Introduction to WAP over GPRS

April 30, 2003
GPRS is a Bearer for WAP

- GPRS is a UDP/IP bearer in the WAP standard
- It is a packet switched network which makes it an optimal bearer for bursty applications, e.g., for a WAP service
Key Aspects of Using GPRS as a WAP Bearer

• Always-on user experience:
  No dial in, no modem synchronization. A logical data pipe can be established at power on, and kept in "stand-by".

• Low radio resource utilization:
  Downloading a WAP deck requires only about 1 time slot second of radio capacity.

• Low power consumption in terminal during session:
  Terminal transmits uplink data only when a message needs to be transferred.

• High user density:
  Allows simultaneous sessions of many users located at the same premises.
How to Speed Up WAP over GPRS (1)

- Wap standard was designed to allow content to be delivered over any bearer service.

- Caching WAP content that is accessed through the Internet
  - Use HTTP proxy to cache content. The proxy should be placed close to the WAP gateway. Home page (first page) might alternatively be kept on a local server, close to the WAP gateway.

- Caching in clients
  - Most clients have a cache and using it is for sure an important way to provide fast user experience.
How to Speed Up WAP over GPRS (2)

- Minimize amount of round-trips
  - Remember that images cause additional round-trips
- Keep size of XHTML pages and WML decks as compact as possible
  - Important for pages that require instant response
- Avoid low-capacity links between WAP gateway and content server
- Avoid packet loss between WAP gateway and GGSN (Gateway GPRS Support Node)
  - Lost packets cause additional delay due to HTTP-retransmission
Network Elements of GPRS (1)

- GPRS introduces some new network elements

  - **SGSN = Serving GPRS Support Node** = GPRS support node that serves GPRS mobile by sending or receiving packets via a base station subsystem.

  - **GGSN = Gateway GPRS Support Node** = GPRS support node which acts as a gateway between the GPRS network and packet switched public data network (PSPDN). GGSN connects to data networks via access points. Via different access points it is possible to have connections to the operator’s own Intranet, Internet, corporate Intranet and other data networks.
Network Elements of GPRS (2)

- GPRS introduces some new network elements
  - Border Gateway = GPRS element which acts as a gateway between the intra-PLMN GPRS network and inter-PLMN GPRS network. For example GPRS roaming is arranged via border gateways to other operator's GPRS networks.
  - Access Point = GPRS element which acts as a gateway between the GPRS network (GGSN) and data network (Internet, Corporate Intranet etc.).
GPRS Network Architecture

GPRS-Capable
GSM Client

Inter-PLMN
Backbone

Intra-PLMN
Backbone

Border
Gateway

SGSN

Charging
Gateway

BTS

GPRS
Network

BSC

MSC

PSTN
Network

Billing
System

Firewall

Access Point

Data
Network

GGSN

Access Point

Firewall

Router

Corporate
LAN

Data
Network

Inter-PLMN
Network

Inter-PLMN
Network
WAP over GPRS

- A GPRS-capable WAP Client requests for WAP content via an Access Point.
- It depends on the configuration of the Access Point which data networks or IP addresses can accessed via this particular Access Point. GPRS operator defines the configuration of its access points.
- There are several differently configured access points on a GPRS network.
- The GPRS network assigns dynamic IP addresses to WAP Clients for temporary use.
WAP over CSD vs. WAP over GPRS (1)

A Bursty Application (e.g., WAP Browsing):

With Circuit Switched Connection (e.g., GSM CSD Client):

WAP browsing with GSM CSD.
A client reserves a time slot but doesn't use it all the time. Idle times cannot be provided for other clients.
WAP over CSD vs. WAP over GPRS (2)

A Bursty Application (e.g., WAP Browsing):

With Packet Switched Connection (e.g., GPRS Client):

WAP browsing with GPRS.
A client doesn't reserve a whole time slot for itself. Idle times can be provided for other clients.
GPRS Capacity Allocation in GSM Network

The GSM/GPRS network operator defines how many time slots are available for GPRS use in one frequency channel. This can be changed dynamically depending on the load of the network.

A downlink time slot in GPRS usage (PDCH)

Time slots of one downlink frequency channel in GSM Network (0-7)

GSM CSD

GPRS

NOKIA
Effective Radio Resource Usage in GPRS

In this example three clients share one time slot for WAP Browsing
-> Effective usage of radio capacity
One round trip

- Optimizing the whole end to end delay chain is what brings the maximum throughput and the optimal end user experience.
### Multislot Terminal Classes (GPRS)

**Class 6 terminal can handle:**

- 3+1 asymmetric multiple-slot connection, and
- 2+2 symmetric multiple-slot connection

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GPRS Symmetric Multiple-slot Connection

GPRS data connection can, for example, use capacity of

- Two time slots of a downlink frequency channel to receive data (maximum peak bit rate is 2 x 14.4 kbps = 28.8 kbps), and
- Two time slots of an uplink frequency channel to send data (peak bit rate is 2 x 14.4 kbps = 28.8 kbps)

GPRS symmetric data connection, e.g., WAP browsing
GPRS Asymmetric Multiple-slot Connection

GPRS data connection can, for example, use capacity of

- Three time slots of a downlink frequency channel to receive data (maximum peak bit rate is $3 \times 14.4 \, \text{kbps} = 43.2 \, \text{kbps}$), and
- One time slot of an uplink frequency channel to send data (peak bit rate is $1 \times 14.4 \, \text{kbps} = 14.4 \, \text{kbps}$)

GPRS asymmetric data connection, e.g., WAP browsing
EDGE Symmetric Multiple-slot Connection

EGPRS data connection can, for example, use capacity of:

- Three time slots of a downlink frequency channel to receive voice call data, WAP browsing data, and videoconferencing data, and
- Three time slots of an uplink frequency channel to send voice call data, WAP browsing data, and videoconferencing data.
EDGE Asymmetric Multiple-slot Connection

EGPRS data connection can, for example, use capacity of

- Four time slots of a downlink frequency channel to receive voice call data and WAP browsing data, and
- Two time slots of an uplink frequency channel to send voice call data and WAP browsing data
GPRS Terminal Class A

The GPRS standard also divides mobile stations into 3 further classes; Class A, B, and C:

Class A:

- Simultaneous GPRS and speech connection is possible
- Network co-ordination for this is not standardized
- MS must enable two simultaneous (multiple-slot) calls/connections
GPRS Terminal Class B

Class B:

- Simultaneous GPRS and speech connection is not possible
  - With a GPRS connection open, the MO (mobile-originated) and MT (mobile termination) circuit switched service will put the GPRS into suspend. GPRS will remain suspended as long as the phone remains in the dedicated mode (e.g., voice call is on).

  GPRS-speech-GPRS automatic connection alternation is possible without terminating the GPRS connection
  - The GPRS connection will be resumed automatically after ending the dedicated mode connection (e.g., voice call or SMS over GSM).

- Speech-GPRS-speech automatic connection alternation is not possible without disconnecting the speech call.

- Nokia handsets belong to terminal Class B.
GPRS Terminal Class C

Class C:

- Manual switching between GPRS and speech connections
- No circuit switched paging received during the GPRS connection