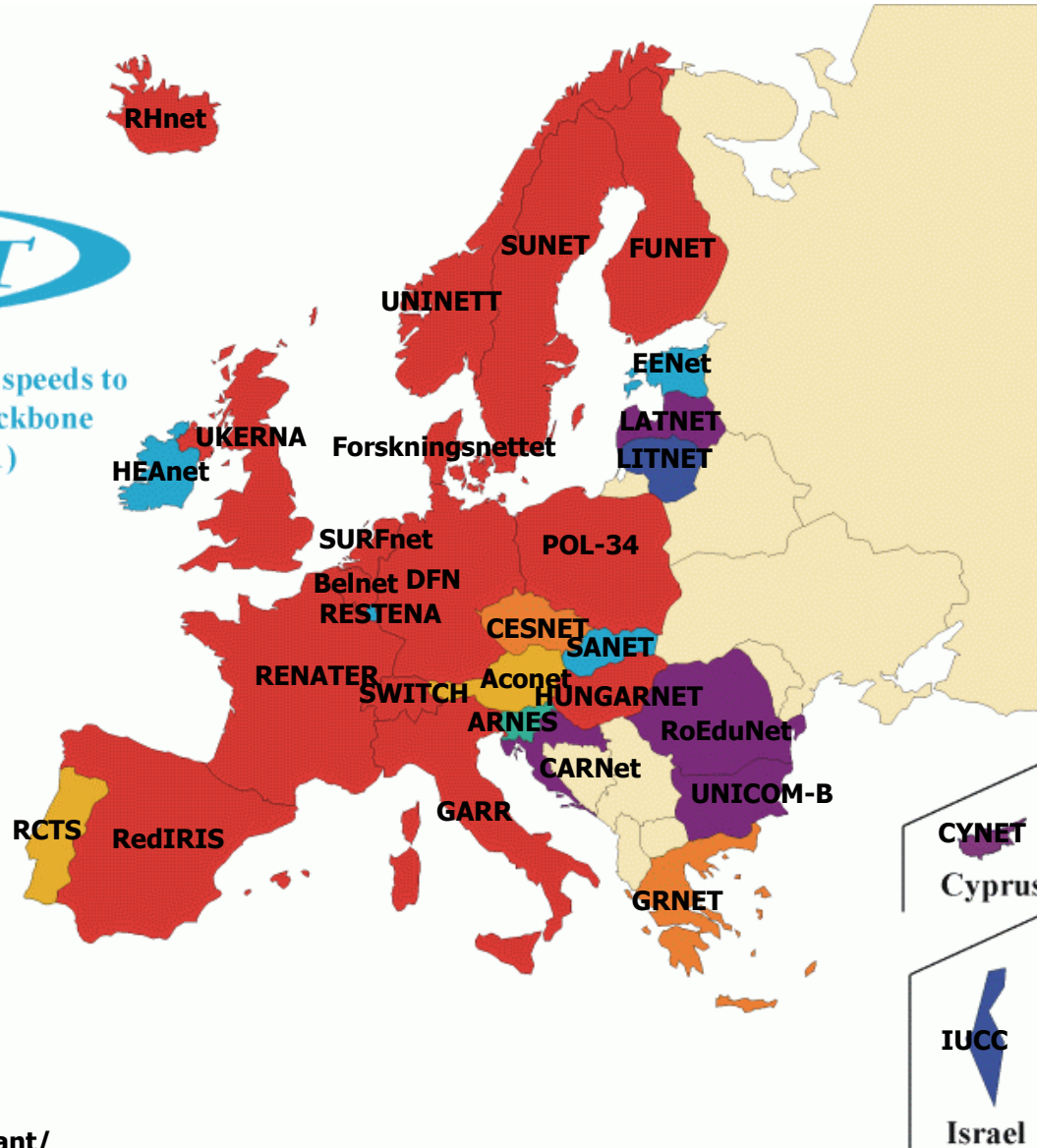


# Pan-European Research Networking



Planned national access speeds to the pan-European backbone (November 2001)

	2.5 Gbit/s
	1.2 Gbit/s
	622 Mbit/s
	310 Mbit/s
	155 Mbit/s
	45 Mbit/s
	34 Mbit/s



**10 Gb/s backbone with Juniper M160s**

**WDM optical technology**

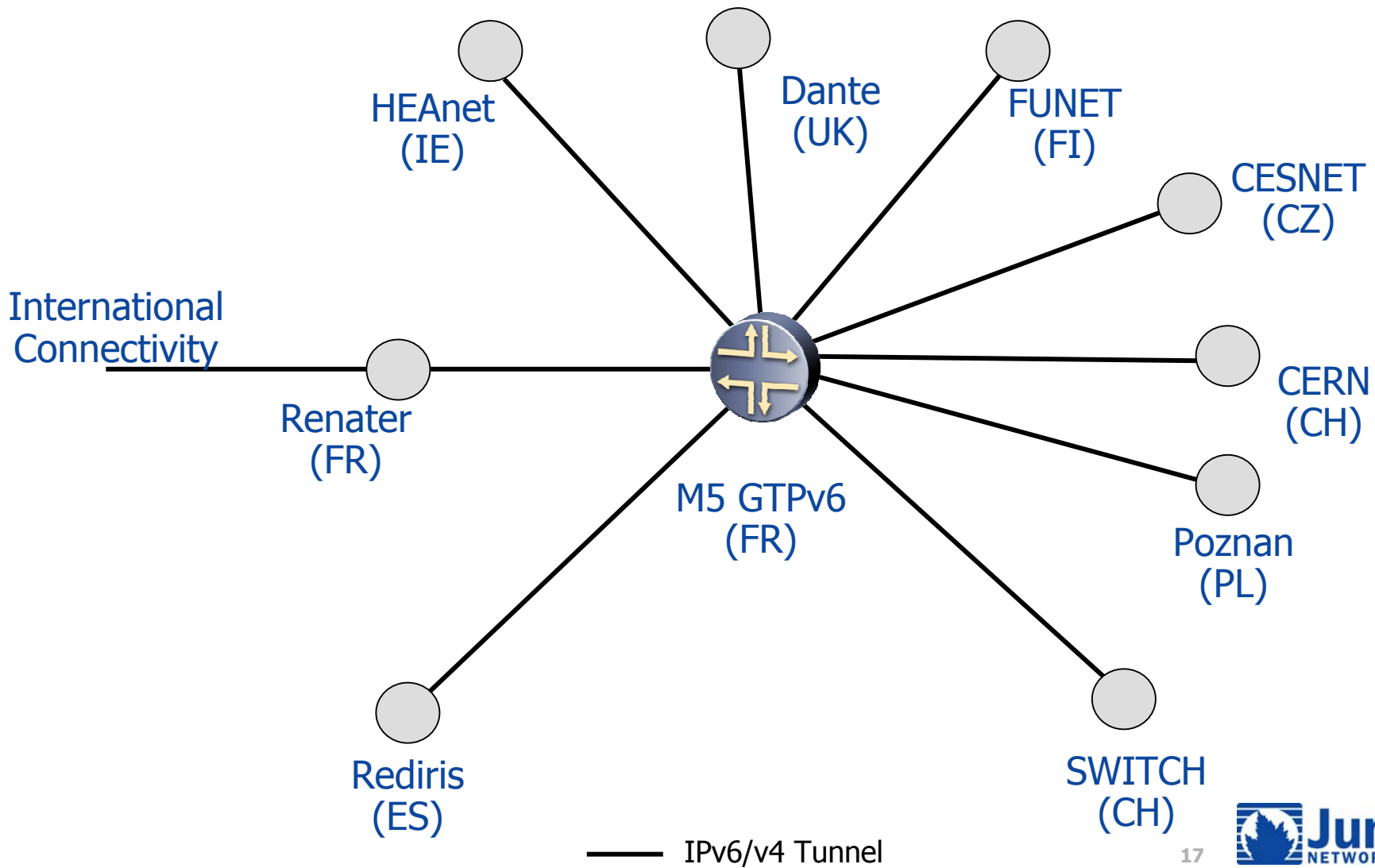
**30 R&E connected organizations**

**European connectivity to over 3000 R&E institutions**





# Juniper IPv6 router Peerings





# Research and Education Customers

## National Research Networks & Meet Points

### Global

- ◆ GTRN (Global Terabit Research Network)

### North America

- ◆ Abilene - Internet2
- ◆ AMPATH - Latin American Meet Point (Miami)
- ◆ CA\*net4 - Canada
- ◆ ESnet - Department of Energy
- ◆ vBNS+ - Worldcom
- ◆ STAR TAP - Global Meet Point (Chicago)
- ◆ SUPERNET - DARPA's NGI Network
- ◆ TeraGrid - NSF's distributed Super Computer project

### Europe

- ◆ ARNES - Slovenia
- ◆ FUNET - Finland
- ◆ GÉANT - DANTE (Pan-European)
- ◆ RedIRIS – Spain
- ◆ VTHD - France

### Asia

- ◆ APAN - Asia-Pacific Advanced Network Consortium
- ◆ JGN - Japan Gigabit Network
- ◆ SINET - Japan
- ◆ TransPac (Tokyo-Chicago)

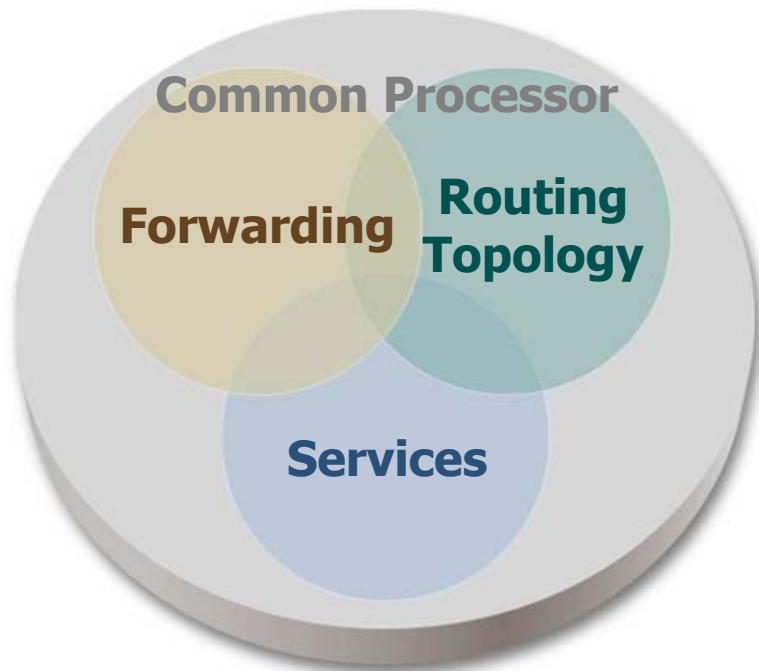


# Agenda

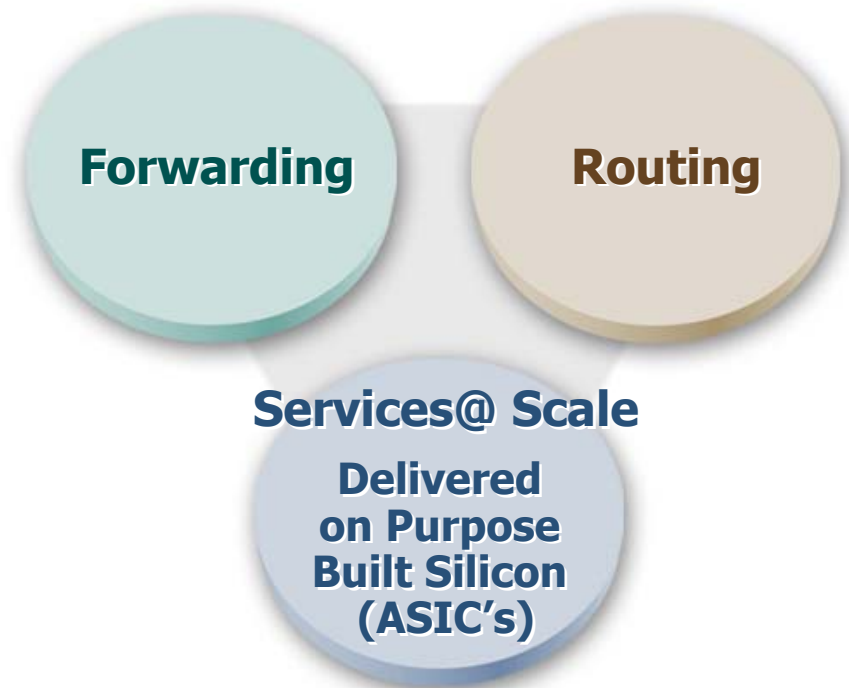
- ◆ **Juniper in R&E Networks**
  - ❖ Application Examples
  - ❖ R&E References
- ◆ **Juniper Product Technical Overview**
  - ❖ **Architecture & Platforms**



# Purpose Built Architecture



**'Traditional' CPU-Based Router**



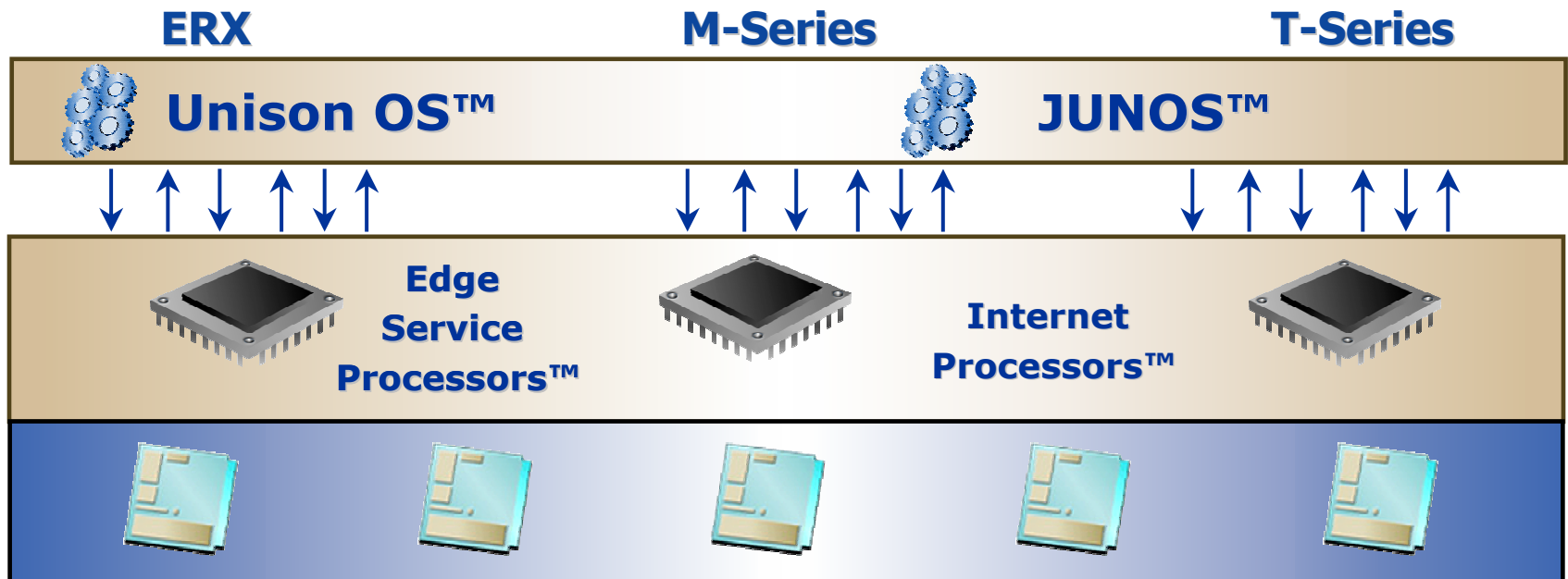
**Juniper Networks Architecture**



# Juniper Networks

## Unprecedented Control Plane Scale

- ◆ Clean separation of control and forwarding planes
- ◆ Modular OS enables scale
- ◆ Unison™ optimized for granular control of many interfaces
- ◆ JUNOS™ optimized for high bandwidth, dynamic routing





# Best in Class IP Portfolio

**Dependable**

**Uncompromising  
Performance**

**Security**

**BRAS &  
Circuit Aggregation**



**ERX Family**



**Service Activation, Deployment  
& Accounting**

**SDX - Service Deployment Portal**

**HS Circuit Aggregation  
& Small/Medium Core**



**M-Series Family**

**Metro  
Aggregation**



**T-Series Family**

**Large  
Core**

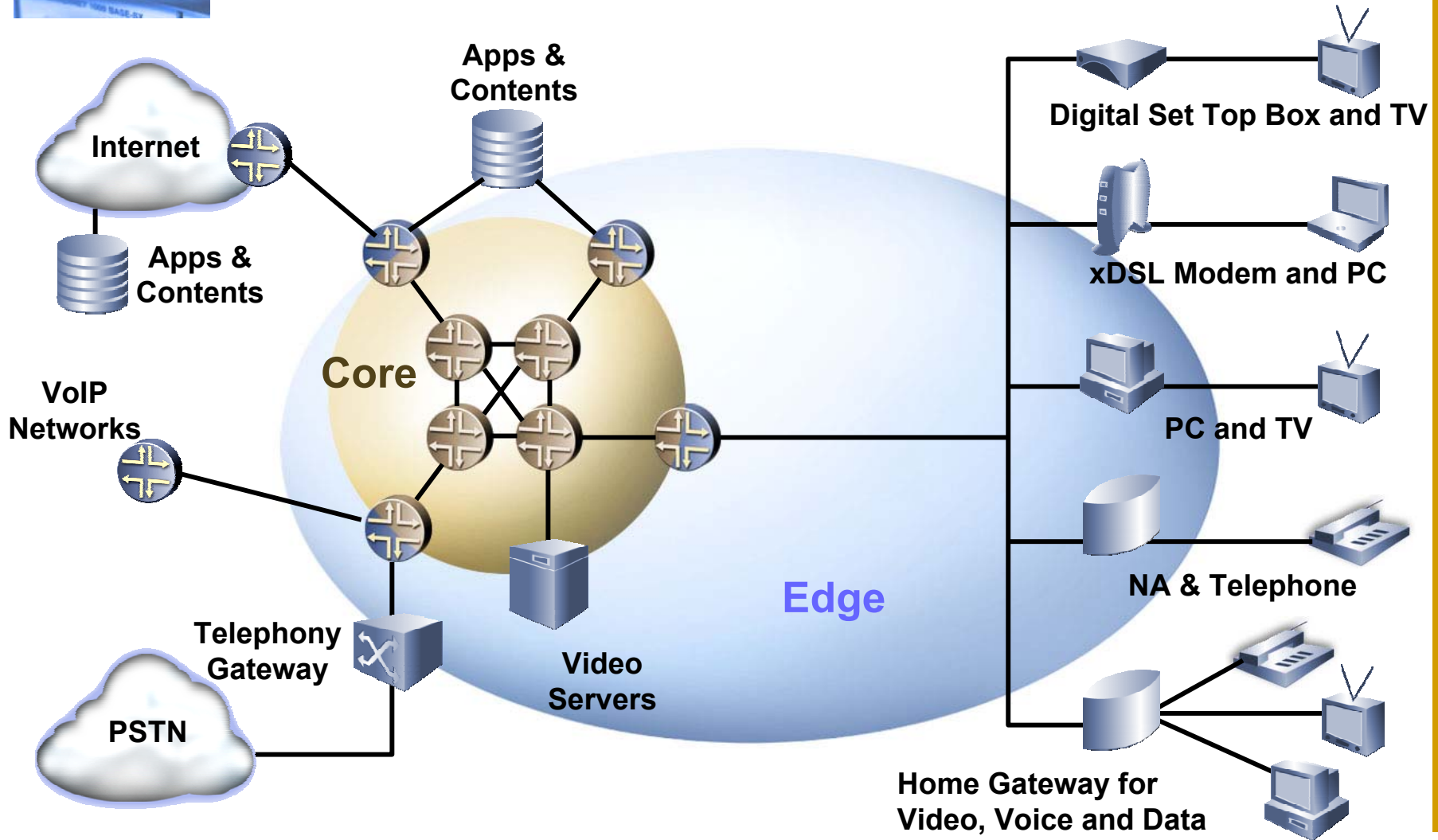
**Seamless Scale**

**Operational  
Simplicity**

**Rich Services**



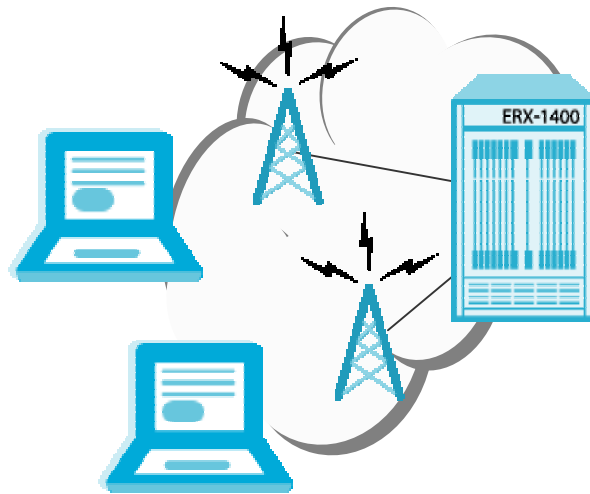
# Video, Voice, and Data Convergence





# 802.11 Wi-Fi “HotSpot” Networks

- ◆ Internet & VPN access using 802.11 Wi-Fi technology
- ◆ Enable network access anywhere with notebooks and PDAs
- ◆ Integrated with ERX and SDX platforms

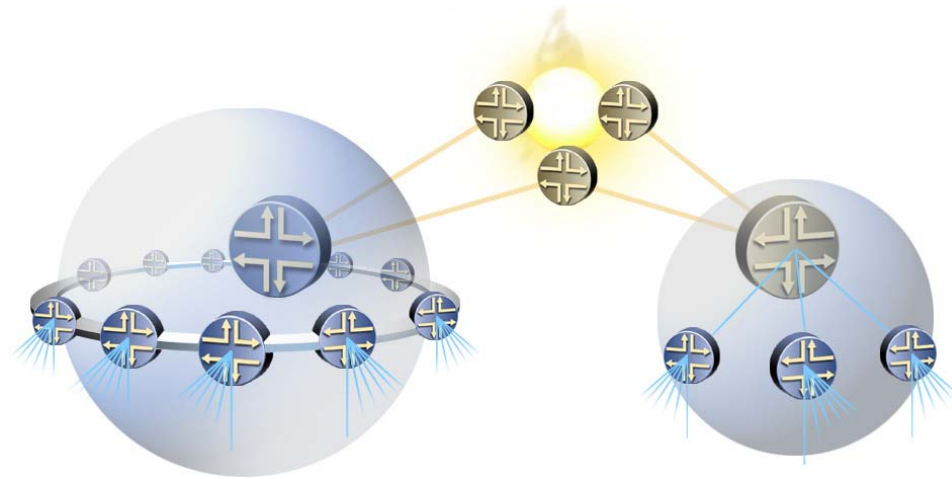
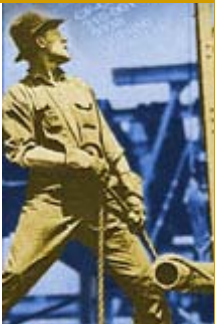






# Agenda - Summary

- ◆ **Juniper in R&E Networks**
  - ❖ **Application Examples**
  - ❖ **R&E References**
- ◆ **Juniper Product Technical Overview**
  - ❖ **Architecture & Platforms**



**Thank You**