Migration of GSM Networks to GPRS

WHITE PAPER

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The migration path from GSM to GPRS requires additional packet switching nodes, software upgrades in the base station subsystem, the existing GSM nodes to be upgraded with GPRS functionality, commercial data services to provided - for this a GPRS operator needs to deploy other elements like Access servers and Firewalls.

The General Packet Radio Service (GPRS) is a new non-voice value added service that allows information to be sent and received across a mobile telephone network. It supplements today's Circuit Switched Data and Short Message Service. With the growing data traffic in the Internet world today, the need to look for better methodologies to meet the upcoming demand of the Internet users has become inevitable. GPRS has evolved to cater to the mobile users by enabling them to access the Internet world incessantly. It would also provide a massive boost to mobile data communication.

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As a point of caution, there are various issues that need to be addressed, like the billing methods, mediating the network elements, provisioning of services that are quite complex and need attention. This paper aims at devising an approach and a framework to resolve the issues involved in the migration from GSM to GPRS.

This is an analysis on how one can enhance the existing IP mediation, provisioning systems to support non-voice data transmissions and eventually migrate to 3G Technologies.

1. Introduction to GPRS

General Packet Radio Services (GPRS) is a standardized packet switched data service for GSM allowing data rates up to 170 kbits/sec. It presents new opportunities for GSM operators to grow and incre ase revenues and profits by opening up new packet data services. The GPRS provides us with:

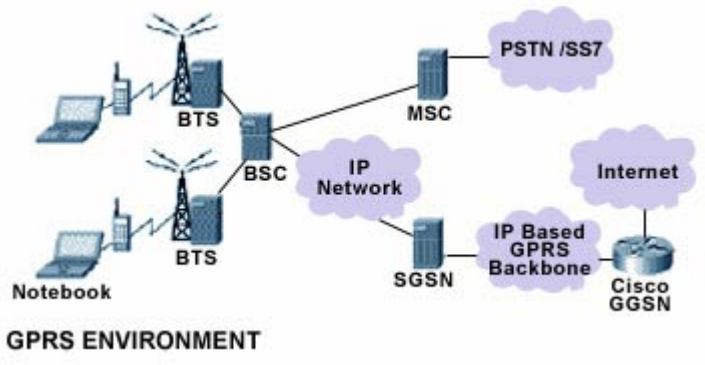
- New business opportunities in wireless data communications
- An evolution path to **3 rd generation** services
- Fast coverage rollout, adding packet switching nodes to an existing GSM network
- Efficient use of scarce radio resources
- Simultaneous GSM and GPRS without disturbance of existing services]

2. Architecture of GPRS

The GPRS Architecture is an extension of the GSM architectures. One of the main goals in the GPRS design is to support bursty data transfer. Although GPRS is considered to be part of the GSM service, it has its own core network and radio network, which is shared between the GPRS and GSM cores. Two new elements are added to the existing infrastructure to keep packet data traffic separated from traditional GSM voice and data

- The Serving GPRS Support Node (SGSN) for handling packet data traffic of users in a geographical area.
- The Gateway GPRS Support Node (GGSN) node that would connect to outside data networks and to other GPRS networks.

SGSN and GGSN are mobile aware routers. The nodes are inter connected via an IP backbone network as shown in the fig below.



GPRS ENVIRONMENT

a. SGSN - SERVING GPRS SUPPORT

The SGSN provides packet routing to and from the SGSN service area. It would be serving all GPRS subscribers that are physically located within the SGSN service area. A GPRS subscriber may be served by any SGSN in the network depending on location. The traffic is routed from the SGSN to the BSC via the BTS to the mobile station.

The SGSN provides:

- Authentication, ciphering and IMEI check.
- Mobility management
- Logical link management towards the Mobile Station
- Packet routing and transfer
- Charging data
- Connection to the HLR, MSC, and BSC

b. GGSN - GATEWAY GPRS SUPPORT NODE

The GGSN provides the interface with other GPRS networks as well as the exter nal IP networksandX. 25 networks. The GGSN has mobility management and access server functionality. The mobility management function is standardized by ETSI. These GPRS protocols are limited to setting up an IP bearer between the MS and the Access Server: a logical link. It translates data formats, signaling protocols and address information in order to permit communication between the different networks. From the external IP network's point of view, the GGSN is a host owning all IP addresses of all subscribers served by the GPRS network. Functional ity for routing to the right SGSN and protocol conversion is also provided by the GGSN.

3. Migration from GSM to GPRS

The migration path from GSM to GPRS requires:

- Additional packet switching nodes (routers between the base stations and the mobile switch center),
- Software upgrades in the base station subsystem (the base station and base station controller).
- The existing GSM nodes to be upgraded with GPRS functionality. Further more, the same
- transmission links can be reused, for example, between Base Transceiver Stations (BTSs) and Base
- Station Controllers (BSCs) for both GSM and GPRS.
- Commercial data services to provided, for this a GPRS operator needs to deploy other elements like Access servers and Firewalls.

Since the migration path from GSM to GPRS is not too onerous, telecommunications providers can quickly and easily provide GPRS services to existing GSM coverage areas. Thus, there should be minimal changes to the circuit switched GSM network, except where this confers a benefit to the GSM network. The GPRS architecture will demonstrate to the marketplace that packet switched technology and services for the wireless environment is viable, and will also stimulate marketplace demand for wireless data services.

4. Leveraging the GSM infrastructure for GPRS

The GPRS cost model provides incremental cost results, which does demonstrate that it's relatively cheap for GSM services providers to provide GPRS services in addition to their GSM service offerings for their existing subscribers. The GSM providers incur a relatively low incremental cost in providing GPRS services because the resources allocated to developing the GSM infrastructure subsidizes the development of the GPRS network. Thus the GSM providers can afford to leverage their existing infrastructures to provide wireless data.

5. Factors to be considered during the Migration

5.1 TO MEET GPRS REQUIREMENTS

5.1.1 – Fast Setup/Access Time

5.1.2 – Efficient use of scarce radio resources

5.1.3 – Connectivity to other data networks

5.1.4 – Flexible service

5.1.5 – Efficient transport of packets

5.1.6 – Reuse of GSM functions/Network

5.1.7 – Co-existence of both GSM and GPRS without disturbance

5.2 MEDIATION

5.2.1 CHARGING GATEWAY FUNCTIONALITY : Transactions over a GPRS network generate CDRs from both the Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN).

The SGSN CDR (S-CDR) provides the Radio Network Billing Information:

1. Subscriber identity – International Mobile Subscriber Identifier (IMSI)
2. Location (Cell ID)
3. QoS, Data Volume
4. Link/Downlink duration

The GGSN CDR (G-CDR) provides the Data Network Billing Information:

1. Subscriber identity (IMSI)

2. External Address - Access Point Network (APN)

3. Data Volume

4. Link/Downlink duration

The Charging Gateway Functionality (CGF) in a GPRS network provides the first level of mediation, consolidating the S-CDRs and G-CDRs into a meaningful format for the external Customer Care & Billing (CCB) system. The CGF passes the mediated CGF-CDRs to the CCB system for rating. Thus, the charging gateway function is more of a policing function than a charging function.

5.2.2 WAP SERVER

In order to provide a rate for GPRS transactions, additional information is required. Data services over GPRS will rely on WAP servers to convert HTML content from Web servers into a suitable format for mobile devices.WAP servers generate transaction information that would be necessary to effectively provide a rate for data services such as content from the Internet. Service providers will want to offer different pricing plans, depending on the value of the content they are providing. Distinguishing content will require information from WAP servers such as the URLs for an Internet session. Therefore, in addition to CGF-CDRs, there will be the need to use WAP-CDRs for rating.

5.2.3 RADIUS SERVER

Access (authentication & authorization) to a GPRS network is controlled at the SGSN. A Radius server may control access to external networks. The Radius server allocates IP addresses for a GPRS transaction and as a result, provides the necessary information to relate International Mobile Subscriber Identifier (IMSI) numbers from a mobile subscriber and the associated IP address for rating. Therefore, in addition to mediating CGF-CDRs and WAP-CDRs, there is a requirement to mediate information from Radius - CDRs.

Network Mediation = CGF-CDR + WAP-CDR + Radius-CDR

GSM CCB systems are not capable of mediating event records from these various sources.

5.2.4 BUSINESS MEDIATION

In addition to Network Mediation requirements, there are Business Mediation requirements to enable services such as Revenue Sharing and Sponsored Billing that are common business models within the IP environment.

5.3 BILLING

Since GPRS is an “always-on” technology, the time-based pricing models of the current GSM world are not appropriate for GPRS. Hence GPRS would require:

- Content
- Application Volume
- Quality of Service
- Transactions
- And location based

pricing models to appeal to users. To support the collection of billable application and content usage data, the data will need to be collected directly from CGSN/SGSN and enhanced and merged with the IP-based applications, servers and network elements.

6. Upgrading the existing Mediation set up in WIPRO to suit the framework of GPRS

Wipro has its GSM customers spread all over India, where the Mediation application has been implemented. Hence the existing framework for GSM can be improvised to meet the GPRS requirements. The following are some of the suggested enhancements:

- An existing Mediation setup to support HTML formats to decipher the information obtained from WAPSERVER and RADIUS Server.
- The output format obtained from the Mediation application be of a common format that could be understood by any OSS end-user application
- Re-designing the mediation application such that it acts like a black box, thereby reducing the customization at the interfaces.
- It is envisaged that the volume of accounting data would greatly increase, in the order of 50 CDRs per person per day and hence the Mediation application to be improvised, in order toprocess a multitude of records from different elements, as otherwise it would have a direct hit on the the performance of the system.
- In the context of GPRS, provisioning of services would include both GSM and IP services.
- Direct Provisioning of the IP should take place at the centralized LDAP servers and for the GSM at the HLR/MSC.

7. Conclusion

In theory, the GPRS should cost uses less than circuit-switched services since communication channels are being used on a shared basis and also the packets are need-based rather than dedicated only to one user. The next stepping stone would be moving towards 3G by implementing EDGE (Enhanced Data rates for Global Evolution), offering data services and applications at speeds up to 384kbits / sec using the existing infrastructure. Others include UMTS (Universal Mobile Telephone System), WDCMA (Wideband-CMDA) and TD/CDMA (Time Division/Code Division Multiple Access) that are being developed to address 3G networks.

In conclusion, the GPRS is the key transition phase and is a fundamental requirement for Third Generation Mobile Communications.

8. List of Acronyms

1. GSM - Global System for Mobile Communications
2. GPRS - General Packet Radio Service
3. MS - Mobile Station
4. SGSN - Serving GPRS Support Node
5. GGSN - Gateway GPRS Support Node
6. BTS - Base Station Transceiver Subsystem
7. BSC - Base Station Controller
8. HLR - Home Location Register
9. MSC - Mobile Services Switching Center
10. 3G - Third generation; (is a generic name for next-generation mobile networks (Universal Telecommunications System [UMTS], IMT-2000; sometimes the GPRS is called a 3G in North America)
11. ETSI - European Telecommunications Standards Institute
12. RADIUS - Remote Authentication Dial-In User Service
13. CDR - Collector Data Records
14. WAP - Wireless Application Protocol
15. CGF - Charging Gateway Functionality

16. IMSI - International Mobile Subscriber Identifier
17. CCB - Customer Care & Billing
18. APN - Access Point Network
19. EDGE - Enhanced Data rates for Global Evolution)
20. TD/CDMA - Time Division/Code Division Multiple Access
21. WDCMA - Wideband-CMDA
22. LDAP - Lightweight Directory Access Protocol.

9. References

Links

1. GSM - An Introduction to GPRS
   www.gsmworld.com
2. Billing and Usage Strategies
   www.xacct.com
3. Implementation of GPRS
   www.cisco.com
4. A Guide to GSM Network Migration – White paper
   www.nokia.com
5. From GSM to UMTS
   www.siemens.com
6. General GPRS Architecture
   www.ericsson.com

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Wipro in GPRS

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