Mobile IP NGN Architectures

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Agenda

CISCO IP NGN STRATEGY OVERVIEW

DRIVERS FOR MOBILE CARRIERS

MOBILE APPLICATION CONVERGENCE

MOBILE SERVICE CONVERGENCE

MOBILE NETWORK CONVERGENCE

CISCO IP NGN MOBILITY LEADERSHIP

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Cisco Service Provider Vision

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

CONSUMER

SMALL/MEDIUM BUSINESS

ENTERPRISE

SP WHOLESALE

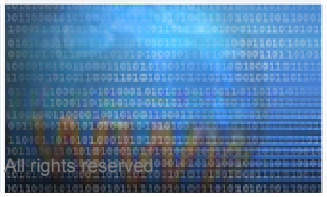
IP NEXT-GENERATION NETWORK

VPNs

INTERNET

CONTENT

VOICE & VIDEO



MOBILITY

TRANSPORT

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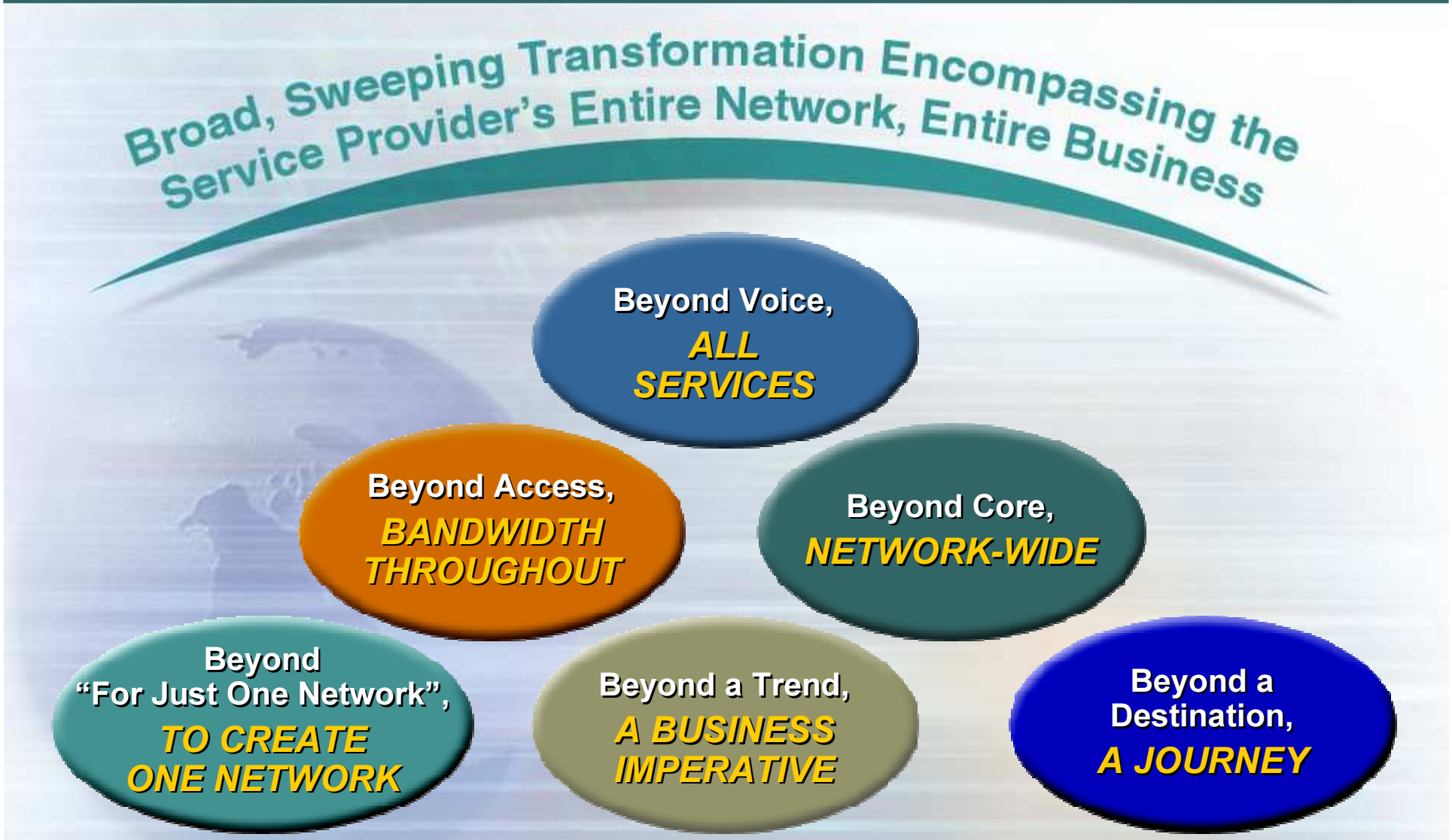
IP-Based Next-Generation Networking

Connecting Customers to Revenue-Based Services, Service Infrastructure with Networks and Networks with Each Other



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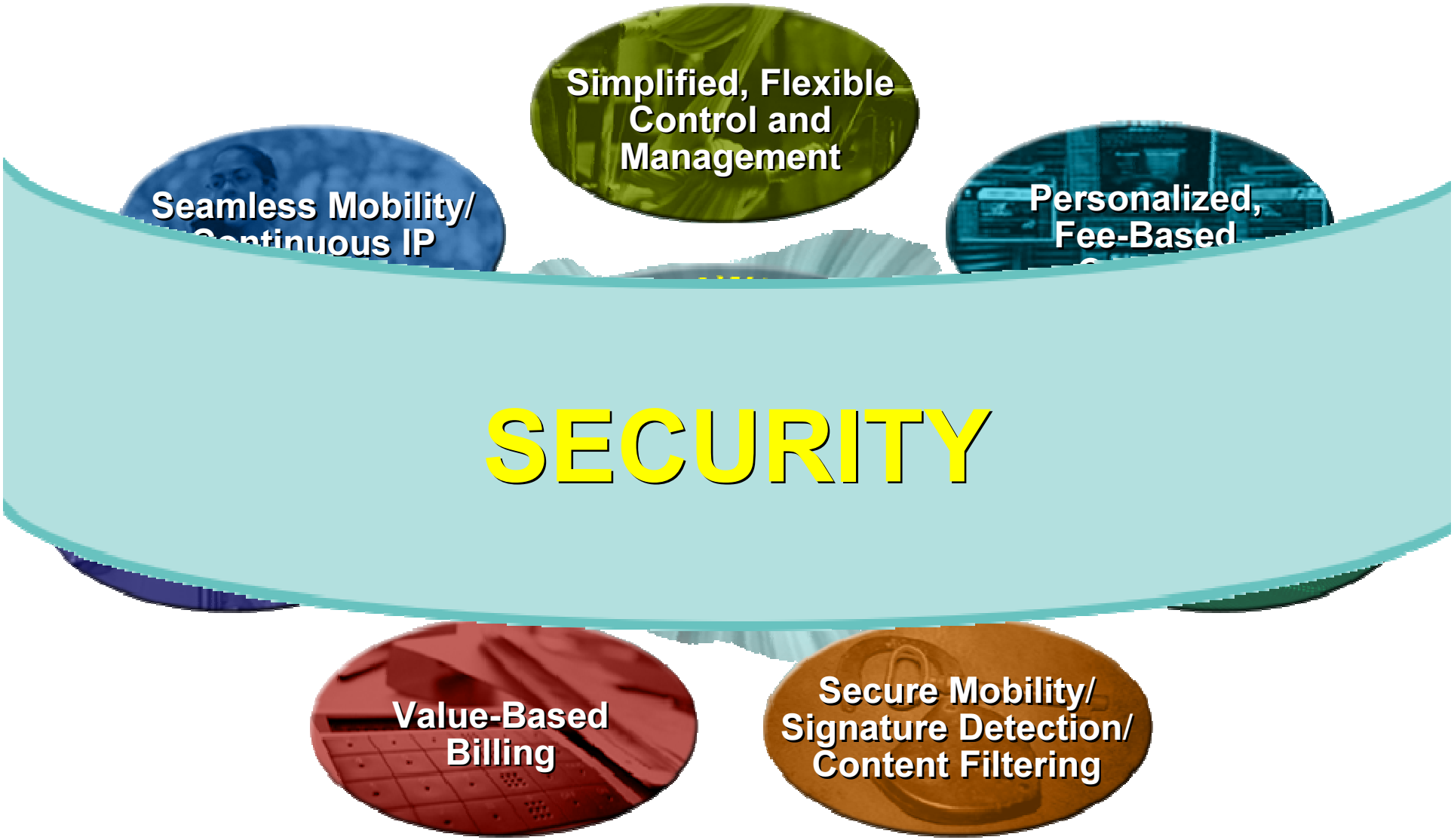
Characteristics of an Ideal Mobile Network

Fusing the Best of Today's Networks and More



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Cisco IP NGN Mobility Architecture

Achieving a Whole Greater Than the Sum of the Parts

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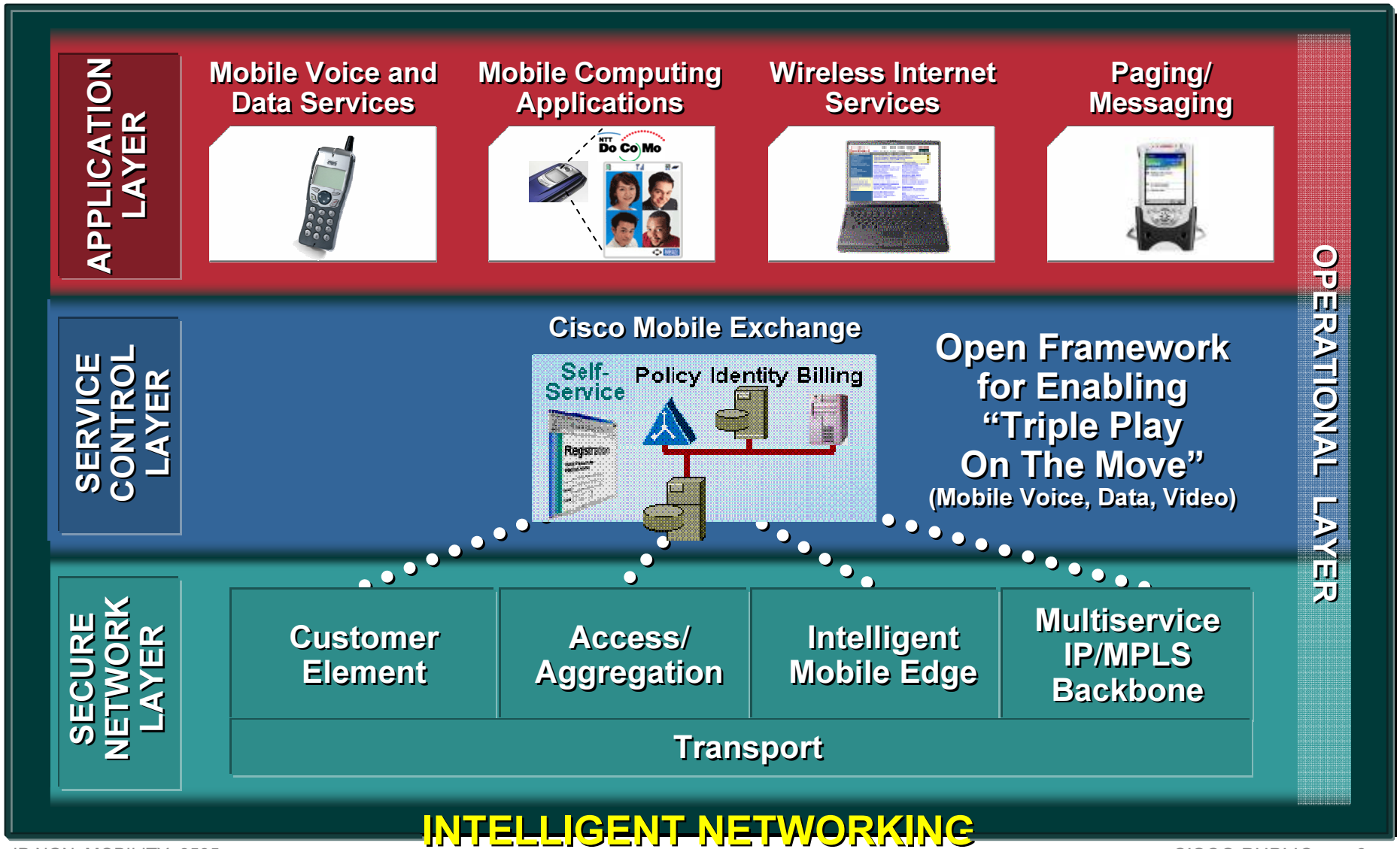

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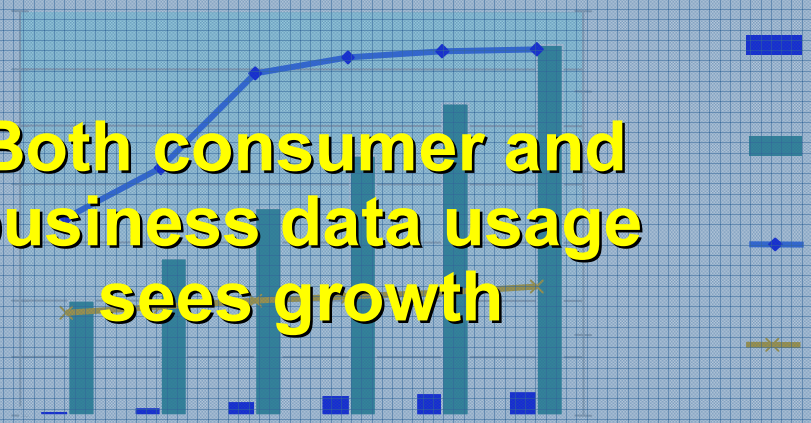
World Wide Mobile Services Market Forecasts

The Significance and Growth of Mobile Data Services

Overall revenues from mobile are increasing

Data usage is keeping overall ARPU nearly constant



Both consumer and business data usage sees growth

Source: Ovum 09/04

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Increasing Mobile Data Revenue and ARPU

Mobile Data Services Producing Benefit Now and Growing

MOBILE DATA SUCCESS

INTEGRATION	CONTROL	ACCESS AGNOSTIC	SERVICE INNOVATION
• Fixed/mobile • Public/private • Converged network core	• Personalization • Subscriber/ application/ content aware • BW Management • Secure mobility	• CDMA • GPRS • UMTS • WLAN	• Business/ consumer • Industry verticals

Enabled by Mobile Intelligent Information Network

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IP NGN Journey for Mobile
Defined by Multiple Layers of Convergence

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swisscom mobile
Go far. Come close.

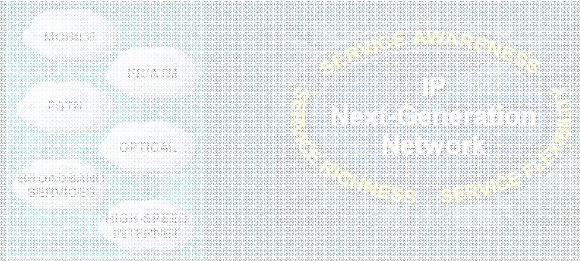
T-Mobile

APPLICATION CONVERGENCE

Integration of New Innovative IP D/V/V Services over Mobile Networks for Increased Differentiation & Revenue

SERVICE CONVERGENCE

Seamless and Secure Service Continuity across Access for Customer Loyalty And Stickiness



NETWORK CONVERGENCE

Simplified Network Design, Control & Mgmt, Accelerate Service Introduction Increased OPEX/CAPEX Efficiencies

Device Functionality is Blurring...

Consumers and Businesses: Any Service, Any Device, Anywhere

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Mobile VoIP	Custom Ring Tones / MP3 Player / Camera	Seamless Roaming	Messaging/Alerting/ Notification (SMS / MMS)	Dual-Mode Voice
Push-to-Talk over Cellular (PoC)	Mobile Infotainment	Location-Based & Context-Based Services	PDA/ Email	Mobile Commerce

AT WORK, AT HOME, ON THE ROAD

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Creating a Multitude of New Mobile Service Opportunities…

INTEGRATED NETWORKS, CONTENT, AND BUSINESS/CONSUMER SERVICES MOVING UP THE VALUE CHAIN WITH THE CUSTOMER

CONVERGED MOBILE ACCESS

MOBILE COMMERCE

WIRELESS MONITORING/ SECURITY

ENTERPRISE REMOTE ACCESS

TRANSPORTATION, PUBLIC SAFETY & FIRST RESPONDER SOLUTIONS

REAL-TIME ASSET TRACKING, INVENTORY & LOGISTICS

SMS/MMS

MOBILE INFOTAINMENT

LOCATION-BASED & CONTEXT-BASED SERVICES

MOBILE VoIP

END-TO-END INTELLIGENT NETWORK

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…Placing Even More Stringent Requirements on the Infrastructure and Services

RESILIENT

- Secure Mobility
- High Availability
- Scalable

INTEGRATED

- Subscriber Aware
- Application Aware
- Content Aware
- Service Management

ADAPTIVE

- Personalized Services
- Free, fee-based or restricted content
- Self-Defending

AN INTELLIGENT NETWORK ENABLES BUSINESS SUCCESS

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IP NGN Journey for Mobile
Defined by Multiple Layers of Convergence

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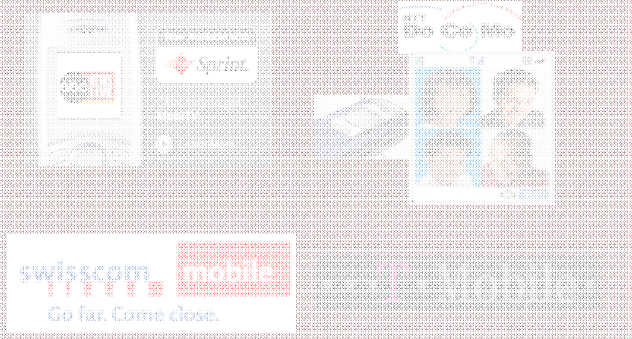
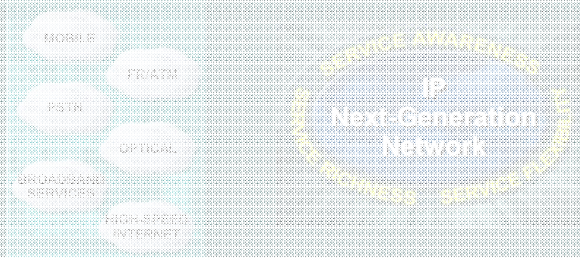


APPLICATION CONVERGENCE

Integration of New Innovative IP D/V/V Services over Mobile Networks for Increased Differentiation & Revenue

SERVICE CONVERGENCE

Seamless and Secure Service Continuity across Access for **Customer Loyalty And Stickiness**



NETWORK CONVERGENCE

Simplified Network Design, Control & Mgmt, Accelerate Service Introduction Increased OPEX/CAPEX Efficiencies

Triple Play on the Move

Providing the Means for Seamless and Secure Mobile Service Continuity

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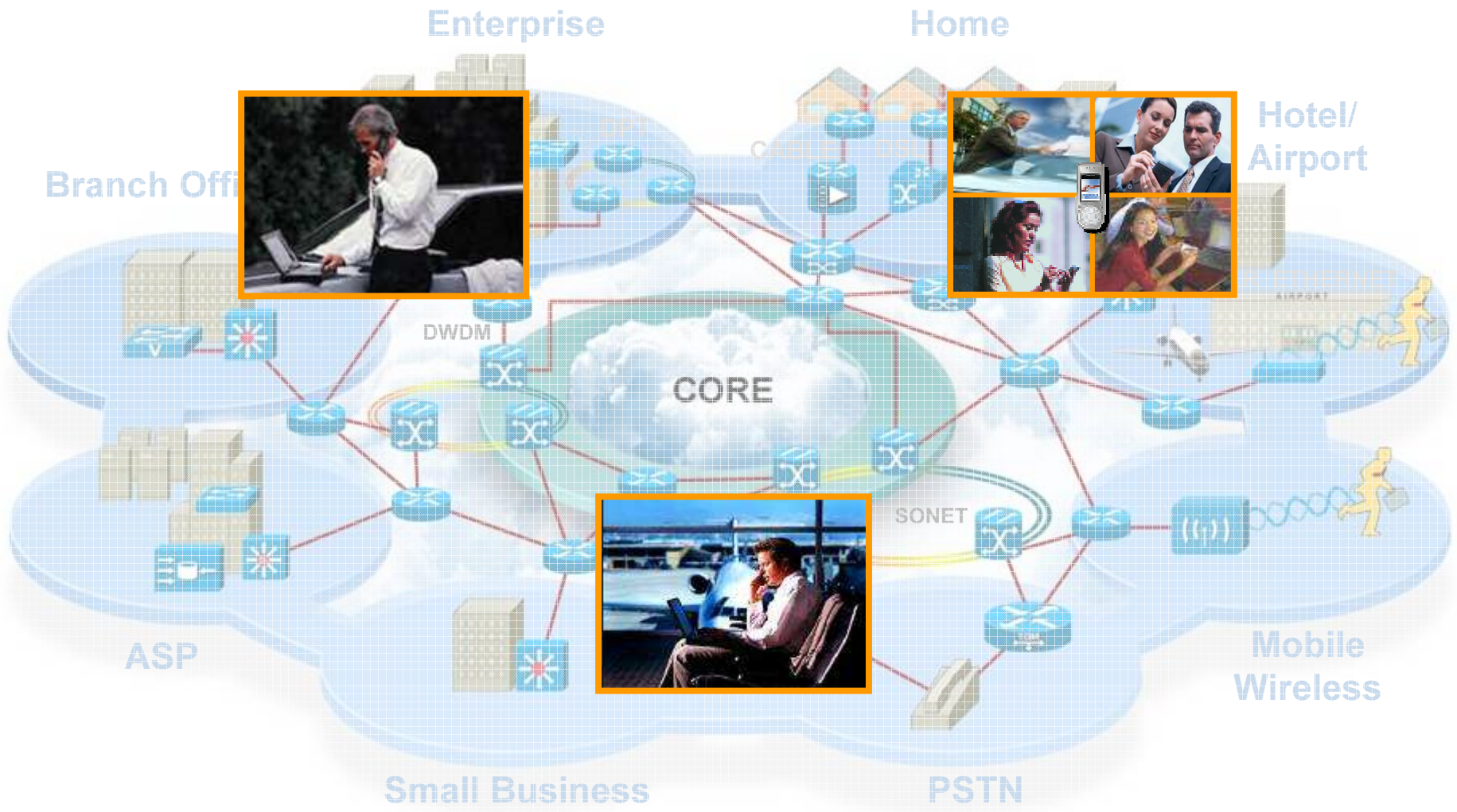

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Cisco IP NGN Architecture

Enabling Better Service Control and Awareness

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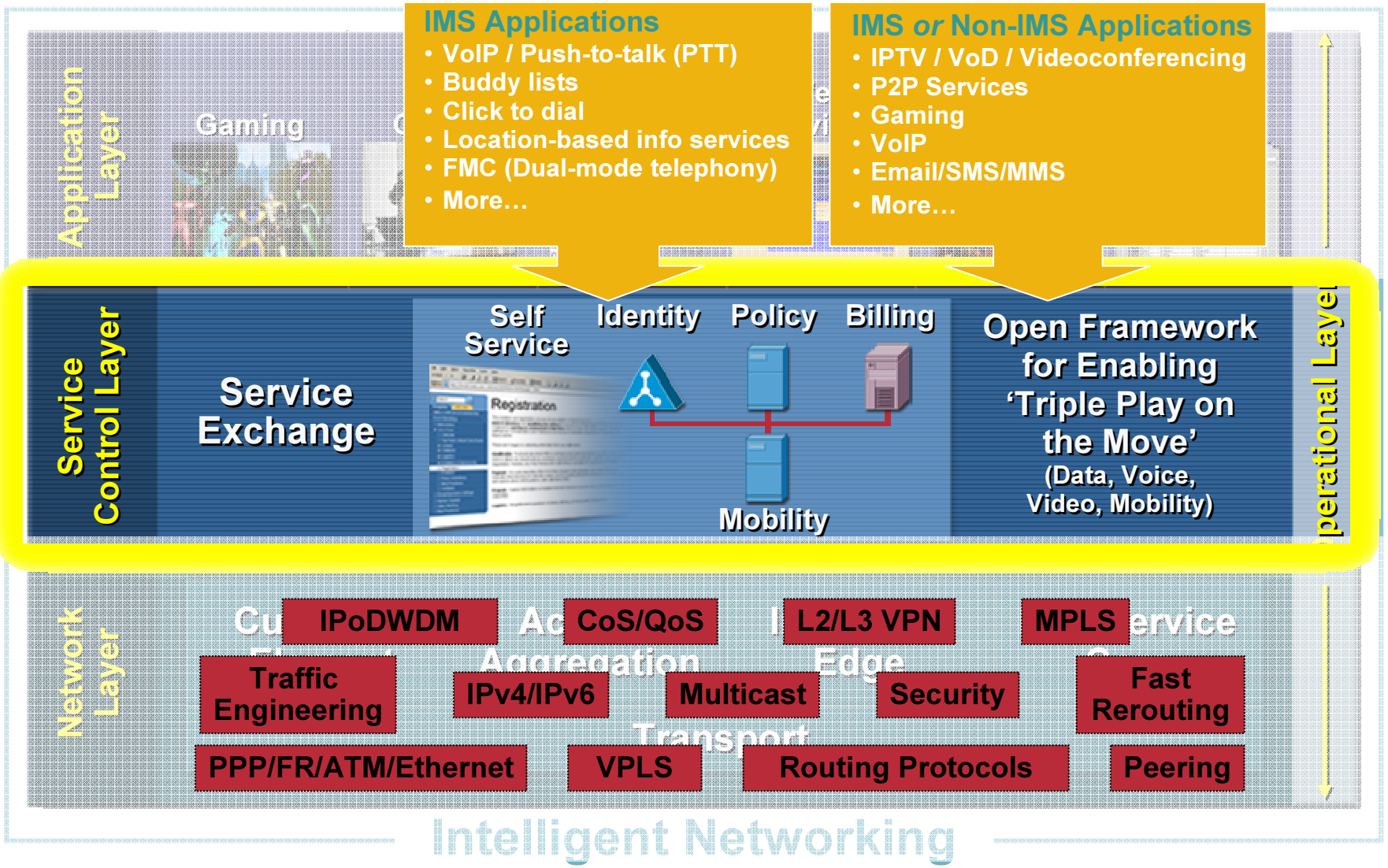

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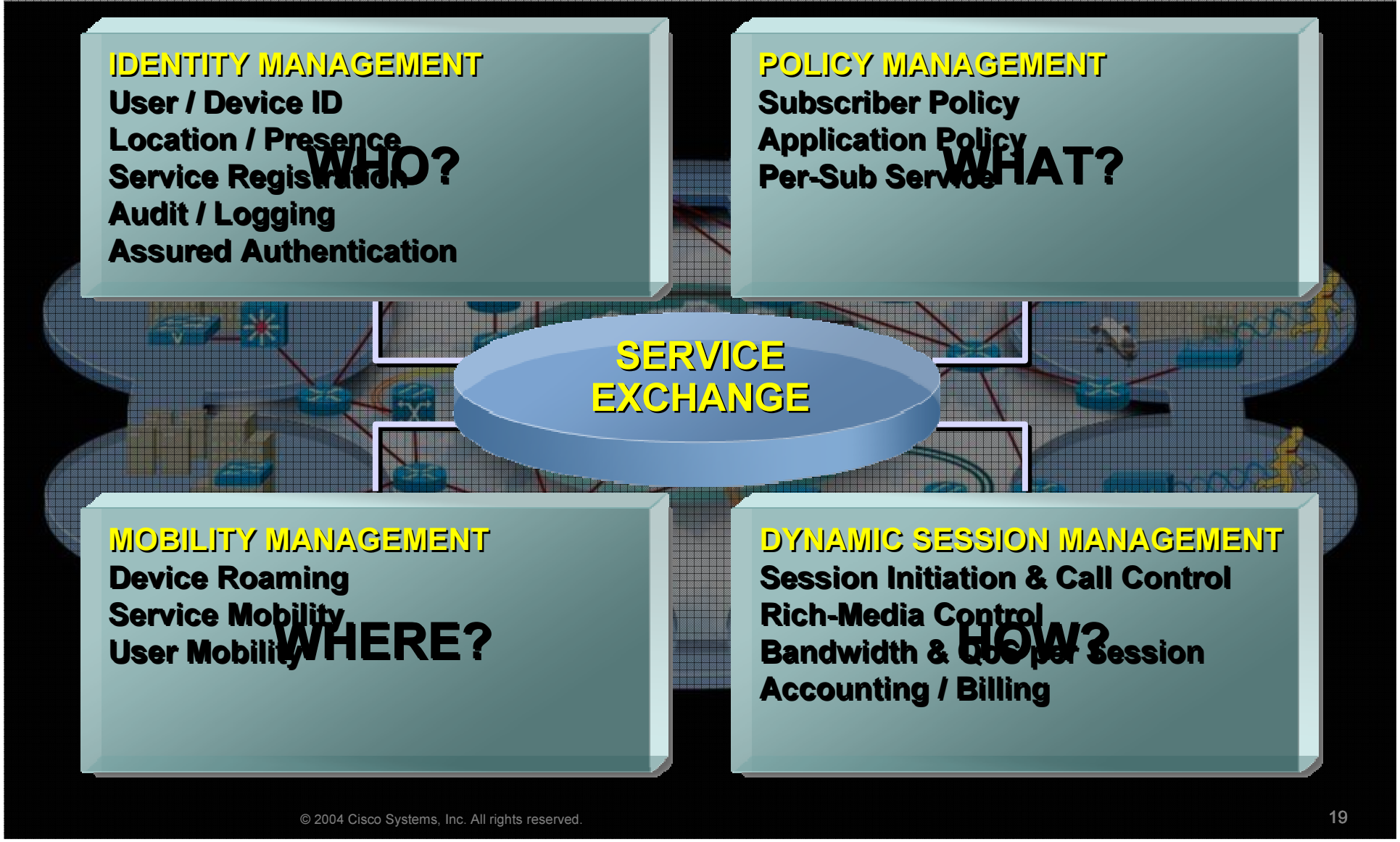
Service Exchange Framework

Multimedia Service Control for Wireline / Wireless Convergence



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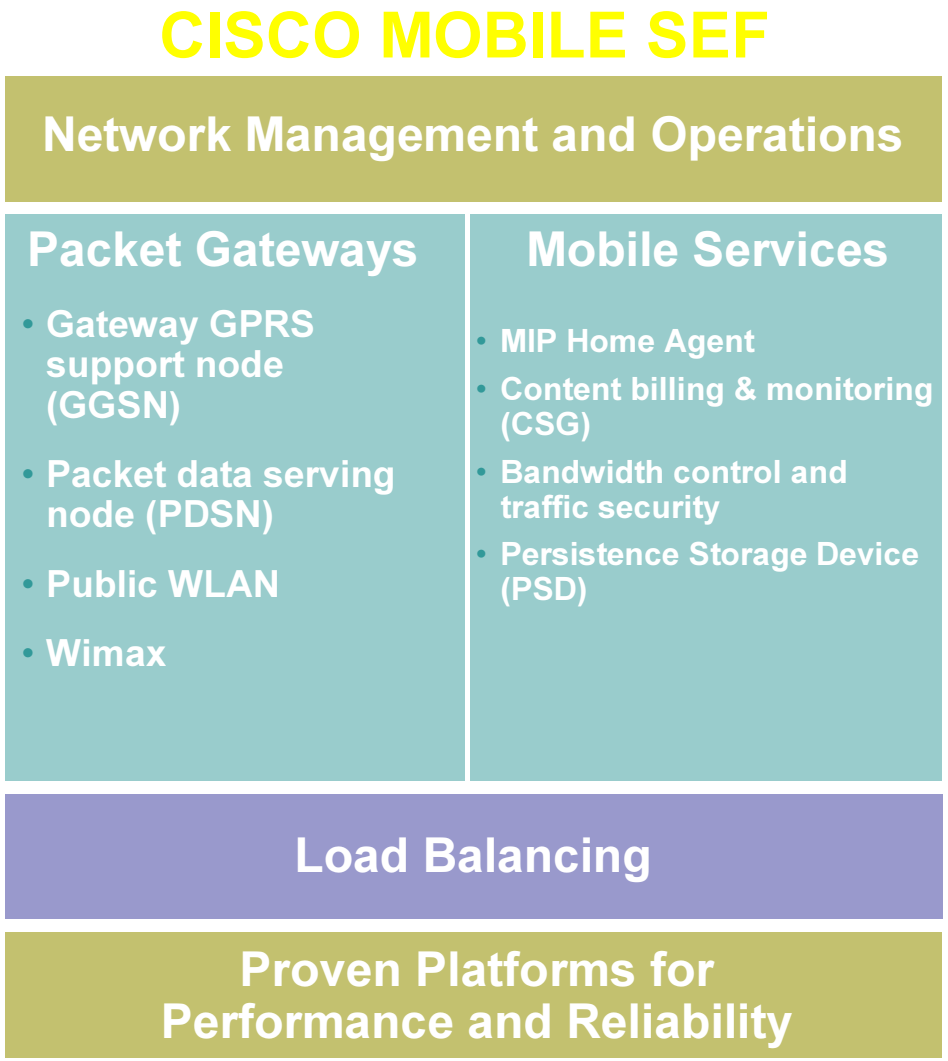
Cisco Mobile SEF

Enabling Profitable Data Services for Mobile Operators

- **Framework of solutions targeted at the mobile internet edge**
- **Delivers cost effective and scalable solutions to meet the needs of mobile operators**
- **Seamlessly report, police and charge for all mobile services**
- **Leverages Cisco 7600 Series and Cisco IOS**



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mSEF enhanced GGSN

Cisco.com

Cisco 7600
Scalable solution (from 4 to 13 slots chassis)
High-End Edge routing/switching platform
Hardware assisted(routing, QoS, security)
High-Availability
Ready for future services (IPv6 in HW)
Advanced load-balancing

Billing Policy Server

OAM/AAA

Applications/Services

GGSN:
- 2G/3G GTP handling
- APN management
- QoS management
- VPN
- Prepaid/Postpaid Billing
- Address management
- Security
- Policy Enforcement

Content Service Gateway
- Deep/ShallowPacket inspection
- Content/Service/Event based billing
- Volume, Time and Event reporting
- Redirect for AoC or Recharge
- Policy Enforcement
- Content Filtering

Persistent Storage Device
CDR backup for GGSN and CSG
Automatic CDR auto-retrieval

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Service Exchange—Mobile

Open Framework for Triple Play on the Move

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- Protecting branded service
- Access independent service control
- Speed to service
- Open interfaces

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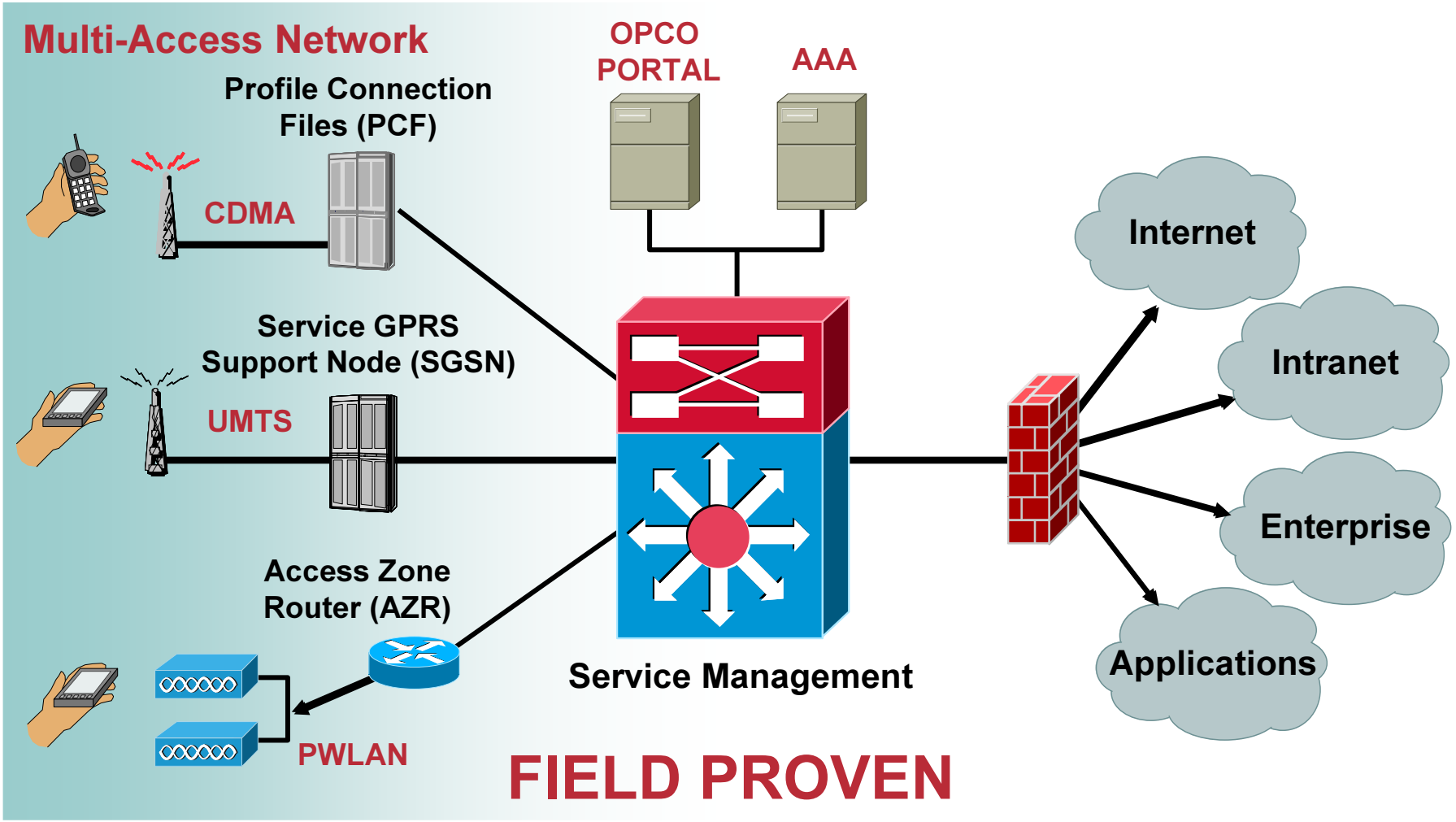
Mobile Service Convergence
Mobile Access and Service Management

SEAMLESS MOBILITY



FIELD PROVEN

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Content Aware Service Control

Managing and Protecting Network Resources

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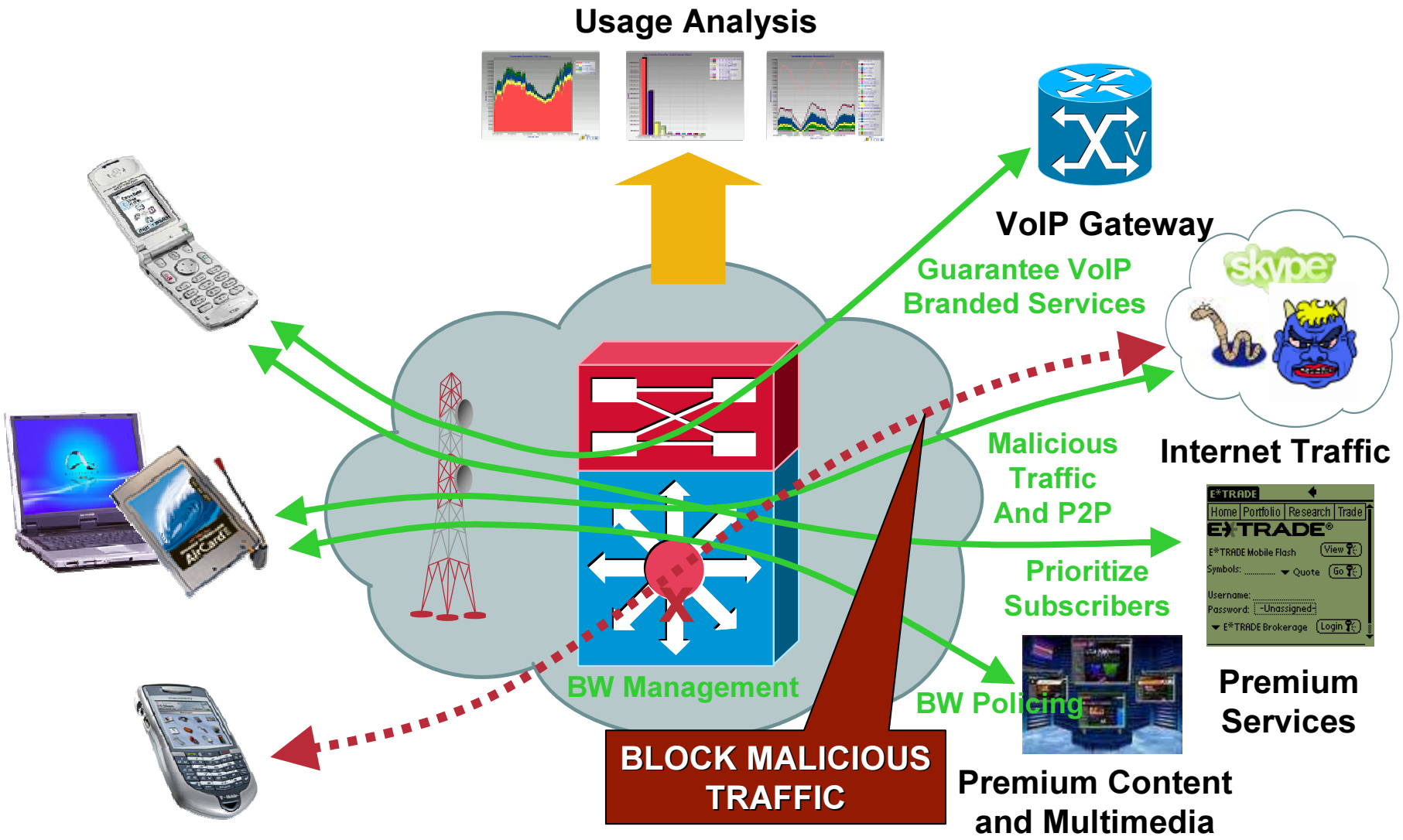

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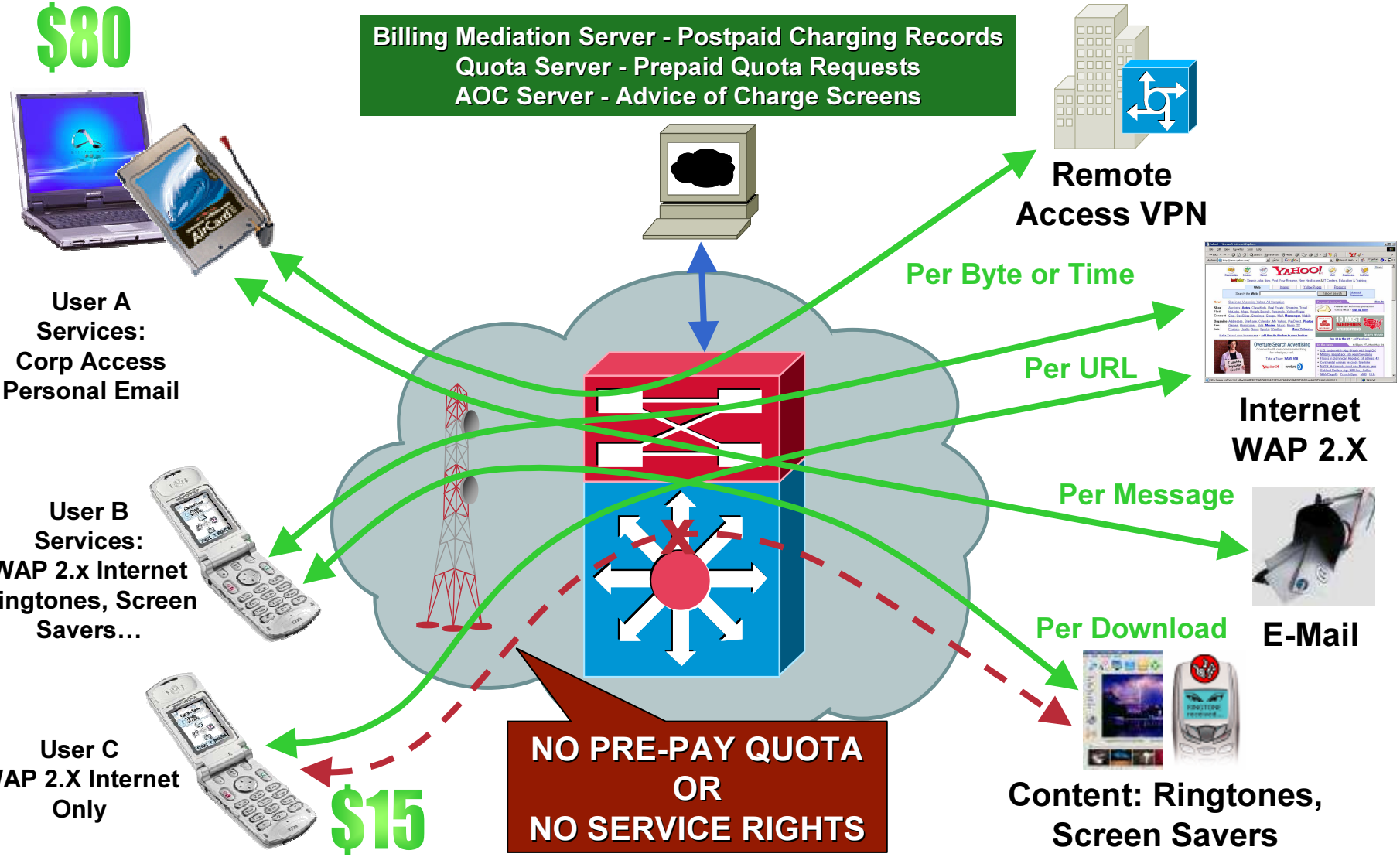
Content Billing and Service Management

Value-Based Billing for Pre-Paid and Post-Paid Services

Cisco.com



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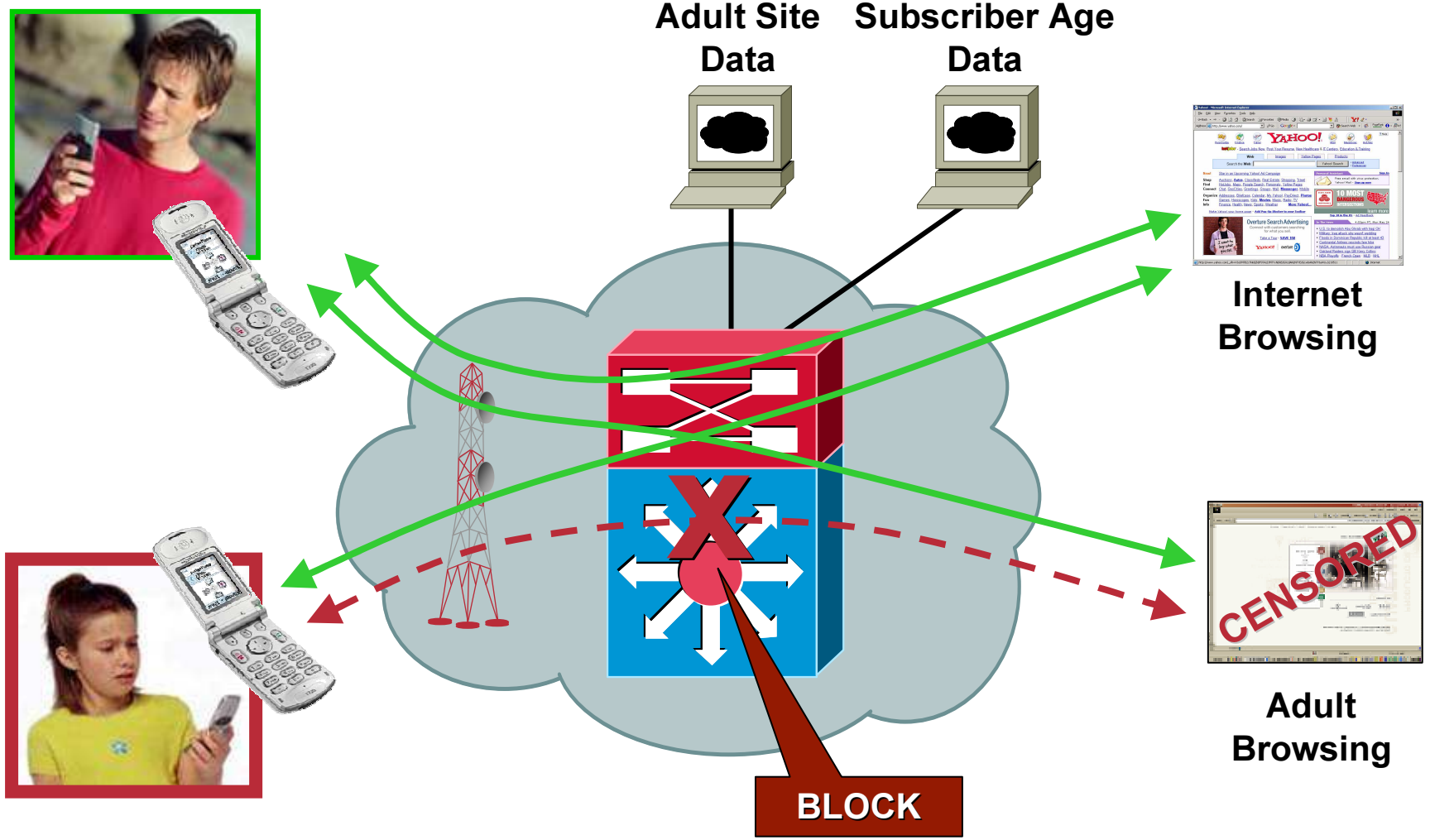
Content Filtering and Control

Blocking Access to Unwanted Content (User-Defined and Managed)

Cisco.com



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IP NGN Journey for Mobile
Defined by Multiple Layers of Convergence

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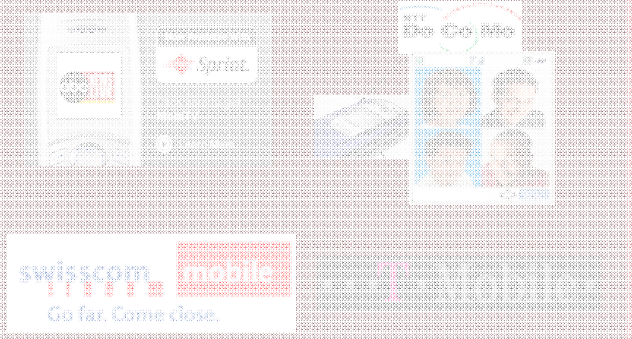

APPLICATION CONVERGENCE

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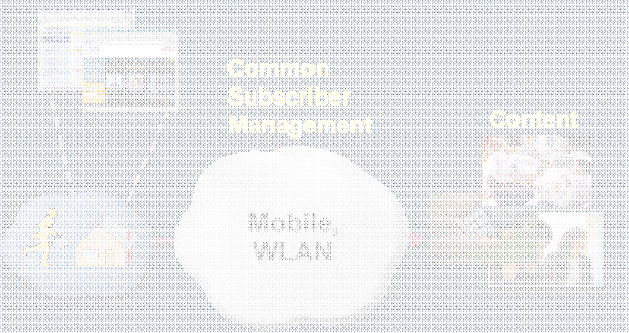
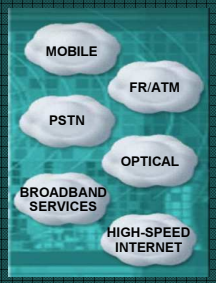


SERVICE CONVERGENCE

Seamless and Secure Service Continuity across Access for Customer Loyalty And Stickiness



NETWORK CONVERGENCE

Simplified Network Design, Control & Mgmt, Accelerate Service Introduction Increased OPEX/CAPEX Efficiencies

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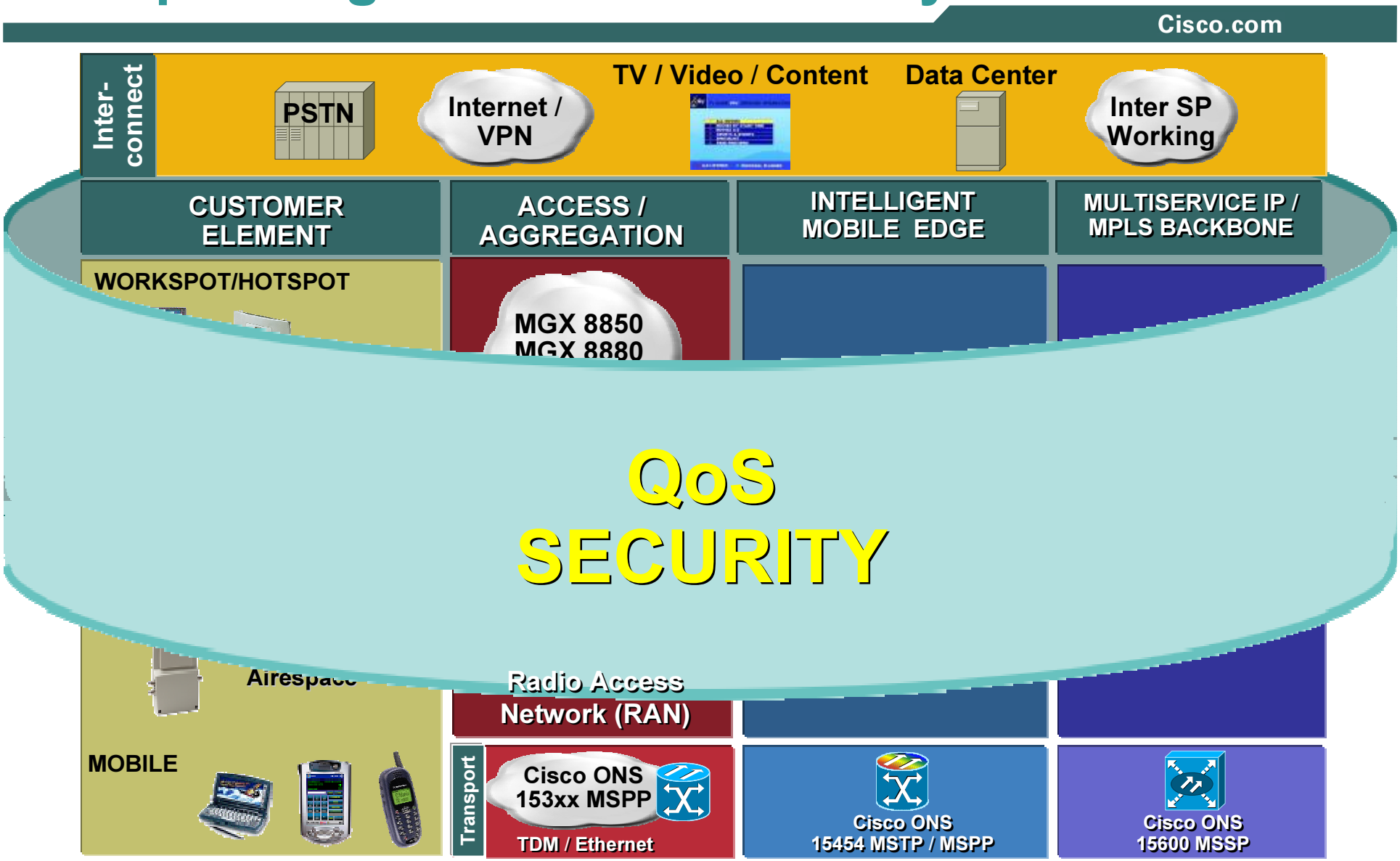
Cisco IP NGN Technology—Mobile
Spanning Secure Network Layer



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Cisco Mobility IP NGN Architecture

Achieving a Whole Greater Than the Sum of the Parts

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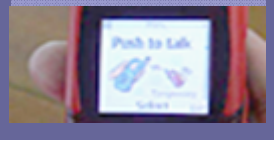
Intelligent Networking

Application Layer

- Push to Talk



- VoIP over Mobile

- Mobile Gaming

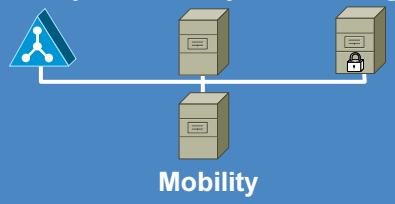
- Picture Messaging

- Mobile TV

Service Layer

- Service Exchange Framework
- Self Service

- Identity
- Policy
- Billing
- Mobility



- Open Framework for Enabling "Triple Play on the Move" (Data, Voice, Video, Mobility)

Network Layer

- Radio
- Cell Site
- Aggregation
- IP/MPLS Backbone
- Signaling over IP
- Access
- Cisco Intelligent IP Transport

Operational Layer

Security, Service Assurance, BW Management, Traffic Engineering

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ACCESS/AGGREGATION

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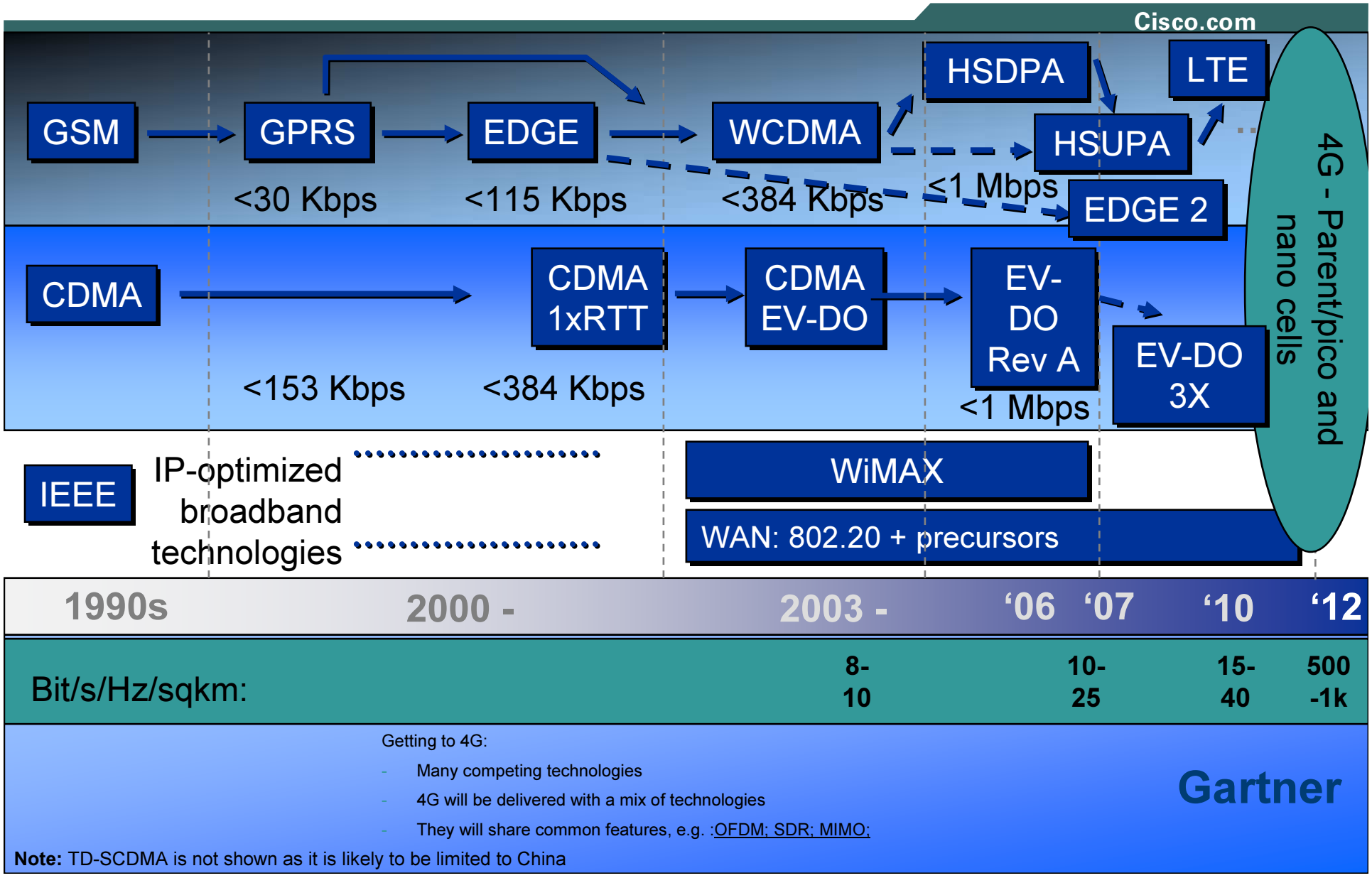
Wireless Evolution Timeline



Getting to 4G:

- Many competing technologies
- 4G will be delivered with a mix of technologies
- They will share common features, e.g. :OFDM; SDR; MIMO;

Gartner

Note: TD-SCDMA is not shown as it is likely to be limited to China

Top Findings

- Operators are committed to evolving to packet backhaul network over time driven by the promise of a lower cost transport.
- The majority of mobile operators also assume that their network is evolving to a multiservice access network (MSAN) to support other access technologies and service types besides cellular.
- Self-build is poised to increase in both the access and the metro part of the network over the next three years.
- Few operators expect a typical metro cell site to need more than 20 Mbit/s of backhaul capacity by 2009.*

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** We are working with a handful of MSP's that are looking at 30M*

Drivers For Packet Based RAN

factor	value
Reduced cost per transported bit	**8.59**
Converged transport layer around IP/Ethernet	**8.34**
Improved reliability/availability	**8.12**
Flexible connectivity	**7.88**
Rich service-aware functions with IP	**7.75**

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Key service requirements for packet backhaul

service	value
Availability	9.03
Cost per bit	8.75
Minimum/maximum latency requirements	8.50
Minimum/maximum bandwidth requirements	8.47
Minimum/maximum jitter	8.27
Mean time to repair	8.09
Ease of provisioning	8.05
Synchronization	7.83
3GPP roadmap alignment	7.69

Bandwidth Availability and Cost per bit are key drivers

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HEAVY READING
REAL WORLD RESEARCH

How important is pseudowire technology?

	responses	percent of total
Very important, it's a near-term strategic focus for us	29	25%
Somewhat important, but 2-3 years away	53	46%
Not very important, maybe something to consider in 5+ years	16	14%
Not at all important, no plans to pursue this approach	16	14%

71% of surveyed MSP's state that Pseudowire is important

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Mobile Backhaul Key Issues

- Prediction**: Despite the hype around fiber and wireless access technologies, through 2008 and beyond,** access will remain the bottleneck **in all large networks (0.9 probability)**
- **Cellular** Backhaul is ~70% of transmission OPEX
- **Possible options for capacity:**
  - **Increase MW capacity**
    - **Adding more PDH links → frequency limitation**
    - **Replacing PDH MW w/ SDH MW links → Large CAPEX**
  - **More leased lines -> Higher OPEX**
  - **xDSL, Metro Ethernet -> limited distances and deployment**
  - **WiMAX -> may not be cost efficient wrt MW**
  - **Dig Fibers -> Deployment slow, ROI slower**
- **Other approach:** Traffic Aggregation and Optimization

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Backhaul and Transport - *Evolution*

- **Backhaul Requirements**

  High bit rate to support new services

  High QoS

  Low cost per bit (target is 50% lower cost per Mbps than equivalent STM-1)

- **Transport Requirements**

  Transport cost to be competitive with equivalent fixed line at that time, and close to xDSL costs initially

- **All IP transport and backhaul**

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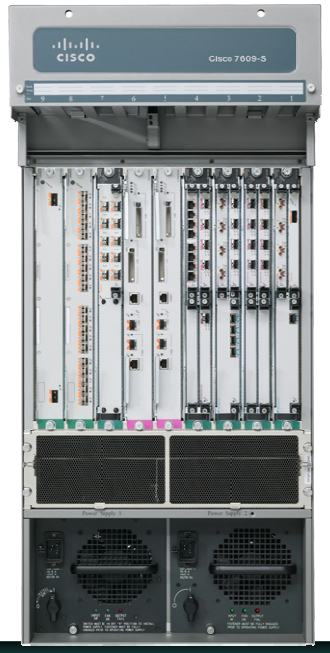
Mobile Transport over Pseudowires

Enables Service Flexibility, Lower RAN OPEX/CAPEX

NEW!



Cisco 7600 Series

Cisco 7600 MToP in the RAN: Scale + Economics

- High Availability: < 50ms switch over using MPLS/FRR, network upgrade using in-service software upgrade (ISSU)
- Scalability: Add more bandwidth easily as needed
- Efficiency: IP, TDM, and ATM transport using one platform and one network at a lower cost-per-bit
- Advanced OAM&P Features: IP service level agreement
- Flexibility: Connect cell sites to RNC/MSC as capacity allows, not dictated by geography

Circuit Emulation over Packet Shared Port Adapters

- Circuit Emulation SPAs can backhaul ATM & TDM RAN traffic over MPLS PWE3
- Advanced clocking emulation provides synchronization using Carrier Ethernet transport

Two Models:

1-Port ChOC3/ STM1

24-Port ChT1/E1/J1

Enabling Cost-Effective RAN Evolution and Profitable Service Growth

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MToP in the RAN

- **RAN traffic groomed over** MPLS Pseudowires **for backhaul**
- **Reduced OPEX – Bandwidth Flexibility**
- **Eliminates need for ADM and ATM switches**
  - **“Flatten the network”, Simplify, Reduce costs**
- **Pseudowire enables greater flexibility for traffic handling**
  - **Proactive scalability -- Self-Adjusting Backhaul Transport**
  - **Pre-provision new and future services**
- **Provides** Clock Recovery per 3GPP CESOPN Standards
- **Continuity of** IP Security **between the Core and the RAN**
- **Longevity**
  - **Compliance with 3GPP/3GPP2 Reference Architectures up to R8**
- **Continuity with Cisco IP-MPLS Core Infrastructure**

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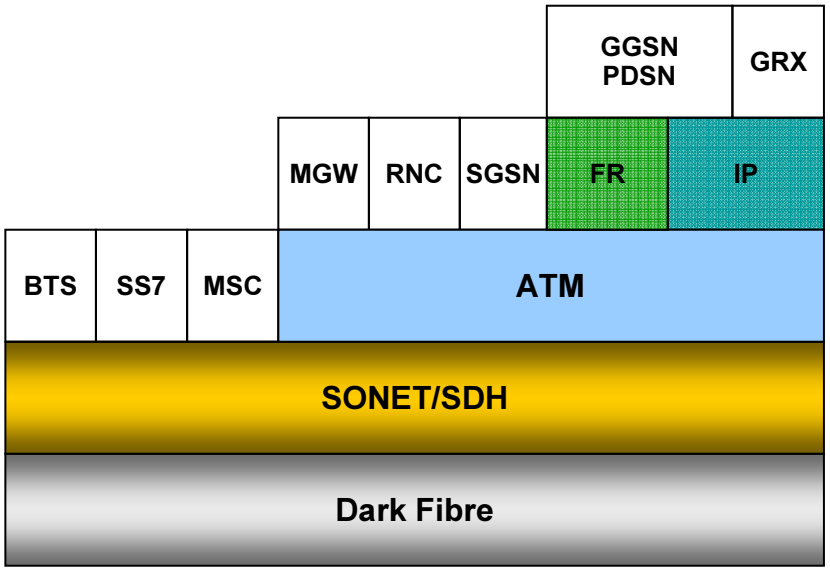
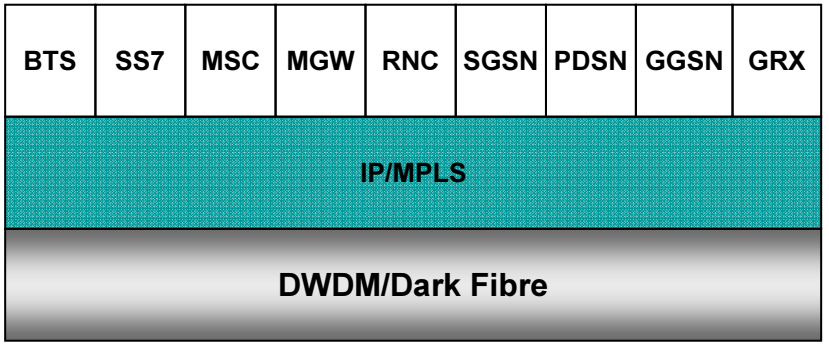
Simplify the Network Transport

Multiple Layers



Collapsed Transport



Simplifies Planning and Operations

Reduces OPEX

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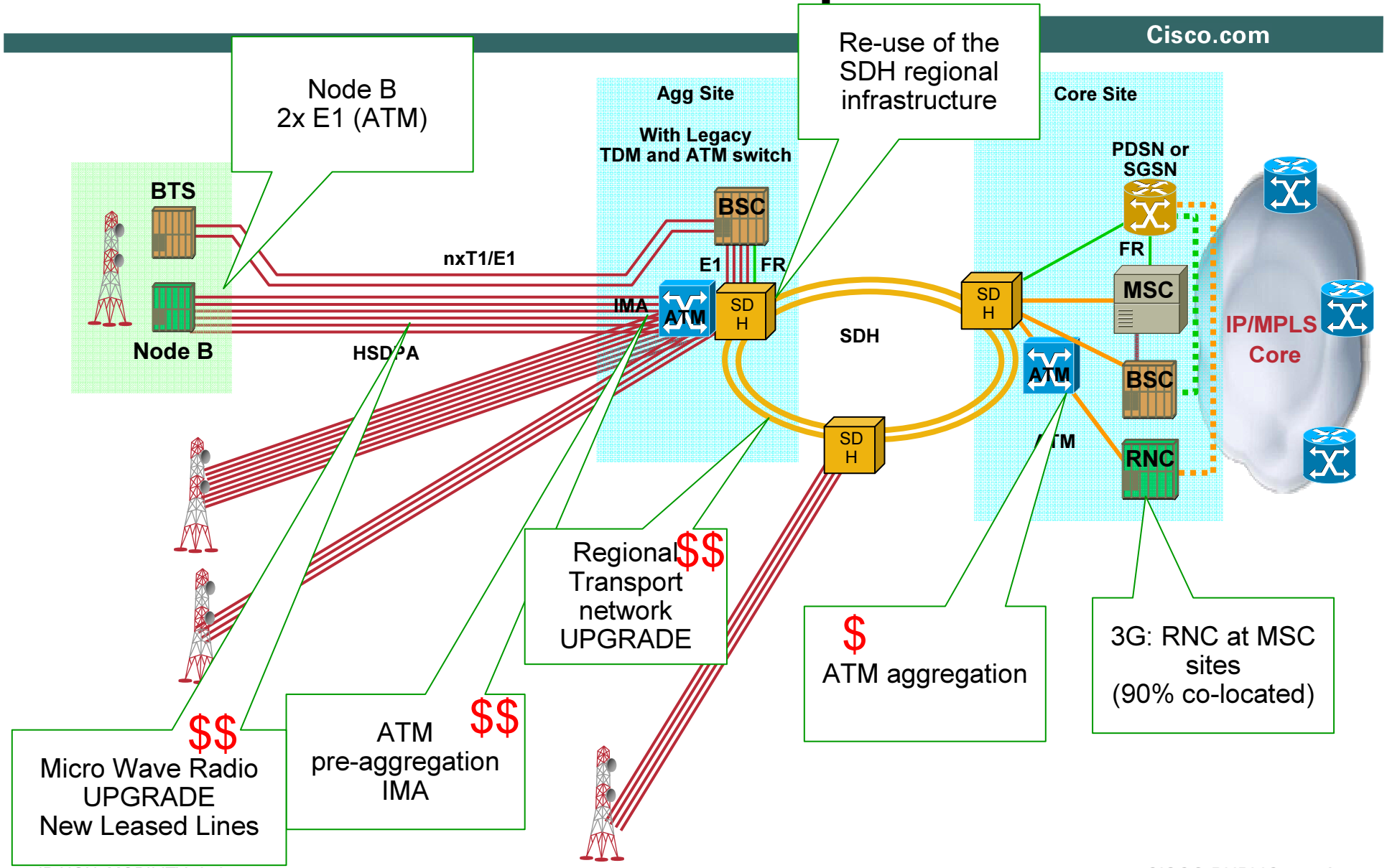
RAN via Traditional Transport



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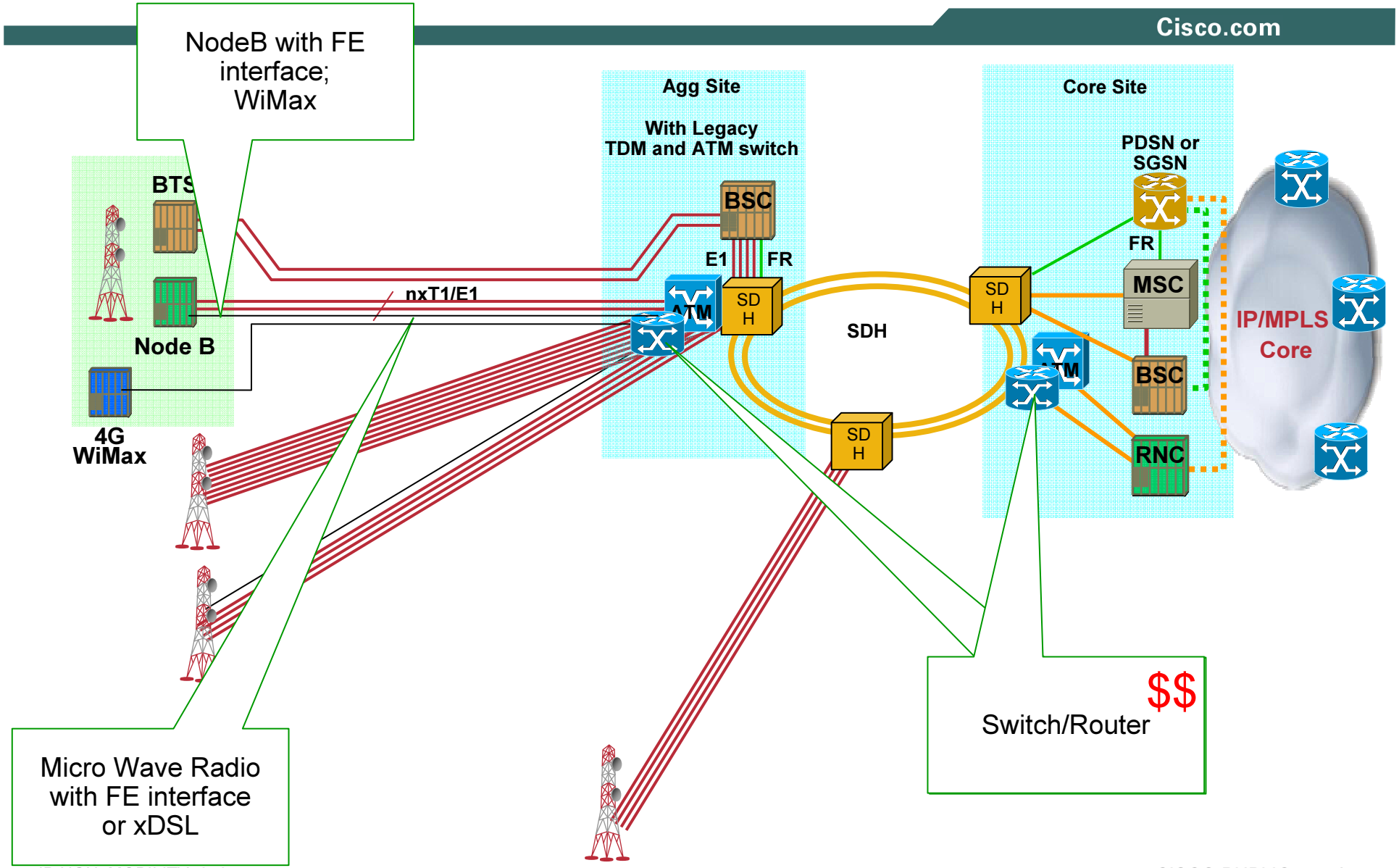
RAN evolution R4-R6 and 4G



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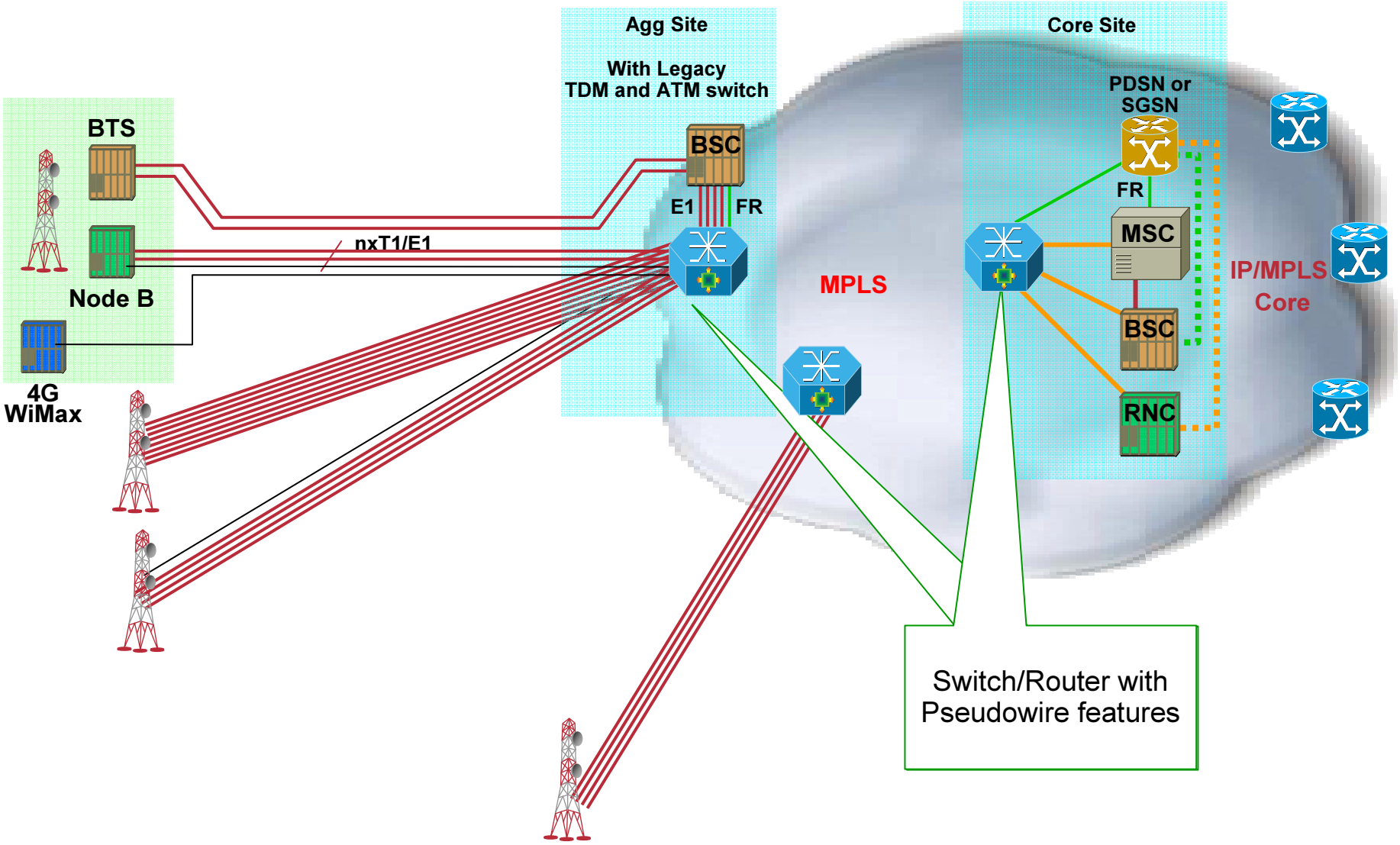
Cisco IP RAN



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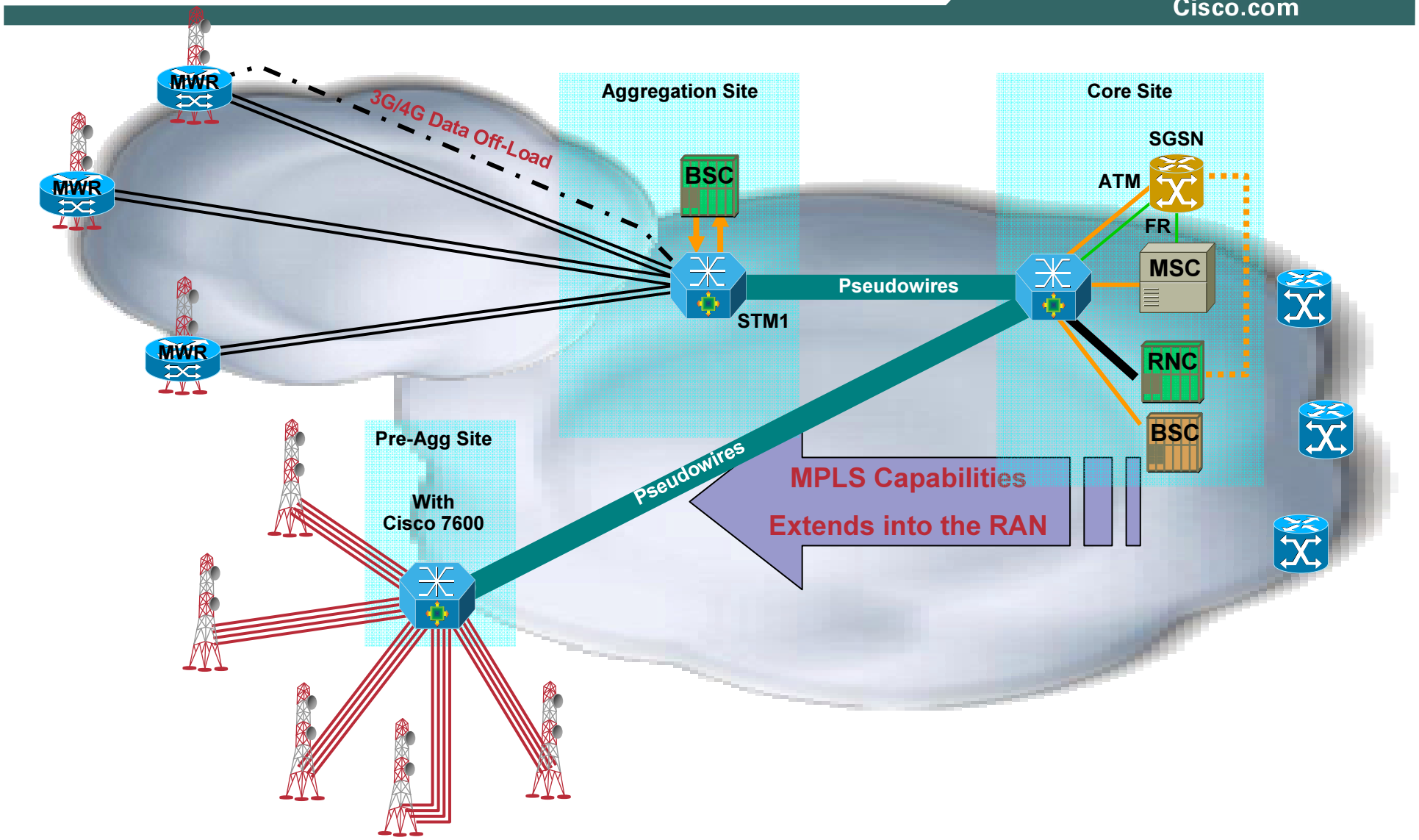
Cisco-in-the-RAN

Cisco's Next-Generation IP RAN Portfolio



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Inflection Points Create Operator Challenges

Backhaul Costs

- Additional leased lines, satellite links, and microwave channels increase costs and reduce profits

T1/E1 Availability

- T1/E1s often not available in desired timeframe or quantity

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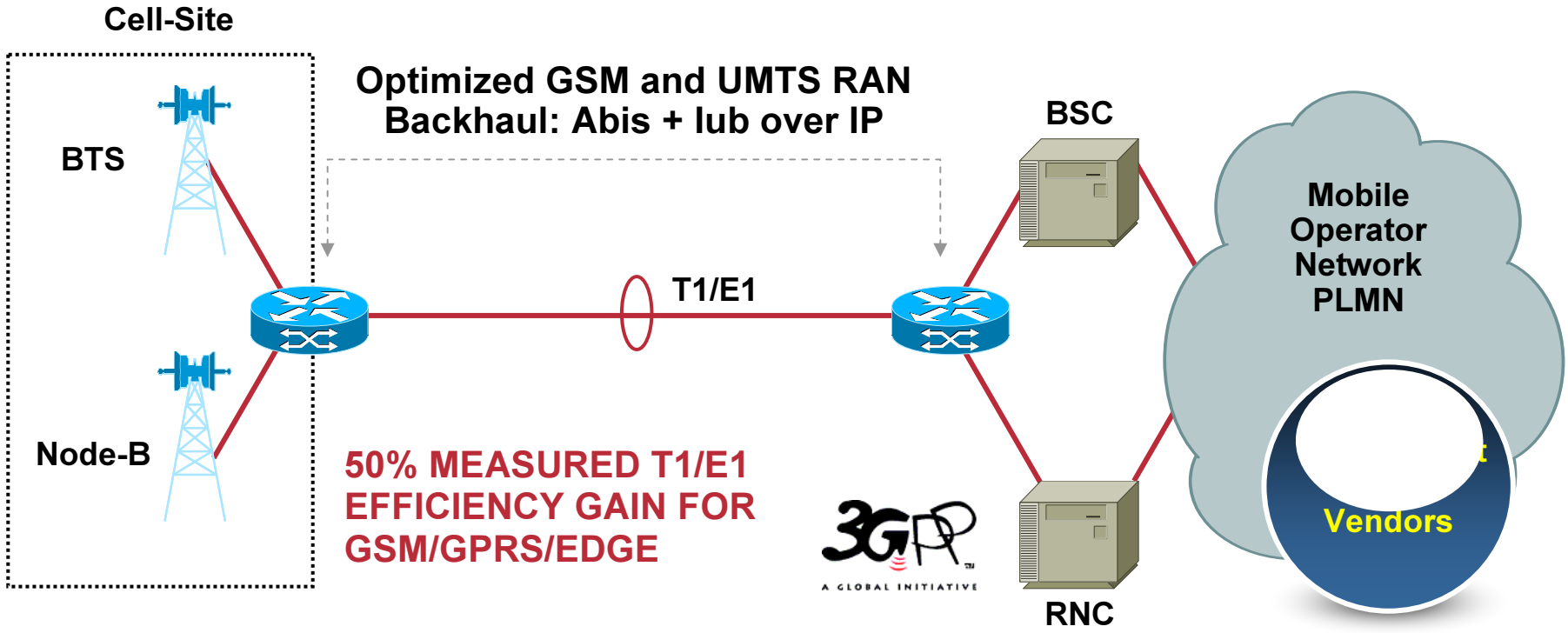
Cisco RAN Transport Optimization over IP for GSM and UMTS

Cisco.com



BENEFITS

- 50%+ measured efficiency gain on GSM and 15% to 90% on UMTS
- No change to RAN backhaul design
- Single IP backhaul network serves 2G/3G/4G
- Operates with ALL major radio vendors equipment

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Cisco RAN-O Product Family

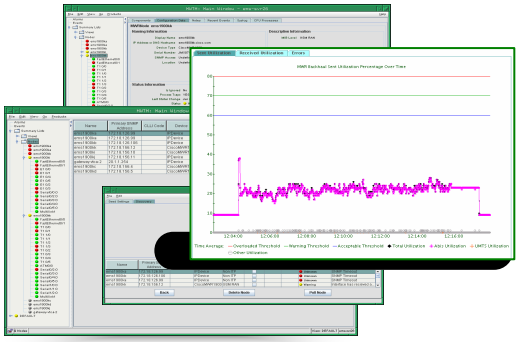
Cisco.com

MWR 1941-DC-A
Cell Site Access Platform
Shipping

- GSM & UMTS Transport Optimization
- GPRS/EDGE support
- All GSM codecs
- Satellite transport support
- UMTS and HSDPA Offload
- IP Broadband RAN Transport with ext clock
- QoS, basic IP Services
- IP transport for 2G/3G/4G
- T1/E1 Protection Switching
- Extended Operating Temp
- Vendor independent
- Advanced Services/CA Package

ONS 15454
Aggregation Platform
EFT Q4CY06

- GSM & UMTS Transport Optimization
- GPRS/EDGE support
- All GSM codecs
- UMTS and HSDPA Offload
- IP Broadband RAN Transport with ext clock
- QoS, basic IP Services
- IP transport for 2G/3G/4G
- N:1 redundancy
- Extended Operating Temp
- Vendor independent
- Advanced Services/CA Package



MWTM
Network Management
Shipping

- Centralized management console
- Real-time backhaul utilization by traffic type and radio
- Event monitoring
- Web based reporting
- Auto discovery and topology
- Inventory
- OSS integration
- Capacity planning
- Client-server architecture
- Multiple OS support—Solaris, Windows, Linux

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IP Point-of-Presence
Important Capabilities

- **Extends the capability to reach customers from the Core out to the Aggregation Points or the Cell Site**
- **Cisco Next-Gen RAN solutions push IOS capabilities and features into the RAN**
  - **QoS, IP-Security**
- **Target Enterprise, Commercial, SOHO, Residential**
- **Provide Managed Services at lower cost of access**
  - **Managed-VPN, Private-VPN, Meshed-WiFi, IP-PBX Services**
  - **Provide Fixed-Mobile Service Offerings**

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IP Point-of-Presence
Important Capabilities

- Often aggregation sites or cell sites are located in or near buildings that house businesses
- IP-based services can be easily extended to customers in and near these sites
- Cisco Next-Gen IP-RAN solutions become platforms of new revenue generating services
  - Increase revenues
  - Gain new customers
  - Add customer “Stickiness”

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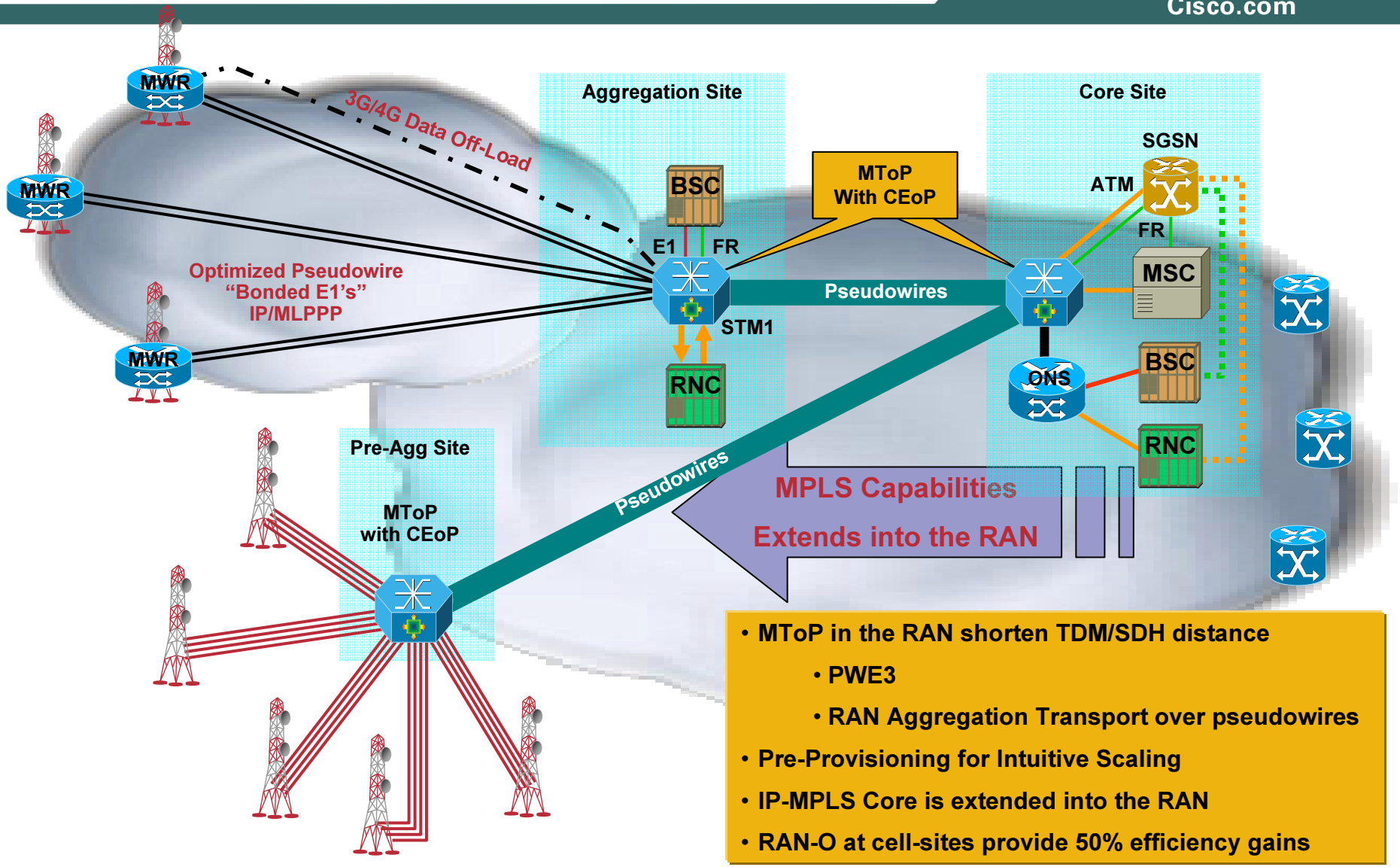
Cisco-in-the-RAN

Cisco's Next-Generation IP RAN Portfolio

Cisco.com



- MToP in the RAN shorten TDM/SDH distance
  - PWE3
  - RAN Aggregation Transport over pseudowires
- Pre-Provisioning for Intuitive Scaling
- IP-MPLS Core is extended into the RAN
- RAN-O at cell-sites provide 50% efficiency gains

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Agenda

Cisco Mobile SEF Overview

eGGSN Features

Billing

Performance/Capacity/Management

Case Studies

Evolutions/Summary/Conclusion

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INTELLIGENT SERVICE EDGE

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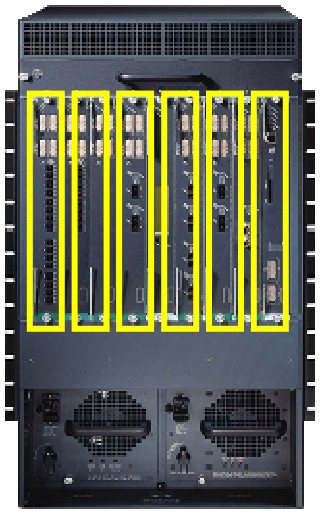
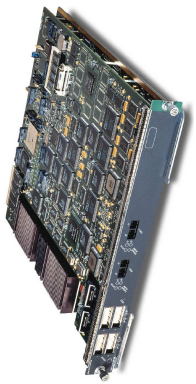
Cisco Mobile Exchange Chassis-Based System

Delivering True Deployment Flexibility



CISCO 7609 CHASSIS

IPSEC



CSG

FIREWALL

GGSN PDSN/HA

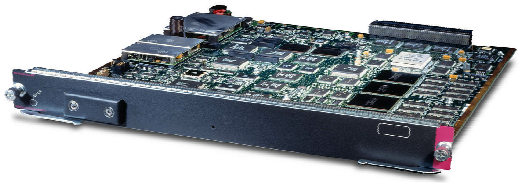
SSG

SWITCHING AND ROUTING ENGINE

LINE CARDS

LATEST ADDITION

SERVICE CONTROL ENGINE



LINUX SERVICE MODULE

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MULTISERVICE IP/MPLS BACKBONE

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Cisco Mobility IP NGN Architecture

Achieving a Whole Greater Than the Sum of the Parts

Cisco.com

Intelligent Networking

Application Layer

- Push to Talk

- VoIP over Mobile

- Mobile Gaming

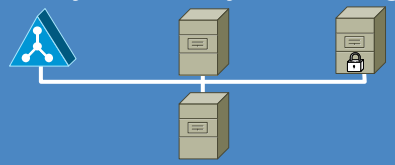
- Picture Messaging

- Mobile TV

Service Layer

- Service Exchange Framework
- Self Service

- Identity
- Policy
- Billing



- Mobility
- Open Framework for Enabling "Triple Play on the Move" (Data, Voice, Video, Mobility)

Network Layer

- Radio
- Cell Site
- Aggregation
- IP/MPLS Backbone
- Signaling over IP
- Access
- Cisco Intelligent IP Transport

Operational Layer

Security, Service Assurance, BW Management, Traffic Engineering

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Mobile Operators Proliferation of Disparate Networks

Voice	Data	
2G Voice	2.5G GPRS	WAP
3G Voice	3G GPRS	V110 Dial
Enterprise	Enterprise	WLAN
Retail Stores	Retail Stores	Billing
Call Centres	Call Centres	IPSec
Corporate Access	Corporate Access	Signalling
	Management	Paging

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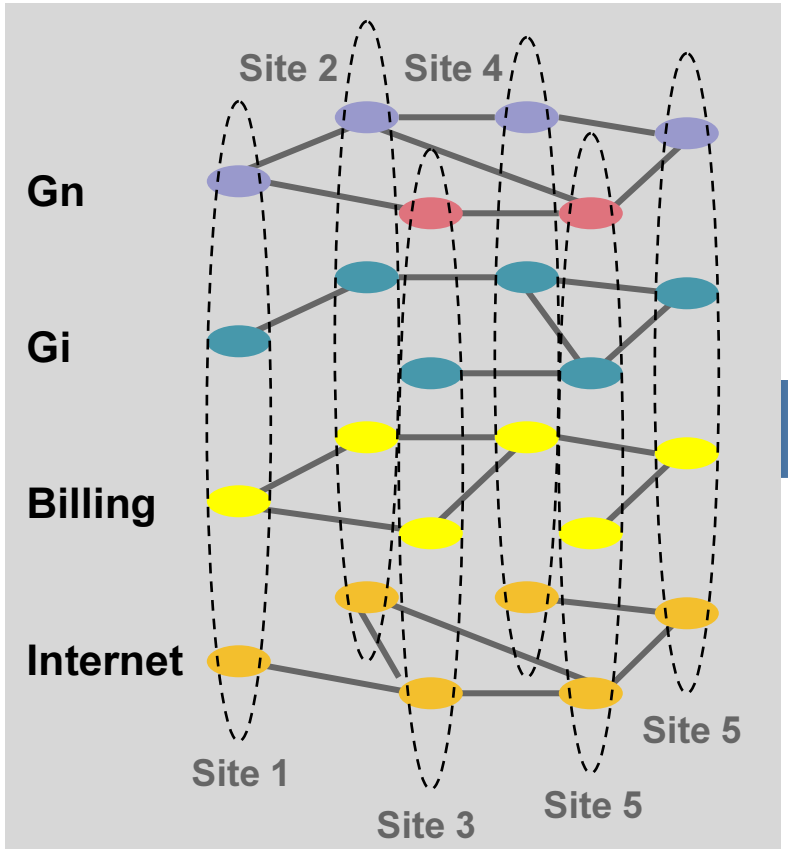
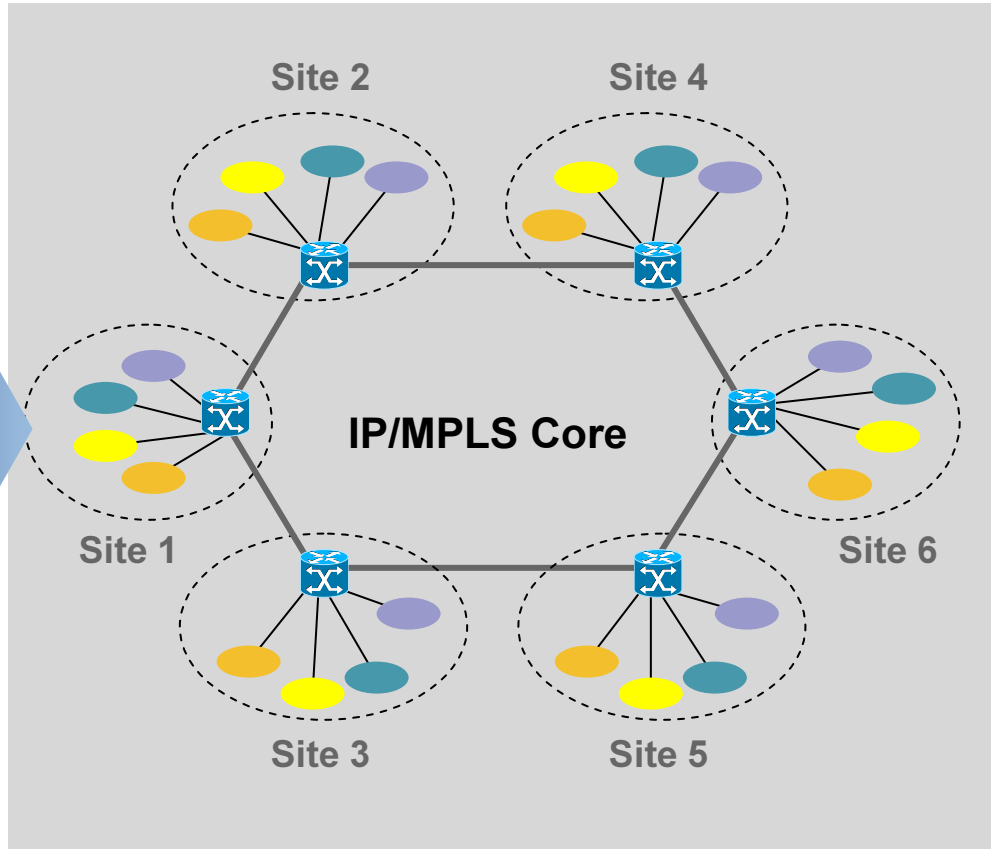
Migrate Disparate Networks to Single IP/MPLS Core



Many Networks on Common Sites with Different Edge Devices and Transmission



Single Network over High-Capacity Transmission Carrying All Services

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The Business Case for a Converged Network

By Reducing the Number of Networks

- Lower transmission costs
  - e.g., cost of 9xE1 = 1xSTM1
  - Use alternates such as GE/10GE
- Less maintenance contracts
- Single management solution
- Quickly deploy new services

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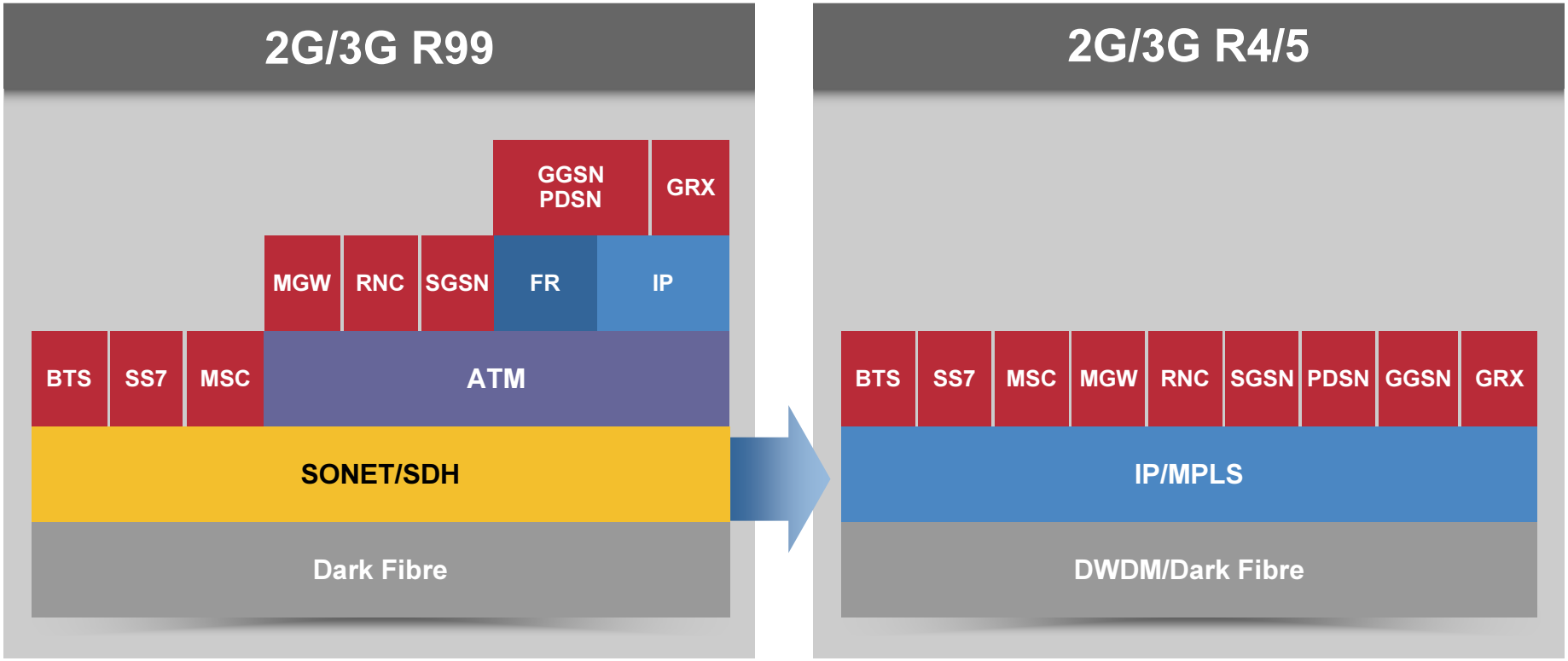
Reducing Complexity and Overlap



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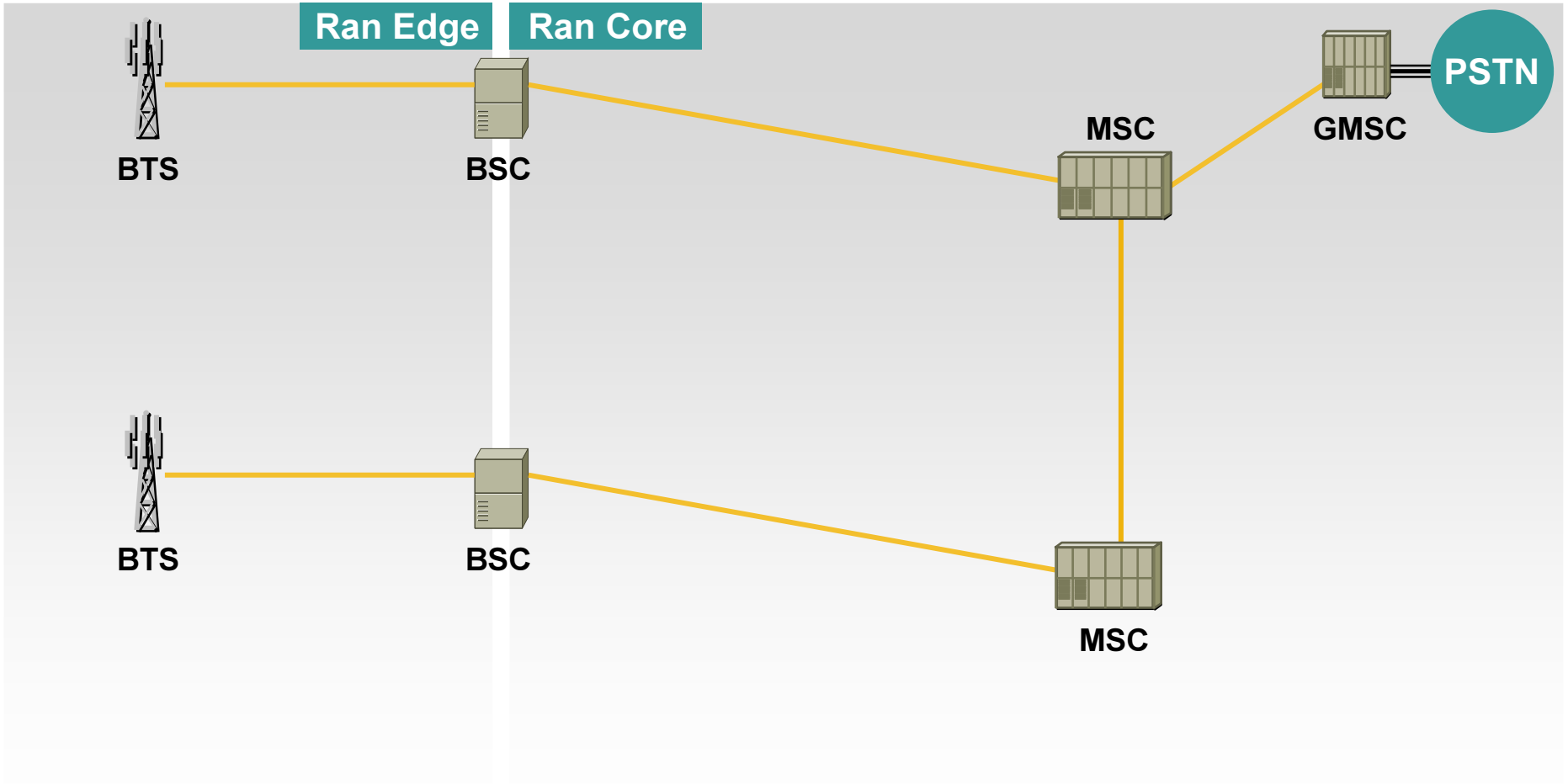
2G Voice



SDH

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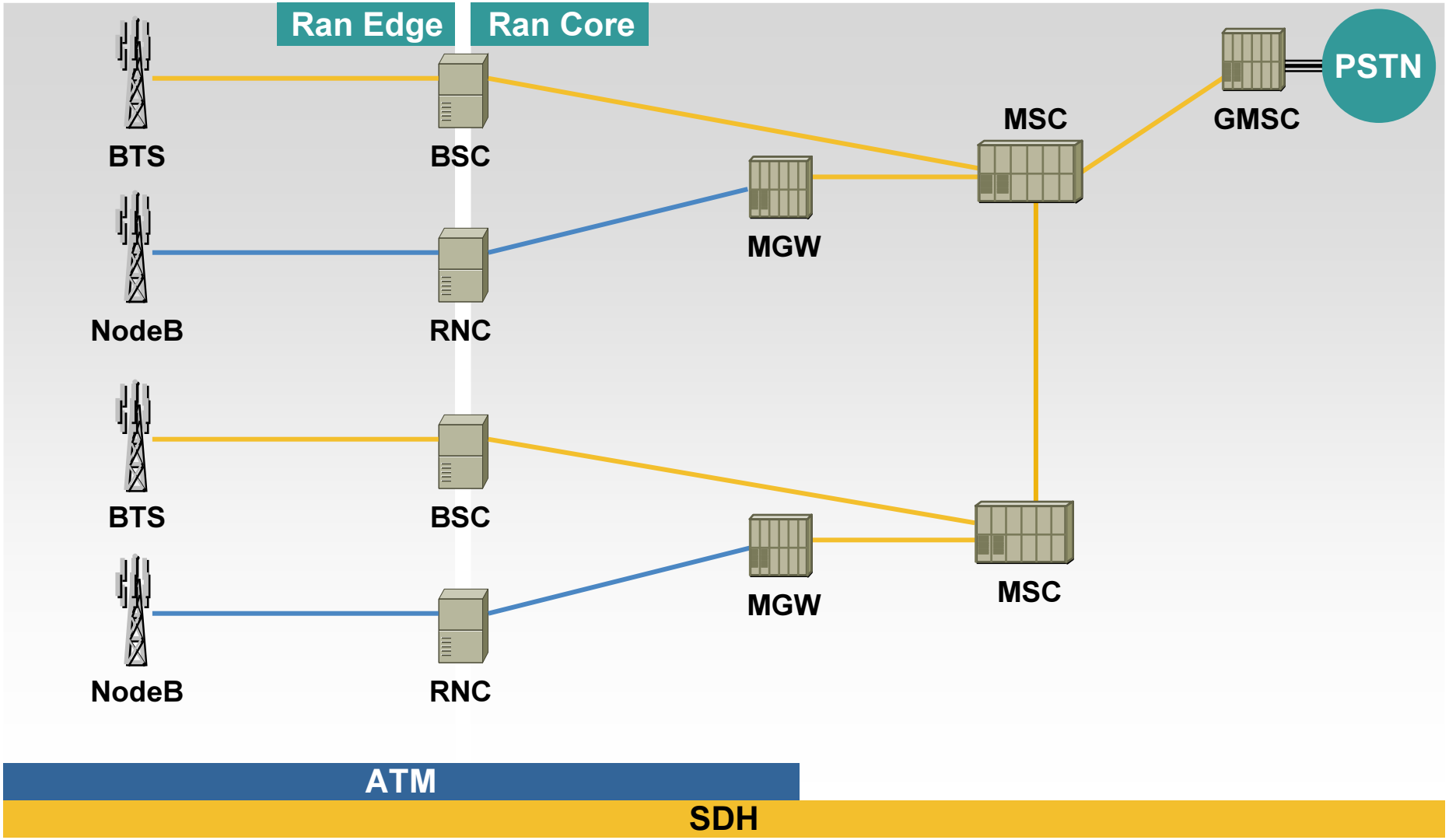
2G and R99 Voice



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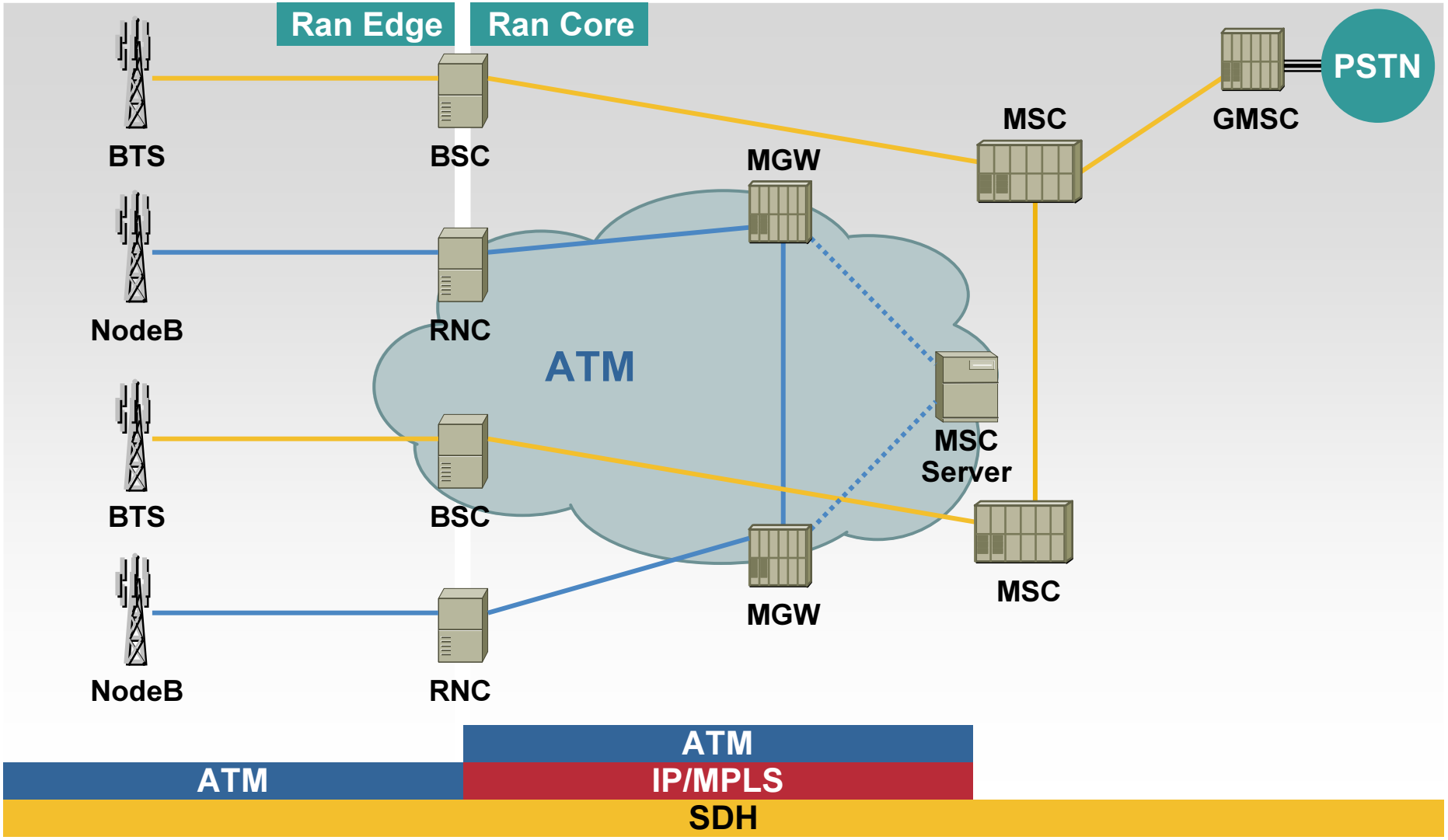
R4 with ATM MGW Voice Interconnect

Cisco.com



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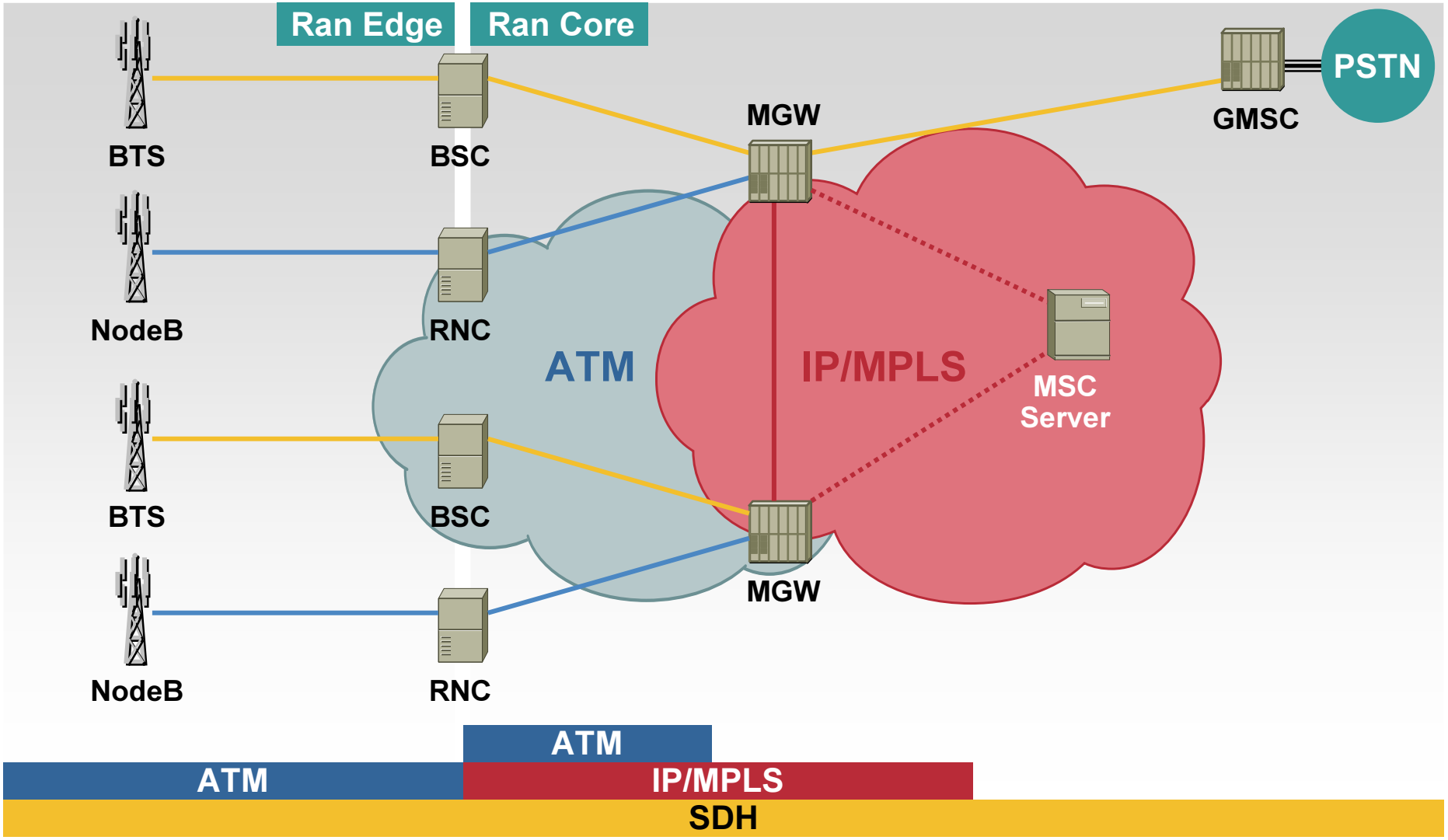
R4 with IP MGW Voice Interconnect



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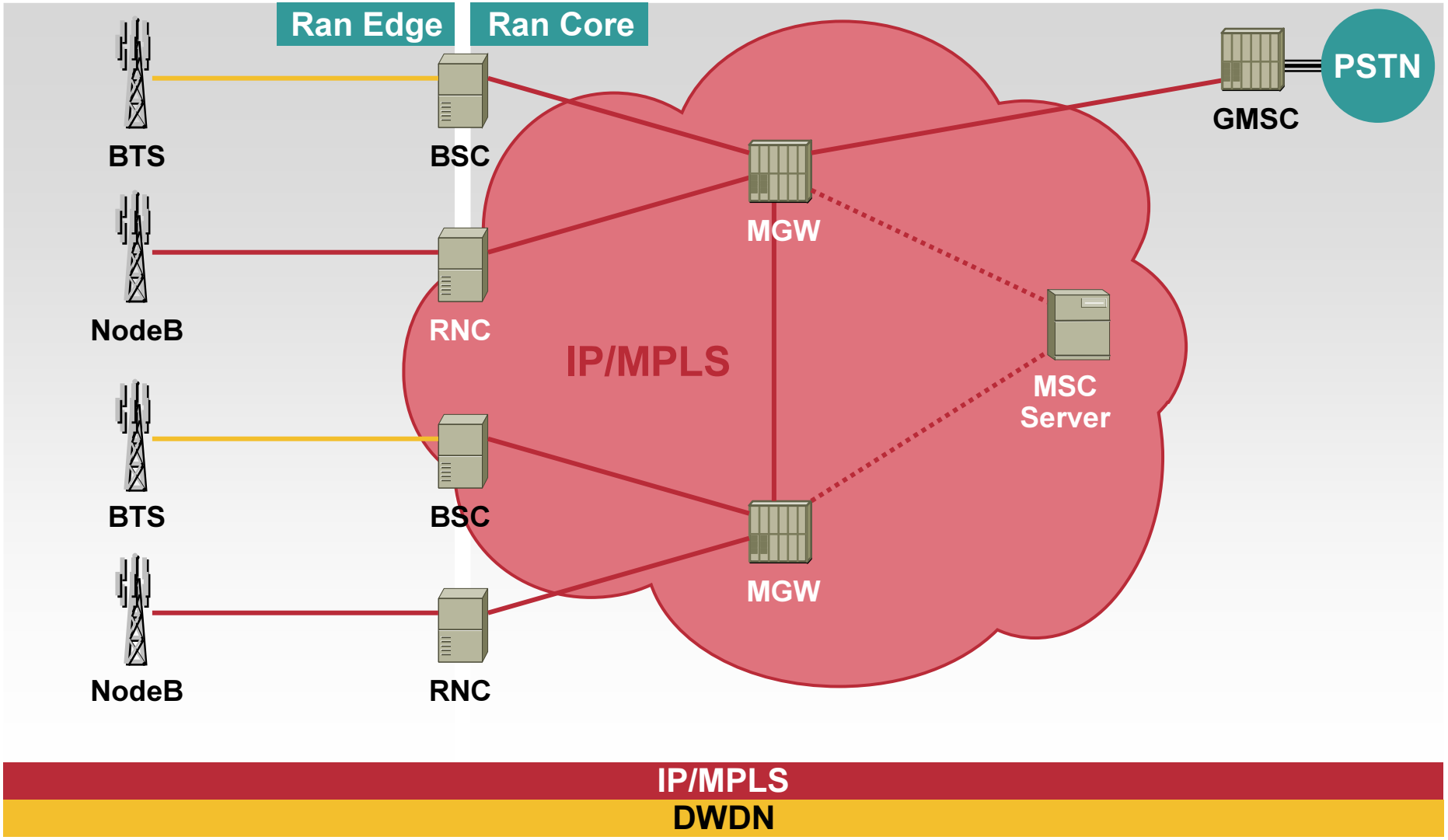
R5+



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Deploying Tight SLA Services on an IP Backbone

Number of Tools Are Available to Enabled Tight SLA Services

- Physical network topology and structure
- Capacity planning and active monitoring
- Diffserv: per-hop congestion management
- Traffic engineering: avoid aggregation on shortest path
- Convergence
  - FRR protection
  - Tuning IGP convergence

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Availability

Define Requirements for Each Service

- **What is the service availability requirement**
  - **Often quoted 5-9's target equal to 5 minutes down time**
  - **Is end application resilient**
- **What is the convergence requirement in event of failure**
  - **For IP user data an outage of three seconds may be acceptable**
  - **For signalling an outage of 60 seconds may be acceptable if using diverse paths (SCTP will recover)**
  - **For user voice an outage of less than 300–500ms may be required**
  - **If targeting SDH/SONET protection may require sub 50ms for all services**

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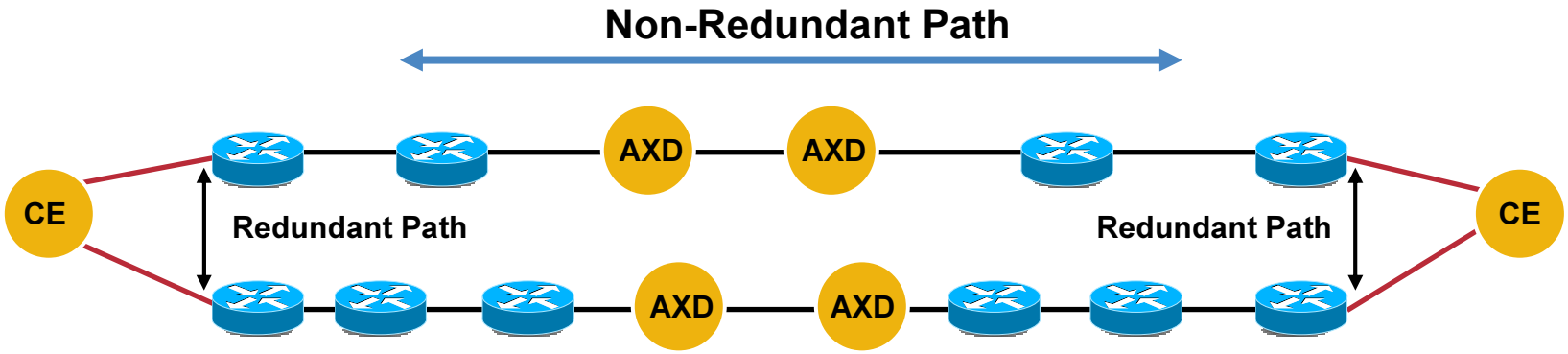
Network Availability

Based on Worst Path with All 12406 Routers

- Network availability 99.99980%
- Or one minute downtime per year



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Convergence

- **Fast convergence protocols**
  - **ISIS, OSPF, LDP, BGP, VPN**
  - **Typically convergence in seconds**
- **MPLS TE FRR**
  - **Link, node, path protection**
  - **Target sub 50ms**
  - **Covered in examples**

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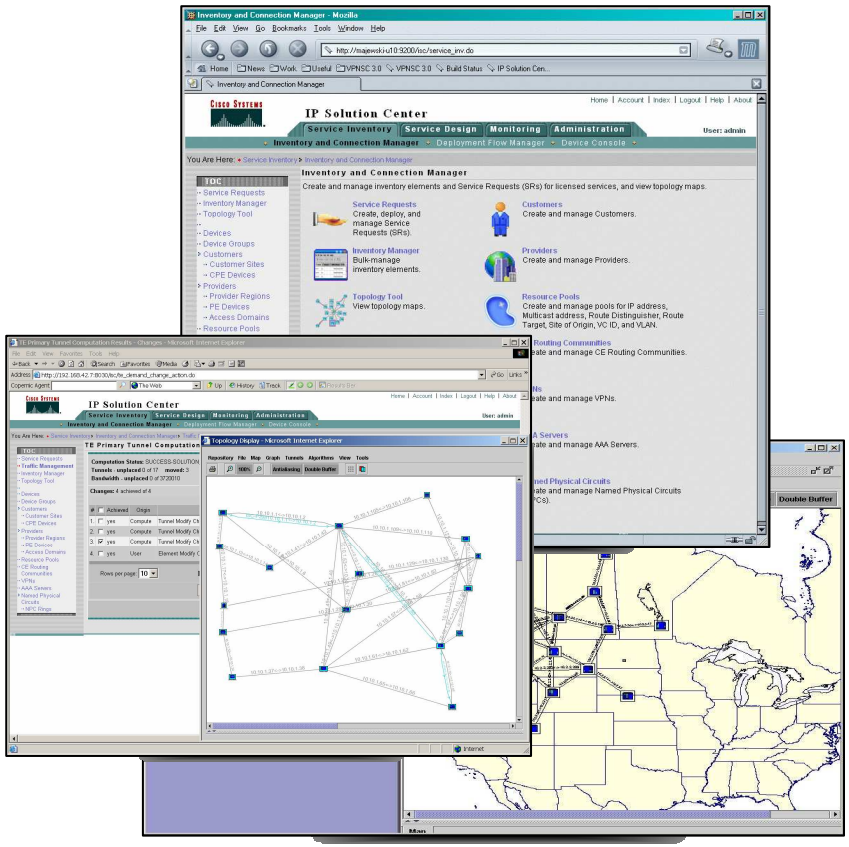
IP Solution Center Overview

- **A Family of Network-Intelligent Element Management Applications for Managing MPLS and Metro Ethernet Networks**
  - **MPLS Virtual Private Network Management Application (ISC:MPLS)**
  - **Layer 2 Virtual Private Network and Metro Ethernet Application (ISC:L2VPN, ISC:METRO)**
  - **Traffic Engineering Management Application (ISC:TEM)**



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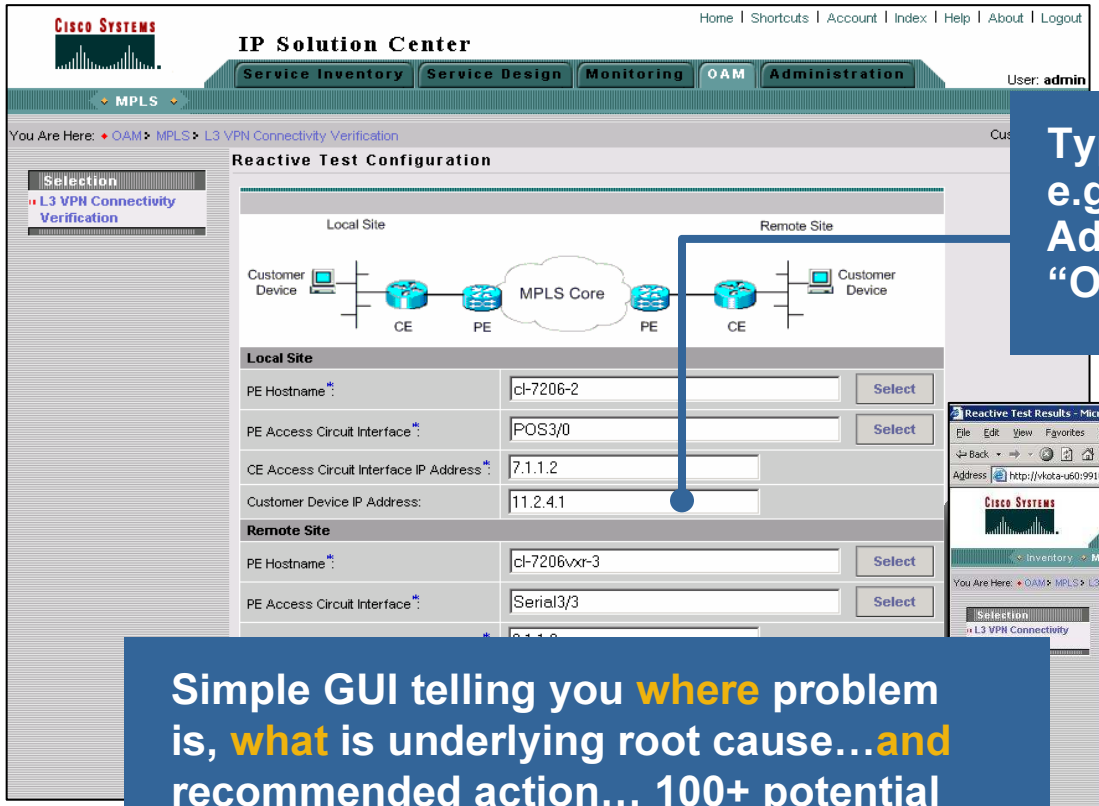
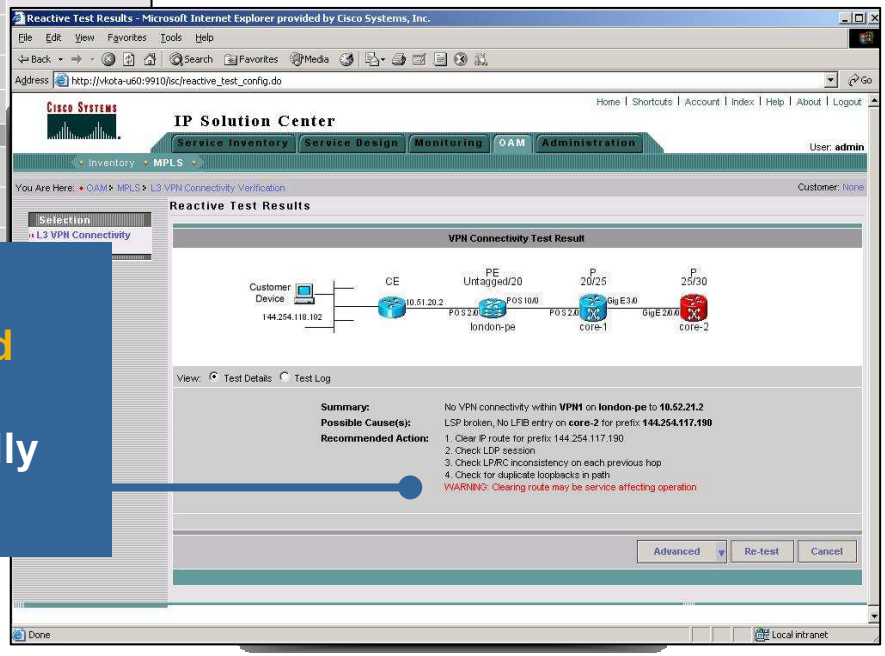
The Cisco Approach: Intelligent MPLS Instrumentation and Cisco MPLS Diagnostics Expert (GA Dec. 2005)

Cisco.com



Type in Simple Details e.g., Customer Edge IP Addresses… and Press "OK" to Start



Simple GUI telling you where problem is, what is underlying root cause…and recommended action… 100+ potential failure scenarios checked automatically —repeatable process

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Extending the Cisco CRS-1 Family

Introducing Cisco CRS-1 8-Slot Single-Shelf System

- **Continuous system operation**
  - True Telco grade OS
  - Separate control, data and management planes
  - Hitless in-service hardware and software 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

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Agenda

CISCO IP NGN STRATEGY OVERVIEW

DRIVERS FOR MOBILE CARRIERS

MOBILE APPLICATION CONVERGENCE

MOBILE SERVICE CONVERGENCE

MOBILE NETWORK CONVERGENCE

CISCO IP NGN MOBILITY LEADERSHIP

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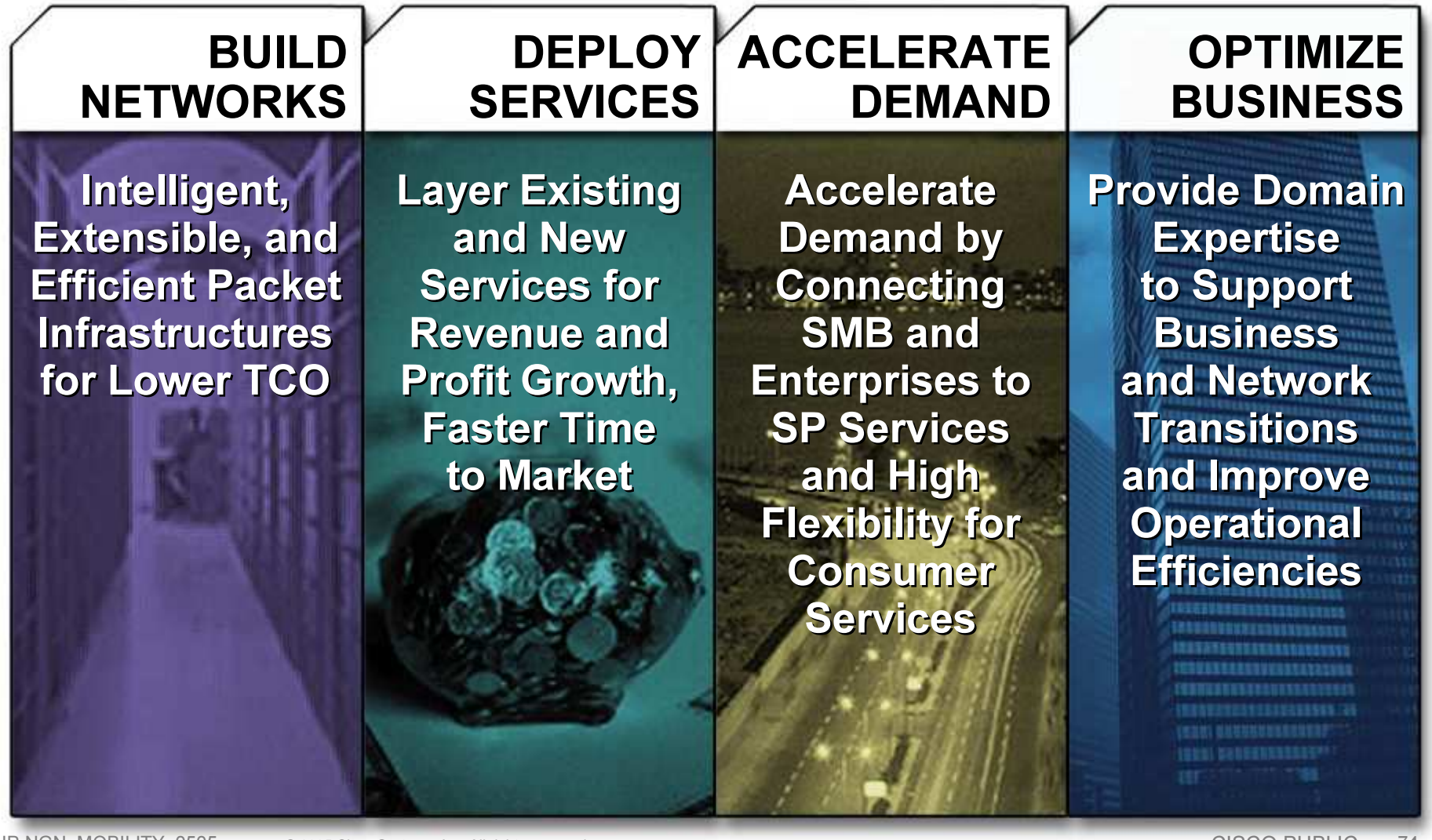
Cisco Service Provider Strategy
The Most Complete Partner for SP Success

Cisco.com



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Cisco IP NGN Mobility Momentum
Global Mobile IP Penetration

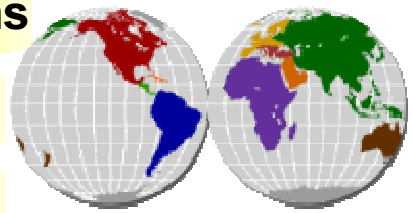
Cisco.com

Australia	Austria	Bahrain	Belize	Bosnia	China	France	France	Germany	Hong Kong
Indonesia	Iran	Iraq	Ireland	Italy	Japan	Luxembourg	Malaysia	Malaysia	Malta
Monaco	Morocco							Netherlands	Norway
Oman	Poland							Portugal	Qatar
Romania	Russia	Russia	Russia	Slovenia	South Africa	South Africa	Spain	Sweden	Sweden
Switzerland	Switzerland	Russia	Thailand	Turkey	United Kingdom	United States	United States	United States	Vietnam

Flexible, Scalable Solutions

Open, Standards-Based

Carrier-class Performance



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Strength in Partnerships
Enhancing Cisco Mobile IP Solutions

Cisco.com

TECHNOLOGY PARTNERS

SYSTEMS INTEGRATION PARTNERS

BILLING MEDIATION PARTNERS

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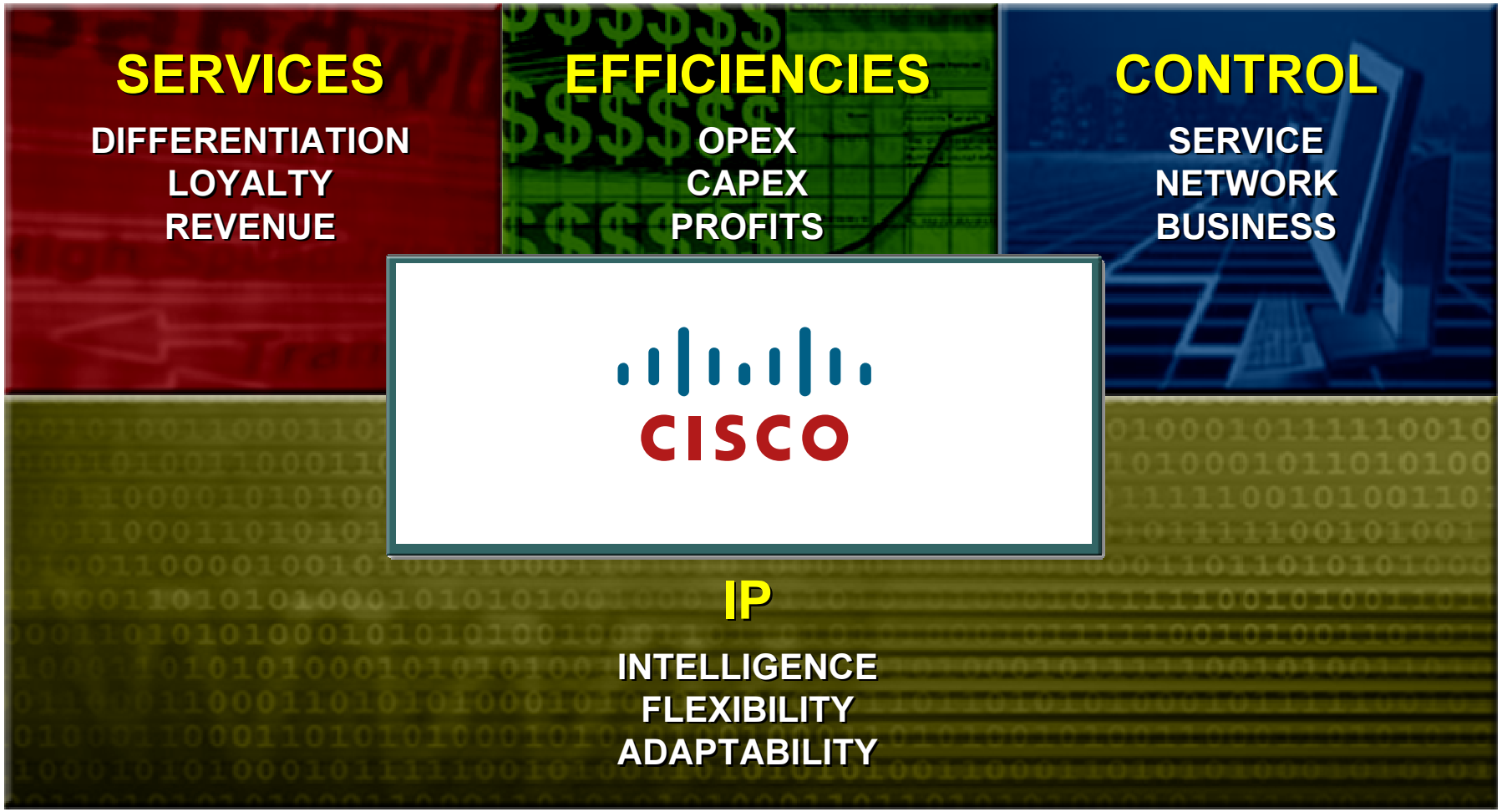
Cisco IP NGN Architecture

Addressing the Needs of Mobile Service Providers



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CISCO