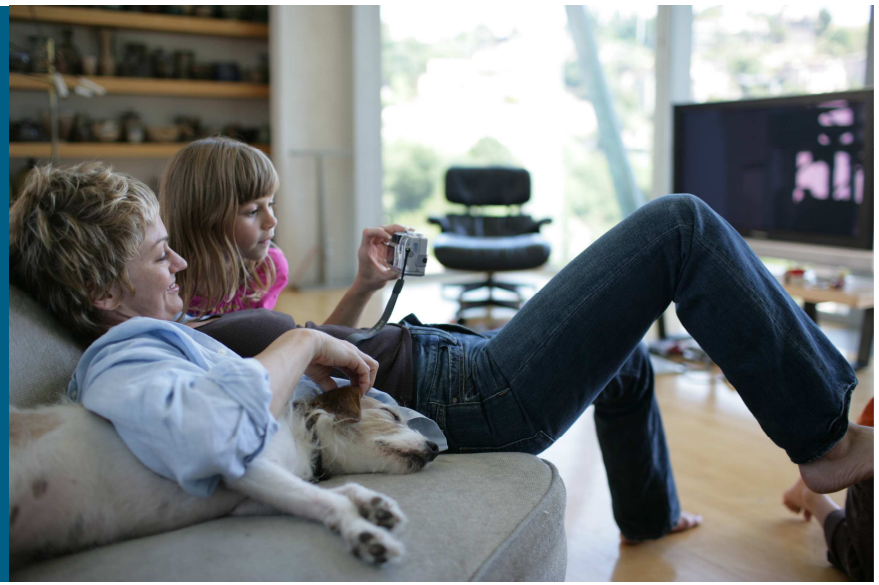
Cisco Mobile IP NGN Solution Overview



Imal Kalutotage

ikalutot@cisco.com
CCIE 15471

Agenda

- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Cisco's Mobility Vision

'Any Play Services'

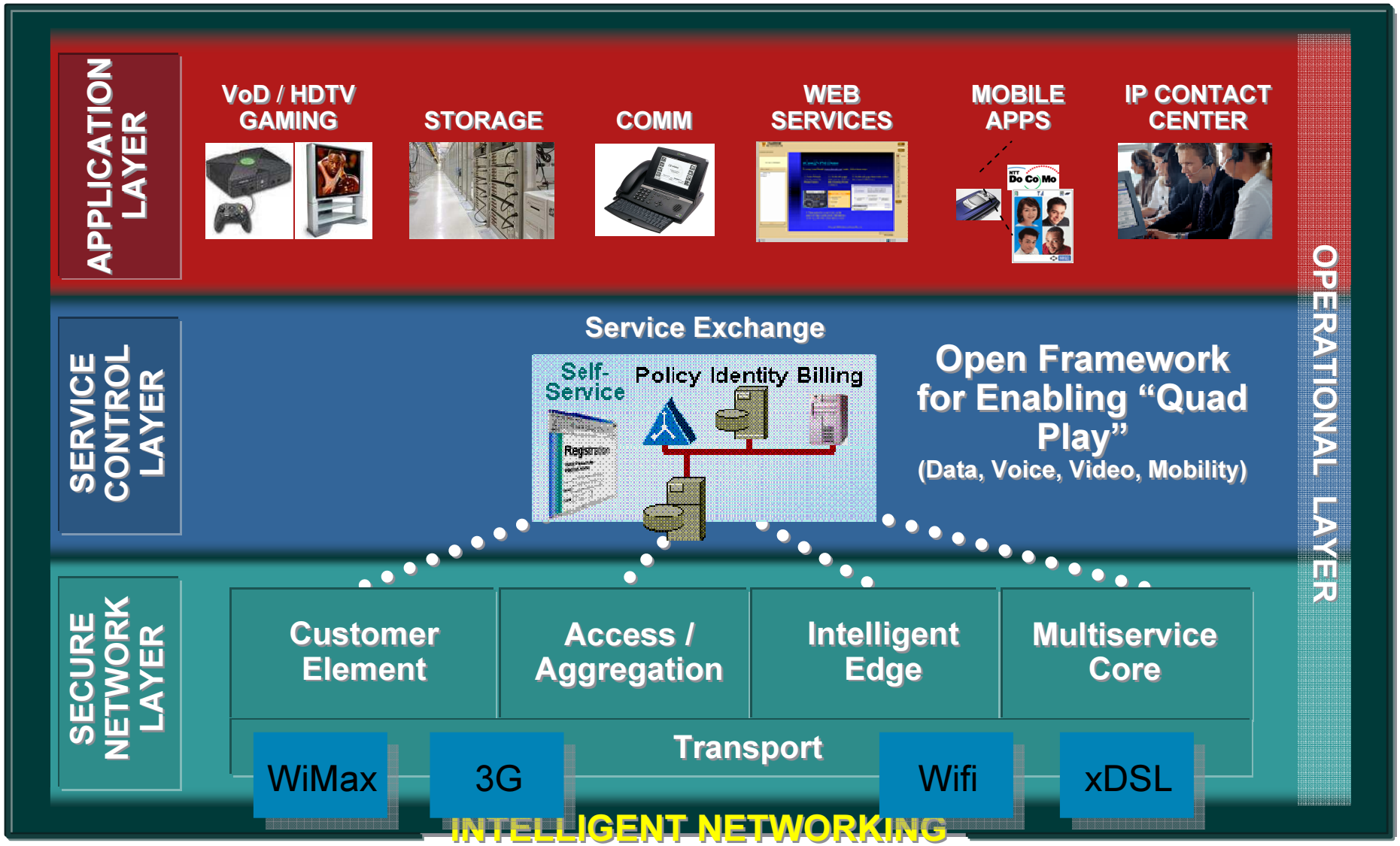
Across Devices

Across Segments

Across Technologies

Cisco Mobile IP NGN Architecture

Achieving a Whole Greater Than the Sum of the Parts



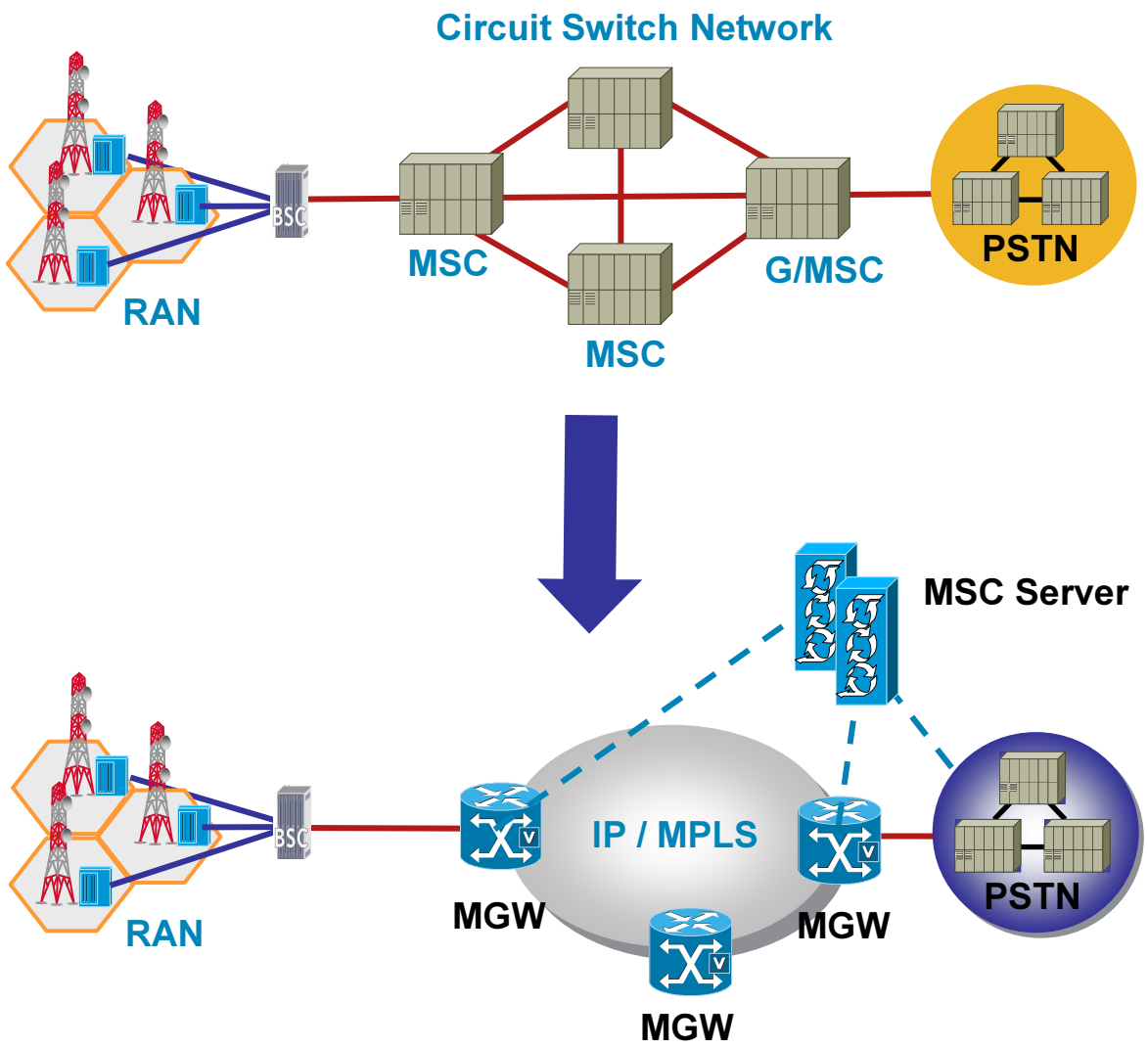
Agenda

- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Mobile Telephony Evolution

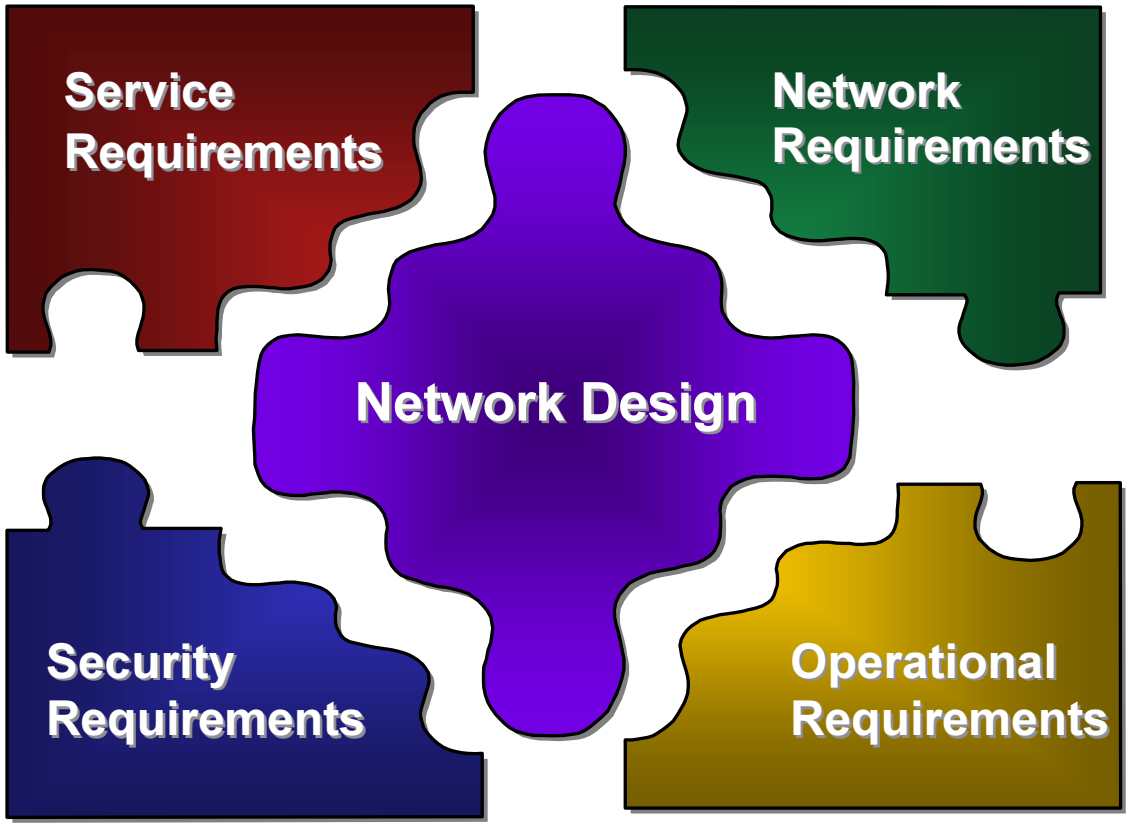
From TDM to IP using a split Telephony Architecture

- Different Architecture
  Providing the same Services
- Addt'l Control Plane IW
  Considerations for C7 Stability
- Bearer/Control Separation
  Extreme is two Services
- Converged IP Network
  Requirements per Service
- Service-oriented Design Approach
  Network for Services rather than Services for Network
- Edge transport multiplicity
  Affects OAM, QoS, Provisioning etc
- RAN Requirements typically exceed core requirements



Transforming Traditional IP to Carrier Class IP

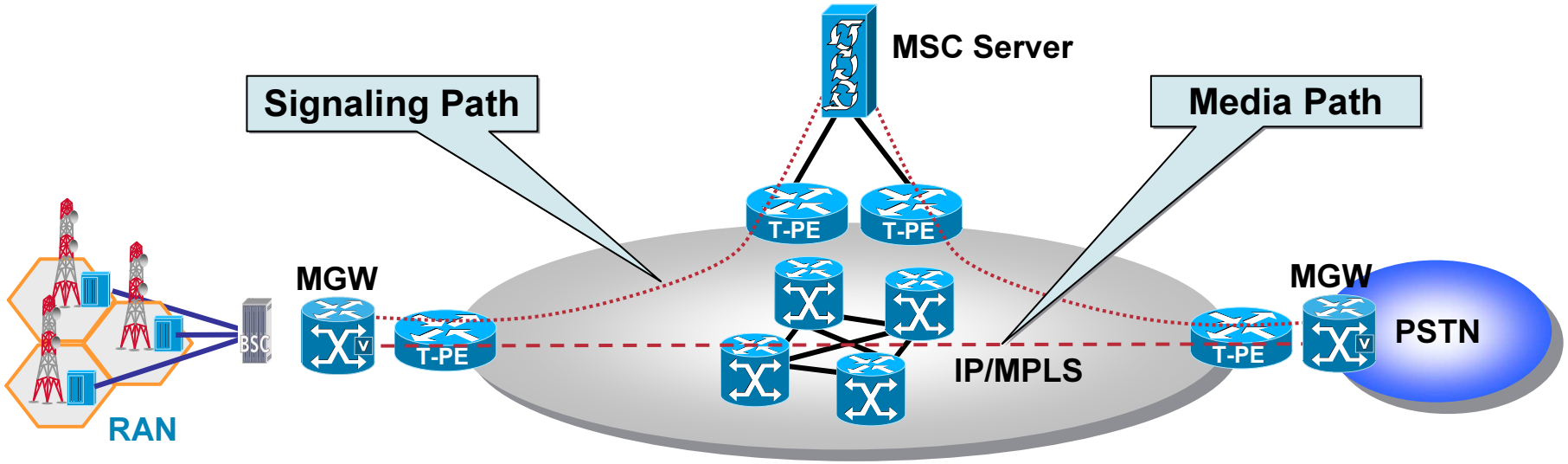
Defining the Requirements



All pieces working together provides the foundation for Carrier Class IP and consequently IP NGN

Service Requirements

Mobile Carrier Class Telephony



- The stringent requirements imposed when migrating a Mobile Telephony network to IP/MPLS is mainly dependent on two equally important parts:

  Media - Bearer Plane related = Speech or other service payload

  Signaling - Telephony Control Plane = Call Setup/Teardown

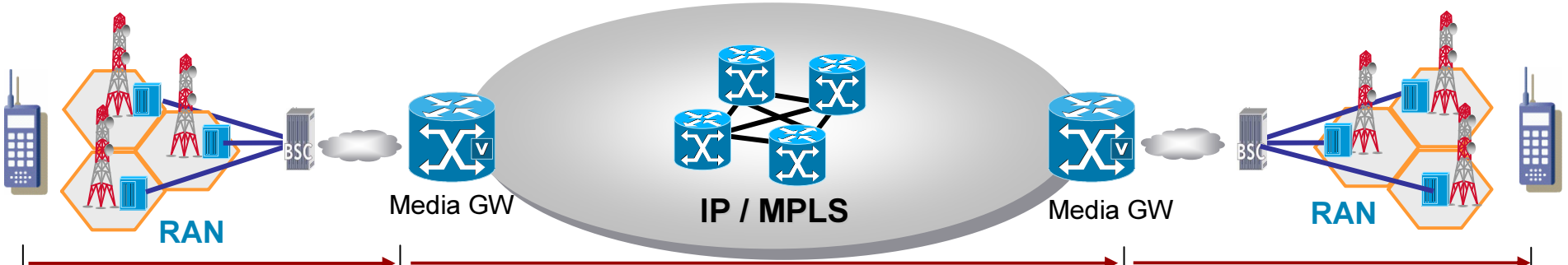
Typical SLA Requirements
Bearer and Signaling

	Traffic Type	SLA Metric (KPI)	Value	Comments
Summary Input from Customers and RAN vendors	Bearer	Average Delay	**10 – 30 ms**	Delay budget allocation for IP / MPLS typically around 20ms
		Max Delay	**50 – 100 ms**	Max Jitter is by definition <= Max delay
		Jitter	**< 5ms**	Less stringent if the codec used has support for Error concealment
		Packet Loss	**10^{-3} - 10^{-5}**	
		Failover Time	**1s - 2s**	If too high the user will simply hang-up
		Ordered Packets	**Required**	Out of order packet are considered lost

	Traffic Type	SLA Metric (KPI)	Value	Comments
Summary Input from Customers and RAN vendors	Signalling	Average Delay	**< 50 ms**	Typical Recommendation ~ 20ms
		Max. Delay	**50 – 100 ms**	Signaling is less delay senstive
		Packet Loss	**10^{-4}**	SCTP offers retransmission capabilitites
		Restoration Time	**Path Diversity And / Or Sub 400 - 800 ms**	Typically RAN vendors recommend using SCTP with Path Diversity but there are also scenarios where the Fast Convergence approach is leveraged. In the latter case the network is tuned to converge so fast that the error goes un-noticed to the signaling network.
				Some customers have articulated a desire to do both as the network will need FC tuning for future services anyway.

Delay Reference Model

Where does it go?



Air/Access network delay

~125 ms

Propagation delay
+
IP Processing delay

Prop. delay (5 ms/1000 km)
~10 ms (2000 km)

IP processing delay
Budget: 500 µs per hop

Air/Access network delay

~125 ms

The sum of all delay inducing components must be <400 ms

*** Assumes TrFO, Ref 3GPP TR26.935**

IP/MPLS Multiservice Network

Delivering on Network Requirements

Carrier-Class Protection and Restoration

- **Overall performance goal for convergence usually stated to be <1 second**
- **Extensive testing has been performed to validate performance and provide design guidelines**

	Native IP	MPLS (TE)
CE-PE Link Failure	**150 ms**	**150ms**
PE Failure	**Subsecond (Topology Dependent)**	**Subsecond (Topology Dependent)**
Core Link Failure	**Subsecond (Topology Dependent)**	**2 ms**
Core Node Failure	**Subsecond (Topology Dependent**	**2 ms**

Exceeding the service convergence requirements introduced by Carrier Class Telephony

Network Restoration

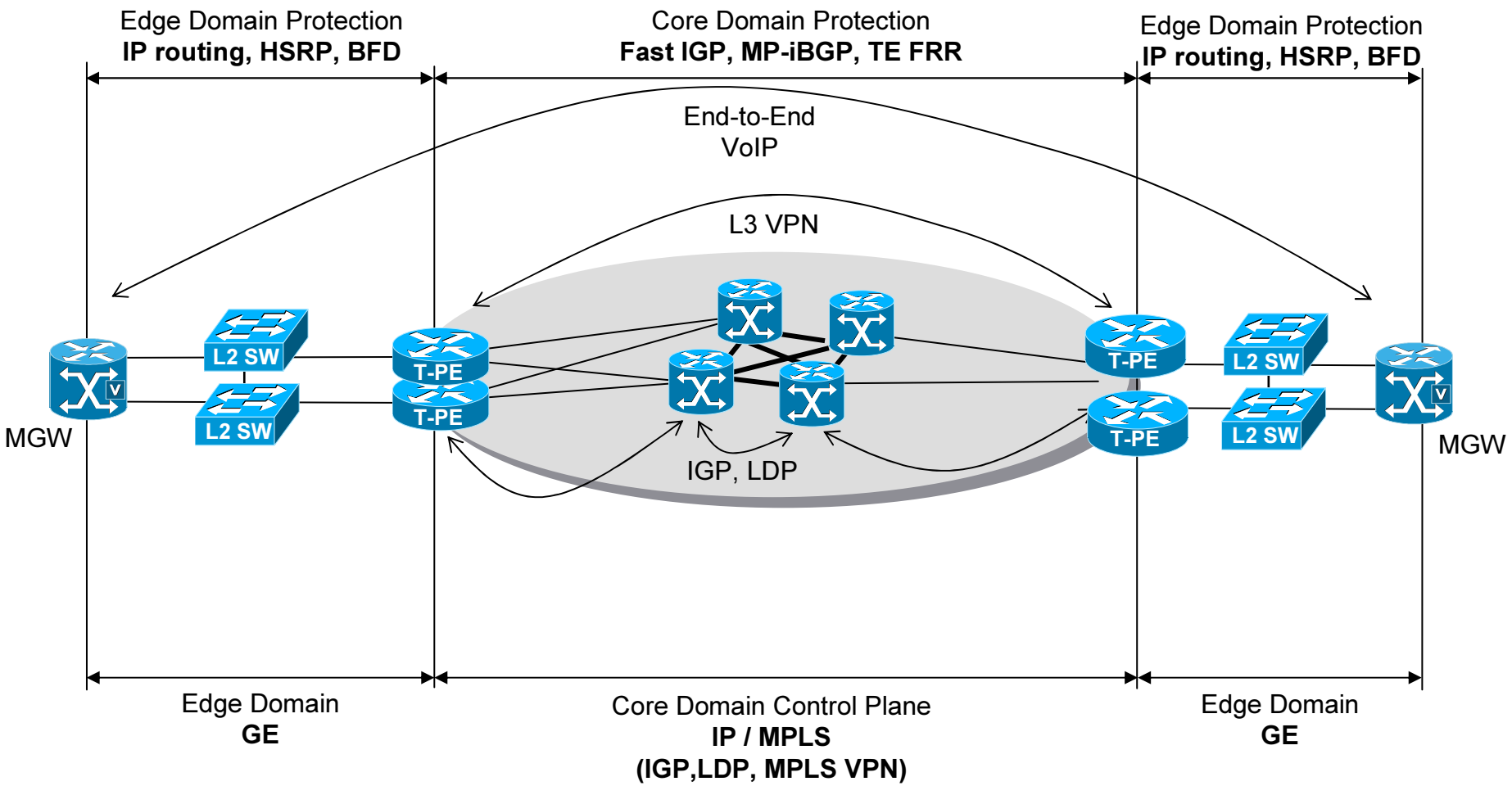
Summarizing the restoration operation, the total restoration delay can be computed as follows:

- Failure Detection Delay **(SDH and/or LoS and/or BFD)** +
- Failure Propagation Delay **(IGP and/or BGP)** +
- Update Network View **(IGP and/or LDP and/or BGP)** +
- Update Forwarding Plane == Service Restoration Time

- To optimize network convergence and service restoration, one or several steps must be minimized or avoided
- Control Plane optimizations, Platform optimizations and design all contribute

R4 Site structure and IP / MPLS Core Design

Site MGW Connectivity is typically layered for Scale and Services



Mobile Carrier IP / MPLS Investments are for the Long Term

First step is 3GPP R4 Telephony Bearer and Signaling

- R4 Telephony is only the beginning of a journey towards an **All IP Mobile Broadband Architecture**
- Immediate challenge lies in delivering a network with **Deterministic Performance and Characteristics**
- The R4 network must provide for a dynamic SLA environment coupled with:
  - **Rapid Subscriber and Traffic Growth**
  - **Feature and Service Flexibility and more**
  - **Uncompromised Deterministic Network Performance and Service Quality**

Applications and Services	IP / MPLS Capabilities
MultiService Environment **Mobile Telephony (R4)** **Data Services, VPN, Internet** **IMS, Gaming** **IPTV, Video on Demand**	**L2 and L3 VPN Technologies** **Quality of Service** **Security** **Multicast**
Continous Service Operation **High availability** **Fast Protection and Restoration** **Signaling path diversity**	**Fast Convergence** **IGP** **BGP / MPLS VPN** **Traffic Engineering and FRR** **In Service Software Upgrades** **Non Stop Forwarding- Non Stop Routing**

Agenda

- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Cisco RAN Solution Overview

- Cisco RAN Solutions catering for different Radio Technologies

GSM/UMTS/HSPA

RAN Backhaul Optimization (RAN-O)

Mobile Transport over Pseudowires (MToP)

Ethernet Backhaul for Mobile Transport

CDMA-2000/EVDO

EV-DO Aggregation

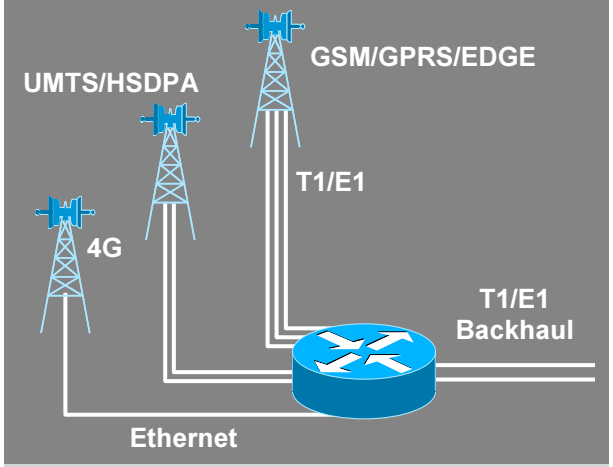
WiMAX

Ethernet Backhaul for WiMax

Cisco RAN-O Applications
Allowing Operators to Meet These Challenges

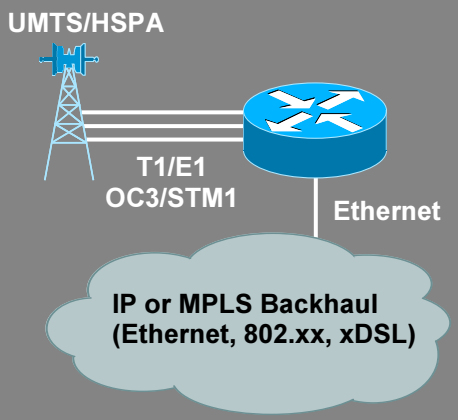
10 Wins, 50+ trials in progress or completed

2G/3G/4G RAN Transport Optimization over IP



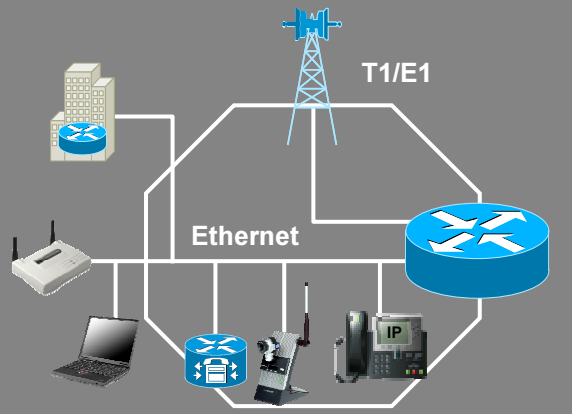
- 50%+ measured eff gain on GSM and UMTS
- No change to RAN backhaul design
- Single IP backhaul network serves 2G/3G/4G

HSDPA offload over IP/Ethernet Backhaul



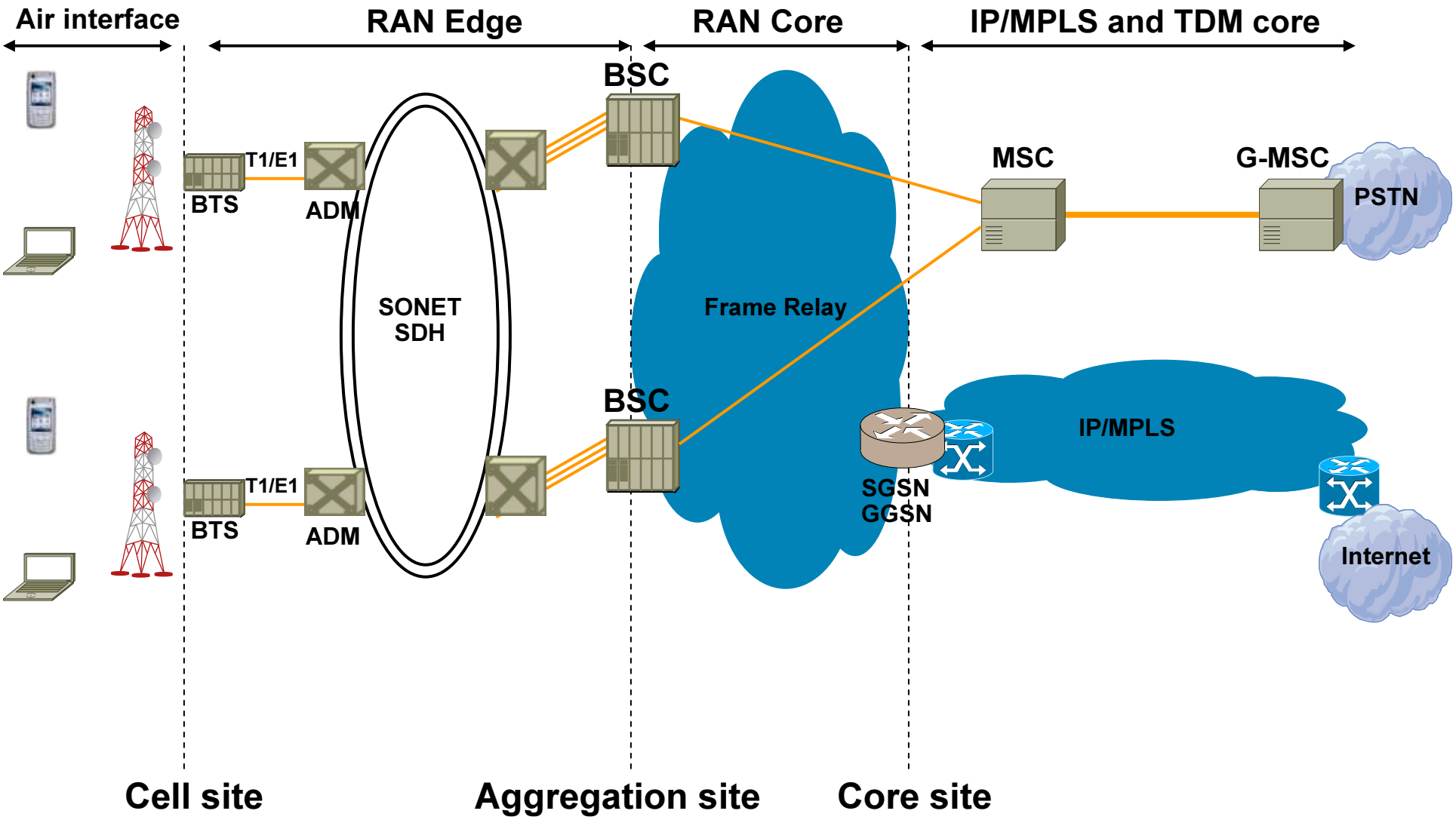
- RAN backhaul over any network
- Offload bandwidth hungry HSPA and UMTS data
- Simple network expansion

Cell Site IP POPs Unified RAN Network

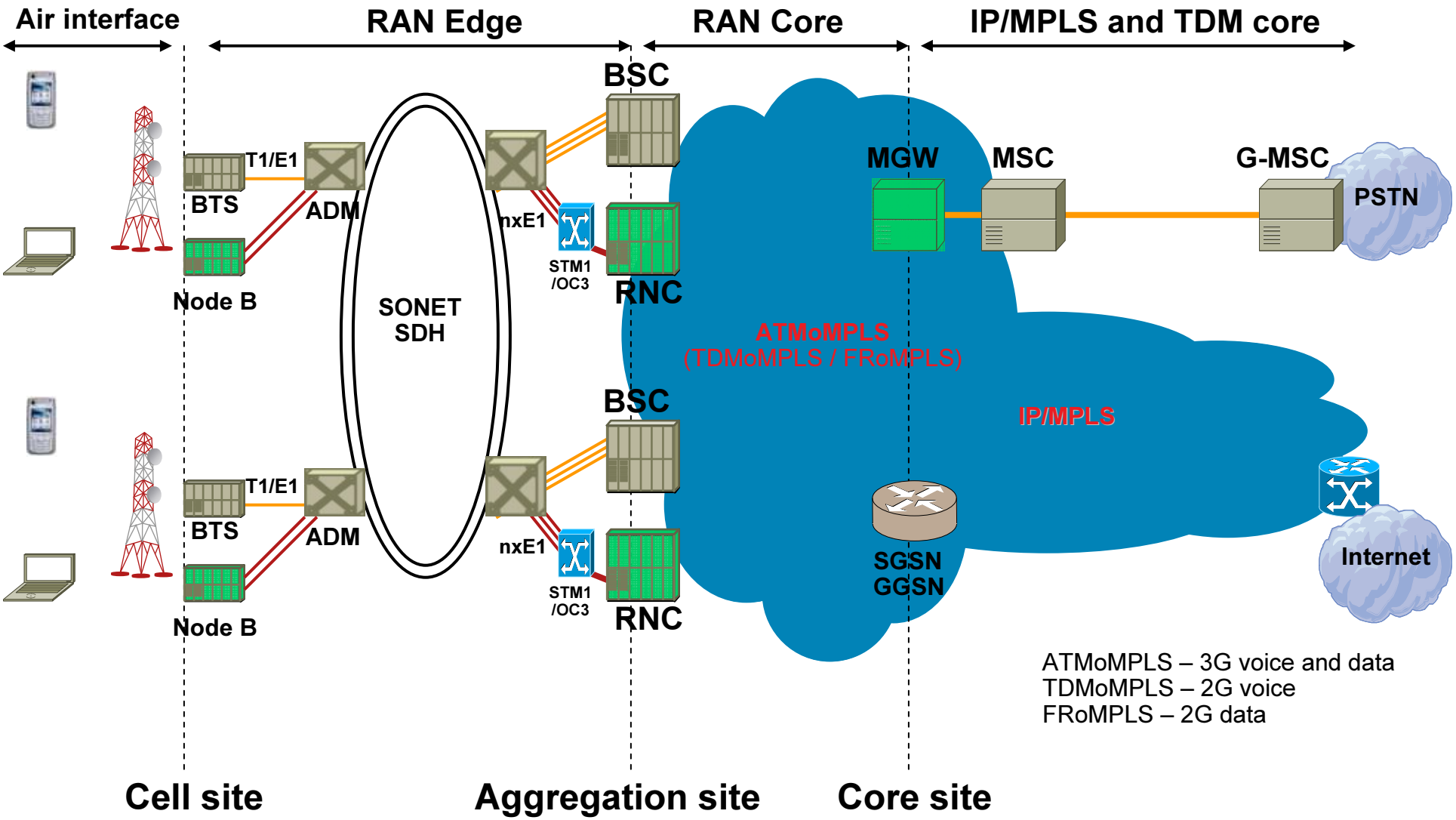


- Intelligent cell site IP enables new revenue generating services
- Remote cell site management and LAN extension
- Seamless expansion to 4G

Existing 2.5G Network Architecture

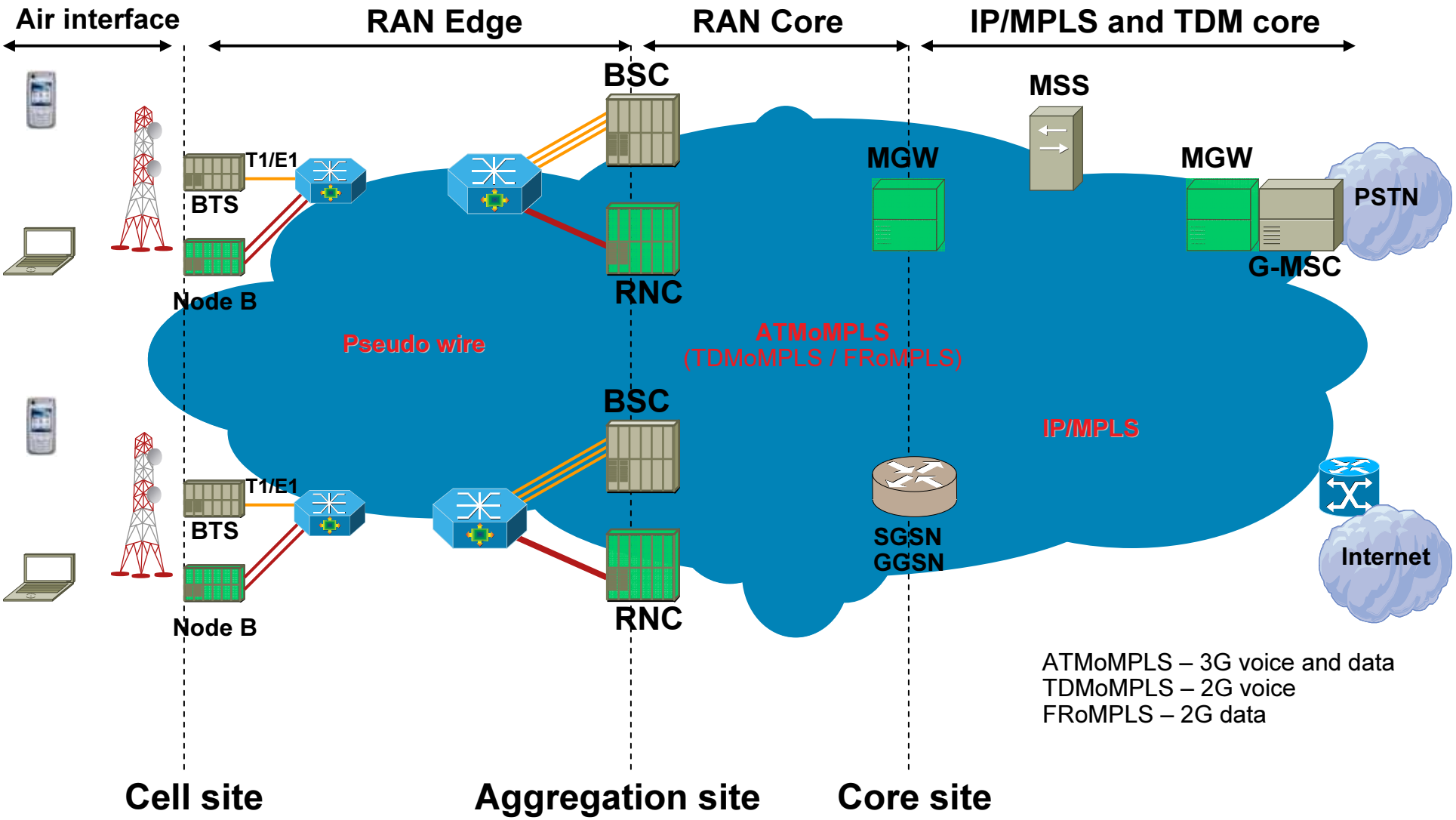


ATM pseudowire in the RAN core allow operator to cap investment in ATM

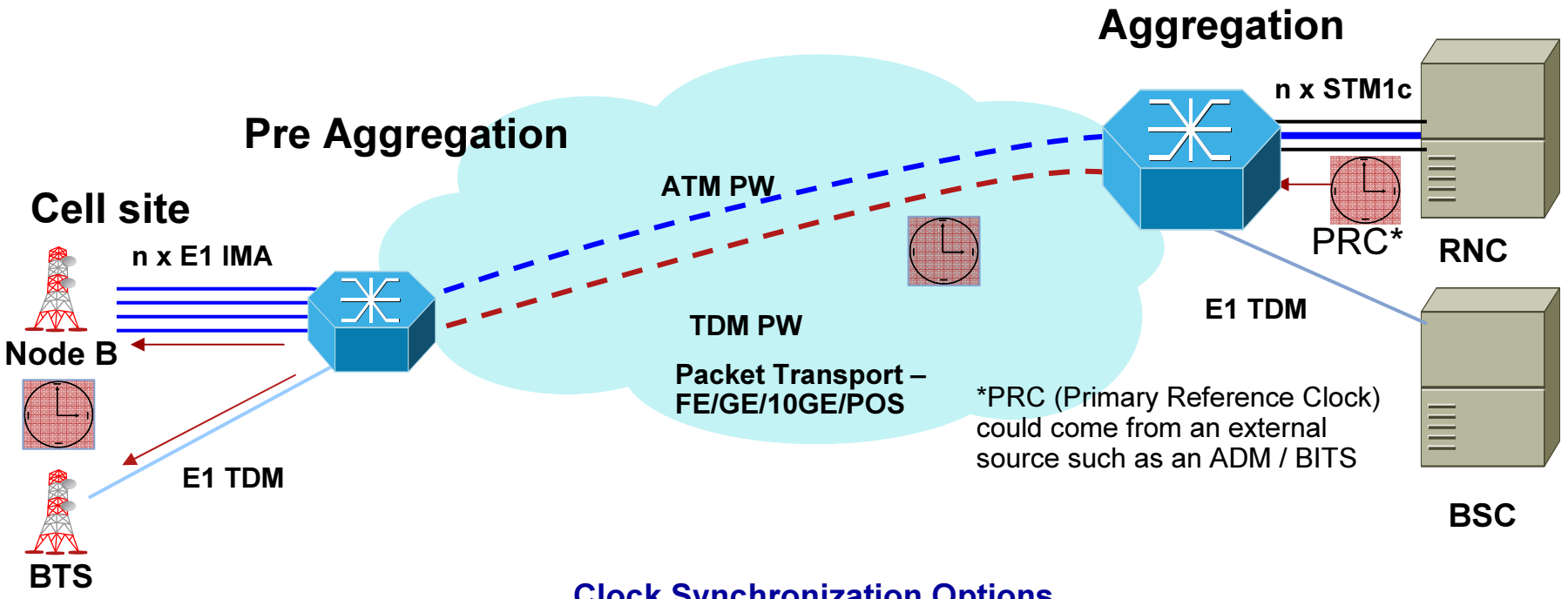


ATMoMPLS – 3G voice and data
TDMoMPLS – 2G voice
FRoMPLS – 2G data

3G R4 IP or ATM true converged IP backbone



Clock Distribution
Mixed TDM/ATM Cell Sites



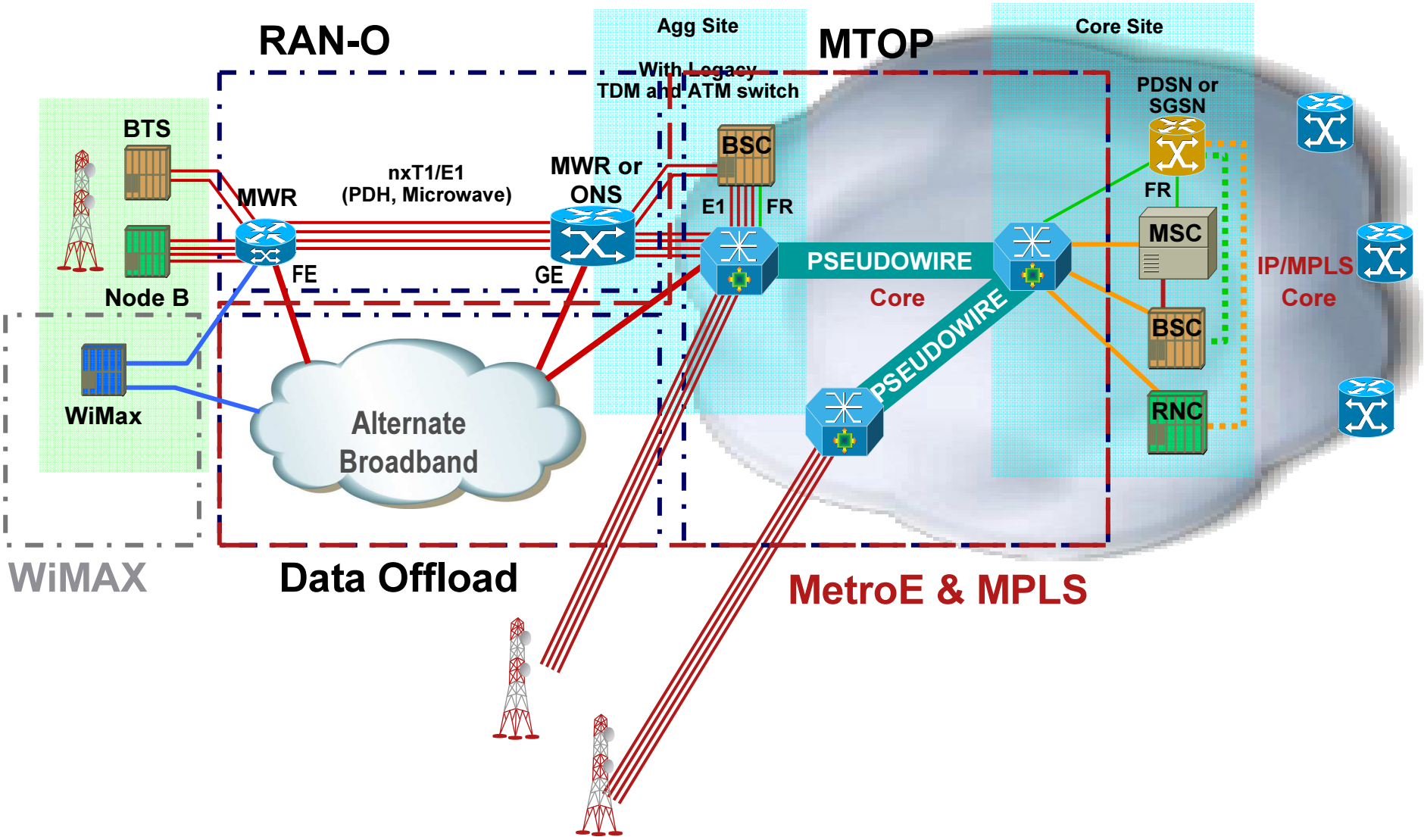
Clock Synchronization Options

1. **Synchronous** : Cell site receives the same TDM clock from an external source, like, BITS, SONET, GPS, etc. Most expensive option.

2. **Differential** : Both ends of the PW source clock from the same reference. The TDM clocks are derived at the pre aggregation point from differential information passed in the PW.

3. **Adaptive** : PW endpoints do NOT have common clock source. Instead, the clock is derived based on packet arrival rates.

Recap on What we are Offering

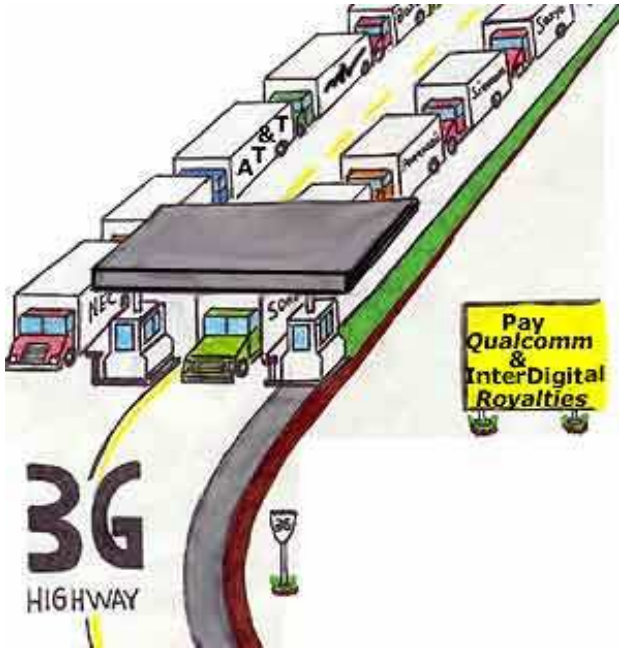


Agenda

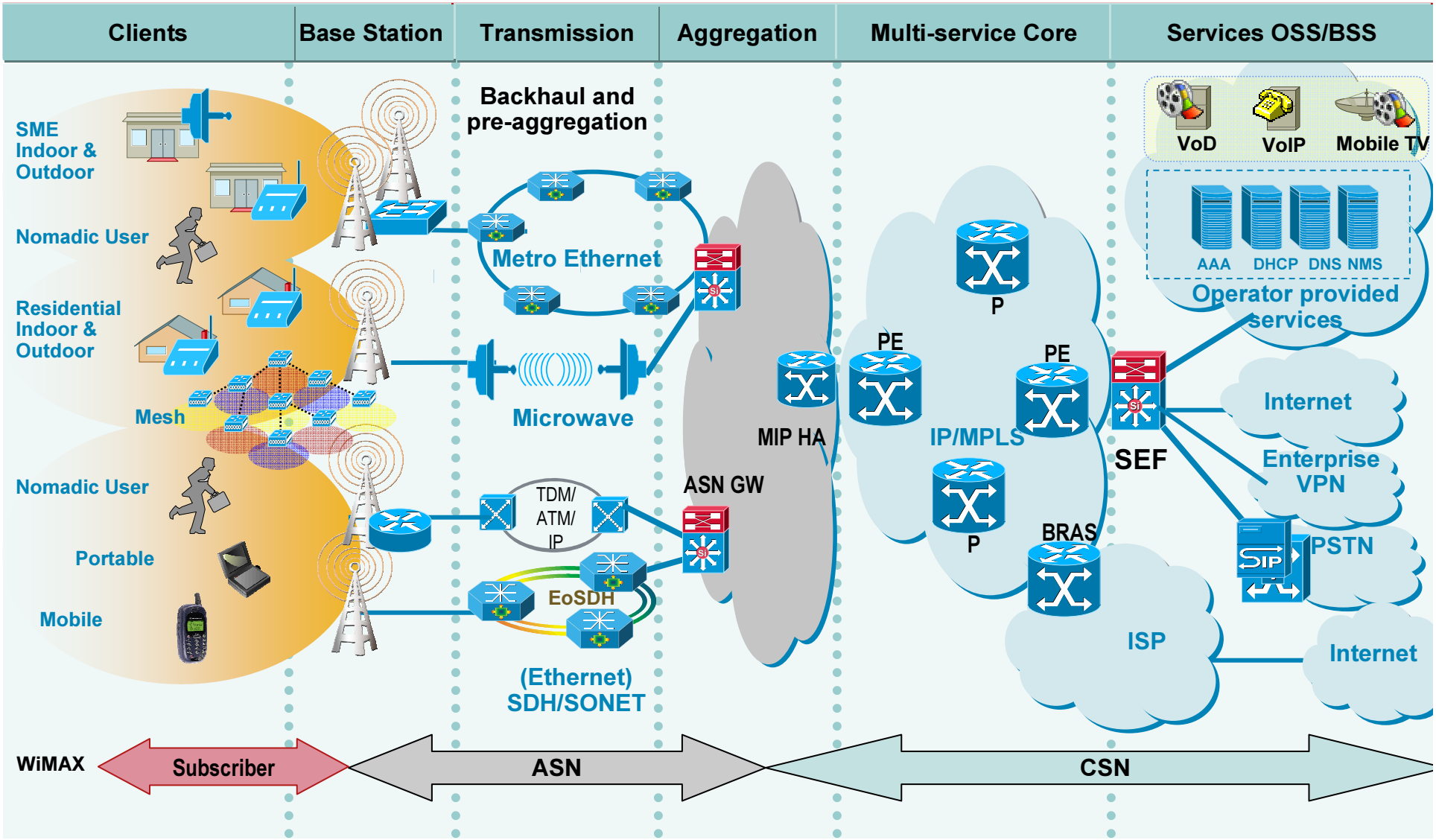
- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Why is WiMAX Attractive to Operators ?

- Intellectual Property Rights (IPR) problems with 3G (Qualcomm)
- Large ecosystem is developing including handset vendors
- Spectrum is becoming available
- Will go all-IP e2e years ahead of 3G
- Leading the movement to “open” systems
- Is being incorporated into WiFi muni-mesh opportunities (Cisco Digital Cities Initiative)
- WiMAX Forum driving the technology forward (approaching 400 members)
- Will adopt OFDMA and MIMO well ahead of the 3G camps
- Emerging Market is seeing lots of activity
- WiMAX is excellent where countries & locations have no existing infrastructure



Cisco E2E Mobile WiMax Solution Architecture

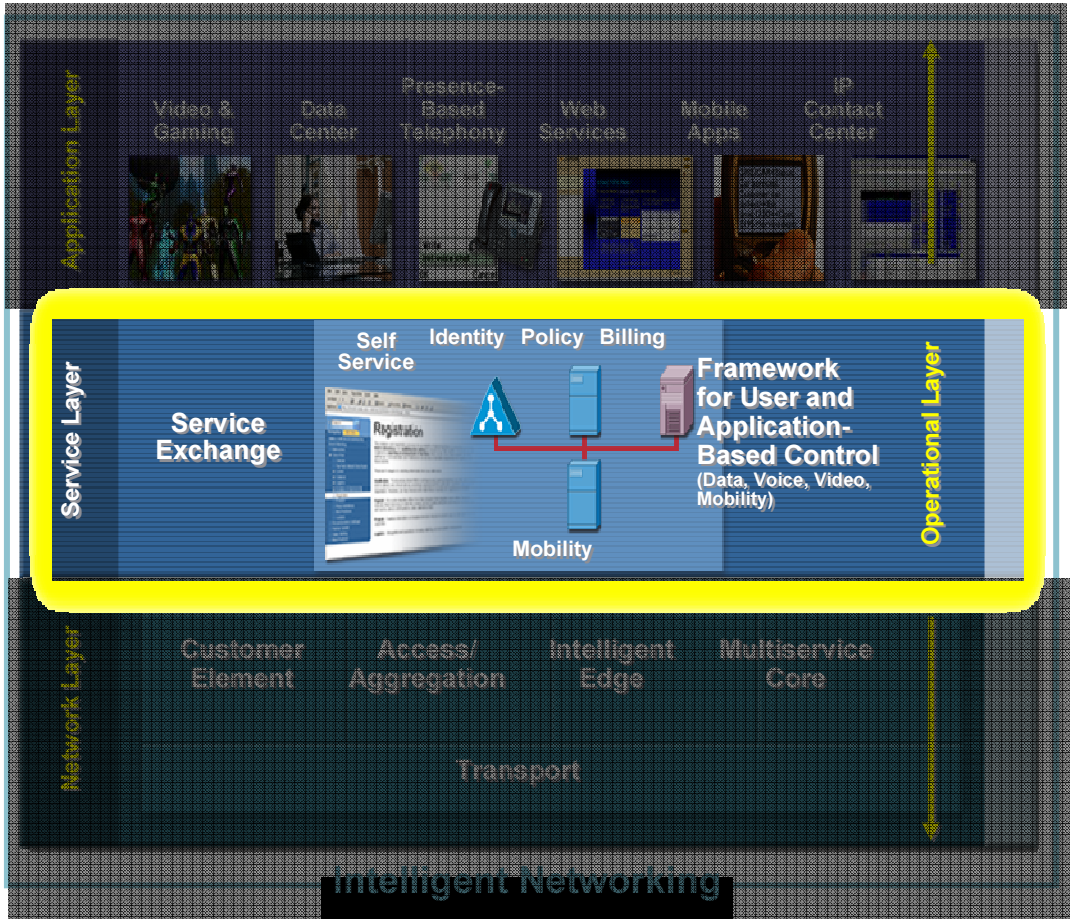


Agenda

- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Cisco IP NGN Service Exchange Framework (SEF)

- SEF provides service and application convergence layer for next generation networks
  - Enables service providers to control customer access through use of dynamic session and service management
  - Open approach—standard interfaces
  - Provides service/application abstraction layer from network
  - Network and access agnostic capability exposure
  - Zero touch provisioning
  - Rapid service deployment



Service Exchange Framework

Making 'Triple Play on the Move' Real

WHO?

- Who is the user?
  - Devices
  - Profile
  - Location
  - Presence

HOW?

- How can I dynamically control resources?
  - Interwork & provide rich media control
  - Monitor & charge on a per service/per user basis
  - Enable application awareness

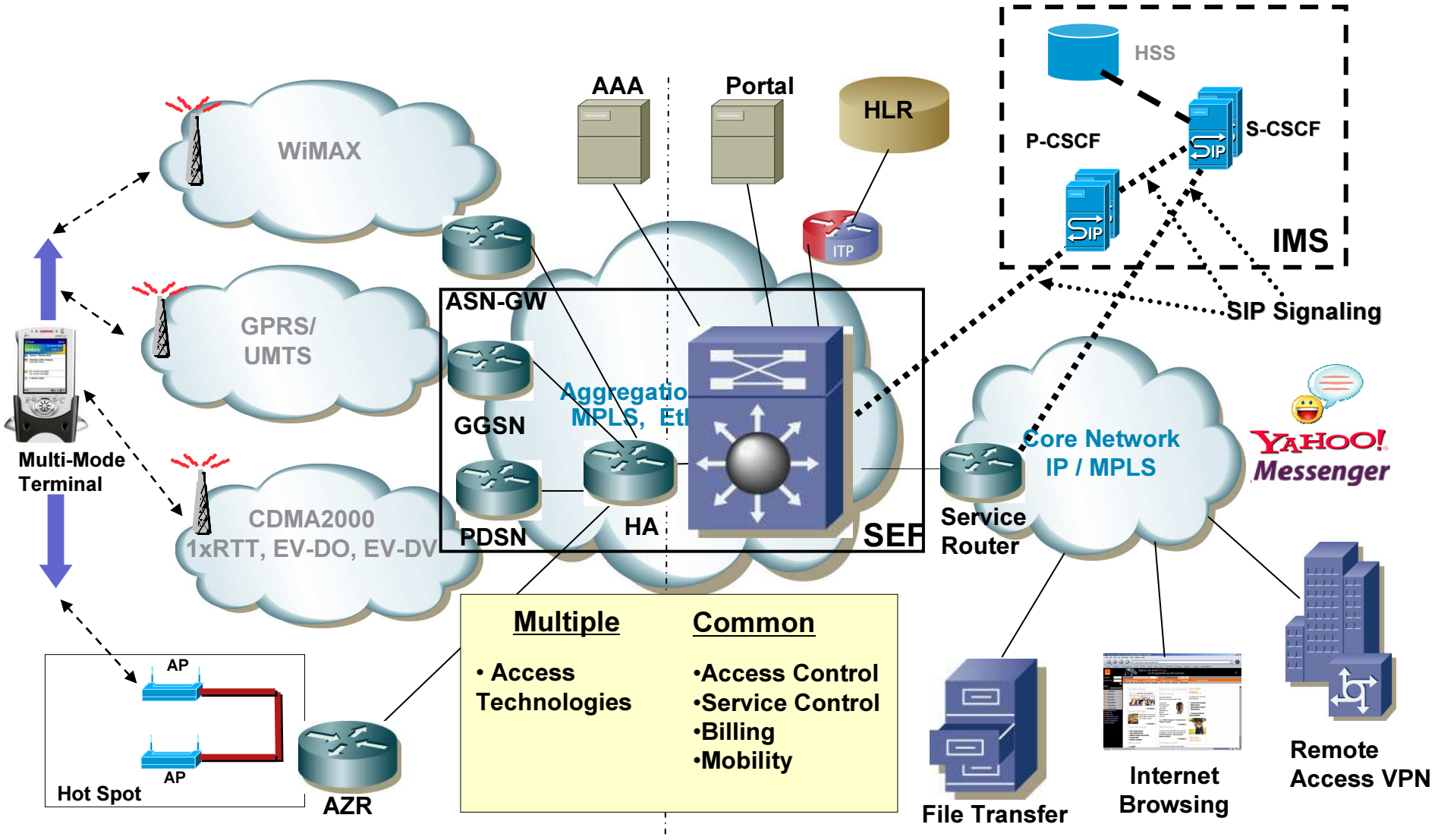
WHAT?

- What can the user do?
  - Within what timeframe
  - To what extent
  - Under what rules

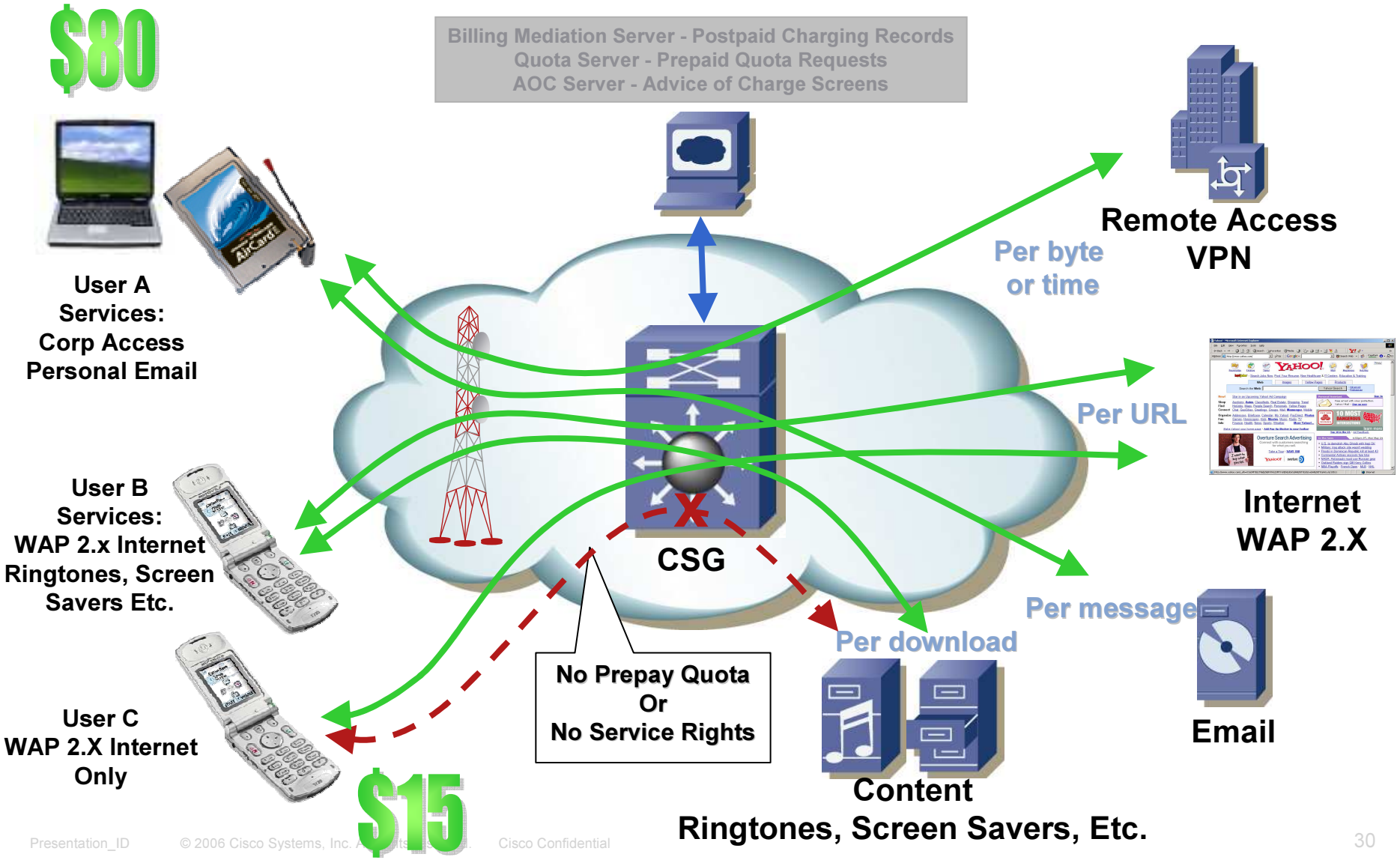
WHERE?

- Where can the user roam?
  - Track/recognize user devices across carriers
  - Maintain user sessions across multiple networks
  - Offer all services in all locations

SEF Architecture
Common Service Layer for Different Access Networks

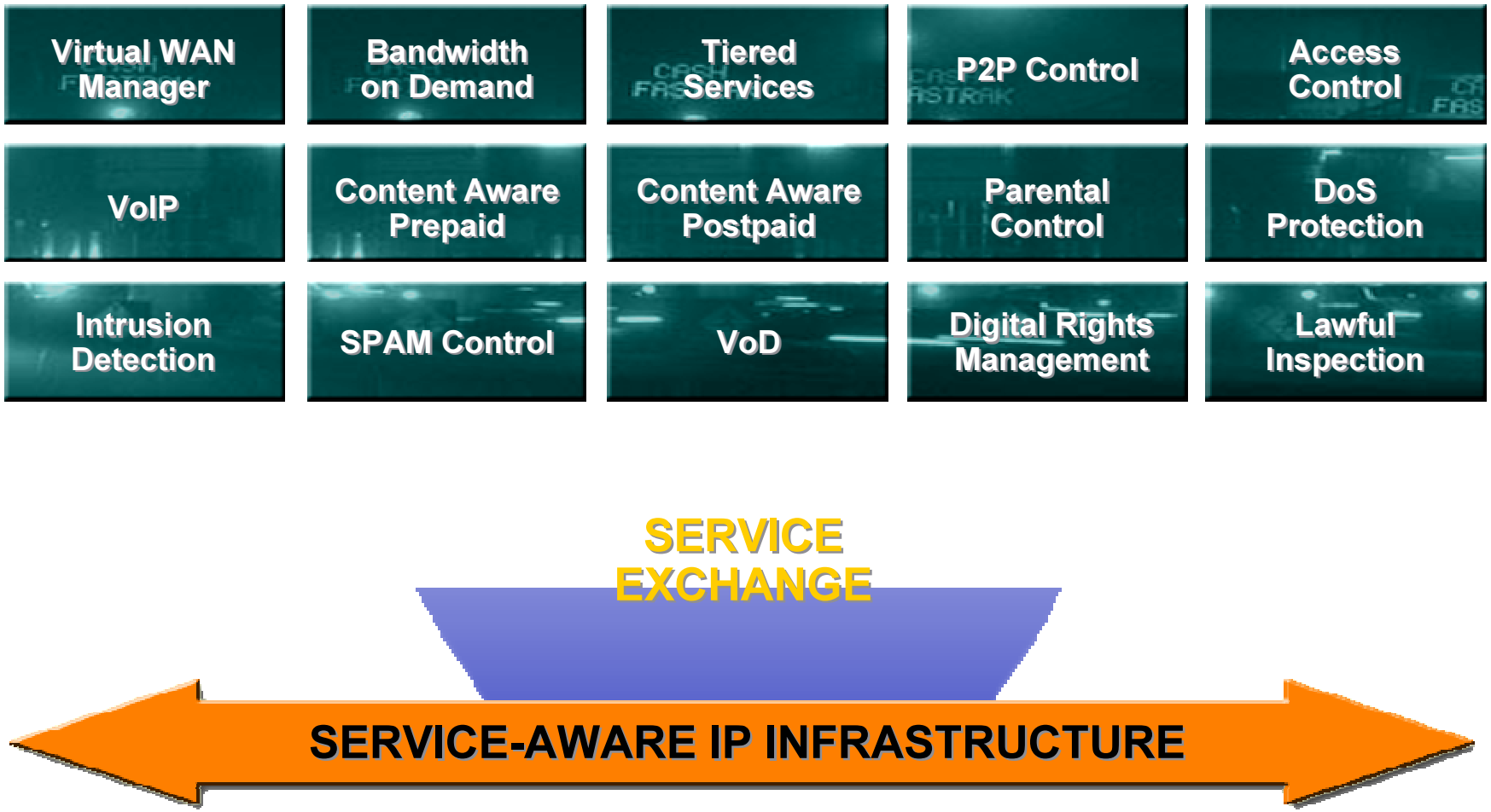


SEF-Content Billing and Service Control



Services: Highway to Tollway Transition

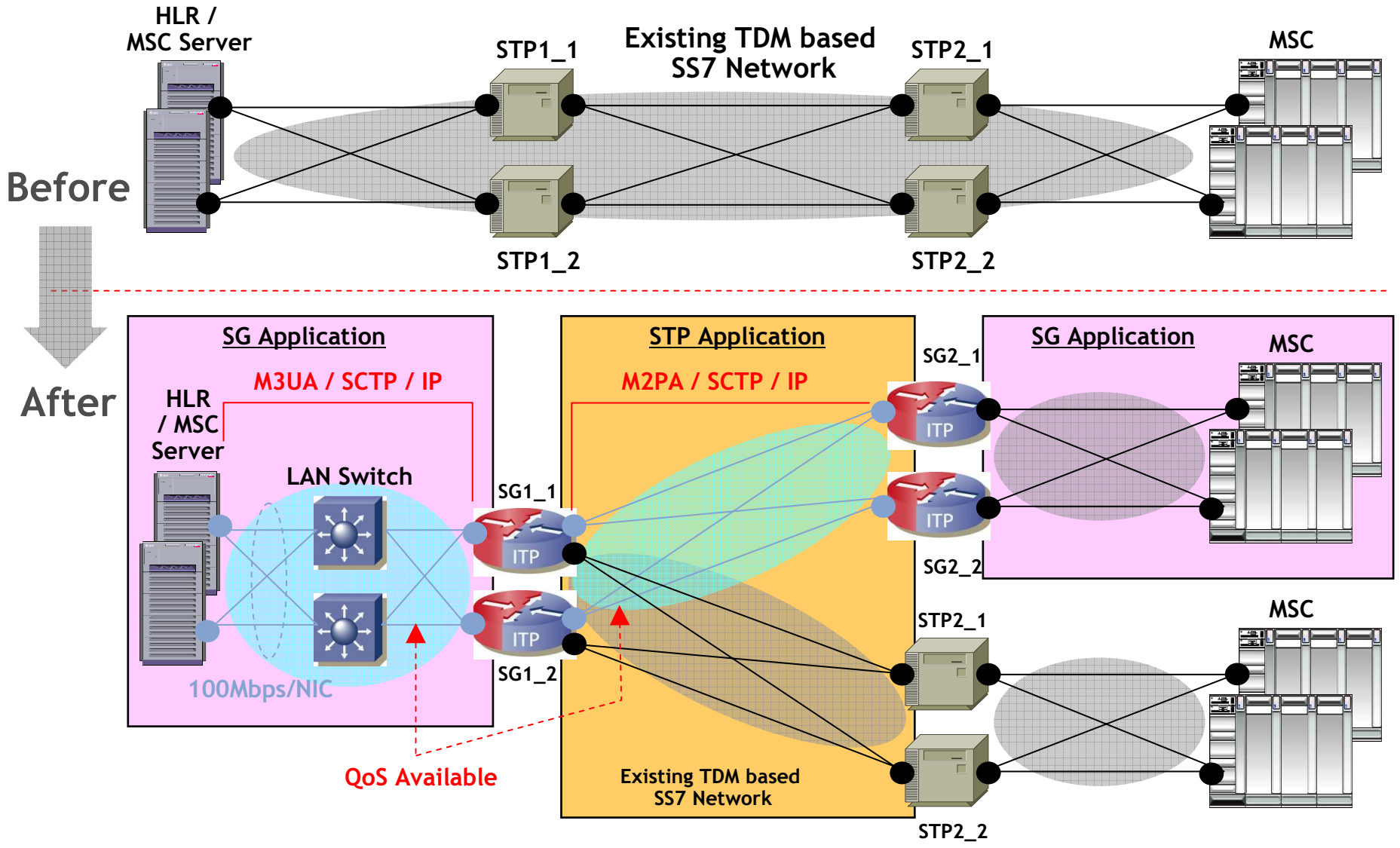
From Flat-Fee to Value-Based Revenue Model



Agenda

- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Signaling Over IP (SG & STP Offload)

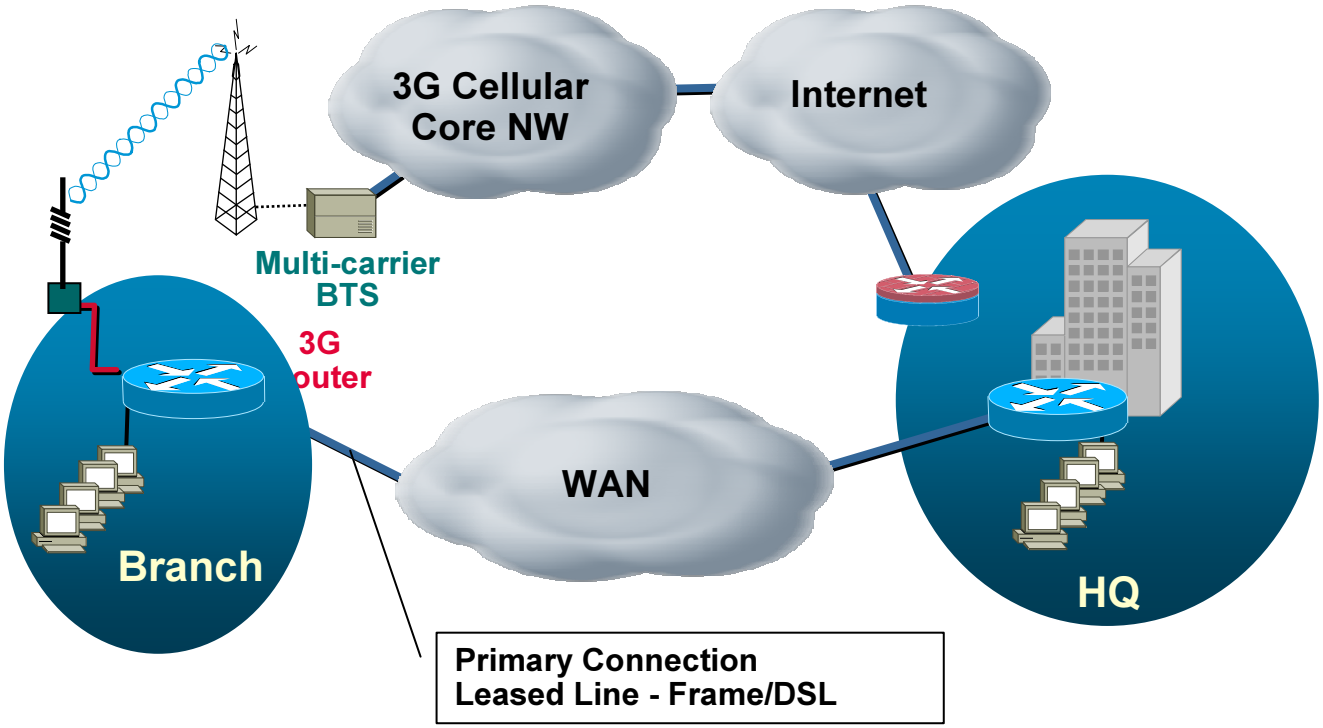


An “ITP” is:

- An integrated STP/SG (and high capacity IP router)
- A core STP with:
  - –Carrier Grade reliability
  - –Low Power/Small Footprint
  - –Traditional TDM-based STP
  - –Next-generation STP
- A Signaling Gateway with:
  - –Flexible edge platforms to suit operators needs
  - –Proprietary Group feature enhances reliability
  - –Strong SMS routing features
  - –Strong partnership with Database vendors

Coming

Wireless Secure Broadband Connected Mobile
(Remote Store or Branch WAN Backup)



Notes:
Can be more Cost Effective than Leased Line

Excellent Alternate connection –
- Primary and backup typically carried in same conduit
- BTS often served by independent CO providing reliability

Excellent solution for temporary access

Primary alternative for certain customers
- ATM Locations
- Small retail
- Construction Sites
- Trade Shows
- Kiosks

3G HWIC provides a cost effective alternative to ISDN dial back up for Business Continuity

Agenda

- Vision for Mobility & IP NGN Architecture
- IP Transport in Mobile Core (Mobile R4)
- IP Transport in RAN (IP RAN)
- Wi-Max
- Mobile Service Exchange Framework (mSEF)
- SS7 over IP & Other Solutions
- Mobile Security Solutions

Top of Mind Security Concern for Mobile Operators

- Attacks to the mobile SP business (and their network)
- Storing of forensic logs—SOX, HIPPA, stolen credit information etc.
- Content Control becoming mandated either internally or externally
- P2P misuse—Skype, Blubster
- SMS Spam
- Flow Metrics—Understanding Traffic flows and control of these flows
- Mobile Protocol Inspection—mobile IP, GTP
- Security as a new revenue stream

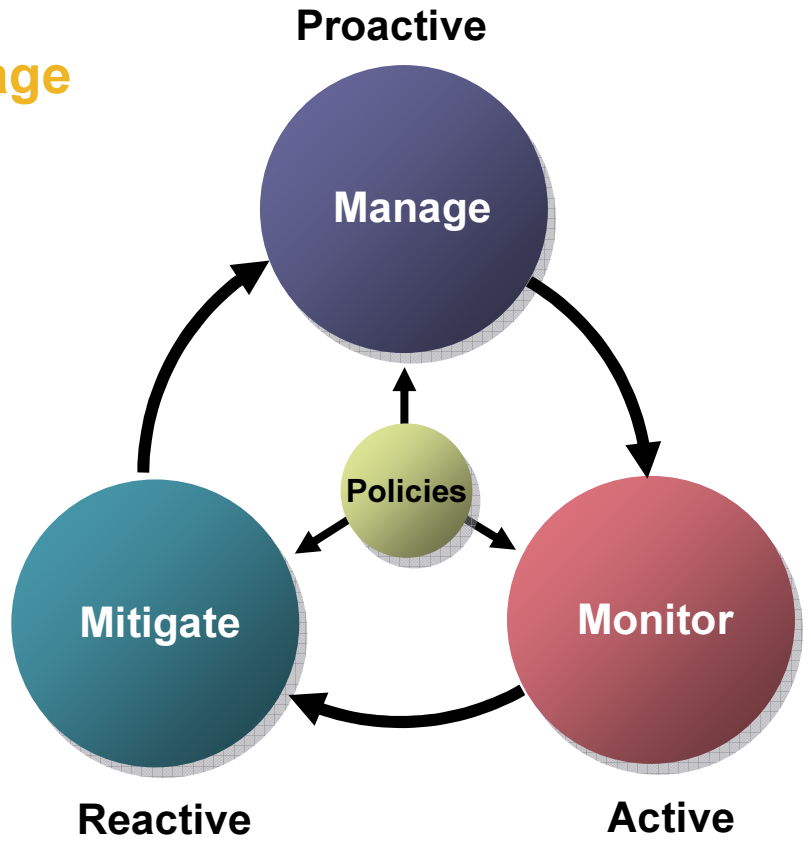
Solutions Engineered With Latency and Scalability in Mind

Cisco Mobile Security Framework

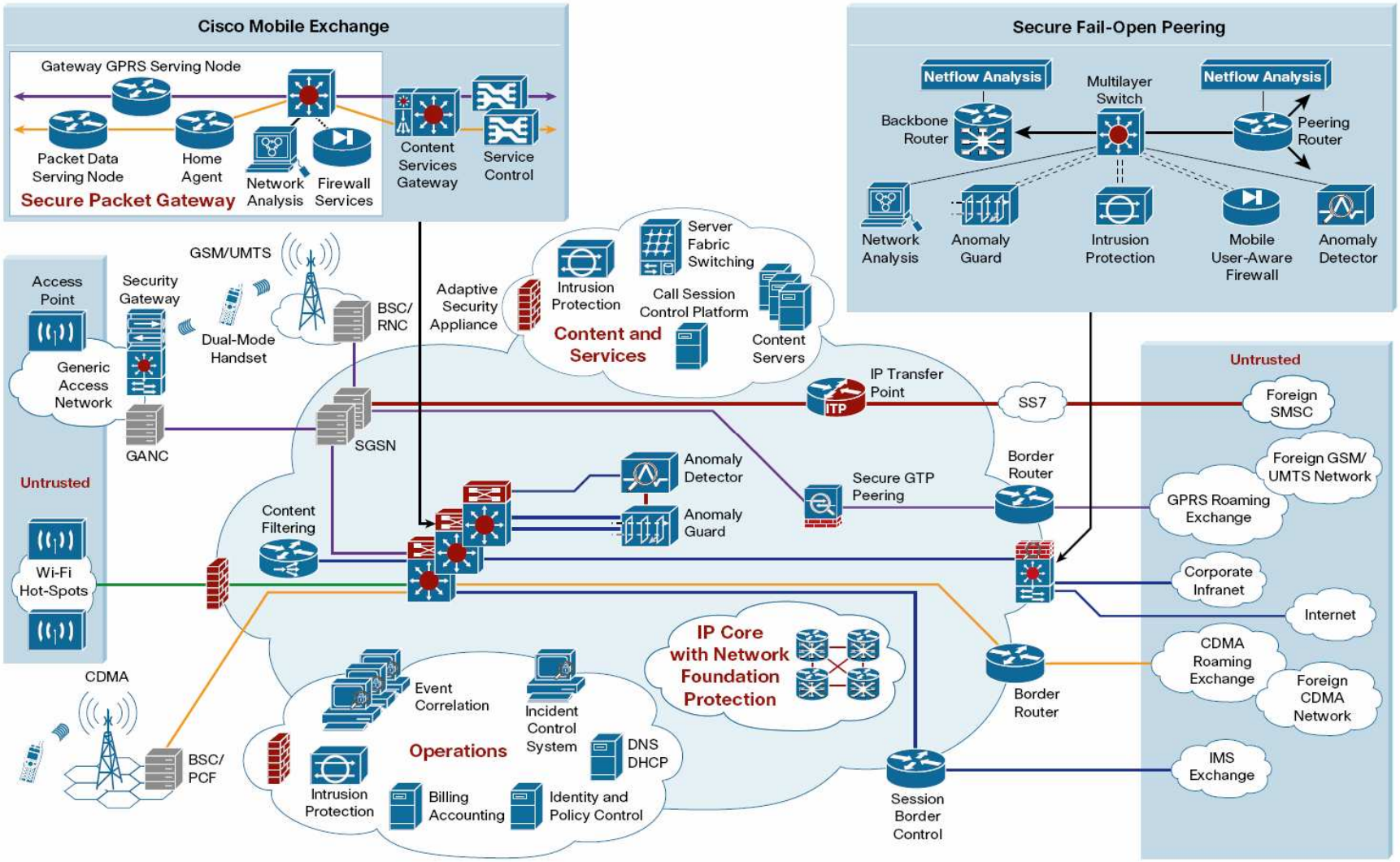
Manage, Monitor, Mitigate…

To effectively address the risks inherent to Mobile networks operators must implement a continuous, iterative process of:

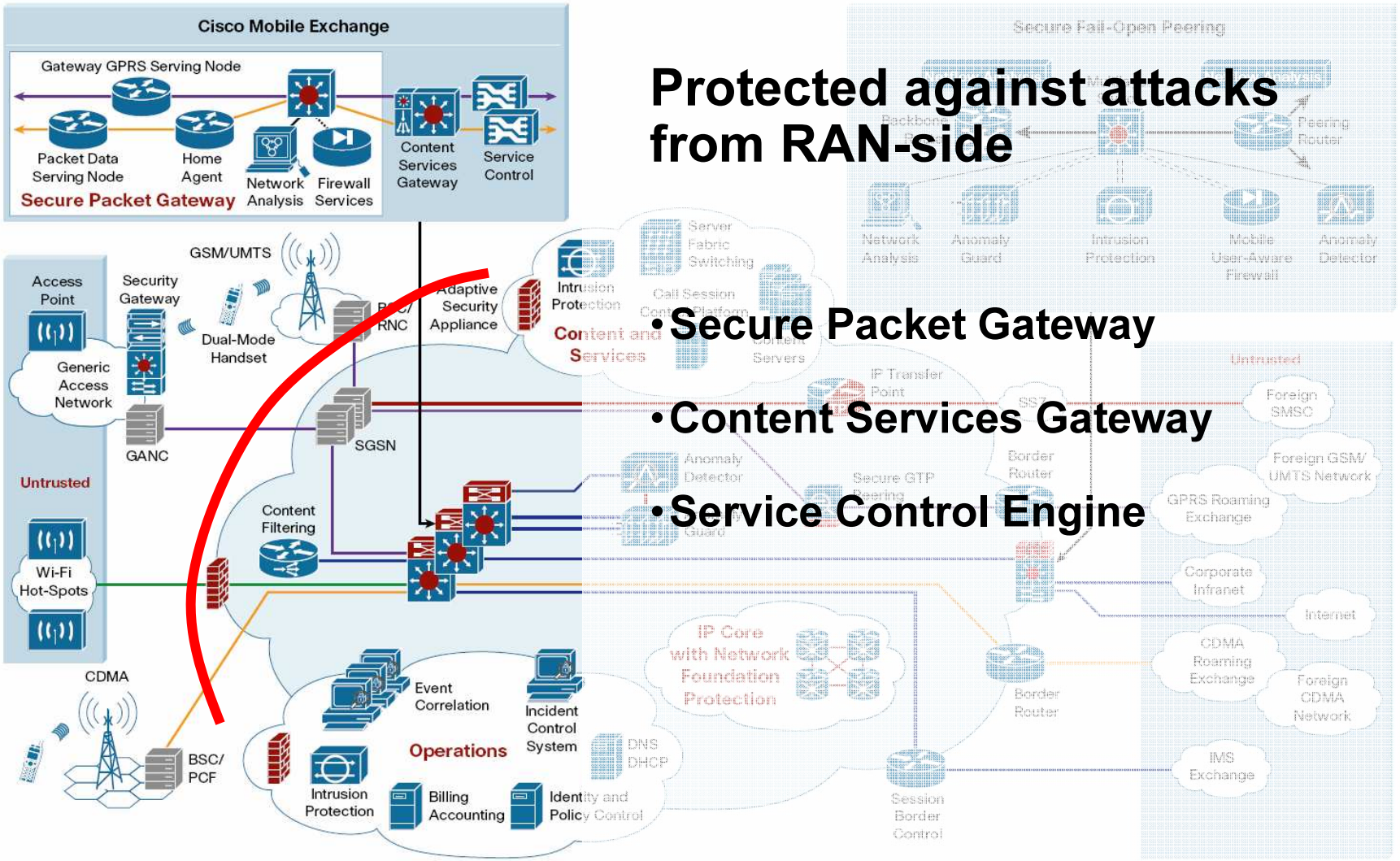
- **Proactively applying policies to manage subscriber behavior and harden the network and services infrastructures**
- **Actively monitoring network usage and subscriber behavior to assure policy compliance and the detection service-impacting events**
- **Reacting quickly to mitigate attacks and respond to non-compliant subscriber behavior**



Cisco Mobile Security Framework



RAN-side Protection



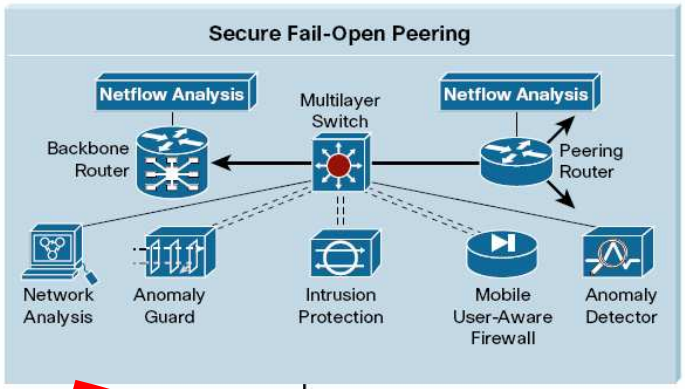
Protected against attacks from RAN-side

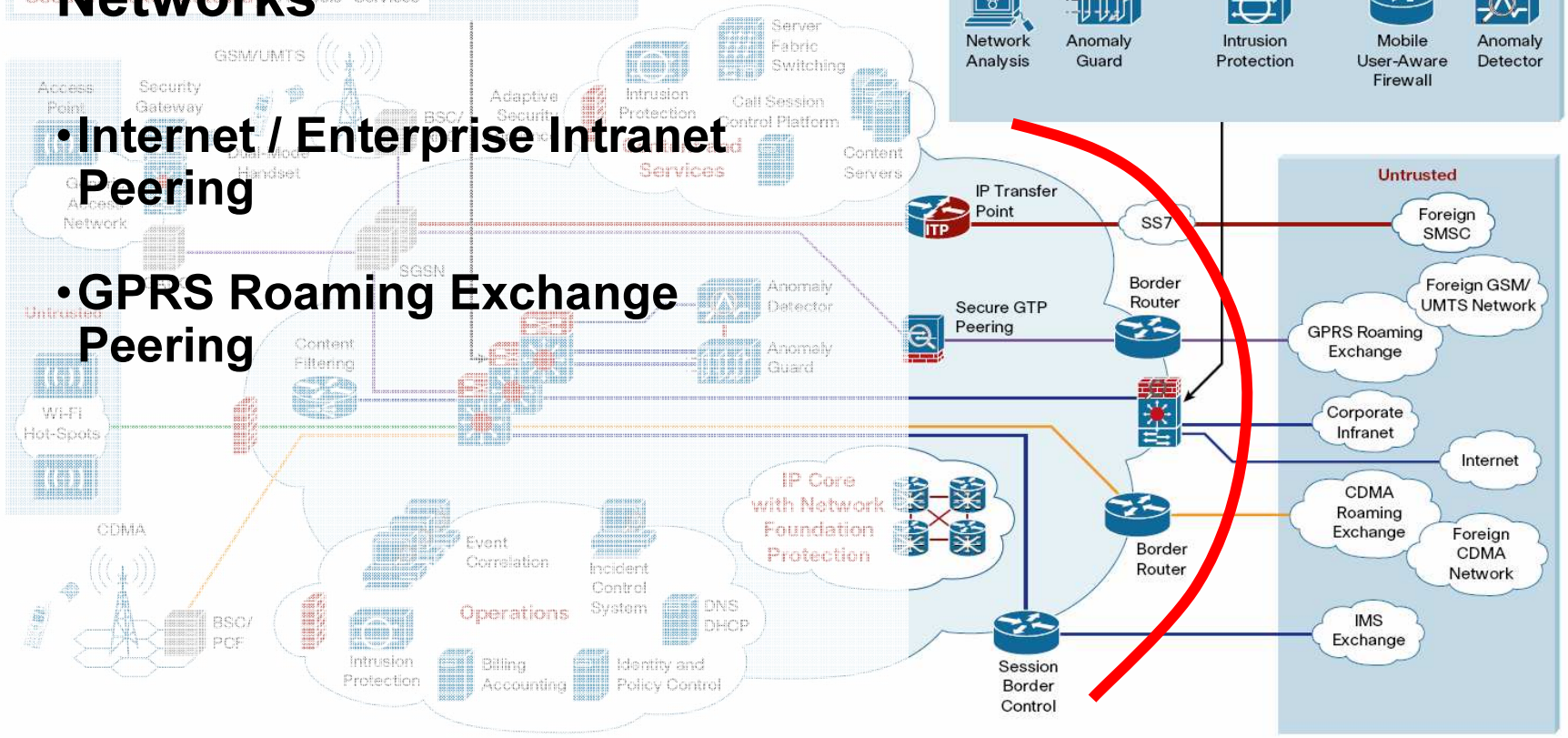
- **Secure Packet Gateway**
- **Content Services Gateway**
- **Service Control Engine**

Peering Protection

Protected against attacks from un-trusted Peering Networks

- **Internet / Enterprise Intranet Peering**
- **GPRS Roaming Exchange Peering**

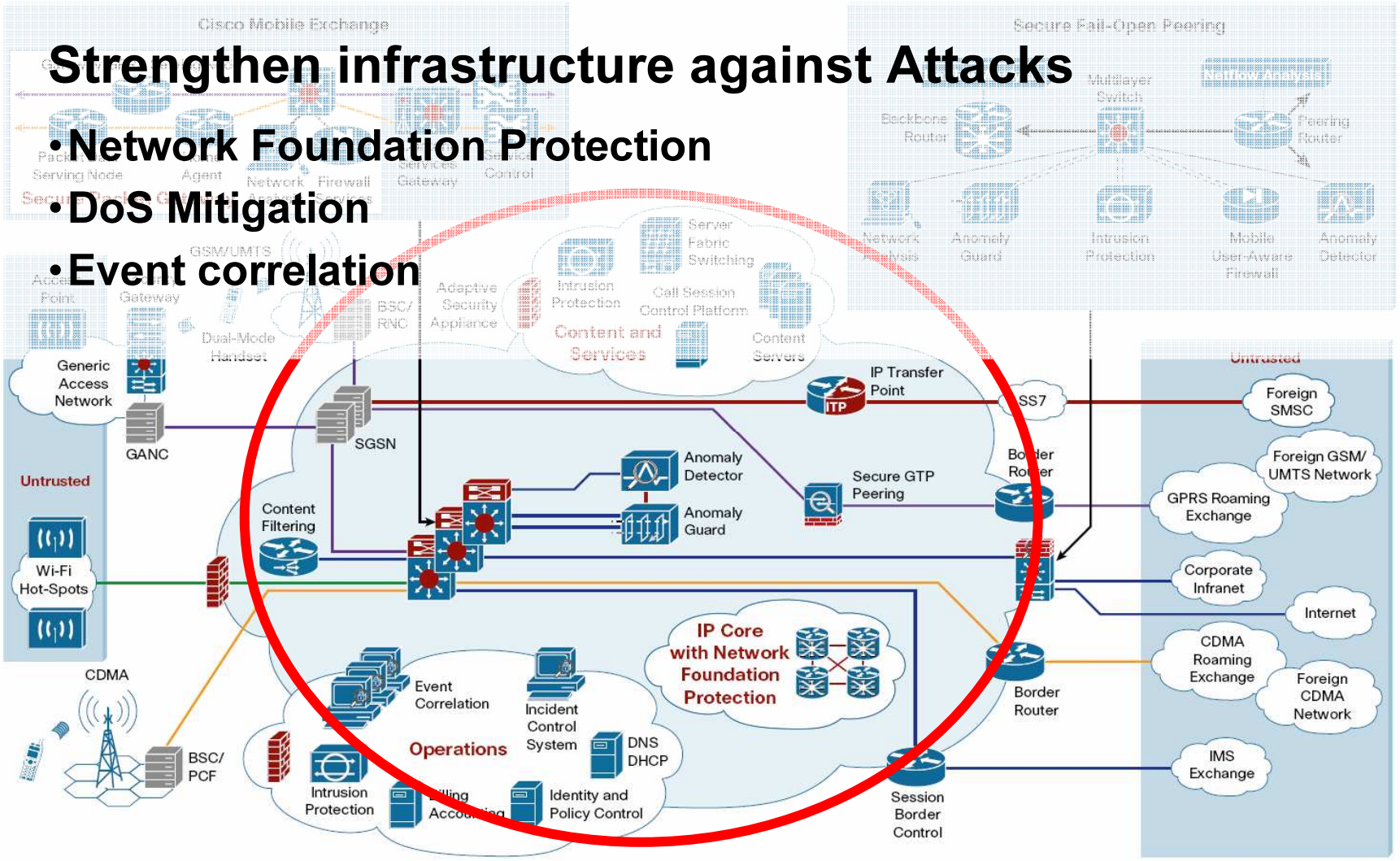




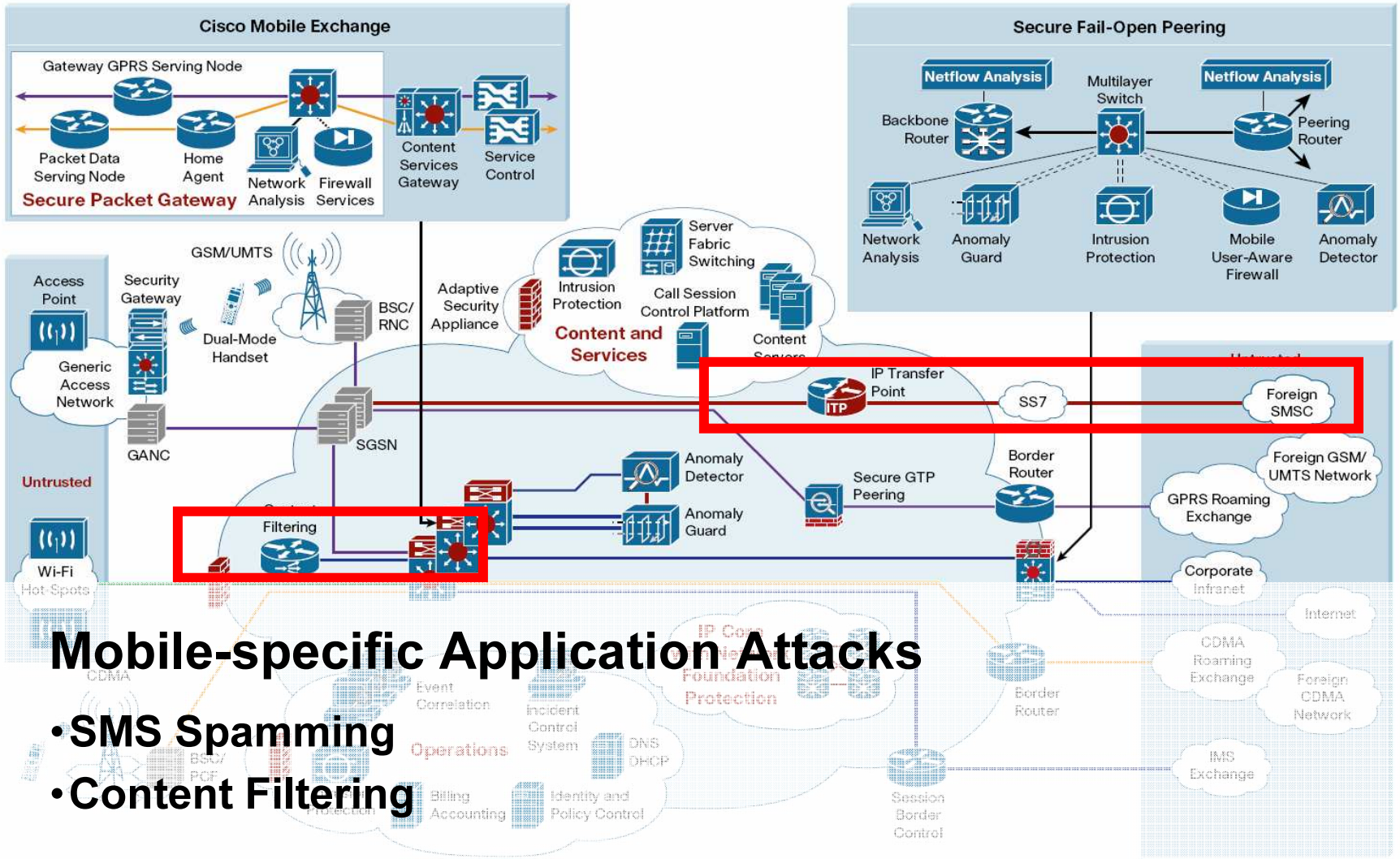
Infrastructure Protection

Strengthen infrastructure against Attacks

- Network Foundation Protection
- DoS Mitigation
- Event correlation



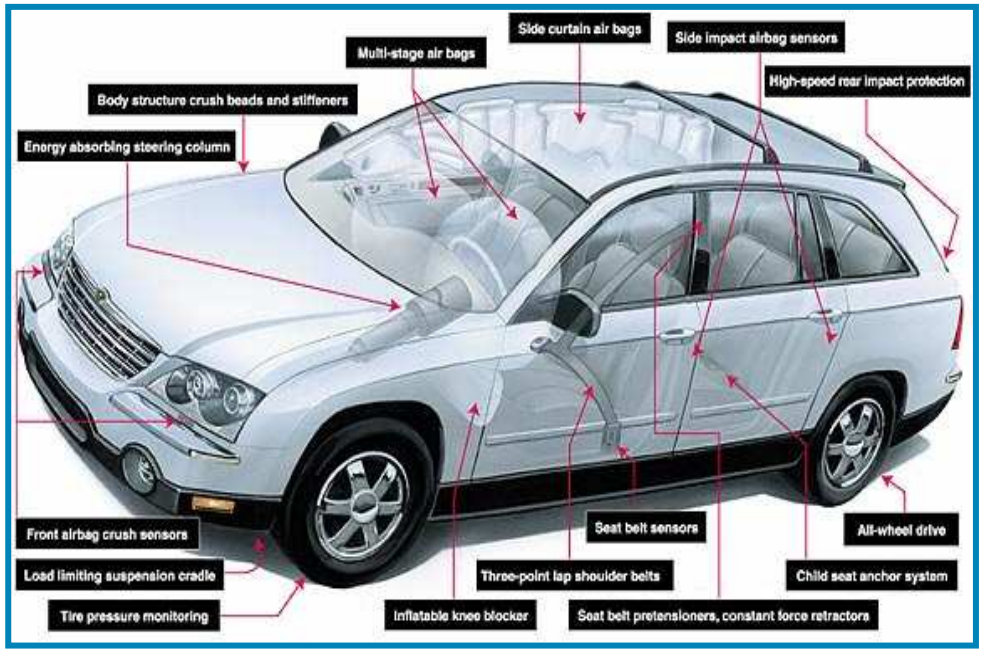
Application Protection



Mobile-specific Application Attacks

- SMS Spamming
- Content Filtering

Choose the Right Approach …



Security as an Option

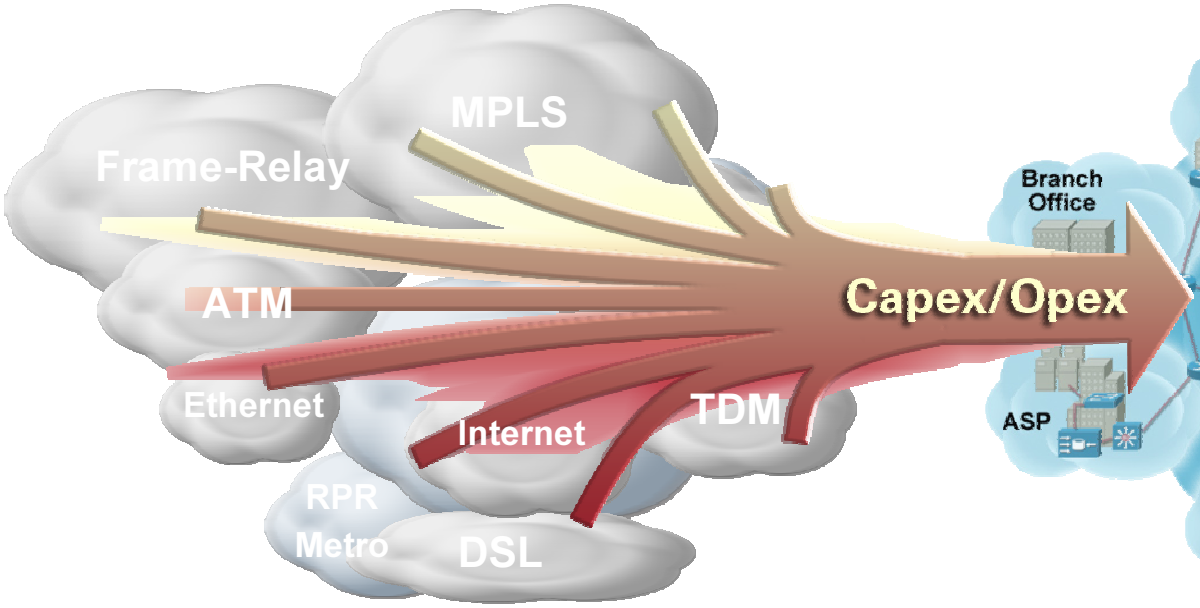
- Security is an add-on
- Challenging integration
- Not cost-effective
- Cannot focus on core priority

Security as INTEGRAL of a System

- Security is built-in
- Intelligent collaboration
- Appropriate security
- Direct focus on core priority

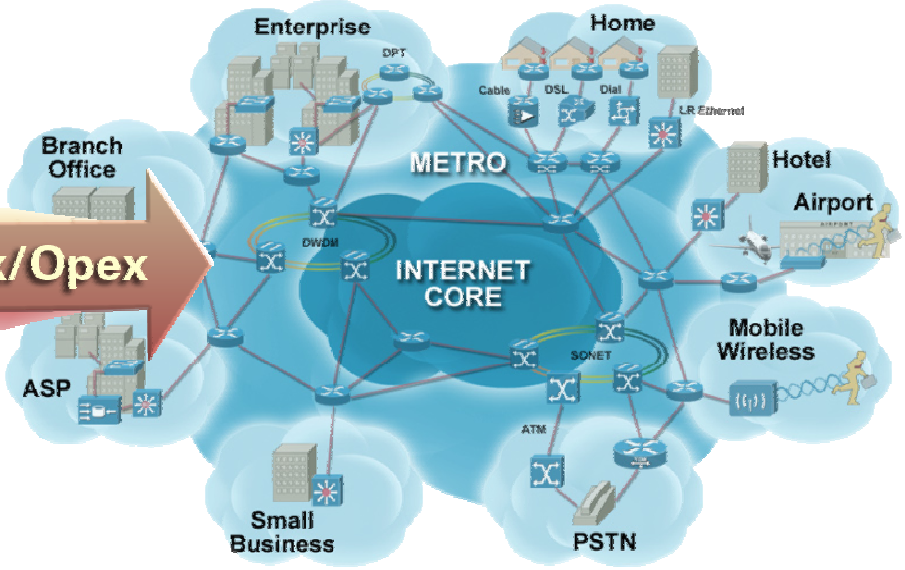
Mobile Networks are Evolving

Multiple Interworked Networks



- Often connection oriented
- End-to-end provisioning
- Scalability issues
- Capex intensive
- Less Opex efficient

Converged Network

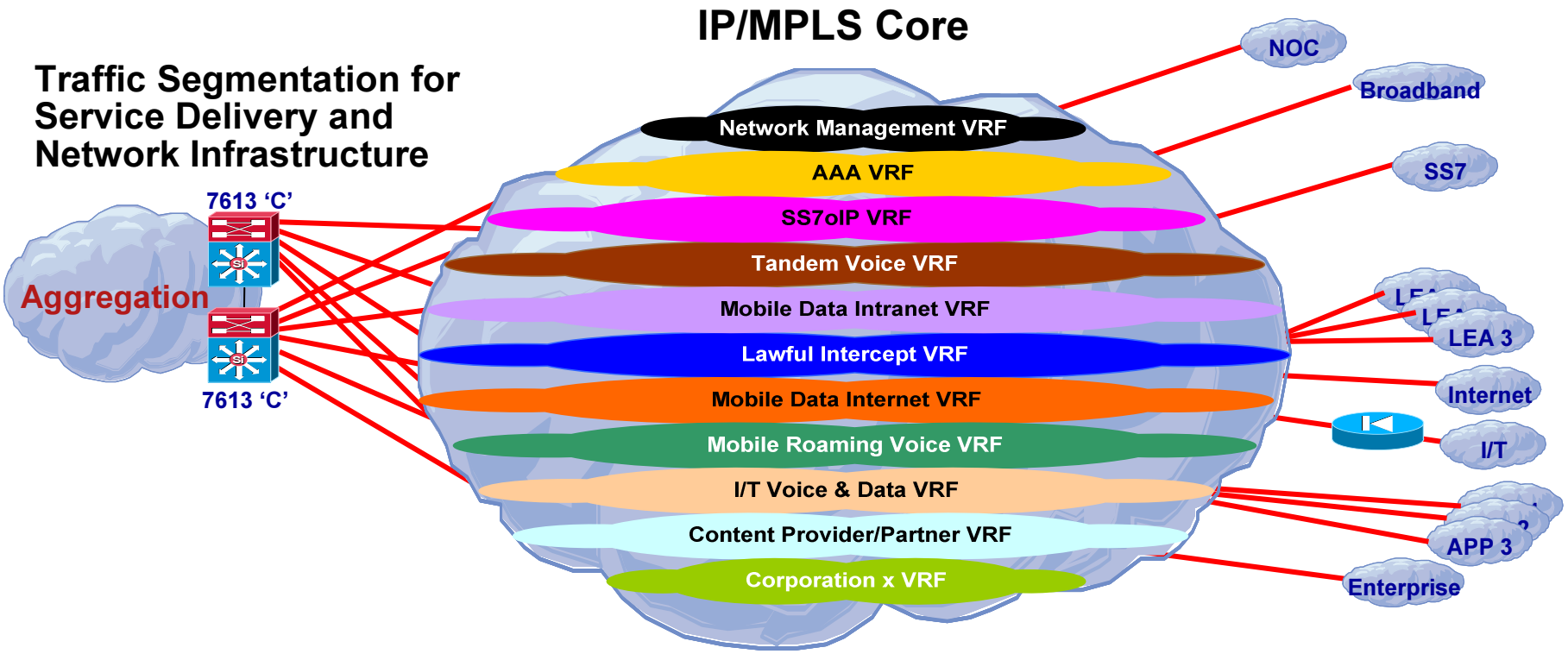


- Mostly connectionless
- IP/MPLS aware end-to-end
- Reduced provision replication
- Highly scalable
- More Capex and OPEX efficient

Benefits of Cisco Mobile IP NGN

- Cisco Mobile IP NGN delivers:
  - A profitable migration path to an IP foundation for 3G/4G/5G
  - Support for both IMS and non-IMS applications to achieve more services, better control and greater network efficiencies
  - A standard-based and access-agnostic platform for converged services
  - Support for flexible billing and service plans for customization and time to market
- Cisco Mobile IP NGN provides a foundation for achieving voice/data/video services any where, any time, across any device

One Network, Many Services

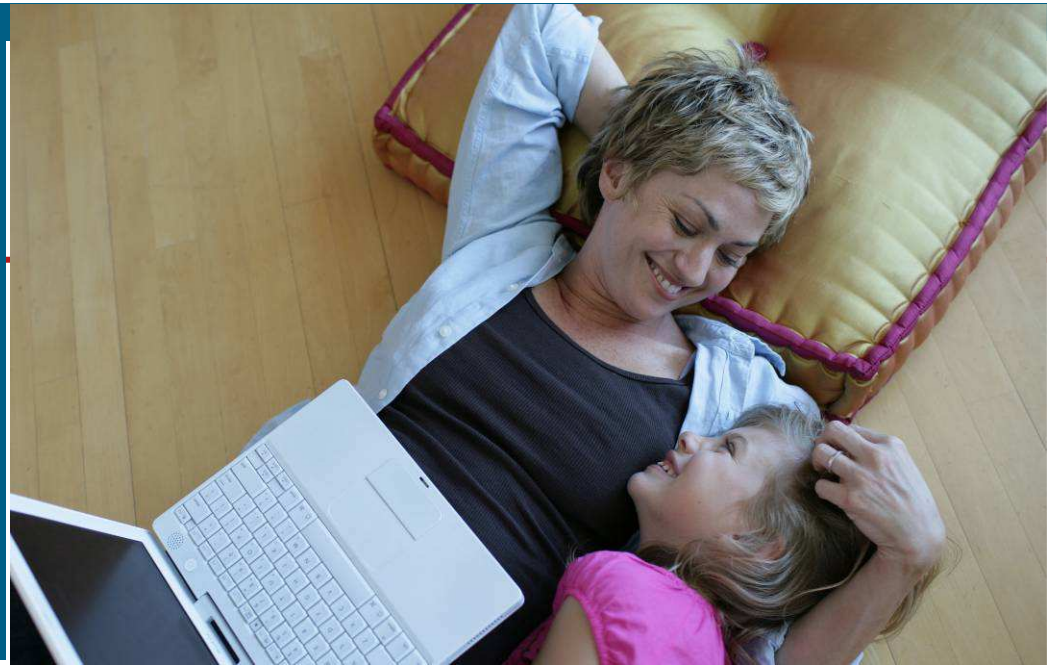


Business Value recognized by Vodafone UK CEO

…All IP program reduced the opex by 20%

London Analyst conference 27th Sept. 2004

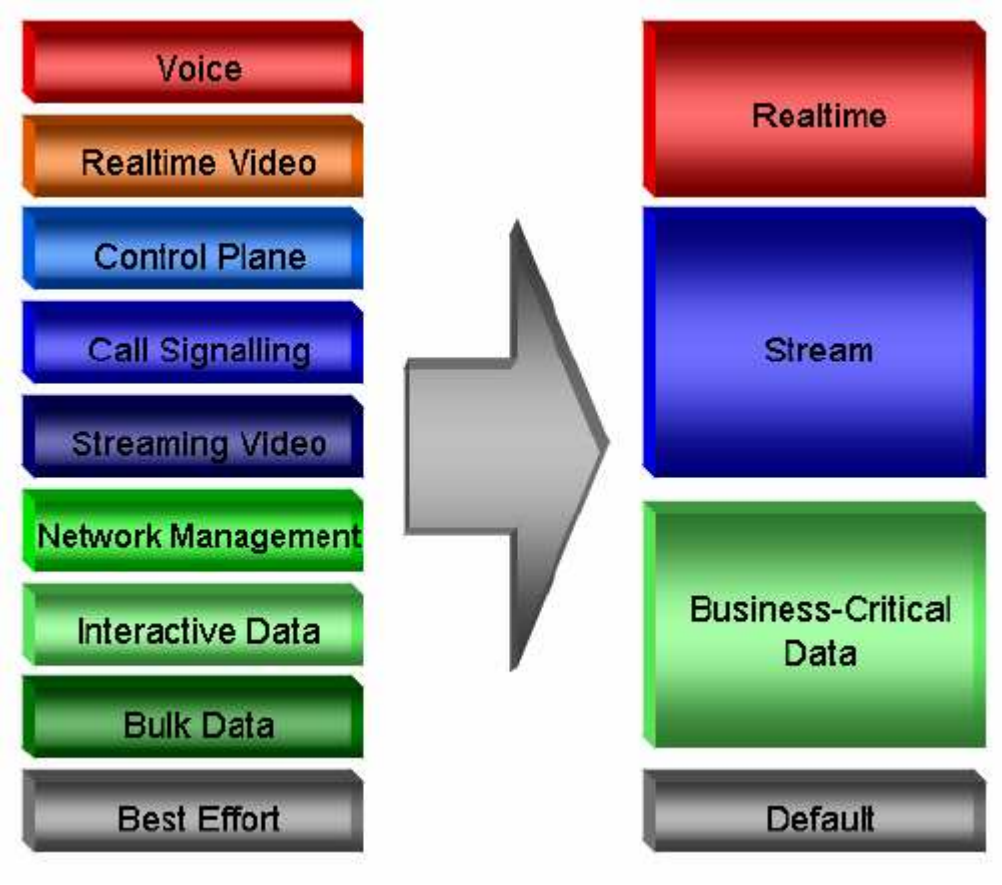
Q and A



QoS (Diffserv Tunnelling Approach)

Service Characteristics	Service / Application	DSCP	COS	EXP
Network Control	Ring Protection	CS7	7	7
	Routing Protocols	CS7	7	7
	Network Management (Network monitoring, remote login, remote desktop, firewall management)	CS7	7	7
	* Reserved For Future use	CS6	6	6
Jitter sensitive, Realtime ,high human interaction	Voice & Video calls, TDMoIP , Video conferencing , CEoIP	EF	5	5
Jitter sensitive, realtime , medium human interaction, lower drop	Voice & Video Signaling (SIGTRAN,H.323,H.248),RADIUS	AF41	4	4
Jitter sensitive, realtime , Low human interaction, medium drop	Multimedia - Voice Streaming, Video Streaming, IP TV,VOD	AF31	3	3
Non jitter sensitive , Low drop, Application interactive, delay sensitive	Data 1- Interactive real time (Banking applications, Database accessTransactional data, SAP,ERP, online gaming ,Radius, terminal session, custom application, PRBT,RVA/RVD,CDR transfer, SMPP)	AF21	2	2
Medium application interaction , medium delay sensitive	Data 2- Interactive non real time and (DNS,NTP,HTTP/S, Web proxy)	AF22	2	2
No Application interaction, not delay sensitive	Data 3- Non interactive (FTP, bulk data, SMTP,POP,IMAP)	AF23	2	2
Low loss dedicated internet Access	Dedicated Internet Access	AF11	1	1
Best effort	Broadband Internet Access	Default	0	0

QoS



33%

Remaining 25%

Remaining 15%

Remaining 60%