

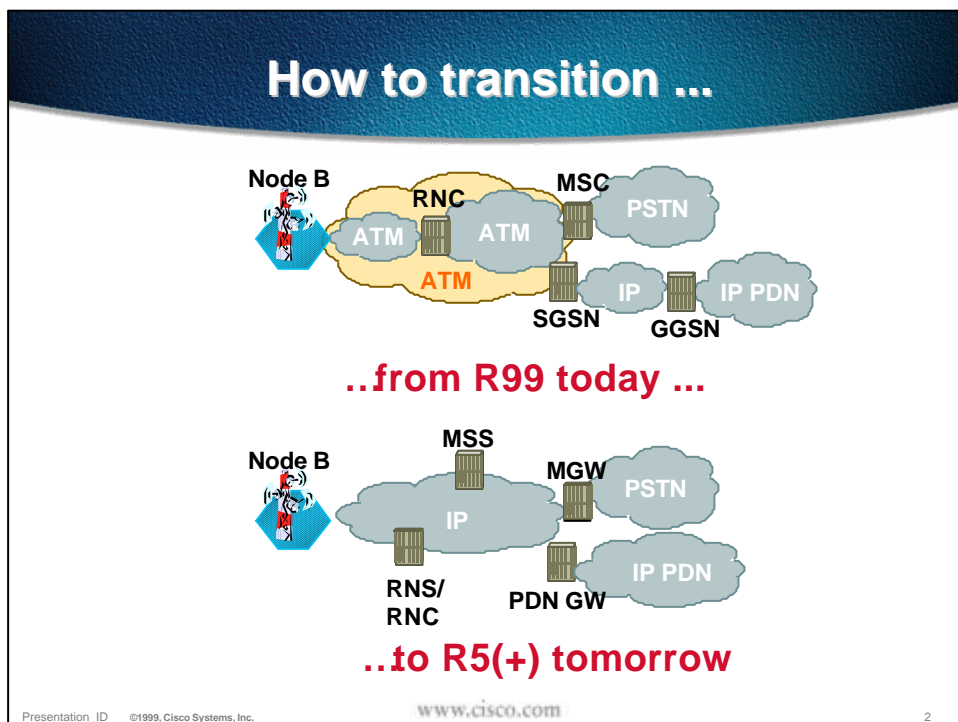
3G: From R99 to R00 Building a Packet Core Network R4 and R5

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Cisco Systems

Course Number
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What will tomorrow be?

- Let me know, I'm really concerned ;o)
- **R99+** will use IP as protocol to transport UMTS traffic from Node B to core network
- Any L2 transport method is possible
 - ATM will –obviously- be the first one
 - PPPMux (LIPE, CIP, MPLS[®]) at the access (*NodeB to ?*)
- What will become of the radio equipment?
 - Split, purpose/function, peering
 - Protocols behavior

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R4, R5 and +

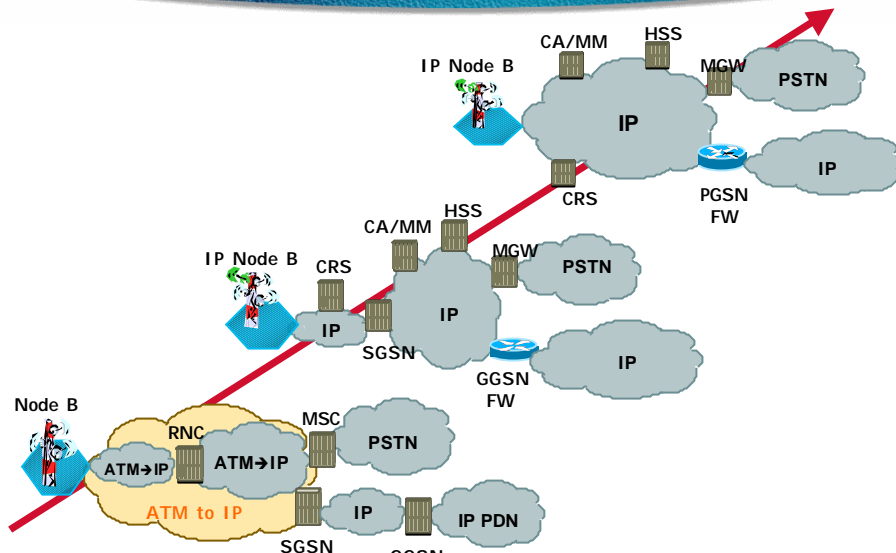
- **R4:**
 - Should be IP transport in UTRAN
 - Split the functions
- **R5:**
 - IM at the handset
 - New devices: CSCF (I-, P- & S-), PCF
- **After?**
 - Still encapsulation of UE IP packet?
 - MobileIP in the RAN?

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To All IP



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Agenda

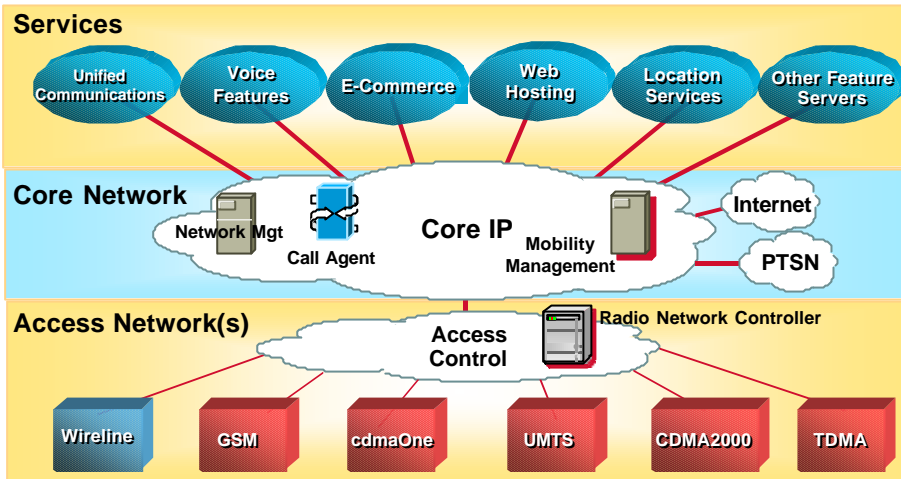
- MPLS
- IP addressing
- IPv6
- CoS/QoS
- Intelligence at the Edge

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Common Target IP Architecture



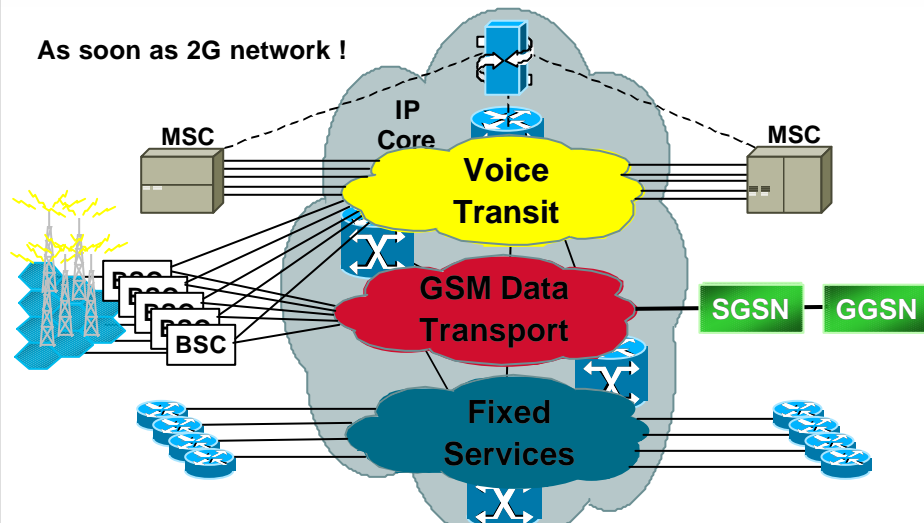
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Common Voice & Data Infrastructure

As soon as 2G network !

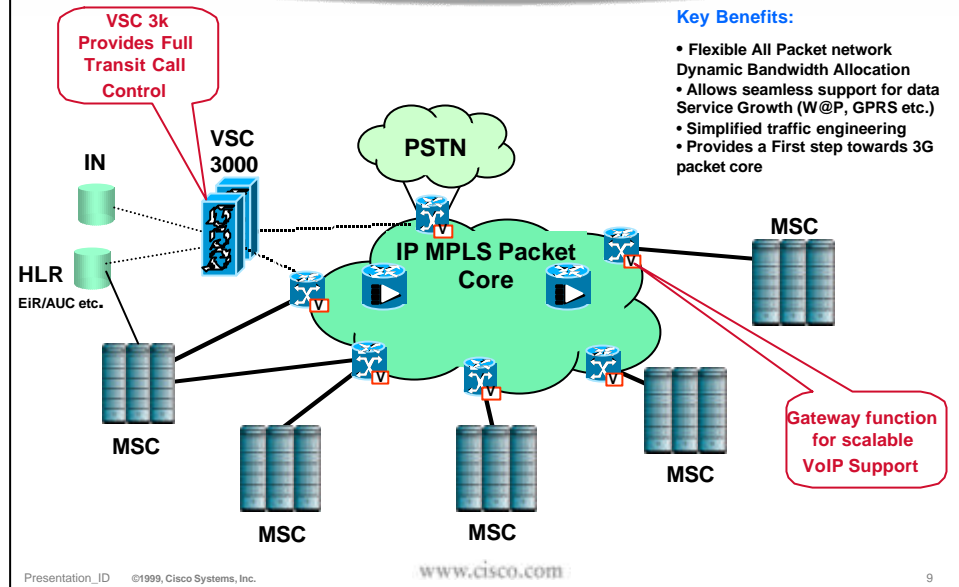


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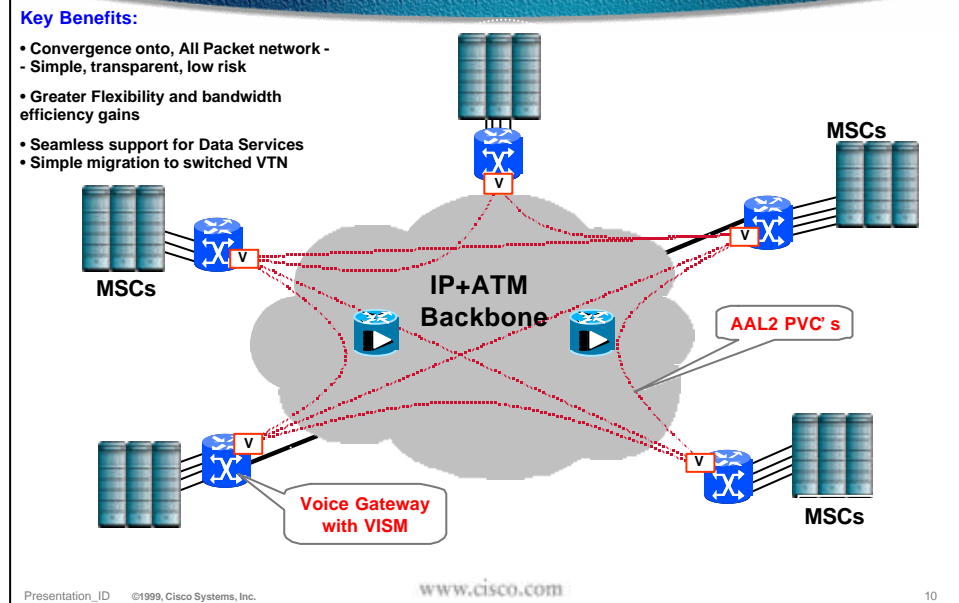
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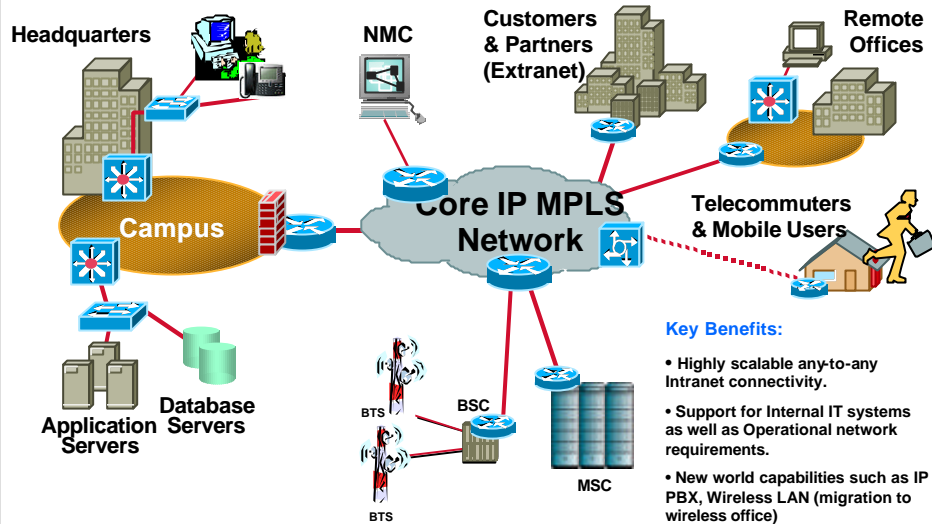
Virtual Transit Network



Inter-MSC Voice Trunking



Mobile SP Internal IT Network

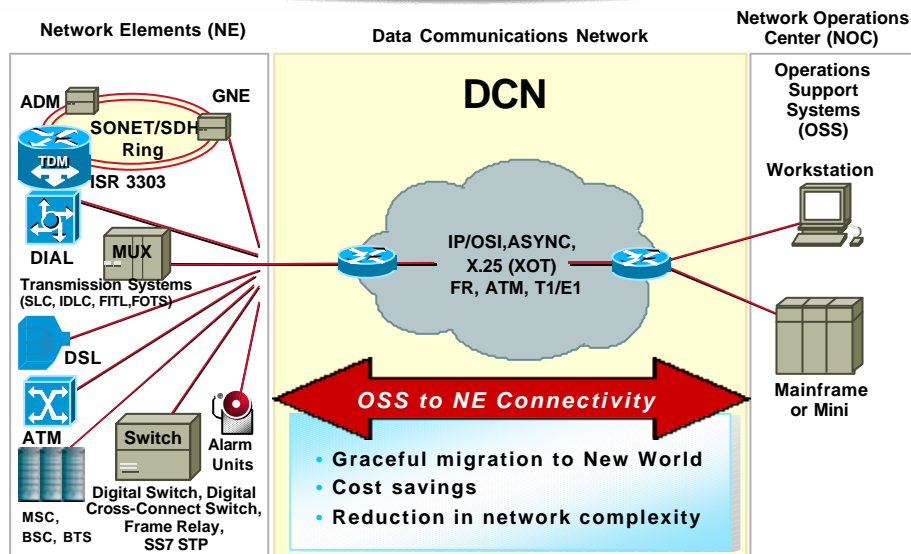


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Consolidated "Network of Networks"



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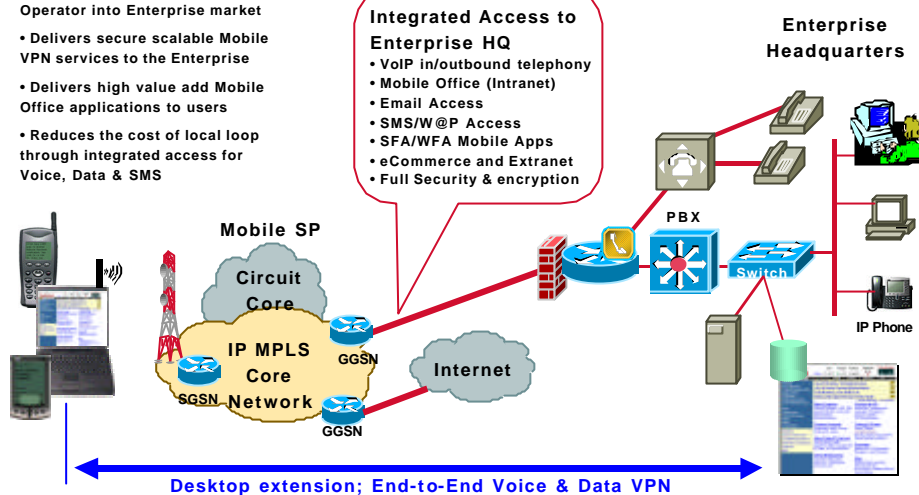
Extension VPN Integrated Access

Key Benefits:

- Increase reach of Mobile Operator into Enterprise market
- Delivers secure scalable Mobile VPN services to the Enterprise
- Delivers high value add Mobile Office applications to users
- Reduces the cost of local loop through integrated access for Voice, Data & SMS

Integrated Access to Enterprise HQ

- VoIP in/outbound telephony
- Mobile Office (Intranet)
- Email Access
- SMS/W@P Access
- SFA/WFA Mobile Apps
- eCommerce and Extranet
- Full Security & encryption



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Why build an MPLS IP Core with VPN

- IP is used today for
 - Data over GSM (Modem or V.110), SMS, W@P
 - Internal IT
 - DCN : OSS/BSS
- IP backbone is more and more an advantage for
 - GPRS traffic
 - SMS offload
 - SS7 offload (e.g. MAP)
 - Voice Transit Switches
- IP is the enterprise plug
- IP enables new services
 - eCommerce, ISP Portal, IP Billing
 - Unified Messaging, Distributed Web Call Center
- IP is the future for 3G

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IP addressing

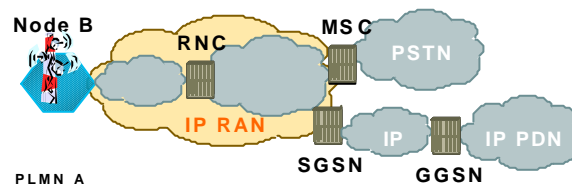
- If all devices speak IP, they should have *at least* one IP address
- Any IP device that should speak to another IP device should be in the same subnet
- One IP device could be in more than one subnet
 - Does not mean this is a router
 - Means it has more than one IP address (one per subnet at least)
- Multiple subnets may then be independent
- 3GPP specifies multiple logical interfaces
- Some logical interfaces may be on same physical one

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R99+ : Who speaks to who ?

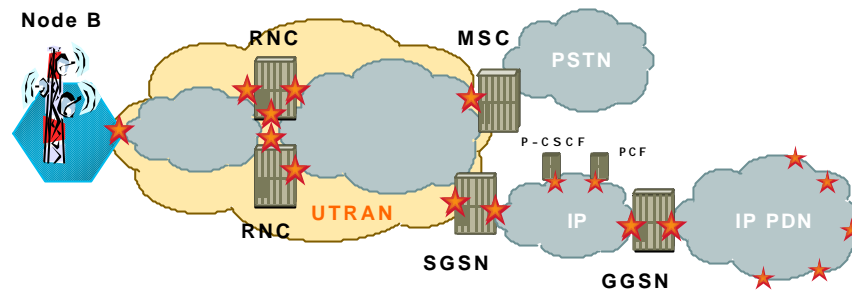


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Who speaks to who ?



- Iub : Node B to RNC, potentially thru aggregation device
- Iu-CS : RNC to MSC
- Iur : RNC to RNC (handoff)
- Iu-PS : RNC to SGSN
- Gn : between GSN
- Gi : into PLMN, to PLMN services; outside PLMN, to customers
- Others: P-CSCF to PCF, PCF with GGSN

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And so ...

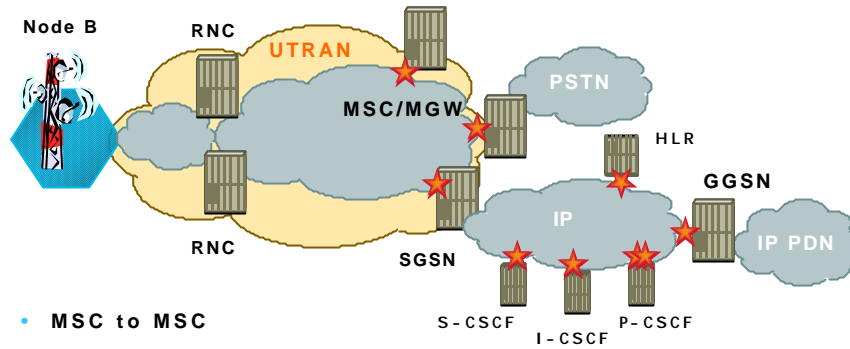
- They are all but Gi exclusively internal connections inside the PLMN
- Private addressing may be used
- But IPv6 will be mandatory in RAN
 - See next slides
- On Gi:
 - Private addressing to PLMN service gear
 - Private addressing with NAT to external services
 - Public addressing
 - Everything based on DHCP/DNS
 - Except if IPv6 (R5) from the handset

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But ...



- MSC to MSC
- SGSN to HLR (HSS + x)
- GGSN to P-CSCF
- P-CSCF to I-CSCF and S-CSCF

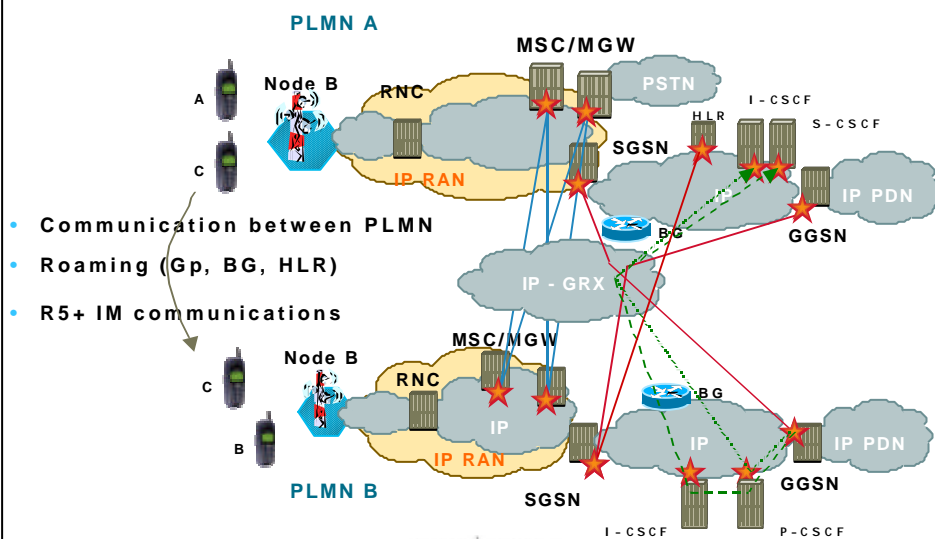
Should be considered differently

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R99+ : Who speaks to who ?



- Communication between PLMN
- Roaming (Gp, BG, HLR)
- R5+ IM communications

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And so ...

- They have to speak with foreign gear
- They so need public addressing
 - What about NAT? ALG for GTP, MAP, Diameter?
 - IPv6: GRX concerns if L3 GRX (DNS)
- Still uncertainty of the final specifications
 - CSCF use, HLR protocols
- MSC may use plenty of MGW
 - How many MSC per PLMN?
 - How many MGW per MSC?
 - How many interfaces per MGW?

Methodology

- Wait for the final specs
 - E.g. MSC/MGW will have to speak IPv6 or to be dual stack
- Have the final design with evolution plan
 - Numbers of GSN, x-CSCF, MSC
- Know the gear and design accordingly
 - MOT use up to 6 IP addresses per interfaces
 - NOKIA uses same physical interface (same IP address) for Gn (internal) and Gp (external)
- No one design
- Define the IP addressing budget
 - Public IPv4 availability depends on the country

IPv6 in ...

- The RAN

CN3 meeting: TS 29.414

IPv6 mandatory, IPv4 optional

L1, L2 can be used: safe way?!

IPv6 transition tools

- The Core

Up to the MSP

Still lot of concerns (DNS, DHCP, strong routing, management..)

Issues have been raised to 3GPP from IETF

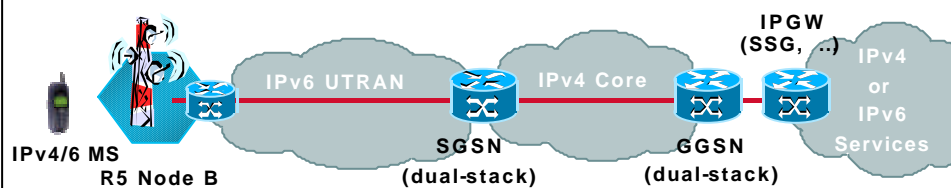
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IPv6 in the UMTS network

IPv6 required in the MS, and in the UTRAN



- IPv6 from the TE (MS) is independent of IPv6 in RAN devices
- If UTRAN has to use IPv6
 - GTP encapsulation has to be IPv6 between RNC and SGSN
 - GTP encapsulation may be encapsulated in IPv4 (optional)
 - GTP encapsulation changed from Iu-ps to Gn (IPv4)

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IPv6 Tunnels over IPv4 or MPLS Infrastructure

IPv6 over IPv4 Internet
ala 6Bone

Any Cisco IOS 12.2(1)T
routers can be used as IPv6
Edge

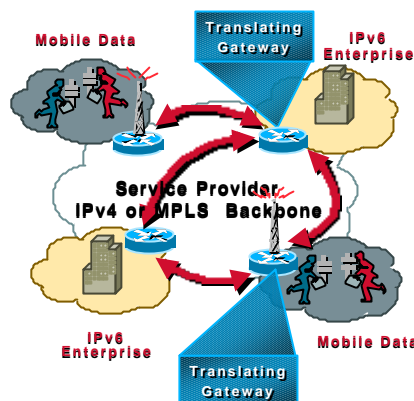
6to4 Tunnel

Leveraging defined
Tunneling Technology

No impact on existing IPv4
or MPLS backbones
using high-speed POS
interfaces

Edge IPv6 Infrastructure:

IPv6 over IPv4 Internet:



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Native IPv6 over Dedicated Links

Native IPv6 over dedicated
infrastructures

No impact on IPv4 traffic and
revenues

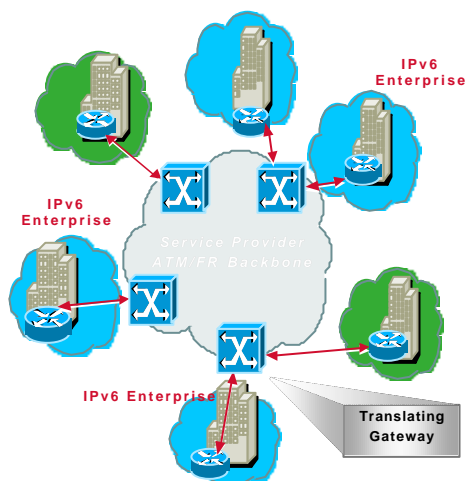
Any Cisco IOS 12.2(1)T routers can be
configured

ATM & Frame Relay PVC's
Serial Lines, Sonet/SDH, FE/GE

GSR 12000 with Sonet/SDH interfaces
can get IPv6 support

Today, EFT on private 12.0ST branch

IPv6 over FE/GE, ATM or Sonet/SDH
can run over an optical infrastructure
(dedicated lamda)



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IPv6 over “Any Transport over MPLS”

“Any Transport over MPLS”

IOS 12.0(11)ST on Cisco 12000

Emulates ATM VC over MPLS

MPLS backbones built on GSR

up to OC-48/OC-192 Sonet/SDH core

Cisco IOS IPv6 on Edge routers

ATM OC-3 uplink to GSR

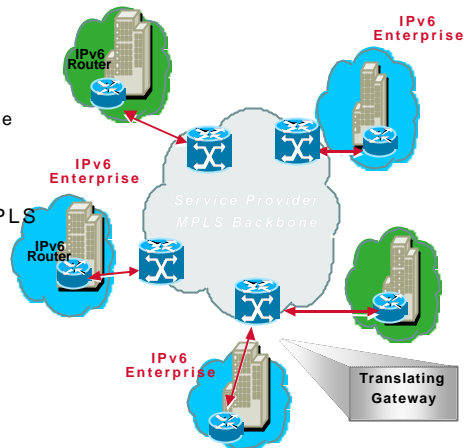
Aggregation of IPv6 edge routers

IPv6 services can take benefits of MPLS

features

MPLS/CoS

Traffic Engineering



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IPv6 over MPLS

IPv6 may become the “Multiprotocol”

portion of MPLS

Multiple implementation's options ...

Scalable & Reliable

IPv6 on CE only, not really MPLS

IPv6 on PE, IPv4 Control Plane,

MPLS Data Plane means No Forklift

Native IPv6 Control Plane

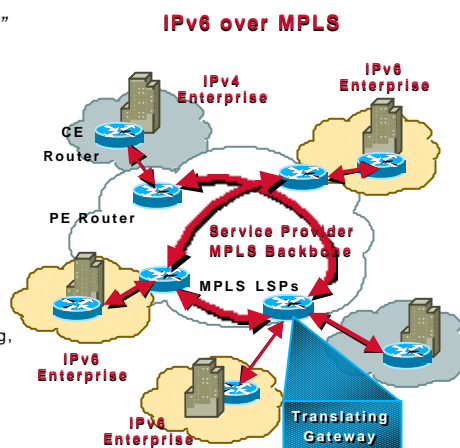
Leverages MPLS feature set

VPN Support

Traffic Engineering capabilities

Services Transparency - e.g. Provisioning,

QoS, Security.



Providers can therefore readily offer IPv6 Addresses while preserving investment

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IPv6 design

- **NodeB, RNC, SGSN (Iu-ps) and MSC-S will need an IPv6 address**
 - Should be site-local addressing
 - Why use global unicast?
- **Subnetting**
 - How to use the hierarchical address architecture?
 - geographical
 - other: to discuss with customer
 - what will be the next step in spec?
- **IPv4 for the transport**
 - Radio equipments with IPv6 transition tools
 - Dedicated transition devices (encap overhead?)

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CoS / QoS

- **Remark1: we do not own all the gear**
 - In such, Mobile market is different from others for Cisco
 - As we play mainly on the transport side, we can only cover this part
- **Remark2: we have to rely on radio gear / vendors**
 - Critical functions are out of our management
 - This has to be clear for any MSP

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Few words about RAN

- **Abis is the radio interface**
Extremely complex
Lot of CoS/QoS parameters
often reduced (simplified) to the 4 UMTS classes
what about the management, provisioning, measurement?
- **Iub is the first link to play with**
If not wireless (Nokia)
R99 specifies AAL2 designed for "the bandwidth efficient of low-rate, short, variable length packets in delay sensitive applications"
But concerns about real QoS between voice and data
TSG RAN3 #8 (99)e19 documents the transmission problem
TSG RP#7 (00)0134 "QoS optimization for AAL2 connections over Iub and Iur" for resolution proposals
Radio gears (NodeB and RNC) issue
Cisco have TM4.0 compliant ATM switches

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When RAN will speak IP ...

- **From TSG R3-011149**
"The use of one exclusive L2 protocol shall not be standardised for IP transport. One or a limited set of L2 protocols shall be specified and required."
- **This will obviously be on ATM as L2 for R99 backward compatibility**
New protocol could be PPPmux (LIPE, CIP, MPLS')
SDH is an easy alternative (e.g. Nokia)
- **For ATM**
 - IP to ATM CoS mapping still to be done on Radio equipments
 - Edge equipment should manage the congestion
 - ATM network continues to provide ATM QoS

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..radio equipment will have to be strong in IP QoS

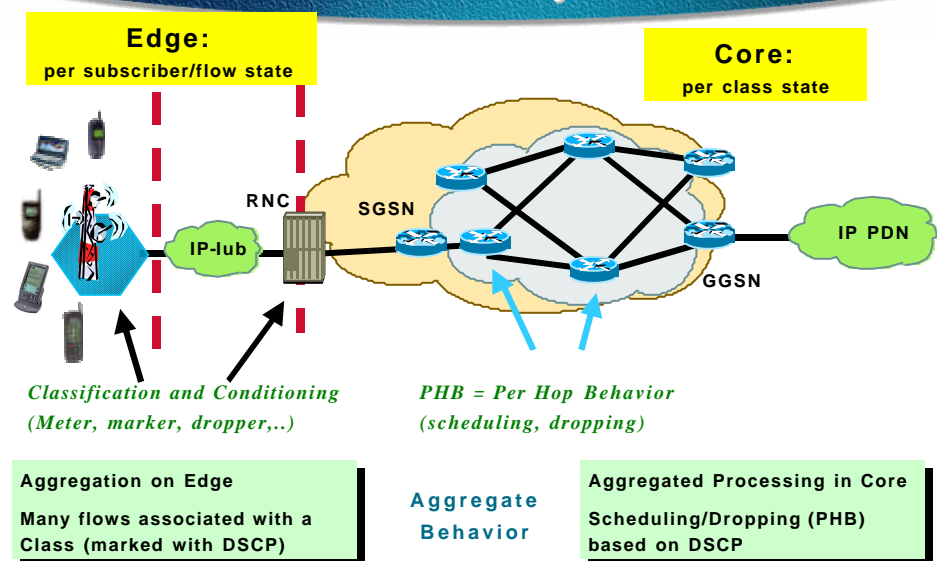
- Iub and Iur QoS transport should rely on classification and marking done at their edge
- This is not GTP domain
- Should use PDP context negotiation result too?
- We can make assumption

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IETF Diff-Serv Model: Scalability !

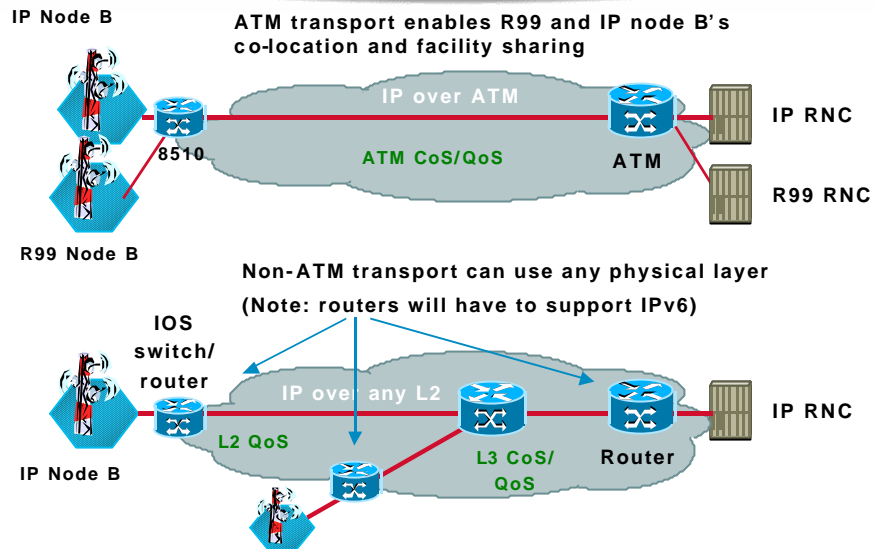


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IP in the RAN



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GTP

- In Core and UTRAN
- Use of proposed DiffServ classes
 - EF
 - BE
 - 4 AF classes with 3 dropping levels?
- But mainly UDP traffic (for data, TCP for sig)
 - Drop behavior during congestion management?
- Marking and overall policy are key
- Why not just IP prec (Class Selector Codepoint)?

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In the Core

- **What about the mapping on MPLS core**

MPLS EXP is 3 bits (8 classes)

New aggregation of classes

Class Selector Codepoint

CoS transparency

- **But not only GTP traffic in the core**

Need more classes? Cannot expand EXP

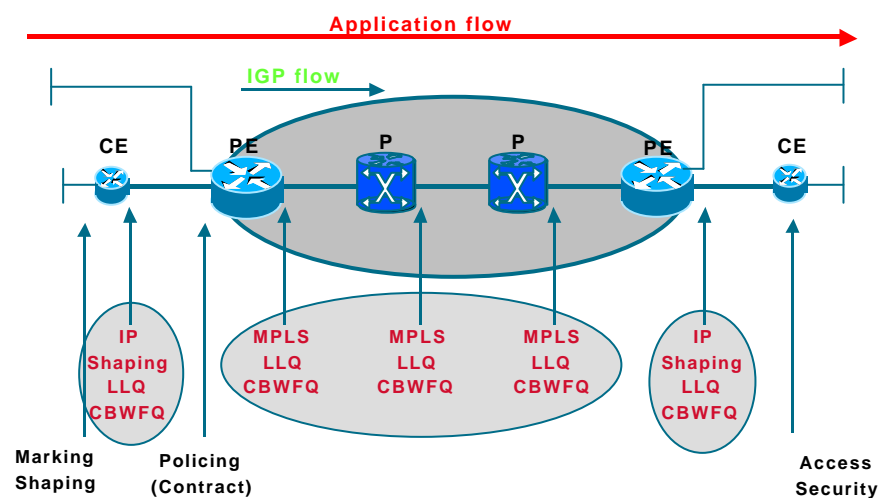
Aggregate behaviour

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MPLS End-to-End QoS Design goal



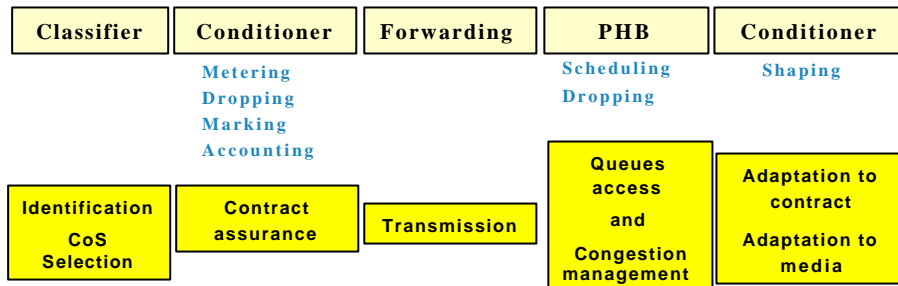
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DiffServ Architecture IPprec, DSCP, MPLS EXP

Functional blocks



Cisco Implementation of DiffServ Architecture



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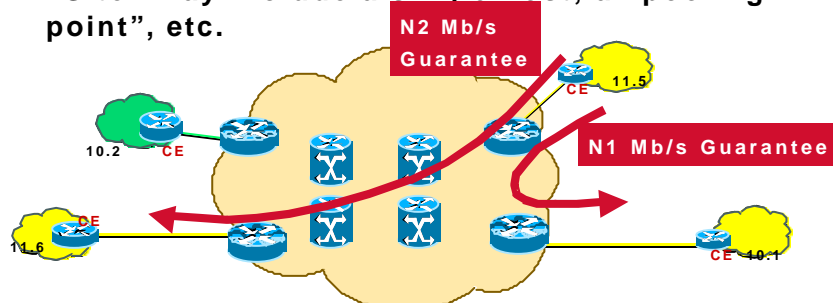
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MPLS Guaranteed Bandwidth

- “Guaranteed QoS” is a unidirectional point-to-point bandwidth guarantee from Site-Sx to Site-Sy :

“The Pipe Model”

- “Site” may include a single host, a “pooling point”, etc.

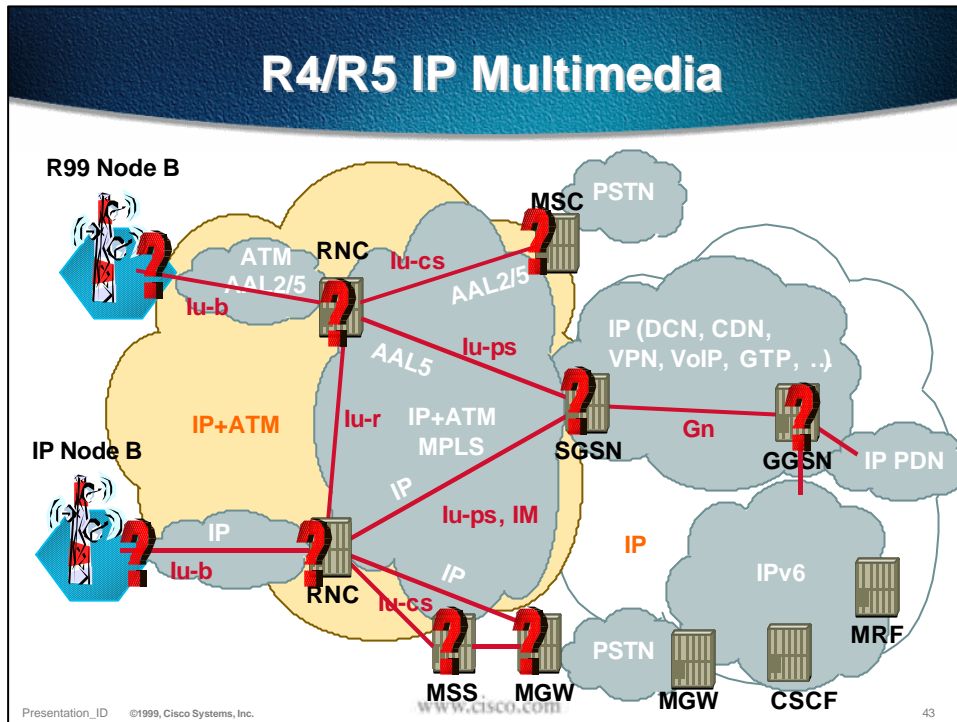


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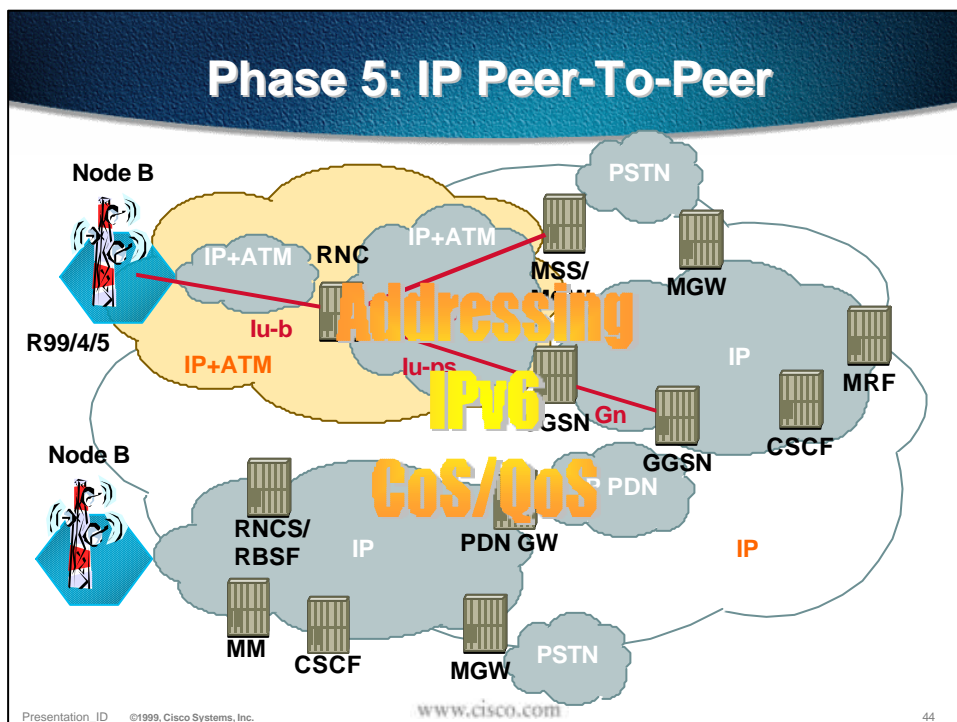
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R4/R5 IP Multimedia



Phase 5: IP Peer-To-Peer

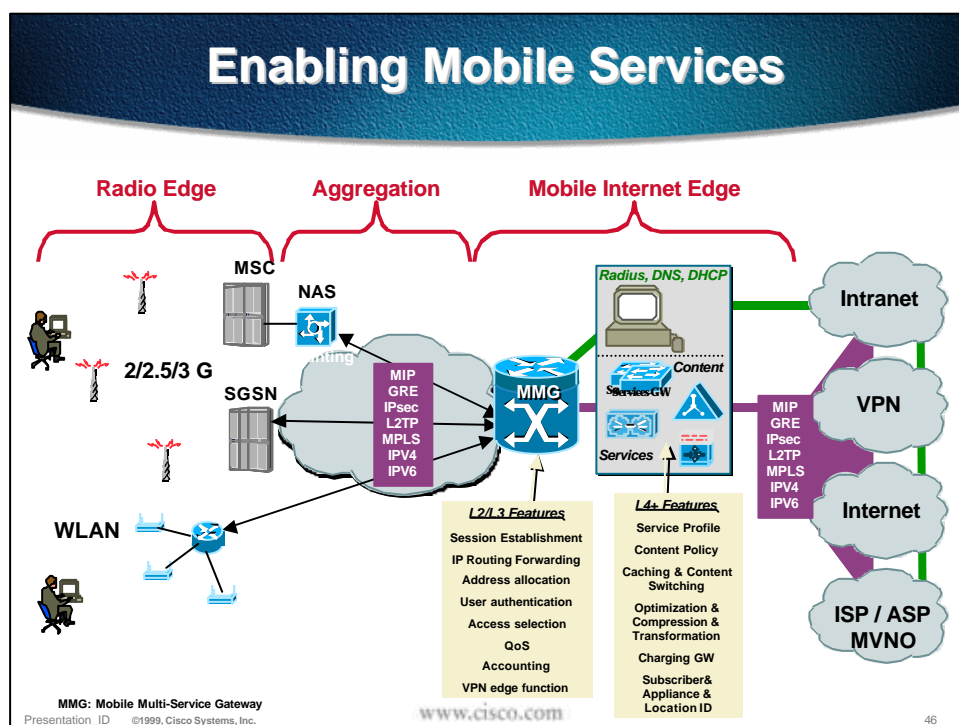


Intelligence at the Edge

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Why MMG ?

- Not just GGSN / PDSN
- Aggregation Node for Mobile Edge
- Mobile Internet Edge Enabler (Mobile Multi-Service Gateway)
 - GGSN / PDSN
 - Load Balancing
 - SSG
 - Content Awareness
- Higher Capacity (PDP Contexts, PPP Sessions)
- High Availability
- Asia Pac and US – need for large boxes
- EMEA – Combination of Large and Small boxes

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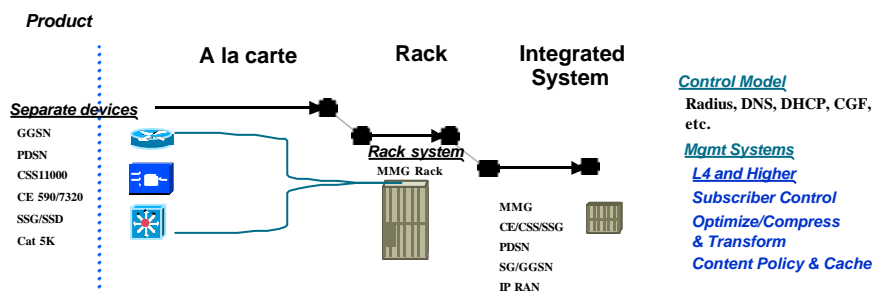
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What is MMG ?

MMG is a Family of Products which:

- Enables Mobile Internet Edge Services (Aggregation Layer)
- Provides a line of scalable products
- Products for both GPRS and CDMA1x technologies

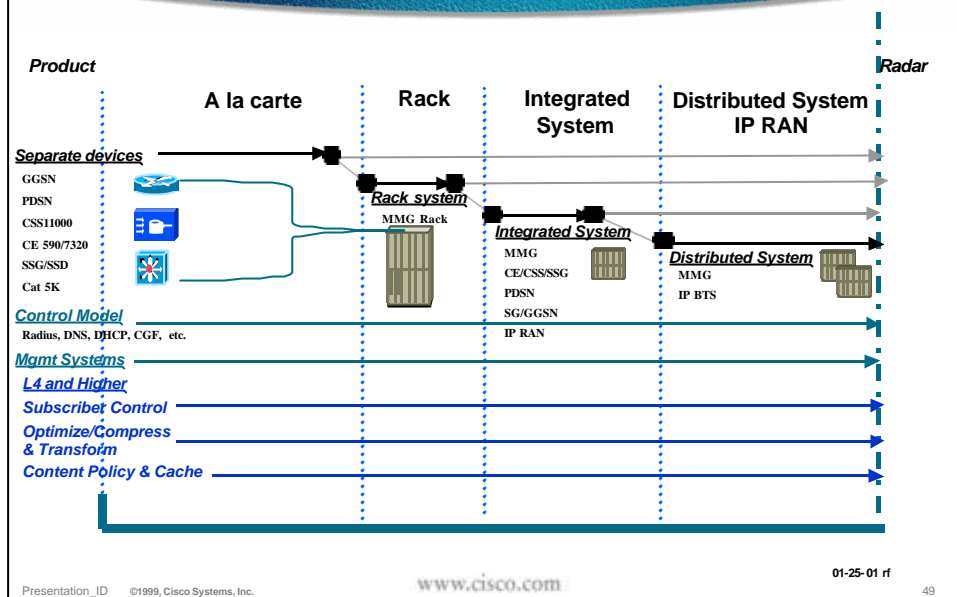


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Mobile Internet Edge – Product Portfolio



Cisco Mobile Multi-Service Gateway Regular Version



GPM Flavor
GGSN Processing Module



GDM Flavor
GTP Director Module



GLM Flavor
GTP Load Balancer Module



PSM Flavor
Portal Support Module

Cisco MMG
Regular Version
Different Flavors

- Any type of VPN sessions mix
- Per-Session Traffic Shaping
- Per-Session accounting
- Multiple sessions per-user
- Overlapping of IP Addresses
- HTTP redirection
- Mobile IP FA/HA
- VPN selection on any key

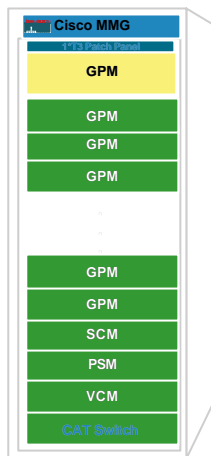
GPM **IOS Software Modules**
Optional Modules

GLM : GTP Load Balancer Module
GPM : GGSN Processing Module
GDM : GTP Director Module
PSM : Portal Support Module

Cisco Mobile Multi-Service Gateway Tall Version



**Cisco MMG Tall
Version**



- Any type of VPN sessions mix
- Per-Session Traffic Shaping
- Per-Session accounting
- Multiple sessions per-user
- Overlapping of IP Addresses
- HTTP redirection
- Mobile IP FA/HA
- VPN selection on any key

1 Million sessions

GLM : GTP Load Balancer Module
GPM : GGSN Processing Module
VCM : VPN Concentrator Module
PSM : Portal Support Module
SCM : System Controller Module

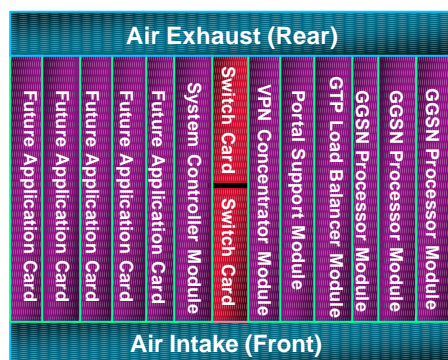
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Cisco Mobile Multi-Service Gateway Grande Version



**Cisco MMG
Grande Version**

- Any type of VPN sessions mix
- Per-Session Traffic Shaping
- Per-Session accounting
- Multiple sessions per-user
- Overlapping of IP Addresses
- HTTP redirection
- Mobile IP FA/HA
- VPN selection on any key

**Single Chassis
Solution
2 Million sessions**

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Cisco's Value Add

- Common control model regardless of mobile access technology (GPRS, PDSN, 802.11 AP, etc) - IP
- Bridge between the Intelligent Network and IP. That bridge allows retrieval and manipulation of data in multiple domains transparently.
- Migration path away from IN-specific applications to IP applications that are applicable in both environments
- Allows division of features between GGSN and SSG to be controlled, depending on Network Topology, without impact to portals and applications.
- Enables common backend for various access methods, simplifies operator's burden and integrator's task
- Enables third-party portals to control and deal with a wider variety of Cisco access technologies and service features
- Path to L4+ service management

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Questions?



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