

## Cisco's Role in the Mobile Internet Era

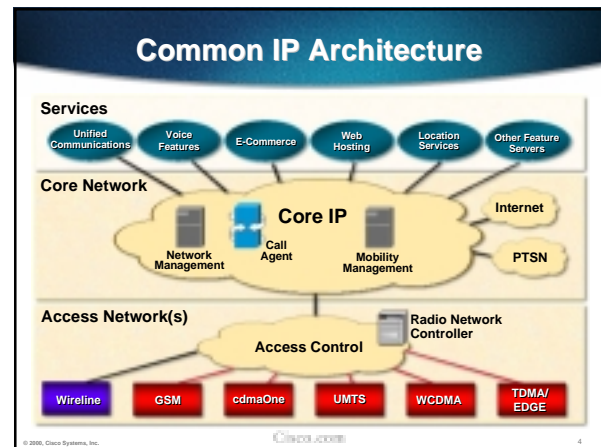
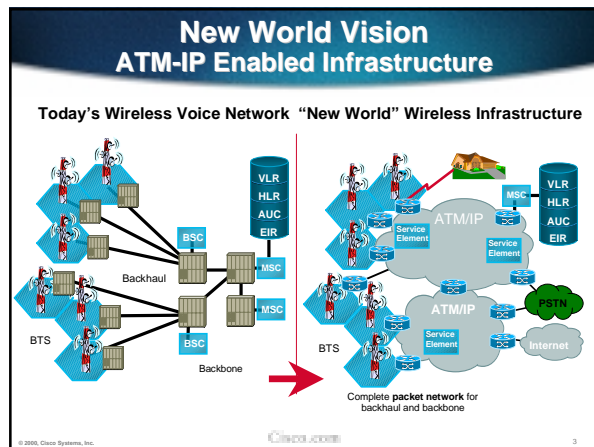
Paul Williams  
pawillia@cisco.com

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## The New World

- Packet based vs. circuit based
- Distributed vs. centralized
- “Open” vs. closed
- New and better paradigm—but must connect to old
- Time to market is key
- Driven by cost, functionality, and competition

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## End of Vertical Integration

- Operators looking for best-of-breed subsystems
- Network architectures and tenders define subsystems and open interfaces
  - RAN
  - Core
  - Control network
  - Internet
  - Services platforms
  - Switch/MSC
- Operators desire primary supplier/integrator

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## Services

- Remote access to corporate intranet
 

Enable the connection of users from “anywhere”, to access their corporate intranet, and work “as if” they were at the office, down- and uploading all the required information.

Note: the corporate intranet must, of course, be connected (either physically, or via a Virtual Private Network), to the GPRS network.
- Machine-to-machine connection
 

Enable wireless connection to any “telemetry” application, without the need of installing a direct connection between the apparatus and the network.

Typical example: parking automate, car supervisor, ..

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## Services

- **WAP applications (Residential segment)**

WAP, or Wireless Application Protocol, can be seen as a reduced web browser protocol suite, optimized to run on low capacity (CPU and memory) mobile.

It creates an environment where development of new services/applications are easy and fast, as it is the case with HTML.

WAP can already work with existing support (SMS, Circuit Switched at 9,600 bps), but will work in a much more efficient way with GPRS.

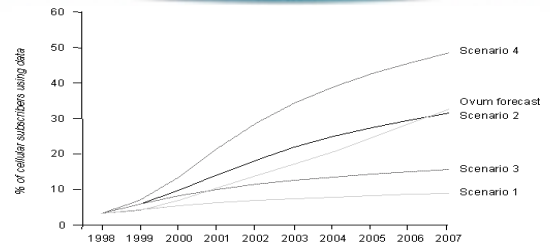
New services based on WAP can be hotel/ticket reservation, stock price consultation (push/pull), games, ..

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## Mobile Users Employing Data? 1 in 3 by 2007



- **Projections**

2007, thirty percent of mobile users will be using data

Alex Nourouzi  
Senior Consultant, Ovum  
"Packet is going to drive the mobile data market."

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## Mobile Network Challenges

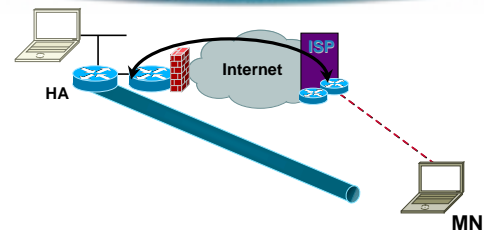
- Transport data over GSM Infrastructure
- Dynamically allocate Bandwidth & Services via Radio Access Layer
- Enable Added Value Data Services (VPN, Mobility,...)
- Transport all traffic (inc Voice & Data) over IP infrastructure

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## Overview: Mobile IP Functionality



Mobile IP Forms a Layer 3 Tunnel from a Home Agent (HA) to the Mobile Node (MN), Which Can Continue to Use Its Home Address to Receive IP Datagrams

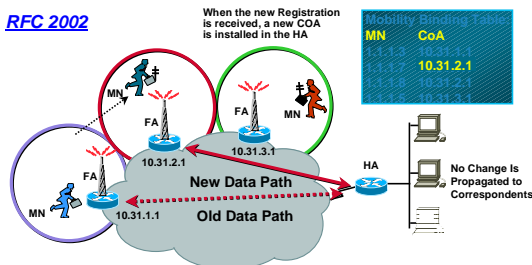
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## Mobile IP

[RFC 2002](#)



The Movement Is Transparent to all Other Devices

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## Mobile IP Is the Solution for Wireless Connectivity

- Transparent interoperability with all other hosts
- Mobile always reachable at the same IP address
- Only the home agent needs to know the mobile's location
- All other routers do normal forwarding

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## Mobile IP

- The IETF proposed standard solution for mobility at Layer 3
- RFCs 2002–2006 define the functionality
- Protocol works over any intermediate media
- Movement is transparent to hosts who communicate with the mobile user
- No IP address changes are needed to allow mobility

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## Data Services on Cellular

- Standards for packet services on cellular are already defined
  - GSM: GPRS - GSM Packet Radio System
  - CDMA: IWF and MobileIP
- Both utilize bandwidth over the backhaul/backbone to gateway devices
- A data network built for packet data transport can reduce the need to expand the backbone beyond voice requirements

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## GPRS and others

<u>Technology</u>	<u>Speed*</u>	<u>C/I</u>	<u>Who</u>	<u>When</u>
• GSM data	Circuit	9.6 kbits/s	ETSI	Now
• HSCSD Circuit	56 kbits/s	Medium	ETSI	Now
• GPRS Packet	150 kbits/s	Medium	ETSI	Now-2001
• EDGE Packet	380 kbits/s	Medium	ERICY	2000-2001
• UMTS Packet	2 Mbits/s	High	ETSI	2002

\* Raw Channel THRPP

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## GSM Packet Data Service Options

- Two services as part of "Phase 2+" of the GSM specification
  - High Speed Circuit Switched Data (HSCSD)
  - GSM Packet Radio Service (GPRS)

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## High Speed Circuit Switched Data (HSCSD)

- allows the combination of multiple timeslots
- Channels can be multiplexed together to offer a data rate of up to 56 Kbit/s when using all four slots (14.4 Kbs/channel)
- because each time slot could carry a conventional conversation, the use of multiple slots restricts the capacity for speech traffic, resulting in the handset user specifying a minimum acceptable data rate and a preferred (and usually higher) data rate
- will prove particularly useful for applications with high-speed data requirements, such as large-scale file transfers, advanced fax services and mobile video communications

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## General Packet Radio Service (GPRS)

- available over GSM networks
- based on the transportation and routing of packetized data
- Capacity limitation is hence in terms of the amount of data being transmitted rather than the time of connection
- reduces the time spent setting up and taking down connections
- works with public data networks using Internet protocol & X.25
- "bursty" applications such as e-mail, traffic telematics, telemetry, broadcast services, and Web browsing
- requires modifications to the GSM system architecture and has targeted commercial availability in the 1999 timeframe

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## HSCSD vs GPRS

- HSCSD is a small market
- HSCSD doesn't do anything to ease spectrum capacity constraints that operators are facing
- GPRS benefits
  - ultimately, higher speed data
  - the packet data element is most important because it uses the spectrum in a better way
  - not tying up a whole channel end-to-end for one user

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## Enhanced Data Rate for GSM Evolution (EDGE)

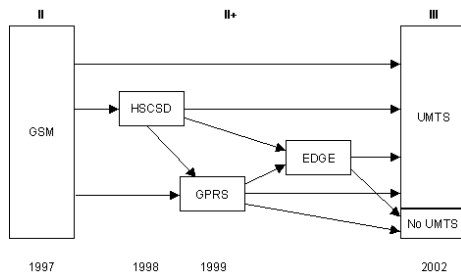
- GSM Standard bodies are defining data networking technologies which will build upon GPRS
- One such technology is Enhanced Data Rate for GSM Evolution (EDGE)
  - EDGE will offer a theoretical rate of up to 384 Kbs.
- Beyond EDGE, 3G (UMTS) cellular systems will eventually offer data rates up to 2 Mbs

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## GSM to UMTS Evolution

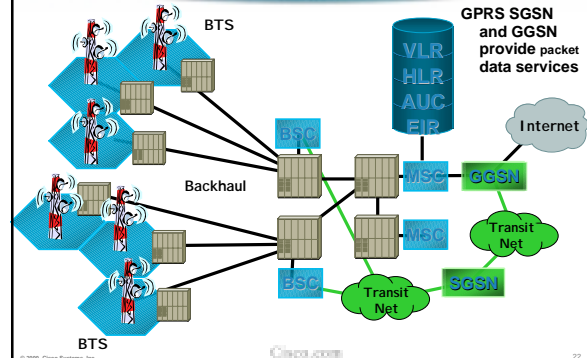


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## GSM Cellular Packet Data



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## Cisco 7200 SGSN and GGSN

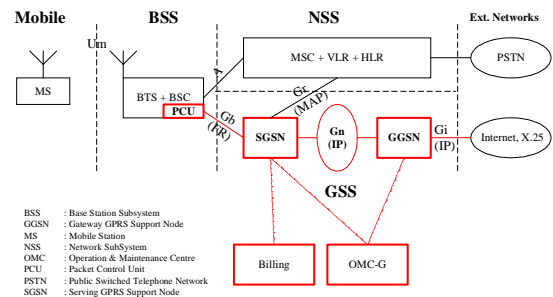


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## Architecture

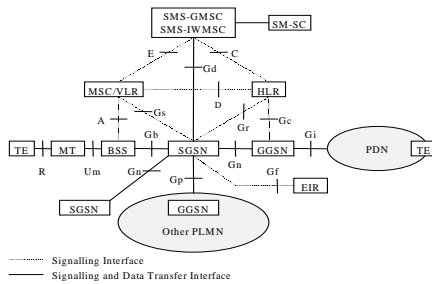


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## Architecture



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## Architecture

- **Gateway GPRS Support Node (GGSN)**  
 Gateway with the external networks, possibly RADIUS and DHCP client  
 For Internet, it appears as a host owning all the active mobiles  
 Generate charging data
- **Serving GPRS Support Node (SGSN)**  
 Route the packet from the GGSN towards the good BSC and mobile  
 Takes care of the security, mobility management, and charging data generation

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## Architecture

- **Packet Control Unit (PCU)**  
 New functionality of the BSC  
 Interface with the SGSN  
 Utilizes BSC resources to establish virtual links with the Mobile Stations

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## Architecture

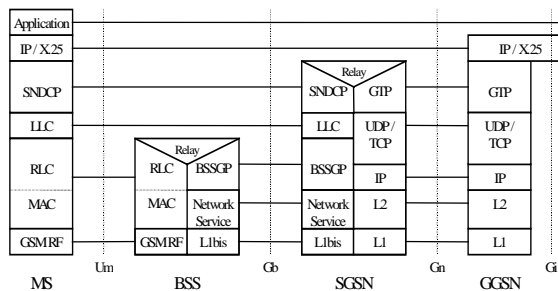
- **3 Classes of Mobile Terminals**  
 Class A: support simultaneous circuit and packet traffic  
 Class B: support alternate circuit and packet traffic, but simultaneous signaling  
 Class C: manual selection between circuit and packet traffic

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## GPRS Protocol stack



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## GPRS Protocol stack

### GGSN/SGSN interface (Gn)

- **IP/X.25**  
 External Packet Data Network protocol
- **GPRS Tunneling Protocol**  
 From/to the entry GGSN to/from the SGSN supporting the MS
- **UDP+TCP**  
 Transport the data and signaling frames in the GPRS network
- **L2 + L1**

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## GPRS Protocol stack

### SGSN/BSS/MS

- **SubNetwork Data Convergence Protocol (SNDCP)**  
Enable possibility to use non-GSM L2 services  
Compression of redundant information (TCP/IP headers) and data (V.42bis)  
Segmentation and re-assembly
- **Logical Link Control (LLC)**  
Enable possibility to use non-GSM L1 services  
Provide a highly reliable logical link connection between the SGSN and the MS
- **Base Station System GPRS Protocol (BSSGP)**  
Provisioning of radio-related information
- **Network Service**  
Frame Relay network

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## GPRS Protocol stack

### BSS/MS Interface

#### • Radio Layer Control (RLC)

Defines the procedures for selective retransmission of unsuccessfully delivered RLC data block.

#### • Medium Access Control (MAC)

Defines the procedures to enable multiple MSs to share the common transmission link

Possibility to have several mobiles on the same TS

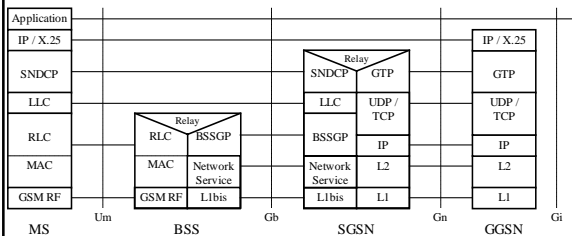
Possibility to give one MS several TS

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## GPRS Transmission Plane



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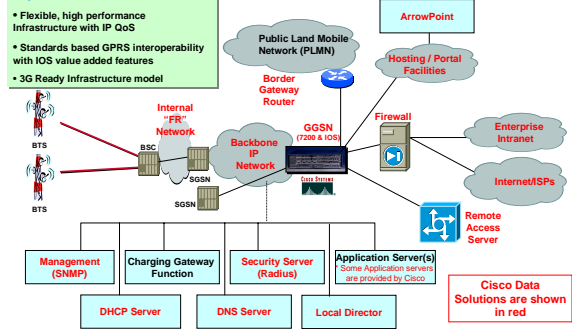


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## GPRS Mobile Internet Solution

### Key Benefits:

- Flexible, high performance Infrastructure with IP QoS
- Standards based GPRS interoperability with IOS value added features
- 3G Ready Infrastructure model



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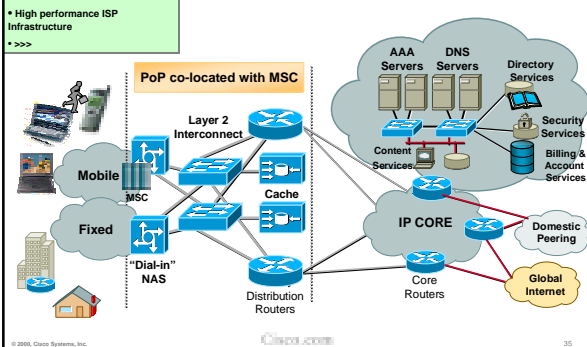


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## Mobile ISP Infrastructure

### Key Benefits:

- High performance ISP Infrastructure
- >>>

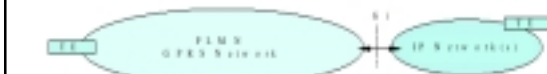


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## GPRS PDN Interworking Model

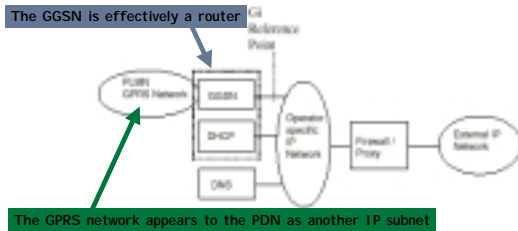


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## GPRS PDN Interworking Model

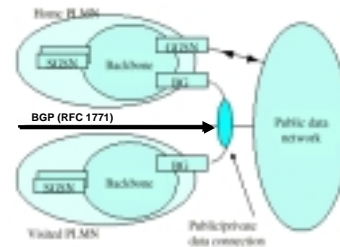


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## Interworking Between GPRS Roaming User's



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## QoS

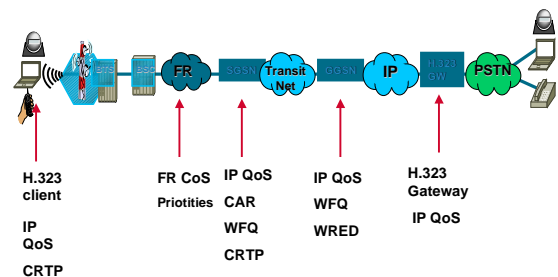
- GPRS introduces the notion of Quality of Service offered to the customer, defined by:
  - Precedence (priority)
  - Reliability
  - Delay
  - Throughput

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## QoS on GPRS



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## GPRS Precedence Setting

- High precedence:**  
Service commitments will be maintained ahead of all other precedence levels
- Normal precedence:**  
Service commitments will be maintained ahead of low priority users.
- Low precedence:**  
Service commitments will be maintained after the high and normal priority commitments have been fulfilled.

CAR Packet Tagging for end-to-end CoS

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## Quality of Service

- Mapping between GPRS QoS and IP QoS levels

Delay Class	Precedence	Mean-Throughput	Resulting "canonical" QoS Class
Best Effort	any	any	Best Effort
1, 2, 3	low	any	Best Effort
1, 2, 3	any	Best Effort	Best Effort
1, 2, 3	normal	specified	Normal
1, 2, 3	high	specified	Premium

- Use of IP CoS mechanisms in GGSN/SGSN and in the Backbone: WRED, WFQ, CAR
- Admission Control (GGSN):  $\Sigma \text{traffic} < \text{Total BW}$

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## Backbone issues

- Leverage End-to-End Consistency
- WFQ, WRED, CAR
- MPLS (GGSN as edge router)
- Integrated management

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## Systems Approach

- Internet/intranet access
  - IP address management, Security
- Service
  - QoS, management, billing
- System
  - Reliability of the system
  - Scalability of the system
  - performance

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## IP address management

- GGSN can hold (local pool/DHCP):
  - Operator's public IP addresses
  - Operator's private IP addresses (NAT)
  - Other's public IP addresses (local pool)
  - Other's private IP addresses (local pool, dedicated I/F)
- configuration per APN

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## IP address management

- GGSN can allocate addresses:
  - transparently (local pool using built-in IOS DHCP server/DHCP)
  - non-transparently (CHAP/IPCP processing, RADIUS/DHCP requests generation) through IOS built-in RADIUS/DHCP clients
- configuration per APN

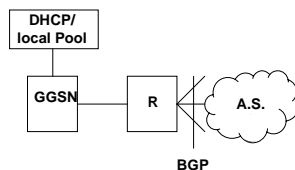
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## Access to the Internet

- APN=gprs.operator.com



- GPRS operator owns and holds public IP addresses
- BGP function can be supported by the GGSN

However!

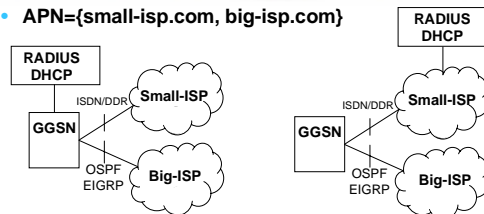
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## Access to an ISP

- APN={small-isp.com, big-isp.com}



- GPRS operator holds ISPs addresses (transparent) OR
- GGSN sends out RADIUS/DHCP requests toward ISP's server

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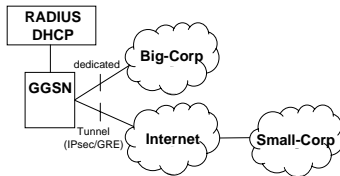


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## Access to an intranet

- APN={small-corp.com, big-corp.com}



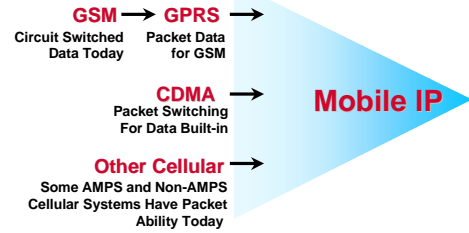
- RADIUS/DHCP can also reside in Corporate's premise

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## Evolution of Data Services



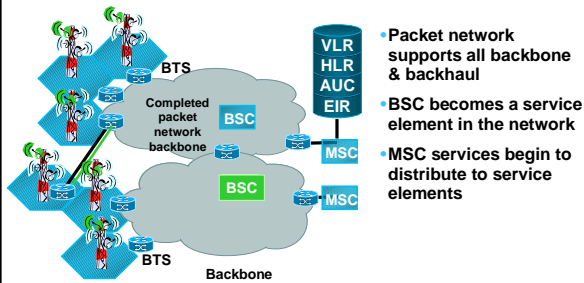
Cellular Systems Are Moving Toward Support for Packet Data. This Is the Foundation for Mobile IP

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## A Look Ahead for Cellular & PCS Backbone Transition from Circuit to Packet



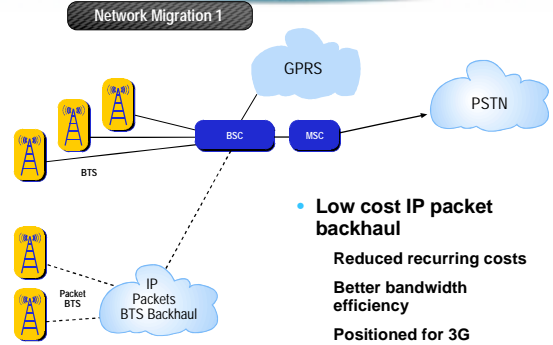
- Packet network supports all backbone & backhaul
- BSC becomes a service element in the network
- MSC services begin to distribute to service elements

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## BTS Packet Backhaul



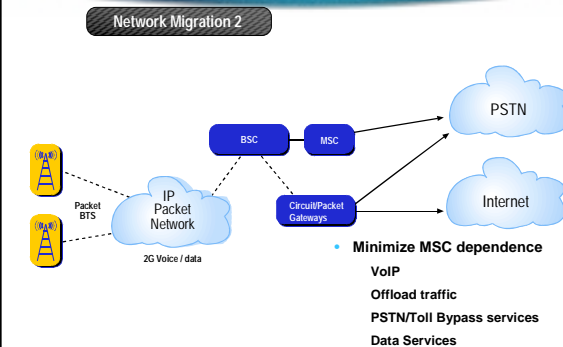
- Low cost IP packet backhaul
- Reduced recurring costs
- Better bandwidth efficiency
- Positioned for 3G

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## Circuit/Packet Gateways



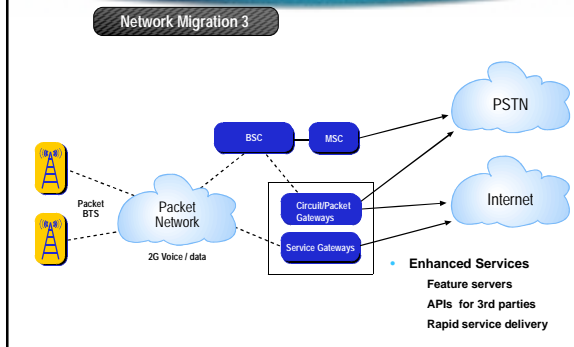
- Minimize MSC dependence
- VoIP
- Offload traffic
- PSTN/Toll Bypass services
- Data Services

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## Service Gateways

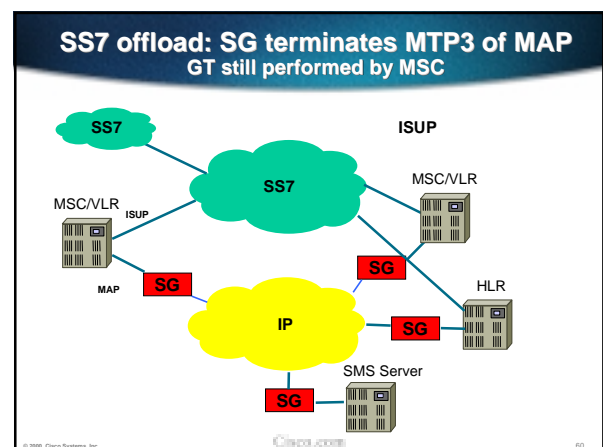
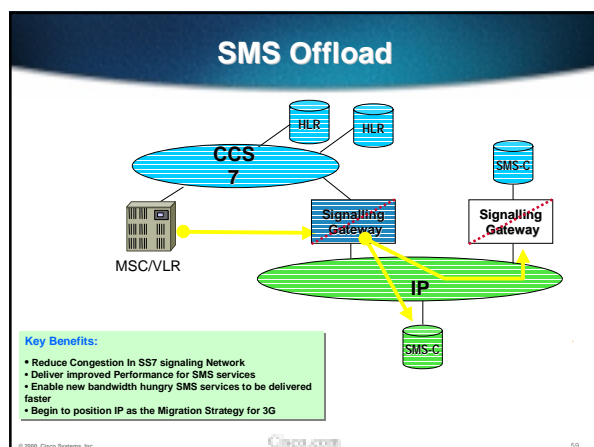
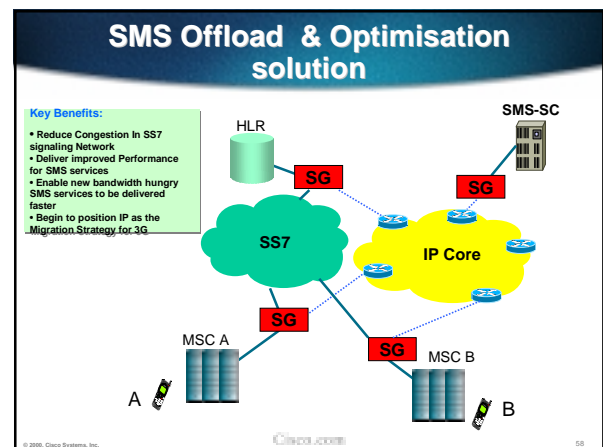
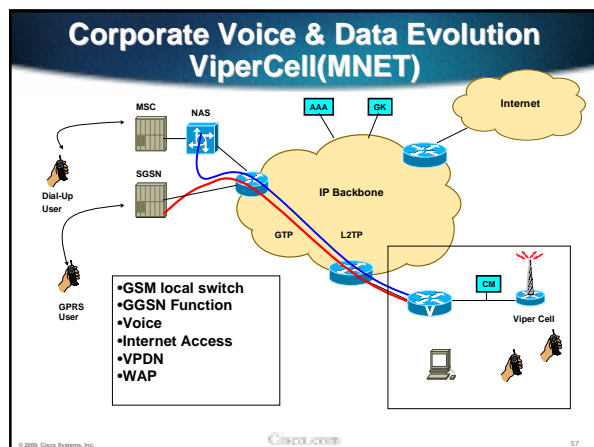
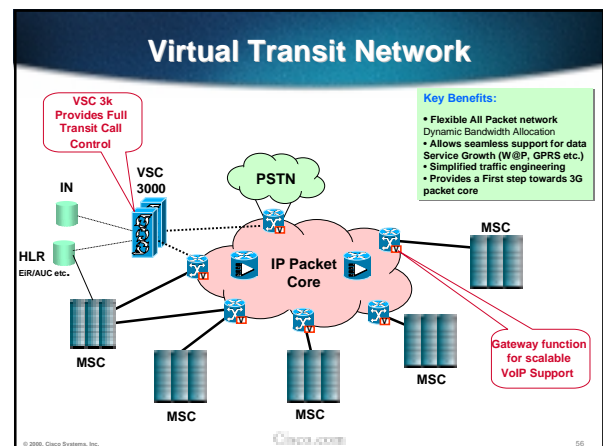
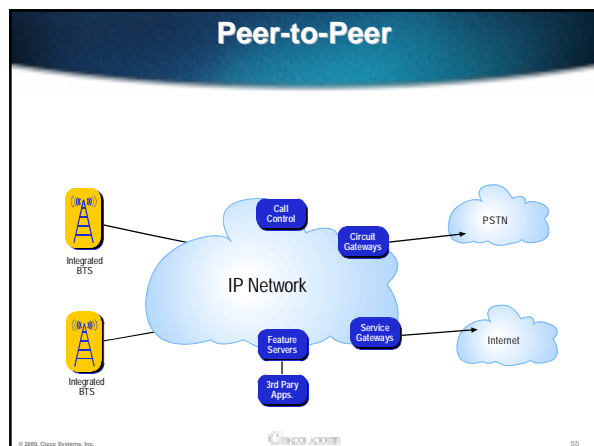


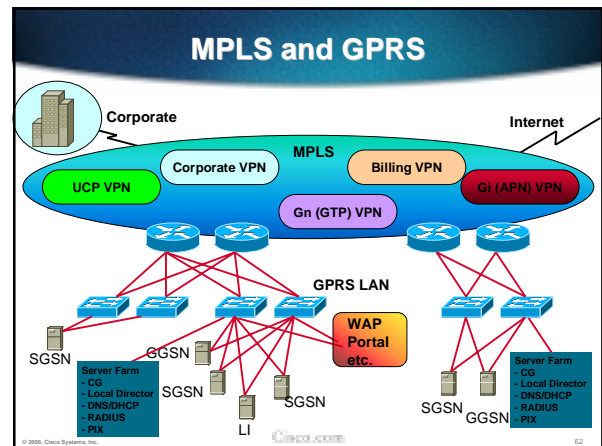
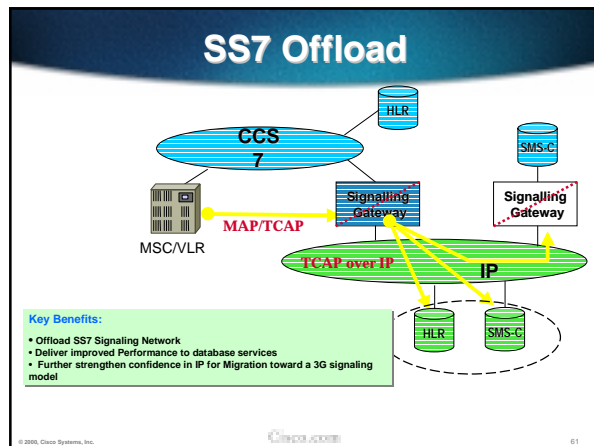
- Enhanced Services
- Feature servers
- APIs for 3rd parties
- Rapid service delivery

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## Summary

- **Mobile market will be the next market to convert**
- **Market Inflection Point - Mobile Data**
- **Build data services offerings now - 3G investment**
- **Cisco is well positioned to lead the data services investment in mobile**

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## Success Factors in the 3G Era

**Key success factors pre-date 3G rollout**

- Establish transport data service offering - 2.5 G
- Establish enterprise service offering
- Leverage Internet
  - Supplementary content
  - Time to market
  - Value add services
- Build subscriber value
  - Personalization capabilities
  - Web based customer service approach
  - Controllable services e.g. unified messaging

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