

**TONY BATES
VICE PRESIDENT/GENERAL MANAGER
ROUTING TECHNOLOGY GROUP**

CISCO IP NGN

APRICOT 2005 – February 24th



Agenda

Cisco.com



SERVICE PROVIDER DRIVERS



IP NGN OVERVIEW



APPLICATION CONVERGENCE



SERVICE CONVERGENCE



NETWORK CONVERGENCE



INNOVATION – CRS1

SPs are Driving Towards...

Cisco.com

SERVICES

DIFFERENTIATION
LOYALTY
REVENUE

EFFICIENCIES

OPEX
CAPEX
PROFITS

CONTROL

SERVICE
NETWORK
BUSINESS

IP

INTELLIGENCE
FLEXIBILITY
ADAPTABILITY

Cisco Service Provider Vision

Cisco.com

CONNECTING CUSTOMERS WITH SERVICES,
SERVICES WITH NETWORKS,
AND NETWORKS WITH EACH OTHER

CONSUMER



SMALL/MEDIUM
BUSINESS



ENTERPRISE



SP
WHOLESALE



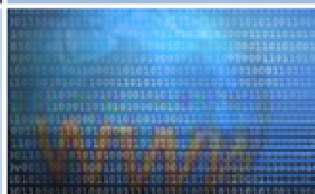
IP NEXT GENERATION NETWORK

VPNs



VOICE &
VIDEO

INTERNET



MOBILITY

CONTENT

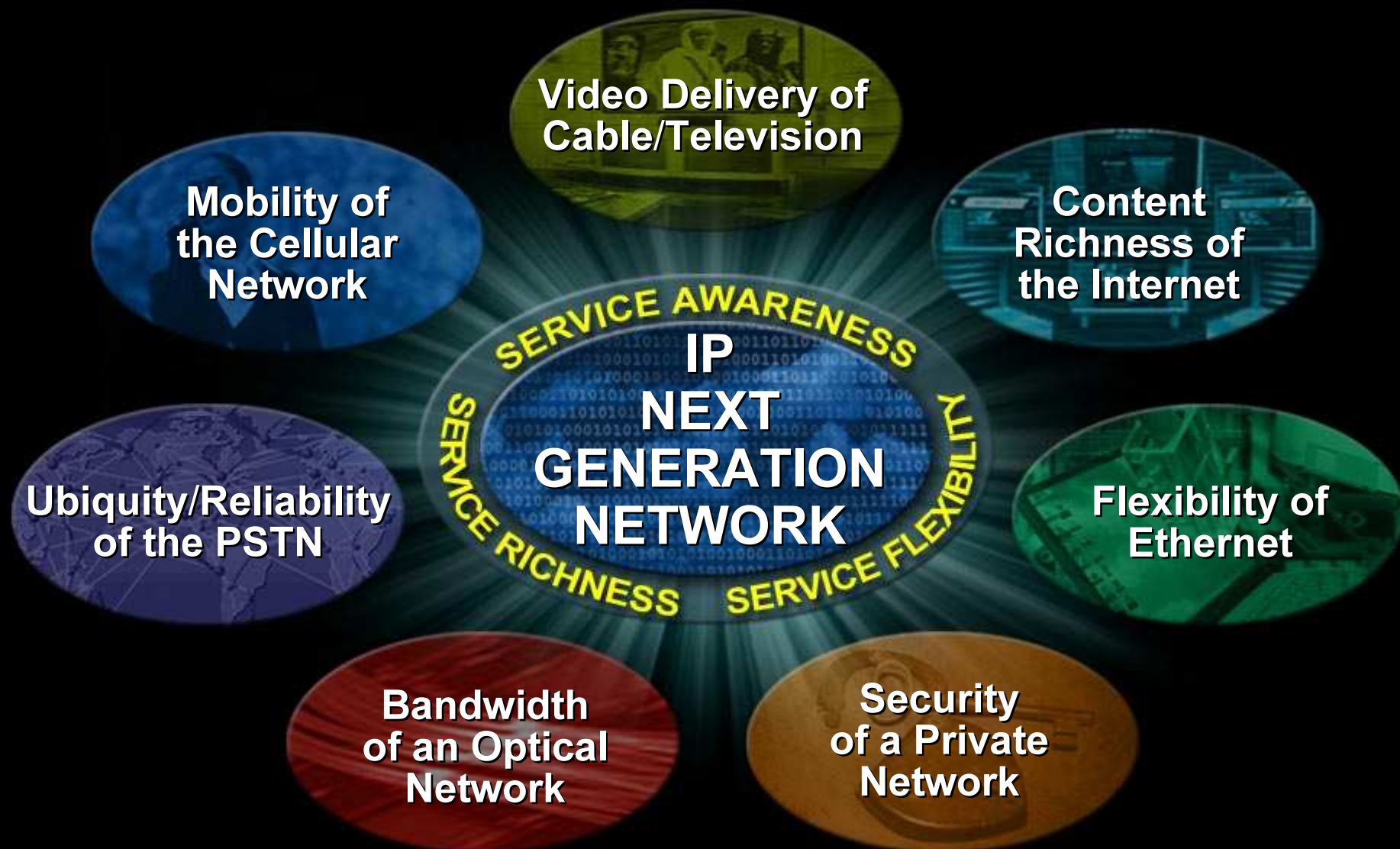


TRANSPORT

Characteristics of an Ideal Network

Fusing the Best of Today's Networks and More

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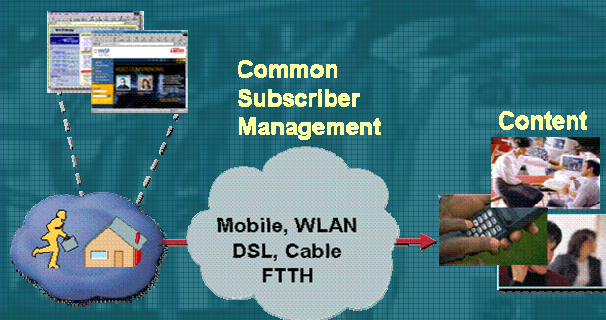
Layers of Convergence in IP NGN

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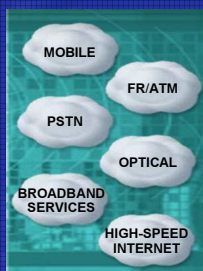
APPLICATION CONVERGENCE

Integration of New Innovative IP D/V/V Services over Broadband
Increase Revenue



SERVICE CONVERGENCE

Service Continuity and Creation
Customer Loyalty and Stickiness



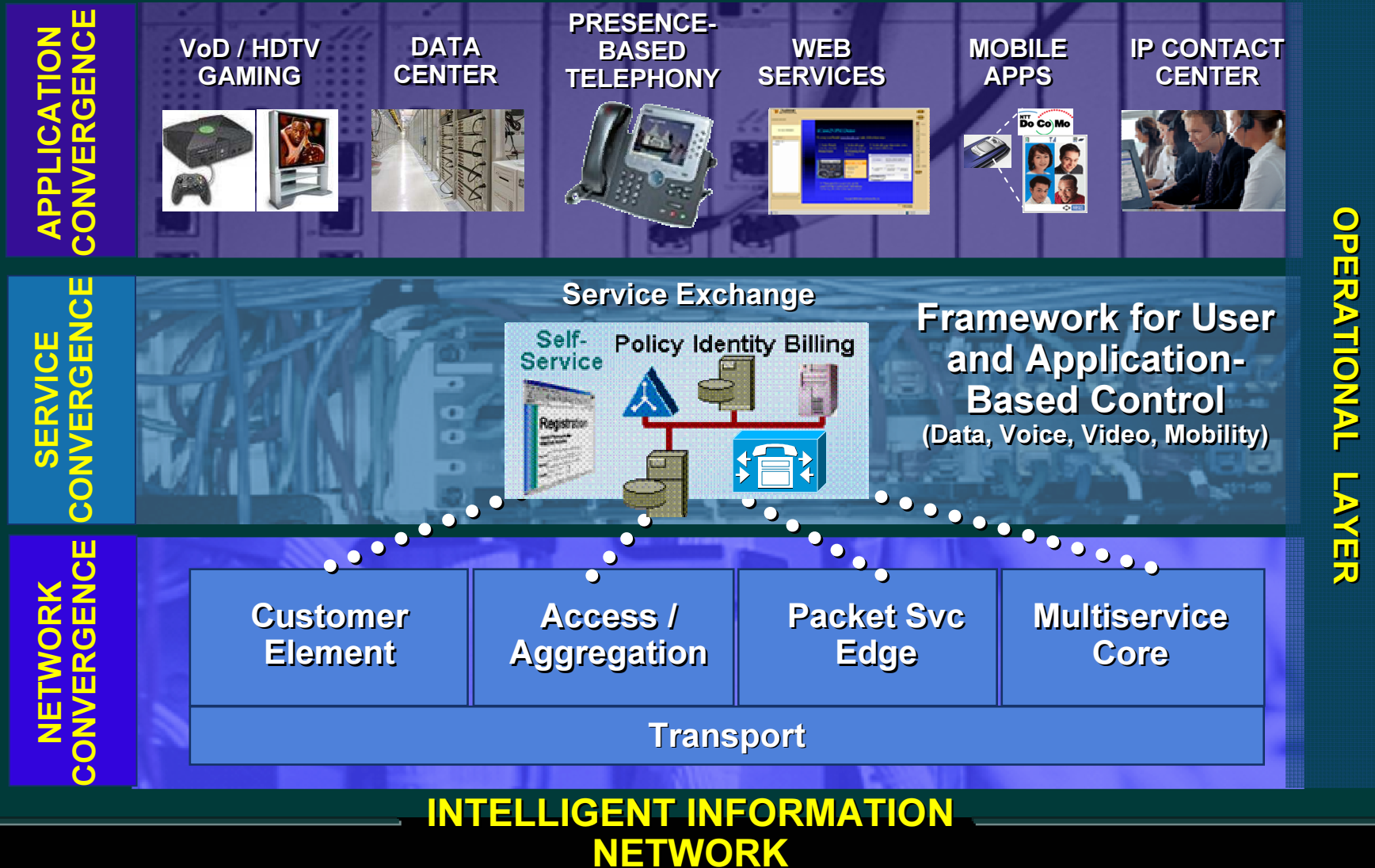
NETWORK CONVERGENCE

Eliminate Layers in the Network
Reduce OPEX / CAPEX

Cisco IP NGN Architecture

Achieving a Whole Greater Than the Sum of the Parts

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Application Convergence

Cisco.com

APPLICATION
CONVERGENCE

VoD / HDTV
GAMING



DATA
CENTER



PRESENCE-
BASED
TELEPHONY



WEB
SERVICES



MOBILE
APPS



IP CONTACT
CENTER



SERVICE
CONVERGENCE

NETWORK
CONVERGENCE

Customer
Element

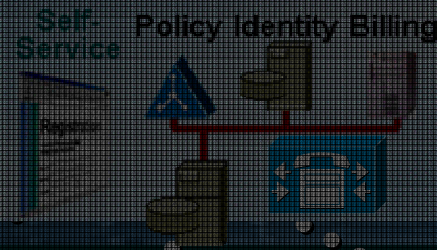
Access /
Aggregation

Packet Svc
Edge

Multiservice
Core

Transport

Service Exchange



Framework for User
and Application-
based Network
Control
(Data, Voice, Video, Mobility)

OPERATIONAL LAYER

INTELLIGENT INFORMATION
NETWORK

Innovation at the Application Layer

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Presence-Based
Communication

Video
Telephony

Video-on-
Demand

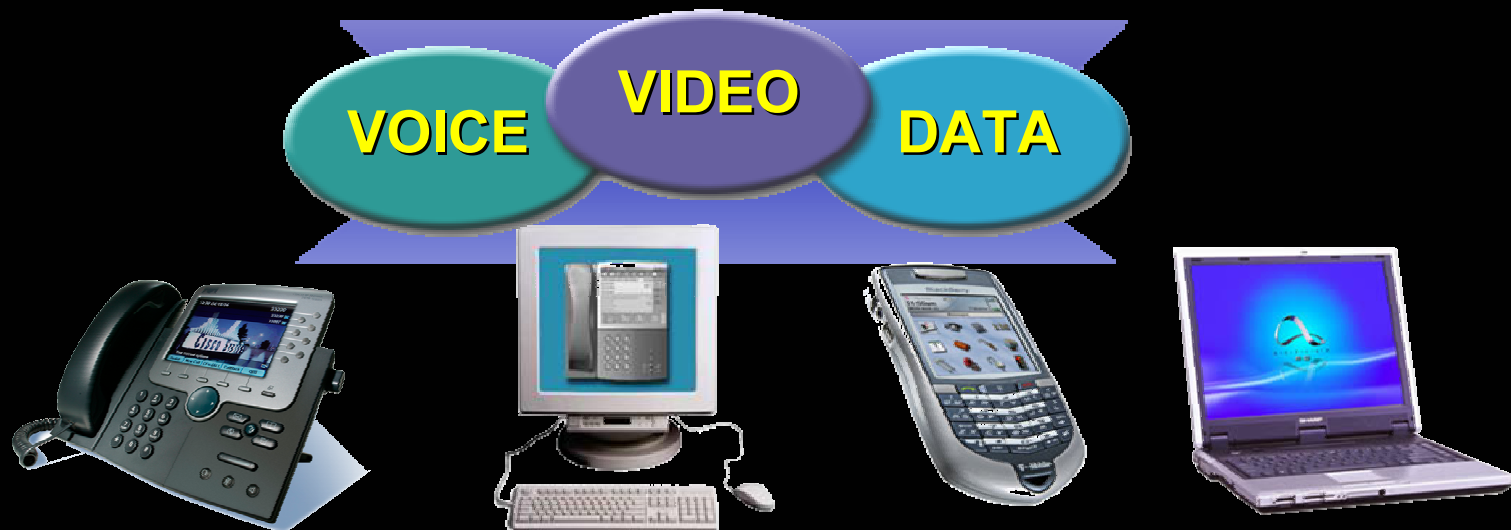
Multi-Player
Gaming

TV / Web
Integration

Push-to-Talk

Video-Based
Security

Mobile
Enterprise



AT WORK, AT HOME, ON THE ROAD

Creating a Multitude of New Service Opportunities...

Example: Residential Broadband Services

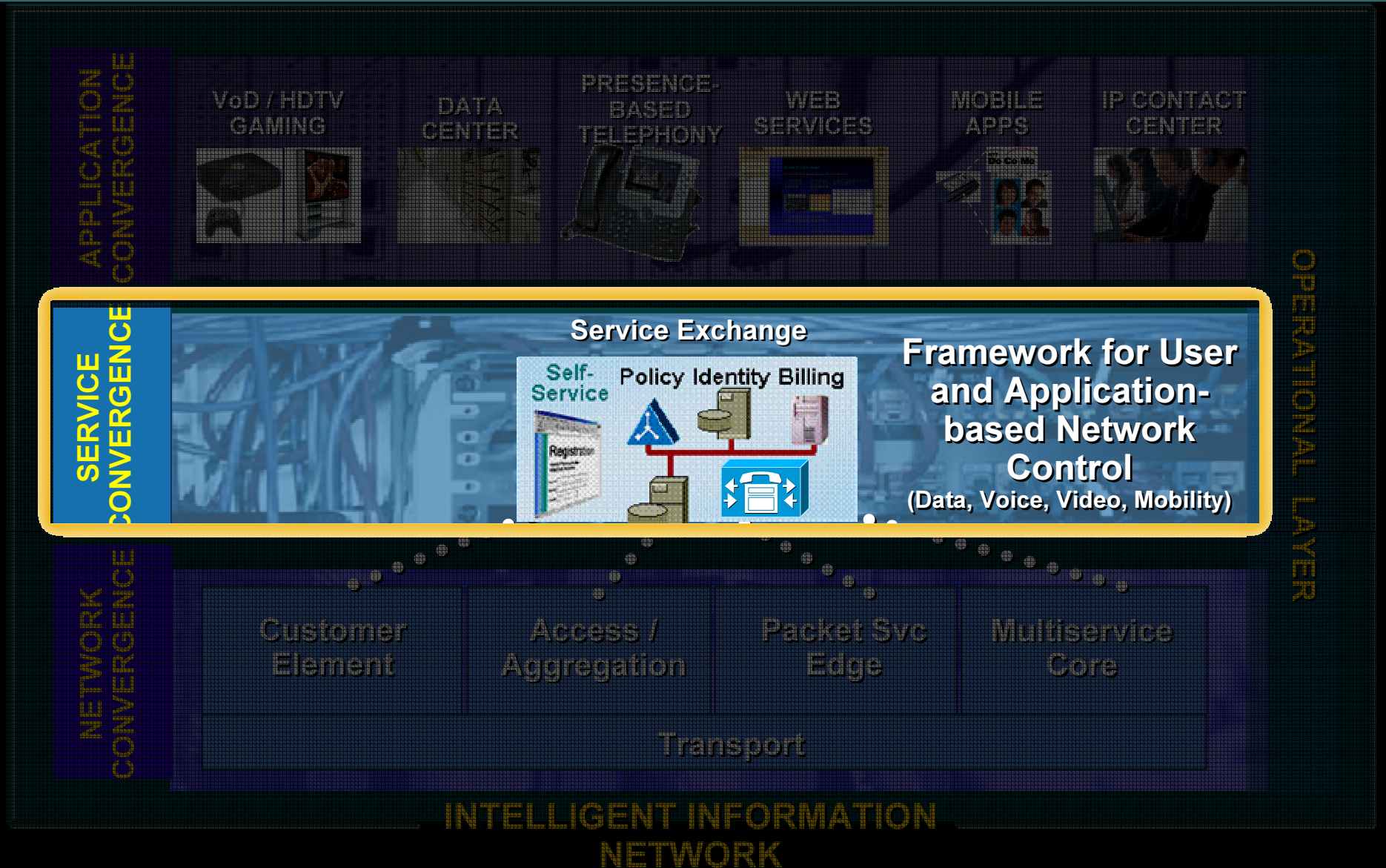
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Integrated Networks, Content and Entertainment Systems

Service Convergence

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Service Exchange Framework

Multimedia Service Control for Wireline/Wireless Convergence

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IDENTITY MANAGEMENT

User / Device ID
Location / Presence
Service Registration
Audit / Logging
Assured Authentication

WHO?

POLICY MANAGEMENT

Subscriber Policy
Application Policy
Per-Sub Service
Service Invocation

WHAT?

Service
Exchange

MOBILITY MANAGEMENT

Device Roaming
Service Mobility
User Mobility

WHERE?

DYNAMIC SESSION MANAGEMENT

Call Control / Session Border Ctrl
Rich-Media Control
Bandwidth & QoS per Session
Accounting / Billing

HOW?

Introducing Cisco Service Control Engine

Cisco.com

- **Programmable Exchange Point for Application and User-Level Control:**

Stateful deep packet inspection

Wire-speed analysis and control

Subscriber and application-awareness

Integration with OSS and BSS systems

- **Delivering:**

Granular usage analysis

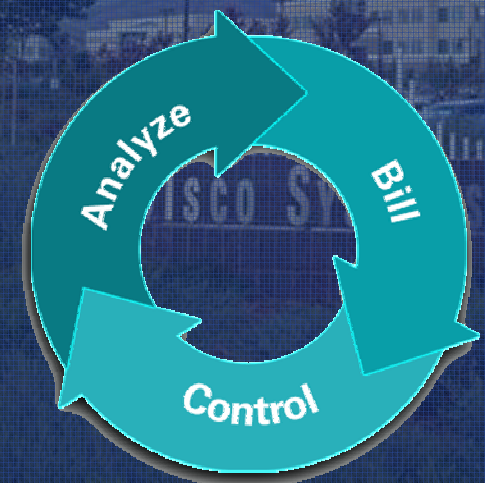
Application-level traffic optimization

Service-level security

Tiered services and access control

Content charging

Cisco Service Control Engine



The Foundation: Network Convergence

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OPERATIONAL LAYER

APPLICATION
CONVERGENCE

VoD / HDTV
GAMING



DATA
CENTER



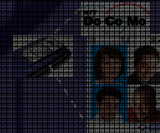
PRESENCE-
BASED
TELEPHONY



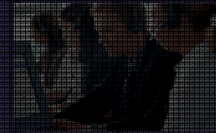
WEB
SERVICES



MOBILE
APPS

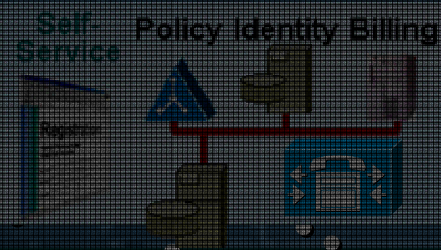


IP CONTACT
CENTER



SERVICE
CONVERGENCE

Service Exchange



Framework for User
and Application-
based Network
Control
(Data, Voice, Video, Mobility)

NETWORK
CONVERGENCE

Customer
Element

Access /
Aggregation

Packet Svc
Edge

Multiservice
Core

Transport

INTELLIGENT INFORMATION
NETWORK

IP NGN: Fundamental Requirements

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- **Scalability**

Service, System, PoP

- **Availability**

Layered Services → beyond 99.999%

Security – Public vs. Private

- **Flexibility**

Traditional internet + real time

APPLICATION
CONVERGENCE
SERVICE
CONVERGENCE
NETWORK
CONVERGENCE

Customer
Element

Access /
Aggregation

Intelligent
Edge

Multiservice
Core

Transport

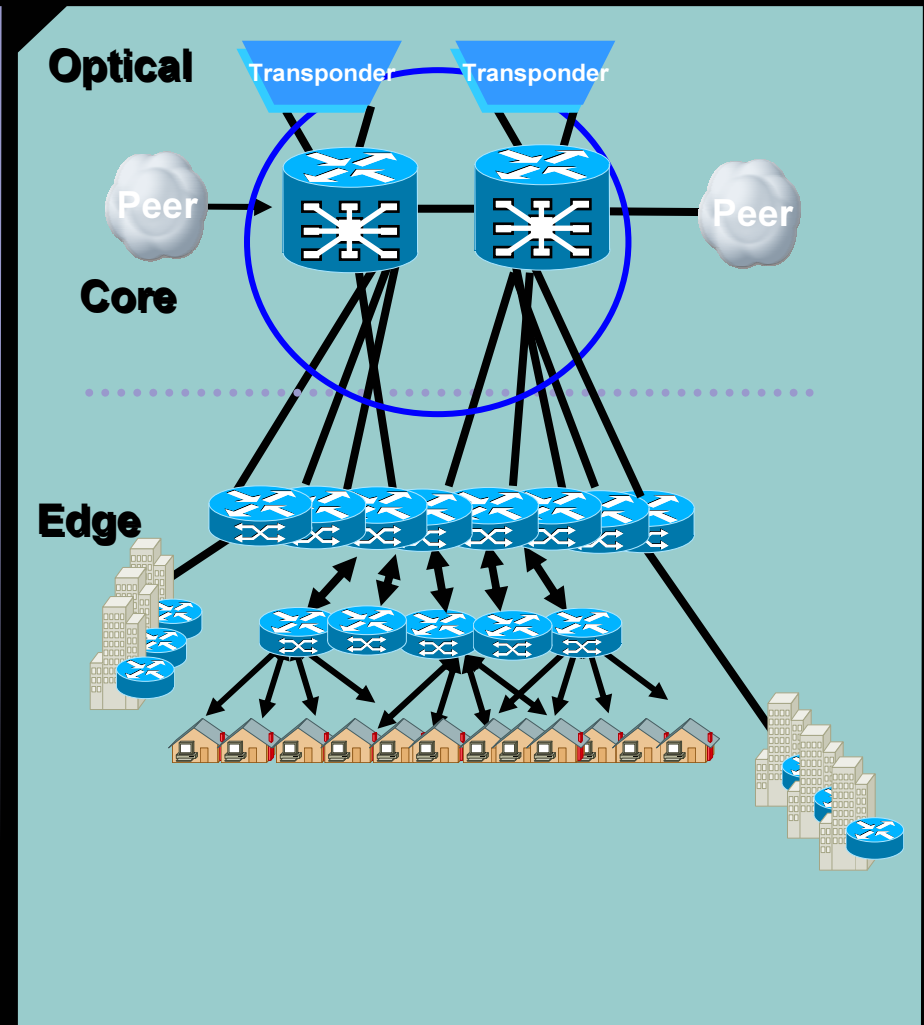
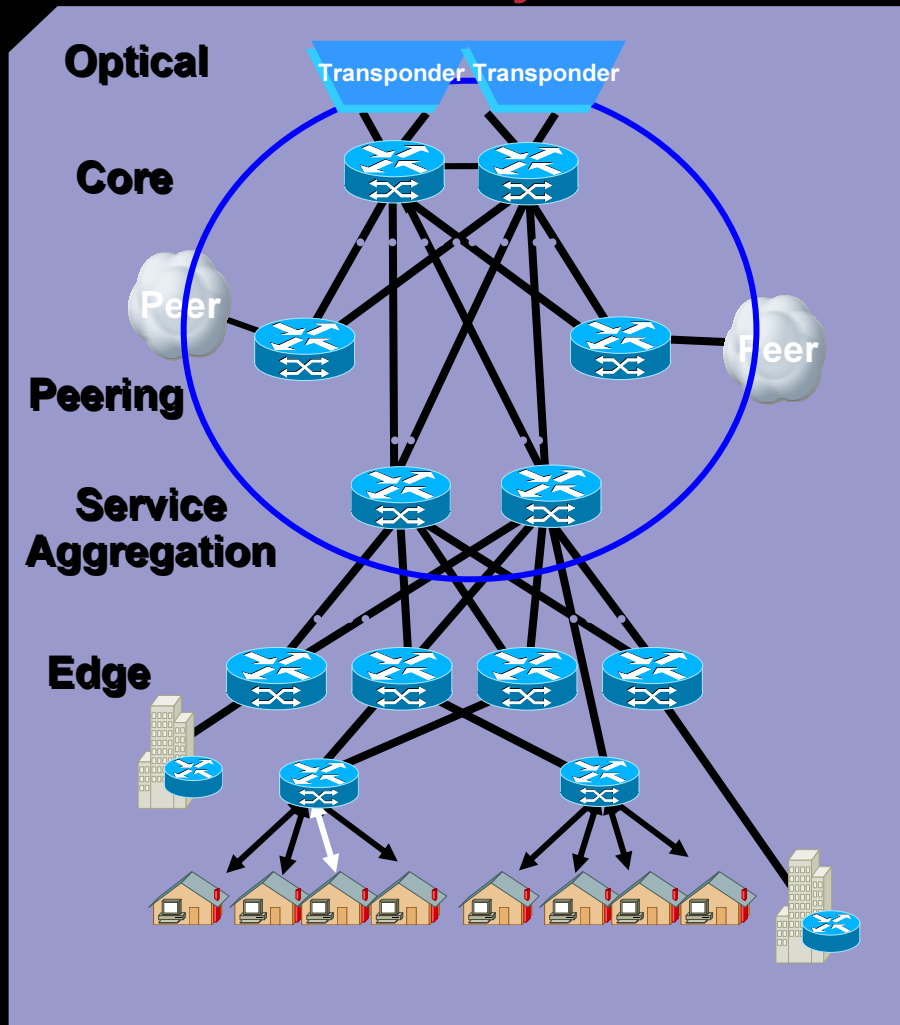
**INTELLIGENT INFORMATION
NETWORK**

Scaling the PoP: Traditional Thinking

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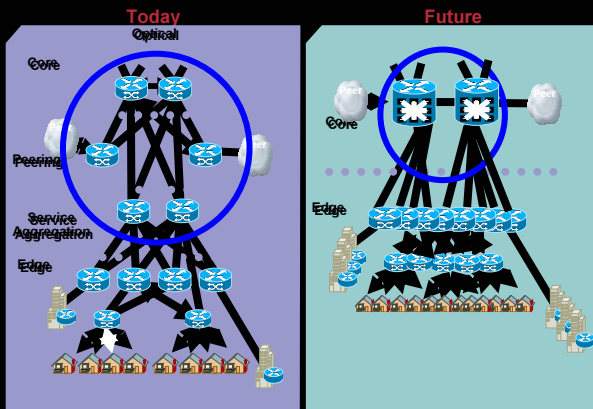
Today

Future



NGN: Not A Traditional Challenge

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Addressing Core Capacity only the first step

Slow provisioning, Difficult to scale

Edge + Core simultaneously

Core vs. Edge Feature Discontinuity

Security, Software, QoS, Multicast

Large Number of routers remain

Difficult to manage, large # of intra-pop links

Technology Refresh
to Increase Network
Capacity

2-5 years

Technology Refresh
to Increase Network
Capacity

2-5 years

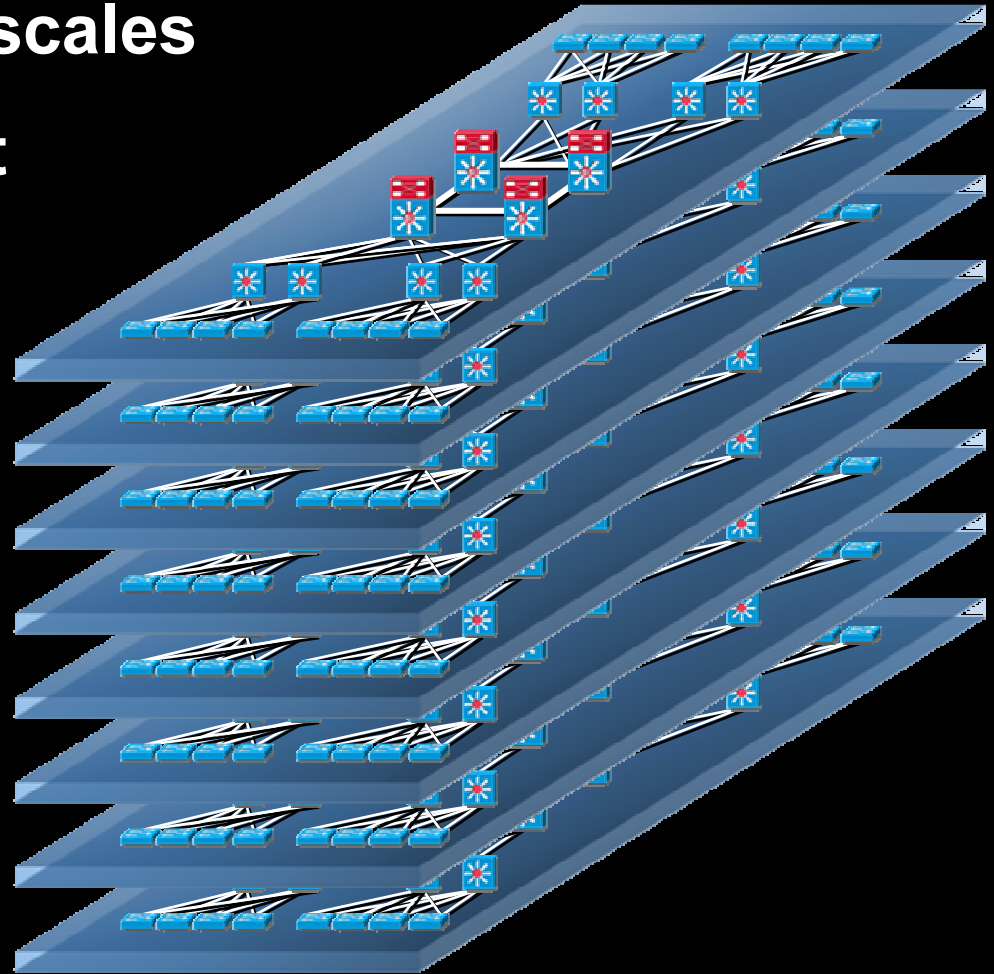
Technology Refresh
to Increase Network
Capacity

Resolving These Conflicts Requires a
Clean-Slate System Design

It's All About Virtualization

Cisco.com

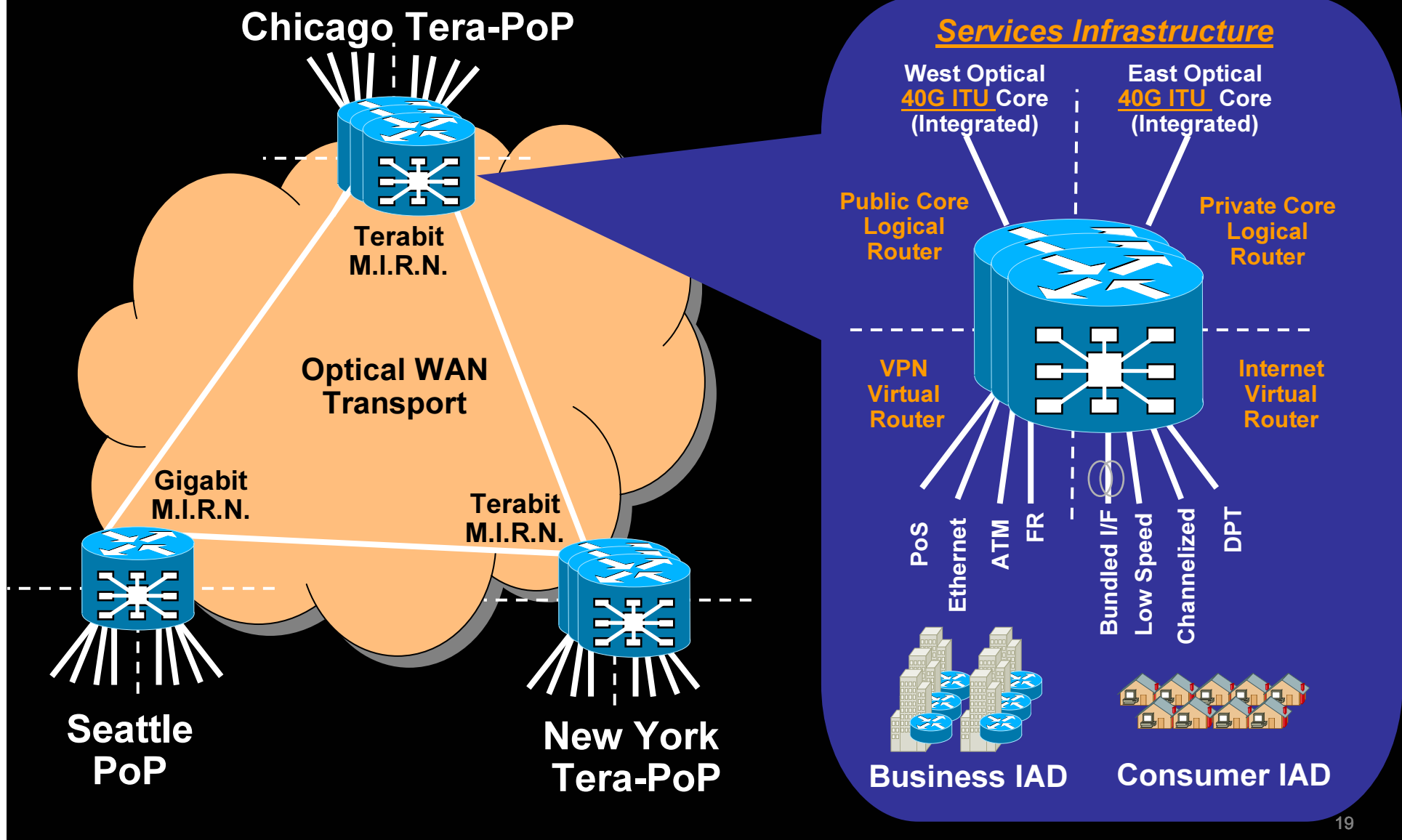
- **An Architecture that scales**
- **An Infrastructure that dynamically adapts**
- **A network that partitions and consolidates resources**
- **An environment which is flexible and manageable**



The Vision: Multi-Instance Routing Nodes

Networks, Systems, Services

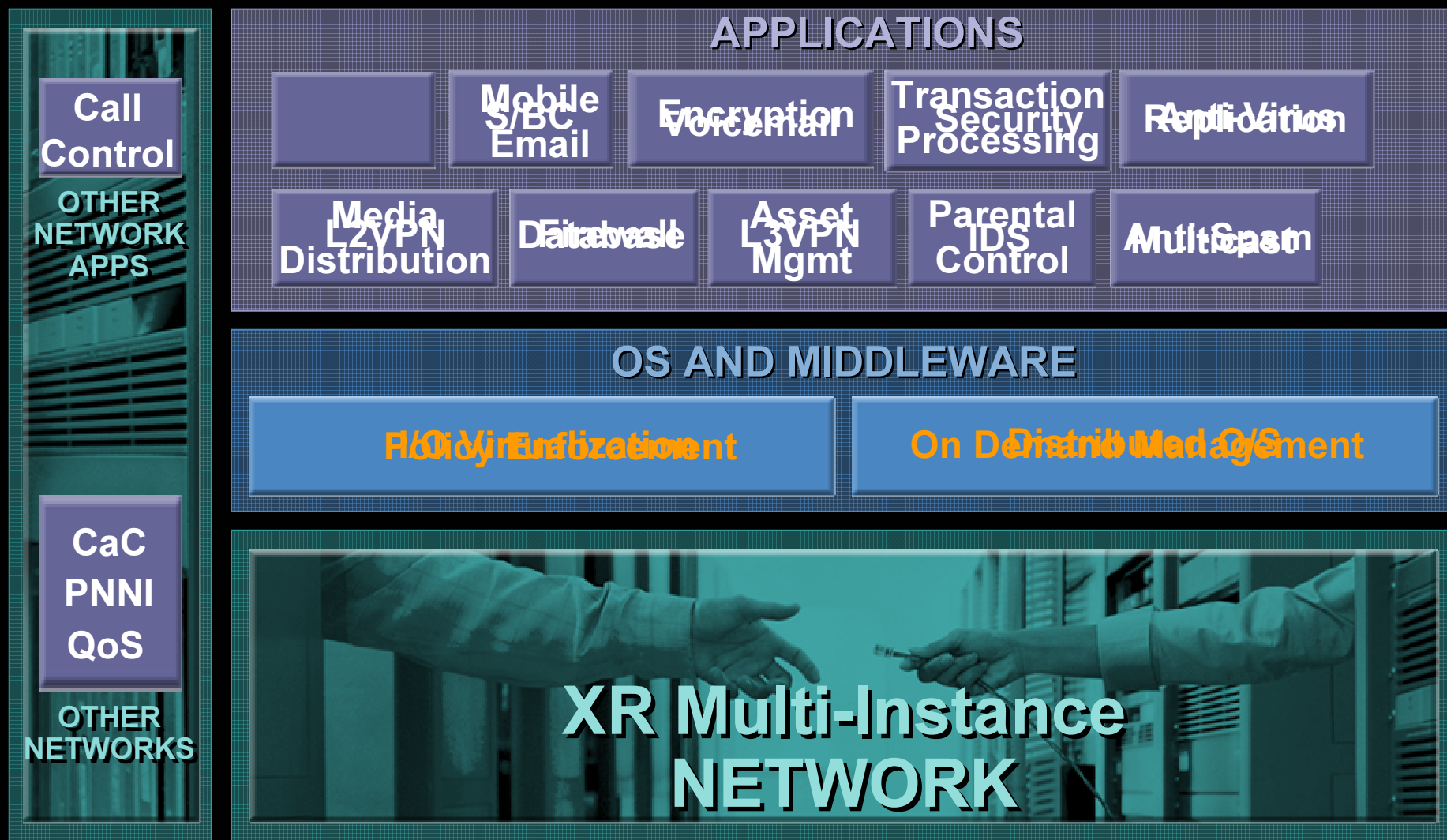
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Multi-Instance Routing

Intelligent Networks

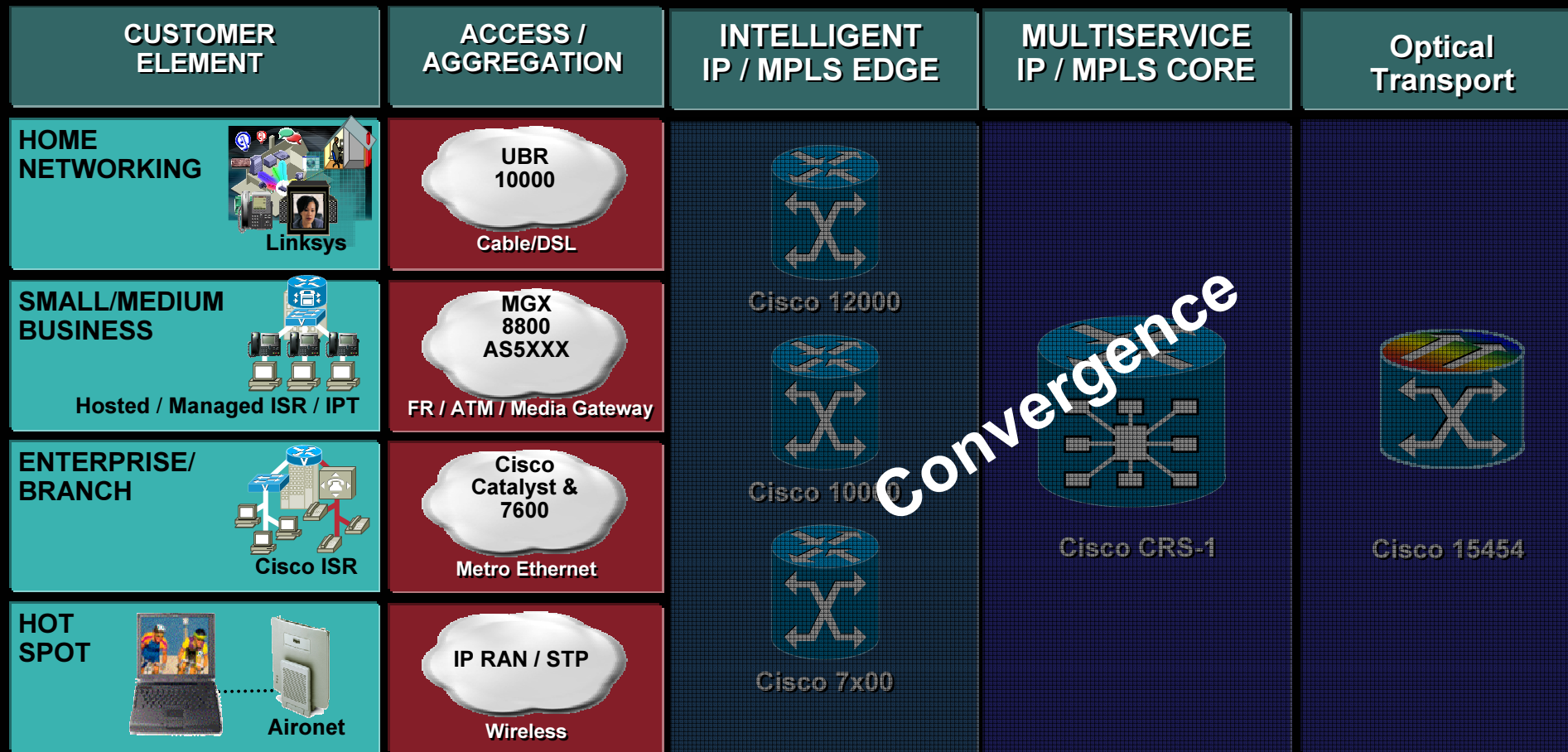
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Multi-Instance Routing

Enables Convergence for the NGN

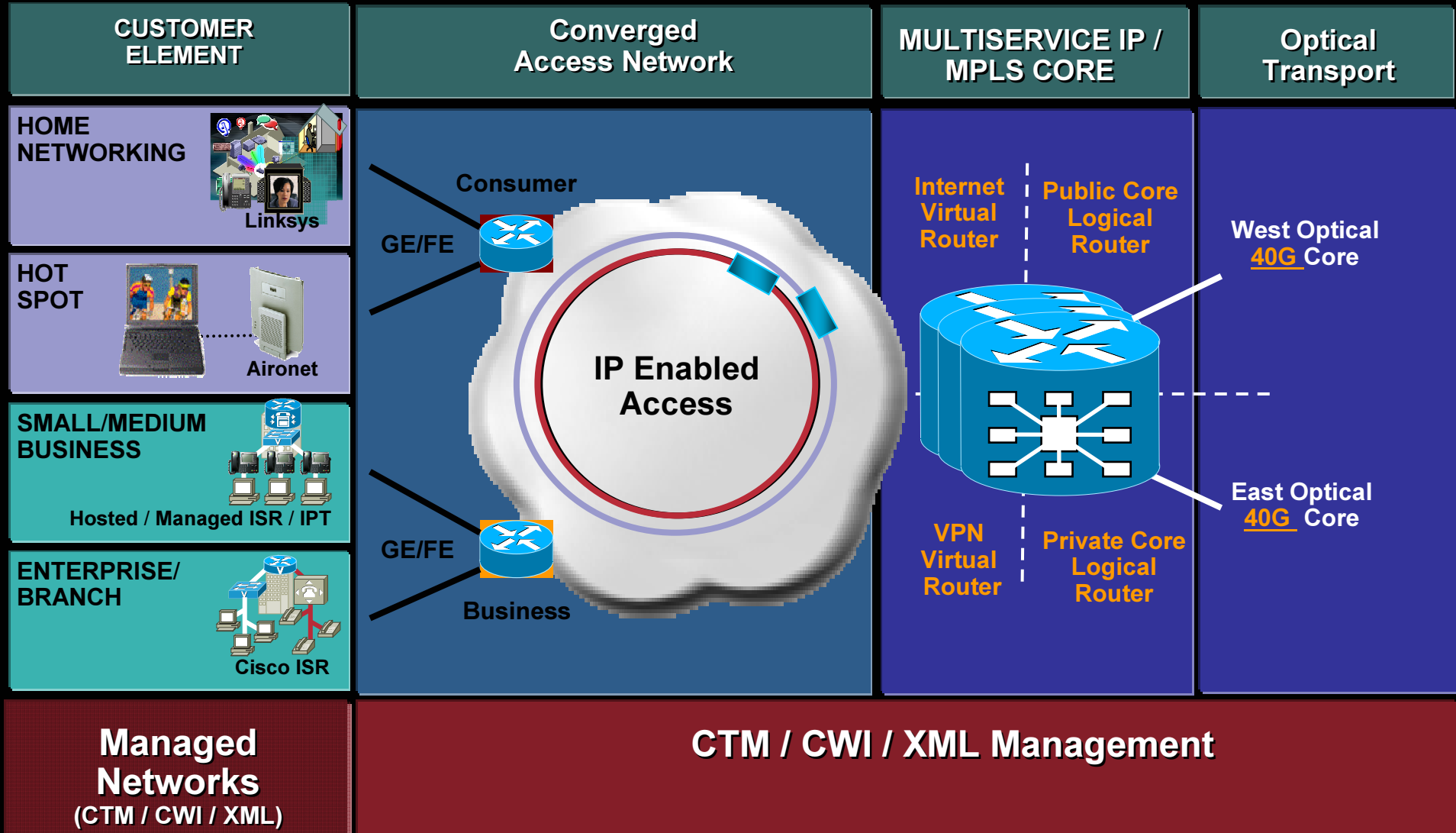
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CTM / CWI / XML Management

NGN Evolution

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Cisco CRS-1 Product Family

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- **Continuous System Operation**

- True Telco grade OS

- Separate control, data and management planes

- Hitless in-service HW and SW upgrades

- Simple, large scale management

- **Unprecedented Service Flexibility**

- Network convergence using logical routers

- Speed-to-Service elements

- Single system PoP design

- **Unparalleled System Longevity**

- Multi-chassis fabric scales to 92Tbps

- Programmable 40G silicon packet processor for IPv4, IPv6 and MPLS

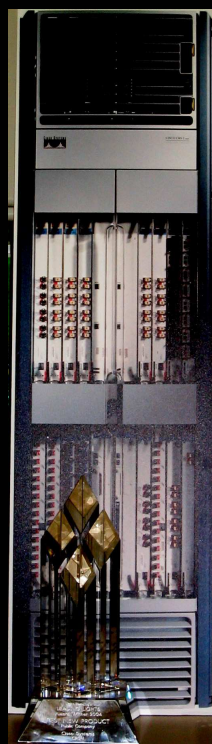


CRS-1 delivers stellar result in independent test

Cisco.com

“The industry said Cisco Systems Inc. (Nasdaq: CSCO - message board) couldn’t build a carrier-class router. But Cisco didn’t listen. They built it. We tested it. It really works. It can’t be said enough: The CRS-1 is Cisco’s most important product in years.”

http://www.lightreading.com/document.asp?doc_id=64526&site=lightreading



“...scales to meet the requirements of service providers far into the future”

“..... software upgrades interrupted the traffic for only nanoseconds even on a fully loaded, live chassis”

“..scaled to terabits-per-second of bandwidth, millions of routes, and tens of millions of IPv4 and IPv6 flows”

“...throughput capabilities scale to multi-chassis configurations.”

CRS-1 System Overview

Two Main System Building Blocks

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FABRIC SHELVES

- Optical Backplane
- Redundant Fans/Power

FRONT:

24 Fabric cards
2 SC Cards

BACK:

Optical Fiber
Interconnect Panels



100m



LINE CARD SHELVES

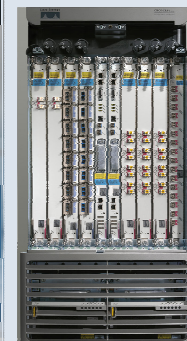
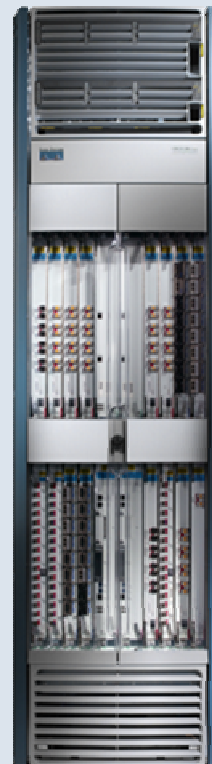
- Mid-Plane Design
- Redundant Fans/Power

FRONT:

8/16 Interface Slots
2 RP Slots
2 Controller slots

BACK:

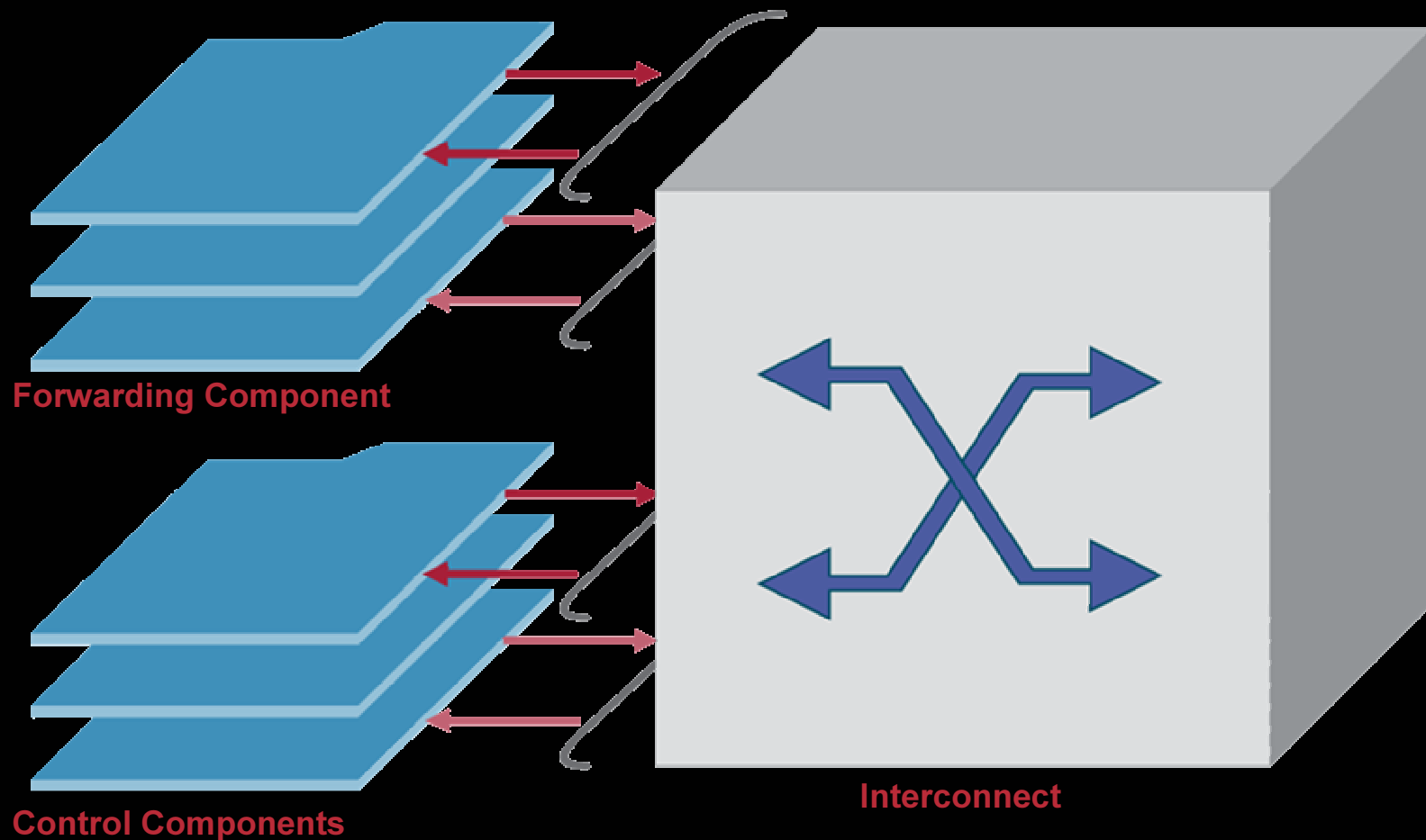
8/16 LC Slots
8 Fabric Card Slots



Basic Router Architecture

Cisco.com

3 Main components: Line cards, Switching mechanism, Route Processor(s), Routing Applications



Cisco CRS-1 System

Distributed Architecture

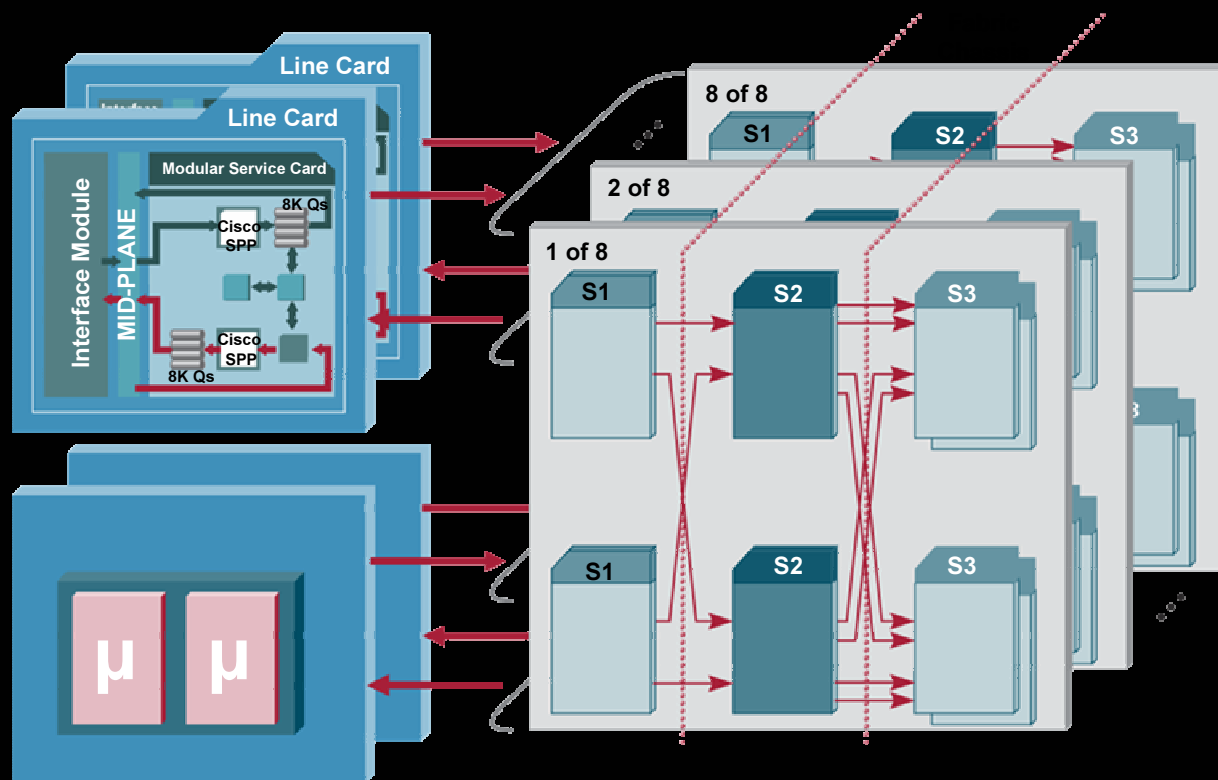
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Flexible Forwarding Plane

- Up to 1152 40G Line Cards (Independent Forwarding)
- Highly programmable SPP supporting 40G Line Rate performance
- Robust Queuing with 8K per ingress/egress

Distributed Control Plane

- Multiple control processors (minimum of 144 Processors)
- Control SW distributed across all processors



Multistage Switch Fabric

1296x1296 non-blocking buffered fabric

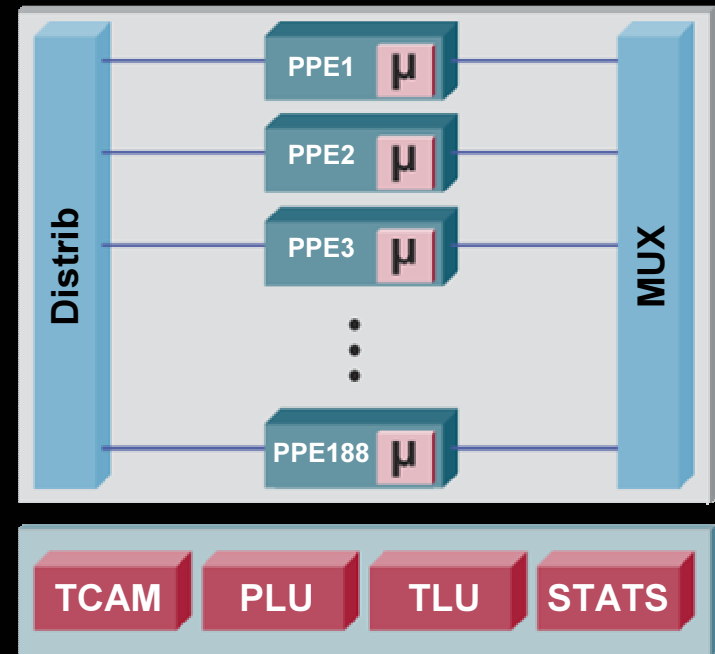
1:N Redundancy

Service Intelligence with hi/lo priority uni-cast/multicast recognition

CRS-1 Packet Forwarding Engine – Silicon Packet Processor (SPP)

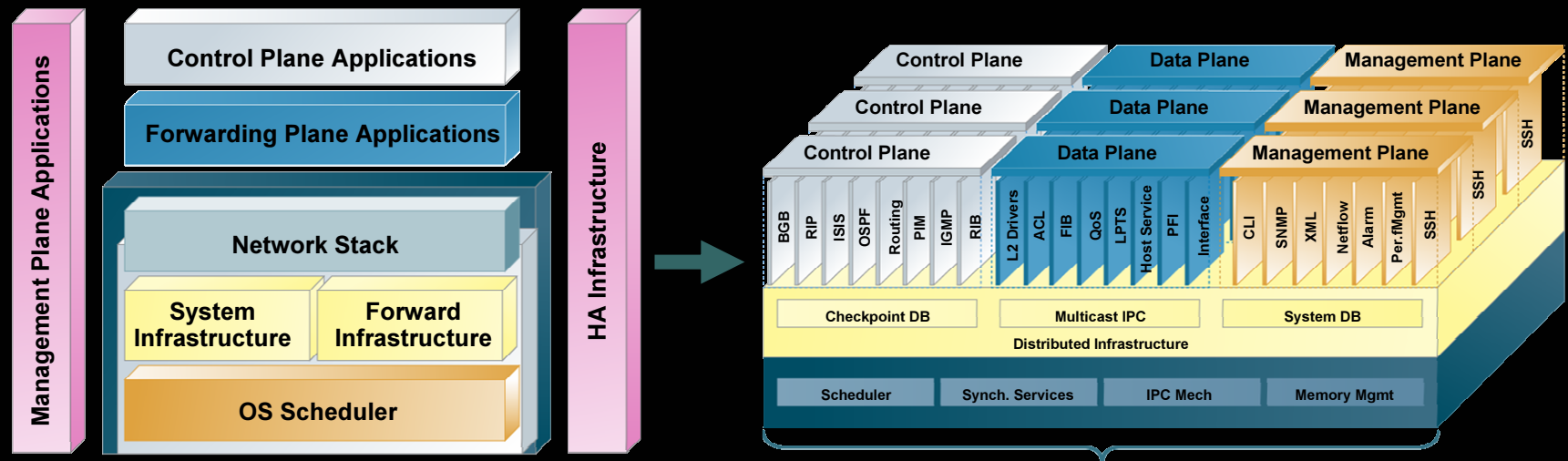
Cisco.com

- **Parallel Processor Architecture**
- **IBMs Cu-11 ASIC process**
- **188 Packet Processing Engines (PPE)**
 - Packets evenly distributed across PPEs
 - Each PPE is a 32-bit RISC processor @250MHz
- **48,000 MIPS**
- **Fully Programmable**
- **Integrated with key-off-chip memories**
 - 512K entry TCAM for feature scale (ACLs/Netflow/Policing/etc)
 - 2M entries for IPv4/IPv6/Multicast/MPLS lookup
 - 1M 64Bit Stats counters



Router OS Evolution

Cisco.com



- Monolithic Kernel
- Centralized Infrastructure
- Integrated Network stack
- Centralized applications



- Micro Kernel
- Distributed Infrastructure
- Independent Network stack
- Distributed applications

IOS XR Software Architecture Overview

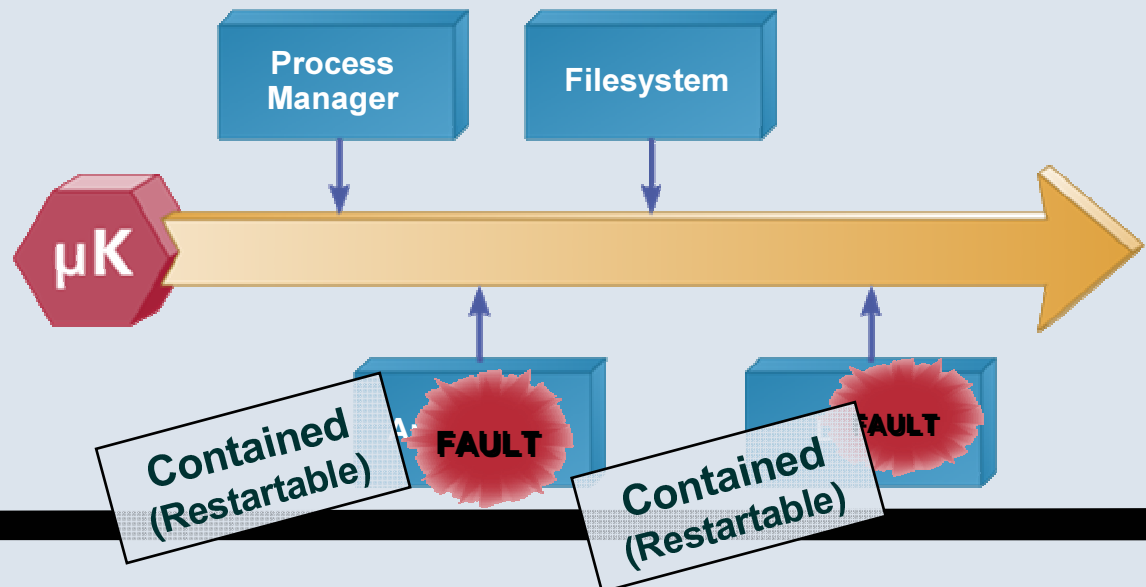
Picking The Correct OS To Meet CRS Software Requirements

Cisco.com

TRUE Microkernel (Mach, QNX)

MMU with full protection

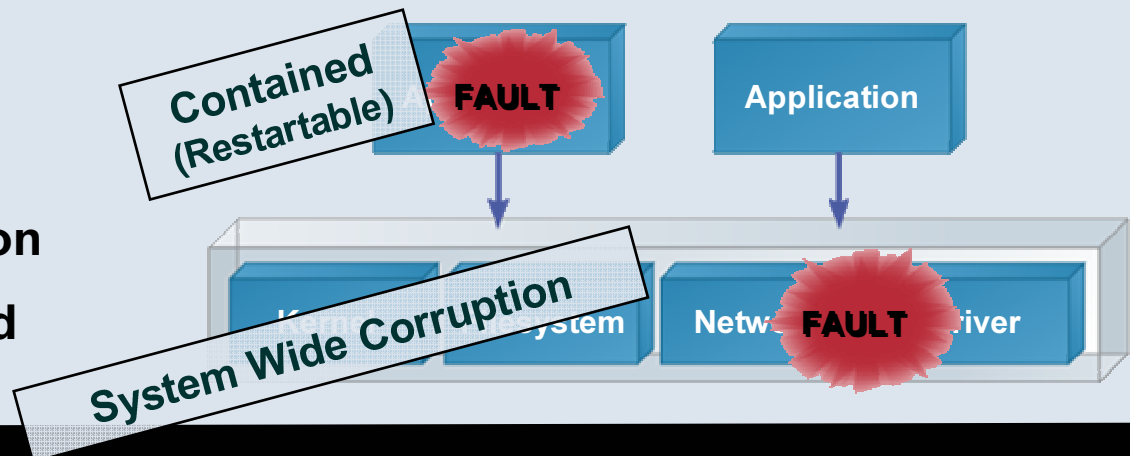
Applications, drivers, and protocols are protected



Monolithic Kernel (BSD/Linux, NT)

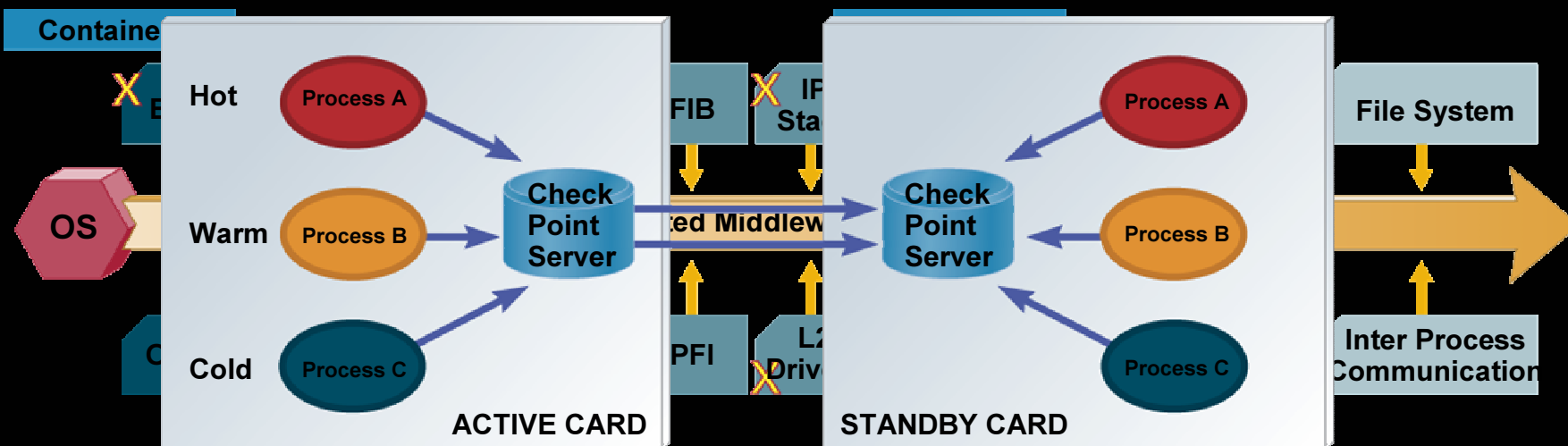
MMU with partial protection

Applications are protected



High Availability Infrastructure

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- Distribution improves fault tolerance and recovery time by localizing the database and system management functionality to each node
- Granular process restart allows for fast recovery from failures
- IOS XR is designed to optimize the switch over between redundant hardware elements (RP, SC, PS, Fan C.)

IOS XR is designed to route around fabric failure

Line cards are protected by link bundling, APS, IPS, ECMP etc.

