WAP WDP

Version 14-May-1999

**Wireless Application Protocol
Wireless Datagram Protocol Specification**

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This document is subject to change without notice.

Contents

1 Scope

The Transport layer protocol in the WAP architecture consists of the Wireless Transaction Protocol (WTP) and the Wireless Datagram Protocol (WDP). The WDP layer operates above the data capable bearer services supported by the various network types. As a general datagram service, WDP offers a consistent service to the upper layer protocol (Security, Transaction and Session) of WAP and communicate transparently over one of the available bearer services.

The protocols in the WAP family are designed for use over narrowband bearers in wireless telecommunications networks.

Since the WDP protocols provide a common interface to the upper layer protocols (Security, Transaction and Session layers) ,they are able to function independently of the underlying wireless network. This is accomplished by adapting the transport layer to specific features of the underlying bearer.

2 Document Status

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2.3 Comments

Comments regarding this document can be submitted to the WAP Forum in the manner published at http://www.wapforum.org/.

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4 Definitions and abbreviations

4.1 Definitions

For the purposes of this specification the following definitions apply.

Cell Broadcast
> Cell Broadcast permits a number of short messages to be broadcast to all receivers within a particular region.

Cellular Digital Packet Data (CDPD)
> CDPD is an AMPS overlay packet radio service.

CS
> Cell Station is similar to Base Station .
> This term is used in RCR STD-28 (for PHS).

CSD
> Circuit-Switched Data provides a point-to-point connection between the device and the network. This service is typically available in cellular and PCS networks.

Device
> An entity that is capable of sending and/or receiving packets of information via a wireless network and has an unique device address. See [WAP] for further information.

Device Address
> The address of a device is its unique network address assigned by a carrier and following the format defined by an international standard such as E.164 for MSISDN addresses, X.121 for X.25 addresses or RFC 791 for IPv4 addresses. An address uniquely identifies the sending and/or receiving device.

DM
> DataTAC Messaging is a protocol that enables two-way communications between wireless terminals.

FLEX™
> A one-way paging protocol developed to optimise channel efficiency, battery life, and cost per bit for transmitting messages over a wide geographical area.

FLEX™ Suite of Application Enabling Protocols
> A suite of protocols and features which enable applications on FLEX and ReFLEX networks. The FLEX Suite protocols operate at the layer above the FLEX and/or ReFLEX protocol layers.

GPRS
> General Packet Radio Service as defined in GSM 02.60 and 03.60. GPRS provide a packet data service overlay to GSM networks.

iDENÔ
> Integrated Digital Enhanced Network.

iDENÔ Circuit Switched Data
> iDEN Circuit-Switched Data provides a point-to-point connection between the device and the network.

iDENÔ Packet Data

iDEN Packet Data provides a packet data radio service to the iDEN system. This packet data service utilises mobile IP as the mechanism to enable mobile devices to roam within iDEN.

IS-136 General UDP Transport Service (GUTS)

GUTS is a general-purpose application data delivery service. GUTS utilises the Internet Standard User Datagram Protocol (UDP) to specify the intended application or port.

IS-136 Packet Data

IS-136 Packet Data provides a packet data radio service in IS-136.

IS-136 R-DATA

IS-136 R-Data is a two-way narrowband transport mechanism that is supported on the digital control channel (DCCH) and digital traffic channel (DTC). R-Data can be used to carry GUTS messages or other teleservices messages such as the Cellular Messaging Teleservice (CMT). It is by nature similar to a datagram service.

IS-637 SMS

IS-637 specifies the transport and relay layers for SMS over IS-95 CDMA networks.

Maximum Packet Lifetime, MPL

MPL is fixed by the used carrier (the network system).

MSC

Mobile-services Switching Center provides controls for call connection and service to support mobile communications services for PDC.

NCL

Native Command Language is a protocol that enables two-way communications between a DTE and a wireless modem.

Network Type

Network type refers to any network, which is classified by a common set of characteristics (i.e. air interface) and standards. Examples of network types include GSM, CDMA, IS-136, iDEN, FLEX and Mobitex. Each network type may contain multiple underlying bearer services suitable for transporting WDP.

Packet

A packet is a set of bytes being transmitted over the network as an undivided entity. Each packet contains a header, which describes the context of the packet, its position in the packet group, its position in the transmission, and other pertinent information. The WDP header is positioned into the packet according to the features of the underlying bearer.

Port

Ports are used as a sub-addressing mechanism inside a device. A port number identifies the higher layer entity (such as a protocol or application) directly above the WDP layer.

ReFLEX™

A two-way paging protocol developed to enable the efficient delivery of messages and content over-the-air in both the outbound (system to pager) and inbound (pager to system) directions.

SMS

Point-to-Point Short Message Service is a narrow bandwidth data transport mechanism typically available in cellular and PCS networks.

SCR

Standard Context Routing is a protocol that enables two-way communications between fixed host computers and wireless terminal fleets.

Transmission

Transmission is a collection of one or more packet from a source to a destination.

Underlying Bearer

An underlying bearer is a data transport mechanism used to carry the WDP protocols between two devices. Examples of underlying bearers include CDPD, GSM SMS, GSM USSD, GSM CSD, GSM GPRS, IS-136 GUTS, CSD, and Packet Data. During a data exchange between two devices, more than one underlying bearer may be used.

USSD

Unstructured Supplementary Service Data is narrow bandwidth transport mechanism. USSD is a GSM supplementary service. It uses the signalling channels as a bearer, and is half-duplex (only one of the parties are allowed to send at any one moment). It is by nature similar to circuit switched data service.

4.2 General Concepts

This chapter describes the industry terminology related to the specifications.

Client and Server

The terms client and server are used in order to map the WAP environment to well known and existing systems. A client is a device (or application) which initiates requests for data. The server is a device which passively waits for data requests from client devices or actively pushes data to client devices. The server can either accept the request or reject it.

A device can simultaneously act both as client and server for different applications, or even in the context of one application. An application can serve a number of clients (as a server), but act as a client towards another server.

4.3 Abbreviations

For the purposes of this specification the following abbreviations apply.

API	Application Programming Interface
BMI	Base Station, MSC, Interworking Function (IWF)
BSD	Berkeley Software Distribution
CBC-IF	Cell Broadcast Centre Interface
CBS	Cell Broadcast short message service
CDMA	Code Division Multiple Access
CDPD	Cellular Digital Packet Data
DM	DataTAC Messaging
CS	Cell Station
CSD	Circuit Switched Data
DBMS	Database Management System
DCS	Data Coding Scheme
ETSI	European Telecommunication Standardisation Institute

GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
GTR	Group Trailer, indicates the end of packet group
GUTS	General UDP Transport Service
HLR	Home Location Register
iDEN	Integrated Digital Enhanced Network
IE	Information Element
IP	Internet Protocol
IWF	Interworking Function
LAPi	Link Access Protocol iDEN
LSB	Least significant bits
MAC	Medium Access Control
MAP	Mobile Application Part
MDBS	Mobile Data Base Station
MDG	Mobile Data Gateway
MD-IS	Mobile Data - Intermediate System
MDLP	Mobile Data Link Protocol
MGL	Maximum Group Length
MMI	Man Machine Interface
MPL	Maximum Packet Lifetime (constant)
MPS	Maximum Packet Size
MSISDN	Mobile Subscriber ISDN (Telephone number or address of device)
MS	Mobile Station
MSB	Most significant bits
MSC	Mobile Switching Centre
MSC	Mobile-services Switching Center (for PDC)
MSS	Maximum Segment Size
NCL	Native Command Language
PCI	Protocol Control Information
PCS	Personal Communication Services
PDC	Personal Digital Cellular
PDLP	Packet Data Link Protocol
PHS	Personal Handy Phone System
PDLP	Packet Data Link Protocol
PLMN	Public Land Mobile Network
PPP	Point-to-Point Protocol
RAS	Remote Access Server
R-Data	Relay Data
RFCL	Radio Frequency Convergence Layer
RLP	Radio Link Protocol
RTT	Round-Trip Time
SAR	Segmentation and Reassembly
SCR	Standard Context Routing
SMSC	Short Message Service Centre
SMSCB	Short Message Service Cell Broadcast
SMS	Short Message Service
SNDCP	SubNetwork Dependent Convergence Protocol
SPT	Server Processing Time
SS7	Signalling System 7
SSAR	Simplified Segmentation and Reassembly
TCAP	Transaction Capability Application Part
TCP/IP	Transmission Control Protocol/Internet Protocol
TDMA	Time Division Multiple Access
TIA/EIA	Telecommunications Industry Association/Electronic Industry Association

TSAP	Transport Service Access Point
TTR	Transmission Trailer, indicates the end of transmission
UDH	User-Data Header (see GSM 03.40)
UDHL	User-Data Header Length
UDL	User-Data Length
UDP	User Datagram Protocol
UDCP	USSD Dialogue Control Protocol
USSD	Unstructured Supplementary Service Data
USSDC	Unstructured Supplementary Service Data Center
VLR	Visitor Location Registry
VPLMN	Visitor Public Land Mobile Network
WAE	Wireless Application Environment
WAP	Wireless Application Protocol
WDP	Wireless Datagram Protocol
WORM-ARQ	WORM-Auto Repeat Request
WSP	Wireless Session Protocol
WTP	Wireless Transaction Protocol

4.4 Requirements

This specification uses the following words for defining the significance of each particular requirement:

MUST

This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.

MUST NOT

This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.

SHOULD

This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.

SHOULD NOT

This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.

MAY

This word, or the adjective "OPTIONAL", mean that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option MUST be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option MUST be prepared to interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.)

4.5 Security Considerations

WDP has no authentication mechanisms.

5 WDP Architectural Overview

The WDP protocol operates above the data capable bearer services supported by multiple network types. WDP offers a consistent service to the upper protocols (Security, Transaction and Session) of WAP and communicate transparently over one of the available bearer services.

5.1 Reference Model

The model of protocol architecture for the Wireless Datagram Protocol is given in Figure 5.1.

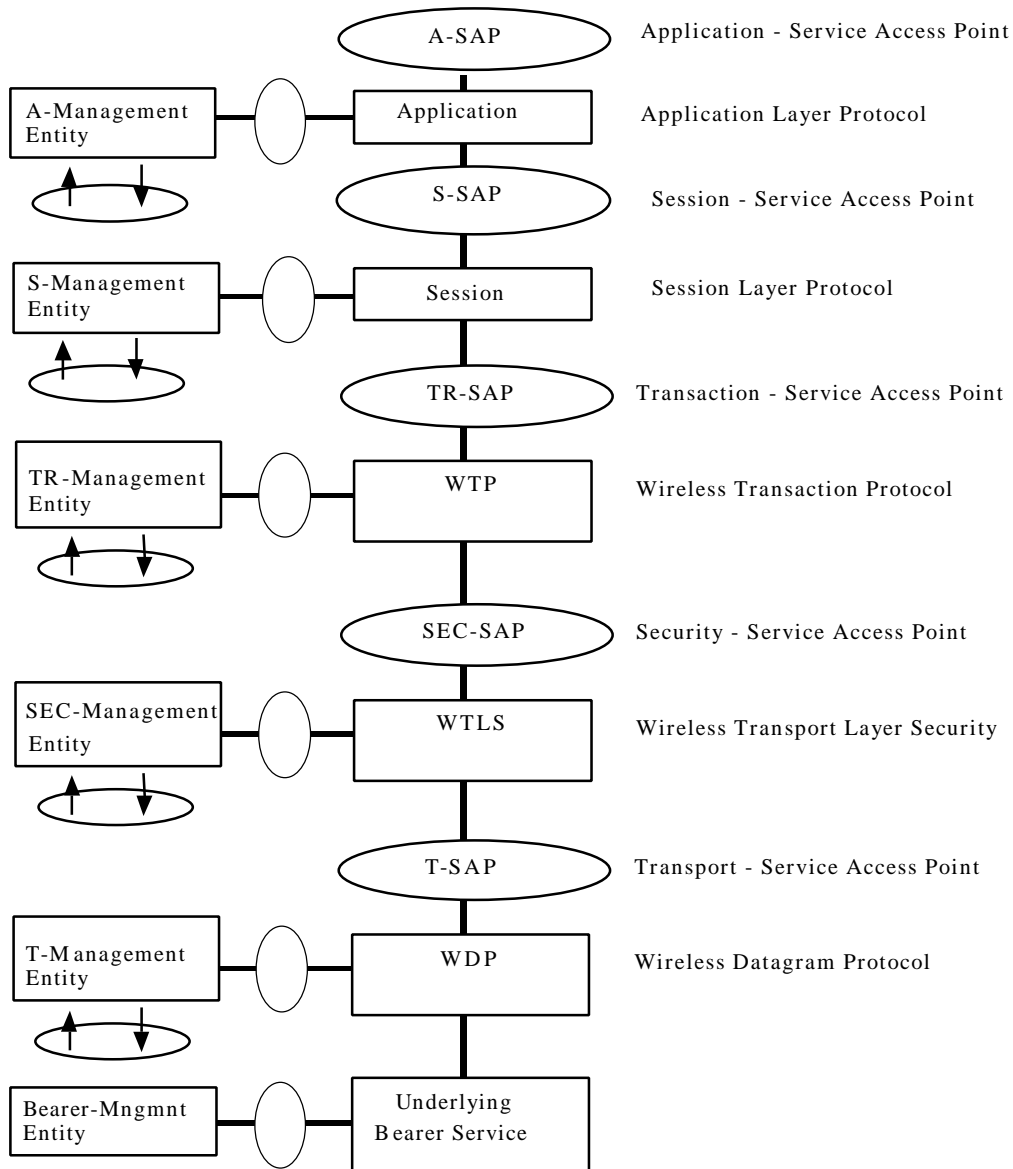|	
A-SAP	Application - Service Access Point
A-Management Entity — Application	Application Layer Protocol
S-SAP	Session - Service Access Point
S-Management Entity — Session	Session Layer Protocol
TR-SAP	Transaction - Service Access Point
TR-Management Entity — WTP	Wireless Transaction Protocol
SEC-SAP	Security - Service Access Point
SEC-Management Entity — WTLS	Wireless Transport Layer Security
T-SAP	Transport - Service Access Point
T-Management Entity — WDP	Wireless Datagram Protocol
Bearer-Mngmnt Entity — Underlying Bearer Service	

Figure 5.1 Wireless Datagram Protocol Architecture

The services offered by WDP include application addressing by port numbers, optional segmentation and reassembly and optional error detection. The services allow for applications to operate transparently over different available bearer services.
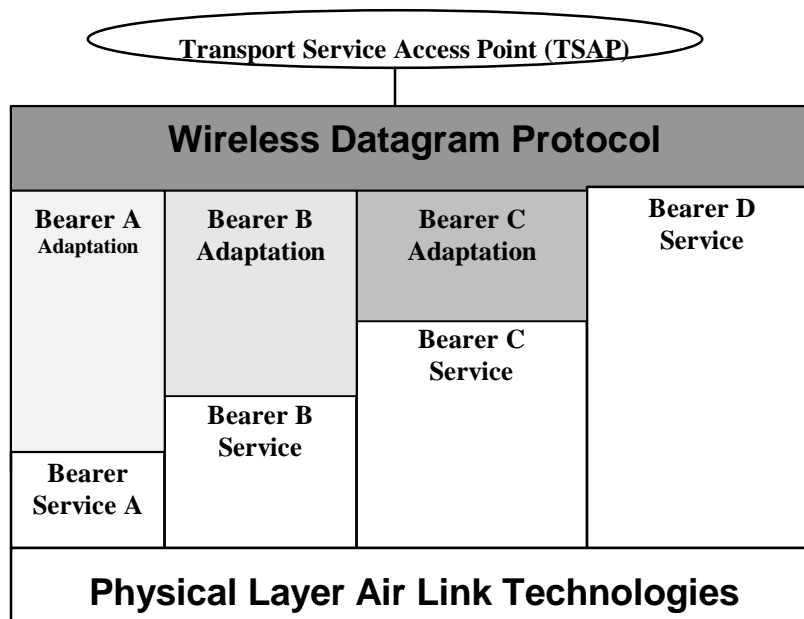
Figure 5.2: Wireless Datagram Protocol Architecture

The model of protocol architecture for the Wireless Transport Protocol is given in Figure 5.2.

WDP offers a consistent service at the Transport Service Access Point to the upper layer protocol of WAP. This consistency of service allows for applications to operate transparently over different available bearer services. The varying heights of each of the bearer services shown in figure 5.2 illustrates the difference in functions provided by the bearers and thus the difference in WDP protocol necessary to operate over those bearers to maintain the same service offering at the Transport Service Access Point is accomplished by a bearer adaptation.

WDP can be mapped onto different bearers, with different characteristics. In order to optimise the protocol with respect to memory usage and radio transmission efficiency, the protocol performance over each bearer may vary. However, the WDP service and service primitives will remain the same, providing a consistent interface to the higher layers.

5.2 General Description of the WDP Protocol

The WDP layer operates above the data capable bearer services supported by the various network types. As a general datagram service, WDP offers a consistent service to the upper layer protocol (Security, Transaction and Session) of WAP and communicate transparently over one of the available bearer services.

WDP supports several simultaneous communication instances from a higher layer over a single underlying WDP bearer service. The port number identifies the higher layer entity above WDP. This may be another protocol layer such as the Wireless Transaction Protocol (WTP) or the Wireless Session Protocol (WSP) or an application such as electronic mail. By reusing the elements of the underlying bearers, WDP can be implemented to support multiple bearers and yet be optimised for efficient operation within the limited resources of a mobile device.

Figure 5.3 shows a general model of the WAP protocol architecture and how WDP fits into that architecture.
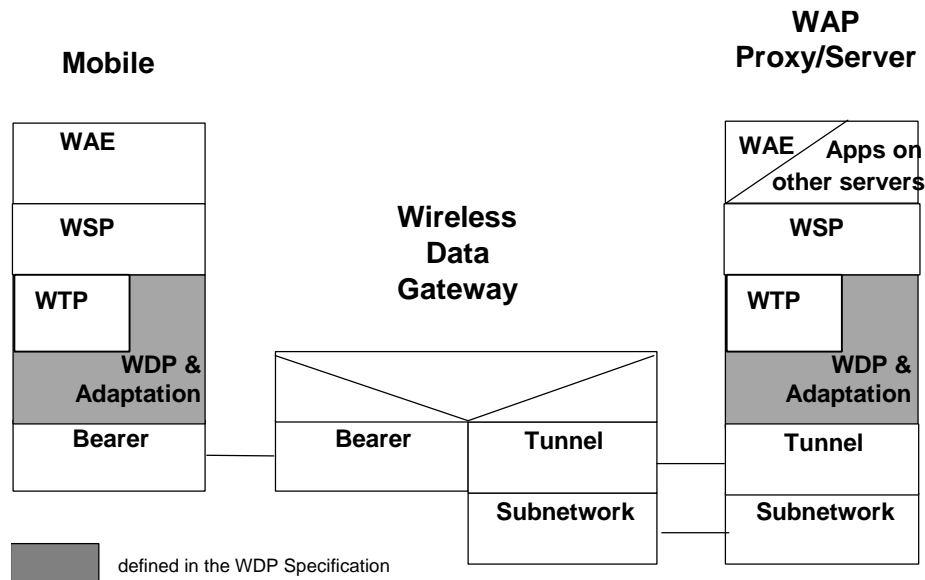
Figure 5.3 General WDP Architecture

In figure 5.3 the shaded areas are the layers of protocol which the WDP Specification is specifically applicable. At the Mobile the WDP protocol consists of the common WDP elements shown by the layer labelled WDP. The Adaptation Layer is the layer of the WDP protocol that maps the WDP protocol functions directly onto a specific bearer. The Adaptation Layer is different for each bearer and deals with the specific capabilities and characteristics of that bearer service. The Bearer Layer is the bearer service such as GSM SMS, or USSD, or IS-136 R-Data, or CDMA Packet Data. At the Gateway the Adaptation Layer terminates and passes the WDP packets on to a WAP Proxy/Server via a Tunnelling protocol, which is the interface between the Gateway that supports the bearer service and the WAP Proxy/Server. For example if the bearer were GSM SMS, the Gateway would be a GSM SMSC and would support a specific protocol (the Tunnelling protocol) to interface the SMSC to other servers. The SubNetwork is any common networking technology that can be used to connect two communicating devices, examples are wide-area networks based on TCP/IP or X.25, or LANs operating TCP/IP over Ethernet. The WAP Proxy/Server may offer application content or may act as a gateway between the wireless WTP protocol suites and the wired Internet.

5.2.1 WDP Management Entity

The WDP Management Entity is used as an interface between the WDP layer and the environment of the device. The WDP Management Entity provides information to the WDP layer about changes in the devices environment, which may impact the correct operation of WDP.

The WDP protocol is designed around an assumption that the operating environment is capable of transmitting and receiving data.

For example, this assumption includes the following basic capabilities that must be provided by the mobile:

- the mobile is within a coverage area applicable to the bearer service being invoked;
- the mobile having sufficient power and the power being on;
- sufficient resources (processing and memory) within the mobile are available to WDP;
- the WDP protocol is correctly configured, and ;
- the user is willing to receive/transmit data.

The WDP Management Entity would monitor the state of the above services/capabilities of the mobile's environment and would notify the WDP layer if one or more of the assumed services were not available.

For example if the mobile roamed out of coverage for a bearer service, the Bearer Management Entity should report to the WDP Management Entity that transmission/reception over that bearer is no longer possible. In turn the WDP Management Entity would indicate to the WDP layer to close all active connections over that bearer. Other examples such as low battery power would be handled in a similar way by the WDP Management Entity.

In addition to monitoring the state of the mobile environment the WDP Management Entity may be used as the interface to the user for setting various configuration parameters used by WDP, such as device address. It could also be used to implement functions available to the user such as a "drop all data connections" feature. In general the WDP Management Entity will deal with all issues related to initialisation, configuration, dynamic re-configuration, and resources, as they pertain to the WDP layer.

Since the WDP Management Entity must interact with various components of a device which are manufacturer specific, the design and implementation of the WDP Management Entity is considered outside the scope of the WDP Specification and is an implementation issue.

5.2.2 Processing Errors of WDP Datagrams

Processing errors can happen when WDP datagrams are sent from a WDP provider to another. For example, a Wireless Data Gateway may not be able to send the datagram to the WAP Gateway, or there is no application listening to the destination port, or the receiver might not have enough buffer space to receive a large message.

The Wireless Control Message Protocol (WCMP) provides an efficient error handling mechanism for WDP, resulting in improved performance for WAP protocols and applications. Therefore the WCMP protocol SHOULD be implemented. See the [WCMP] specification.

5.3 WDP Static Conformance Clause

This static conformance clause defines a minimum set of WDP features that can be implemented to ensure that implementations from multiple vendors will be able to interoperate.

The WDP protocol operates over various bearer services. Each bearer service for which WDP is specified supports a datagram service. It is this datagram service which WDP uses to support the abstract service primitives defined in this specification. For bearer services supporting IP the WDP protocol MUST be UDP. For bearer services not supporting IP the WDP protocol defined in this specification MUST be used. In the following table Mandatory (M) and Optional (O) features of WDP when operating over a bearer not supporting IP are listed.

Function	Operation	WDP over a Non-IP bearer	Notes
Source Port Number	Send	M	
	Receive	M	
Destination Port Number	Send	M	
	Receive	M	
Segmentation and Reassembly (SAR)	Send	O	
	Receive	O	The provider must be able to recognise SAR upon receive, where applicable for the bearer.
Text Header	Send	O	
	Receive	O	
T-DUnitdata Service Primitive	Request	M	
	Indication	M	
T-Derror Service Primitive	Indication	O	

Table 5.1: WDP Static Conformance Clause for Non-IP Bearer Operation

5.4 WDP Bearer Dependent Profiles

The following figures illustrate the protocol profiles for operating WDP between a mobile device and server over a specific RF technology and a specific bearer within that technology.

5.4.1 WDP over GSM

5.4.1.1 GSM SMS Profile

Figure 5.4 illustrates the protocol profile for the WDP layer when operating over the SMS bearer service.
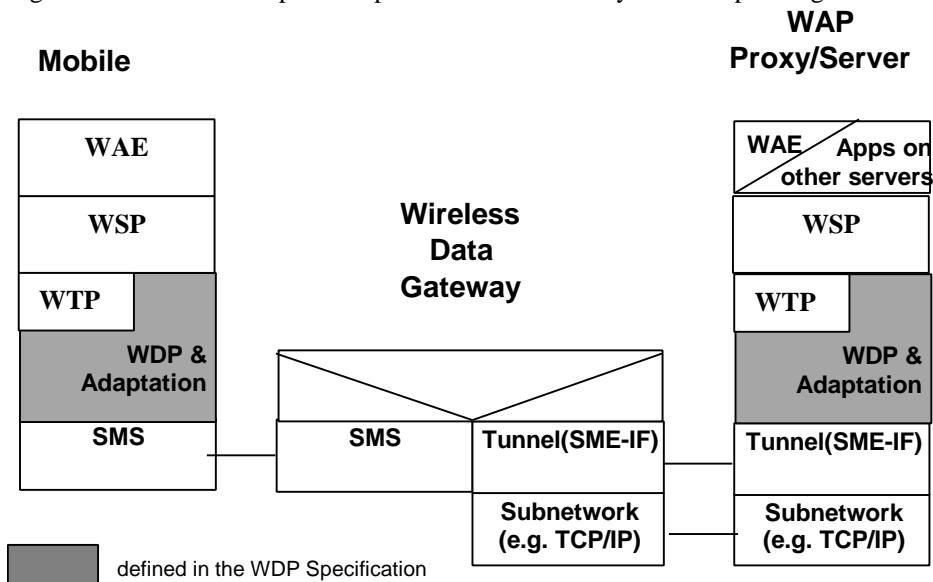
Figure 5.4: WDP over a GSM SMS

5.4.1.2 GSM USSD Profile

Figure 5.5 illustrates the protocol profile for the WTP layer when operating over the USSD bearer service.
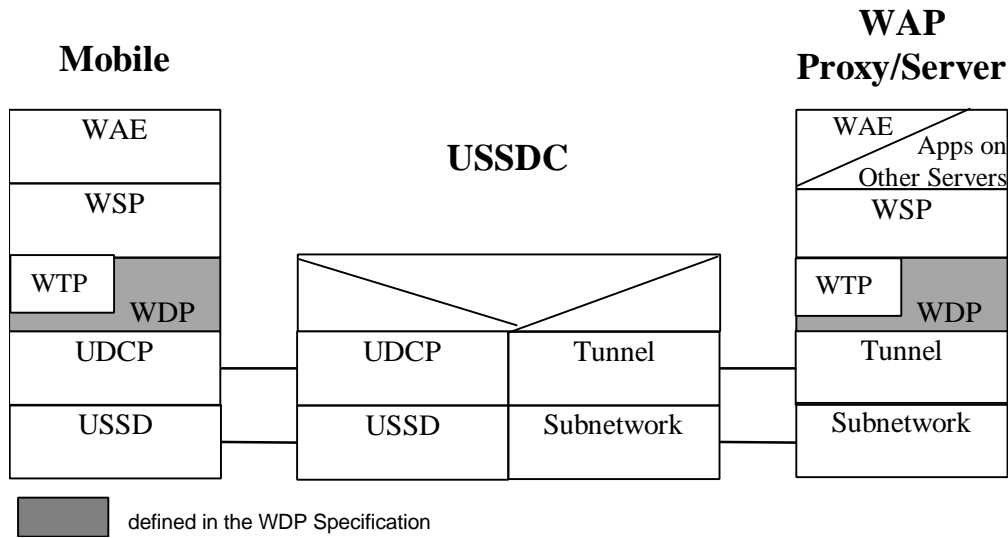
Figure 5.5 USSD Profile.

The USSD Dialogue Control Protocol (UDCP) is responsible for managing the half duplex USSD dialogue and providing the upper layer with the address to the WAP Proxy/Server.

5.4.1.3 GSM Circuit-Switched Data

Figure 5.6 illustrates the protocol profile for the WDP layer when operating over a Circuit-Switched Data connection. The IWF provides non-transparent CSD services and is not present in transparent circuit data calls. The Remote Access Server (RAS) or the Internet Service Provider (ISP) provides connectivity to the Internet network so that the mobile and WAP proxy server can address each other. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet.
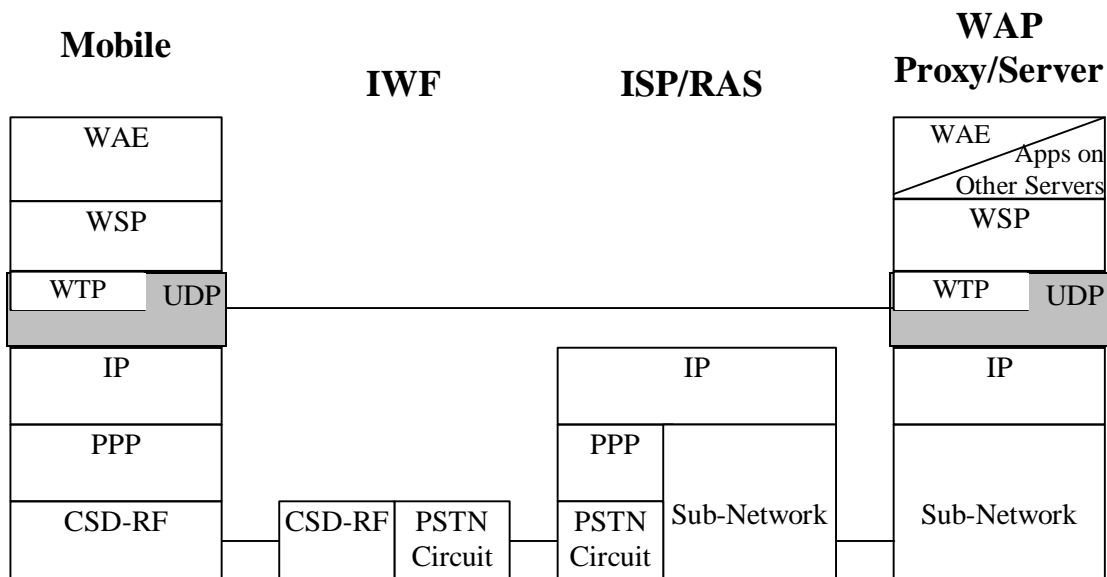
Figure 5.6: WDP over GSM Circuit-Switched Data Channel

5.4.1.4 GSM GPRS Profile

Figure 5.7 illustrates the protocol profile for the WDP layer when operating over the GPRS bearer service. GPRS supports IP to the mobile therefore UDP/IP will provide datagram services.
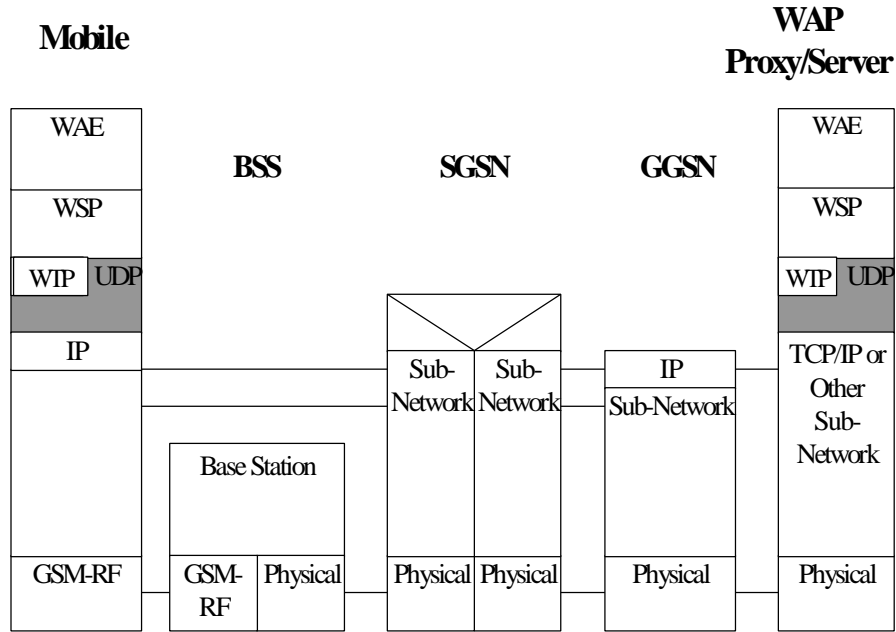
Figure 5.7: WDP over GSM GPRS

5.4.1.5 GSM Cell Broadcast

Table 5.8 illustrates the protocol profile for the WDP layer when operating over the GSM Cell Broadcast bearer service.
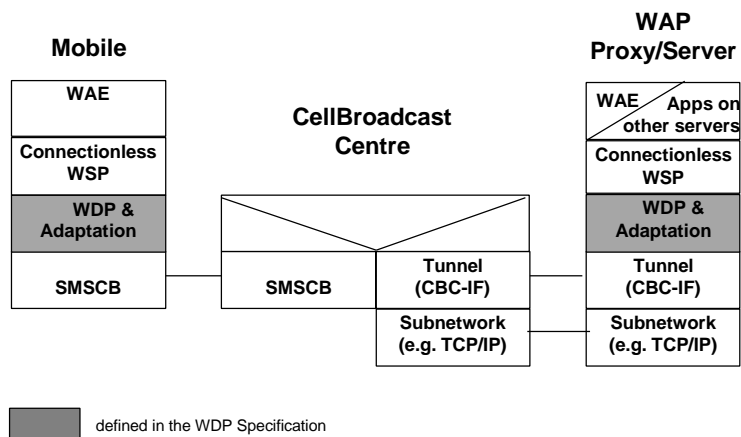
Figure 5.8: WDP over GSM Cell Broadcast

5.4.2 WDP over IS-136

The WDP layer operates above the data capable bearer services supported by IS-136.

5.4.2.1 IS-136 R-Data Profile

Figure 5.8 illustrates the protocol profile for the WDP layer when operating over the IS-136 GUTS and R-Data bearer service. For efficiency WDP can be supported directly on GUTS. A GUTS protocol discriminator would be needed for this purpose. The IS-136 Teleservice Server interface protocol is SubNetwork dependent and not specified in the WAP specifications.
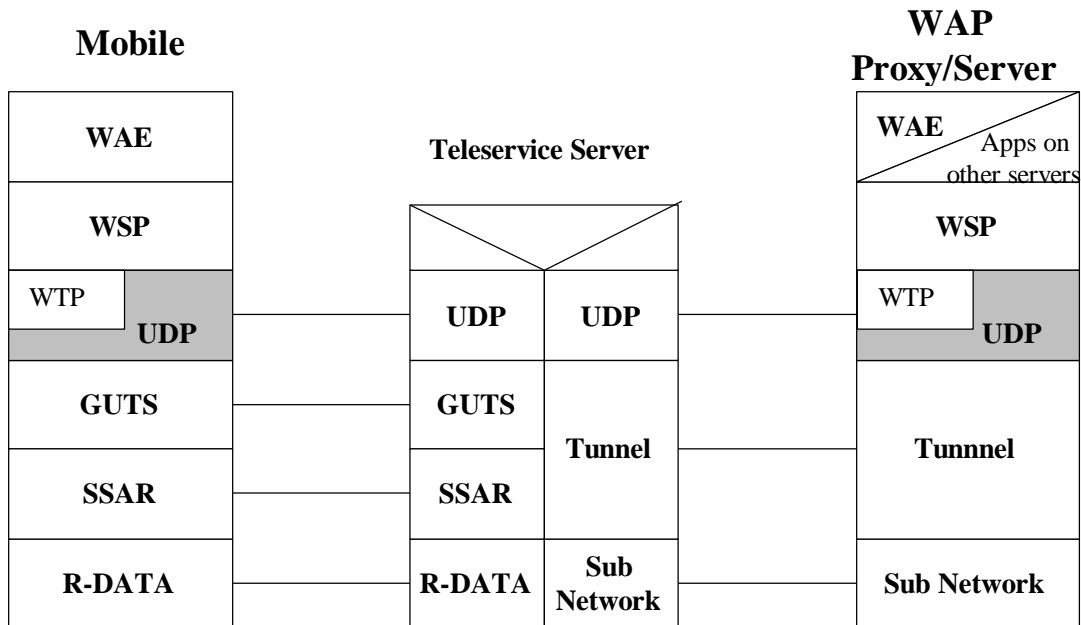
Figure 5.9 WDP over IS-136 R-Data

5.4.2.2 IS-136 Circuit-Switched Data Profile

Figure 5.10 illustrates the protocol profile for the WDP layer when operating over an IS-136 Circuit-Switched Data connection. A remote access or an Internet service provider (ISP) provides connectivity to a WAP proxy server. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet.

Figure 5.10 WDP over IS-136 Circuit-Switched Data

5.4.2.3 IS-136 Packet Data Profile

Figure 5.11 illustrates the protocol profile for the WDP layer when operating over the IS-136 Packet Data bearer service. IS-136 Packet Data supports IP to the mobile therefore UDP/IP will provide the datagram services.
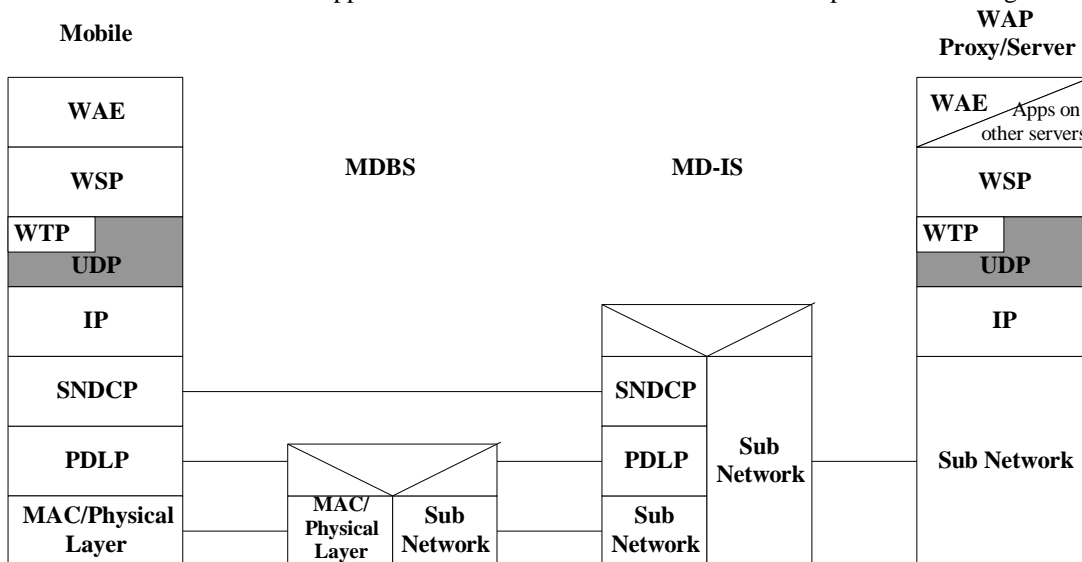
Figure 5.11 WDP over IS-136 Packet Data

5.4.3 WDP over CDPD

Figure 5.12 illustrates the protocol profile for the WDP layer when operating over the CDPD bearer service. CDPD supports IP to the mobile therefore UDP/IP will provide the datagram services.
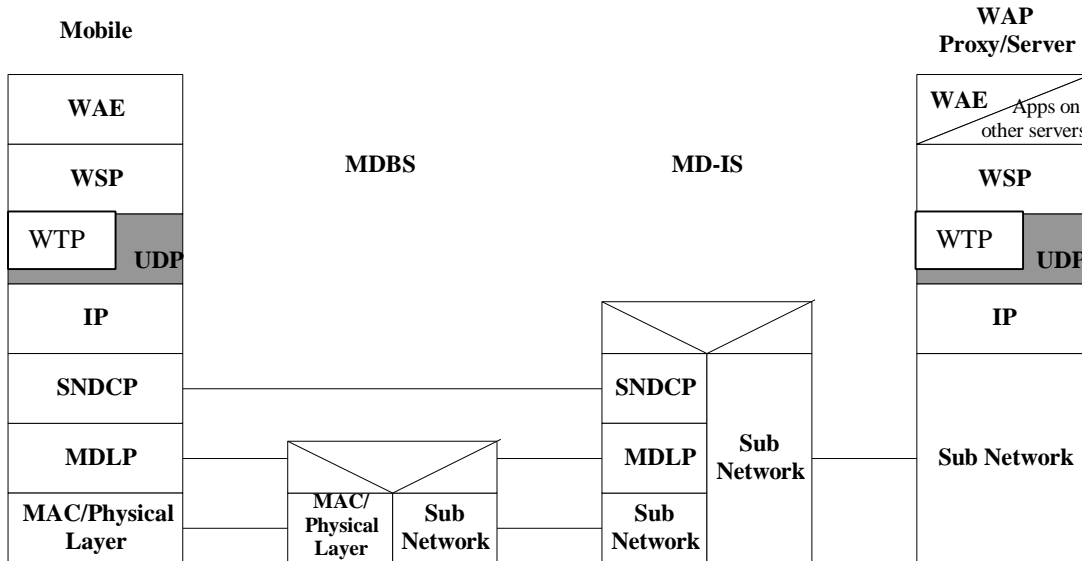
Figure 5.12 WDP over CDPD

5.4.4 WDP over CDMA

The WDP layer operates above the data capable bearer services supported by CDMA. Figure 5.13 identifies the CDMA bearer services presented in this specification.
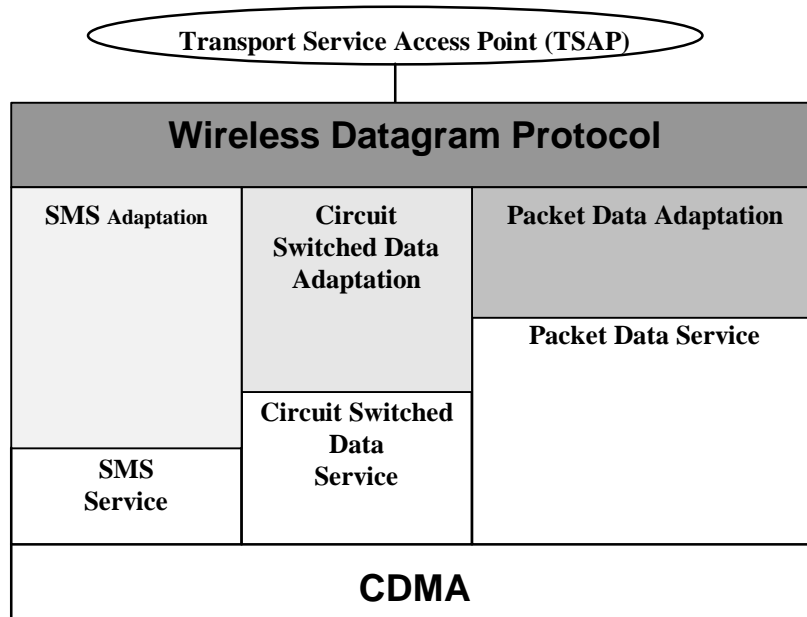
Figure 5.13 WDP over CDMA Bearer Services

5.4.4.1 CDMA Circuit-Switched Data Profile

Figure 5.14 illustrates the protocol profile for the WDP layer when operating over the CDMA Circuit-Switched Bearer Service. The Internet Service Provider (ISP) provides connectivity to the Internet network so that the mobile and WAP proxy server can address each other. The WAP proxy/server can terminate the WAE or serve as a proxy to other applications on the Internet. The CDMA Circuit-Switched Data protocol consists of TCP, IP, PPP & RLP layer as defined in IS-707 specification over IS-95 air interface.

Mobile   IWF/ ISP   WAP Proxy/Server
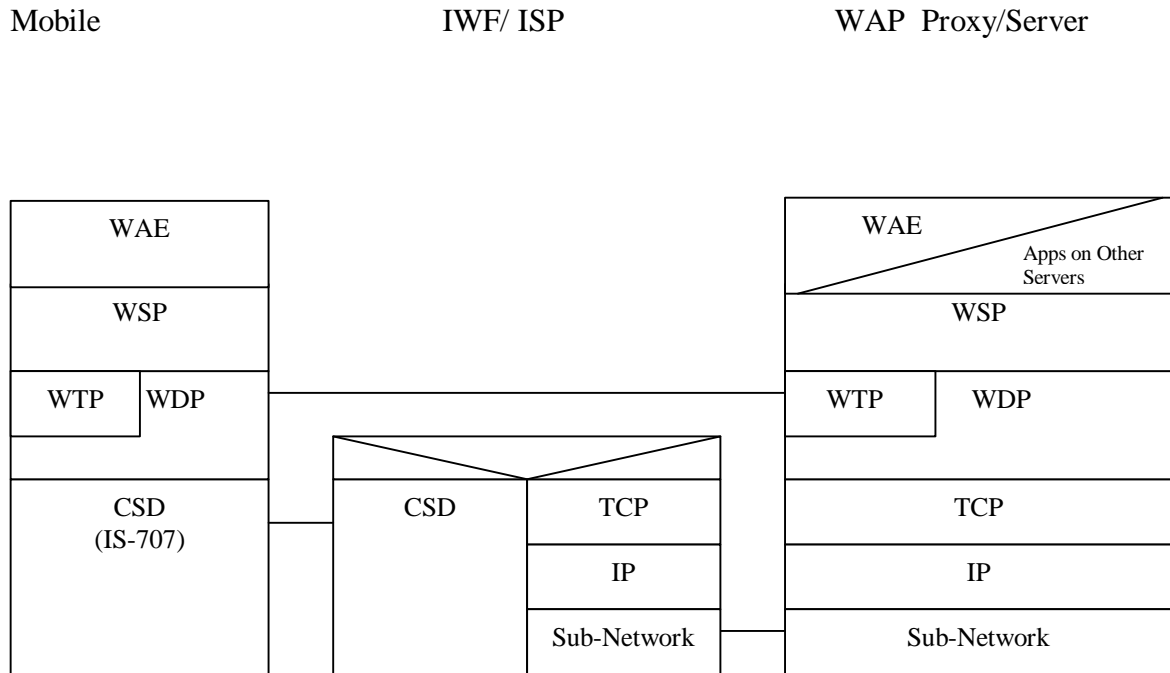
Figure 5.14:WDP over CDMA Circuit-Switched Data Channel

5.4.4.2 CDMA Packet Data Profile

To be defined by WDP CDMA Ad Hoc Group

5.4.4.3 CDMA SMS

Figure 5.15 illustrates the protocol profile for the WDP layer when operating over the IS-637 SMS bearer service. The WAP Proxy/Server is Terminal Equipment, as defined in the reference model in IS-637, section 1.4.
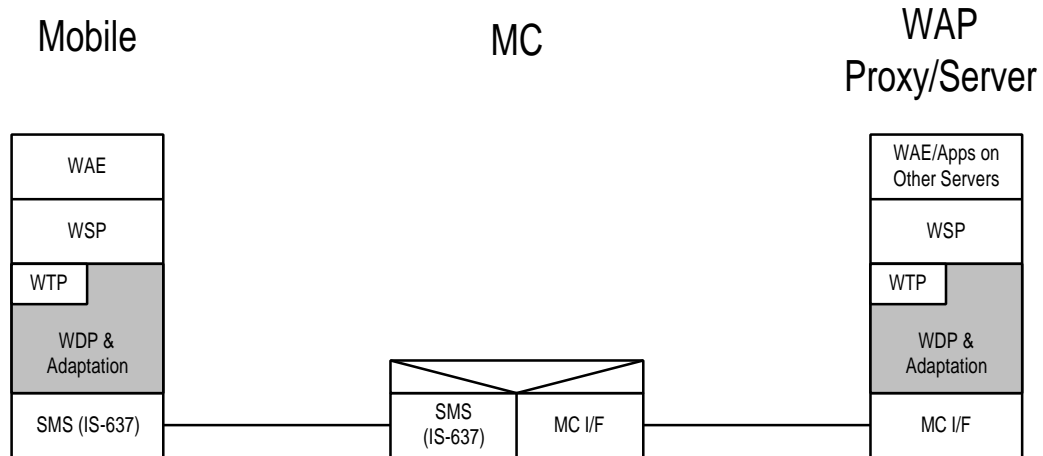
Figure 5.15

5.4.5 WDP over PDC (Japan)

PDC is a digital cellular network which air interface is defined in RCR STD-27 and network inter-node interface is defined in TTC Standards JJ-70.10. The WDP layer operates above the data capable bearer services supported by PDC. Figure 5.16 identifies the PDC bearer services presented in this specification. PDC provides Circuit Switched Data Service.

```
                  Transport Service Access Point (TSAP)


         ┌──────────────────────────────────────────────────┐
         │                                                  │
         │          1.1 Wireless Datagram                   │
         │                                                  │
         ├──────────────────────────────────────────────────┤
         │  Circuit Switched Data Adaptation                 │
         │                                                  │
         │                                                  │
         ├──────────────────────────────────────────────────┤
         │                                                  │
         │          Circuit Switched  Data Service          │
         │                                                  │
         ├──────────────────────────────────────────────────┤
         │                                                  │
         │                     PDC                          │
         │                                                  │
         └──────────────────────────────────────────────────┘
```
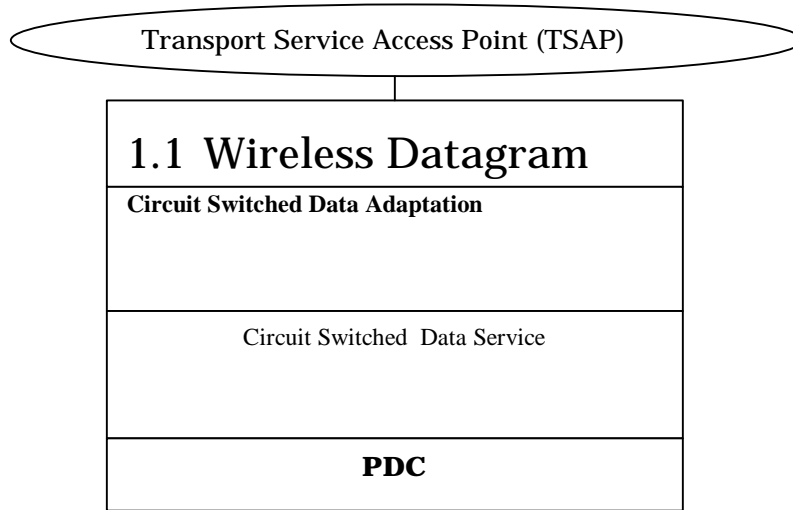
Figure 5.16 WDP over PDC Bearer Services

5.4.5.1 PDC Circuit-Switched Data

Figure 5.17 illustrates the protocol profile for the WDP layer when operating over a PDC Circuit-Switched Data connection. The MSC terminates air protocol for PDC. The Internet Service Provider (ISP) Provides Internet connectivity to the Internet network so that the mobile and the WAP Proxy/Server can address each other. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet.

```
                                                             WAP
                                                          Proxy/Server

    Mobile              BS/MSC              ISP/RAS

  ┌──────────┐                                           ┌──────────┐
  │   WAE    │                                           │   WAE    │
  ├──────────┤                                           ├──────────┤
  │   WSP    │                                           │   WSP    │
  ├────┬─────┤                                           ├────┬─────┤
  │WTP │     │                                           │WTP │     │
  │    │ UDP │                                           │    │ UDP │
  ├────┴─────┤                                           ├────┴─────┤
  │    IP    │              ┌────────────────┐           │    IP    │
  ├──────────┤              │       IP       │           ├──────────┤
  │   PPP    │              ├──────┬─────────┤           │   Sub    │
  ├──────────┤              │ PPP  │  Sub    │           │ Network  │
  │ WORM-ARQ │  ┌──────────┬──│     │ Network │           │          │
  ├──────────┤  │ WORM-ARQ │Sub  ├──────────┤           │          │
  │    L1    │  ├──────────┤Net- │  Sub     │           │          │
  └──────────┘  │    L1    │work │ Network  │           └──────────┘
                └──────────┴─────┴──────────┘
```
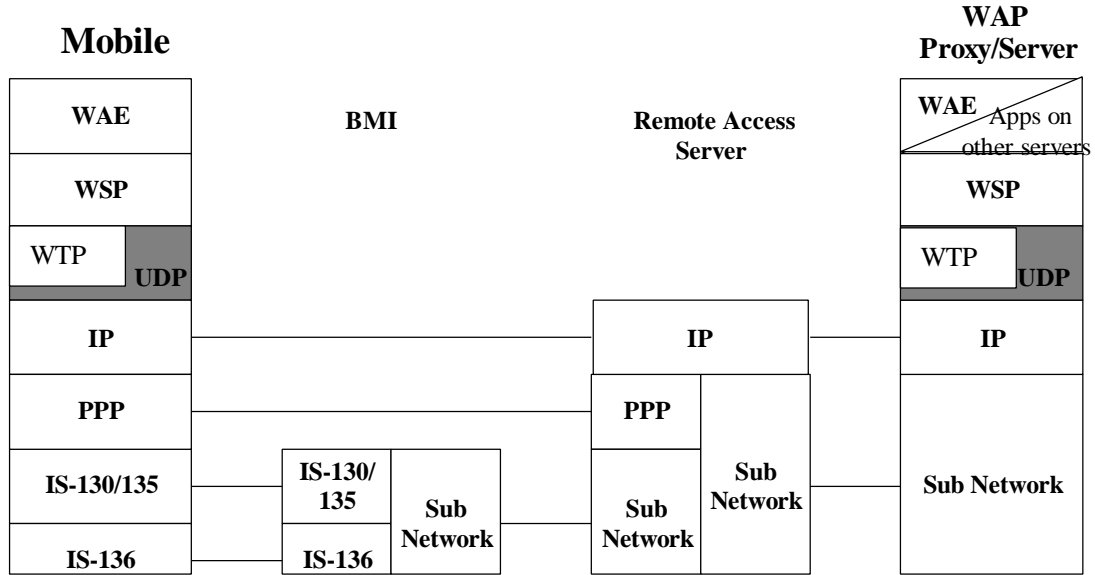
Figure 5.17: WDP over PDC Circuit-Switched Data Channel

5.4.5.2 PDC Packet Data Profile

Figure 5.18 illustrates the protocol profile for the WDP layer when operating over a PDC Packet Data bearer service. PDC Packet Data supports IP to the mobile. WTP over UDP and UDP/IP provide transaction-oriented and datagram services respectively to WTP. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet.

Figure 5.18: WDP over PDC Packet Data Channel

5.4.6 WDP Profile Over iDEN

iDEN provides three data services, Short Message Service, Circuit Switched and iDEN Packet Data.. Both the Circuit Switched and Packet Data services provide IP connectivity to the mobile device. Therefore the datagram protocol used for iDEN's data bearer services is UDP. This section provides a high level protocol architecture description of these two bearer services.

5.4.6.1 iDEN Short Message Service

The SMS service adaptation of WDP has not yet been defined.

5.4.6.2 iDEN Circuit-Switched Data

Figure 5.19 illustrates the protocol profile for the datagram layer when operating over an iDEN Circuit-Switched Data connection. The IWF provides non-transparent Circuit Switched Data services for all CSD calls within iDEN. The iDEN CSD service is very similar to the GSM CSD service. The Remote Access Server (RAS) or the Internet Service Provider (ISP) provides connectivity to the Internet network so that the mobile and WAP proxy server can address each other. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet.
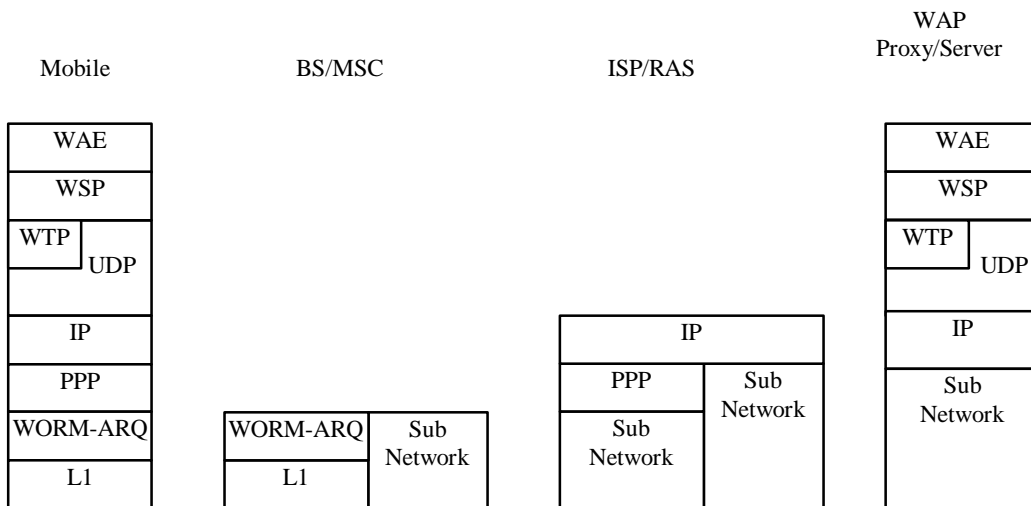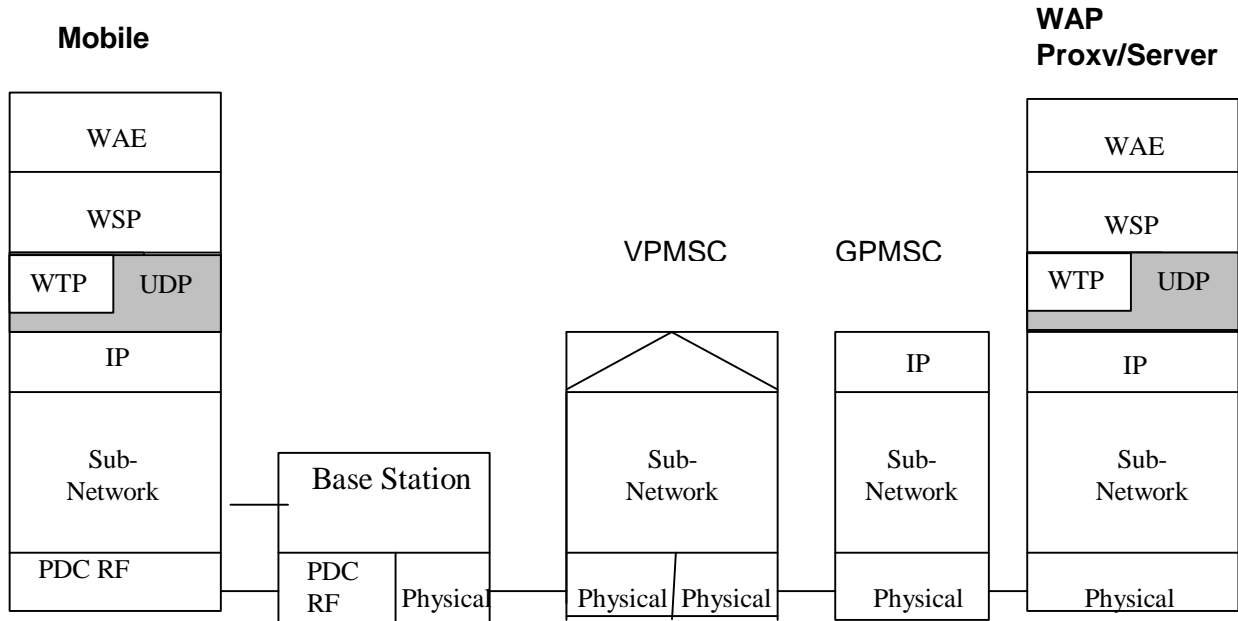

Figure 5.19: WDP over iDEN Circuit-Switched Data Channel

5.4.6.3 iDEN Packet Data

Figure 5.20 illustrates the protocol profile for the WTP layer when operating over the iDEN Packet Data bearer service. The iDEN packet data network utilises the IETF defined mobile IP tunnelling protocol to route data to the mobile device. A Home Agent router on the mobile's home network forwards datagrams to an iDEN Mobile Data Gateway. The MDG acts as a mobile IP Foreign Agent that transfers IP between the wired IP network and the wireless device via the iDEN RF protocols.
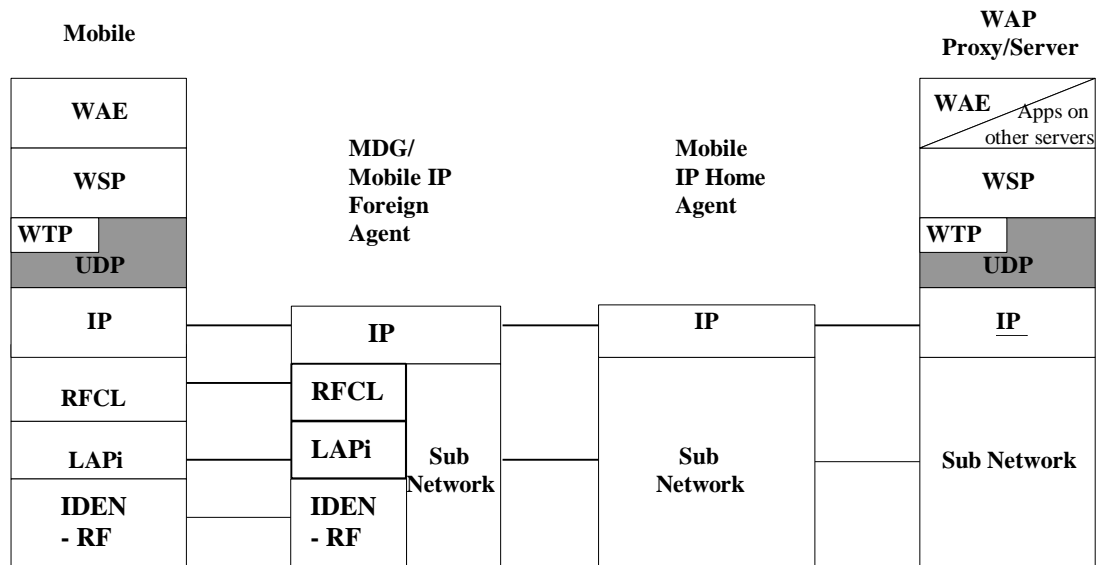
Figure 5.20 WTP over iDEN Packet Data

5.4.7 WDP over FLEX and ReFLEX

Figure 5.21 illustrates the protocol profile for the WDP layer when operating over the FLEX and ReFLEX paging protocols. The profile for FLEX and ReFLEX requires a generic messaging network protocol for connecting the WAP Proxy/Server to the FLEX or ReFLEX network. WDP packets are transferred between the mobile and the paging network through the use of the FLEX Suite of Application Enabling protocols. Optionally, the FLEX Suite protocols may be carried to the WAP Proxy/Server, depending on the desired functionality. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet or other networks.
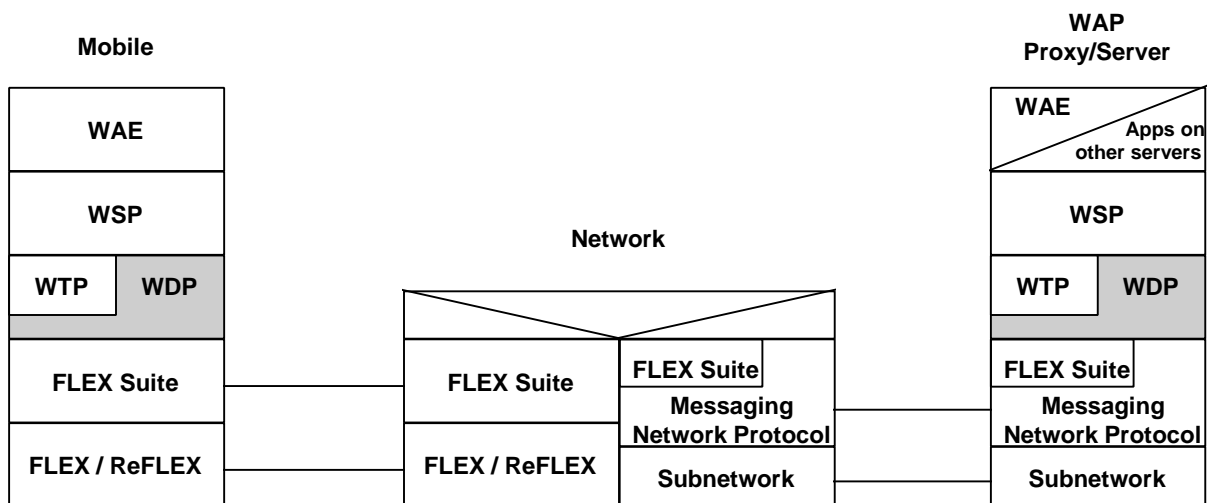
Figure 5.21: FLEX and ReFLEX Profile

5.4.8 WDP over PHS

PHS is a digital cordless network which air interface is defined in RCR STD-28 and CS – digital network interface is defined in TTC JT-Q931-b,JT-Q932-a,and JT-Q921-b.
The WDP layer operates above the data capable bearer services supported by PHS. Figure 5.22 identifies the PHS bearer services presented in this specification. PHS provides Circuit Switched Data.

Transport Service Access Point (TSAP)

Wireless Datagram Protocol

Circuit Switched Data Adaptation

Circuit Switched Data Service

PHS
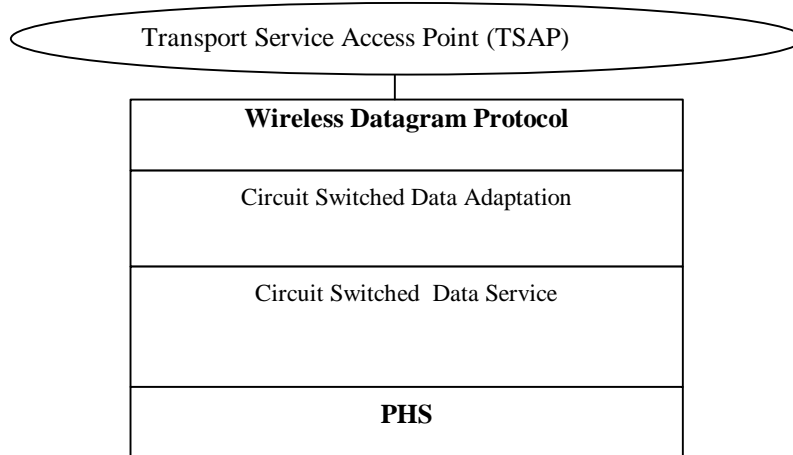
Figure 5.22 WDP over PHS Bearer Services

5.4.8.1 PHS Circuit-Switched data

Figure 5.23 illustrates the protocol profile for the WDP layer when operating over the PHS Circuit-Switched Data connection. The Internet Service Provider(ISP) Provides Internet connectivity to the Internet network so that the mobile and the WAP Proxy/Server can address each other. The WAP Proxy/Server can terminate the WAE or serve as a proxy to other applications on the Internet.
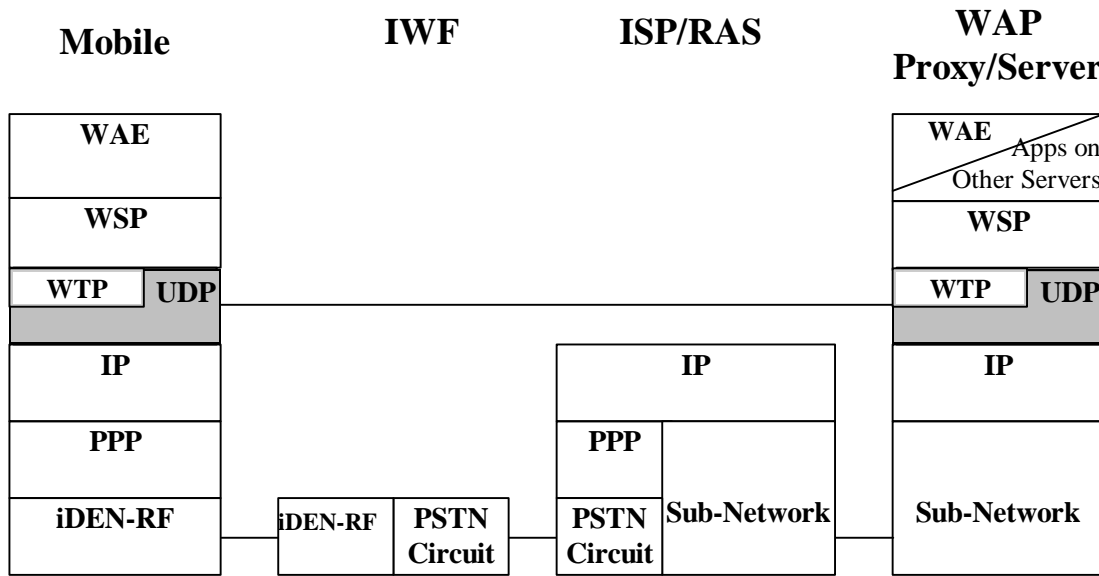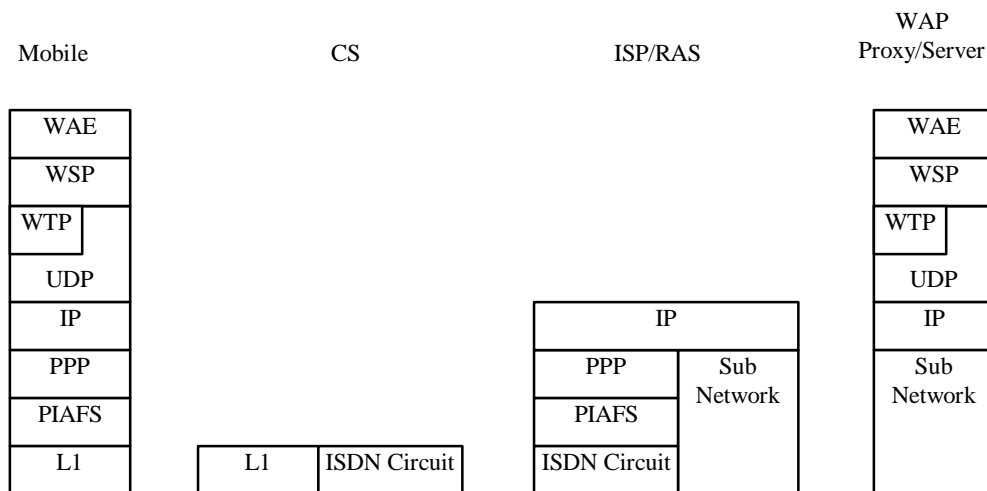
Figure 5.23 WDP over PHS Circuit-Switched Data Channel

5.4.9 WDP over DataTAC

Figure 5.24 illustrates the protocol profile for the WDP layer when operating over the DataTAC SCR bearer service.
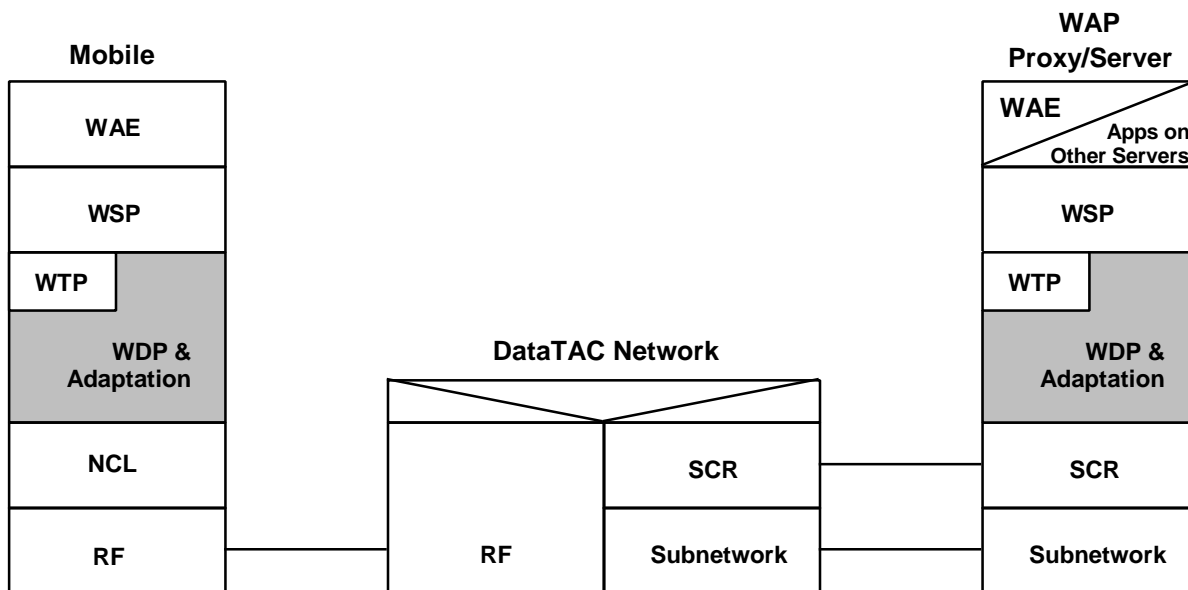
Figure 5.24: DataTAC Profile

6 Elements for layer-to-layer communication

6.1 Service Primitive Notation

Communications between layers and between entities within the transport layer are accomplished by means of service primitives. Service primitives represent, in an abstract way, the logical exchange of information and control between the transport layer and adjacent layers. They do not specify or constrain implementations.

Service primitives consist of commands and their respective responses associated with the services requested of another layer. The general syntax of a primitive is:

> X - Generic name . Type (Parameters)

where X designates the layer providing the service. For this specification X is:

> "T" for the Transport Layer.

An example of a service primitive for the WDP layer would be T-DUnitdata Request .

Service primitives are not the same as an application programming interface (API) and are not meant to imply any specific method of implementing an API. Service primitives are an abstract means of illustrating the services provided by the protocol layer to the layer above. The mapping of these concepts to a real API and the semantics associated with a real API are an implementation issue and are beyond the scope of this specification.

6.2 Service Primitives Types

The primitives types defined in this specification are:

6.2.1 Request (.Req)

The Request primitive type is used when a higher layer is requesting a service from the next lower layer.

6.2.2 Indication (.Ind)

The Indication primitive type is used by a layer providing a service to notify the next higher layer of activities related to the Request primitive type of the peer.

6.2.3 Response (.Res)

The Response primitive type is used by a layer to acknowledge receipt, from the next lower layer, of the Indication primitive type.

6.2.4 Confirm (.Cnf)

The Confirm primitive type is used by the layer providing the requested service to confirm that the activity has been completed (successfully or unsuccessfully).

6.3 WDP Service Primitives

6.3.1 General

The following notation is used in the description of the service primitives:

Abbreviation	Meaning
M	Presence of the parameter is mandatory
C	Presence of the parameter is conditional
O	Presence of the parameter is a user option
*	Presence of the parameter is determined by the lower layer protocol
blank	The parameter is absent
(=)	The value of the parameter is identical to the value of the corresponding parameter of the preceding primitive

The WDP protocol uses a single service primitive T-DUnitdata. WDP may also receive a T-DError primitive if the requested transmission cannot be executed by the WDP protocol layer.

6.3.1.1 T-DUnitdata

T-DUnitdata is the primitive used to transmit data as a datagram. T-DUnitdata does not require an existing connection to be established. A T-DUnitdata.Req can be sent to the WDP layer at any time.

Primitive	T-DUnitdata			
Parameter	*REQ*	*IND*	*RES*	*CNF*
Source Address	M	M(=)		
Source Port	M	M(=)		
Destination Address	M	O(=)		
Destination Port	M	O(=)		
User Data	M	M(=)		

Destination Address

> The destination address of the user data submitted to the WDP layer. The destination address may be an MSISDN number, IP address, X.25 address or other identifier.

Destination Port

> The application address associated with the destination address for the requested communication instance.

Source Address

> The source address is the unique address of the device making a request to the WDP layer. The source address may be an MSISDN number, IP address, X.25 address or other identifier.

Source Port

> The application address associated with the source address of the requesting communication instance.

User Data

> The user data carried by the WDP protocol. The unit of data submitted to or received from the WDP layer is also referred to as the Service Data Unit. This is the complete unit (message, packet, package) of data which the higher layer has submitted to the WDP layer for transmission. The WDP layer will transmit the Service Data Unit and deliver it to its destination without any manipulation of its content.

6.3.1.2 T-DError

The T-DError primitive is used to provide information to the higher layer when an error occurs which may impact the requested service. A T-DError Indication may be issued by the WDP layer only after the higher layer has made a request to the WDP layer, such as by issuing a T-DUnitdata Request. The T-DError primitive is used when the WDP layer is unable to complete the requested service due to a local problem. It is not used to inform the upper layer of networking errors external to the device/server.

An example would be if the upper layer issues a D-Unitdata Request containing an SDU which is larger than the maximum size SDU allowed by the specific WDP implementation. In this case a T-DError Indication would be returned to the upper layer with an error code indicating the SDU size is too large.

Primitive	T-Error			
Parameter	*REQ*	*IND*	*RES*	*CNF*
Source Address		O		
Source Port		O		
Destination Address		O		
Destination Port		O		
Error Code		M		

Error Code

> An error return code carried by the D-Error primitive to the higher layer. The error codes are of local significance only.

7 WDP Protocol Description

7.1 Introduction

In order to implement the WDP datagram protocol the following fields are necessary:

- Destination Port
- Source Port
- If the underlying bearer does not provide Segmentation and Reassembly the feature is implemented by the WDP provider in a bearer dependent way.

7.2 Mapping of WDP for IP

The User Datagram Protocol (UDP) is adopted as the WDP protocol definition for any wireless bearer network where IP is used as a routing protocol. UDP provides port based addressing and IP provides the segmentation and reassembly in a connectionless datagram service. There is no value in defining a new datagram protocol to operate over IP when the ubiquitous User Datagram Protocol (UDP) will provide the same mechanisms and functions, and is already very widely implemented. Therefore in all cases where the IP protocol is available over a bearer service the WDP Datagram service offered for that bearer will be UDP. UDP is fully specified in RFC 768 while the IP networking layer is defined in RFC 791.

7.3 Mapping of WDP for GSM SMS and USSD

WDP bearers in the Global System for Mobile Communications (GSM) include GSM Short Message Service (GSM SMS) and GSM Unstructured Supplementary Service Data (GSM USSD).

WDP for GSM supports mandatory binary and optional text based headers. GSM USSD Phase 2 supports binary headers, GSM SMS Phase 2 supports both binary and text based headers and GSM SMS Phase 1 supports text based headers.

Each packet (segment) used in the WDP protocol are identified by a User Data Header Information Element Identifier defining a port number structure located in the header of the packet. This Information Element Identifier for GSM SMS or USSD has a similar function to the Protocol Identifier in a IP based network. The construct enables the WDP protocol to coexist with other features of the legacy bearer network.

7.3.1 Header Formats

7.3.1.1 Binary Header Format

For GSM SMS and GSM USSD the WDP headers structure is defined using the User Data Header (UDH) framework as defined in GSM 03.40: See Appendix A for more information.

7.3.2 Segmentation and Reassembly

The WDP segmentation is implemented as specified in GSM 03.40

Two segmentation formats, the short format and the long format have been defined. The difference between the two formats is only the range of the Datagram Reference Number. A format with only 8 bits for reference number is good enough for mobile originated communication, but in high volume applications originated at a fixed server the reference number wraps around very quickly. The larger reference number range significantly lessens the risk of overlapping reference numbers, and thus incorrect reassembly.

Mobile stations may use the 8 bit or 16 bit reference number header for sending messages, but fixed devices MUST use the 16 bit reference number, unless it is known to the device that the receiver supports only 8 bit reference numbers (this distinction is an implementation matter for each fixed device manufacturer). Each implementation of the WDP MUST support reception of both 8 and 16 bit reference numbers, but a mobile implementation can be restricted to sending capability of only 8 bit reference numbers.

7.3.2.1 Fragmentation Information Element (short)

The Fragmentation Information-Element (short) -Identifier is defined in GSM 03.40, where it is referred to as Concatenated short messages, 8-bit reference number. The Short Information-Element –Identifier is an octet with the hex value 00.

7.3.2.2 Fragmentation Information Element (long)

The Fragmentation Information-Element (long) –Identifier is defined in GSM 03.40, where it is referred to as Concatenated short messages, 16-bit datagram reference number. The Long Fragmentation Information-Element - Identifier is an octet with the hex value 08.

The Long Information-Element-Data octets shall be coded as shown in Figure 7.1.

Octet 1-2	Datagram reference number	Octet 1 contains the high part of the reference number and octet 2 the low part. This octet shall contain a modulo 0xFFFF counter indicating the reference number for a particular datagram. This reference number shall remain constant for every segment which makes up a particular datagram.
Octet 3	Maximum number of segments in the datagram.	This octet shall contain a value in the range 1 to 255 indicating the total number of segments within the datagram. The value shall remain constant for every segment which makes up the datagram. If the value is zero then the receiving entity shall ignore the whole Information Element.
Octet 4	Sequence number of the current segment	This octet shall contain a value in the range 1 to 255 indicating the sequence number of a particular segment within the datagram. The value shall start at 1 and increment by one for every segment sent within the datagram. If the value is zero or the value is greater than the value in octet 3 then the receiving entity shall ignore the whole Information Element.

Figure 7.1 : Segmentation and Reassembly Information Element using 16 bit reference number

An Information Element (IE) identifier is to be applied and obtained from ETSI.

7.3.2.3 Port address Information Element

The Information-Element-Identifier is defined in GSM 03.40.

7.3.3 Mapping of WDP to GSM SMS Phase 1 Text based headers

The text based headers are designed as an optional method for environments that support only reduced character sets, and for example not 8 bit binary headers. This is the case for GSM phase 1 SMS, but can also be used as a generic mechanism in similar environments.

No protocol indication at a higher level is needed to indicate the presence of protocol information in the data part of the message. The first characters "//SCK" identify the WDP datagram addressing scheme to the receiving device. The header can be presented in various lengths, from 2 bytes (only destination port) to 15 bytes (containing full WDP information), in addition to the 5 bytes of "//SCK".

<WDP -text-socket-header> ::=
<WDP-keyword> <WDP-port-information> [*<WDP-other-header>*] *<WDP delimiter>*

<WDP-delimiter> ::= <space>

<WDP-keyword> ::= "//**SCK**"

<WDP-port-information> ::=
<WDP-short-destination-address> |
<WDP-short-destination-address> <WDP-short-source-address> |
<WDP-short-destination-address> <WDP-short-source-address> <WDP-SAR- information> |
"**L**" *<WDP-long-destination-address>* |
"**L**" *<WDP-long-destination-address> <WDP-long-source-address>* |
"**L**" *<WDP-long-destination-address> <WDP-long-source-address> <WDP-SAR-information>*

<WDP-other-header> ::= *<header-expansions-starting-with-// >*

<WDP-short-destination-address> ::= *<common-hex-digit> <common-hex-digit>*

; Destination WDP port in ASCII coded hexadecimal [00..FF, or 00..FFFF]. When the truncated port presentation is used (only destination port), then the source port of the message is defaulted to be the same as the destination port.'

<WDP-short-source-address> ::= *<common-hex-digit> <common-hex-digit>*
; Source WDP port in ASCII coded hexadecimal [00..FF], i.e., decimal [0..255].'

<WDP-long-destination-address> ::=
<common-hex-digit> <common-hex-digit> <common-hex-digit> <common-hex-digit>
; Destination WDP port in ASCII coded hexadecimal [0000..FFFF] , i.e., decimal [0..65535].'

<WDP-long-source-address> ::=
<common-hex-digit> <common-hex-digit> <common-hex-digit> <common-hex-digit>
; Source WDP port in ASCII coded hexadecimal [0000..FFFF] , i.e., decimal [0..65535].

<WDP-SAR-information> ::=
<WDP-SAR-reference> <WDP-SAR-total-segments> <WDP-SAR-current- segment>

<WDP-SAR-reference> ::= *<common-hex-digit> <common-hex-digit>*
; Concatenated message reference number in ASCII coded hexadecimal [00..FF], i.e., decimal [0..255].'

<WDP-SAR-total-segments> ::= *<common-hex-digit> <common-hex-digit>*

; 'Concatenated message total *segment* count in ASCII coded hexadecimal [01..FF], i.e., decimal [1..255].'

<*WDP-SAR-current-segment*> ::= <*common-hex-digit*> <*common-hex-digit*>

; 'Concatenated message segment index in ASCII coded hexadecimal [01..FF], i.e., decimal [1..255].'

Figure 7.2 : Definition of WDP headers in text format

0	1	2	3	4	5	6	7
"/"							
"/"							
"S"							
"C"							
"K"							
"L"							
Destination port MSB (High hex)							
Destination port MSB (Low hex)							
Destination port LSB (High hex)							
Destination port LSB (Low hex)							
Originator Port MSB (High hex)							
Originator Port MSB (Low hex)							
Originator Port LSB (High hex)							
Originator Port LSB (Low hex)							
Reference number (High hex)							
Reference number (Low hex)							
Total number of *segment*s (High hex)							
Total number of *segment*s (Low hex)							
Segment count (High hex)							
Segment count (Low hex)							
<space>							
1 - n 7-bit characters of User Data							

Figure 7.3: Example of a WDP header for compatibility with legacy GSM networks

The text based header is always terminated with a space (" ") character. This allows for future enhancements to the protocol.

Devices not supporting the concatenation should <u>not</u> put dummy values into the header, as they can be misinterpreted and consume valuable bandwidth. Instead they shall truncate the header and omit the Segmentation and Reassembly part of the header

7.3.4 Mapping of WDP to GSM USSD

GSM USSD adaptation layer is specified in WAP WDP Implementation Companion document, see [WAPGSMUD].

7.4 Mapping of WDP for IS-136 GUTS/R-Data

IS-136 GUTS is used to support UDP datagrams on IS-136 R-Data. GUTS adds a one octet protocol discriminator and message type to the UDP header. Port address information is assumed to be carried within the UDP header. Segmentation and reassembly can be optionally provided by the IS-136 Simplified Segmentation and Reassembly (SSAR) layer between GUTS and R-Data. IP address and routing information is specified within the R-Data layer when using GUTS.

7.5 Mapping of WDP to CDPD

To be defined.

7.6 Mapping of WDP to CDMA

WDP sends datagrams in the User Data subparameter of IS-637 SMS point-to-point messages. A datagram consists of a four byte header followed by the data.

Because some datagrams may be too long to fit in one SMS message, a datagram can be segmented, sent in several SMS messages, and reassembled at the destination. IS-637 does not define segmentation and reassembly procedures, so they are defined in this document.

SMS messages containing WDP datagrams use the WAP teleservice, which will be defined in an upcoming version of IS-637.

7.6.1 **Datagram Structure**

A WDP datagram containing N bytes of data sent over IS-637 SMS has the following structure:

Field	Length (bits)
SOURCE_PORT	16
DESTINATION_PORT	16
DATA	N * 8

7.6.2 **SMS User Data**

The CHARi fields of the User Data subparameter in a WDP SMS message contain one segment of a WDP datagram. The structure of the CHARi fields is as follows:

Field	Length (bits)
MSG_TYPE	8
TOTAL_SEGMENTS	8
SEGMENT_NUMBER	8
DATAGRAM	(NUM_FIELDS – 3) * 8

MSG_TYPE   Message Type

This field shall be set to '00000000', to indicate that this is a WDP message. This field distinguishes WDP messages from other WAP messages such as WCMP messages.

TOTAL_SEGMENTS   Total Number of Segments

The WDP end point issuing this SMS message shall set this field to the total number of segments that make up the datagram being delivered. This field shall not be set to '00000000'.

SEGMENT_NUMBER   Segment Number

The WDP end point issuing this SMS message shall set this field to the segment number for this segment of the datagram. In the first segment of a datagram this field shall be set to '00000000'. In each subsequent segment, SEGMENT_NUMBER shall increase by 1.

DATAGRAM   Datagram bytes

The WDP end point issuing this SMS message shall fill this field with the datagram bytes in this segment of the datagram. The NUM_FIELDS field of the User Data subparameter shall be set to the number of datagram bytes in the segment plus 3. If SEGMENT_NUMBER is not '00000000', the number of datagram bytes in this segment of the message shall not be greater than the number of bytes in the preceding segment.

7.6.3 **IS-637 MESSAGE_ID Field**

When sending a WDP datagram in an IS-637 SMS message, the WDP endpoint MUST set the MESSAGE_ID field of the Message Identifier subparameter as follows:
- If this SMS message contains the first segment of the first WDP datagram sent after powering up, the endpoint MUST set MESSAGE_ID equal to a random number in the range 0 through 65535.
- Otherwise, if this SMS message contains the first segment of a WDP datagram, the endpoint MUST increment the MESSAGE_ID value from the last WDP datagram sent, modulo 65536, to generate the MESSAGE_ID field for the SMS message.
- If the SMS message does not contain the first segment of a WDP datagram, the endpoint MUST set the MESSAGE_ID field equal to the MESSAGE_ID field from the SMS message containing the first segment of the WDP datagram.

7.6.4 **Segmentation and Reassembly**

Segmentation and reassembly of a datagram use five parameters in a WAP SMS message: the Originating Address parameter from the SMS Transport Layer, MESSAGE_ID from the SMS Message Identifier subparameter, MSG_TYPE, TOTAL_SEGMENTS, and SEGMENT_NUMBER.

MSG_TYPE identifies WAP messages containing WDP datagrams. The Originating Address and MESSAGE_ID together identify a datagram. TOTAL_SEGMENTS and SEGMENT_NUMBER are used to verify that a complete datagram has been received and is ready to be passed to a higher layer.

7.6.5 **Segmentation Example**

Figure 7.4 shows an example of a WDP Datagram that is sent in two IS-637 SMS Point-to-Point messages. The datagram has been broken into two segments, which are contained in the CHARi fields in the User Data subparameters of the messages (only the second SMS message is shown).
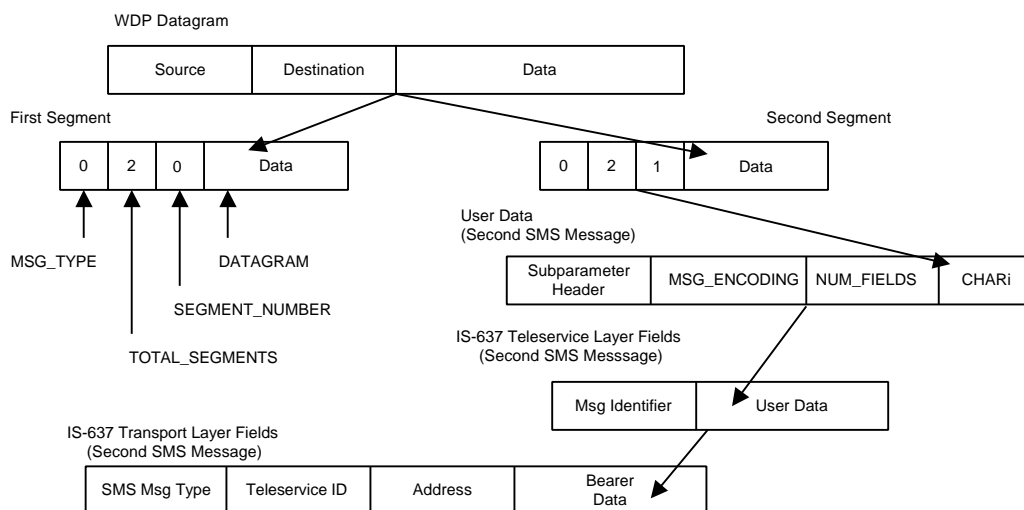
Figure 7.4

7.7 Mapping of WDP to PDC

To be defined.

7.8 Mapping of WDP to iDEN

To be defined.

7.9 Mapping of WDP to FLEX and ReFLEX

To be defined.

7.10 Mapping of WDP to DataTAC

The generic WDP header format for DataTAC uses bit fields within octets. The bit fields are numbered from left to right with zero as the high order bit. The generic WDP header format for DataTAC is shown both graphically and in the table below:

Octet(s)	Field name	Field description	Comments
	Bearer Header(s)	Any headers required by the Bearer Protocols	In a DataTAC system these include: Application, Native Command Language, DataTAC Messaging, RF and Standard Context Routing
1	Format and Version	Identifies the adaptation layer protocol format and version	A single octet binary field containing two bit fields The first field uses bits 0 through 3 to define the format. The second field uses bits 4 through 7 to define the version.
	Format Dependent Content	An optional content that carries WDP information that is not available in the standard bearer protocol headers.	A variable length field dependent on the Format and Version octet.
	Data	Contains the User Data	User specified text or binary information

The WDP header with the Format bits set to binary 0000 and the Version bits set to binary 0000 is shown both graphically and in the table below:

Octet(s)	Field name	Field description	Comments
	Bearer Header(s)	Any headers required by the Bearer Protocols	In a DataTAC system these include: RF, Application, Standard Context Routing, DataTAC Messaging
1	Format and Version	Identifies the adaptation layer protocol format and version	Set bits to 0000 0000 (0x00)
2 - ~	Data	Contains the User Data	User specified text or binary information. The adaptation layer will log the received data.

NOTES:

1. Format: 0000, Version: 0000 is reserved. The adaptation layer should log any received data and then discard the packet.
2. There is no Format Dependent Content.

The WDP header with the Format bits set to binary 0001 and the Version bits set to binary 0000 is shown both graphically and in the table below:

Octet(s)	Field name	Field description	Comments
	Bearer Header(s)	Any headers required by the Bearer Protocols	In a DataTAC system these include: RF, Application, Standard Context Routing, DataTAC Messaging
1	Format and Version	Identifies the adaptation layer protocol format and version	Set bits to 0001 0000 (0x10)
2	Source Format	Identifies the source address and port	A single-octet binary field containing two bit fields. The Source Address Format field uses bits 0 through 3 as follows: 　　0000 = Extended 　　0001 = IPv4 　　0010 = IPv6 　　0011 = X.121 　　0100 = DataTAC LLI-4 　　0101 = DataTAC LLI-7 　　1111 = From Bearer Header(s) The Source Port Format field uses the remaining four bits as follows: 　　0000 = Extended-1 　　0001 = Extended-2 　　0010-1100 = Table Lookup 　　1111=From Bearer Header(s)
3	Destination Format	Identifies the destination address and port	The bit field definitions for Destination Address Format and

		Destination Port Format match those in the Source Format field (Octet 2)

Optional Source Address	Identifies, if required, an optional source address	An optional, variable-length field dependent on the Source Address Format (Octet 2) field values:
		  0000=An Address Type octet followed by the address.
		  0001 = An IPv4 address
		  0010 = An IPv6 address
		  0011 = An X.121 address
		  0100 = A 4-octet DataTAC LLI
		  0101 = A 7-octet DataTAC LLI
		  0110-1111 = Field not included

Optional Destination Address	Identifies, if required, an optional destination address	Refer to Optional Source Address; dependent on the Destination Address Format (Octet 3) field values

Optional Source Port	Identifies, if required, an optional source port	An optional variable-length field dependent on the Source Port Format (Octet 2) field values:
		  0000 = A one octet binary port
		  0001 = A two octet binary port
		  0010-1111 = Field not included

Optional Destination Port	Identifies, if required, an optional destination port	Refer to Optional Source Port; dependent on the Destination Port Format (Octet 3) values
Data	Contains the User Data	User-specified text or binary information

NOTES:

1. Format: 0001 Version: 0000 does not provide packet segmentation (i.e. this is a single-segment packet as far as WDP is concerned).
2. If a table lookup port is specified the adaptation layer will access a local table to determine the actual port. This mechanism can be used, for example, to store the WAP port numbers

The WDP header bit fields, with the Format bits set to binary 0001 and the Version bits set to binary 0000, are shown graphically below:

msb   lsb

8	7	6	5	4	3	2	1
0	0	0	1	0	0	0	0

8	7	6	5	4	3	2	1
Source Address Format				**Source Port Format**			

8	7	6	5	4	3	2	1
Destination Address Format				**Destination Port Format**			

8	7	6	5	4	3	2	1

Source Address

8	7	6	5	4	3	2	1

8	7	6	5	4	3	2	1

Destination Address

8	7	6	5	4	3	2	1

8	7	6	5	4	3	2	1

Source Port

8					3		

8	7	6	5	4	3	2	1

Destination Port

8					3		

The WDP header with the Format bits set to binary 0010 and the Version bits set to binary 0000 is shown both graphically and in the table below:

Octet(s)	Field name	Field description	Comments
	Bearer Header(s)	Any headers required by the Bearer Protocols	In a DataTAC system these include: RF, Application, Standard Context Routing, DataTAC Messaging
1	Format and Version	Identifies the adaptation layer protocol format and version	Set bits to 0010 0000 (0x20)
2	Source Format	Identifies the source address and port	Refer to Format:0001, Version: 0000, Octet 2
3	Destination Format	Identifies the destination address and port	Refer to Format:0001, Version: 0000, Octet 3
4	Segment Format	Identifies the format used for packet segmentation	A single-octet binary field containing three bit fields. The More Bit field uses bit 0 as follows: 0 = no more segments to come 1 = more segments to come The Packet Segment Number field uses bits 1 through 3 as follows: 000 = Extended 001-111 = Segment numbers 1 through 7

		The Packet Number field uses the remaining four bits as follows:
		  0000 = Reserved
		  0001-1111 = Packet numbers 1 through 15

Optional Segment Number	Identifies, if required, an optional packet segment number	An optional two-octet field dependent on the Packet Segment Number field values of the Segment Format (Octet 4):
		  000 = A two-octet binary packet segment number
		  001-111 = Field not included

Optional Source Address	Identifies, if required, an optional source address	Refer to Format:0001 Version: 0000
Optional Destination Address	Identifies, if required, an optional destination address	Refer to Format:0001 Version: 0000
Optional Source Port	Identifies, if required, an optional source port	Refer to Format:0001 Version: 0000
Optional Destination Port	Identifies, if required, an optional destination port	Refer to Format:0001 Version: 0000
Data	Contains the User Data	User specified text or binary information

NOTES:

If a table lookup port is specified the adaptation layer will access a local table to determine the actual port. This mechanism can be used, for example, to store the WAP port numbers.

The WDP header fields with the Format bits set to binary 0010 and the Version bits set to binary 0000 are shown graphically below:

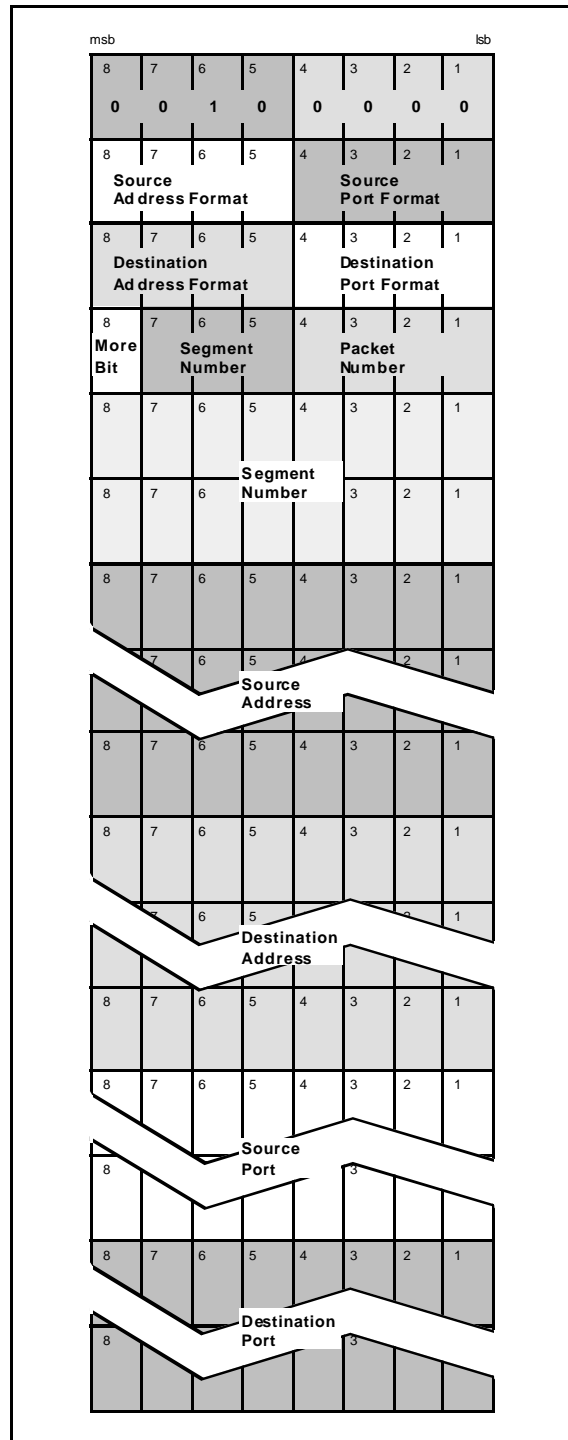| msb							lsb
8	7	6	5	4	3	2	1
0	**0**	**1**	**0**	**0**	**0**	**0**	**0**

8	7	6	5	4	3	2	1
Source Address Format				Source Port Format			

8	7	6	5	4	3	2	1
Destination Address Format				Destination Port Format			

8	7	6	5	4	3	2	1
More Bit	Segment Number			Packet Number			

8	7	6	5	4	3	2	1
			Segment Number				

8	7	6	5	4	3	2	1

Source Address

8	7	6	5	4	3	2	1

Destination Address

8	7	6	5	4	3	2	1

Source Port

8	7	6	5	4	3	2	1

Destination Port

An example of the WDP header with Format bits set to binary 0010 and the Version bits set to 0000 is shown below. This example is provided simply to demonstrate how some of the extensible fields may be used and is not intended to represent any specific implementation of WAP over DataTAC.

In this example, an extended source address type is used with a two-byte source port. The destination address is a 4-byte DataTAC LLI and the destination port is obtained from a table-lookup algorithm to be defined within the WDP adaptation layer. An extended segment numbering scheme is used with a two-byte segment number.

msb							lsb
8	7	6	5	4	3	2	1
0	**0**	**1**	**0**	**0**	**0**	**0**	**0**
8	7	6	5	4	3	2	1
0	**0**	**0**	**0**	**0**	**0**	**0**	**1**
8	7	6	5	4	3	2	1
0	**1**	**0**	**0**	**0**	**0**	**1**	**0**

More Bit — **0 0 0** — **Packet Number**

Segment Number

Source Address Type

Source Address

Destination Address is a 4-Octet DataTAC Logical Link Identifier (LLI)

Source Port
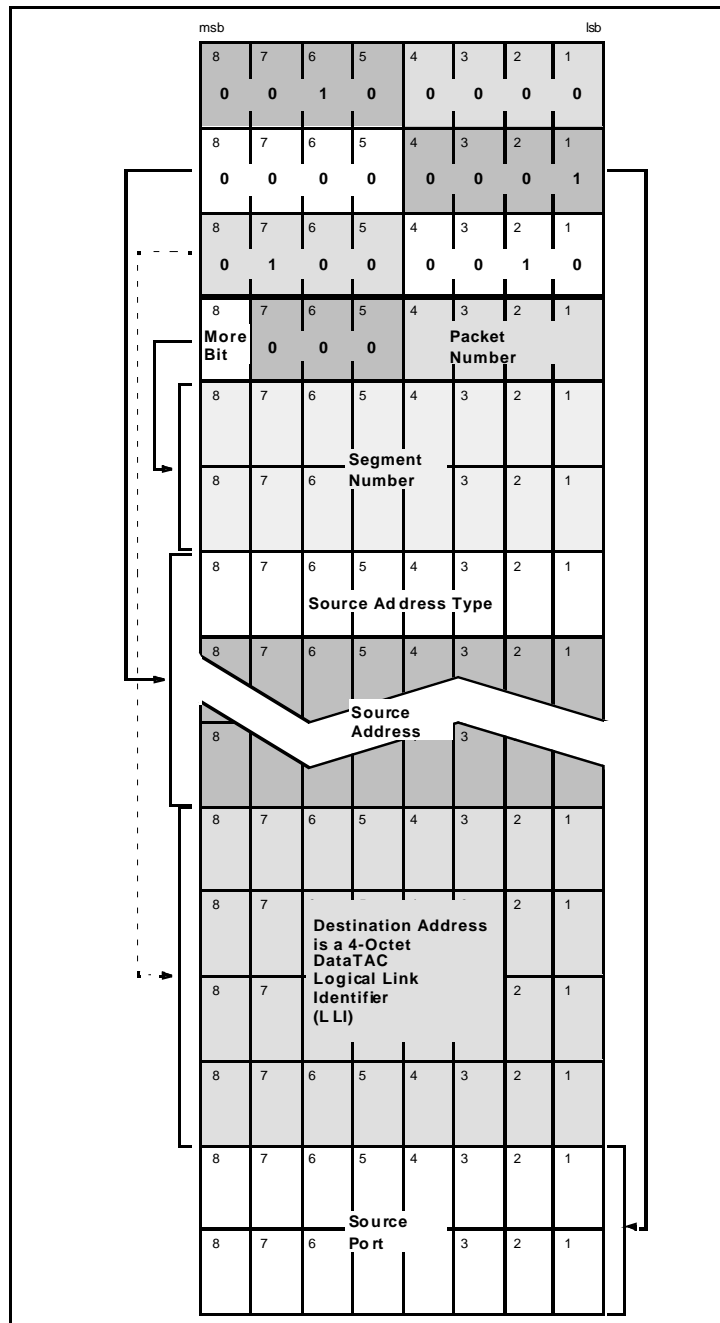
The WDP header with the Format bits set to binary 0100 and the Version bits set to binary 0000 is shown both graphically and in the table below:
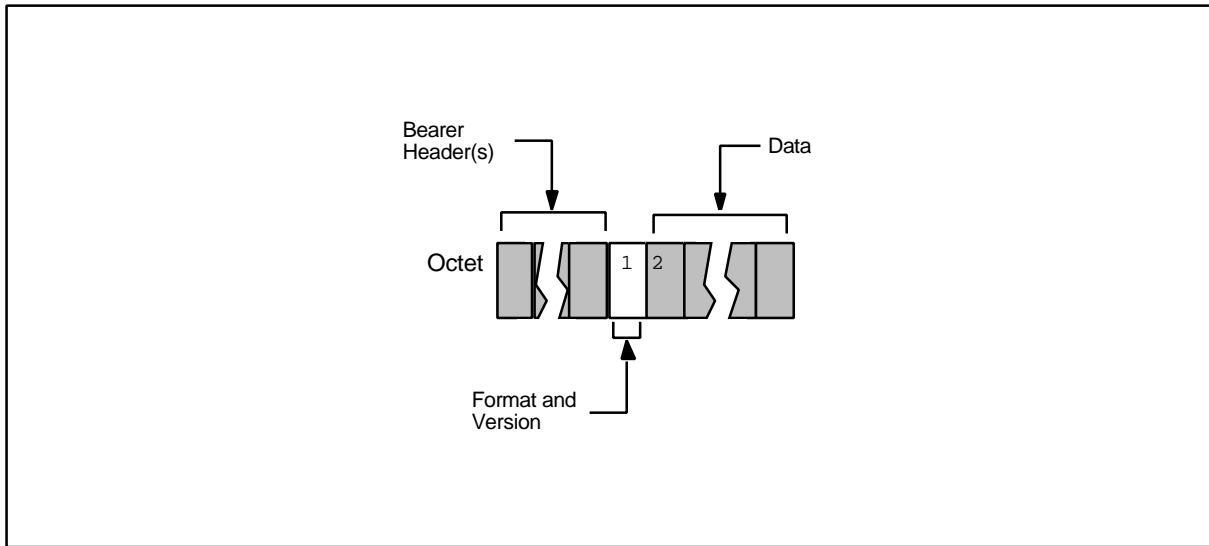
Octet(s)	Field name	Field description	Comments
	Bearer Header(s)	Any headers required by the Bearer Protocols	In a DataTAC system these include: RF, Application, Standard Context Routing, DataTAC Messaging
1	Format and Version	Identifies the adaptation layer protocol format and version	Set bits to 0100 0000 (0x40)
2 - ~	Data	Contains the User Data	User specified text or binary information

NOTES:

1. There is no Format Dependent Content
2. This format may be used to intercept DataTAC '@nn' infrastructure signals. Applications that use the '@nn' format are also supported provided a minimal adaptation layer exists and the port and address mappings are static.

The WDP header with the Format bits set to binary 1111 and the Version bits set to binary 0000 is shown both graphically and in the table below:
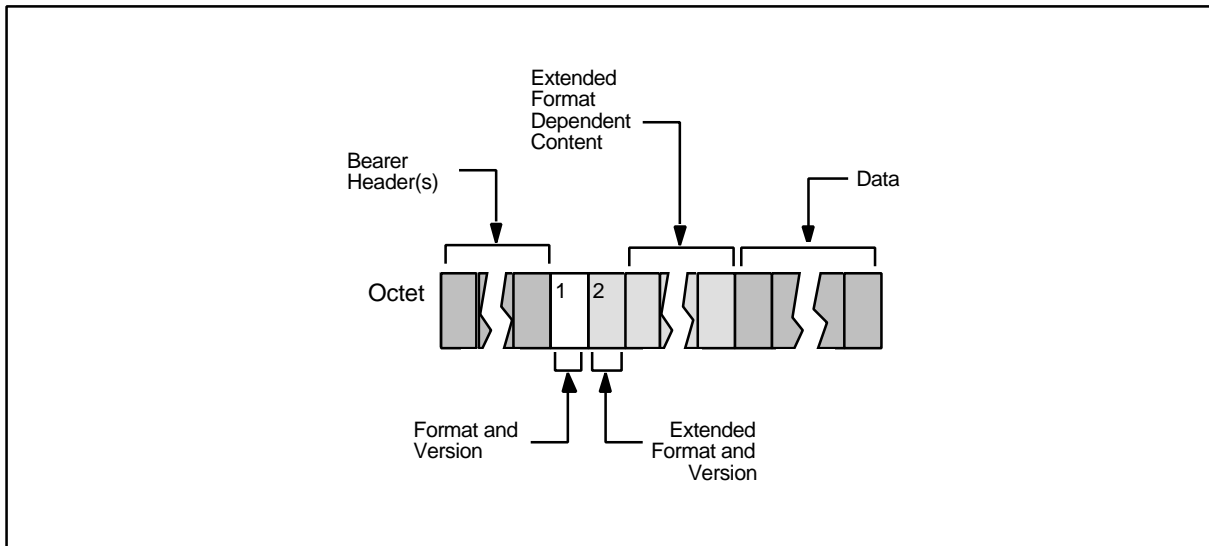

Octet(s)	Field name	Field description	Comments
	Bearer Header(s)	Any headers required by the Bearer Protocols	In a DataTAC system these include: Application, Native Command Language, DataTAC Messaging, RF and Standard Context Routing
1	Format and Version	Identifies the adaptation layer protocol format and version	Set bits to 1111 0000 (0xF0). This format indicates that an Extended Format and Version field is present.
2	Extended Format and Version	Identifies the adaptation layer protocol extended format and version	A single-octet binary field containing two bit fields. The Extended Format field uses bits 0 through 3 The Extended Version field uses the remaining four bits
	Extended Format Dependent Content	An optional content that carries WDP information that is not available in the standard bearer protocol headers.	A variable-length field dependent on the Extended Format and Version octet.
	Data	Contains the User Data	User specified text or binary information

The WDP header fields with the Format bits set to binary 1111 and the Version bits set to binary 0000 are shown graphically below:

7.11 Mapping of WDP to GSM Cell Broadcast

7.11.1.1   Binary Header Format

WDP over GSM Cell Broadcast uses the binary User Data Header (UDH) framework as defined in [GSM0340] to provide port level addressing. A WDP entity receiving a CBS message in which the data encoding is set to 8-bit data must assume the existence of a User Data Header in the message.

7.11.1.2   Source and Destination Port Addressing

WDP over GSM Cell Broadcast uses the 8 or 16 bit address application port addressing scheme as defined in [GSM0340] to provide port level addressing.

7.11.1.3   Segmentation and Reassembly

The GSM CBS message comprises of 82 octets of user data. Concatentation of up to 15 CBS messages, where supported in the GSM network, is handled via the GSM macro-message as described in [GSM0341].

The Concatenated short messages (0x00) and (currently proposed) Enhanced Concatenated short messages (0x08) Information Element Identifiers should not be used for WAP formatted messages over GSM Cell Broadcast. A WDP entity should ignore any CBS message received which contains either of these Information Element Identifiers relating to concatenation.

Appendix A: Mapping WDP over GSM SMS and USSD

This appendix describes additional information on mapping WDP over GSM SMS and USSD.

A.1 Binary Header Format

For GSM SMS and GSM USSD the WDP headers structure is defined using the User Data Header (UDH) framework as defined in GSM 03.40:

FIELD	LENGTH
Length of User Data Header	1 octet
Information Element Identifier 'A'	1 octet
Length of Information-Element 'A'	1 octet
Information-Element 'A' Data	1 to 'n' octets
Information-Element-Identifier 'B'	1 octet
Length of Information-Element 'B'	1 octet
Information-Element 'B' Data	1 to 'n' octets
. . . .	
Information-Element-Identifier 'n'	1 octet
Length of Information-Element 'n'	1 octet
Information-Element 'n' Data	1 to 'n' octets

Figure A.1:The generic User Data Header structure in GSM SMS and GSM USSD

The 'Length-of-Information-Element' fields shall be the integer representation of the number of octets within its associated 'Information-Element-Data' field which follows and shall not include itself in its count value.

The 'Length-of-User-Data-Header' field shall be the integer representation of the number of octets within the 'User-Data-Header' information fields which follow and shall not include itself in its count.

Byte order of integers is most significant byte first. In case the information word of the payload data is different from an octet then the binary header is padded with bits to the start position of an information word (GSM uses a 7 bit alphabet) in most cases. Thus the header is compatible with legacy devices not supporting the WDP Datagram protocol.

A.2 Segmentation and Reassembly
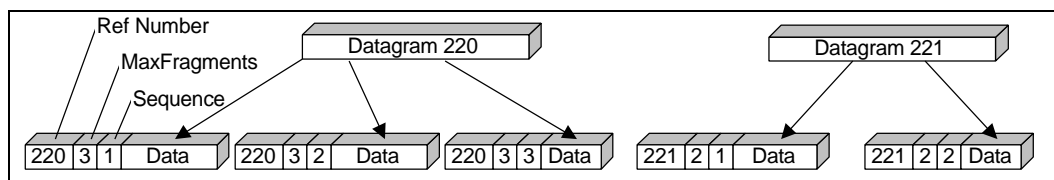
Figure A.2: Segmentation

Figure A.2 shows how a typical datagram will be segmented to be transported. It only shows the segmentation logic, i.e. the adaptation layer. A reference number is used to distinguish between different datagrams. The segmentation and reassembly mechanism uses a sequence number and a maxsize number to define the order and the completeness of the message.

The header of a packet contains the following segmentation information

1. reference number for WDP packet (0-255, or 0-65535)
2. total number of segments in datagram (max 255)
3. segment number. (1-255)

The maximum length of a segmented datagram using this scheme is dependent on the packet size. In GSM SMS the maximum network packet size is 140 bytes and in GSM USSD the maximum network packet size is 160 bytes

The sequence (reference and segment) number may be used to resolve problems with duplicate, dropped, and out of order packet delivery. The sequence number can be regarded as a counter that is incremented for each packet.

Reassembly is performed using a list of received packets. As packets arrive, they are inserted in order into the list, and then the list is checked for a complete datagram (all packets received, matching sequence numbers and originator address). If an entire datagram exists it can be delivered to the upper layer.

A.3 Combined Use of Headers

The figures below illustrate the use of the User Data Header framework and the various Information Elements defined for WDP. A datagram always contains the port numbers for application level routing, and optionally (if segmentation and reassembly is needed) contains also the adaptation layer.

0	1	2	3	4	5	6	7
Length of total User Data Header (all Information Elements)							
UDH IE identifier: Port numbers (5)							
UDH port number IE length (4)							
Destination Port (High)							
Destination Port (Low)							
Originator Port (High)							
Originator Port (Low)							
UDH IE identifier: SAR (0)							
UDH SAR IE length (3)							
Datagram Reference number							
Total number of segments in Datagram							
Segment count							
Padding Bits if User Data uses 7 bit alphabet							
1 - n bytes of User Data							

Figure A.3: A complete datagram header with 8 bit reference and 16 bit addressing scheme for WDP in GSM SMS

Figure A.3 shows the complete datagram header using GSM phase 2 backward compatible headers.

0	1	2	3	4	5	6	7
Length of total User Data Header (all Information Elements)							
UDH IE identifier: Port numbers (5)							
UDH port number IE length (4)							
Destination Port (High)							
Destination Port (Low)							
Originator Port (High)							
Originator Port (Low)							
Padding Bits if User Data uses 7 bit alphabet							
1 - n bytes of User Data							

Figure A.4: A datagram header without SAR for WDP in GSM SMS

Figure A.4 shows a datagram which content fits into one bearer network package. In this case no Segmentation and Reassembly header is present. This is possible since the UDH framework is modular.

Appendix B: Port Number Definitions

WAP has registered the ports in table C.1 with IANA (Internet Assigned Numbers Authority).

Port Number	Application/Protocol
9200	WAP connectionless session service
	Protocol: WSP/Datagram
9202	WAP secure connectionless session service
	Protocol: WSP/WTLS/Datagram
9201	WAP session service
	Protocol: WSP/WTP/Datagram
9203	WAP secure session service
	Protocol: WSP/WTP/WTLS/Datagram
9204	WAP vCard
	Protocol: vCard/Datagram
9206	WAP vCard Secure
	Protocol: vCard/WTLS/Datagram
9205	WAP vCal
	Protocol: vCalendar/Datagram
9207	WAP vCal Secure
	Protocol: vCalendar/WTLS/Datagram

Table B.1: WAP Port Number

The WAP protocols defined in the initial specifications are

- Wireless Session Protocol (WSP/B) with and without security. The Wireless Session Protocol has two modes: a connection oriented mode and a connectionless mode, and thus 4 ports are reserved. The connection oriented mode uses [WTP] for transaction support.
- vCard for use for push of "phone book items" (with and without security) to an application in either a mobile client or a fixed server. The vCard structure is placed as the userdata of the UDP/WDP datagram.
- vCalendar for push of calendar events (with and without security) to a calendar application in either a mobile client or a fixed server. The vCalendar structure is placed as the userdata of the UDP/WDP datagram.

The security protocol for the above secure ports is WTLS.

Appendix C: Bearer Type Assignments

This appendix lists the bearer type code assignments.

Bearer	Assigned Number
IPv4	0x00
IPv6	0x01
GSM USSD	0x02
GSM SMS	0x03
IS-136 R-Data	0x04
IS-637 CDMA SMS	0x05

Table C.1: Bearer Type Codes

Appendix D. History and Contact Information

<table>
<tr><td colspan="3" align="center">**Document history**</td></tr>
<tr><td align="center">**Date**</td><td align="center">**Status**</td><td align="center">**Comment**</td></tr>
<tr><td>30-Jan-1998</td><td>Draft</td><td>Draft Version of the Specification for public review</td></tr>
<tr><td>30-Apr-1998</td><td>Final</td><td>Version 1.0 of the Specification</td></tr>
<tr><td>23-Feb-1999</td><td>Proposal</td><td>Added Change Request:

1. **WDP Specification Changes to Support CSD in CDMA Networks** (Samsung) figure 5.13 updated, as well as description before picture. Other changes from addendum will be added later if necessary

2. **WDP Specification Additions** (Samsung)

3. **WDP Specification Changes to support PHS Networks** (Panasonic, NEC, Fujitsu)

4. **WDP Specification Changes to Support CDMA SMS Networks** (Nokia)

5. **WDP Specification Changes to support DataTAC Networks** (Motorola)

6. **WDP Specification Corrections** (Nokia)

7. **WDP Specification Changes to support PDC Networks**(Panasonic, Fujitsu, NEC)

8. **Addition of support for GSM Cell Broadcast bearer** (Logica Aldiscon)

9. **New port numbers** (Unwired Planet)

10. **Bitorder inconsistency between specifications** (Unwired Planet)

PICS removed.

Some minor corrections according e-mail comments</td></tr>
<tr><td>07-May-1999</td><td>Proposal</td><td>Copyright updated.</td></tr>
<tr><td>14-May-1999</td><td>Proposal</td><td>Added Change Request:

1. **Updatings in User Data Header framework for the Fragmentation Information Element** (*WDP-Ericsson-22-March-1999-1*, Ericsson) Changes to Chapter 7.3

2. **WDP Specification Corrections** (*Nokia-1-Mar-1999-1*, Nokia) Table B.1 updated

3. *Nokia/2-Dec-98/SD-4*, CDMA addition to Table C.1

4. **WDP Specification Changes to Support CDMA SMS Networks** (*WPG-WDP-004*, Nokia) CDMA SMS definition

5. *Nokia/2-Dec-98/SD-3*, CDMA SMS corrections</td></tr>
</table>

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