Technical Specification Group Services and System Aspects **TSGS#21(03)0387**

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Presentation of Specification to TSG or WG

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Document for presentation:	**TR 23.976, Push Architecture**
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Presented for:	**Information**

Abstract of document:

TR 23.976 is a study of the mechanisms to support Push service requirements as described in the Stage 1 TS 22.174.

TR 23.976 is more than 50% complete and is presented to SA for information.

TR 23.976 describes the architecture used to support Push services. It includes the description of how the delivery networks (PS Domain, CS Domain, and IMS) and delivery mechanisms offered within those networks such as SMS, PDP Context, circuit-switched data, and SIP are used to support push services. These descriptions include the architecture of the network elements and interfaces for each of these delivery mechanisms, and how these network services are established, maintained and withdrawn.

Changes since last presentation to SA

This is the first presentation to SA of TR 23.976.

Outstanding Issues:

Further work in the areas of;

- Push with Dynamic IP Address Assignment
- Push with PDP Context State Notification message
- MBMS Delivery Networks supporting Push
- WLAN Delivery Networks supporting Push

Are required to complete the TR.

Contentious Issues:

None at present.

3GPP TR 23.976 V1.0.0 (2003-09)

Technical Report

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects Push Architecture; (Release 6)

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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The purpose of this technical report is to analyse the service requirements for push services as defined in 3GPP TS 22.174 Push Service; Service aspects (Stage 1). It continues the work of TR 23.875.

This technical report describes methods for supporting push services by 3GPP delivery networks. The mechanisms described apply to existing delivery networks for the 3GPP Packet Switched Domain (PS domain), Circuit-Switched Domain (CS Domain), IP Multimedia Core Network Subsystem (IMS), Multimedia Broadcast Multicast Service, and Wireless LAN. Any necessary changes identified during this work will be introduced by means of CRs to the appropriate specifications.

Definition of push functions that apply to push application servers is outside the scope of this work. The definition of push functions that are best implemented in push application servers such as a Push Proxy and Push Initiator will be undertaken by other standards bodies and industry forums.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document.*

[1] 3GPP TR 21.905: " Vocabulary for 3GPP Specifications ".

[2] 3GPP TS 22.060: " General Packet Radio Service (GPRS); Service description; Stage ".

[3] 3GPP TS 22.174: " Push Service; Service aspects (Stage 1) ".

[4] 3GPP TS 23.039: " Interface protocols for the connection of Short Message Service Centres (SMSCs) to Short Message Entities (SMEs) ".

[5] 3GPP TS 23.040: " Technical realization of the Short Message Service (SMS) ".

[6] 3GPP TS 23.060: " General Packet Radio Service (GPRS); Service description; Stage 2 ".

[7] 3GPP TS 23.228: " IP Multimedia (IM) Subsystem - Stage 2 ".

[8] 3GPP TS 23.002: "Network Architecture".

[9] 3GPP TS 29.007: "General Requirements on interworking between the PLMN and the ISDN or PSTN".

[9] 3GPP TR 23.875: "Support of Push Services".

[10] 3GPP TR 23.910: "Circuit Switched Data Bearer Services".

[11] 3GPP TS 29.061 " Interworking between the Public Land Mobile Network (PLMN) supporting Packet Based Services and Packet Data Networks (PDN) ".

[12] 3GPP TS 24.229: "IP Multimedia Call Control Protocol based on SIP and SDP".

[13] RFC 3428 "Session Initiation Protocol (SIP) Extension for Instant Messaging".

[14] RFC 3265 "Session Initiation Protocol (SIP)-Specific Event Notification".

[15] 3GPP TS 23.207: "End-to-end Quality of Service (QoS) concept and architecture".

[16] 3GPP TR 23.917: "Dynamic Policy control enhancements for end-to-end QoS".

[17] RFC 2748: "Common Open Policy Service protocol (COPS)".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TS 22.174 [3] and the following apply.

delivery network: a network that supports connectionless or connection oriented push services. A delivery network may simply be a GPRS network.

application server: a server that provides push services through a delivery network, e.g. via an IP connection

user IP address: an IP address provided by the delivery network that can be used by an application server ~~to~~ for access to a push services user. The address may be permanently assigned (static) or temporarily assigned (dynamic).

user-ID: an identity or name that can be used to deliver push content to a user in a delivery network The format of user-ID is dependent on the protocol for the push services.

user availability: the ability of a~~n~~ delivery network to provide push service to a subscribed user.

user terminal: the end user equipment that receives push content.

long-lived PDP Context: this is a PDP Context that remains active/open for an indefinite period of time. Also referred to as “always-on PDP context”.

always-on PDP Context: this is a PDP Context that remains active/open for an indefinite period of time. Also referred to as “long-lived PDP context”.

Push Data: data sent by the push initiator to the push recipient, of a format known to the receiver (push recipient), and not otherwise defined by the push service.

Push function: the function in the PLMN that receives the Push Data from the Push initiator. The push function is responsible for delivering the push data to the Push recipient.

Push initiator: the entity that originates push data and submits it to the push function for delivery to a Push recipient. A Push initiator may be e.g. an application providing value added services.

Push recipient: the entity that receives the push data from the Push function and processes or uses it. This may include the UE with which the PLMN communicates with, the user agent with the application level address, and the device, machine or person which uses the push data. A Push recipient is controlled by an individual user .

Push service: a service capability offered by the PLMN. The Push Service is initiated by a Push Initiator in order to transfer push data (e.g. data, multimedia content) from the Push Initiator to the Push Recipient without a previous user action. The Push Service could be used as a basic capability or as component of a value added service.

Push User agent: is any software or device associated with a Push recipient that interprets Push Data to the user. This may include textual browsers, voice browsers, search engines, machine or device interface software, etc.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

NAT Network Address Translator
NRPCA Network Requested PDP Context Activation
OTA Over The Air delivery protocol
PP Push Proxy
PI Push Initiator

4 Architecture Requirements

4.1 Delivery Network Independent Support for Push Service

The Push Function shall be able to transmit the push data over a delivery network independent of the other delivery networks. Therefore the Push Service, as required by a Push Function, and within the capabilities of the delivery network shall be supported over Circuit-Switched (C-S Data and SMS) services, PS Domain (PDP Context and SMS) services and IMS services, independently of the availability of other delivery network services within an operator network.

The above does not exclude the support of Push Services by combining the capabilities of two or more delivery network services, but there shall be no direct dependence on the availability of a specific delivery network in order for another delivery network to support the Push Service.

4.2 Selection of Delivery Network

Where a network supports Push Services the capabilities offered by the delivery network shall be configured in the Push Function to allow the Push Function to select a delivery network. If the network supports Push Services and offers more then one delivery network, the network shall allow the Push Function to select the delivery network and where practical submit configuration settings to indicate desired services supported within that chosen delivery network. For example where a 3G network supports multiple push delivery network options supporting different characteristics for delivery of push data (priority delivery, acknowledged or unacknowledged delivery, store and forward) the network shall allow the Push Function to select the appropriate delivery network and provide preferences for delivery of the push data.

4.3 Delivery Network Support of Acknowledged and Unacknowledged Push Data delivery

When a delivery network has acknowledgement capability and the user has invoked the acknowledgment mode service, the delivery network shall provide some means to communicate to the Push Function the successful delivery of, or the failure to deliver, a push message.

In the case of unacknowledged delivery, where the delivery network has enough information to determine the delivery was unsuccessful, the delivery network may provide some means to communicate to the Push Function a message delivery failure.

5 Push Architecture Overview

The Push Service Architecture overview is shown in figure 1. This includes the push application servers Push Function (or Push Proxy) and Push Initiator as well as the delivery networks available and the Push Recipient or UE. The definition of functions in the Push Function (Push Proxy) and Push Initiator are outside the scope of this TR. Figure 1 also shows the Push Function performing delivery network selection, the definition of how this is performed and the criteria for delivery network selection are part of the definition of the Push Function and are outside the scope of this TR. Figure 1 depicts the Push Function being located within the PLMN, this is a logical representation of the Push Service Architecture and does not imply the physical co-location of a Push Function within the PLMN infrastructure.

The description of the delivery network used to support push services and how those delivery network services are established, maintained and withdrawn is the main focus of this section.

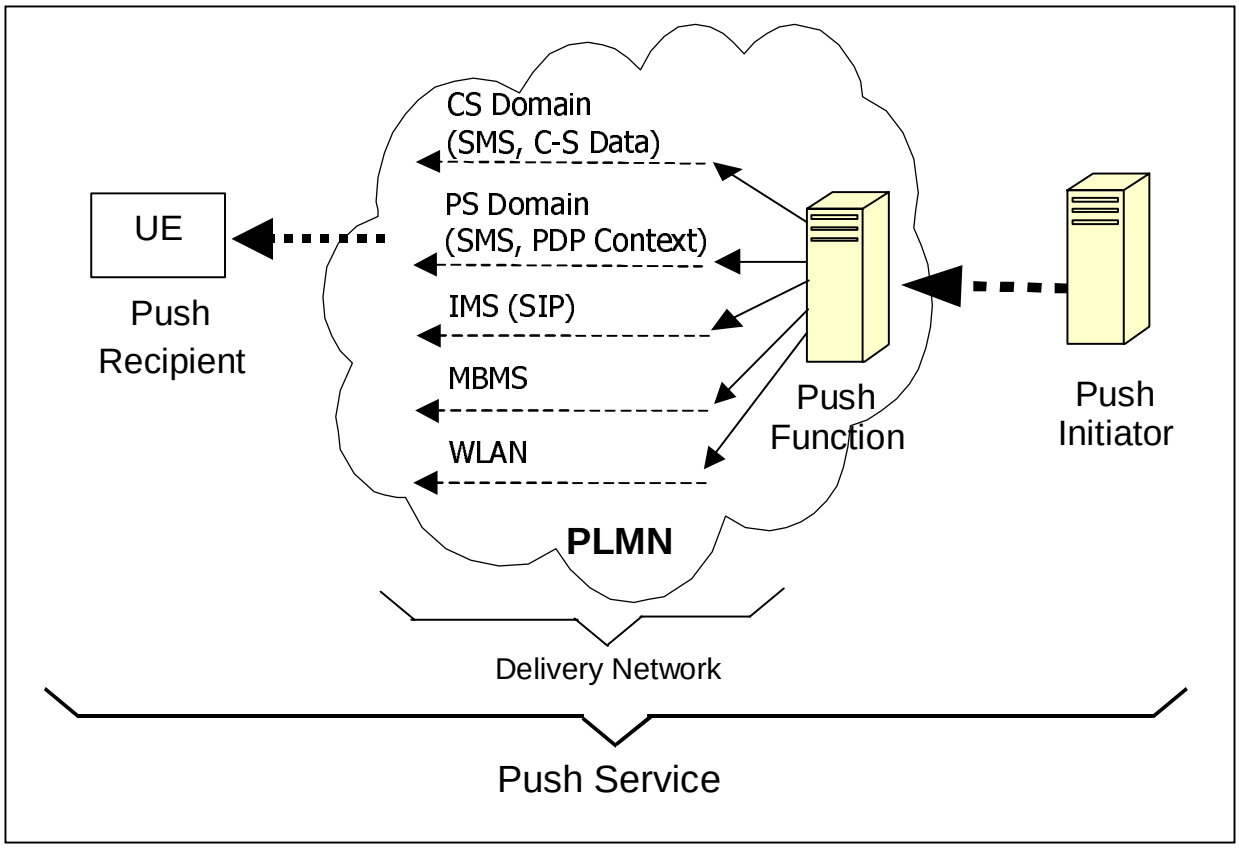

Figure 1: Push Service Architecture Overview.

5.1 PS Domain Delivery Networks Supporting Push

This section describes the use of various mechanisms in the PS Domain to establish and/or maintain a bearer service connection to the UE over which Push services may be delivered.

5.1.1 PS Domain Network Elements and Interfaces supporting Push

The following diagram illustrates the network elements and interfaces that are necessary to support Push over a PS Domain PDP Context and/or SMS. The Push Function interfaces to the GGSN via the Gi reference point when using a PDP Context and to the Short Message Service Centre (SM-SC) when using the Short Message Service.

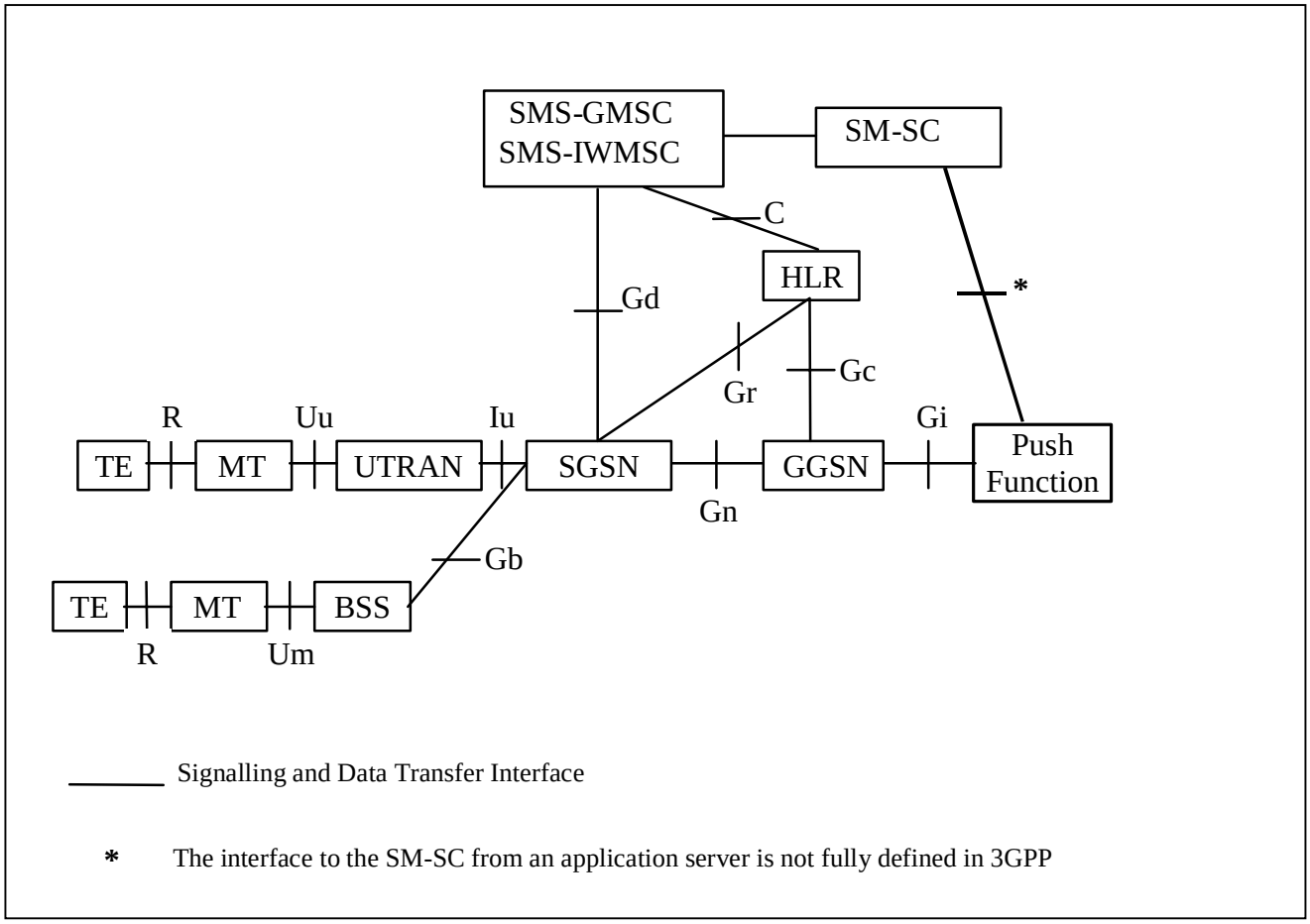

Figure 2. Network Elements and Interfaces supporting Push over the PS Domain (PDP Context and SMS).

The Push Function interfaces to the GGSN using the Gi reference point. This is an Internet Protocol (IP) interface that supports IP formatted packets. IP packets sent to/from the Gi reference point are mapped to/from a PDP Context in the GGSN. Interworking over the Gi reference point is defined in 3GPP TS 29.061.

The GSM/3GPP standards do not fully define the SM-SC's interfaces. The interface from the SM-SC to the Access Network is defined within the 3GPP standards (primarily 3GPP TS 23.040). The interface to the SM-SC from an external Application Server is not standardized by 3GPP (3GPP TR 23.039 provides guidance on this interface).

SM-SC implementations today often support an IP network connection for SMS message access from an Application Server. This IP interface can be used to allow a Push Function to push messages or notifications to a mobile user.

5.1.2 NRPCA with Static IP Address Assignment

The nature of push data is in many cases non-deterministic in terms of when it will arrive and when the recipient will want the information. Therefore the NRPCA feature is well suited to the needs of a Push Service. Provided the UE is attached to the network, the NRPCA feature can initiate a PDP Context to the UE for push data.

The feature in 23.060 section 9.2.2.2 Network Requested PDP Context Activation can be used to support push services.

5.1.3 Push using SMS in the PS Domain

Figure 3 illustrates the basic steps involved in an SMS Push service.

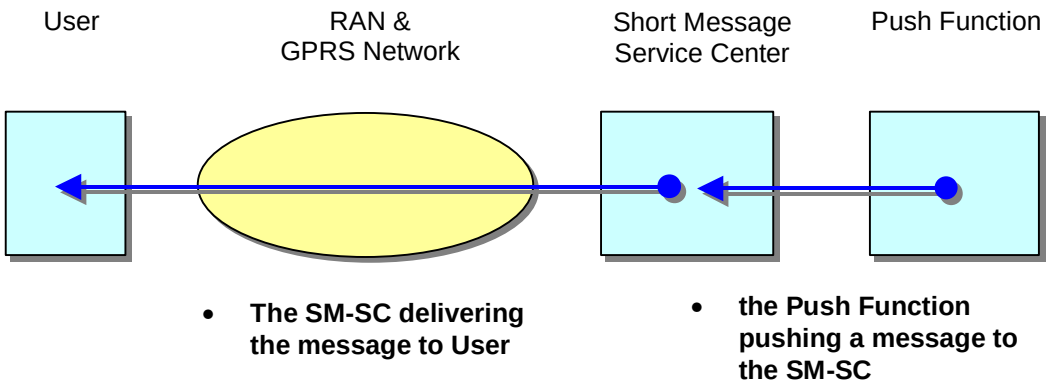

Figure 3: SMS Push Message Scenario

The SMS Service Center (SM-SC) receives the initial push message from the Push Function. The message is delivered to the User/UE through the SMS Delivery Network using the Gd reference point.

5.1.3.1 Push Notification with User Connect Scenario

When the SMS environment is not adequate, the Push Function can push a notification to the user allowing the user to establish a direct connection to the Push Function or Push Initiator. The conditions for Push Notification with User Connect Scenario are:

- data to be pushed exceeds SMS message size limits, or
- the data to be delivered requires a directly addressable IP connection to the user.

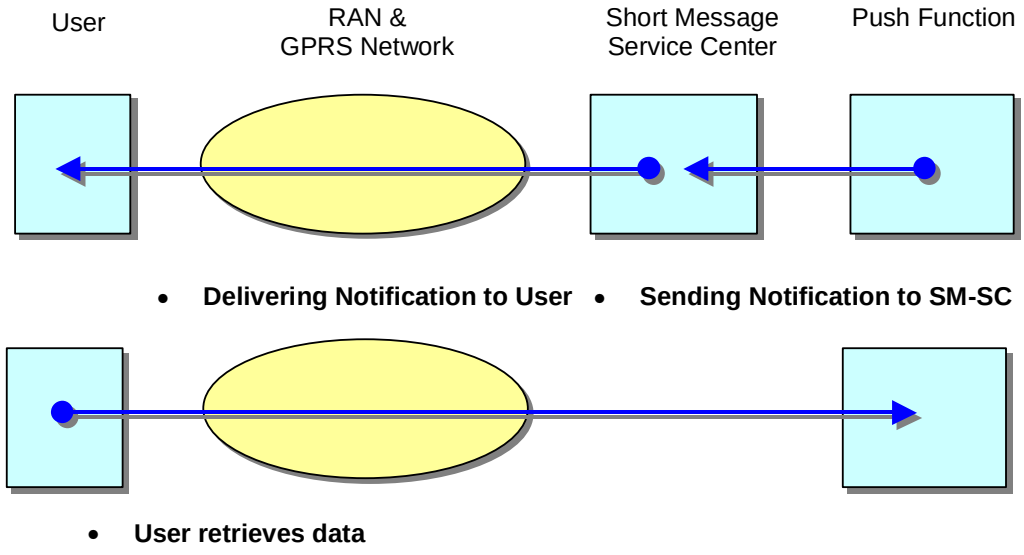

Figure 4: SMS Push Notification with User Connect Scenario

In figure 4, the notification pushed to the user must contain the information necessary for the user to initiate a connection (e.g. PDP Context) and retrieve the intended data. The information in the notification, for example, may be directed to an application such as an email agent for automatic retrieval of an email message, or a URL which the user can invoke through a browser. The user may choose to ignore a push notification.

5.1.3.2 Push Broadcast Scenario

The existing standards allow delivery of broadcast messages using SMS formats. This requires support for Cell Broadcast in the Service Center.

Addresses supplied in this case would identify a broadcast area instead of a specific user. This delivery method could be used with either a push message or a push notification.

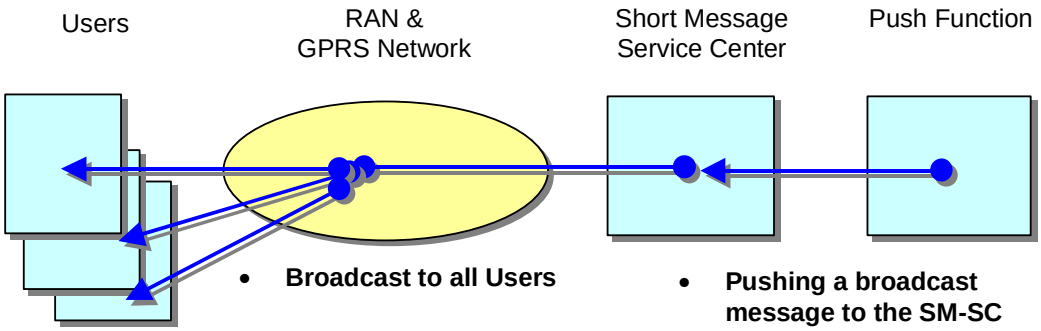

Figure 5: Push Broadcast Scenario

5.1.3.3 Addressing

The Push Function will use the existing addressing scheme to the SM-SC. For an IP network interface, the SM-SC will be addressable in a standard network format (e.g. Domain Name, IP address). The SMS message will be contained in the data portion of the IP packet and will use the SMS addressing mechanism, i.e. MSISDN or E.164.

5.1.3.4 Delivery Reliability

SMS is a store and forward service and includes message delivery reliability mechanisms. If a user is not accessible or has some condition that prohibits message delivery, the Delivery Network will provide an Alert to the SM-SC when the condition has cleared. This allows the SM-SC to attempt delivery again as soon as the user is able to receive the message.

Figure 6 shows an example sequence with a Push message being delivered while a user's mobile is powered off.

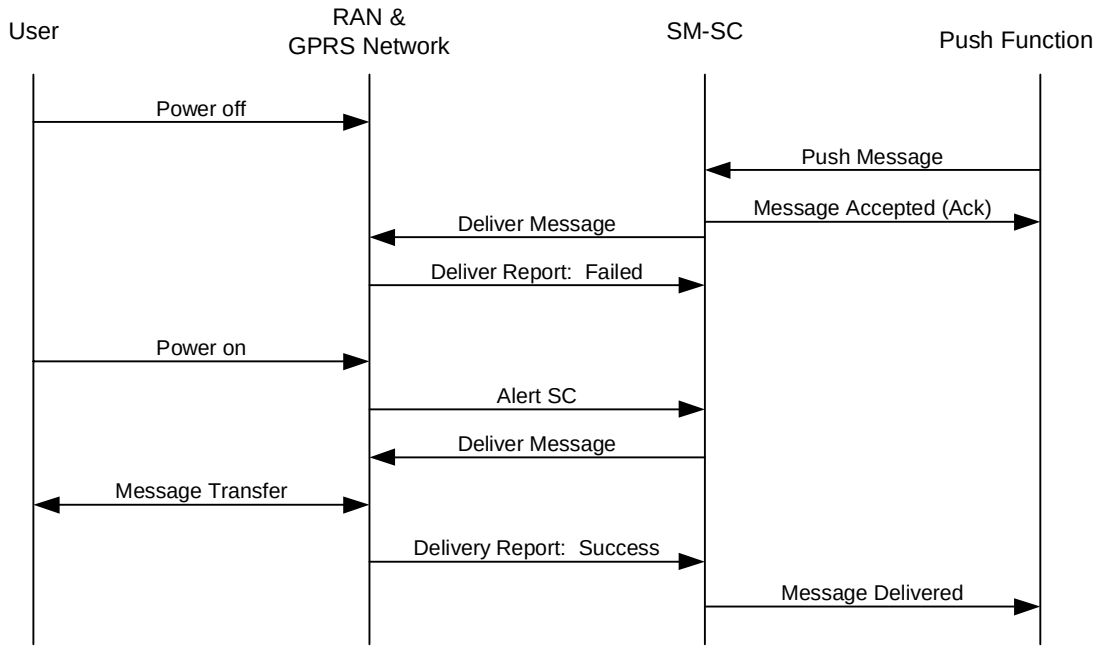

Figure 6: SMS Reliable Delivery Sequence

As shown in figure 6, the SM-SC receives an alert notification when the user becomes accessible. The SM-SC is then able to attempt a second delivery of the message, which now succeeds.

The Alert SM-SC message is provided by the HLR/HSS per the existing SMS service definition TS 23.040.

The reliable delivery feature of SMS would also apply to the "Push Notification with User Connect Scenario".

It is also possible for the SM-SC to relay Alert notices to the Push Function. In this case, the Push Function would be responsible for maintaining a copy of the message and re-transmitting when the user becomes available.

5.1.4 Push using Long-Lived PDP Context

A long-lived PDP Context is a good mechanism for timely delivery of Push data, and where the user is receiving data on a frequent basis a long-lived PDP Context is also an efficient use of network resources. The existing definition of a PDP Context in TS 23.060 does not specify a maximum time limit for a PDP Context to be active before it must be deactivated. In theory all PDP Contexts are long-lived (always-on) where their activation and deactivation are determined by the user and/or application. In practice networks will deactivate PDP Contexts for various reasons such as network maintenance or after long periods where the PDP Context has not carried traffic. When a PDP Context is deactivated by the network, the Push Function needs to know the PDP Context is no longer available so it does not continue to use it for push data.

In the case where the PDP Context is deactivated by the network, there are five mechanisms that may be deployed to inform the Push Function of the PDP Context deactivation. These mechanisms are listed and discussed in the following subsections.

5.1.4.1 Internet Control Message Protocol

The Internet Control Message Protocol (ICMP) is defined in the IETF RFC 792. TS 23.060 section 9.1.1 makes reference to the use of ICMP error notifications sent from the GGSN when a mobile-terminated IP packet is received in the INACTIVE state, indicating the PDP Context is deactivated.

ICMP error notification messages are sent from the GGSN when the GGSN is unable to forward an IP packet to its destination. Therefore the Push Function must generate an IP packet towards the GGSN before it will receive an ICMP message informing it that the packet is not deliverable. In this scenario the GGSN and Push Function may be unsynchronised for some period between when the PDP Context is deactivated at the GGSN, and when the Push Function transmits an IP packet to the deactivated PDP Context and receives back an ICMP message.

When using ICMP as the mechanism to inform the Push Function that a PDP Context has been deactivated, the network configuration may need to ensure the address allocation mechanism for dynamically assigned IP addresses (IPv4 or IPv6) incorporates a sufficiently long time before re-allocation of an IP address to another PDP Context. This is to guard against a Push Function transmitting an IP packet using an IP address that had been previously used by a PDP Context that has been deactivated and then re-assigned to a new PDP Context before the Push Function learned (via ICMP) of the deactivation of the first PDP Context.

It is for further study whether ICMP support at the GGSN may apply to all APNs serviced by the GGSN, or on a per APN basis.

5.1.4.2 PDP Context State Notification message

5.1.4.3 Radius Accounting START/STOP messages

Although the use of Radius is not mandatory in 3GPP networks it is widely deployed. Radius is an Authorization, Authentication, and Accounting service that may also take on the function of IP address allocation (like DHCP), see TS 29.061. The Radius Accounting START/STOP messages have a side effect of indicating when a PDP Context is activated and de-activated. A Radius Server by using the information collected as a result of Accounting START/STOP messages can inform the Push Function on the state of a PDP Context.

The interworking of a Push Function to a Radius Server is outside the scope of this specification.

5.1.4.4 COPS DRQ operation

The COPS protocol operates between the GGSN and the PDF over the Go reference point. TS 23.207 section 5.3 describes the Go interface and the COPS messages exchanged over it, including the Delete Request State (DRQ) message. TS 23.207 section 6.3.2 describes how the COPS DRQ message is used to indicate the release of a PDP Context to the PDF. In TR 23.917 section 8.10 shows when a PDP Context is deactivated at the GGSN a COPS DRQ message is sent to the PDF. The PDF upon receipt of the COPS DRQ message may forward an indication to an Application Function over the Gq reference point indicating that network resources have been removed. This mechanism could be used to indicate to a Push Function that a PDP Context has been deactivated. Gq is being defined as part of Release 6.

5.1.4.5 Keep Alive Messages

Most networks set a maximum time for a PDP Context to be open and idle, after which the PDP Context is dropped. But upon deactivation no message is sent to the application server to inform it that a PDP Context is unavailable. To prevent this from happening an application server may simulate network traffic by periodically sending a keep alive message over the PDP Context to ensure the idle timer in the network is reset and the PDP Context remains open.

The use of keep alive messages consumes network resources and counters the operators' attempts to properly manage its network resources e.g. the number of available PDP Contexts. The work in this TR is exploring mechanisms where the network can report the state of a PDP Context to the application server, particularly when a PDP Context is deactivated. These mechanisms use substantially less network resources than what are required for keep alive messages, and provide PDP context status information known at the GGSN to the Push Function.

The use of keep alive messages is not encouraged and instead one or more of the methods described in this section should be used to maintain synchronization of the Push Function with the state of the PDP Context in the network.

Editors Note: the following bullets provide guidance for further work

- Push with Dynamic IP Address Assignment
    - *This section describes a mechanism to establish a PDP Context that can be used to carry Push services to a UE when the PS Domain implements Dynamic IP address assignment.*

5.2 CS Domain Delivery Networks Supporting Push

This section describes the use of various mechanisms in the CS Domain to establish and/or maintain a bearer service connection to the UE over which Push services may be delivered.

5.2.1 CS Domain Network Elements and Interfaces supporting Push

The following diagram illustrates the network elements and interfaces that are necessary to support Push over a CS Domain circuit connection. The Push Function interfaces to the MSC/IWF using the appropriate connection type as defined in TS 43.010 and TS 29.007 or to a Short Message Service Centre (SM-SC) when using the Short Message Service.

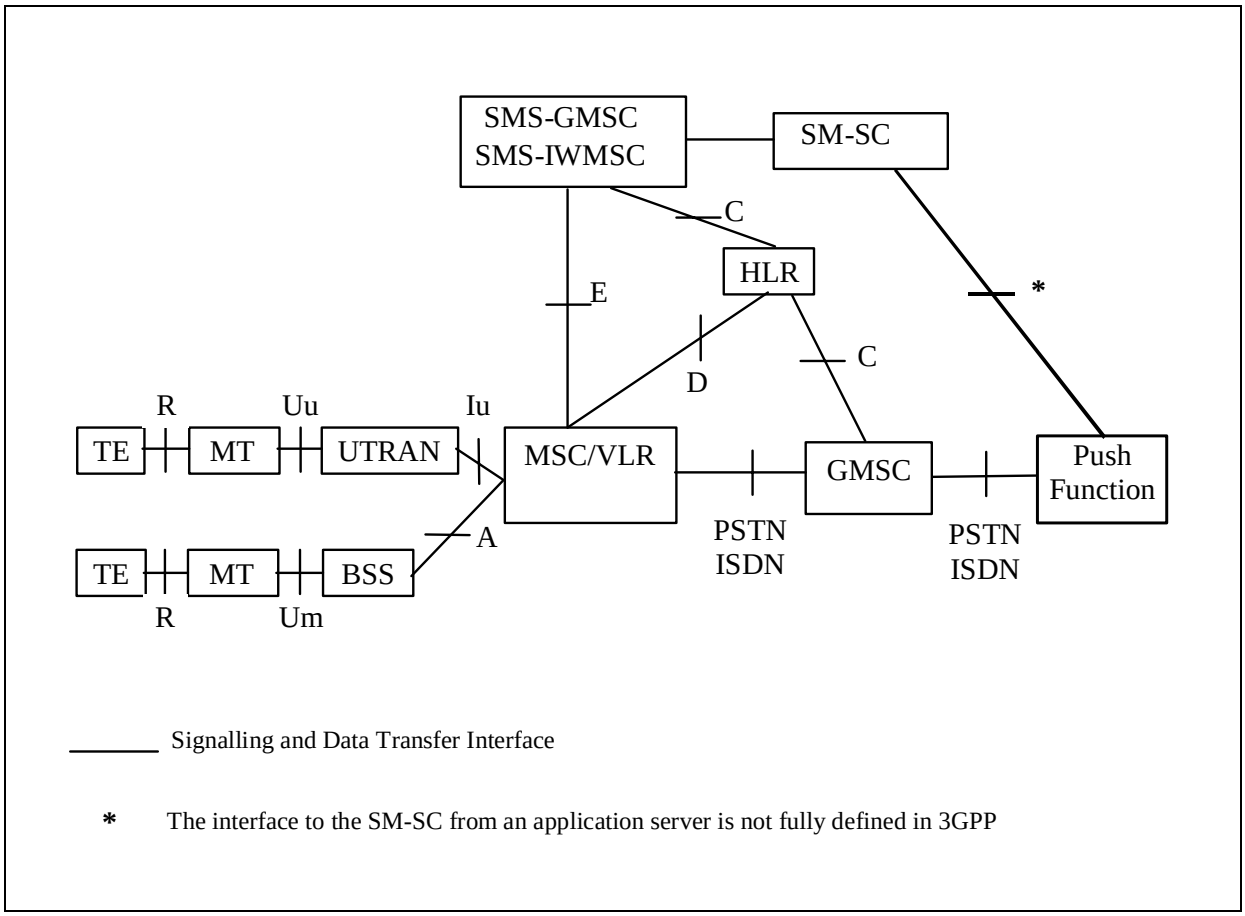

Figure 7. Network Elements and Interfaces supporting Push over the CS Domain (circuit connection and SMS).

The Push Function interfaces to the MSC/IWF to transmit and receive circuit-switched data traffic. This interface may operate over a PSTN, ISDN or PDN. The MSC/IWF will perform the appropriate conversion for the connection type operating between the MSC/IWF and the Push Function to support data traffic over a GSM/3G PLMN circuit connection to the UE .

The interface between the Push Function and the SM-SC is the same as that described in section 5.1.1 above.

5.2.2 Push using SMS in the CS Domain

Push using SMS in the CS Domain operates as described in section 5.1.3. SMS messages are delivered to the UE using the A or Iu reference points.

5.3 IMS Delivery Networks Supporting Push

This section describes methods using the SIP protocol in IMS to carry Push services to a UE.

5.3.1 IMS Network Elements and Interfaces supporting Push

The IMS architecture has been described in the 3GPP TS 23.228 [7]. The Multimedia call control protocol in IMS is described in the 3GPP TS 24.229 [12].

The following diagram illustrates the network elements and interfaces that are necessary to support Push over IMS.

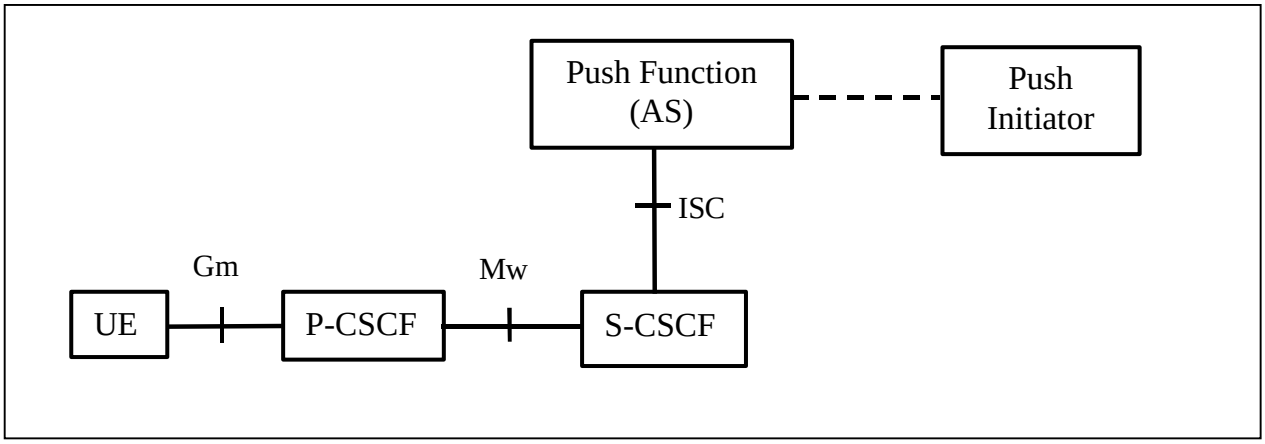

Figure 8: Network Elements and Interfaces supporting Push over IMS.

Push Function adopts the role of an Application Server (AS). Push Function functioning as an AS is connected via an ISC-interface towards the Serving CSCF (Call Session Control Function). Terminating IMS routing mechanisms are used for reaching the Push recipient (the terminating UE).

5.3.2 Push based on SIP

The applicability of the SIP protocol extends well beyond simple call control, and several extensions for specific usages have been developed. There are two extensions that potentially provide solutions to enable SIP as a push transport, namely SIP for instant messaging (the MESSAGE method RFC 3428 [13]), and the SIP events framework (the SUBSCRIBE/NOTIFY methods RFC 3265 [14]):

a) Using the MESSAGE mechanism, the Push Function (Application Server) sends a MESSAGE request to the Push Recipient (UE) with an appropriate push message as the payload of the request. The UE replies back with a 200 OK completing the transaction.

b) Using the SIP events framework, the Push Recipient (UE) first subscribes to the particular push event by sending a specific SUBSCRIBE request to the Push Function (Application Server). The Push Function accepts the subscription with a 200 OK response, and sends an initial NOTIFY request, which the Push Recipient acknowledges by replying with a 200 OK. Subsequent push messages would be delivered in the payload of additional NOTIFY requests from the Push Function to the Push Recipient.

5.4 MBMS Delivery Networks Supporting Push

5.5 WLAN Delivery Networks Supporting Push

6 Analysis and Conclusion

Annex <A> (normative):
<Normative annex title>

Annex <B> (informative):
<Informative annex title>

Annex <X> (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2003–01					Created at SA2#29 San Francisco		0.0.0
2003-01					Revised at SA2#29 San Francisco. Approved via email. Assigned number 23.976.	0.0.0	0.1.0
2003-02					Revised scope at SA2#30 Milan.	0.1.0	0.2.0
2003-03					Revised as per approved documents from SA2#31 Seoul, see S2-031537, S2-031600, S2-031539rev2, and S2-031540.	0.2.0	0.3.0
2003-05					Revised as per approved documents from SA2#32 San Diego, see S2-032128, S2-032129, and S2-032130.	0.3.0	0.4.0
2003-07					Revised as per approved documents from SA2#33 Sophia-Antipolis, see S2-032491, S2-032493rev1, S2-032699, and S2-032700.	0.4.0	0.5.0
2003-08					Revised as per approved documents from SA2#34 Brussels, Belgium, see S2-033170, S2-033171, S2-033172, S2-033173, and S2-033174.	0.5.0	0.6.0
2003-09	21				Presented to TSG SA#21 for information.	0.6.0	1.0.0