



---

**Document no. CUST0700-01**

# **Wireless Application Development Guidelines**

## **Version 5.1**

---

Prepared by: Telstra Mobility Solution Architects, Mobility Engineering and Mobile Network Services.

This Release: 23 May 2007

This publication is only available to the general public in PDF format.

This publication has been prepared and written by Telstra Corporation Limited (ACN 051 775 556), and is copyright. Other than for the purposes of and subject to the conditions prescribed under the Copyright Act, no part of it may in any form or by any means (electronic, mechanical, microcopying, photocopying, recording or otherwise) be reproduced, stored in a retrieval system or transmitted without prior written permission from the document controller. Product or company names are trademarks or registered trademarks of their respective holders.

Note for non-Telstra readers: The contents of this publication are subject to change without notice. All efforts have been made to ensure the accuracy of this publication. Notwithstanding, Telstra Corporation Limited does not assume responsibility for any errors nor for any consequences arising from any errors in this publication.

Telstra Corporation Limited  
ACN 051 775 556

**RECORD OF ISSUES**

<b>Issue No.</b>	<b>Issue Date</b>	<b>Nature of amendment</b>	<b>Author</b>
Version 5.0	1 <sup>st</sup> Dec 2006	New, rewritten, reformed version	Kalev Pank
Version 5.1	18 <sup>th</sup> May 2007	14.4.1. – UDP timeout value changed from 1 minute to 20 minutes.	Kalev Pank
Version 5.1	23 <sup>rd</sup> May 2007	14.1.1. – added HTTP timeout value of 5 mins	Kalev Pank

## Table of Contents

RECORD OF ISSUES .....	2
1. AIM 7	
2. SCOPE 7	
3. DISCLAIMER .....	7
4. SHORT LIST OF ABBREVIATIONS (SEE APPENDIX FOR MORE EXTENSIVE LIST) .....	8
5. TELSTRA WIRELESS DATA NETWORKS.....	10
6. BRIEF COMPARISON OF WIRELESS TECHNOLOGIES.....	10
7. GPRS/EDGE WIRELESS NETWORK.....	11
7.1. Introduction.....	11
7.2. GPRS Network Description.....	11
7.2.1. Subscriber Identity Module (SIM) with GPRS subscription.....	11
7.2.2. MS (Mobile Station) - GPRS Device .....	11
7.2.3. BTS (Base Transceiver Station).....	12
7.2.4. BSC (Base Station Controller) .....	12
7.2.5. SGSN (Serving GPRS Support Node) .....	12
7.2.6. GGSN (Gateway GPRS Support Node).....	13
7.3. EDGE description .....	13
7.4. GPRS Protocol Stack.....	13
7.5. Mobile Station Modes of Operation.....	15
7.6. Mobility Management States .....	16
7.7. Packet Data Protocol (PDP) States .....	18
7.8. Static and Dynamic PDP Addresses .....	18
7.9. Affect of Coverage on Retaining GPRS Sessions.....	19
7.10. GPRS Caveats.....	20
7.10.1. Limited Cell Capacity for all Users.....	20
7.10.2. Radio Network Quality .....	20
7.10.3. Security .....	20
7.10.4. Packet Switched versus Circuit Switched .....	20
7.10.5. Latencies .....	20
8. 3G (UMTS) WIRELESS NETWORKS .....	21
8.1. Introduction.....	21
8.2. UMTS Network Description.....	21
8.2.1. Core Network (CN).....	21
8.2.2. Terrestrial Radio Access Network (UTRAN) .....	22
8.2.3. User Equipment (UE).....	22
8.2.4. UMTS Network Elements.....	22

8.3.	UMTS & GPRS Logical Architecture .....	22
8.4.	Mobile Station modes of operation .....	23
8.5.	Mobility Management States .....	24
8.5.1.	PMM-DETACHED State .....	24
8.5.2.	PMM-IDLE State .....	24
8.5.3.	PMM-CONNECTED State .....	24
8.5.4.	State Transitions and Functions .....	24
8.6.	Packet Data Protocol (PDP) States .....	25
9.	COMMON (SHARED) GPRS/EDGE AND UMTS FEATURES/FUNCTIONS .....	26
9.1.	SIM and USIM .....	26
9.2.	Access Point Name (APN).....	26
9.2.1.	Full APN Names .....	26
9.3.	Packet Data Protocol (PDP) States .....	26
10.	IP WIRELESS AND IP WAN .....	28
10.1.	Description.....	28
10.2.	GPRS, 3G/UMTS and IP Wireless – session establishment.....	30
11.	TELSTRA’S 3G-UMTS & GPRS NETWORK ARCHITECTURE .....	32
12.	GPRS AND 3G/UMTS CONNECTION ESTABLISHMENT PROCEDURES.....	33
12.1.	AT Commands and GPRS Connection Establishment .....	33
12.1.1.	GPRS & 3G/UMTS PDP Context Activation.....	37
12.2.	Dial-Up Networking configuration examples.....	39
13.	NETWORK SPECIFIC USAGE COMPLIANCE REQUIREMENTS & CONSIDERATIONS .....	44
13.1.	Common requirements.....	44
13.2.	Application or Telstra Product Specific Requirements.....	44
<b>13.2.1.</b>	<b>Telemetry</b> .....	44
14.	APPLICATION DEVELOPMENT GUIDELINES.....	45
14.1.	Designing Wireless Data Applications .....	45
14.2.	Protocols .....	46
14.3.	IP Address assignment - Static and Dynamic Addresses.....	46
14.4.	Internet Based Connections .....	46
14.4.1.	Firewall considerations .....	46
14.5.	Connections & Data Sessions .....	46
14.6.	Connection/session interruption handling.....	47
14.7.	Establishing the connection .....	47
14.8.	Data session initiation & data push to the mobile terminal.....	47
14.9.	Loss of connectivity.....	47

14.10. Detecting loss of connectivity.....	47
14.11. Regaining connectivity .....	48
14.12. Maintaining Connectivity .....	48
14.12.1. Host unreachable.....	48
14.13. Coverage / reception related issues.....	49
14.14. Data usage optimisation.....	49
14.15. Closing connection .....	49
14.16. Application testing.....	49
14.17. Diagnostics / Trouble Shooting .....	49
14.18. User Interface.....	50
14.18.1. User Interface / Trouble shooting.....	50
14.19. Improving User Experience .....	50
14.20. Documentation.....	50
14.21. Factors Governing Performance .....	50
14.21.1. Latency.....	50
14.21.2. Data Rates .....	51
14.21.3. Quality of Service .....	51
14.21.4. MTU Size.....	51
14.22. Security.....	51
14.22.1. Dedicated APN .....	51
14.23. Device Software.....	51
14.24. Improving battery life .....	51
14.25. Modem Interface.....	51
14.25.1. AT Commands .....	52
14.26. Authentication Failures .....	52
14.27. Hibernation and suspension .....	52
14.28. Middleware applications.....	52
15. FAULT FINDING PROCEDURE.....	53
16. CAPTURING PPP SESSION LOGS ON WINDOWS .....	54
17. APPENDIX A – SUPPORT CONTACTS, HELP DESKS, WEB SITES ETC .....	55
17.1. Customer Support – IP Wireless / IP WAN.....	55
17.2. Customer Support – Wireless Data Customer Support.....	55
17.3. Pre-sales - Mobility Solution Architects .....	55
17.4. Other useful URLs: .....	55
17.5. Other Non-Telstra Development Support.....	55
18. APPENDIX B - ACTIVATION PROCESSES.....	56

18.1. Activation Process for Mobile Service .....56

18.2. Activation Process for IP Wireless/IP WAN .....56

19. APPENDIX C - REFERENCE INFORMATION .....57

19.1. Standards Bodies.....57

19.2. Mobile Technologies and links .....59

19.3. Developer Assistance Web Sites and Magazines.....60

19.4. Abbreviations (ref: ETSI standards document - TR 121 905) .....61

19.5. 3GPP – Glossary of Terms and Definitions .....70

19.6. Documents Referenced by these Guidelines & references .....78

## **1. AIM**

The aim of this document is to provide Telstra specific software development guidelines for applications that are intended to utilise, in a wireless aware manner, the Telstra wireless networks.

## **2. SCOPE**

The document is targeted at software application developers who have a good understanding of non-wireless software applications but need additional information on wireless technologies.

It covers GPRS, UMTS 850, UMTS 2100, but does not cover Circuit Switched Data (GSM UDI, CDMA QNC), SMS, WAP, MMS or WLAN.

## **3. DISCLAIMER**

This document is to be used as a guide only. Reliance upon any representations made or information contained in this document is at your own risk. Telstra does not warrant or represent that successful integration of a software application into Telstra's wireless network will result in contemplation by Telstra of a business opportunity relating to that software application.

#### 4. SHORT LIST OF ABBREVIATIONS (SEE APPENDIX FOR MORE EXTENSIVE LIST)

<b>2G</b>	2 <sup>nd</sup> Generation
<b>3G</b>	3 <sup>rd</sup> Generation
<b>3GPP</b>	Third Generation Partnership Project
<b>APN</b>	Access Point Name
<b>AuC</b>	Authentication Centre
<b>BS</b>	Base Station
<b>BSC</b>	Base Station Controller
<b>BSS</b>	Base Station System
<b>BTS</b>	Base Transceiver Station
<b>CDMA</b>	Code Division Multiple Access
<b>CSD</b>	Circuit Switched Data
<b>DAE</b>	Dynamic Access Edge device
<b>EDGE</b>	Enhanced Data rates for GSM Evolution
<b>EGPRS</b>	Enhanced GPRS
<b>ETSI</b>	European Telecommunications Standards Institute
<b>GERAN</b>	GSM EDGE Radio Access Network
<b>GGSN</b>	Gateway GPRS Support Node
<b>GMM</b>	GPRS Mobility Management
<b>GPRS</b>	General Packet Radio Service
<b>GSM</b>	Global System for Mobile communications
<b>GSN</b>	GPRS Support Nodes
<b>GTP</b>	GPRS Tunnelling Protocol
<b>HLR</b>	Home Location Register
<b>HN</b>	Home Network
<b>HSCSD</b>	High Speed Circuit Switched Data
<b>HSDPA</b>	High Speed Downlink Packet Access
<b>IMEI</b>	International Mobile Equipment Identity
<b>IMSI</b>	International Mobile Subscriber Identity
<b>IP</b>	Internet Protocol
<b>IWF</b>	InterWorking Function
<b>LCP</b>	Link Control Protocol
<b>LNS</b>	L2TP Network Server
<b>ME</b>	Mobile Equipment
<b>MGW</b>	Media GateWay
<b>MO</b>	Mobile Originated
<b>MS</b>	Mobile Station
<b>MSC</b>	Mobile Switching Centre
<b>MSISDN</b>	Mobile Subscriber ISDN Number
<b>MT</b>	Mobile Terminated
<b>PDN</b>	Packet Data Network
<b>PDP</b>	Packet Data Protocol
<b>PDU</b>	Protocol Data Unit

<b>PLMN</b>	Public Land Mobile Network
<b>PPP</b>	Point-to-Point Protocol
<b>PS</b>	Packet Switched
<b>PSPDN</b>	Packet Switched Public Data Network
<b>PSTN</b>	Public Switched Telephone Network
<b>QoS</b>	Quality of Service
<b>RADIUS</b>	Remote Authentication Dial In User Service
<b>RAN</b>	Radio Access Network
<b>RNC</b>	Radio Network Controller
<b>RSSI</b>	Received Signal Strength Indicator
<b>SGSN</b>	Serving GPRS Support Node
<b>SIM</b>	GSM Subscriber Identity Module
<b>SIP</b>	Session Initiated Protocol
<b>SMS</b>	Short Message Service
<b>SMSC</b>	Short Message Service Centre
<b>TA</b>	Terminal Adapter
<b>TCP</b>	Transmission Control Protocol
<b>TE</b>	Terminal Equipment
<b>UDP</b>	User Datagram Protocol
<b>UE</b>	User Equipment
<b>UMTS</b>	Universal Mobile Telecommunications System
<b>URAN</b>	UMTS Radio Access Network
<b>USIM</b>	Universal Subscriber Identity Module
<b>UTRAN</b>	Universal Terrestrial Radio Access Network
<b>VLR</b>	Visitor Location Register
<b>VPN</b>	Virtual Private Network
<b>WAP</b>	Wireless Application Protocol
<b>WCDMA</b>	Wideband Code Division Multiple Access
<b>WWW</b>	World Wide Web

## 5. TELSTRA WIRELESS DATA NETWORKS

Telstra operate a number of wireless data, wide area networks, associated with the respective voice networks. As part of the Telstra “transformation” strategy announced in November 2005, Telstra has deployed a 3G UMTS network in the 850 MHz frequency band (the Telstra **Next G™** network). This network will provide equivalent or better coverage and services than the CDMA network, which is planned to be closed in 2008. Telstra’s wireless network strategy is to operate wide area wireless networks that are part of the GSM “family” of technologies. These are the existing GSM network, providing GPRS & EDGE based packet data services, the 3G UMTS network operating in the 2100 MHz frequency band (sharing some infrastructure with Hutchinson) and the new 3G UMTS (**Next G™**) network in the 850 MHz band. These three networks use the same core infrastructure technology and data device connectivity methodology as originally designed for GSM and GPRS, so from an application developer’s point of view device configuration and connectivity parameters are the same. The main difference between the networks, especially between GPRS/EDGE and the 3G networks is in network performance.

The 3G UMTS network data specification evolved from the GPRS specification, so knowledge of GPRS and the terminology used forms a basis for understanding 3G UMTS data services.

## 6. BRIEF COMPARISON OF WIRELESS TECHNOLOGIES

Some of the following parameters will vary dependent on measuring conditions. They are primarily provided to give a relative performance comparison between the Telstra mobile networks.

Network Technology	Latency	Downlink theoretical peak throughput	Downlink average throughput	Uplink theoretical peak throughput	Uplink average throughput
GPRS	400 to 500 ms	53.6 kbps	30-40 kbps	53.6 kbps	10-30 kbps
EDGE	400 to 500 ms	236 kbps	160-190 kbps	236 kbps	50-60 kbps
3G 2100MHz WCDMA (2006)	150 to 300 ms	384 kbps	180 - 280 kbps	64 kbps	50 kbps
3G 850MHz “Next G” HSDPA (2006)	80 to 100 ms	3.6 Mbps	550 – 1500 kbps	384 kbps	180-280 kbps
3G 850MHz “Next G” HSDPA, HSUPA (2007)	Expected <100 ms	14.4 Mbps	Expected >1 Mbps	1.46Mbps [later 5.76Mbps]	>1Mbps

Table 1: Brief Comparison of Telstra Packet Radio Network Services

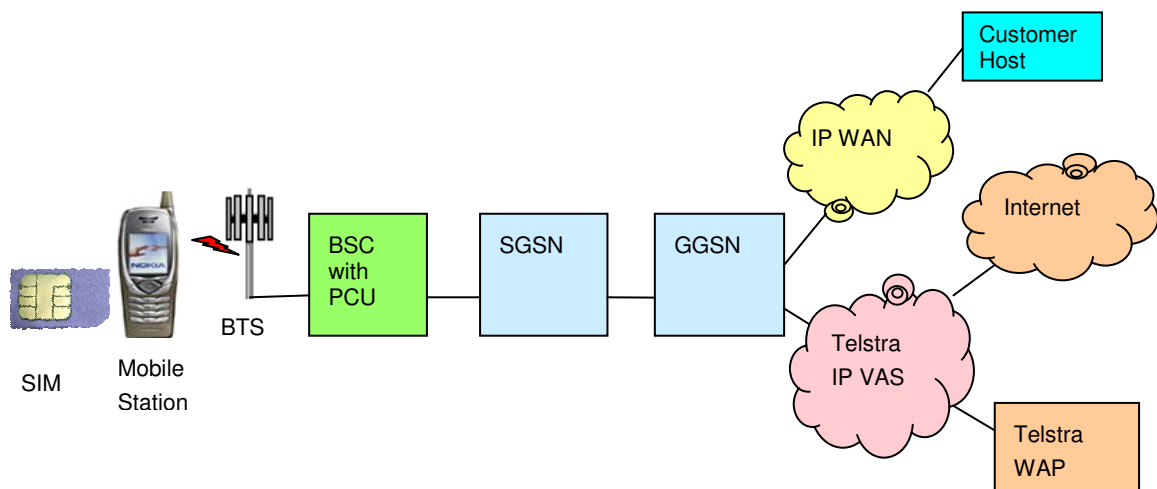
## 7. GPRS/EDGE WIRELESS NETWORK

### 7.1. Introduction

Telstra introduced the GPRS packet data service on its GSM network in 2001. GPRS provides packet data capability over IP with throughputs up to 48 kbps. In 2006 Telstra upgraded its network to support EDGE (Enhanced Data rates for GSM Evolution).

GPRS is implemented on the GSM infrastructure through the addition of two network nodes, the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN). GPRS shares the existing GSM radio network including BSCs and BTSs.

### 7.2. GPRS Network Description



**Figure 1: Basic GPRS Network Elements End to End**

Note: The diagram above is simplified. Telstra has many BSCs, and multiple SGSNs and GGSNs.

Following is a short description of the some of the key components of a GPRS network:

#### 7.2.1. Subscriber Identity Module (SIM) with GPRS subscription

The SIM card within a GSM/GPRS device identifies the network subscription, not the device itself. The SIM is a smart card that securely stores subscriber information, authentication information and provides storage space for text messages. Subscribers are uniquely identified by the International Mobile Subscriber Identity (IMSI) number stored on the card, which is linked to the subscriber's mobile number within the internal network subscriber database, the Home Location Register (HLR).

#### 7.2.2. MS (Mobile Station) - GPRS Device

The end-user equipment (MS) is logically divided into two parts: the Terminal Equipment (TE) and the Mobile terminal (MT). The TE contains the application and obtains GPRS connectivity via the MT. The MT contains the GSM radio components and implements the GPRS functionality.

A GPRS phone with in-built Internet browser is an example of a device that combines the TE and MT functionality seamlessly into one unit, when using the Internet service.

A Personal computer connected to a GPRS modem is an example of where the TE and MT functionality is split into two units. In this latter case PPP is used as the protocol between the TE and the MT.

GPRS phones and modems implement a PPP server. The use of PPP means that existing terminal and Dial-up Networking Software can be used to communicate to GPRS devices and allow GPRS sessions to be established. As part of this PPP compatibility, the GPRS specification defines particular AT-commands to initialise the GPRS modem, and then a particular dial-string to initiate a GPRS session. It is therefore possible to make function calls to existing Operating System software to establish GPRS sessions. When using this method it is still necessary to initialise the GPRS modem prior to dialling. Most Dial-up networking software offer the ability to send “extra” AT-commands to a modem prior to dialling.

To obtain greater control over the modem, many applications developers choose to develop their own software to directly control the GPRS modem. In this case the application developer must issue AT-commands to initialise the GPRS device, dial a session, and then launch a PPP client to interact with the GPRS modem.

Typical AT commands, dial-strings, and PPP interaction are further discussed in Section 12.

### **7.2.3. BTS (Base Transceiver Station)**

The BTS is more commonly referred to as a base station (usually deployed as a mobile phone tower). The BTS hosts radio equipment that provides radio coverage to a specific area. These areas are called “cells”. A base station may have multiple cells. The capacity of a cell is determined by the number of radio transceivers connected to that cell. The cell’s capacity is shared by all users locked onto and communicating with that cell.

At any given moment a GPRS device will be locked onto one cell only and communicate with that cell as required. As the device moves around the network and/or the signal levels from surrounding cells vary, the device will move from one cell to another. In GPRS this process is known as “Cell Update” (For voice calls the similar process is called handover). During Cell Update there is a short period when the device cannot send or receive data (typically in the order of 3 seconds, but sometimes longer).

### **7.2.4. BSC (Base Station Controller)**

Each BTS is connected to one BSC. The BSC controls a number of base stations in a geographical area to support communication over a radio connection, and is involved in the allocation and control of radio resources to individual mobiles. Inside the BSC is a Packet Control Unit (PCU) which is used in the GPRS network to send packet data and control signals to the SGSN.

### **7.2.5. SGSN (Serving GPRS Support Node)**

The SGSN Interacts with BSC PCUs covering a specific geographical area. Key functions of the SGSN are firstly to keep track of GPRS mobile/device locations within the radio network, and secondly to communicate with the mobile to establish GPRS sessions. The whole process of tracking the GPRS device location is known as GPRS Mobility Management (GMM). The processes surrounding establishing and maintaining GPRS sessions is called GPRS Session Management (GPRS SM).

#### **7.2.5.1. *SGSN GPRS Mobility Management (GMM)***

It is important to note that prior to being able to use GPRS, a device must register its presence with the SGSN serving the coverage area where the mobile is located. When the device is first turned on the signalling to register is called “GPRS Attach”. During

the GPRS Attach process, the SGSN will query the subscriber database to check whether the phone number of the SIM card is subscribed to GPRS.

After the initial attachment, the device periodically sends an update to the network to keep the network informed that it has remained within the GPRS coverage area. These updates are known as “Routing Area Updates”.

This whole process of tracking the GPRS device location is known as GPRS Mobility Management (MM).

#### **7.2.5.2. SGSN GPRS Session Management**

When a device establishes a GPRS Session, the request is passed transparently over the radio network to the SGSN. In the GPRS specifications a GPRS session is called a Packet Data Protocol Context (PDP Context). The SGSN receives the PDP Context Request message from the mobile and checks whether the mobile number has been subscribed to the requested APN (Access Point Name). If not the SGSN will reject the request.

The SGSN then chooses the appropriate GGSN and sends a Create PDP Request to the GGSN. Based on the reply back from the GGSN the SGSN will reply back to the mobile with a successful response, or a PDP reject message.

### **7.2.6. GGSN (Gateway GPRS Support Node)**

The GGSN supports multiple SGSNs. The GGSN acts as a gateway between the GPRS network and packet data networks (eg the Internet). The GGSN responds to PDP Context Requests and is involved in the allocation of IP addresses back to the device (communicating via the SGSN). Depending upon the APN, the GGSN may allocate IP addresses itself, or it may use a DHCP, RADIUS, or L2TP client to request an IP address from another packet data network or server.

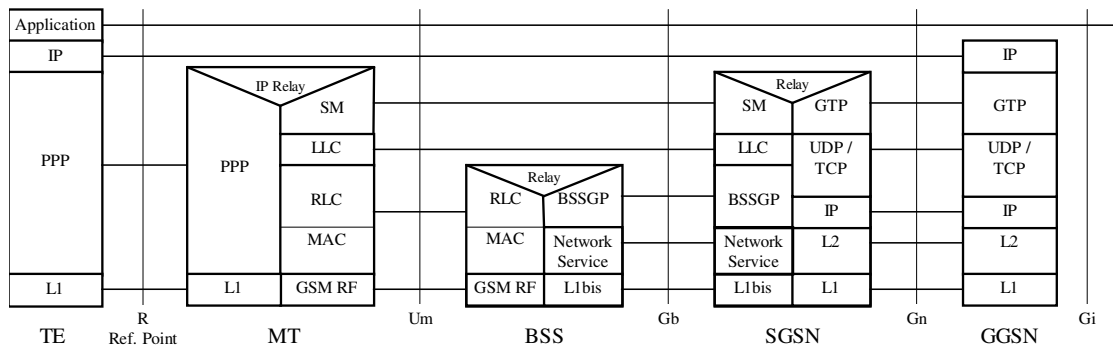
## **7.3. EDGE description**

EDGE increases packet data rates by a factor of three over GPRS and doubles data capacity within the existing radio spectrum. A GPRS network using the EDGE radio interface is technically called an Enhanced GPRS (EGPRS) network. EDGE is fully backwards compatible with GPRS, thus any application developed for GPRS will also work with EDGE. An EDGE capable device will automatically use EDGE for data communication where EDGE coverage is available. Some devices may indicate that they are using EDGE, but many will just continue to show GPRS access, even though they are operating at increased EDGE throughput levels.

As EDGE only changes the radio interface, the operation of the GPRS core infrastructure, the GPRS protocol stack, Mobility Management States and PDP context handling remains the same - only throughput per timeslot is changed.

## **7.4. GPRS Protocol Stack**

The GPRS protocol stack consists of a layered protocol structure providing user information transfer, along with associated information transfer control procedures (e.g., flow control, error detection, error correction and error recovery) as shown in Figure 2. The diagram shows the signalling plane. The transmission plane protocol stack (ie protocols used to carry user data) is very similar, except that SMDCP is used above LLC, between the mobile and the SGSN. In the diagram below SM refers to Session Management – ie the signalling between the mobile and the SGSN to create and tear down GPRS sessions.



**Figure 2: GPRS Protocol Stack**

Legend:

- GPRS Tunneling Protocol (GTP): This protocol tunnels user data and signalling between GPRS Support Nodes in the GPRS backbone network. GPRS Tunneling Protocol encapsulates all PDP PDUs. GTP is specified in GSM 09.60.
- TCP carries GTP PDUs in the GPRS backbone network for protocols that need a reliable data link (e.g., X.25), and UDP carries GTP PDUs for protocols that do not need a reliable data link (e.g., IP). TCP provides flow control and protection against lost and corrupted GTP PDUs. UDP provides protection against corrupted GTP PDUs. TCP is defined in RFC 793. UDP is defined in RFC 768.
- IP: This is the GPRS backbone network protocol used for routing user data and control signalling. The GPRS backbone network is initially be based on the IP version 4. Ultimately, IP version 6 shall be used. IP version 4 is defined in RFC 791.
- Subnetwork Dependent Convergence Protocol (SNDCP): This transmission functionality maps network-level characteristics onto the characteristics of the underlying network. SNDCP is specified in GSM 04.65.
- Logical Link Control (LLC): This layer provides a highly reliable ciphered logical link. LLC shall be independent of the underlying radio interface protocols in order to allow introduction of alternative GPRS radio solutions with minimum changes to the NSS. LLC is specified in GSM 04.64.
- Relay: In the BSS, this function relays LLC PDUs between the Um and Gb interfaces. In the SGSN, this function relays PDP PDUs between the Gb and Gn interfaces.
- Base Station System GPRS Protocol (BSSGP): This layer conveys routing- and QoS-related information between BSS and SGSN. BSSGP does not perform error correction. BSSGP is specified in GSM 08.18.
- Network Service (NS): This layer transports BSSGP PDUs. NS is based on the Frame Relay connection between BSS and SGSN, and may be multi-hop and traverse a network of Frame Relay switching nodes. NS is specified in GSM 08.16.

- RLC/MAC: This layer contains two functions: The Radio Link Control function provides a radio-solution-dependent reliable link. The Medium Access Control function controls the access signalling (request and grant) procedures for the radio channel, and the mapping of LLC frames onto the GSM physical channel. RLC/MAC is defined in GSM 04.60.
- GSM RF (Radio Frequency Bearers): As defined in GSM 05 series.

## 7.5. Mobile Station Modes of Operation

### Mobile Class

Three classes of GPRS MS have been defined. An MS's class is defined by its mode of operation which depends on the services that the MS can attach to, i.e., only GPRS or both GPRS and other GSM services, and upon the MS's capabilities to operate GPRS and other GSM services simultaneously.

- Class-A mode of operation: The MS can attach to both GPRS and other GSM services, and the MS supports simultaneous operation of GPRS and other GSM services.
- Class-B mode of operation: The MS can attach to both GPRS and other GSM services, but the MS can only operate one set of services at a time.
- Class-C mode of operation: The MS can only attach to GPRS services.

The three modes of operation are defined in GSM 02.60. Class-A device support is not currently available.

### Coding Scheme and Data Rates

There are 4 different coding schemes that can be used to squeeze more data rate out of existing GPRS timeslots. The "higher" coding schemes carry more user data by having less error correction bits, and are thus not optimal for all radio conditions.

The raw data rates are described below at the RLC level (Refer to previous protocol stack). Higher layer headers of RLC, LLC, SNDCP and IP will reduce the effective user data rate per timeslot slightly. A rule of thumb is that one timeslot using CS-2 will provide approximately 10 kbps of user data above IP.

CS-1 9.05kbps per timeslot

CS-2 13.4kbps per timeslot

CS-3 15.6kbps per timeslot

CS-4 21.4kbps per timeslot

Currently, the coding scheme is set by network configuration and Telstra uses CS-2 for user data and CS-1 for signalling. There are no plans at this stage to use CS-3 or CS-4.

### Time Slot Availability

Many phones can use more than one timeslot at once, as described further below, thus achieving data rates that are a multiple of the CS-2 rate listed above. The actual number of timeslots used at any given time depends on the available cell resources. Each base station cell has multiple RF carriers and each carrier has 8 time slots. To guarantee some GPRS capacity in a cell, each cell has at least 1 timeslot dedicated for GPRS use only. The rest of the timeslots are available either for use by GSM voice or GPRS data (with various levels of priority given to GSM voice). In some GPRS high traffic areas, the cells have 4 dedicated GPRS timeslots. Telstra has reserved sufficient capacity for GPRS traffic and is continuously monitoring network capacities, and adds extra RF carriers as required.

### GPRS Multislot Class

As previously commented, many GPRS devices can use more than one timeslot, and this capability is defined by the "MultiSlot Class". The list of Multi-Slot Classes is shown below.

MultiSlot Class	Downlink Slots	Uplink Slots	Active Slots
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5

**Table 2: GPRS Multi-Slot Classes**

In the table:

- "Downlink Slots" means the maximum number of timeslots the mobile can use for receiving information

- "Uplink Slots" means maximum number of timeslots the mobile can use for sending information

- "Max Slots" means the sum of the number of simultaneously sending & receiving timeslots, cannot exceed this figure - e.g. MC-10 supports a maximum of 2 timeslots uplink, but not if you are already using 4 timeslots on the downlink, because the sum of uplink & downlink timeslots cannot be greater than 5.

The BSC will not always be able to allocate the maximum number of timeslots supported by the multislot class, depending upon the number and arrangement of free timeslots in the cell, and sometimes timeslots will be shared amongst multiple users.

Examples of Multi-Slot Classes are:

Class 4 3 Down + 1 Up e.g. 24-36kbps Receive and 8-12kbps Send

Class 8 4 Down + 1 Up e.g. 32-40kbps Receive and 8-12kbps Send

Class 10 Configurable 4 Down + 1 Up or 3 Down and 2 Up (so long as 5 active slots)

So it depends on the model of mobile phone used that determines the maximum number of timeslots utilised in the downlink and uplink.

## 7.6. Mobility Management States

Mobility Management (MM) is important because it can affect how quickly radio packets are sent from the terminal to the host as the modem may need to change from idle state to a ready state before it can send a packet. It also determines what AT commands need to be issued by

the TE to complete actions like sending a packet from the terminal to host because the GPRS modem may actually be disconnected from the GPRS network at the time a packet needs to be sent.

The Mobility Management (MM) activities related to a GPRS subscriber are characterised by one of three different MM states. Each state describes a certain level of functionality and information allocated. The information sets held at the MS and SGSN are denoted MM context.

#### **a. IDLE GPRS State**

In GPRS IDLE state, the subscriber is not attached and therefore has no GPRS Mobility Management context. The MS and SGSN context hold no valid location or routing information for the subscriber. The subscriber-related mobility management procedures are not performed.

PLMN selection and GPRS cell selection and re-selection processes are performed by the MS.

Data transmission to and from the mobile subscriber as well as the paging of the subscriber are not possible. The GPRS MS is seen as not reachable in this case.

In order to establish MM contexts in the MS and the SGSN, the MS shall perform the GPRS Attach procedure.

#### **b. STANDBY State**

In STANDBY state, the subscriber is attached to GPRS mobility management. The MS and SGSN have established MM contexts for the subscriber's IMSI.

Pages for data or signalling information transfers may be received. It is also possible to receive pages for the CS services via the SGSN. Data reception and transmission are not possible in this state.

The MS performs GPRS Routing Area (RA) and GPRS cell selection and re-selection locally. The MS executes mobility management procedures to inform the SGSN when it has entered a new RA. The MS does not inform the SGSN on a change of cell in the same RA. Therefore, the location information in the SGSN MM context contains only the GPRS RAI for MSs in STANDBY state.

The MS may initiate activation or deactivation of PDP contexts while in STANDBY state. A PDP context shall be activated before data can be transmitted or received for this PDP context.

The SGSN may have to send data or signalling information to an MS in STANDBY state. The SGSN then sends a Paging Request in the routing area where the MS is located if PPF is set. If PPF is cleared, then paging is not done. The MM state in the MS is changed to READY when the MS responds to the page, and in the SGSN when the page response is received. Also, the MM state in the MS is changed to READY when data or signalling information is sent from the MS and, accordingly, the MM state in the SGSN is changed to READY when data or signalling information is received from the MS.

The MS or the network may initiate the GPRS Detach procedure to move to the IDLE state. After expiry of the mobile reachable timer the SGSN may perform an implicit detach in order to return the MM contexts in the SGSN to IDLE state. The MM and PDP contexts may then be deleted.

The GPRS modem can receive incoming data whilst in the STANDBY state. The network will signal the GPRS modem that data is waiting and the mobile will enter into READY state and receive the data.

#### **c. READY State**

In READY state, the SGSN MM context corresponds to the STANDBY MM context extended by location information for the subscriber on cell level. The MS performs mobility management procedures to provide the network with the actual selected cell. GPRS cell selection and re-selection is done locally by the MS, or may optionally be controlled by the network.

An identifier of the cell, the Cell Global Identity including RAC and LAC, is included in the BSSGP header of the data packet from the MS.

The MS may send and receive PDP PDUs in this state. The network initiates no GPRS pages for an MS in READY state, pages for other services may be done via the SGSN. The SGSN transfers downlink data to the BSS responsible for the subscriber's actual GPRS cell.

The MS may activate or deactivate PDP contexts while in READY state.

Regardless if a radio resource is allocated to the subscriber or not, the MM context remains in the READY state even when there is no data being communicated. The READY state is supervised by a timer with expiry period of 44 seconds. An MM context moves from READY state to STANDBY state when the READY timer expires. In order to move from READY state to IDLE state, the MS initiates the GPRS Detach procedure.

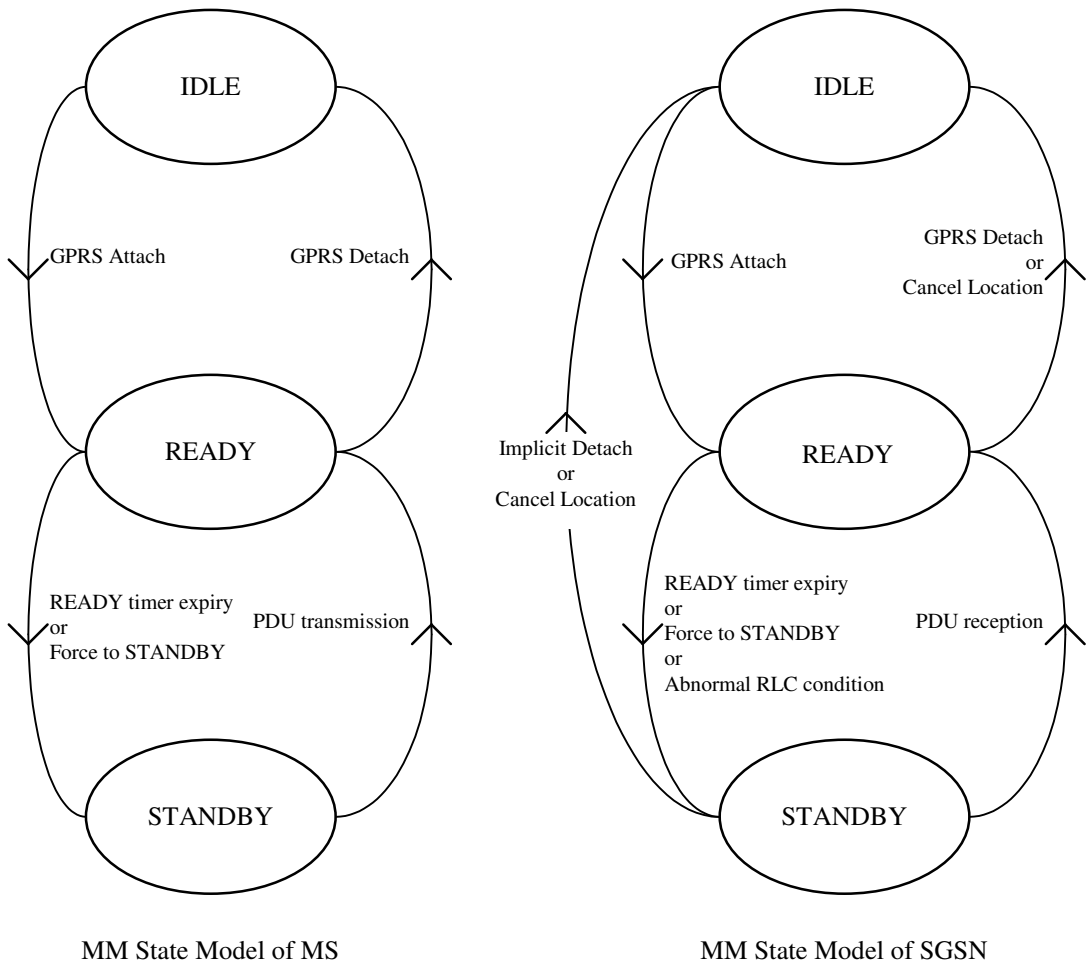


Figure 3: Functional Mobility Management State Model

### 7.7. Packet Data Protocol (PDP) States

For GPRS & UMTS PDP states are the same , see Section 9.3.

### 7.8. Static and Dynamic PDP Addresses

PDP addresses can be allocated to an MS in three different ways:

- The network operator assigns a PDP IP address permanently to the MS (static PDP address) - this is currently not offered by Telstra.
- The network operator assigns a PDP IP address to the MS when a PDP context is activated (dynamic HPLMN PDP address). This form of IP address allocation is currently used by Telstra for Telstra Value Added Services such as Internet access, WAP, etc.
- IP Wireless (see Section 10) based allocation from customer or Telstra RADIUS server. When IP Wireless/IP WAN is used to connect GPRS terminals to the customers network, then dynamic or static IP addressing can be used, the IP addresses may be public or private, and IP addresses may be allocated by the customer's Radius server or by Telstra's IP WAN Managed Radius server. Note that the static IP address is only associated with the username used to login to the IP WAN and is not fixed to the mobile IMSI. So it is possible for another mobile IMSI to use the same login name and be assigned the same fixed IP address (as long as no-one else was using that login name at that instance).

## 7.9. Affect of Coverage on Retaining GPRS Sessions

Drawing together the above information on GPRS Sessions and GPRS Mobility Management:

- IP connectivity depends on the underlying GPRS session remaining active.
- A GPRS session depends on the mobile remaining in coverage (because GPRS MM registration is based on the mobile remaining in coverage).
- A series of timers supervises how long a mobile may remain out of coverage before the GPRS session is disconnected by the SGSN.
  - Telstra usually quotes a figure of 1 hour for the mobile to remain out of coverage before the GPRS session is disconnected. The detail behind this 1 hour figure is discussed in the paragraphs below.

Supervision of whether a device is in GPRS coverage or not is carried out by the mobile network and is based on the mobile maintaining registration with the SGSN. When the mobile is first turned on, it registers its presence to the SGSN using the Attach Procedure. From that time on, the mobile does periodic registration updates at least every hour to let the SGSN know that it remains within coverage (the periodic registration timer is reset every time the mobile makes contact with the network for any reason).

When the mobile goes out of coverage and misses a periodic registration, the SGSN will start a 58 minute timer called the "Mobile Reachable Timer". Once this timer expires, the SGSN will start another timer called the "Implicit Detach Timer". Once the Implicit Detach Timer expires after approximately 1 hour, the SGSN will delete the registration of the mobile and this will also cause any active PDP Contexts to be deleted in the SGSN and GGSN.

When the mobile returns to coverage, it will attempt to do a periodic registration update (if more than 54 minutes has elapsed since losing coverage).

If implicit deregistration has occurred, it will be rejected by the SGSN. This should cause the mobile to delete its PDP Context and start the Attach Procedure. A new GPRS session (PDP Context) would then need to be established to continue data transfer and a new IP address is likely to be allocated if dynamic IP addressing is used.

If implicit deregistration has not occurred, then the PDP Context will remain active and the IP address of the mobile will not have changed.

Since the implicit deregistration time out can vary, Telstra generally quotes the 1 hour Mobile Not Reachable timer as the maximum time a mobile may be out of radio coverage in order to maintain the GPRS session.

## 7.10. GPRS Caveats

### 7.10.1. Limited Cell Capacity for all Users

Radio network resources are shared between all users and between voice and GPRS. Performance of GPRS can be impacted by the demand for resources generated by voice users. In all areas a minimum of 1 GPRS timeslot has been reserved for exclusive GPRS usage. In areas of high demand (for example, CBD areas), this reservation has been increased. Usage of voice and data is monitored on an on-going basis.

### 7.10.2. Radio Network Quality

GPRS performance can suffer while moving from one cell to another (Cell Update) resulting in extended packet delays and occasional packet loss. In good conditions cell update takes in the order of 3 sec. Across Routing Area boundaries, extra signalling is required and a typical time to complete the required cell update and signalling is in the order of 6 sec. Telstra is continually optimising network performance and therefore the Routing Area boundaries change.

GPRS is more sensitive to poor radio network environment than voice. Factors such as interference and lack of a single dominant cell can reduce GPRS performance. TCP reacts to this, so TCP-based applications will not work as well in poor radio conditions or while mobile in urban environments. Small-packet UDP applications are sometimes better suited to GPRS. Companies using GPRS for applications like courier dispatch, often use some communications server middleware to manage UDP messages between clients and back-end systems.

### 7.10.3. Security

Data encryption is implemented over the GPRS air interface between the MS and the SGSN. Therefore data sent and received over the air interface is extremely difficult to decipher.

When connecting to a host over the Internet, VPN software with IPSec encryption is often used to provide end to end security.

For security, without the added overhead of IPSec, a Telstra IP Wireless connection through IP WAN should be considered rather than using a host connected off the Internet.

### 7.10.4. Packet Switched versus Circuit Switched

GPRS, being a packet switched data mode, has a key difference to Circuit Switched Data (CSD) GSM - the session does not "drop-out" if moved out of coverage or network congestion - i.e. there is not continuous supervision of the bearer like in CSD calls. As data is sent within individual packets, radio resources are only allocated while data is being sent. The ability to transmit data cannot be guaranteed until an attempt is made to transmit that data. This is a different paradigm to the circuit switched wireless and wireline data environments.

For many applications, it is useful to build in a level of supervision in the application, or fall-back procedures, to handle an inability to communicate with the host.

### 7.10.5. Latencies

Be aware that GPRS latencies are going to be much greater than in the fixed wire connection solutions.

## 8. 3G (UMTS) WIRELESS NETWORKS

### 8.1. Introduction

3G (Third Generation) is a generic name for technologies that support high-quality voice, high-speed data and video in wireless cellular networks. When initially launched, 3G Wideband CDMA (WCDMA) services were referred to as the Universal Mobile Telephony System (UMTS). Although continuing to be referred to in standards documents and most product specifications as UMTS, the GSM Association changed the name, from a marketing perspective, to 3GSM, to more clearly align UMTS with 3G from the GSM technology family. Technical descriptions and specifications will refer to UMTS instead of 3GSM, terms such as UTRAN, USIM and interface labels derive from “UMTS”. The following sections will refer to UMTS when discussing Telstra’s 3G WCDMA network technology.

### 8.2. UMTS Network Description

An overview of a 3G UMTS/WCDMA wireless network is shown below.

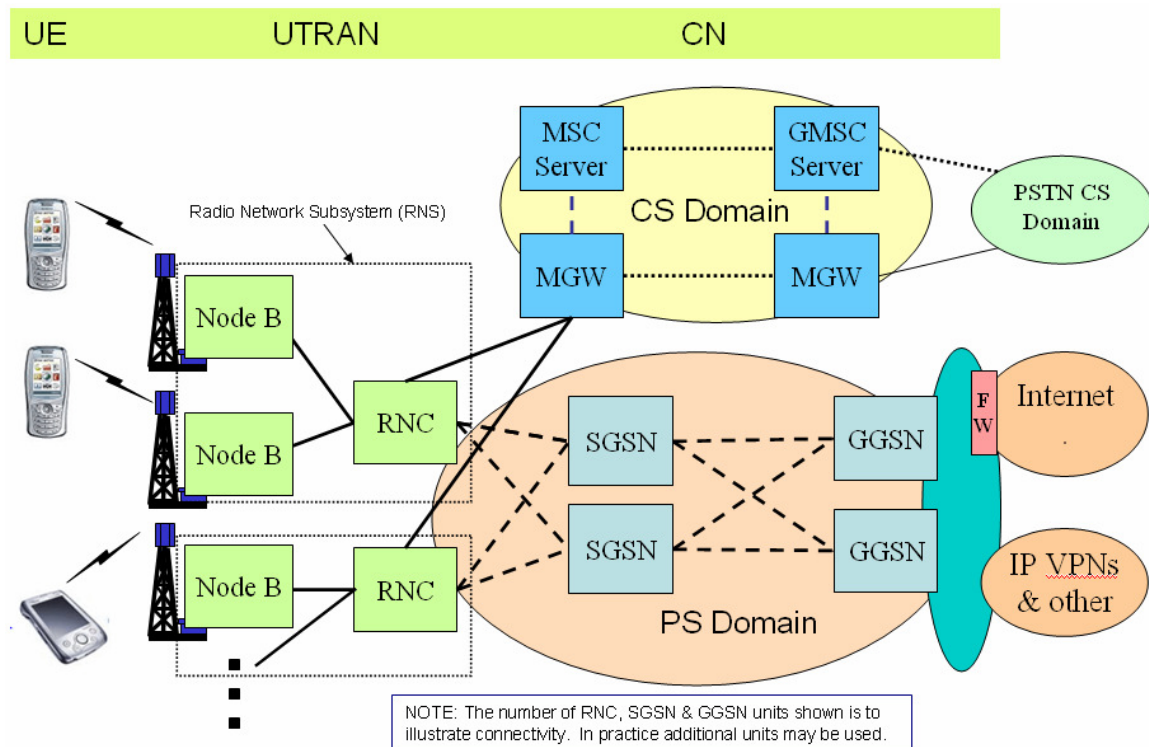


Figure 4: 3G UMTS/WCDMA wireless network – main components

A UMTS network consists of - Core Network (CN), UMTS Terrestrial Radio Access Network (UTRAN) and User Equipment (UE). The main function of the core network is to provide switching, routing and transit for user traffic. The Core network also contains the databases and network management functions.

#### 8.2.1. Core Network (CN)

The Core Network architecture for UMTS is based on many of the GSM/GPRS network components. The main function of the core network is to provide switching, routing and

transit for user traffic. The Core network also contains the databases and network management functions.

The CN is divided into circuit switched (CS) and packet switched (PS) domains. Some of the circuit switched elements are the Mobile services Switching Centre (MSC), Visitor location register (VLR) and Gateway MSC. Packet switched elements are Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN). Some network elements, like EIR, HLR, VLR and AUC are shared by both domains.

**8.2.2. Terrestrial Radio Access Network (UTRAN)**

The UTRAN provides the air interface access for User Equipment. It includes the Radio Network Controllers (RNC’s), the Radio Base stations (Node B’s).

Wide band CDMA technology was selected to for the UTRAN air interface. UMTS WCDMA is a Direct Sequence CDMA system where user data is multiplied with quasi-random bits derived from WCDMA Spreading codes. WCDMA has two basic modes of operation: Frequency Division Duplex (FDD) and Time Division Duplex (TDD).

**8.2.3. User Equipment (UE)**

UE is equivalent to the GSM Mobile Station (MS) consisting of the Terminal Equipment (TE), Mobile Termination (MT) and SIM. The UMTS standard does not restrict the functionality of the User Equipment and in fact the MS may connect using GPRS or EDGE as well as UMTS WCDMA or HSDPA.

**8.2.4. UMTS Network Elements**

UMTS Network Elements	
USIM	A UICC smart card (equivalent to a GSM SIM) which stores user subscriber information, authentication information and provides storage space for text messages.
MSC	The Mobile Switching Centre (MSC) switch, including the Visitor Location Register (VLR), is a switch that serves the Mobile Equipment (ME) in its current location for Circuit Switched (CS) services.
GMSC	The Gateway MSC (GMSC) switch serves the UMTS network at the point where it is connected to the external CS network.
MGW	The MSC and GMSC handle control functionality, but user data goes through the Media Gateway (MGW), which performs the actual switching for user data and network inter-working processing.
SGSN	The Serving GPRS Support Node (SGSN) covers functions similar to the MSC for packet data, including VLR type functionality
GGSN	The Gateway GPRS Support Node (GGSN) connects the Packet-Switched (PS) core network to other networks such as the Internet.
Node B	A UMTS Base station (Node B) handles radio channels, including the multiplexing/demultiplexing of user voice and data information.
RNC	The Radio Network Controller (RNC) is responsible for controlling and managing the multiple base stations (Node Bs) including the utilization of radio network services.

**Table 3: UMTS Network Elements**

**8.3. UMTS & GPRS Logical Architecture**

UMTS also uses the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN). The diagram below is similar to the Logical Architecture diagram in the GPRS section, but includes UMTS radio access network and equipment.

To aid in understanding of UMTS and GPRS, and the terminology that may be encountered, the diagram below names the logical interfaces between nodes. This diagram is a logical view, not a physical view of the network.

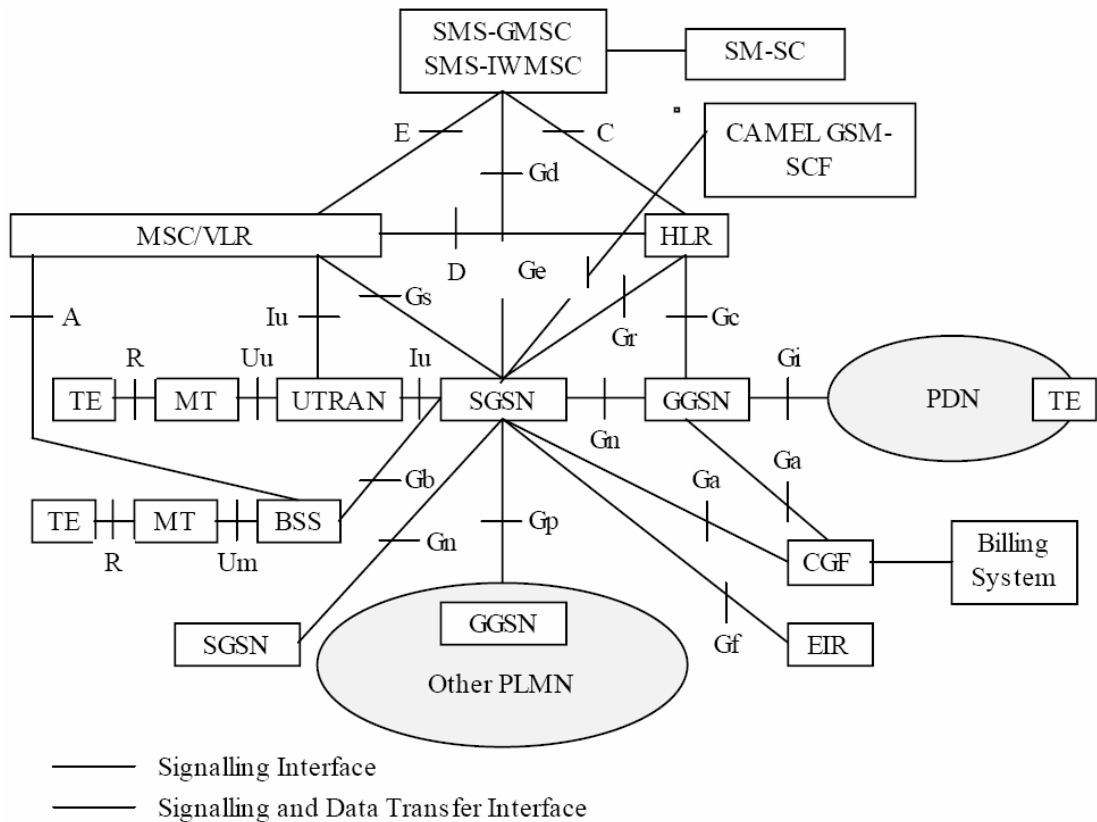


Figure 5: Overview of the GPRS & UMTS Logical Architecture

#### 8.4. Mobile Station modes of operation.

A UMTS (or **Iu mode**, see Figure 5) Mobile Station (MS) operates in one of three modes of operation. However, these operation modes are different from the ones of a GPRS (**A/Gb mode**, Figure 5) MS due to the capabilities of an UMTS mode RAN to multiplex CS and PS connections.

The different Iu mode MS operation modes are defined as follows:

- **CS/PS mode of operation:** The MS is attached to both the PS domain and CS domain, and the MS is capable of simultaneously signalling with the PS and CS core network domains. This mode of operation is comparable to the class-A mode of operation defined for GPRS. The ability to operate CS and PS services simultaneously depends on the MS capabilities (for example GPRS MS of class B, which can not operate simultaneously CS and PS services, may have the same limitations when changing to UMTS and CS/PS mode of operation).
- **PS mode of operation:** The MS is attached to the PS domain only and may only operate services of the PS domain. However, this does not prevent CS-like services to be offered over the PS domain (e.g. VoIP). This mode of operation is equivalent to the GPRS class-C mode of operation.
- **CS mode of operation:** The MS is attached to the CS domain only and may only operate services of the CS domain. However, this does not prevent PS-like service to be offered over the CS domain. The CS mode of operation is outside the scope of this specification.

All combinations of different operation modes as described for A/Gb mode and Iu mode MSs are allowed for GERAN and UTRAN multisystem terminals.

## 8.5. Mobility Management States

Note: PMM - Packet Mobility Management

### 8.5.1. PMM-DETACHED State

In the PMM-DETACHED state there is no communication between the MS and the 3G-SGSN. The MS and SGSN contexts hold no valid location or routing information for the MS. The MS MM state machine does not react on system information related to the 3G-SGSN. The MS is not reachable by a 3G-SGSN, as the MS location is not known.

In order to establish MM contexts in the MS and the SGSN, the MS shall perform the GPRS Attach procedure. When the PS signalling connection is established between the MS and the 3G-SGSN for performing the GPRS attach, the state changes to PMM-CONNECTED in the 3G-SGSN and in the MS. The PS signalling connection is made up of two parts: an RRC connection and an Iu connection.

### 8.5.2. PMM-IDLE State

The MS location is known in the 3G-SGSN with an accuracy of a routing area. Paging is needed in order to reach the MS, e.g. for signalling. The MS and SGSN have established MM contexts as described in clause "Information Storage".

The MS shall perform a routing area update if the RA changes. Signalling towards the HLR is needed if the 3G-SGSN does not have an MM context for this MS.

The MS and 3G-SGSN shall enter the PMM-CONNECTED state when the PS signalling connection is established between the MS and the 3G-SGSN.

GPRS detach changes the state to PMM-DETACHED. The 3G-SGSN may perform an implicit GPRS detach any time after the MS reachable timer expiry. The MS's MM context is deleted, preferably after a certain (implementation dependent) time. The HLR may be informed about the deletion (see clause "Purge Function").

### 8.5.3. PMM-CONNECTED State

The MS location is known in the 3G-SGSN with an accuracy of a serving RNC. In the PMM-CONNECTED state, the location of the MS is tracked by the serving RNC. The MS performs the routing area update procedure when RAI in the MM system information changes.

When an MS and a 3G-SGSN are in the PMM-CONNECTED state, a PS signalling connection is established between the MS and the 3G-SGSN.

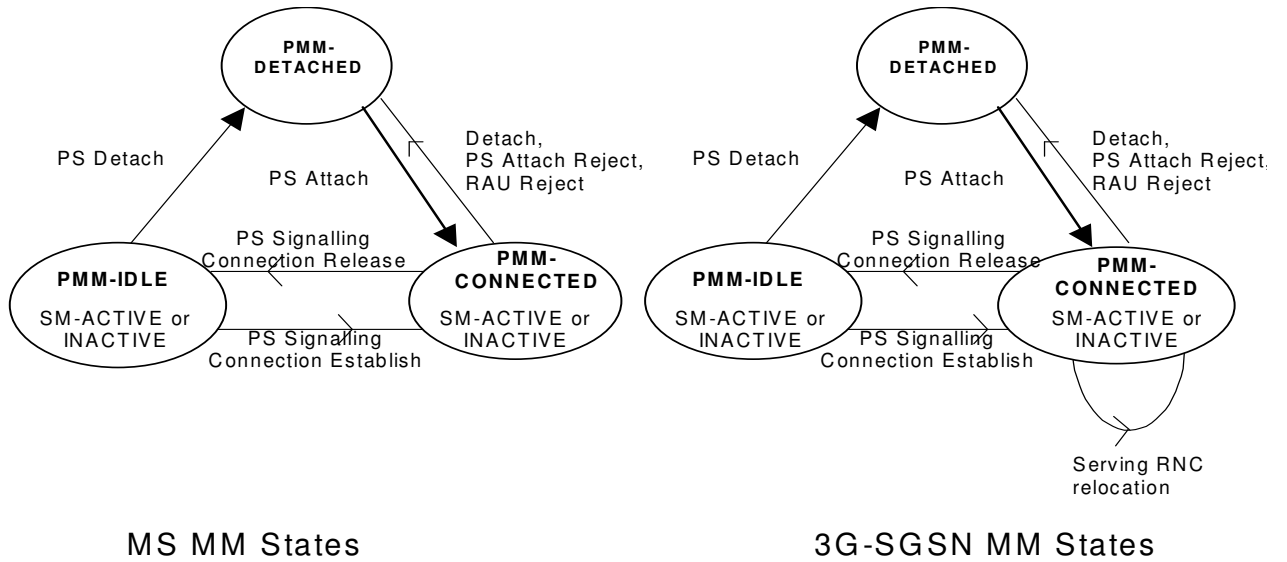
In the 3G-SGSN, PS signalling connection release or failed downlink transfer with cause "IMSI unknown in RNC" changes the state to PMM-IDLE.

The MS shall enter the PMM-IDLE state when its PS signalling connection to the 3G-SGSN has been released or broken. This release or failure is explicitly indicated by the RNC to the MS or detected by the MS (RRC connection failure). The radio connection shall also be released if a URA update fails because of "RRC connection not established", or if the URA update timer expires while the MS is out of coverage.

After a signalling procedure (e.g. routing area update), the 3G-SGSN may decide to release the PS signalling connection, after which the state is changed to PMM-IDLE.

GPRS detach changes the state to PMM-DETACHED.

### 8.5.4. State Transitions and Functions



**Figure 6: PMM State Model**

**NOTE:** In both the PMM-IDLE and the PMM-CONNECTED states, session management may or may not have activated a PDP context. The consequence is that in PMM-CONNECTED state, only a signalling connection may be established. In PMM-IDLE state, a PDP context may be established, but no corresponding connection over the Iu interface nor the radio are established.

### 8.6. Packet Data Protocol (PDP) States

For UMTS & GPRS PDP states are the same, see Section 9.3.

## 9. COMMON (SHARED) GPRS/EDGE AND UMTS FEATURES/FUNCTIONS

### 9.1. SIM and USIM

The SIM or USIM card within a GSM/GPRS/UMTS device identifies the network subscription, not the device itself. The SIM is a smart card that securely stores subscriber information, authentication information and provides storage space for text messages. Subscribers are uniquely identified by the International Mobile Subscriber Identity (IMSI) number stored on the card, which is linked to the subscriber's mobile number within the internal network subscriber database, the Home Location Register (HLR).

### 9.2. Access Point Name (APN)

Instead of ringing phone numbers, GPRS and UMTS use the concept of Access Point Name (APN). The APN is an alphanumeric string used to identify the service that is being accessed. Within the network the APN is used to select what service (or port) is accessible by the particular GPRS/UMTS subscriber, i.e. APN can also affect the IP address range allocated and the routing allowed.

Below are examples of the some of the more common APNs that Telstra currently define:

APN	Capability
telstra.internet	Provides basic access to the Internet. Private IP addresses are allocated and a firewall and NAT (Network Address Translation) Proxy is used to access the Internet.
telstra.wap	Provides access to the Telstra WAP gateway.
telstra.corp	Used to access Telstra's Private IP network (IP WAN).
telstra.mms	Provides access to the Telstra MMSC for the collection of "picture messages".

**Table 4: Telstra GPRS/UMTS APNs**

#### 9.2.1. Full APN Names

Whilst roaming overseas, the full APN name needs to be used to ensure the local carrier forwards data to the Telstra service. Otherwise, the user may not be able to access Telstra VAS services.

The full APN name (for Telstra) is the shortened APN with "mnc001.mcc505.gprs" appended. For example, if the short APN is telstra.mms, then the full APN is telstra.mms.mnc001.mcc505.gprs

### 9.3. Packet Data Protocol (PDP) States

A GPRS or 3G/UMTS subscription contains the subscription of one or more PDP addresses. Each PDP address is described by an individual PDP context in the MS, the SGSN, and the GGSN. Every PDP context exists independently in one of two PDP states. The PDP state indicates whether the PDP address is activated for data transfer or not. Activation and deactivation are described in "PDP Context Activation, Modification, and Deactivation Functions". All PDP contexts of a subscriber are associated with the same MM context for the IMSI of that subscriber.

#### a. INACTIVE PDP State

The INACTIVE state characterises the data service for a certain PDP address of the subscriber as not activated. The PDP context contains no routing or mapping information to process PDP PDUs related to that PDP address. No data can be transferred. A changing location of a

subscriber causes no update for the PDP context in INACTIVE state even if the subscriber is attached to the GPRS MM.

Mobile-terminated PDP PDUs received in INACTIVE state by the GGSN may initiate the Network-Requested PDP Context Activation procedure if the GGSN is allowed to initiate the activation of the PDP context for that PDP address. Currently Telstra does not support Network-initiated PDP Contexts. Otherwise, mobile-terminated PDP PDUs received in INACTIVE state invoke error procedures in the GGSN relevant to the external network protocol, for example, an IP packet is discarded and an ICMP (see RFC 792) packet (error notification) is returned to the source of the received packet. Other error procedures may be introduced on the application level, but this is outside the scope of this document.

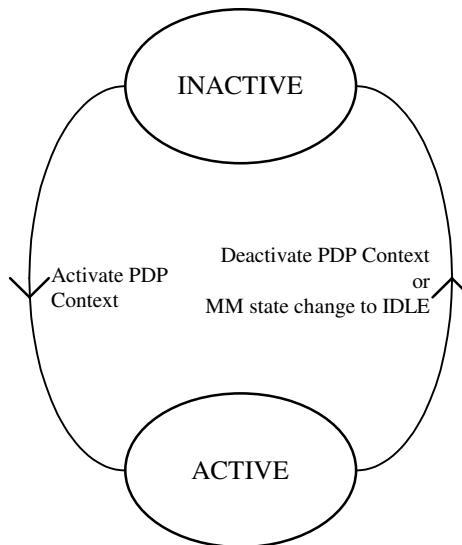
The MS initiates the movement from INACTIVE to ACTIVE state by initiating the PDP Context Activation procedure.

**b. ACTIVEPDP State**

In ACTIVE state, the PDP context for the PDP address in use is activated in MS, SGSN and GGSN. The PDP context contains mapping and routing information for transferring PDP PDUs for that particular PDP address between MS and GGSN. The PDP state ACTIVE is permitted only when the mobility management state of the subscriber is STANDBY or READY – ie if GPRS registration is lost for any reason the PDP Contexts will also be torn down.

An active PDP context for an MS is moved to INACTIVE state when the deactivation procedure is initiated.

All active PDP contexts for an MS are moved to INACTIVE state when the MM state changes to IDLE.



**Figure 6: Functional PDP State Model**

There is no inactivity timeout for IP Wireless connected sessions (see Section 10). As long as the MS remains within GPRS radio coverage, the session will be maintained. If GPRS radio coverage is lost, the session will be maintained for about 1 hour before it is dropped and the MS will lose its current PDP Context (IP address). However, if the GPRS registration is lost, then the PDP context will definitely be lost. This could happen if the GPRS network had an outage and deregistered the GPRS modem as a result of the outage.

## 10. IP WIRELESS AND IP WAN

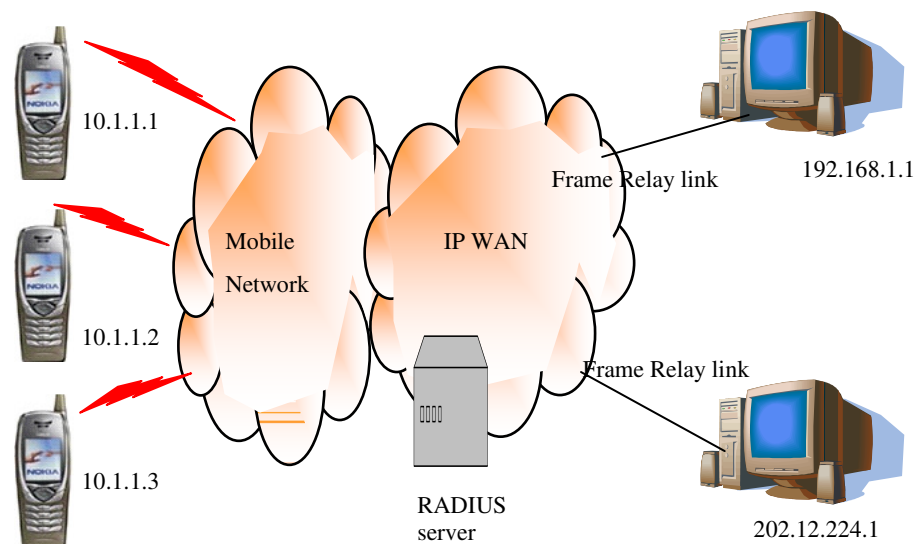
### 10.1. Description

The Telstra IP Wireless product provides access from wireless network connected devices to host computers connected to the Telstra IP WAN network. Specific references to GPRS within this section also apply to 3G/UMTS as GPRS and UMTS data services share the same connection and data session establishment procedures.

Host computers may be connected to the IP WAN with the following physical links:

- ADSL, Frame Relay, ATM, PSTN Dial Up, ISDN, Ethernet

The IP WAN provides an IP VPN which only permits the customer's terminal fleet to communicate with the customer host computers. Each customer's IP VPN is segregated from others within the IP WAN infrastructure. Mobile devices can send and receive data to and from the host computers using IP. Hosts can communicate with each other using IP if more than one host is connected to the IP WAN. Mobile devices can also communicate with other mobile devices while connected through the IP VPN.



**Figure 7: Example Connections through IP WAN**

The customer can choose the IP address range for the mobiles and hosts. Static and dynamic addressing is possible. Since it is a private VPN, public and private IP addresses may be used.

The advantage of dynamic addressing is that the Customer does not need to manage which mobile has which IP address. Static IP addressing may be useful when connecting fixed devices such as used for telemetry, where the telemetry protocols have been based around use of static IP addresses.

Customers may choose to use their own Radius server or use a Telstra managed Radius server to serve up the IP addresses for the mobile terminals. Mobile terminals log into the IP WAN Radius using username and password.

Example Username Mobile1@Company1.com.au

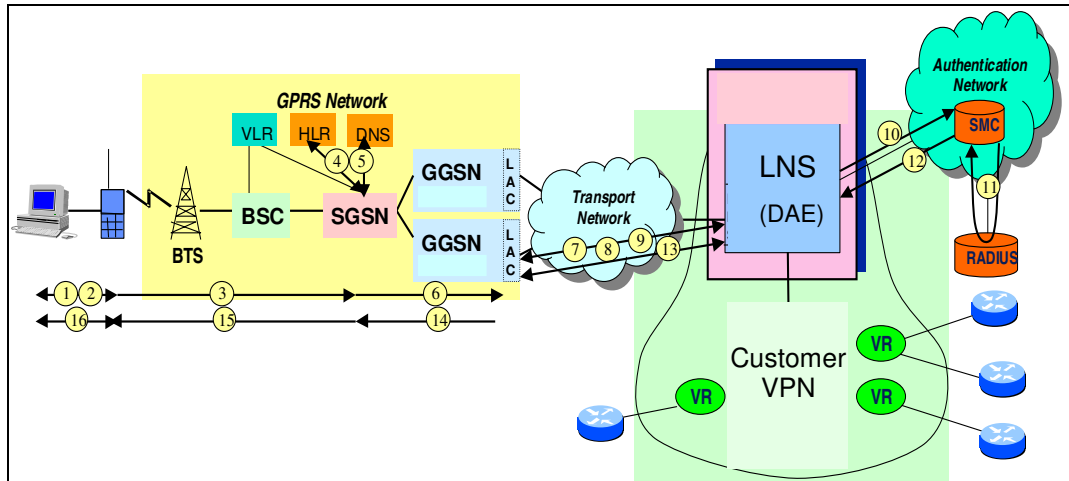
Example Password Secret1

The username comprises a unique part relating to the mobile terminal or user, in the example it is Mobile1, followed by a domain (or “realm”) suffix @Company1.com.au.

For GPRS the mobile devices must be subscribed to an APN which gives access to the IP Wireless Port and thus Telstra IP WAN. Currently, there is a general purpose APN “telstra.corp” which can do this. Customers can also have a customised (dedicated) APN such as “company1.com.au” which Telstra can also point to the appropriate company IP WAN VPN.

## 10.2. GPRS, 3G/UMTS and IP Wireless – session establishment

This section provides an overview of the steps required to establish a PPP session to an IP WAN service from a GPRS or 3G/UMTS device. GPRS and UMTS data services share the same connection and data session establishment so references to GPRS also apply to 3G/UMTS devices. To simplify the description, some of the steps involved in establishing the session through the mobile network are not included. Please refer to GPRS and UMTS documentation if this information is required.



**Figure 8: GPRS IP Wireless Connection**

Prior to establishing a session through the GPRS network, the PPP client software in the CPE must be configured with the Private IP APN as part of the dial string.

1. The PPP client initiates a PPP session to the mobile station (MS).
2. The PPP client and the MS negotiate LCP and commence the Authentication Stage. During the Authentication Stage, the PPP client passes the user-name ([username@domain](#)) and the password to the MS.
3. The MS initiates an “Activate PDP<sup>1</sup> Context Request” message to the SGSN. This message includes the user-name, password and APN.
4. The SGSN checks the requested APN against the subscribed APNs that were fetched from the HLR during the attach/location update procedure to verify that the user is permitted to access the APN.
5. The SGSN queries the GPRS Domain Name Server (DNS) to identify the required GGSN for the given APN.
6. The SGSN initiates a GPRS Tunnelling Protocol (GTP) tunnel to the specified GGSN and sends a “Create PDP Context Request” to the GGSN. This message includes the user-name, password, MS-ISDN (calling number) and APN as per Step 3.

<sup>1</sup> A Packet Data Protocol (PDP) context describes the characteristics of a session. It contains the PDP type (e.g., IPv4), the PDP address assigned to the mobile station (e.g., 129.187.222.10), the requested GPRS QoS and the address of a GGSN that serves as the access point to the external network. This context is stored in the MS, the SGSN, and the GGSN. With an active PDP context, the mobile station is “visible” to the external network and is able to send and receive data packets.

7. The GGSN identifies the L2TP tunnel end-point (based on the APN) and establishes a tunnel to that end-point if one does not already exist.
8. The GGSN initiates a new PPP session across the L2TP tunnel.
9. PPP LCP negotiation and authentication take place between the GGSN and the L2TP Network Server (LNS) using the user-name and password forwarded from the CPE to the GGSN.
10. The LNS initiates an Access-Request RADIUS message to the SMC containing the user-name (username@domain).
11. The SMC authenticates the user via the customer's RADIUS server (or optionally via IP WAN managed RADIUS server).
12. If successful, the SMC returns an Accept-Accept message to the LNS containing the user's IP address and the GPRS service profile identifier.
13. PPP NCP negotiation then takes place between the GGSN PPP client and the LNS.
14. The GGSN then instantiates a new PDP context for the session and sends a "Create PDP Context Response" to the SGSN.
15. The SGSN instantiates a new PDP context for the session and sends an "Activate PDP Context Accept" message to the MS.
16. The MS instantiates a new PDP context. It then completes the Authentication Stage and negotiates NCP with the CPE PPP client.

## 11. TELSTRA'S 3G-UMTS & GPRS NETWORK ARCHITECTURE

Telstra's wireless network strategy is to operate wide area wireless networks that are part of the GSM "family" of technologies. These are the existing GSM network, providing GPRS & EDGE based packet data services, the 3G UMTS network operating in the 2100 MHz frequency band (sharing some infrastructure with Hutchinson) and the new 3G UMTS (Next G™) network in the 2100 MHz band. These three networks use the same core infrastructure technology.

The diagram below is a representation of the Telstra wireless wide area network architecture (excluding the CDMA network, which is due close in 2008).

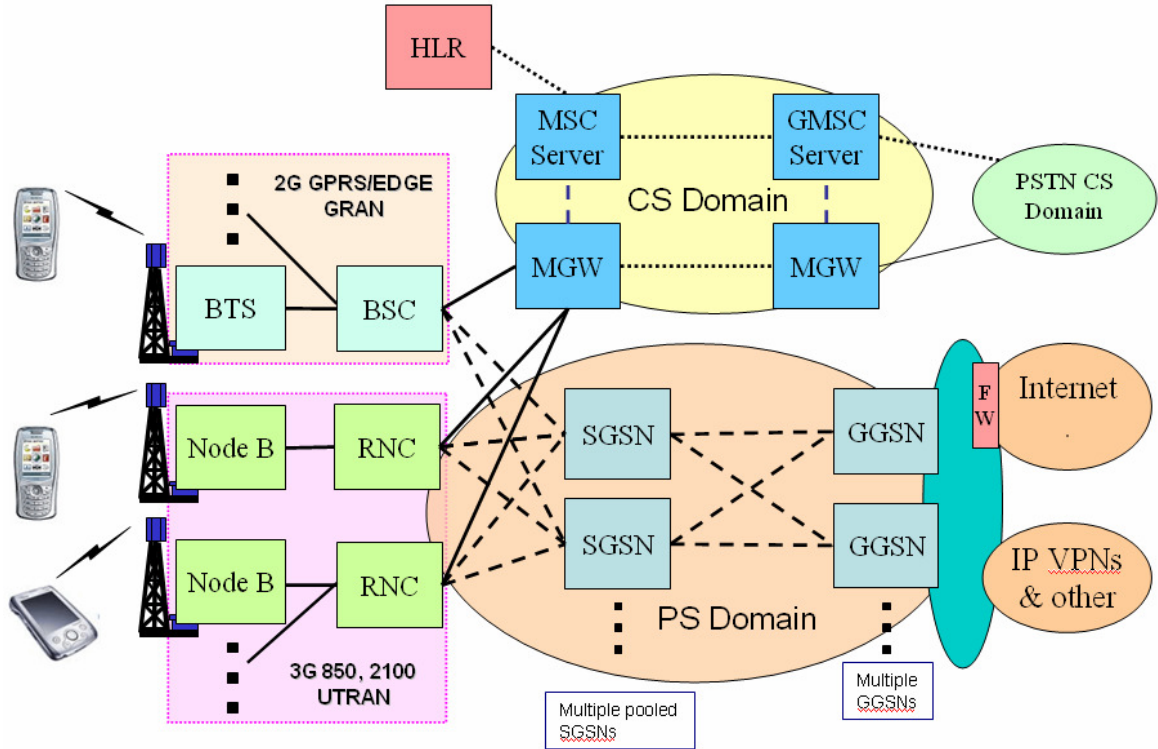


Figure 9: Representation of Telstra's 3G-UMTS & GPRS Network Architecture

## 12. GPRS AND 3G/UMTS CONNECTION ESTABLISHMENT PROCEDURES

GPRS and UMTS data services share the same connection and data session establishment procedures and control commands. This section summarises appropriate procedures and AT commands as well as Windows Dial-up Networking configuration. All references in this section to GPRS also include UMTS.

GPRS phones and modems implement a PPP server. The use of PPP means that existing terminal and Dial-up Networking Software can be used to communicate to GPRS devices and allow GPRS data sessions to be established. As part of this PPP compatibility, the GPRS specification defines particular AT-commands to initialise the GPRS modem, and then a particular dial-string to initiate a GPRS session. It is therefore possible to make function calls to existing Operating System software to establish GPRS sessions. When using this method it is still necessary to initialise the GPRS modem prior to dialling. Most Dial-up networking software offer the ability to send “extra” AT-commands to a modem prior to dialling.

To obtain greater control over the modem, many applications developers choose to develop their own software to directly control the GPRS modem. In this case the application developer must issue AT-commands to initialise the GPRS device, dial a session, and then launch a PPP client to interact with the GPRS modem.

### 12.1. AT Commands and GPRS Connection Establishment

As previously discussed an application developer can elect to either use existing dial-up network clients provided by an Operating System, or for greater control directly control the device. Either way AT commands are required to configure the device.

AT commands are needed start a GPRS session between the mobile subscriber and the GPRS network. Below is a typical sequence of commands to connect to the GPRS network and start a GPRS session.

It is assumed that a secure GPRS connection is being established using authentication. If a connection is being made to the public Internet, then ignore the authentication references.

The timings included below are recommendations to in most cases allow sufficient time for the event to occur. However in some cases IMSI attach, GPRS attach, and PDP Context will occur more quickly than the times allowed for below. If time to connect is critical to the application, the developer could check the status of the device more often, but should still be prepared to wait the full period if necessary.

1. Power on device to connect to the network – assuming this also powers up the modem.
2. Wait 30 seconds.  
This delay allows the device sufficient time to find the network and IMSI attach. “IMSI attach” is the standard function to register with the GSM network.
3. Check whether the device is “IMSI attached”:  
**AT+CREG?**

The expected response to this command is:

**+CREG: x, 1**

(where x is don't care and 1 stands for registered, home network).

The application should not proceed if the device does not return the above response.

4. Check the signal strength:  
**AT+CSQ**

The expected response to this command is:

**+CSQ: n,00**

(where **n** should be greater than or equal to 10, which approximates to a received signal level of -93dBm, and 00 indicates good signal quality).

The application should not proceed if **n** is not greater than or equal to 10.

5. The PDP context contains the information about which GGSN the MT should connect to, what addressing it should use, and the kind of transmission required between the MT and the GGSN. Most GPRS devices can hold a number of contexts in memory and these are assigned a number. The PDP context settings could be set and saved within the modem prior to attaching to the network, or they could be sent within the connection establishment sequence.

Define the PDP context

**AT+CGDCONT =n,"IP","APN"**

The **n** value in this command is the PDP Context ID. The Context ID value is later used to initiate the PDP context and GPRS data session – using the associated APN name and specified parameters. The APN name that would be used in this command will depend on what has been activated for the subscriber's GPRS service.

Example: To set up context number 1 for an IP connection to the Telstra private IP network, asking for the network to provide the IP address, and turning off data and header compression, the following AT command would be sent to the module:

**AT+CGDCONT=1,"IP","telstra.corp","0.0.0.0",0,0**

Note: For most modems this command can be abbreviated to:

**AT+CGDCONT=1,"IP","telstra.corp"**

6. Attach to GPRS:  
**AT+CGATT = 1**

The GPRS attach state includes a retry algorithm, the device will try to GPRS attach to the network 5 times with an interval of 15 seconds between retries.

Note, there is a corresponding command **AT+CGATT=0** which can be used to explicitly detach from the GPRS network.

7. Wait 30 seconds.
8. Check the GPRS network registration status:  
**AT+CGREG?**

The response **+CGREG:0,1** means the MT is successfully attached

The response **+CGREG:0,0** means the MT is trying to attach

The response **+CGREG:0,2** means the MT has failed to attach and has stopped trying to attach (this could occur. within 1-3 minutes).

Alternatively, the attach status can be retrieved using:

**AT+CGATT?**

The response **+CGATT:1** means the MT is successfully attached.

Whereas response **+CGATT:0** means the MT is not attached, or has failed to attach.

**Note:** Some devices automatically attempt to attach to the network & GPRS when powered up.

9. Once the MT has been programmed with a context and attached to the GPRS network, the connection can be made in one of two ways.

The first is by dialling a special number:

**ATD\*99\*\*\*n#**

(to connect context ID 'n'), or

**ATD\*99#**

(to connect to the default context, or only loaded context)

**ATD\*98\*n#**

(to connect context ID 'n').

**Note:** the required form of the above command may vary with different devices.

The other method is to explicitly start the GPRS data connection:

**AT+CGDATA="PPP",n**

(to connect context ID 'n').

(Should get a "CONNECT" response from the modem.)

Every GPRS device should support at least one of those methods. When the connection is made, the GPRS radio modem begins to talk PPP to the Terminal Equipment (TE) (the computer or handset). The modem is then in "data" mode, as compared to AT "command" mode, and will not accept further AT commands (Although some modems may have an extra port that allows other queries mid-session).

10. From this point, the TE can commence PPP negotiation by starting a PPP client.

The PPP client in the TE negotiates a PPP session with the PPP Server in the MT (ie Mobile Terminal - the GPRS modem). The TE does not negotiate PPP with the GPRS network directly, but with the MT. Note: The modem responds to LCP, PAP, and IPCP, in that order, not the network directly. (See Figure 10). When the IPCP-Configure-Request is sent by the TE, this triggers the MT to send a PDP context request to the GGSN, with the PPP information encapsulated in the PDP Context Request.

For example, under Linux, `pppd` (Linux's PPP talker), could be run to complete the context activation process. If using Windows, Windows Dial-Up Networking will handle PPP negotiation and only the dial number `*99***1` needs to be specified (assuming Context ID is 1). If the Context ID of 1 has not already been setup in the GPRS modem beforehand, the additional command `AT+CGDCONT=1,"IP","telstra.internet"`, would need to be specified, where the APN in this case is "telstra.internet".

The GGSN acts as a host server and forwards the PPP parameters on. So a PDP Context must be active in order to have a PPP connection active. Some responses, like IP address allocation, cannot be delivered back to the TE until the PDP Context has been unwrapped and the relevant PPP parameters passed onto the customers RADIUS or DHCP server. Hence, PPP generally takes longer in wireless environment than in a wireline environment

11. If the PDP is successful the MT will respond with an IPCP-Configure-Response message, if unsuccessful (eg because the SIM is not subscribed to the requested APN), the MT will respond with a LCP-Terminate message.

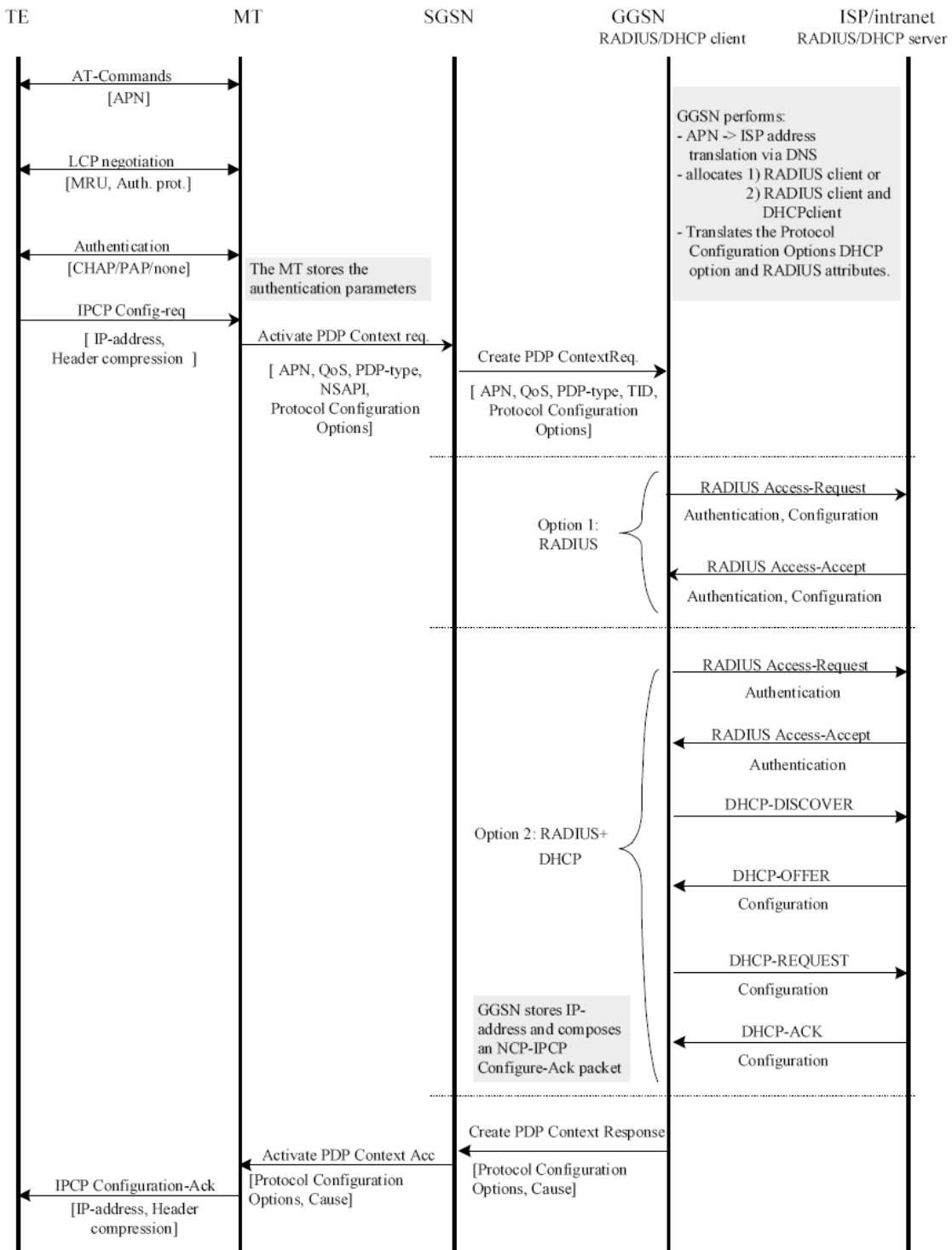
It is important that the PPP client wait sufficient time for the PDP Context to be set up, about 20 to 30 sec is recommended, even though most PDP contexts are successful well under this time.

12. Note that the PPP connection *always* accepts the authentication data provided. The MT then uses that data to authenticate itself to the RADIUS, or other authentication server, when asking for an IP address, so an authentication failure will be reported as a failure to negotiate an IP address.
13. If the GPRS modem (the MT) is disconnected from the network, a PPP Disconnect message (LCP Link Down) will be sent to the device (TE) connected to the GPRS modem.

14. To end the session from the client end, the standard PPP command (LCP terminate) could be used.
15. Once back in command mode you can detach from GPRS using AT+CGATT=0.

*Note: Despite some degree of standardisation of the AT command set for GPRS, some manufacturers are not in full compliance. While the above should work under most circumstances, consult the terminal equipment's manual to confirm the exact commands.*

### 12.1.1.1. GPRS & 3G/UMTS PDP Context Activation



**Figure 10: PPP Used as the Layer 2 Protocol between the TE and MT interface. (from ETSI TS 129 061 V6.9.0 (2006-09))**

#### 12.1.1.1. Relationship between PPP and PDP Context

For GPRS the MT acts as the PPP server, stores parameters and then encapsulates the PPP info. (eg PAP & IPCP) into the PDP Context. There have been examples of modems failing to respond to PPP correctly and this is thought to be the network - but the network

is not involved until the IPCP-Configure Request Message is sent. Also if timers aren't long enough the PDP may be established, but the PPP client times out and hence the PPP session isn't established. GPRS specification 3GPP TS 09.61 [1] has an essential diagram showing the flow of signalling between PPP & GPRS. It discusses the transparent case (which is applicable to "telstra.internet" APN access) and the non-transparent case (which is applicable to "telstra.corp" & "telstra.wap" access).

In particular, wireline IP stacks usually default to about 10 sec time-out for PPP negotiation. This needs to be changed to between 20-30 sec for GPRS to give PPP negotiation to completely finish during setting up of PDP Context. See the earlier section discussing typical at-commands and wait periods.

## 12.2.Dial-Up Networking configuration examples

Below are some examples of configuring existing dial-up networking clients provided by Operating Systems to control a GPRS modem/phone.

### Example 1 Connecting to the Internet using GPRS follows using Windows XP Dialup Networking.

Will use the following configurations:

Context ID = 1

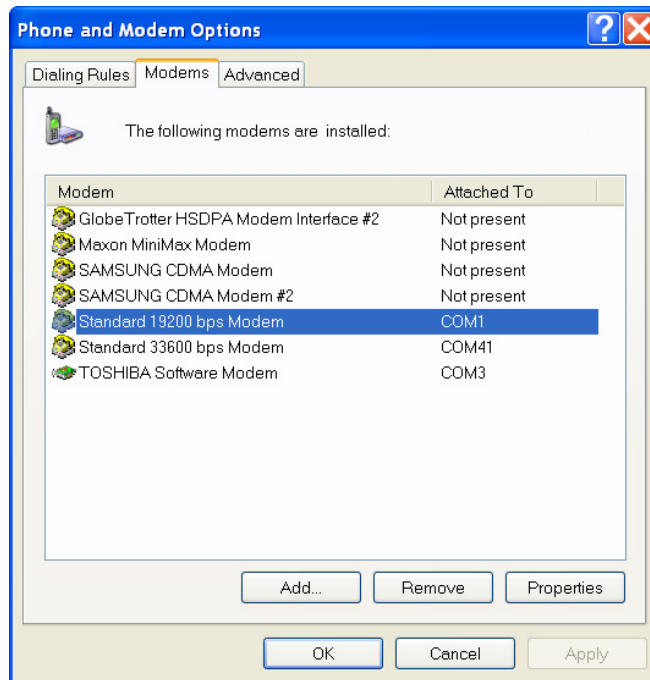
APN = telstra.internet

For connection to the internet, no username or password is required.

Need to configure the modem first, then Dialup Networking.

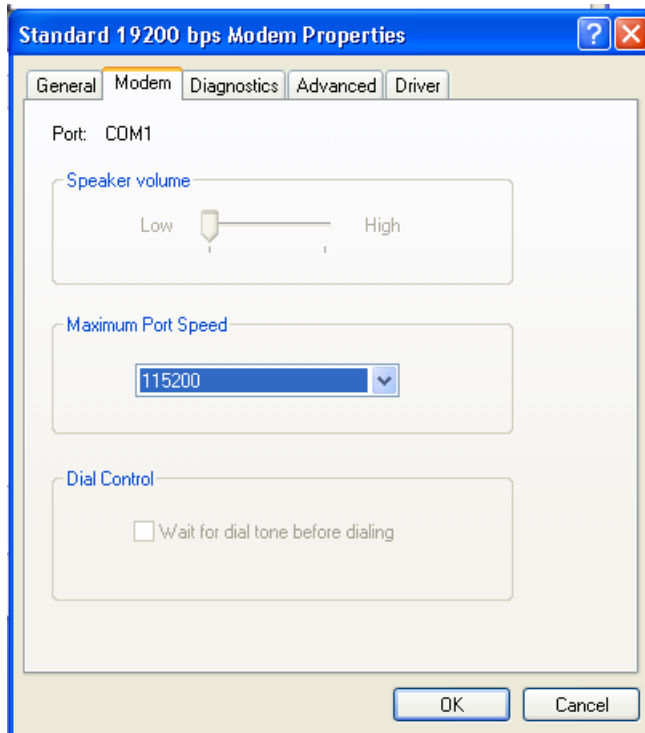
Access the modem through the Windows Control Panel and choose Phone and Modems Options. Using a Standard Modem as representative of the GPRS modem generally works, so long as it is attached to COM1, the serial port connected to the GPRS modem.

In most cases phone manufacturers will supply GPRS modem drivers specifically for their phones – It is always preferable to use the modem driver supplied by the phone manufacturer.



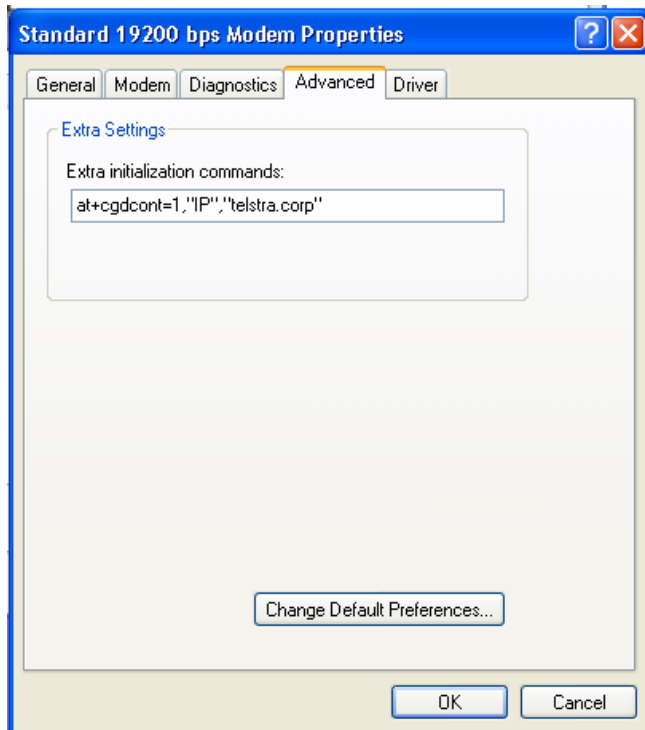
**Figure 11: Showing Phones and Modems Options in Control Panel**

The modem should be set up for maximum speed. So after highlighting the Standard 19200 bps Modem as in Figure 11, select Properties, Modem tab and select 115200 for maximum port speed.



**Figure 12: Showing Maximum Port Speed is set to 115,200 bps.**

Next add the additional AT command string to set up the Context ID and APN by selecting the Advanced tab as shown in Figure 13. In this case, the additional AT string is `AT+CGDCONT=1,"IP","telstra.corp"`.



**Figure 13: Showing Additional AT Command String**

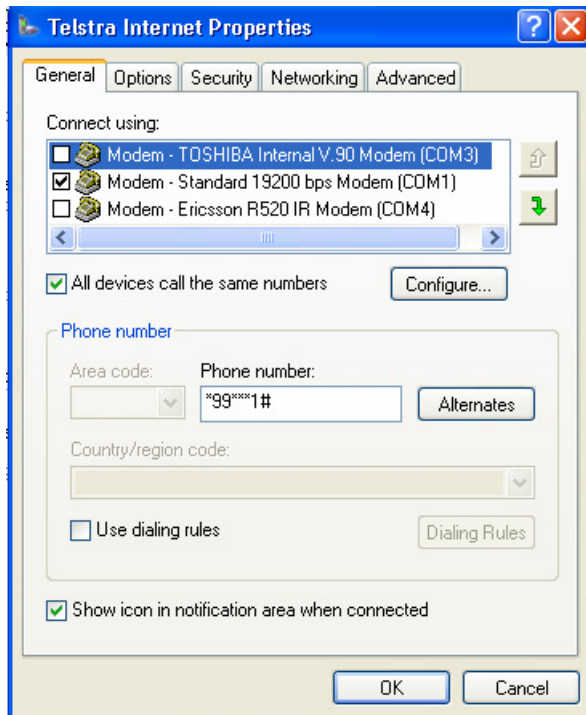
This completes the modem configuration and now Dial Up Networking needs to be configured with the correct dial string to use which would be `*99***1` in this case.

Figure 14 shows the initial pop up windows prompting for username and password. It is important to make sure that the right modem is associated with this Dial Up Networking windows, so hit the Properties button to make sure that the Standard 19200 bps Modem is the modem that will be used.



**Figure 14: Dial Up Networking Pop Up Window**

Figure 15 confirms that the correct modem is associated with this Dial Up Networking icon.



**Figure 15: Showing Modem associated with Dial Up Networking Icon.**

The Telstra GPRS network will dynamically allocate an IP address, default Gateway and default DNS to the mobile terminal, so there is no need to manually set these up in Dial Up Networking (Select “Server Assigned”).

Next is to press OK from the pop up windows in Figure 15 to return to the pop up window shown in Figure 14 and press Dial to connect to the GPRS network.

After you have received a confirmation message from Windows that you have connected, it is a matter of running your IP application such as a MS Explorer web browser.

**Example 2 Connecting to a corporate network through the Telstra IP WAN (a Virtual Private Network) using Windows XP Dial Up Networking.**

Will use the following configurations:

Context ID = 6

APN = telstra.corp

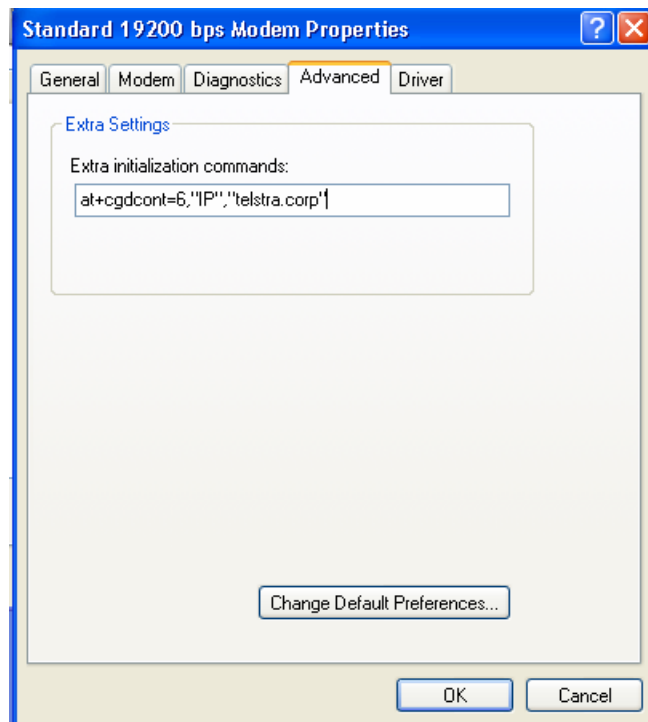
VPN Domain Name will be @acme.com.au

Username will be gary

Password will be hairy1

Figures 11 and 12 are the same for setting up the modem for connecting to the Telstra IP WAN.

The difference comes in setting the additional AT string, which would be as shown in Figure 16 with AT+CGDCONT=6, “IP”, “telstra.corp” in this case using Context ID = 6.



**Figure 16: Showing Additional AT String for Connecting to telstra.corp**

In Dial Up Networking, it is important to check that the Standard 19200bps Modem is associated with the Dial Up Networking icon used for connecting to the Telstra IP WAN, as per Figure 15.

Since the Telstra IP WAN is a VPN, a username and password is required to login into the VPN. PAP or CHAP protocol may be used, and this is configured at the time of setting up the Telstra IP WAN VPN. The username is made up of 2 parts, the variable part of the username which changes from user to user which appears at the start of the username and the fixed part, or the Domain name, which appears at the end of the username.

e.g. gary@acme.com.au would be a valid username in this example where the variable part is gary (and could be robert or james or steve) and the fixed part is the Domain name which is @acme.com.au. So, other login names could be robert@acme.com.au or james@acme.com.au

The password for login name gary@acme.com.au is hairy1. So, the Dial Up Networking pop up windows would look like as per Figure 17. Hitting Dial would initiate the GPRS connection to the Telstra IP WAN. Once Windows has confirmed that the computer has connected, the user can then run their IP client applications to talk to their host applications residing on their corporate servers.



**Figure 17: Showing Dial Up Network window populated with username password and dial number to connect using Context ID = 6.**

## **13. NETWORK SPECIFIC USAGE COMPLIANCE REQUIREMENTS & CONSIDERATIONS**

### **13.1. Common requirements**

It is not permitted to artificially maintain an active dedicated radio data channel by the regular transmission of minimally sized data packets.

This practice was observed on occasions with the CDMA1x/EVDO service to get around the dormant to active session delay time. The current Telstra 3G-UMTS implementation does not present the same type or level of delays that were present with CDMA1x/EVDO and the practice would be unnecessary, as well as being considered by Telstra as not complying with fair use policies.

### **13.2. Application or Telstra Product Specific Requirements**

#### **13.2.1. Telemetry**

1. It is required that the interval between repetitive data transmissions (eg. polling of remote devices, or regular transmission from remote devices) must be greater than 120 seconds.
2. Telemetry applications employing more than one modem device in a single location must ensure that data transmission from the modems are not synchronised with each other, maintaining a minimum data transmission interval between modems of 15 seconds. This control attempts to prevent cell congestion due to time synchronised telemetry data transmissions.
3. Telemetry applications employing more than 50,000 modems will need to provide a facility to control data transmission intervals in real time. Telstra may request data transmission intervals to be increased during periods of network congestion. This control attempts to prevent cell congestion due to unforeseen circumstances in either the telemetry application or the NextG™ network.

## 14. APPLICATION DEVELOPMENT GUIDELINES

### 14.1. Designing Wireless Data Applications

Wireless Data Applications design requires the consideration of a number of factors which have minimal focus with *wired* data application designers. The most important of these is:

- The inherently unreliable nature of radio data transmission.

Whether it is a public mobile cellular network or private or trunk radio, radio data transmission is not insulated from the external environment inside copper or fibre optic cable. The wireless data application designer should be conscious of the fact that data communication to and from their application takes place through a hostile and ever changing environment - data delivery is not guaranteed.

Other factors that relate to the way wireless data applications are used:

- The user is often mobile and is likely to make intermittent connections, rather than be connected 100% of the time.
- The device itself is usually battery powered and may power down unexpectedly.
- Radio signal sensitivity can vary between different types of devices.
- If devices cannot connect to the network it may be because of congestion. A device should be designed to wait for a random period of time and then try again. This is usually implemented by the sum of two timers, one being fixed (perhaps 2 to 10 secs) and then one randomly selected by the device (perhaps in the range 0 to 5 or 0 to 20 seconds). This will reduce the probability of on-going congestion especially in the case when many devices are in the same location.

Other important considerations are:

- Throughput speed and latency may be much less than that experienced with similar wired applications.
- The cost of wireless data transmission is usually much higher than wireline.

The Wireless Data Application Development Guidelines provided in this document can be used to mitigate the effect of these radio environment and mobility factors on the application performance and the end user experience.

Prior to starting the development of wireless application it is useful to consider questions such as:

- How often does information need to be updated?
- Is the application being built from scratch or is an existing wireline application being migrated or modified?
- What data transmission standards and methods should be used?
- Are multiple forms of wireless communication required?
- Should data be processed on the mobile computer or at the host level?
- Should mobile workers use a thin client or thick client?
- How will applications be updated?
- What happens if wireless coverage becomes unavailable?
- Should transaction information be stored in memory or communicated in real time?
- How should enterprise and mobile databases be synchronized?
- Is the application intended for a microbrowser, PDA or notebook computer?
- Does it target a proprietary form factor?
- Does it require a middleware platform or an application service provider or both?

## 14.2. Protocols

Telstra allows the use of both TCP and UDP protocols to encapsulate data over the IP protocol layer. In some applications there are advantages in choosing to use UDP over TCP where there is a need to maximise performance and minimise the amount of data transmitted. Generally UDP is used for short bursty transactional data communications and TCP is used where strong error correction is required.

TCP delivers the transmitted data packets in the right order to the receiver and ensures a reliable connection due to acknowledged data transfer. Errors are corrected with retransmission. Applications requiring ordered reliable delivery of streams of data should use TCP.

UDP provides a means for data transmission with a minimum of protocol mechanism. The protocol is transaction oriented and delivery and duplicate protection are not guaranteed. UDP places the onus on the application layer to ensure integrity of the data and the correct sequence order of the data packets, but the advantage is higher speed in data transfer because there is no acknowledgement and also with a smaller header, less data is transmitted.

TCP is chatty to preserve data integrity, has more overheads and therefore involves more data transmitted over the air. This translates to higher carriage costs compared with UDP generally. Also, if a large number of mobile terminals are connecting to a host computer simultaneously, this may create capacity issues with availability of TCP socket resources to terminate the TCP connections.

## 14.3. IP Address assignment - Static and Dynamic Addresses

IP addresses can be allocated to an MS in three different ways:

- Network operator assigns an IP address permanently to specific mobile service number. This is currently not offered by Telstra.
- Network operator assigns a dynamic IP address to the MS when a packet data session is activated. This form of address allocation is currently used by Telstra for Telstra Value Added Services such as WAP, Internet access, etc.
- An Authentication Server assigns an IP address based on authentication of user login credentials. This method is used by Telstra when IP WAN is used to connect the customer's wireless devices to their Host computers. Dynamic or static IP addressing can be used, and the IP addresses may be public or private (since it is assigned within the customer's VPN environment). The IP addresses may be allocated by the customer's Radius authentication server or by Telstra's IP WAN Managed Radius server. Note that the static IP address is only associated with the username used to login to the IP WAN and is not fixed to the mobile service number. So it is possible for another mobile number to use the same login name and be assigned the same fixed IP address (so long as no-one else was using that login name at that time).

## 14.4. Internet Based Connections

### 14.4.1. Firewall considerations

The Telstra firewalls are configured with an extensive set of idle timeout parameters. Timers relating to specific TCP ports may also be set. Currently (May 2007) the TCP idle timeout value is 30 minutes and UDP is 20 minutes. In addition, HTTP (through Port 80) is configured with an idle timeout value of 5 minutes. Therefore web browser based communication will have an idle timeout of 5 minutes, not the 30 minutes of a TCP session on its own.

These timeout values may affect application configuration / performance.

After the idle timeout expires the public IP Address exposed to the Internet for the TCP or UDP session is released. The same IP address is not guaranteed when initiating another session.

## 14.5. Connections & Data Sessions

The procedures for establishing a connection to the wireless data network and then starting and maintaining a data session are specific to the wireless data network technology and the wireless device being used. Refer to the GPRS and UMTS Connection Establishment Procedures (Section 12) for information and examples of connection and data session establishment and management procedures for GPRS/EDGE & UMTS.

## 14.6. Connection/session interruption handling

Mobile device users may move out of coverage, the mobile network may become unavailable (planned maintenance, hardware/software failure, etc), host application servers may fail, radio interference may occur – at any time. All these situations may lead to a loss of connectivity which should be catered for in the wireless application design (i.e. do not assume that sessions can never be lost). Ensure that terminal applications and host servers can reconnect and restart sessions automatically without manual intervention. But, be mindful of the need to back off so that terminal reconnections attempts do not hammer the host server, or the mobile network, creating problems for other local users or host connected networks.

## 14.7. Establishing the connection

Ensure terminals attach successfully and have a data session established before sending application data.

## 14.8. Data session initiation & data push to the mobile terminal

A data session can only be initiated by the mobile terminal, rather than the network or fixed host computer. So, to provide the ability to push data out to wireless devices, the mobile devices must first connect and establish a data session to the host, before being able to receive data from the host.

An indirect method for the host computer to initiate a GPRS data session from the mobile terminal, could be to program the mobile terminal to react to a particular SMS messages and then initiate a data session.

## 14.9. Loss of connectivity

- A TCP/IP connection is not dropped when coverage is lost for a short time (e.g. going through a tunnel).
- The network maintains the packet data session for at least one hour while out of coverage.
- Everything usually starts working when you regain coverage
- If the out of coverage period extends for more than an hour, the network will drop the connection.
- When the wireless device regains coverage, the connection may still fail to work even though the signal is good
- There is no easy way to detect this by interrogating radio.
- If contact cannot be made with the host, then the connection must be re-established.

## 14.10. Detecting loss of connectivity

Detecting connectivity loss is often neglected in these days of reliable LAN and WLAN communication.

Consider the following:

- Interrogate the radio for signal strength
  - No signal implies that data won't flow
  - A good signal does not necessarily imply that data will flow

- An end-to-end (client to host) check is the most reliable method
  - TCP provides this, but UDP requires appropriate application level checking
- Loss of connection may appear as errors and timeouts from Winsock and higher level libraries such as FTP, Web Service
  - Should check these in any networking application
- Periodic “ping” of the application host server, or a known good address. (See Maintaining Connectivity subsection below for important considerations).

### 14.11. Regaining connectivity

If user is in good coverage but data isn't flowing then the actions that can be taken are (least drastic first!):

- Simply wait and retry later
  - Connectivity may be regained soon, especially if you have been out of coverage
- Drop the connection (detach)
- Wait 10-20 seconds then reconnect – this fixes most problems, some randomness in this time is good design practise (see the note earlier).
- Drop connection and reset radio (power cycle). This is the most drastic action, but almost always works for temporary problems. However it can take a long time
- The above can be combined with signal strength checks to avoid unnecessary connection attempts that may fail

### 14.12. Maintaining Connectivity

A wireless device that is not receiving data very frequently, but needs to maintain connectivity to allow data to be pushed out from the host, could regularly “ping” the application host server to check connectivity. This “ping” or “heart beat” between the wireless device and the host would normally be initiated after a certain amount of time has passed since the last data communication. This time period would depend on the operational requirements of the application.

Be aware that a wireless device cannot send packets to itself by specifying the same IP address in the source and destination fields.

NOTE: On some networks inactivity results in the data session entering a “dormant” mode (eg. CDMA1x/EVDO). It then takes a certain amount of time to enter active mode again when data is to be transmitted or received. To get around this wait time some application developers have configured very frequent heart beats to stop the data session going dormant – especially where very short response times are critical for the performance of the application.

NOTE WELL: This practice is not permitted on almost all wireless data networks worldwide, including Telstra. It results in network resources being monopolised unnecessarily and can lead to serious performance impacts on other network users and potentially lock out access for other users.

Use watchdog timers to reset terminal applications and host applications should they lock up.

It is important that a terminal application should be able to continue operating, or restart without manual intervention, after an interruption to connectivity to the network or host.

#### 14.12.1. Host unreachable

This is a specific situation where an expected response from the application host system is not received after a transmission from the wireless device, and the wireless device starts to repeatedly retry transmission to the (unreachable) host. Network coverage is available and the data session may remain connected.

If a large number of mobile devices in the local base station area are all trying to repeatedly reach one particular unreachable host, it can result in negative effects on other base station users. This could be the result of base station congestion from the large number of repeated data transmissions or attempts to establish a connection.

To ensure this situation does not occur, the wireless data application should use transmission back-off algorithms if it cannot reach the host. An example back off algorithm would be:

- After 3 unsuccessful attempts to reach the host, wait a random time of up to 5 minutes before trying again once, then if unsuccessful, wait a random time of up to 30 minutes, and so on.

### **14.13. Coverage / reception related issues**

Make sure you are aware how the terminal/application behaves in marginal radio coverage areas (i.e. conduct field testing of the application prior to production rollout to a work-force).

Coverage Areas for Next G, 3G 2100 and GSM:

[www.telstra.com.au/mobile/networks/coverage](http://www.telstra.com.au/mobile/networks/coverage)

### **14.14. Data usage optimisation**

- Don't send data that isn't needed in real-time. Send later if connected to another faster or more cost effective network
- Prioritise data; send important data first
- Send changes rather than full screen refreshes
- Compress data before sending
- Avoid multiple round-trips. Higher latency on wireless networks will result in poor performance.
- Aim to fill packets; send data in large chunks
- Non-optimal MTU size may have a significant impact on performance.

### **14.15. Closing connection**

When disconnecting from packet data session, do it correctly rather than just dropping the PPP session. To correctly end the data session from the client end, use the standard PPP command - LCP terminate.

### **14.16. Application testing**

Monitor how the application performs over time in a moving environment and static environment. Sometimes modems need resetting after several days because they lock up. In which case, it is prudent to be able to remotely reset the modem or have a watchdog timer reset the modem.

### **14.17. Diagnostics / Trouble Shooting**

Include a diagnostic menu to assist Telstra or company IT support to debug problems. Some diagnostic information is available by querying the device with AT commands. Refer to the device manufacturer's manual for the AT commands.

A diagnostic display should show if possible:

- Mobile number (MSISDN), and IMSI which can assist Telstra in debugging problems quickly.
- Base station ID and connected timeslot (if available from device)
- Signal strength.

- IP address.
- Default gateway, DNS, DHCP IP addresses.
- Software version number.
- Developer name and contact number.

Provide the ability to use an external serial connection on the terminal to allow Layer 3 logging of the application activities.

Use the serial connection to exercise:

- the GPRS attach,
- PPP negotiation and
- PDP Context setup using AT commands.

Many issues have been found with these three items and it is useful to have diagnostics to debug problems.

## 14.18. User Interface

If a screen display is provided for the user, then a *signal strength* display, *connection to host* indication and *battery power* display are important to provide a comfort factor to the user that the application is operating correctly.

### 14.18.1. User Interface / Trouble shooting

Display meaningful error messages to allow users to identify if it is a terminal, network or host problem and take appropriate action.

## 14.19. Improving User Experience

- If constant connectivity is not required - develop "occasionally connected" applications
- Allow the user to continue working when disconnected
- Synchronize with server when possible
- Consider offline storage such as database or transaction queues
- Perform data communication in background
- Implement recovery as described earlier without asking user for guidance
- Work asynchronously
- Don't lock up interface waiting for response to network requests

## 14.20. Documentation

Document how the application works – an overview of the operational flow. This description, if made available to Telstra, may be of assistance to Telstra in initial problem identification and later debugging of network related problems.

## 14.21. Factors Governing Performance

### 14.21.1. Latency

Be aware that wireless latencies are going to be much greater than in the fixed wire connection solutions.

### **14.21.2. Data Rates**

Users cannot set the data rate to a specific speed. The actual data speed will depend on the quality of signal, the number of other users on the network and the category/capability of the user equipment.

### **14.21.3. Quality of Service**

Dependent on the network, Quality of Service may be best effort, so there cannot be guarantees for throughput and latency.

### **14.21.4. MTU Size**

For communication via IP Wireless and IP WAN, ensure that Maximum Transmission Unit (MTU) is set to a maximum of 1452 bytes. This avoids fragmentation or dropped packets, particularly with tunnelling protocols.

Some commonly used applications such as Citrix have been found to provide better performance over wireless data networks when MTU and/or IP packet sizes as low as 512 bytes are used. Refer to current Citrix documentation for further information.

## **14.22. Security**

In comparison to data transmission over the Internet using a wireline network, wireless wide area networks (WWAN) have sophisticated security and encryption mechanisms to protect user data from eavesdropping and interception.

Should additional security be required, Virtual Private Network (VPN) software using IPSec can provide end-to-end encryption to protect user data, from the mobile computer through to the host network.

For security without requiring the overhead of VPN/IPSec software, a Telstra IP WAN VPN is suggested rather than connecting directly over the Internet. (see IP Wireless and IP WAN, Section 10).

### **14.22.1. Dedicated APN**

Telstra offers the use of a dedicated APN that is unique to a particular company, to allow access to the Telstra IP WAN (private IP network). This ensures that only mobile numbers owned by the company, configured with that APN, can access that company's IP WAN VPN. (see IP Wireless and IP WAN, Section 10).

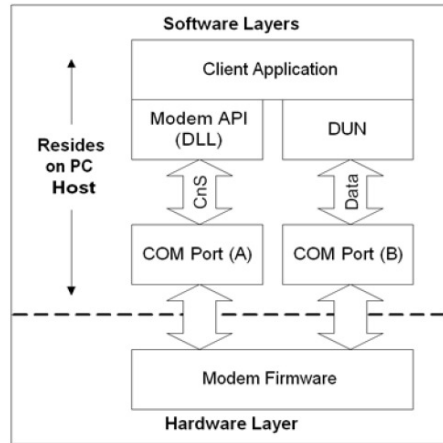
## **14.23. Device Software**

Ensure the latest software/firmware is loaded in the mobile terminal as device vendors are continuously improving how their devices perform on wireless networks, fixing bugs and taking advantage of new network features (i.e. the network vendors are also upgrading to improve their network performance).

## **14.24. Improving battery life**

Leaving WiFi & WWAN(eg UMTS) radios powered on will not cause a significant battery drain and will dramatically speed up the connection of the radio. Note: powered on does not mean having an established data connection.

## **14.25. Modem Interface**



**Figure 18: Modem Interface**

The modem firmware resides on the modem itself and exposes a data communication and configuration interface such that the modem driver (or COM port driver) can control, configure, and send data to and from the modem.

The interface to the hardware differs between the PC Card products, USB modems, embedded modems, and routers.

#### 14.25.1. AT Commands

Use of typical AT command for connection establishment and control is discussed in the GPRS and UMTS Connection Establishment Procedures section. Most wireless devices support a subset of ETSI standard GPRS/UMTS AT commands and also implement additional proprietary commands.

#### 14.26. Authentication Failures

Authentication failures sometimes mask other local configuration or hardware problems.

If connecting through a Telstra IP Wireless port (with an IP WAN IP VPN), then the Telstra IP WAN Helpdesk (1800 467 889) can assist in diagnosing the problem.

#### 14.27. Hibernation and suspension

Laptop computers may go into a stand by or hibernation mode while the wireless data application is still connected in a wireless data session. This situation needs to be tested to understand the effect of this on data session and application connectivity when coming out of these modes. Some wireless modems also have problems when a computer goes into hibernation, or may stop the initiation of hibernation if they are currently active.

#### 14.28. Middleware applications

There are many applications available that are designed to enhance the users wireless data experience. There are applications that are used to optimize speed through compression, or manipulation of data. Other applications provide secure VPN access or session persistence, optimized for wireless use.

Consider whether a middleware application could help to optimize and manage wireless data communication.

## 15. FAULT FINDING PROCEDURE

If there is a problem with making a connection from terminal to host, consider the following steps in fault finding. This assumes the connection is via Telstra IP Wireless/IP WAN.

The following does not necessarily have to be followed sequentially and it is assumed that the application was able to connect successfully before the problem occurred.

1. Check that the power is applied to the modem and terminal microprocessor and that all physical connections are mating correctly (serial, antenna and power). If necessary, perform a power reset.
2. Check that the power is applied to the host and host NTU/switch/router and that all physical connections are mating correctly (serial and power). If necessary, perform a power reset on the host and/or the NTU/switch/router.
3. Check that the terminal is in good radio coverage. If a Telstra GSM (for GPRS application) handset is available, it is generally worthwhile making a voice call to see if there is a problem with the radio access network.
4. Check the modem AT setup strings used in connecting to the network.  
  
Try a different handset/device and/or different SIM. In some cases, the service subscription may have a problem or the device itself may have a problem. For any subscription problems, contact Telstra Wireless Data Customer Support. For any device issues, refer to your device vendor.
5. Check the application configuration software parameters that are specific to the application on both the terminal and the host e.g. IP WAN username and passwords. If possible, check that the IP address allocated to the terminal is in the expected range of IP addresses configured in IP WAN. Check if the PPP timeouts have been altered in any way. It generally needs 20-30 sec to complete PPP negotiation over a wireless connection.
6. To isolate the problem to either the IP WAN component or the GPRS component, change the terminal configuration to connect using the "telstra.internet" APN, which allows direct connection to the Internet, not through the IP WAN. If the terminal can connect and browse to or ping an Internet host then the problem is not in the GPRS network, but in the IP WAN component. If it is clearly a GPRS problem, then contact Telstra Wireless Data Customer Support help desk and log a fault (you will need your mobile number and you will receive a COMM reference number). If using IP WAN then contact the Telstra IP WAN Helpdesk and log a fault (you will need the IP WAN customer network NR number). IP Wireless customers should always use IP WAN Helpdesk as the first fault reporting entry point, and IP WAN will engage WDCS if required.

## 16. CAPTURING PPP SESSION LOGS ON WINDOWS

**Step 1.**

Open a command line window on the PC

**Step 2.**

Enter the RRAS server configuration CLI mode with the netsh command as follows:

```
C:\netsh
```

```
netsh>
```

**Step 3.**

Complete the steps that enable PPP logging with the following two commands:

```
netsh>ras
```

```
netsh ras>
```

```
netsh ras>set tracing PPP enable
```

All PPP logging is stored in the following location:

```
%systemroot%\tracing\
```

**Step 4.**

Attempt to connect to the wireless network several times as you normally would.

**Step 5.**

Disable the PC's PPP logging from the RRAS server command window, as follows:

```
netsh ras>set tracing PPP disable
```

**Step 6.**

Quit the RRAS sever with the bye command, as follows:

```
netsh ras>bye
```

## 17. APPENDIX A – SUPPORT CONTACTS, HELP DESKS, WEB SITES ETC

### 17.1. Customer Support – IP Wireless / IP WAN

If you have a query or problem related to an IP Wireless connected wireless device or IP WAN connection, you should contact the Telstra IP WAN Customer Support.

Telephone 1800 467 889

Web <http://www.telstra.com.au/ipsolutions>

### 17.2. Customer Support – Wireless Data Customer Support

If you are not an IP Wireless user and you have a query about faults or billing related to data services on Telstra's mobile networks, then you could contact the Telstra Wireless Data Customer Support who will be able to assist with your query and escalate it to the support groups as necessary.

Telephone 1300 131 816

Email [wirelessdata@team.telstra.com](mailto:wirelessdata@team.telstra.com)

Hours of operation are:

Mon-Sat	8am-12am EDST (5am-9pm WST)	General Enquires/Faults
Sun	8am-6pm EDST (5am-3pm WST)	General Enquires/Faults
Other Times		Faults Only

### 17.3. Pre-sales - Mobility Solution Architects

Mobility Solution Architects provide pre-sales advice and solution design related to implementation of customer wireless data application projects. They can be contacted through Telstra Account Managers.

### 17.4. Other useful URLs:

Telstra Customer Terms & Conditions (including standard charges) - <http://www.telstra.com.au/customerterms>

Telstra Mobiles Web Pages - <http://www.telstra.com.au/mobile>

Telstra Network Coverage - <http://www.telstra.com.au/mobile/networks/coverage>

Telstra Compatible & In-Compatible Phones & Devices - <http://www.telstra.com.au/mobile/mobiles/phones/compatible.cfm>

Telstra Business Customer related information - <http://www.telstrabusiness.com.au/TelstraTBG>

Telstra Wireless Business Partner Program for wireless application partners - <http://www.telstrabusiness.com.au/TelstraTBG/EnterpriseAndGovernment/Solutions/MobilityAndWireless/PartnerProgram.htm>

### 17.5. Other Non-Telstra Development Support

For other non-Telstra development support, please refer to Appendix C.

## 18. APPENDIX B - ACTIVATION PROCESSES

### 18.1. Activation Process for Mobile Service

A mobile service can be bought through any Telstra Shop or through the Telstra Account Executive or sales representative for the customer.

The Telstra Mobile Helpdesk or Telstra Wireless Data Customer Support can also help with establishing the right product codes on subscriptions to provide specific functionality on Telstra mobile networks.

Functions and APNs required to be activated on the GPRS mobile number:

- MMS – APN: telstra.mms
- WAP – APN: telstra.wap
- Internet – APN: telstra.internet, or telstra.gprs
- IP WAN VPN – APN: telstra.corp, or a dedicated (per company) APN pointing towards Telstra IP WAN.

Note, whilst roaming internationally, the user should use the full APN name to access Telstra GPRS services from another country. The shortened APN names are shown above. The full APN name is the shortened name with “.mnc001.mcc505.gprs” appended, e.g. short APN is telstra.mms and full APN name is telstra.mms.mnc001.mcc505.gprs. The reason the full APN is not always used is that some GPRS terminals cannot accept the full string.

### 18.2. Activation Process for IP Wireless/IP WAN

An IP Wireless Port access connection is needed to allow IP based hosts to be reachable by wireless devices over Telstra IP WAN.

If connecting to IP based hosts directly over the Internet is a less secure wireless connection unless other security protocols are used between the wireless device and the host computer.

To order an IP Wireless Port and IP WAN VPN, contact your local Telstra representative or Account Executive.

## 19. APPENDIX C - REFERENCE INFORMATION

### 19.1. Standards Bodies

- 3GPP**      3<sup>rd</sup> Generation Partnership Project
- The original scope of 3GPP was to produce globally applicable Technical Specifications and Technical Reports for the 3rd Generation Mobile System based on evolved GSM core networks (UMTS/UMTS) and the supported radio access technologies (i.e., Universal Terrestrial Radio Access (UTRA), both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes). The scope was subsequently amended to include the maintenance and development of the Global System for Mobile communication (GSM) Technical Specifications and Technical Reports including evolved radio access technologies (e.g. General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE)).
- [www.3gpp.org](http://www.3gpp.org)
- 3GPP2**      3<sup>rd</sup> Generation Partnership Project 2
- 3GPP2 was born out of the International Telecommunication Union's International Mobile Telecommunications "IMT-2000" initiative, covering high speed, broadband, and Internet Protocol (IP)-based mobile systems featuring network-to-network interconnection, feature/service transparency, global roaming and seamless services independent of location. IMT-2000 is intended to bring high-quality mobile multimedia telecommunications to a worldwide mass market by achieving the goals of increasing the speed and ease of wireless communications.
- [www.3gpp2.org](http://www.3gpp2.org)
- BREW**      Binary Run-time Environment for Wireless
- Qualcomm's BREW solution is a complete, open product and business system for the development and over-the-air deployment of data services on wireless devices. The BREW solution provides the necessary tools and value-added services to developers, device manufacturers and wireless operators for application development and distribution, device configuration and billing payment.
- [www.qualcomm.com/brew](http://www.qualcomm.com/brew)
- CWTS**      China Wireless Telecommunications Standards
- China Wireless Telecommunication Standard group is a non-profit making organisation, which has the responsibility to define, produce and maintain Chinese wireless telecommunications standards in China.
- [www.cwts.org](http://www.cwts.org)
- ETSI**      European Telecommunications Standards Institute
- ETSI (the European Telecommunications Standards Institute) is a not for profit organization whose mission is to produce the telecommunications standards to be used throughout Europe and elsewhere in the world.
- [www.etsi.org](http://www.etsi.org)
- IETF**      Internet Engineering Task Force
- The Internet Engineering Task Force is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.
- [www.ietf.org](http://www.ietf.org)

- ITU**      International Telecommunication Union
- The ITU, headquartered in Geneva, Switzerland is an international organisation within the United Nations System where governments and the private sector co-ordinate global telecom networks and services.
- [www.itu.ch](http://www.itu.ch)
- JCP**      Java Community Process
- The Java Community Process is the way the Java platform evolves. Its an open organization of international Java developers and licensees whose charter is to develop and revise Java technology specifications, reference implementations, and technology compatibility kits.
- [www.jcp.org](http://www.jcp.org)
- OMA**      Open Mobile Alliance
- The mission of the Open Mobile Alliance is to grow the market for the entire mobile industry by removing the barriers to global user adoption and by ensuring seamless application interoperability while allowing businesses to compete through innovation and differentiation.
- The charter for the Open Mobile Alliance is to:
- Deliver responsive and high-quality open standards and specifications based upon market and customer requirements
  - Establish centres of excellence for best practices and conduct interoperability testing (IOT), including multi-standard interoperability to ensure seamless user experience
  - Create and promote common industry view on an architectural framework
  - Be the catalyst for the consolidation of standards working in conjunction with other existing standards organizations and groups such as IETF, 3GPP, 3GPP2, W3C, JCP
- [www.openmobilealliance.org](http://www.openmobilealliance.org)
- Parlay**      Parlay Group
- The Parlay Group is an open multi-vendor consortium formed to develop open technology-independent application programming interfaces (APIs) enabling: technology, Internet and eBusiness companies, independent software vendors (ISVs), software developers, network device vendors, service bureaus, application service providers (ASPs), application suppliers, and enterprises to develop applications and technology solutions that operate across multiple networking platform environments.
- [www.parlay.org](http://www.parlay.org)
- Telstra**      Telstra
- Telstra is Australia's largest telecommunications carrier offering fixed and mobile telecommunication services.
- Mobiles [www.telstra.com.au/mobile](http://www.telstra.com.au/mobile)
- Coverage [www.telstra.com.au/mobile/networks/coverage](http://www.telstra.com.au/mobile/networks/coverage)
- W3C**      World Wide Web Consortium
- The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication, and collective understanding.
- [www.w3c.org](http://www.w3c.org)

## 19.2. Mobile Technologies and links.

GSM	Global System Mobile	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
GPRS	General Packet Radio System	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
HSCSD	High Speed Circuit Switched Data	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
EDGE	Enhanced Data Rates for GSM Evolution	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
UMTS	Universal Mobile Telephony System	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
IS-95-A	cdmaOne System	<a href="http://www.cdg.org">www.cdg.org</a>
IS-95-B	cdmaOne System	<a href="http://www.cdg.org">www.cdg.org</a>
cdma2000 (1xRTT)	1x Radio Telephone Technology (1xRTT)	<a href="http://www.3gpp2.org">www.3gpp2.org</a>
1xEV-DO	1 x Evolution Data Only	<a href="http://www.3gpp2.org">www.3gpp2.org</a>
1xEV-DV	1 x Evolution Data and Voice	<a href="http://www.3gpp2.org">www.3gpp2.org</a>
cdma2000 (3xRTT)	3 x Radio Telephone Technology (3xRTT)	<a href="http://www.3gpp2.org">www.3gpp2.org</a>
W-CDMA (FDD)	Wideband CDMA Frequency Division Duplex	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
W-CDMA (TDD)	Wideband CDMA Time Division Duplex	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
W-CDMA (Low chip rate TDD)	Wideband CDMA 1.28 Mcps Time Division Duplex	<a href="http://www.3gpp.org">www.3gpp.org</a> <a href="http://www.etsi.org">www.etsi.org</a>
TD-SCDMA	Time Division – Synchronous CDMA	<a href="http://www.cwts.org">www.cwts.org</a>

Table 6: Mobile Technologies and links

### 19.3. Developer Assistance Web Sites and Magazines

Cingular - resource for wireless developers	<a href="http://developer.cingular.com/developer">http://developer.cingular.com/developer</a>
Ericsson Mobility World	<a href="http://www.ericsson.com/mobilityworld/">http://www.ericsson.com/mobilityworld/</a>
Qualcomm BREW	<a href="http://brew.qualcomm.com/brew/en/">http://brew.qualcomm.com/brew/en/</a>
3G Americas	<a href="http://www.3gamericas.org">http://www.3gamericas.org</a>
SourceO2	<a href="https://revolution.sourceo2.com/fuel/sourceo2/VendorHome">https://revolution.sourceo2.com/fuel/sourceo2/VendorHome</a>
Forum Nokia	<a href="http://forum.nokia.com/">http://forum.nokia.com/</a>
3G Newsroom	<a href="http://www.3gnewsroom.com/">http://www.3gnewsroom.com/</a>
International Developer (Australian magazine)	<a href="http://www.developer.net.au/">http://www.developer.net.au/</a>
GSM/GPRS/UMTS Information	<a href="http://www.gsmworld.com/technology/index.shtml">http://www.gsmworld.com/technology/index.shtml</a>

Table 7: Developer Assistance Web Sites and Magazines

**19.4. Abbreviations (ref: ETSI standards document - TR 121 905)****0-9**

<b>2G</b>	2 <sup>nd</sup> Generation
<b>3G</b>	3 <sup>rd</sup> Generation
<b>3GPP</b>	Third Generation Partnership Project

**A**

<b>A3</b>	Authentication algorithm A3
<b>A5</b>	Encryption algorithm A5
<b>A8</b>	Ciphering key generating algorithm A8
<b>ACC</b>	Automatic Congestion Control
<b>ACK</b>	Acknowledgement
<b>AK</b>	Anonymity key
<b>API</b>	Application Programming Interface
<b>APN</b>	Access Point Name
<b>ARQ</b>	Automatic Repeat Request
<b>AT</b>	ATtention Command
<b>ATM</b>	Asynchronous Transfer Mode
<b>ATT</b>	Attach
<b>AU</b>	Access Unit
<b>AuC</b>	Authentication Centre

**B**

<b>BCCH</b>	Broadcast Control Channel
<b>BCH</b>	Broadcast Channel
<b>BER</b>	Bit Error Ratio
<b>BS</b>	Base Station Bearer Service
<b>BSC</b>	Base Station Controller
<b>BSIC</b>	Base transceiver Station Identity Code
<b>BSS</b>	Base Station System
<b>BTS</b>	Base Transceiver Station

**C**

<b>CAMEL</b>	Customised Application for Mobile network Enhanced Logic
<b>CB</b>	Cell Broadcast
<b>CCCH</b>	Common Control Channel
<b>CCITT</b>	Comité Consultatif International Télégraphique et Téléphonique (The International Telegraph and Telephone Consultative Committee)
<b>CDMA</b>	Code Division Multiple Access

<b>CDR</b>	Charging Data Record
<b>CF</b>	Conversion Facility all Call Forwarding services
<b>CGI</b>	Common Gateway Interface
<b>CHAP</b>	Challenge Handshake Authentication Protocol
<b>CKSN</b>	Ciphering Key Sequence Number
<b>CLI</b>	Calling Line Identity
<b>CM</b>	Connection Management
<b>CMD</b>	Command
<b>CN</b>	Core Network
<b>CLNP</b>	Connectionless network protocol
<b>CONS</b>	Connection-oriented network service
<b>CORBA</b>	Common Object Request Broker Architecture
<b>CPCH</b>	Common Packet Channel
<b>CPCS</b>	Common Part Convergence Sublayer
<b>CRC</b>	Cyclic Redundancy Check
<b>CS-GW</b>	Circuit Switched Gateway
<b>CS</b>	Circuit Switched
<b>CSD</b>	Circuit Switched Data
<b>CSPDN</b>	Circuit Switched Public Data Network
<b>CTCH</b>	Common Traffic Channel
<b>CTS</b>	Cordless Telephony System
<b>CUG</b>	Closed User Group
<b>CW</b>	Call Waiting
<b>D</b>	
<b>DCCH</b>	Dedicated Control Channel
<b>DCE</b>	Data Circuit terminating Equipment
<b>DECT</b>	Digital Enhanced Cordless Telecommunications
<b>DET</b>	Detach
<b>DF</b>	Dedicated File
<b>DHCP</b>	Dynamic Host Configuration Protocol
<b>DL</b>	Data Layer Downlink (Forward Link)
<b>DSCH</b>	Downlink Shared Channel
<b>DTAP</b>	Direct Transfer Application Part
<b>DTCH</b>	Dedicated Traffic Channel
<b>DTE</b>	Data Terminal Equipment
<b>DTMF</b>	Dual Tone Multiple Frequency
<b>E</b>	
<b>EDGE</b>	Enhanced Data rates for GSM Evolution

<b>EGPRS</b>	Enhanced GPRS
<b>EIR</b>	Equipment Identity Centre Equipment Identity Register
<b>EMC</b>	ElectroMagnetic Compatibility
<b>ETSI</b>	European Telecommunications Standards Institute
<b>F</b>	
<b>FCCH</b>	Frequency Correction CHannel
<b>FDMA</b>	Frequency Division Multiple Access
<b>FEC</b>	Forward Error Correction
<b>FH</b>	Frequency Hopping
<b>FR</b>	Full Rate
<b>G</b>	
<b>GERAN</b>	GSM EDGE Radio Access Network
<b>GGSN</b>	Gateway GPRS Support Node
<b>GMM</b>	GPRS Mobility Management
<b>GPRS</b>	General Packet Radio Service
<b>GSIM</b>	GSM Service Identity Module
<b>GSM</b>	Global System for Mobile communications
<b>GSN</b>	GPRS Support Nodes
<b>GTP</b>	GPRS Tunnelling Protocol
<b>H</b>	
<b>HLR</b>	Home Location Register
<b>HN</b>	Home Network
<b>HO</b>	Handover
<b>HR</b>	Half Rate
<b>HSCSD</b>	High Speed Circuit Switched Data
<b>HSDPA</b>	High Speed Downlink Packet Access
<b>HTTP</b>	Hyper Text Transfer Protocol
<b>HTTPS</b>	Hyper Text Transfer Protocol Secure (https is http/1.1 over SSL, i.e. port 443)
<b>I</b>	
<b>I/O</b>	Input/Output
<b>IC</b>	Integrated Circuit
<b>ICC</b>	Integrated Circuit Card
<b>IETF</b>	Internet Engineering Task Force
<b>IK</b>	Integrity key
<b>IMEI</b>	International Mobile Equipment Identity
<b>IMSI</b>	International Mobile Subscriber Identity
<b>IMUN</b>	International Mobile User Number
<b>IN</b>	Intelligent Network
<b>IP</b>	Internet Protocol

<b>IP-M</b>	IP Multicast
<b>IPv4</b>	Internet Protocol Version 4
<b>IPv6</b>	Internet Protocol Version 6
<b>ISDN</b>	Integrated Services Digital Network
<b>ISO</b>	International Organisation for Standardisation
<b>ISP</b>	Internet Service Provider
<b>ISUP</b>	ISDN User Part
<b>ITU</b>	International Telecommunication Union
<b>IUI</b>	International USIM Identifier
<b>IWF</b>	InterWorking Function
<b>IWU</b>	Inter Working Unit
<b>J</b>	
<b>JTAPI</b>	Java Telephony Application Programming Interface
<b>K</b>	
<b>kbps</b>	Kilo-bits per second
<b>Kc</b>	Ciphering key
<b>L</b>	
<b>LA</b>	Location Area
<b>LAC</b>	Link Access Control
<b>LAN</b>	Local Area Network
<b>LAPB</b>	Link Access Protocol Balanced
<b>LATA</b>	Local Access and Transport Area
<b>LAU</b>	Location Area Update
<b>LCP</b>	Link Control Protocol
<b>LCS</b>	Location Services
<b>LE</b>	Local Exchange
<b>LLC</b>	Logical Link Control
<b>LNS</b>	L2TP Network Server
<b>LR</b>	Location Register
<b>M</b>	
<b>MAC</b>	Medium Access Control (protocol layering context) Message Authentication Code (encryption context)
<b>MAP</b>	Mobile Application Part
<b>MCC</b>	Mobile Country Code
<b>MCU</b>	Media Control Unit
<b>ME</b>	Mobile Equipment
<b>MGW</b>	Media GateWay
<b>MIP</b>	Mobile IP
<b>MIPS</b>	Million Instructions Per Second

<b>MM</b>	Mobility Management Multimedia
<b>MMI</b>	Man Machine Interface
<b>MNC</b>	Mobile Network Code
<b>MNP</b>	Mobile Number Portability
<b>MO</b>	Mobile Originated
<b>MS</b>	Mobile Station
<b>MSC</b>	Mobile Switching Centre
<b>MSID</b>	Mobile Station Identifier
<b>MSIN</b>	Mobile Station Identification Number
<b>MSISDN</b>	Mobile Subscriber ISDN Number
<b>MT</b>	Mobile Terminated Mobile Termination
<b>MTP</b>	Message Transfer Part
<b>MTU</b>	Maximum Transfer Unit
<b>MUI</b>	Mobile User Identifier
<b>MUMS</b>	Multi User Mobile Station
<b>MVNO</b>	Mobile Virtual Network Operator
<b>N</b>	
<b>NAI</b>	Network Access Identifier
<b>NCP</b>	Network Control Protocol
<b>NDC</b>	National Destination Code
<b>NE</b>	Network Element
<b>NMC</b>	Network Management Centre
<b>NMSI</b>	National Mobile Station Identifier
<b>NO</b>	Network Operator
<b>NSAP</b>	Network Service Access Point
<b>NSS</b>	Network Sub System
<b>NUI</b>	National User / USIM Identifier Network User Identification
<b>NUP</b>	National User Part (SS7)
<b>NW</b>	Network
<b>O</b>	
<b>OSI</b>	Open System Interconnection
<b>OSI RM</b>	OSI Reference Model
<b>P</b>	
<b>PABX</b>	Private Automatic Branch eXchange
<b>PAD</b>	Packet Assembler/Disassembler
<b>PAP</b>	Password Authentication Protocol
<b>PBX</b>	Private Branch eXchange
<b>PCCH</b>	Paging Control Channel

<b>PCH</b>	Paging Channel
<b>PCM</b>	Pulse Code Modulation
<b>PCMCIA</b>	Personal Computer Memory Card International Association
<b>PCPCH</b>	Physical Common Packet Channel
<b>PCU</b>	Packet Control Unit
<b>PDN</b>	Packet Data Network Public Data Network
<b>PDP</b>	Packet Data Protocol
<b>PDSCH</b>	Physical Downlink Shared Channel
<b>PDU</b>	Protocol Data Unit
<b>PLMN</b>	Public Land Mobile Network
<b>PNP</b>	Private Numbering Plan
<b>POTS</b>	Plain Old Telephony Service
<b>PP</b>	Point-to-Point
<b>PPP</b>	Point-to-Point Protocol
<b>PPS</b>	Protocol and Parameter Select (response to the ATR)
<b>PS</b>	Packet Switched
<b>PSPDN</b>	Packet Switched Public Data Network
<b>PSTN</b>	Public Switched Telephone Network
<b>PTM</b>	Point-to-Multipoint
<b>PTP</b>	Point to point
<b>PU</b>	Payload Unit
<b>PUSCH</b>	Physical Uplink Shared Channel
<b>PVC</b>	Permanent Virtual Circuit
<b>PW</b>	Pass Word

## Q

<b>QoS</b>	Quality of Service
<b>QPSK</b>	Quadrature (Quaternary) Phase Shift Keying

## R

<b>R00</b>	Release 2000
<b>R99</b>	Release 1999
<b>RAB</b>	Radio Access Bearer
<b>Random</b>	Access Burst
<b>RACH</b>	Random Access Channel
<b>RADIUS</b>	Remote Authentication Dial In User Service
<b>RAN</b>	Radio Access Network
<b>RANAP</b>	Radio Access Network Application Part
<b>RAND</b>	RANDom number (used for authentication)
<b>RB</b>	Radio Bearer

<b>REL</b>	RELease
<b>REQ</b>	REQuest
<b>RF</b>	Radio Frequency
<b>RFC</b>	Request For Comments Radio Frequency Channel
<b>RFCH</b>	Radio Frequency CHannel
<b>RL</b>	Radio Link
<b>RLC</b>	Radio Link Control
<b>RLCP</b>	Radio Link Control Protocol
<b>RLP</b>	Radio Link Protocol
<b>RNC</b>	Radio Network Controller
<b>RNS</b>	Radio Network Subsystem
<b>RPLMN</b>	Registered Public Land Mobile Network
<b>RSSI</b>	Received Signal Strength Indicator
<b>RX</b>	Receive
<b>RXLEV</b>	Received signal level
<b>RXQUAL</b>	Received Signal Quality

**S**

<b>SAT</b>	SIM Application Toolkit
<b>SC</b>	Service Centre (used for SMS) Service Code
<b>SCCH</b>	Synchronisation Control Channel
<b>SCCP</b>	Signalling Connection Control Part
<b>SCF</b>	Service Control Function (IN context), Service Capability Feature (VHE/OSA context)
<b>SCP</b>	Service Control Point
<b>SDCCH</b>	Stand-Alone Dedicated Control Channel
<b>SDH</b>	Synchronous Digital Hierarchy
<b>SDU</b>	Service Data Unit
<b>SGSN</b>	Serving GPRS Support Node
<b>SHCCH</b>	Shared Channel Control Channel
<b>SIM</b>	GSM Subscriber Identity Module
<b>SIP</b>	Session Initiated Protocol
<b>SIR</b>	Signal-to-Interference Ratio
<b>SLA</b>	Service Level Agreement
<b>SMLC</b>	Serving Mobile Location Centre
<b>SMS</b>	Short Message Service
<b>SMSC</b>	Short Message Service Centre
<b>SMS-CB</b>	SMS Cell Broadcast

<b>SN</b>	Serving Network Subscriber Number
<b>SNMP</b>	Simple Network Management Protocol
<b>SQN</b>	Sequence number
<b>SRNC</b>	Serving Radio Network Controller
<b>SRNS</b>	Serving RNS
<b>SS</b>	Supplementary Service
<b>SS7</b>	Signalling System No. 7
<b>SSSAR</b>	Service Specific Segmentation and Re-assembly sublayer
<b>SVC</b>	Switched virtual circuit
<b>SW</b>	Software
<b>T</b>	
<b>TA</b>	Terminal Adaptation Timing Advance
<b>TAC</b>	Type Approval Code
<b>TCH</b>	Traffic Channel
<b>TCP</b>	Transmission Control Protocol
<b>TDMA</b>	Time Division Multiple Access
<b>TE</b>	Terminal Equipment
<b>TEID</b>	Tunnel End Point Identifier
<b>TLS</b>	Transport Layer Security
<b>TMSI</b>	Temporary Mobile Subscriber Identity
<b>TOA</b>	Time of Arrival
<b>TPDU</b>	Transfer Protocol Data Unit
<b>TRX</b>	Transceiver
<b>TS</b>	Technical Specification Teleservice
<b>Time Slot</b>	
<b>TUP</b>	Telephone User Part (SS7)
<b>TX</b>	Transmit
<b>U</b>	
<b>UART</b>	Universal Asynchronous Receiver and Transmitter
<b>UDP</b>	User Datagram Protocol
<b>UE</b>	User Equipment
<b>UI</b>	User Interface Unnumbered Information (Frame)
<b>UICC</b>	Universal Integrated Circuit Card
<b>UL</b>	Uplink (Reverse Link)
<b>UMSC</b>	UMTS Mobile Services Switching Centre
<b>UMTS</b>	Universal Mobile Telecommunications System
<b>UNI</b>	User-Network Interface

<b>UP</b>	User Plane
<b>URAN</b>	UMTS Radio Access Network
<b>URL</b>	Uniform Resource Locator
<b>USB</b>	Universal Serial Bus
<b>USCH</b>	Uplink Shared Channel
<b>USIM</b>	Universal Subscriber Identity Module
<b>USSD</b>	Unstructured Supplementary Service Data
<b>UTRA</b>	Universal Terrestrial Radio Access
<b>UTRAN</b>	Universal Terrestrial Radio Access Network

**V**

<b>VASP</b>	Value Added Service Provider
<b>VBR</b>	Variable Bit Rate
<b>VC</b>	Virtual Circuit
<b>VLR</b>	Visitor Location Register
<b>VMSC</b>	Visited MSC
<b>VoIP</b>	Voice Over IP
<b>VPLMN</b>	Visited Public Land Mobile Network
<b>VPN</b>	Virtual Private Network

**W**

<b>WAP</b>	Wireless Application Protocol
<b>WCDMA</b>	Wideband Code Division Multiple Access
<b>WG</b>	Working Group
<b>WS</b>	Work Station
<b>WSP</b>	Wireless Session Protocol
<b>WTA</b>	Wireless Telephony Applications
<b>WTLS</b>	Wireless Transport Layer Security
<b>WWW</b>	World Wide Web

**X**

<b>XRES</b>	EXpected user RESponse
<b>XID</b>	eXchange Identifier
<b>XML</b>	eXtensible Markup Language

**Y**

&lt;void&gt;

**Z**

&lt;void&gt;

## 19.5. 3GPP – Glossary of Terms and Definitions

### 0-9

**3V technology Smart Card:** A Smart Card operating at  $3V \pm 10\%$  and  $5V \pm 10\%$ .

**1.8V technology Smart Card:** A Smart Card operating at  $1.8V \pm 10\%$  and  $3V \pm 10\%$ .

**3GPP system:** the telecommunication system standardised by the 3GPP consisting of a core network and a radio access network that may be either GERAN or UTRAN, or both.

### A

**Accounting:** The process of apportioning charges between the Home Environment, Serving Network and User.

**Active communication:** a UE is in active communication when it has a CS connection established. For PS active communication is defined by the existence of one or more Activated PDP contexts. Either one or both of the mentioned active communications may occur in the UE.

**Authentication:** A property by which the correct identity of an entity or party is established with a required assurance. The party being authenticated could be a user, subscriber, home environment or serving network.

### B

**Base Station:** A base station is a macrocell, microcell or picocell site and consists of transmitters generating radio frequency electromagnetic energy and receivers in a cabin or cabinet. A base station is connected to antennas by feeder cables.

**Bearer:** An information transmission path of defined capacity, delay and bit error rate, etc.

**Bearer service:** A type of telecommunication service that provides the capability of transmission of signals between access points.

**Best effort service:** A service model which provides minimal performance guarantees, allowing an unspecified variance in the measured performance criteria.

**Billing:** A function whereby CDRs generated by the charging function are transformed into bills requiring payment.

### C

**Call:** a logical association between several users (this could be connection oriented or connection less).

**Call Detail Record (CDR):** A formatted collection of information about a chargeable event (e.g. time of call set-up, duration of the call, amount of data transferred, etc) for use in billing and accounting. For each party to be charged for parts of or all charges of a chargeable event a separate CDR shall be generated, i.e more than one CDR may be generated for a single chargeable event, e.g. because of its long duration, or because more than one charged party is to be charged.

**Camped on a cell:** The UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information. Note that the services may be limited, and that the PLMN may not be aware of the existence of the UE within the chosen cell.

**Cell:** Radio network object that can be uniquely identified by a User Equipment from a (cell) identification that is broadcasted over a geographical area from one UTRAN Access Point. A Cell is either FDD or TDD mode.

**Charging:** A function whereby information related to a chargeable event is formatted and transferred in order to make it possible to determine usage for which the charged party may be billed.

**Cipher key:** A code used in conjunction with a security algorithm to encode and decode user and/or signalling data.

**Common Channel:** A Channel not dedicated to a specific UE.

**Connected Mode:** Connected mode is the state of User Equipment switched on and an RRC connection established.

**Connection mode:** The type of association between two points as required by the bearer service for the transfer of information. A bearer service is either connection-oriented or connectionless. In a connection oriented mode, a logical association called *connection* needs to be established between the source and the destination entities before information can be exchanged between them. Connection oriented bearer services lifetime is the period of time between the establishment and the release of the connection. In a connectionless mode, no connection is established beforehand between the source and the destination entities; the source and destination network addresses need to be specified in each message. Transferred information cannot be guaranteed of ordered delivery. Connectionless bearer services lifetime is reduced to the transport of one message.

**Control channel:** A logical channel that carries system control information.

**Controlling RNC:** A role an RNC can take with respect to a specific set of UTRAN access points. There is only one Controlling RNC for any UTRAN access point. The Controlling RNC has the overall control of the logical resources of its UTRAN access point's.

**Core network:** An architectural term relating to the part of UMTS which is independent of the connection technology of the terminal (eg radio, wired).

**Coverage area (of a mobile cellular system):** An area where mobile cellular services are provided by that mobile cellular system to the level required of that system.

**Current serving cell:** This is the cell on which the MS is camped.

## D

**Dedicated Channel:** A channel dedicated to a specific UE.

**Domain:** The highest-level group of physical entities. Reference points are defined between domains.

**Downlink:** Unidirectional radio link for the transmission of signals from a UTRAN access point to a UE. Also in general the direction from Network to UE.

## E

## F

**FC (Flow Control):** A set of mechanisms used to prevent the network from becoming overloaded by regulating the input rate transmissions.

## G

**GPRS MS:** An MS capable of GPRS services is a GPRS MS.

**GSM BSS:** the GSM/GPRS access network.

**GSM core network:** the GSM NSS and GPRS backbone infrastructure.

**Guaranteed service:** A service model which provides highly reliable performance, with little or no variance in the measured performance criteria.

## H

**Handover:** The transfer of a user's connection from one radio channel to another (can be the same or different cell).

**Handover:** The process in which the radio access network changes the radio transmitters or radio access mode or radio system used to provide the bearer services, while maintaining a defined bearer service QoS.

**Home Environment:** responsible for overall provision and control of the Personal Service Environment of its subscribers.

**Home PLMN:** PLMN where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the IMSI.

**I**

**IC Card:** A card holding an Integrated Circuit containing subscriber, end user, authentication and/or application data for one or more applications.

**Idle mode:** The state of UE switched on but which does not have any established RRC connection.

**Interface:** The common boundary between two associated systems (source: GSM 01.04, ITU-T I.112).

**International Mobile Station Equipment Identity (IMEI):** An "International Mobile Station Equipment Identity" is a unique number which shall be allocated to each individual mobile station equipment in the PLMN and shall be unconditionally implemented by the MS manufacturer.

**International mobile user number (IMUN):** The International Mobile User Number is a diallable number allocated to a UMTS user.

**J**

<void>

**K**

**Key pair:** Key pairs are matching private and public keys. If a block of data is encrypted using the private key, the public key from the pair can be used to decrypt it. The private key is never divulged to any other party, but the public key is available, e.g. in a certificate.

**L**

**Local Service:** A service, which can be exclusively provided in the current serving network by a Value added Service Provider.

**Location Registration (LR):** The UE registers its presence in a registration area, for instance regularly or when entering a new registration area.

**Logical Channel:** A logical channel is an information stream dedicated to the transfer of a specific type of information over the radio interface. Logical Channels are provided on top of the MAC layer.

**M**

**Macro cells:** "Macro cells" are outdoor cells with a large cell radius.

**Medium Access Control:** A sub-layer of radio interface layer 2 providing unacknowledged data transfer service on logical channels and access to transport channels.

**Micro cells:** "Micro cells" are small cells.

**Mobile number portability:** The ability for a mobile subscriber to change subscription network within the same country whilst retaining their original MSISDN(s).

**Mobile termination:** the mobile termination is the component of the mobile station which supports functions specific to management of the radio interface (Um).

**Mobility Management:** A relation between the mobile station and the UTRAN that is used to set-up, maintain and release the various physical channels.

**Multi mode terminal:** UE that can obtain service from at least one UTRA radio access mode, and one or more different systems such as GSM bands or possibly other radio systems such IMT-2000 family members.

**Multimedia service:** Services that handle several types of media such as audio and video in a synchronised way from the user's point of view. A multimedia service may involve multiple parties, multiple connections, and the addition or deletion of resources and users within a single communication session.

**N**

**Negotiated QoS:** In response to a QoS request, the network shall negotiate each QoS attribute to a level that is in accordance with the available network resources. After QoS negotiation, the bearer network shall always attempt to provide adequate resources to support all of the negotiated QoS profiles.

**Network termination:** A functional group on the network side of a user-network interface (source: ITU-T I.112).

**Node B:** A logical node responsible for radio transmission / reception in one or more cells to/from the User Equipment. Terminates the Iub interface towards the RNC.

**Number:** A string of decimal digits that uniquely indicates the public network termination point. The number contains the information necessary to route the call to this termination point.

A number can be in a format determined nationally or in an international format. The international format is known as the International Public Telecommunication Number which includes the country code and subsequent digits, but not the international prefix.

**Number portability:** Where the provision of diallable numbers is independent of home environment and/or serving network.

**Number range owner network:** The network to which the number range containing the ported number has been allocated.

## O

**Originating network:** The network where the calling party is located.

## P

**Packet:** An information unit identified by a label at layer 3 of the OSI reference model (source: ITU-T I.113). A network protocol data unit (NPDU).

**Packet data protocol (PDP):** Any protocol which transmits data as discrete units known as packets, e.g., IP, or X.25.

**Packet transfer mode:** Also known as packet mode. A transfer mode in which the transmission and switching functions are achieved by packet oriented techniques, so as to dynamically share network transmission and switching resources between a multiplicity of connections (source: ITU-T I.113).

**Paging:** The act of seeking a User Equipment.

**Personalisation:** The process of storing information in the ME and activating the procedures which verify this information against the corresponding information stored in the SIM whenever the ME is powered up or a SIM is inserted, in order to limit the SIMs with which the ME will operate.

**Physical channel data stream:** In the uplink, a data stream that is transmitted on one physical channel. In the downlink, a data stream that is transmitted on one physical channel in each cell of the active set.

**Physical Channel:** In FDD mode, a physical channel is defined by code, frequency and, in the uplink, relative phase (I/Q). In TDD mode, a physical channel is defined by code, frequency, and time-slot.

**Pico cells:** "Pico cells" are cells, mainly indoor cells, with a radius typically less than 50 metres.

**PLMN Area:** The PLMN area is the geographical area in which a PLMN provides communication services according to the specifications to mobile users. In the PLMN area, the mobile user can set up calls to a user of a terminating network. The terminating network may be a fixed network, the same PLMN, another PLMN or other types of PLMN. Terminating network users can also set up calls to the PLMN. The PLMN area is allocated to a PLMN. It is determined by the service and network provider in accordance with any provisions laid down under national law. In general the PLMN area is restricted to one country. It can also be determined differently, depending on the different telecommunication services, or type of MS. If there are several PLMNs in one country, their PLMN areas may

overlap. In border areas, the PLMN areas of different countries may overlap. Administrations will have to take precautions to ensure that cross border coverage is minimised in adjacent countries unless otherwise agreed.

**PLMN Operator:** Public Land Mobile Network operator. The entity which offers telecommunications services over an air interface..

**point-to-multipoint service:** A service type in which data is sent to "all service subscribers or a pre-defined subset of all subscribers" within an area defined by the Service Requester.

**Point-to-point:** A value of the service attribute "communication configuration", which denotes that the communication involves only two network terminations.

**Point-to-point service:** A service type in which data is sent from a single network termination to another network termination.

**Ported number:** A MSISDN that has undergone the porting process.

**Ported subscriber:** The subscriber of a ported number.

**Porting process:** A description of the transfer of a number between network operators.

**Protocol:** A formal set of procedures that are adopted to ensure communication between two or more functions within the within the same layer of a hierarchy of functions (source: ITU-T I.112).

**Protocol data unit:** In the reference model for OSI, a unit of data specified in an (N)-protocol layer and consisting of (N)-protocol control information and possibly (N)-user data (source: ITU-T X.200 / ISO-IEC 7498-1).

**Public land mobile network:** A telecommunications network providing mobile cellular services.

## Q

**QoS profile:** a QoS profile comprises a number of QoS parameters. A QoS profile is associated with each QoS session. The QoS profile defines the performance expectations placed on the bearer network.

**QoS session:** Lifetime of PDP context. The period between the opening and closing of a network connection whose characteristics are defined by a QoS profile. Multiple QoS sessions may exist, each with a different QoS profile.

**Quality of Service:** The collective effect of service performances which determine the degree of satisfaction of a user of a service. It is characterised by the combined aspects of performance factors applicable to all services, such as;

service operability performance;

service accessibility performance;

service retainability performance;

service integrity performance; and

other factors specific to each service.

## R

Radio Access Technology: UTRA, GERAN etc.

**Radio Bearer:** The service provided by the Layer 2 for transfer of user data between User Equipment and UTRAN.

**Radio frame:** A radio frame is a numbered time interval of 10 ms duration used for data transmission on the radio physical channel. A radio frame is divided into 15 time slots of 0.666 ms duration. The unit of data that is mapped to a radio frame (10 ms time interval) may also be referred to as radio frame.

**Radio interface:** The "radio interface" is the tetherless interface between User Equipment and a UTRAN access point. This term encompasses all the functionality required to maintain such interfaces.

**Radio link:** A "radio link" is a logical association between single User Equipment and a single UTRAN access point. Its physical realisation comprises one or more radio bearer transmissions.

**Radio Network Controller:** This equipment in the RNS is in charge of controlling the use and the integrity of the radio resources.

**Radio Network Subsystem:** Either a full network or only the access part of a UTRAN offering the allocation and the release of specific radio resources to establish means of connection in between an UE and the UTRAN.  
A Radio Network Subsystem is responsible for the resources and transmission/reception in a set of cells.

**Radio system:** the selected 2<sup>nd</sup> or 3<sup>rd</sup> generation radio access technology, eg UTRAN or GERAN.

**Recipient network:** The network which receives the number in the porting process. This network becomes the subscription network when the porting process is complete.

**Registration:** This is the process of camping on a cell of the PLMN and doing any necessary LRs.

**Repeater:** A "repeater" is a radio transceiver used to extend the transmission of a base station beyond its normal range.

**Requested QoS:** a QoS profile is requested at the beginning of a QoS session. QoS modification requests are also possible during the lifetime of a QoS session.

**Roaming:** The ability for a user to function in a serving network different from the home network.

## S

**Seamless handover:** "Seamless handover" is a handover without perceptible interruption of the radio connection.

**Sector:** A "sector" is a sub-area of a cell. All sectors within one cell are served by the same base station. A radio link within a sector can be identified by a single logical identification belonging to that sector.

**Service Access Point:** A conceptual point where a protocol layer offers access to its services to upper layer.

**Service Area:** The Service Area is defined in the same way as the Service Area according to ITU-T Recommendation Q.1001 [4]. In contrast to the PLMN area it is not based on the coverage of a PLMN. Instead it is based on the area in which a fixed network user can call a mobile user without knowing his location. The Service Area can therefore change when the signalling system is being extended, for example.

**Service Capabilities:** Bearers defined by parameters, and/or mechanisms needed to realise services. These are within networks and under network control.

**Service category or service class:** A service offered to the users described by a set of performance parameters and their specified values, limits or ranges. The set of parameters provides a comprehensive description of the service capability.

**Service Feature:** Functionality that a UMTS system shall offer to enable provision of services. Services, are made up of different service features.

**Service requester:** The entity which requests the initiation of a GPRS operation, through a service request.

**Service subscriber:** Entity which subscribes to the General Packet Radio Service (GPRS) service.

**Services (of a mobile cellular system):** The set of functions that the mobile cellular system can make available to the user.

**Serving Network:** The serving network provides the user with access to the services of home environment.

**Signalling:** The exchange of information specifically concerned with the establishment and control of connections, and with management, in a telecommunications network (source: ITU-T I.112).

**Signalling connection:** An acknowledged-mode link between the user equipment and the core network to transfer higher layer information between the entities in the non-access stratum.

**Signalling link:** Provides an acknowledged-mode link layer to transfer the UE-UTRAN signalling messages as well as UE - Core Network signalling messages (using the signalling connection).

**SIM code:** Code which when combined with the network and NS codes refers to a unique SIM. The code is provided by the digits 8 to 15 of the IMSI

**SIM code group:** Combination of the SIM code and the associated network subset and network codes (it is equivalent to the IMSI).

**Simultaneous use of services:** The concurrent use of a circuit-mode service (voice or data) and packet-mode services (GPRS) by a single mobile station.

**Soft Handover:** Soft handover is a category of handover procedures where the radio links are added and abandoned in such manner that the UE always keeps at least one radio link to the UTRAN.

**Subscribed QoS:** The network will not grant a QoS greater than the subscribed. The QoS profile subscription parameters are held in the HLR. An end user may have several QoS subscriptions. For security and the prevention of damage to the network, the end user cannot directly modify the QoS subscription profile data.

**Subscriber:** The responsibility for payment of charges incurred by one or more users may be undertaken by another entity designated as a subscriber. This division between use of and payment for services has no impact on standardisation.

## T

**Terminal:** A device into which a UICC (USIM) can be inserted and which is capable of providing access to UMTS services to users, either alone or in conjunction with a UICC.

**Terminal equipment:** Equipment that provides the functions necessary for the operation of the access protocols by the user (source: GSM 01.04). A functional group on the user side of a user-network interface (source: ITU-T I.112).

## U

**UMTS core network:** refers in this specification to an evolved GSM core network infrastructure or any new UMTS core network infrastructures, integrating circuit and packet switched traffic..

**UMTS IC Card:** An IC card (or 'smartcard') of defined electromechanical specification which contains at least one USIM.

**UMTS mobile termination:** part of the UMTS Mobile Station which provides functions specific to the management of the radio interface (Um).

**UMTS network:** Network operated by a single network operator and consisting of UTRAN access networks (WCDMA and/or TD-CDMA), optionally GSM BSS access networks, an UMTS core network.

**Universal Mobile Telecommunications System (UMTS):** The telecommunications system, incorporating mobile cellular and other functionality, that is the subject of standards produced by 3GPP. (Also referred to as UMTS)

**Universal Subscriber Identity Module (USIM):** An application residing on the UICC used for accessing services provided by mobile networks, which the application is able to register on with the appropriate security.

**Universal Terrestrial Radio Access Network:** UTRAN is a conceptual term identifying that part of the network which consists of RNCs and Node Bs between Iu and Uu interfaces.

**Uplink:** An "uplink" is a unidirectional radio link for the transmission of signals from a UE to a base station, from a Mobile Station to a mobile base station or from a mobile base station to a base station.

**User:** An entity, not part of UMTS, which uses UMTS services. Example: a person using a UMTS mobile station as a portable telephone.

**User-network interface:** The interface between the terminal equipment and a network termination at which interface the access protocols apply (source: ITU-T I.112).

**User Equipment:** A device allowing a user access to network services. For the purpose of 3GPP specifications the interface between the UE and the network is the radio interface. A User Equipment can be subdivided into a number of domains, the domains being separated by reference points. Currently defined domains are the USIM and ME Domains. The ME Domain can further be subdivided into several components showing the connectivity between multiple functional groups. These groups can be implemented in one or more hardware devices. An example of such a connectivity is the TE – MT interface. Further, an occurrence of a User Equipment is an MS for GSM as defined in GSM TS 04.02.

**User Services Profile:** Contains identification of subscriber services, their status and reference to service preferences.

**User Profile:** Is the set of information necessary to provide a user with a consistent, personalised service environment, irrespective of the user's location or the terminal used (within the limitations of the terminal and the serving network).

**User:** An entity, not part of UMTS, which uses UMTS services. Example: a person using a UMTS mobile station as a portable telephone.

## V

**Value Added Service Provider:** Provides services other than basic telecommunications service for which additional

**Visited PLMN of home country:** This is a PLMN, different from the home PLMN, where the MCC part of the PLMN identity is the same as the MCC of the IMSI.

## W

## X

<void>

## Y

<void>

## Z

<void>

## 19.6. Documents Referenced by these Guidelines & references

**ETSI TS 129 061 V6.9.0 (2006-09); (3GPP TS 29.061 version 6.9.0 Release 6)**  
Digital cellular telecommunications system (Phase 2+);  
Universal Mobile Telecommunications System (UMTS);  
**Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN).**  
*- Describes in detail how PPP negotiation is carried out with GPRS modems.*

**ETSI TS 123 060 V5.12.0 (2005-12); (3GPP TS 23.060 version 5.12.0 Release 5)**  
Universal Mobile Telecommunications System (UMTS);  
**General Packet Radio Service (GPRS);  
Service description;  
Stage 2.**

**ETSI TS 127 007 V6.8.0 (2005-03); (3GPP TS 27.007 version 6.8.0 Release 6)**  
Universal Mobile Telecommunications System (UMTS);  
**AT command set for User Equipment (UE).**

**ETSI TS 125 401 V6.8.0 (2006-09); (3GPP TS 25.401 version 6.8.0 Release 6)**  
Universal Mobile Telecommunications System (UMTS);  
**UTRAN overall description.**

**ETSI TS 125 308 V7.0.0 (2006-03); (3GPP TS 25.308 version 7.0.0 Release 7)**  
Universal Mobile Telecommunications System (UMTS);  
**UTRA High Speed Downlink Packet Access (HSDPA);  
Overall description;  
Stage 2**

**ETSI TS 123 101 V6.0.0 (2004-12); (3GPP TS 23.101 version 6.0.0 Release 6)**  
Universal Mobile Telecommunications System (UMTS);  
**General UMTS Architecture.**

**ETSI TS 123 002 V7.1.0 (2006-03); (3GPP TS 23.002 version 7.1.0 Release 7)**  
Universal Mobile Telecommunications System (UMTS);  
**Network architecture.**

**ETSI TS 100 929 V8.1.0 (2001-07); (GSM 03.20 version 8.1.0 Release 1999)**  
Digital cellular telecommunications system (Phase 2+);  
**Security related network functions.**

**ETSI TR 121 905 V7.2.0 (2006-06); (3GPP TR 21.905 version 7.2.0 Release 7)**  
Universal Mobile Telecommunications System (UMTS);  
**Vocabulary for 3GPP Specifications.**

**ETSI TS 133 102 V6.5.0 (2005-12); (3GPP TS 33.102 version 6.5.0 Release 6)**  
Universal Mobile Telecommunications System (UMTS);  
**3G security;  
Security architecture.**