



Secure User Plane Location Architecture

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1. Scope

(Informative)

The scope of the Secure User Plane Location (SUPL) architecture document is to define the architecture for the SUPL service enabler.

A reference architecture is defined including:

- o Context Model
- o Functional blocks
- o Logical entities
- o Reference Points / Interfaces
- o Messages and message flows

In addition a number of deployment scenarios are considered including different roaming models as well as different mapping of logical functions to architectural elements.

This architecture is based on the requirements listed in the SUPL Requirements document [SUPL RD].

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3. Terminology and Conventions

3.1 Conventions

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

All sections and appendixes, except “Scope” and “Introduction”, are normative, unless they are explicitly indicated to be informative.

3.2 Definitions

Context Model	A model that identifies all contextual items relevant to understanding architecture.
Control Plane	This plane has a layered structure and performs the call control and connection control functions; it deals with the signaling necessary to set up, supervise and release calls and connections.
Emergency IMS Core	IMS core network supporting emergency IMS call. The main components of Emergency IMS Core are P-CSCF and E-CSCF.
End User Device	See [OMA AD].
ImmediateService	Location service where a single location information is needed immediately.
Interface	The common boundary between two associated systems. See [OMA-DICT]
Location Based Application	See [3GPP TS 23.271].
Location (Based) Service	See [3GPP TS 23.271] [3GPP GSM LCS][3GPP WCDMA LCS][3GPP2 X.S0024-0].
MLS Application	An application that requests and consumes the location information.
Non-Proxy Mode	The SPC system will have direct communication with the SET.
Periodic Triggered Service	Location service where a multiple periodic location information is needed.
Proxy Mode	The SPC system will not have direct communication with the SET. In this environment the SLC system will act as a proxy between the SET and the SPC.
Quality of Position	A set of attributes associated with a request for the geographic position of a SET. The attributes include the required horizontal accuracy, vertical accuracy, maximum location age, and response time of the SET position.
Reference Point	See [OMA-DICT]
SET Initiated Services	SET Initiated Services are services that originate from the SET. For these services the SUPL Agent resides within the SET.
SET User	The user of a SET.
SIP/IP Core	A network of servers such as proxies and/or registrars that support a variety of SIP based services.
SUPL Agent	A Software and/or hardware entity accessing the SUPL enabler in order to obtain location information.
SUPL Session	Session established between the SET and the SLP using ULP protocol.
SUPL Enabled Terminal (SET)	A logical entity in a device that is capable of communicating with a SUPL Network. Examples of this could be a UE in UMTS, a MS in GSM or IS-95, or a PC over an IP-based transport.
SUPL Location Center (SLC)	Coordinates the operations of SUPL in the network and interacts with the SET over User Plane bearer.
SUPL Location Platform (SLP)	The entity responsible for Location Service Management and Position Determination. The SLP contains the SLC and SPC Functions.
SUPL Network	Access network which facilitates the Location determination functionality and provides the SUPL bearer

SUPL Network Initiated Services	SUPL Network Initiated Services are services, which originate from within the SUPL Network as opposed to the SET. For these services the SUPL Agent resides in the Network.
SUPL Position Calculation	The position calculation function performs the function of calculating the position of a SET. Various positioning calculation modes may be supported by a SUPL service
SUPL Positioning Center (SPC)	Entity in the SUPL Network responsible for all messages and procedures required for position calculation and for the delivery of assistance data.
SUPL Provider	<p>Location information is sensitive personal information and requires specific care with privacy and security. In the case of a Mobile Network Operator it is important that whatever policy the Network Operator decides to implement SUPL functionality cannot be breached. Valid scenarios for MNO controlled SUPL would be:</p> <ol style="list-style-type: none"> 1) The network operator is the single SUPL Provider. 2) The network operator and roaming partners are the only SUPL Providers. 3) The network operator out-sources the SUPL functionality and there is a single 3rd party SUPL Provider. 4) The network operator has an open policy on the provision of SUPL functionality and there are multiple 3rd party SUPL Providers. <p>The SUPL Provider may be independent of an MNO.</p>
SUPL Security Function	SUPL Security Function manages the Authentication and Authorization for SUPL Agents and MLS Applications to access SUPL Services. This function also provides confidentiality and data integrity.
SUPL Service Management	SUPL Service Management is the function of managing locations of SETs. The function stores, extracts, and modifies the location information of a target SET
System	A functional entity
User Plane	The User Plane, with its layered structure, provides for user information flow transfer, along with associated controls (e.g., flow control, and recovery from errors, etc).

3.3 Abbreviations

AD	Architecture Document
AFLT	Advanced Forward Link Trilateration
A-GANSS	Assisted Galileo and Additional Navigation Satellite Systems
A-GNSS	Assisted Global Navigation Satellite System
A-GPS	Assisted GPS
API	Application Programming Interface
EOTD	Enhanced Observed Time Difference
E-SLP	Emergency SLP
FQDN	Fully Qualified Domain Name
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ILP	Internal Location Protocol
HLIA	Historical Location Immediate Request
HLIR	Historical Location Immediate Answer
H-SLC	Home SLC
H-SLP	Home SLP

H-SPC	Home SPC
HTTP	Hypertext Transfer Protocol
HTTPS	HTTP Secure
IETF	Internet Engineering Task Force
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
LCS	Location Services
LTE	Long Term Evolution
MAC	Message Authentication Code
MC	Message Center
MLP	Mobile Location Protocol
MLS	Mobile Location Services
MNO	Mobile Network Operator
MSISDN	Mobile Subscriber ISDN Number
OMA	Open Mobile Alliance
OTDOA	Observed Time Difference of Arrival
PAP	Push Access Protocol
PC	Personal Computer
PLMN	Public Land Mobile Network
POTAP	WAP Push Over The Air Protocol
PPG	Push Proxy Gateway
PSK-TLS	Pre-Shared Key Ciphersuites for Transport Layer Security
QoP	Quality of Position
RD	Requirement Document
RLP	Roaming Location Protocol
RRC	Radio Resource Control
RRLP	Radio Resource LCS Protocol
R-SLP	Requesting SLP
SADF	SUPL Assistance Delivery Function
SCF	SUPL Charging Function
SET	SUPL Enabled Terminal
SIF	SUPL Initiation Function
SIP	Session Initiation Protocol
SLC	SUPL Location Center
SLIA	Standard Location Immediate Answer
SLIR	Standard Location Immediate Request
SLIRep	Standard Location Immediate Report

SLP	SUPL Location Platform
SMLC	Serving Mobile Location Center
SMPP	Short Message Peer to peer Protocol
SMS	Short Message Service
SMSC	Short Message Service Center
SPC	SUPL Positioning Center
SPCF	SUPL Position Calculation Function
SPF	SUPL Privacy Function
SRLIA	Standard Roaming Location Immediate Answer
SRLIR	Standard Roaming Location Immediate Request
SRRF	SUPL Reference Retrieval Function
SRSF	SUPL Roaming Support Function
SSF	SUPL Security Function
SSMF	SUPL Service Management Function
SSPF	SUPL SET Provisioning Function
SSRLIA	Standard SUPL Roaming Location Immediate Answer
SSRLIR	Standard SUPL Roaming Location Immediate Request
SSRP	Standard SUPL Roaming Position
SUPL	Secure User Plane Location
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
TLS	Transport Layer Security
UDP	User Datagram Protocol
UE	User Equipment
UICC	Universal Integrated Circuit Card
UMB	Ultra Mobile Broadband
URL	Uniform Resource Locator
V-SLC	Visited SLC
V-SPC	Visited SPC
V-SLP	Visited SLP
WAP	Wireless Application Protocol
WCDMA	Wideband Code Division Multiple Access

4. Introduction

(Informative)

Secure User Plane Location (SUPL) is an Enabler which utilizes existing standards where available and possible, to transfer assistance data and positioning data over a User Plane bearer, such as IP, to aid network and SUPL Enabled Terminal (SET) based positioning technologies in the calculation of a SET's position. SUPL includes but is not limited to the definition of a Location User Plane (Lup) Reference Point and corresponding interface between the SUPL Location Platform (SLP) and SET, security functions (e.g., authentication, authorization), charging functions, roaming functions, and privacy functions. SUPL utilizes existing standards where available and possible, and SUPL should be extensible to enabling more positioning technologies as the need arises so that they utilize the same mechanism.

The initial phase, SUPL 1.0, provides full functionality of A-GPS with minimum changes of current network elements.

For SUPL Release 2, the A-GNSS concept is introduced to allow additional Navigation Satellite System assisted positioning technology to be utilized, e.g., A-GANSS.

Note: Applicability of a particular A-GNSS is subject to the support in relevant 3GPP and 3GPP2 specifications that SUPL relies on.

SUPL is used by MLS Applications via a SUPL Agent to determine the position of a SET. SUPL itself does not specify an API for direct use by MLS Applications. The SUPL architecture depends on [OMA RLP 1.0] or [OMA RLP 1.1].

This document describes the architecture for SUPL 2.0.

4.1 Planned Phases

SUPL is being published in different versions. This architecture document specifies SUPL Version 2.

SUPL 1.0 supports the following modes of operation for selected deployments:

- o Proxy flows for GSM/WCDMA deployments;
- o Proxy flows for CDMA/CDMA2000 deployments;[3GPP2 HRPD]
- o Non-proxy flows for CDMA/CDMA2000 deployments.

SUPL 2.0 adds a number of features on top of SUPL 1.0. The major functional enhancements are:

- o Triggered positioning procedures, both periodic and area event;
- o Emergency positioning procedures;
- o Support of A-GANSS positioning method and improvements to enhanced cell id positioning method;
- o Support of proxy flows for LTE networks. [3GPP LTE]
- o Support of proxy flows for TD-SCDMA networks.
- o Support of non-proxy flows for GSM/WCDMA/TD-SCDMA/LTE deployments.
- o Support of proxy and non-proxy flows for UMB networks. [3GPP2 UMB]
- o Support of proxy and non-proxy flows for I-WLAN, WiMAX and I-WiMAX networks;
- o Positioning procedures for delivery to third party and retrieval of location of another SET.

In addition the protocol between SLC and SPC, i.e., the ILP, is defined.

4.2 Security Considerations

This section provides a brief high level description of the SUPL Security Function, the details of which are described in [OMA ULP].

4.2.1 Authentication

Mutual authentication SHALL be supported between a SET and an H-SLP. Server authentication SHALL be supported between a SET and an E-SLP, and mutual authentication MAY be supported between a SET and E-SLP.

When mutual authentication is performed, the SET SHALL act on behalf of the SET User via a SUPL Agent contained in the SET using the security credentials associated with the SET User, which in turn are provisioned by the SUPL Provider.

Note that a successful authentication of the SET User MUST result in a successful identification of the SET User's ID (e.g., MSISDN).

Note that an SLP MUST perform an IMSI to MSISDN binding before the MSISDN of the authenticated SET User is securely identified

4.2.2 Providing the H-SLP Address to the SET

The H-SLP address is made available to the SET by the provisioning of the H-SLP address in the UICC, SET or a default H-SLP address is derived. This address MUST be in the form of a FQDN and SHOULD be securely provisioned by the Home Network of the SET [OMA ULP].

4.2.3 Confidentiality and Data Integrity

TLS 1.1 [TLS] or PSK-TLS [PSK-TLS] SHALL be used to provide Confidentiality and Data Integrity between a SET and an SLP. All SUPL Messages except "SUPL INIT" MUST be delivered within a TLS or PSK-TLS session between a SET and an SLP [OMA ULP].

5. Architectural Model

Secure User Plane Location (SUPL) is an Enabler that utilizes existing standards where available and possible, to transfer assistance data and positioning data over a User Plane bearer, such as IP, to aid network and SET based positioning technologies in the calculation of a SET's position. SUPL includes but is not limited to the definition of a Location User Plane (Lup) Reference Point and corresponding interface between the SUPL Network and SET, security functions (e.g., authentication, authorization), charging functions, roaming functions, and privacy functions.

SUPL is used by MLS Applications via a SUPL Agent to determine the position of a SET. SUPL itself does not specify an API for direct use by MLS Applications.

The SUPL architecture is dependent on [OMA RLP 1.1]. For a limited set of configurations [OMA RLP 1.0] provides sufficient support.

5.1 Dependencies

The SUPL architecture is dependent on the following OMA enablers:

- o OMA Mobile Location Service, Version 1.2 (see [OMA MLP 3.3] and [OMA RLP 1.1])
- o OMA Push (see [WAP PUSH], [WAP POTAP], [WAP PAP], [SIP PUSH])

The SUPL architecture is also dependent on the following specifications:

- o [3GPP RRC]
- o [3GPP RRLP]
- o [3GPP2 C.S0022-A]
- o [3GPP2 C.S0022-0]

5.2 Architectural Diagram

This section identifies the SUPL Network architecture model, comprised of the User Plane location services related network entities and associated Reference Points.

A network entity (i.e., system and subsystem) represents a group of functions, and not necessarily a physical device. The physical realization is an implementation decision: a manufacturer may choose any physical implementation of network entities, either individually or in combination, as long as the implementation meets the functional requirements.

A Reference Point is a conceptual demarcation of two groups of functions. It is not necessarily a physical interface. A Reference Point only becomes one or several physical interfaces when the network entities on each of its sides are contained in different physical devices. One or more protocols may be defined for the instantiation of an interface. As the Lup Reference Point is instantiated by one interface, we use both terms in this document. The corresponding protocol is defined in the detailed technical specification [OMA ULP].

In generic environments, the required SUPL components are the SET and the network component SLP containing the SLC and SPC systems. The SET communicates with the network over the Lup interface. In environments where SLC and SPC are deployed as separate entities, SLC and SPC communicate with each other over the Llp interface. In environments where the SLC and the SPC are deployed as a single entity, the Llp interface does not apply.

In MNO environments, several entities and their interfaces may also be needed as illustrated in the figure in this section.

The detailed functions and definitions of the components defined in this figure are explained in Section 5.2.3, 5.3, 5.4 and 5.5 and in the SUPL TS [OMA ULP].

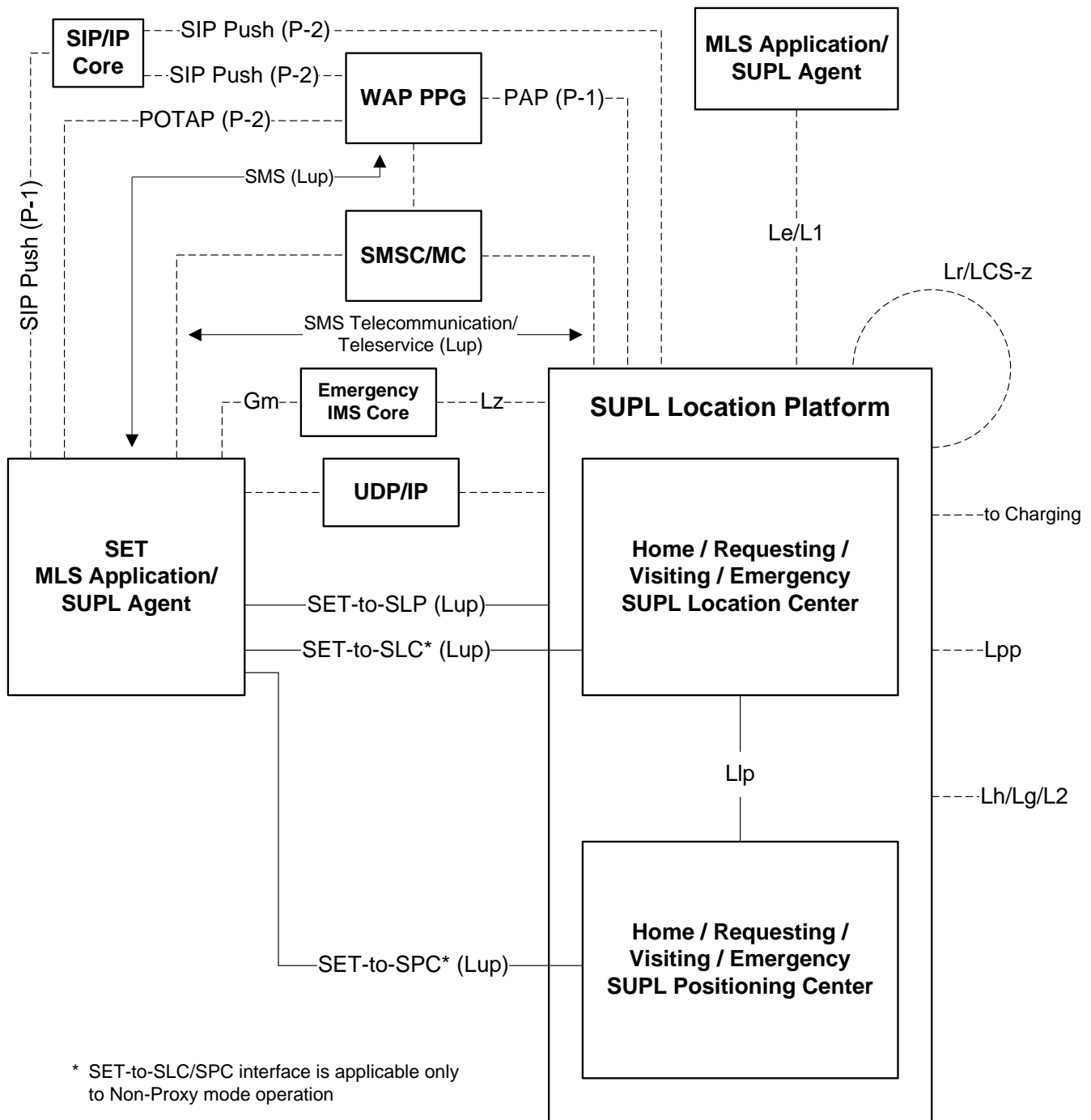


Figure 1: SUPL Architecture

5.2.1 Communication Mechanisms and Interfaces Covered by Lup

The communication mechanisms for conveying location request notification from the SLP to the SET include OMA Push, SMS, UDP/IP and SIP Push. The protocols involved in OMA Push are PAP (Push Access Protocol) for conveying location request notification from the SLP to the PPG (Push Proxy Gateway), and POTAP (Push Over-The-Air Protocol) and SIP Push for conveying such notification from the PPG to the SET. SMS delivery of notification is another option, and can be

initiated either by SMS Trigger from the SLP, or by WAP notification. Protocol interfaces for SMS delivery are not specified in the diagram, since the interface between SLP and SMSC/MC is proprietary (e.g., SMPP) and is not defined by 3GPP/3GPP2. The communication path from SMSC/MC to the SET is outside the scope of this document.

In proxy-mode the SUPL application message exchange for service management and positioning determination occurs between the SLP and the SET. In non-proxy-mode the service management related message exchange occurs between the SLC and the SET, where the positioning determination related message exchange occurs between the SPC and the SET.

5.2.1.1 IMS Emergency Location Services

For IMS emergency location services, the SUPL location request notification may be conveyed from the E-SLP to the SET via the Emergency IMS Core using SIP Push [SIP PUSH]. The Emergency IMS Core correlates the location request notification with the IMS emergency call and delivers the notification to the SET.

5.2.2 SUPL and OMA Architecture models

This section provides an informative mapping of the SUPL architecture as it relates to the OMA Architecture defined in [OMA AD].

- o The SUPL SLP is contained within the OMA Architecture [OMA AD] node called “Location Server”.
- o The SUPL SET is contained within the OMA Architecture [OMA AD] node called “End User Device”.
- o The MLS Application/SUPL Agent corresponds to the OMA Architecture [OMA AD] node “Location Based Application.” Contained within “Requesting Applications”.
- o The SUPL Le/L1 Reference Point refers to the OMA Architecture [OMA AD] Reference Point L-1.
- o The SUPL architecture provides the following alternatives for implementing the SUPL Initiation Function (SIF).
 - The SIF using a WAP PPG refers to the P-1/P-1s per OMA Architecture [OMA AD]. For delivery according to POTAP [WAP POTAP], Reference Point P-2/P-2s of the OMA Architecture [OMA AD] is situated between the WAP PPG and the SET. For delivery according to SIP Push [SIP PUSH], Reference Point P-2 is situated between the WAP PPG and the SIP/IP Core. Reference Point P-1 is situated between the SIP/IP Core and the SET.
 - The SIF using SIP Push [SIP PUSH]. Reference Point P-2 is situated between the SLP and the SIP/IP Core. Reference Point P-1 is situated between the SIP/IP Core and the SET.
 - The SIF using the SMS related Core and Access Network support has no direct mapping to the OMA Architecture [OMA AD].
 - The SIF using the UDP/IP Core and Access Network support has no direct mapping to the OMA Architecture [OMA AD].
 - The SIF using SIP Push [SIP PUSH] for the associated IMS emergency call. Reference Point Lz is situated between the E-SLP and the Emergency IMS Core. Reference Point Gm is situated between the Emergency IMS Core and the SET.

5.2.3 SUPL System and Subsystem Descriptions

5.2.3.1 SUPL Location Platform (SLP)

5.2.3.1.1 SLP Role

For any SET, a SLP can perform the role of the home SLP (H-SLP), visited SLP (V-SLP) or emergency SLP (E-SLP). A particular SLP may perform one or more of these roles for multiple SETs.

The H-SLP for a particular SET contains the subscription, authentication and privacy related data for the SET and would generally be associated with or part of the SET’s home PLMN.

The E-SLP for a particular SET is an SLP associated with or contained within the PLMN serving the SET that is employed by the serving PLMN to perform positioning in association with an emergency services call initiated by the SET. The E-SLP may be the H-SLP if the SET is not roaming. If the SET is roaming and the E-SLP is not the H-SLP or if the SET is not roaming and the E-SLP is physically or logically separate to the H-SLP, SUPL positioning may occur without interaction with the H-SLP.

The V-SLP for a particular SET would be an SLP chosen by the H-SLP or E-SLP to assist positioning. In the case of an H-SLP, the SET would be roaming outside the coverage area of the H-SLP. In the case of an E-SLP, the SET would have initiated an emergency services call outside the coverage area of the E-SLP. Note that the coverage area of an SLP need not be the same as the coverage area of any PLMN with which the SLP is associated.

It should be noted that SUPL roaming will not occur and a V-SLP will not be needed for positioning associated with emergency services calls if calls can only be placed within the service area of an E-SLP.

5.2.3.1.2 SLP Architecture

The SLP consists of an SLC and SPC. The SLC and SPC may be integrated into a single system. The Lup interface is used between the SLP and the SET. The Lup interface is used to deliver messages for Location Management and Positioning Determination.

It may also be possible to separate the SLC and SPC functionality into separate systems within the SLP.

There are two different communication modes between SET and SLP:

- o **Proxy Mode:** The SPC system will not have direct communication with the SET. In this environment the SLC system will act as a proxy between the SET and the SPC.
- o **Non-Proxy Mode:** The SPC system will have direct communication with the SET.

The Lup interface is used between the SLP and SET. The Lup carries two types of messaging:

- o Messaging destined to the SLC system within the SLP – Lup Location Management Messages
- o Messaging destined to the SPC system within the SLP – Lup Positioning Determination Messages

5.2.3.2 SUPL Location Center (SLC)

The SLC system coordinates the operations of SUPL in the network and performs the following functions as it interacts with the SET over User Plane bearer:

- o SUPL Privacy Function (SPF)
- o SUPL Initiation Function (SIF)
- o SUPL Security Function (SSF)
- o SUPL Roaming Support Function (SRSF)
- o SUPL Charging Function (SCF)
- o SUPL Service Management Function (SSMF)
- o SUPL Triggering Function (STF)
- o SUPL Positioning Calculation Function (SPCF)
 - The SLC may perform the translation of a location identifier to a geographic location expressed in latitude and longitude data. This location may meet the requested QoP of the SUPL Agent. In MNO environments this is often referred to as Cell-ID location.

5.2.3.3 SUPL Positioning Center (SPC)

The SPC supports the following functions:

- o SUPL Security Function (SSF)

- o SUPL Assistance Delivery Function (SADF)
- o SUPL Reference Retrieval Function (SRRF)
- o SUPL Positioning Calculation Function (SPCF)

5.2.3.4 SUPL Enabled Terminal (SET)

The SET supports the procedures defined in SUPL as it interacts with the network over the User Plane bearer. The SET may support one or more of the following functions depending on its capabilities and the SUPL Provider's business rules:

- o SUPL Privacy Function (SPF)
- o SUPL Security Function (SSF)
- o SUPL SET Provisioning Function (SSPF)
- o SUPL Initiation Function (SIF)
- o SUPL Triggering Function (STF)

The SET supports SET-based and/or SET-assisted positioning calculation. The SET may support the following functions:

- o SUPL Positioning Calculation Function (SPCF)
- o SUPL Assistance Delivery Function (SADF)

There is overlap between functionalities of SLC/SPC and SET.

5.2.3.5 Allocation of SUPL Functions to SUPL Subsystems

Table 1 shows the allocation of SUPL functional entities to elements of the SUPL System.

	SLC	SPC	SET
SUPL Location Services Functional Group			
SUPL Privacy Function (SPF)	○		○
SUPL Initiation Function (SIF)	○		○
SUPL Security Function (SSF)	○	○	○
SUPL Roaming Support Functions (SRSF)	○		
SUPL Charging Function (SCF)	○		
SUPL Service Management Function (SSMF)	○		
SUPL SET Provisioning Function (SSPF)			○
SUPL Triggering Function (STF)	○		○
SUPL Positioning Functional Group			
SUPL Assistance Delivery Function (SADF)		○	○
SUPL Reference Retrieval Function (SRRF)		○	
SUPL Positioning Calculation Function (SPCF)	○	○	○
	SLC	SPC	SET

Table 1: Allocation of SUPL Functions to SUPL Subsystems

5.3 Functional Groups and Reference Points

5.3.1 SUPL Location Services Functional Group

This section identifies and describes the logical functional entities within the SUPL location services functional group. The purpose of this section is to ensure that all possible functions are identified which are required to enable a SUPL service.

5.3.1.1 SUPL Privacy Function (SPF)

The SPF is the function of ensuring the privacy of a SET User is honored. The following must be considered:

- o Adhere to the target SET User privacy setting regardless of SUPL Network Initiated Services or SET Initiated Services
- o Adhere to notification and verification settings of the target SET User
- o Allow override of the target SET User privacy settings as mandated or allowed by local regulations for positioning for an emergency services call
- o Allow for future lawful override regulations that may apply to the target SET User

SUPL may use other enablers to implement parts of the SPF. Alternatively, the SPF may be implemented in the SET.

5.3.1.2 SUPL Initiation Function (SIF)

The SIF provides a mechanism for a SUPL Network to initiate a transaction with a SET. The initiation function is of special importance in enabling SUPL Network Initiated Services.

In case of a SUPL Network Initiated Service the SUPL Network initiates the SUPL transaction by using one of the following methods:

- o OMA Push
- o SMS directly in an MNO environment
- o UDP/IP
- o SIP Push [SIP PUSH]

Note: OMA Push is considered to be any delivery method that utilizes the Push Access Protocol (PAP), regardless of whether POTAP or SIP Push is used for the final delivery to the SET.

Depending upon SET capabilities, the applicable SIF method is applied by the SUPL Network (determination of SET capabilities is out of scope of SUPL).

A SET SHALL support the SIF using at least one of POTAP, SIP Push and SMS. A SET that is capable of initiating an emergency services call using an IP bearer¹ SHALL also support the SIF using UDP/IP or SIP Push.

For GSM/WCDMA/TD-SCDMA deployments, the SIF using OMA Push SHALL be supported by both the SET and the SLP. For CDMA/CDMA2000 deployments, the SIF using MT SMS SHALL be supported by both the SET and the SLP. Support of other transport protocols is optional.

5.3.1.3 SUPL Security Function (SSF)

The SSF enables the SUPL Network to authenticate and authorize the SET and enables the SET to authenticate and authorize the SUPL Network. This is important in safely enabling both SUPL Network Initiated Services and SET Initiated Services.

The SSF also provides confidentiality and data integrity. Refer to Section 6 in the SUPL 2.0 ULP TS for details of the SSF implementation.

5.3.1.4 SUPL Roaming Support Function (SRSF)

For positioning not associated with an emergency services call, SUPL roaming occurs when a SET leaves the service area of its H-SLP. For positioning associated with an emergency services call, SUPL roaming occurs when the SET is not within the

¹ While SET support of SUPL for positioning in association with an emergency services call initiated using an IP bearer is mandated in this specification, a network operator may choose not to employ SUPL – e.g., may use a control plane location solution.

service area of the E-SLP. The service area of an H-SLP or E-SLP includes the area within which the H-SLP or E-SLP can provide a position estimate for a SET or relevant assistance data to a SET without contacting other SLPs. It should be noted that an H-SLP or E-SLP service area is not necessarily associated with the service area(s) of the underlying wireless network(s).

There are variants of SUPL roaming which are summarized below:

- o The H-SLP or E-SLP may request the V-SLP to provide an initial position estimate, e.g., based upon Location ID.
- o The H-SLP or E-SLP may request the V-SLP to provide the Lpp Positioning Determination and SPC functionality.

The decision of which variant is applied is implementation specific and out of the scope of this specification. For information purposes, the decision will depend upon such factors as:

- (i) Roaming agreements between SUPL Providers;
- (ii) Location ID;
- (iii) Cached information;
- (iv) H-SLP/SET or E-SLP/SET negotiation parameters such as positioning method.

5.3.1.5 SUPL Charging Function (SCF)

The SCF is responsible for charging activities within the SLP. This includes charging of MLS Application, SUPL Agents and SET Users.

The main task of the SCF is to collect appropriate charging related data and data for accounting between SUPL Providers. Additionally, the SCF may authorize activities in the SLP (e.g., assistance data and location delivery) based on assessment of available charging data. Further details of the SCF are outside the scope of SUPL.

5.3.1.6 SUPL Service Management Function (SSMF)

The SSMF is the function of managing locations of SETs. This function stores, extracts, and modifies the location information of a target SET. During the execution of this function, the integration with charging, privacy, security, QoS functions SHALL be considered.

5.3.1.7 SUPL SET Provisioning Function (SSPF)

The SSPF is the function that manages the provisioning for the SET. The SET SHALL be provisioned with the address of the Home SLP. The provisioning of the Home SLP address in the SET MAY use OMA enablers to provision the SET.

5.3.1.8 SUPL Triggering Function (STF)

The SUPL Triggering Function is the function of communicating periodic and event based triggers between the SLP and the SET and evaluating when those trigger conditions have been fulfilled.

For Network Initiated Triggered Services, the SLP delivers trigger criteria to the SET. For SET Initiated Triggered Services, the SET sends trigger criteria to the SLP. In some circumstances, the SLP may also return additional trigger criteria to the SET during SET Initiated Triggered Services (e.g., an area id list if the SET has requested an event based trigger with a geographic target area).

It is the responsibility of the SET to determine when these trigger criteria have been met.

For periodic triggers, the criteria may include:

- o the number of fixes;
- o the interval between fixes;
- o a start time for the trigger.

For event based triggers, the criteria may include:

- o the type of the area event (Entering, Leaving, Inside or Outside) (see 5.3.1.8.2 for more details);
- o a geographic target area list;
- o an area id list;
- o repeated reporting information which indicates whether the SET can re-use the trigger and for how many times and at what minimum interval (see 5.3.1.8.1 for more details);
- o a start and a stop time.

When an area id list but not a geographic target area list is present in an event based trigger, the area id list is used as the target area for the trigger. When a geographic target area list is present but not an area id list, the geographic target area list is taken as the target area. When both a geographic target area list and an area id list are present in an event based trigger, the geographic target area is taken as the actual target area and the area id list is used to help the SET avoid unnecessary positioning attempts (the exact procedure will vary based on the type of trigger and is explained in more detail in [OMA ULP][OMA ULP]).

5.3.1.8.1 Repeated reporting and event triggers

When event based triggers are combined with repeated reporting, a minimum interval and a number of reports must be specified. Regardless of the event type (see 5.3.1.8.2 for a detailed description of the different event types), the SLP and the SET shall continue the triggered event session until either:

- o the requested number of reports has been returned;
- o the stop time, if present, has elapsed;
- o a SUPL TRIGGERED STOP or SUPL END has been received to cancel the session.

5.3.1.8.2 Event trigger types

The “Entering” and “Inside” trigger types both mean the SET should report as soon as it detects that it is inside the target area. The difference between these trigger types is in their behavior when combined with repeated reporting. With repeated reporting, the “Entering” trigger will be initially fulfilled the first time the SET detects that it is inside the target area. For the trigger condition to be fulfilled again, the SET has to subsequently detect that it has left the target area and then re-entered. Whenever the SET sends a report, it must wait for the minimum reporting interval before checking if the trigger condition is fulfilled again.

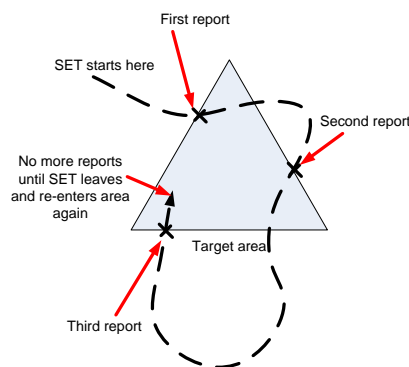


Figure 2: The “Entering” Trigger with Repeated Reporting

The “Inside” trigger, by contrast, when combined with repeated reporting will result in repeated reports for as long as the SET detects that it is inside the area.

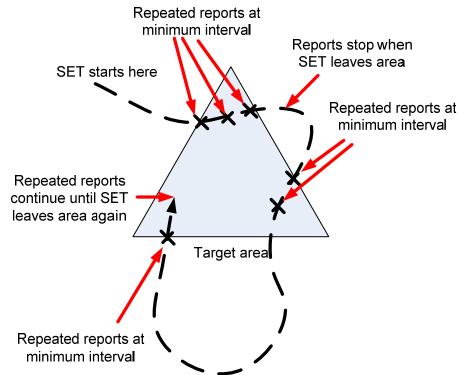


Figure 3: The “Inside” Trigger with Repeated Reporting

Note that for both the “Entering” and “Inside” trigger types, if the SET starts out within the target area when the trigger becomes active (i.e., at the receipt of the trigger criteria if no start time was specified or at the appropriate start time if one was specified), the trigger condition will be fulfilled. There is no requirement for the SET to verify that it was previously outside the area before the first report is sent.

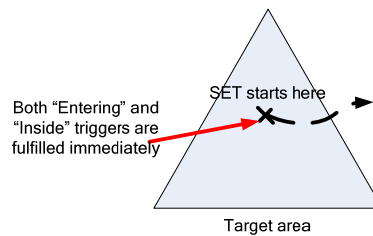


Figure 4: SET Starting Inside Target Area for both “Entering” and “Inside” Triggers

The “Leaving” and “Outside” trigger types behave in a similar manner, but are only fulfilled when the SET is outside the target area. As with the “Entering” and “Inside” trigger types, the “Leaving” and “Outside” triggers have identical behaviors when no repeated reporting is used. They are both fulfilled the first time the SET detects that it is outside the target area.

With repeated reporting, the leaving trigger is fulfilled the first time the SET detects that it is outside the target area, and then subsequently each time the SET detects that it has re-entered the target area and then exited again. Whenever the SET sends a report, it must wait for the minimum reporting interval before checking if the trigger condition is fulfilled again.

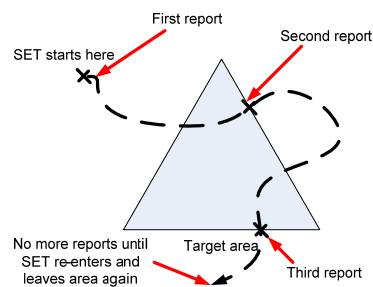


Figure 5: The “Leaving” Trigger with Repeated Reporting

The “Outside” trigger, when combined with repeated reporting, results in repeated reports at the minimum reporting interval for as long as the SET remains outside the target area.

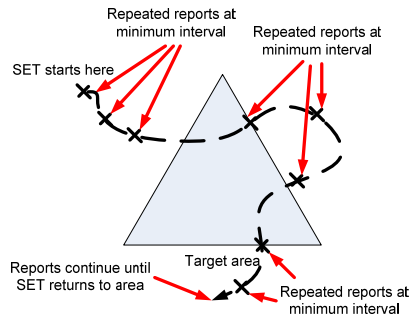


Figure 6: The “Outside” Trigger with Repeated Reporting

5.3.2 SUPL Positioning Functional Group

This section identifies and describes the logical functional entities within the SUPL Positioning Functional Group.

5.3.2.1 SUPL Assistance Delivery Function (SADF)

The SADF selects, generates and delivers available assistance data that is used for the measurement or the calculation of a SET position. The assistance data delivery may be based on a selected subset of GPS or GANSS reference data retrieved from SRRF function, the capability of SET and network, and the approximate position information of the target SET.

Assistance data may consist of the elements defined in [3GPP RRLP], [3GPP RRC], [3GPP2 C.S0022-A], [3GPP2 C.S0022-0], or [3GPP LPP].

5.3.2.2 SUPL Reference Retrieval Function (SRRF)

The SRRF is the function of retrieving GPS or GANSS reference data from a GPS or GANSS reference network. Reference data is needed to generate assistance data. The interface between this function and GPS or GANSS reference network is outside the scope of this document.

5.3.2.3 SUPL Position Calculation Function (SPCF)

The SPCF selects the positioning protocol and protocol version, and performs the function of calculating the position of a SET. One or more of the following positioning calculation modes may be supported by a SUPL service.

- o A-GPS SET assisted
- o A-GPS SET based
- o A-GANSS SET assisted
- o A-GANSS SET based
- o Autonomous GPS or Autonomous GANSS
- o Enhanced Cell/Sector
- o AFLT
- o EOTD
- o OTDOA
- o Location ID – SHALL be supported
 - Perform translation of a location identifier to a geographic location expressed in latitude and longitude. In MNO environments this is often referred to as Cell-ID location.

Note: Applicability of a particular positioning calculation mode is subject to the support in relevant 3GPP and 3GPP2 specifications that SUPL relies on.

5.3.3 SUPL Reference Point Definitions

This section defines the Reference Points identified in the SUPL architecture.

5.3.3.1 Lup Reference Point

The function of the Lup Reference Point is logically separated into Location Service Management and Positioning Determination.

5.3.3.1.1 Lup Location Service Management Messages

This Reference Point is used to enable the SLP to establish a session with the SET and to perform the functions listed in the Location Services Functional Group in Table 1.

Message Name	Description
SUPL INIT	The SUPL INIT message is used by the SLP to initiate a SUPL Session with the SET. This message is used in Network Initiated SUPL Services.
SUPL SET INIT	The SUPL SET INIT message is used by the SET to initiate a SUPL Session to locate the other SET.
SUPL START	The SUPL START message is used by the SET to start a SUPL Session with the SLP.
SUPL TRIGGERED START	The SUPL TRIGGERED START message is used by the SET to start a triggered SUPL Session with the SLP.
SUPL RESPONSE	The SUPL RESPONSE message is used by the SLP as a response to a SUPL START message in a SET initiated location request.
SUPL TRIGGERED RESPONSE	The SUPL TRIGGERED RESPONSE message is used by the SLP as a response to a SUPL TRIGGERED START message.
SUPL TRIGGERED STOP	The SUPL TRIGGERED STOP message is used by the SLP or SET to end an existing SUPL TRIGGERED session.
SUPL END	The SUPL END message is used by the SLP or SET to end an existing SUPL Session.
SUPL AUTH REQ	The SUPL AUTH REQ message is only used in Non-Proxy Mode for authentication of SET and SPC.
SUPL AUTH RESP	The SUPL AUTH RESP message is only used in Non-Proxy Mode for authentication of SET and SPC.
SUPL NOTIFY	The SUPL NOTIFY message is only used by the SLP in notification based on the current location of the SET.
SUPL NOTIFY RESPONSE	The SUPL NOTIFY RESPONSE message is used by the SET as a response to a SUPL NOTIFY. Message.
SUPL REPORT	The SUPL REPORT message is used by the SLP or SET to report position estimate and/or network measurement results.

Table 2 : Lup Location Service Management Messages

5.3.3.1.2 Lup Positioning Determination Messages

The Lup Positioning Determination Reference Point is used to transport information between the SET and the SLP for the calculation of position. The functions of the Positioning Determination Functional Group are shown in Table 1.

Table 3 lists the Lup Positioning Determination messages.

Message Name	Description
SUPL POS	The SUPL POS message is used between the SLP and SET to exchange positioning procedure messages (RRLP/RRC/TIA-801) used to calculate the position of the SET.
SUPL POS INIT	The SUPL POS INIT message is used by the SET to initiate the positioning protocol session (RRLP/RRC/TIA-801) with the SLP.
SUPL REPORT	The SUPL REPORT message is used by the SLP or SET to report position estimate result.
SUPL END	The SUPL END message is used by the SLP or SET to end an existing SUPL Session.

Table 3: Lup Positioning Determination Messages

5.3.3.2 Llp Reference Point

The Llp reference logically separates the Positioning Control Function and the Positioning Data Function.

5.3.3.2.1 Llp Positioning Control Function Messages

The Positioning Control Function is used in the establishment, maintenance and clearing of sessions between the SLC and the SPC. The Positioning Control Function enables the SLC and SPC to perform the Position Calculation Function.

Table 4 lists the Llp Positioning Control Function messages.

Message Name	Description
PREQ	The PREQ message is used by the SLC to request a SUPL Session of the SPC.
PRES	The PRES message is the response to a PREQ message and sent by the SPC to the SLC.
PRPT	The PRPT message is used by the SPC to report a position estimate or an error to the SLC.
PLREQ	The PLREQ message is used by the SLC (or SPC) to request a cell-id translation into coarse position estimate from the SPC (or SLC).
PLRES	The PLRES message is used by the SPC (or SLC) to report a coarse position estimate based on cell-id translation to the SLC (or SPC).
PAUTH	The PAUTH message is used by the SLC to send SUPL authentication parameters to the SPC.
PALIVE	The PALIVE message is used by the SLC to verify the operational status of the SPC. The SLC may send the PALIVE message at any time. The SPC must then respond with a corresponding PALIVE message.
PEND	The PLEND message is used by the SLC (or SPC) to inform the SPC (or SLC) about the end of a SUPL Session.

Table 4: Llp Positioning Control Function Messages

5.3.3.2 Llp Positioning Data Function Messages

The Positioning Data Function is used to transport the data that is used for position calculations. The Positioning Data Function interface is only used in Proxy Mode.

lists the Llp Positioning Data Function messages.

Message Name	Description
PMESS	The PMESS message is bidirectional and is used to carry RRLP/RRC/TIA-801 payloads.
PINIT	The PINIT message is used by the SLC to initiate the positioning protocol session (RRLP/RRC/TIA-801) with the SPC.

Table 5: lists the Llp Positioning Data Function Messages

5.4 Llp Reference Point Flows

The flows shown in this chapter show the Llp interface message exchange. The flows can be divided into two scenarios, Network initiated and SET initiated.

A Network initiated flow occurs when the positioning is requested by an SUPL Agent in the network.

A SET initiated flow occurs when the positioning is requested by the SET.

A high level description is given below by showing a typical flow for each scenario. These flows are intended to illustrate basic concepts and are not an exhaustive list. These flows are only illustrative. Refer to [OMA ULP] for detailed flows.

5.4.1 SET Initiated flows – Proxy Mode – Immediate Service

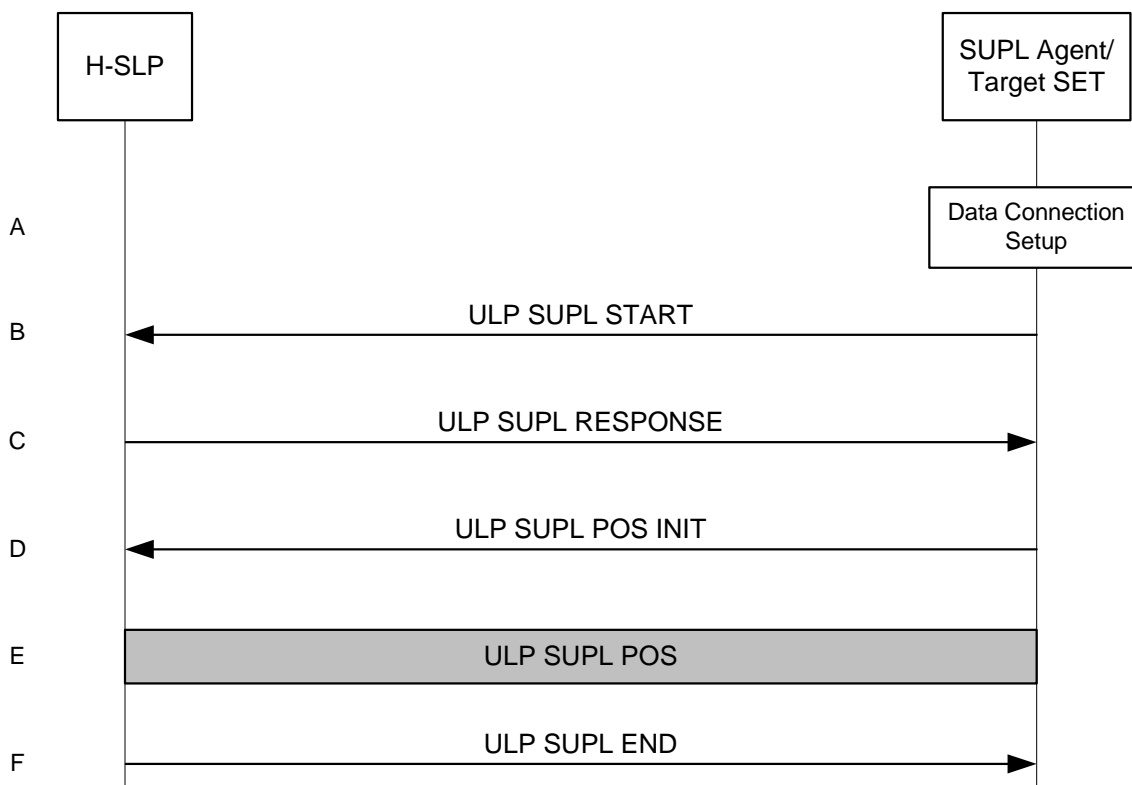


Figure 7: SET-Initiated Non-Roaming Successful Case – Proxy Mode

- A. The SUPL Agent on the SET receives a request for position from an application running on the SET. The SET establishes secure connection to the H-SLP.
- B. The SET sends a ULP SUPL START message to start a SUPL Session with the H-SLP. The ULP SUPL START message contains SET capabilities and location identifier.
- C. The H-SLP responds with a ULP SUPL RESPONSE message to the SET. The message contains the requested positioning method. It may also contain location information that does not meet the QoP requested by the SUPL Agent, but gives a coarse approximation of the position, based on information received in the ULP SUPL START message.
- D. The SET then sends a ULP SUPL POS INIT message to start a positioning session with the H-SLP. The message contains the SET capabilities and the location identifier.
- E. The H-SLP then determines the positioning method and exchanges several successive ULP SUPL POS messages, containing the used positioning protocol (i.e., RRLP, RRC, TIA-801), as needed to determine the position
- F. When the position calculation is complete the H-SLP sends the ULP SUPL END message to the SET informing it that the SUPL Session is finished. The SET then releases the secure connection to the H-SLP.

5.4.2 SET Initiated flows – Non-Proxy Mode – Immediate Service

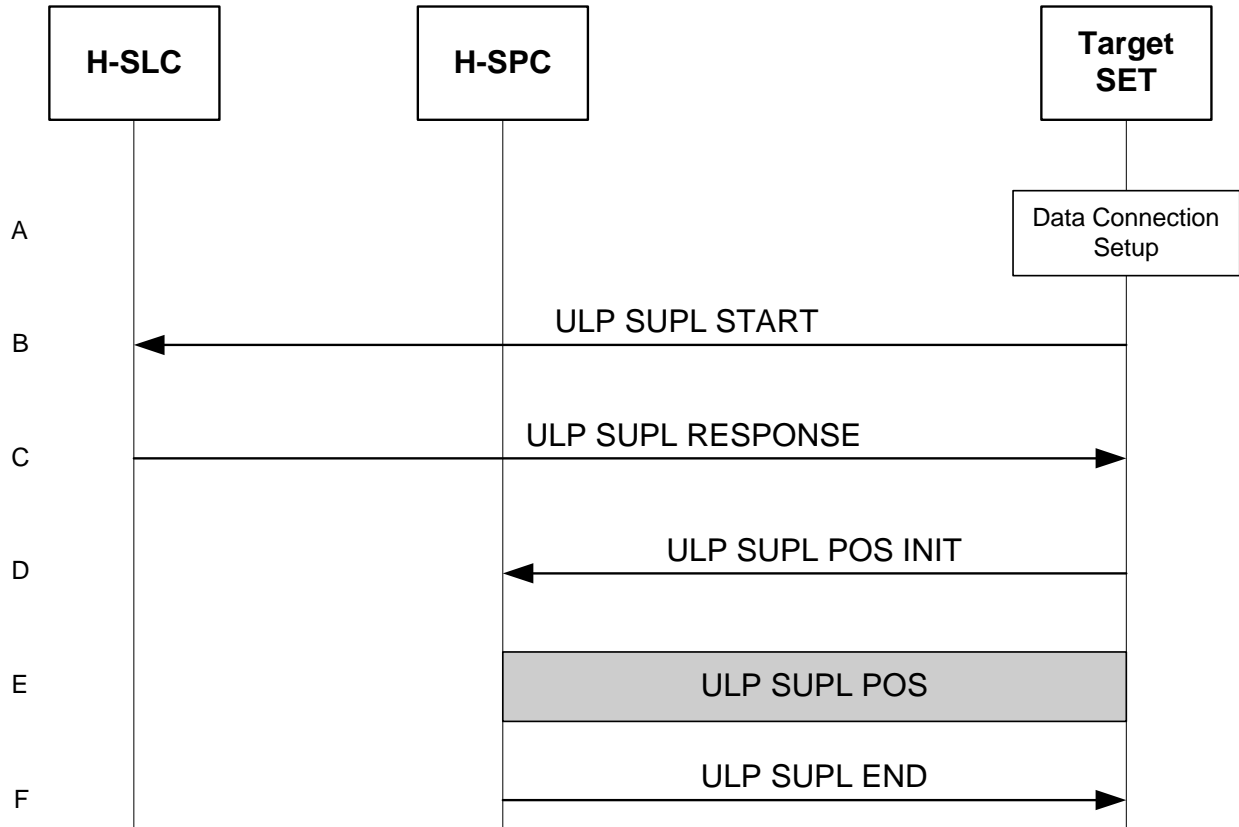


Figure 8: SET-Initiated Non-Roaming Successful Case – Non-Proxy Mode

- A. The SUPL Agent on the SET receives a request for position from an application running on the SET. The SET establishes a secure connection to the H-SLC.
- B. The SET sends an ULP SUPL START message to start a SUPL Session with the H-SLC. The ULP SUPL START message contains SET capabilities and location identifier.
- C. The H-SLC responds with a ULP SUPL RESPONSE message to the SET. The message contains the requested positioning method. It also contains key information required for the SET to establish a secure connection to the H-SPC. It MAY also contain location information not meeting the QoP requested by the SUPL Agent, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message.
- D. The SET establishes a secure connection to the H-SPC and sends a ULP SUPL POS INIT message to start a positioning session with the H-SPC. The message contains the SET capabilities and the location identifier.
- E. The H-SPC then determines the positioning method and exchanges several successive ULP SUPL POS messages, containing the used positioning protocol (i.e., RRLP, RRC, TIA-801), as needed to determine the position.
- F. When the position calculation is complete the H-SPC sends the ULP SUPL END message to the SET informing it that the SUPL Session is finished. The SET then releases the secure connection to the H-SPC.

Note: the internal communication between the H-SLC and the H-SPC is not shown in Figure 8.

5.4.3 Network Initiated flows – Non-Proxy Mode – Immediate Service

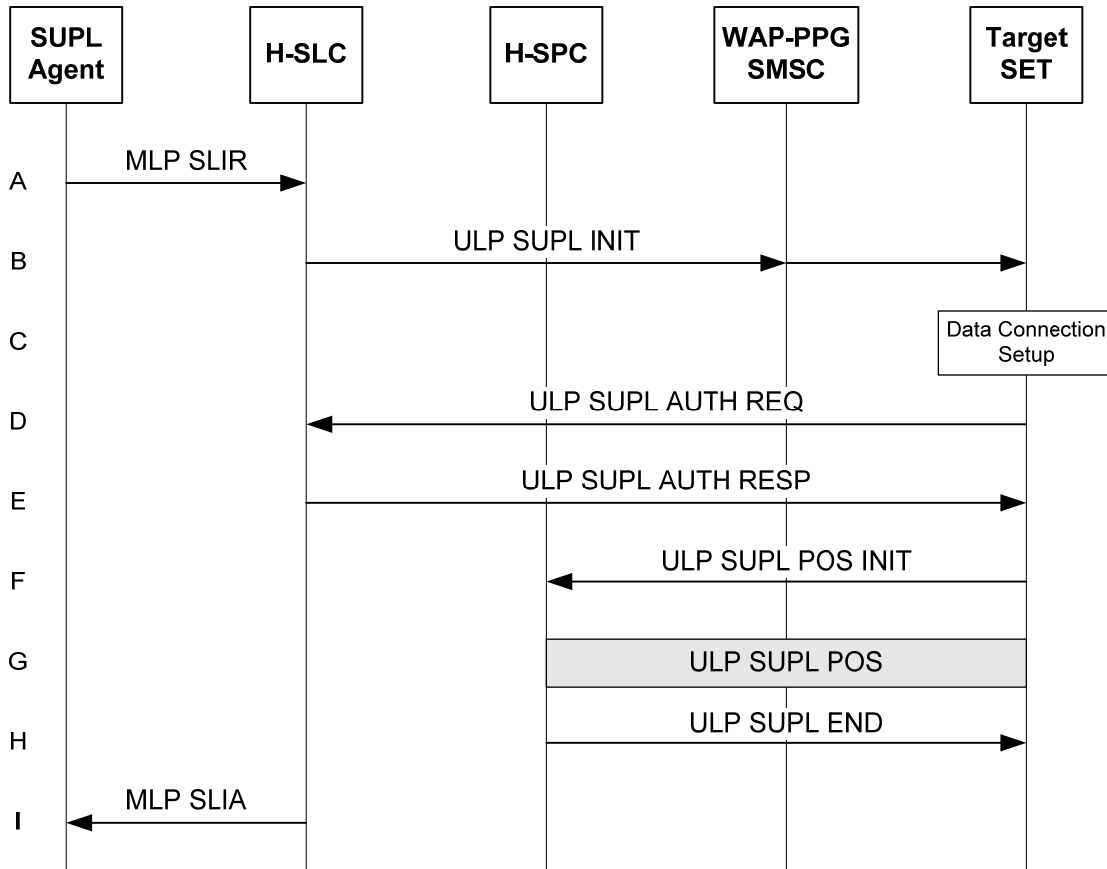


Figure 9: NW Initiated flow – Non-Proxy Mode

- A. The SUPL Agent issues an MLP SLIR message to the H-SLC.
- B. The H-SLC initiates the SUPL Session with the SET by sending a ULP SUPL INIT message. The message contains requested positioning method and SPC address.

Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- C. When the ULP SUPL INIT is received by the SET it establishes a secure connection to the H-SLC.
- D. For authentication purposes, the SET sends an ULP SUPL AUTH REQ message to the H-SLC.
- E. The H-SLC responds with an ULP SUPL AUTH RESP message to the SET. The SET releases the secure connection to the H-SLC.
- F. The SET establishes a secure connection to the H-SPC and sends a ULP SUPL POS INIT message to start a positioning session with the H-SPC. The message contains the SET capabilities.
- G. The H-SPC then determines the positioning method and exchanges several successive ULP SUPL POS messages, containing the used positioning protocol (i.e., RRLP, RRC, TIA-801), as needed to determine the position.
- H. When the position calculation is complete the H-SPC sends the ULP SUPL END message to the SET informing it that the SUPL Session is finished. The SET then releases the secure connection to the H-SPC.
- I. The H-SLC sends the position estimate back to the SUPL Agent in an MLP SLIA message.

Note: the internal communication between the H-SLC and the H-SPC is not shown in Figure 11.

5.4.4 Network Initiated flows – Proxy Mode – Immediate Service

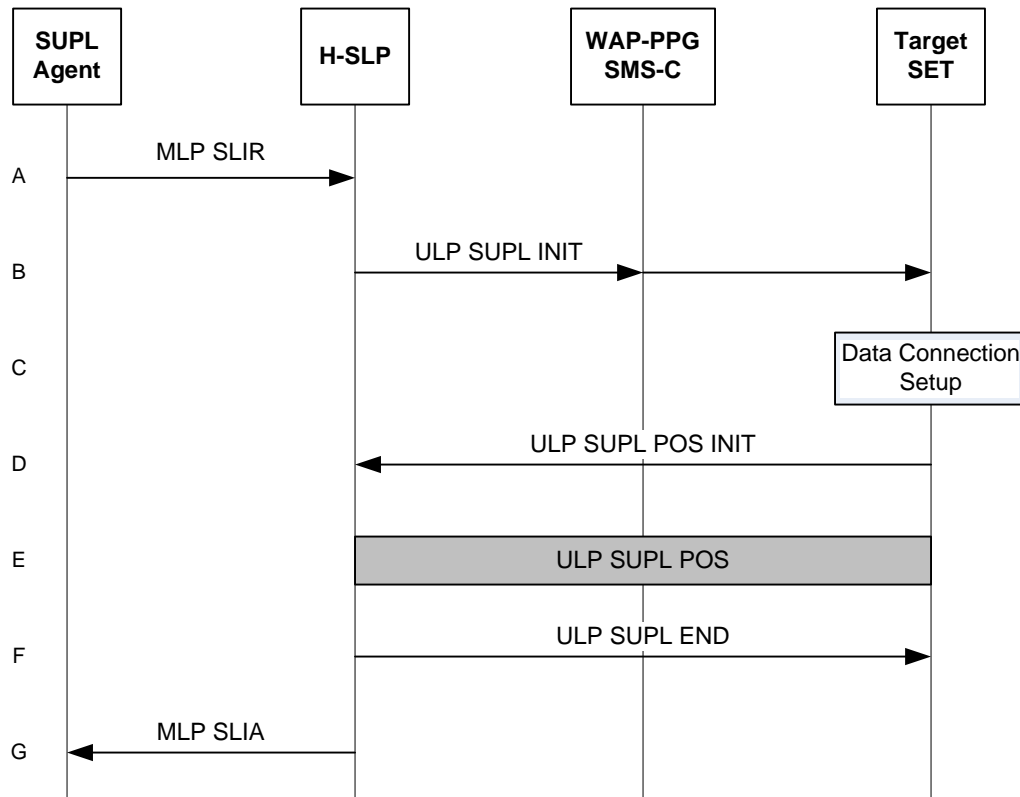


Figure 10: NW Initiated flow – Proxy Mode

- A. The SUPL Agent issues an MLP SLIR message to the H-SLP.
- B. The H-SLP initiates the SUPL Session with the SET by sending a ULP SUPL INIT message. The message contains requested positioning method.

Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- C. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLP.
- D. The SET then sends a ULP SUPL POS INIT message to start a positioning session with the H-SLP. The message contains the SET capabilities.
- E. The H-SLP then determines the positioning method and exchanges several successive ULP SUPL POS messages, containing the used positioning protocol (i.e., RRLP, RRC, TIA-801), as needed to determine the position.
- F. When the position calculation is complete the H-SLP sends the ULP SUPL END message to the SET informing it that the SUPL Session is finished. The SET then releases the secure connection to the H-SLP.
- G. The H-SLP sends the position estimate back to the SUPL Agent in an MLP SLIA message.

5.4.5 Network Initiated Proxy Mode – Triggered Services: Periodic Triggers

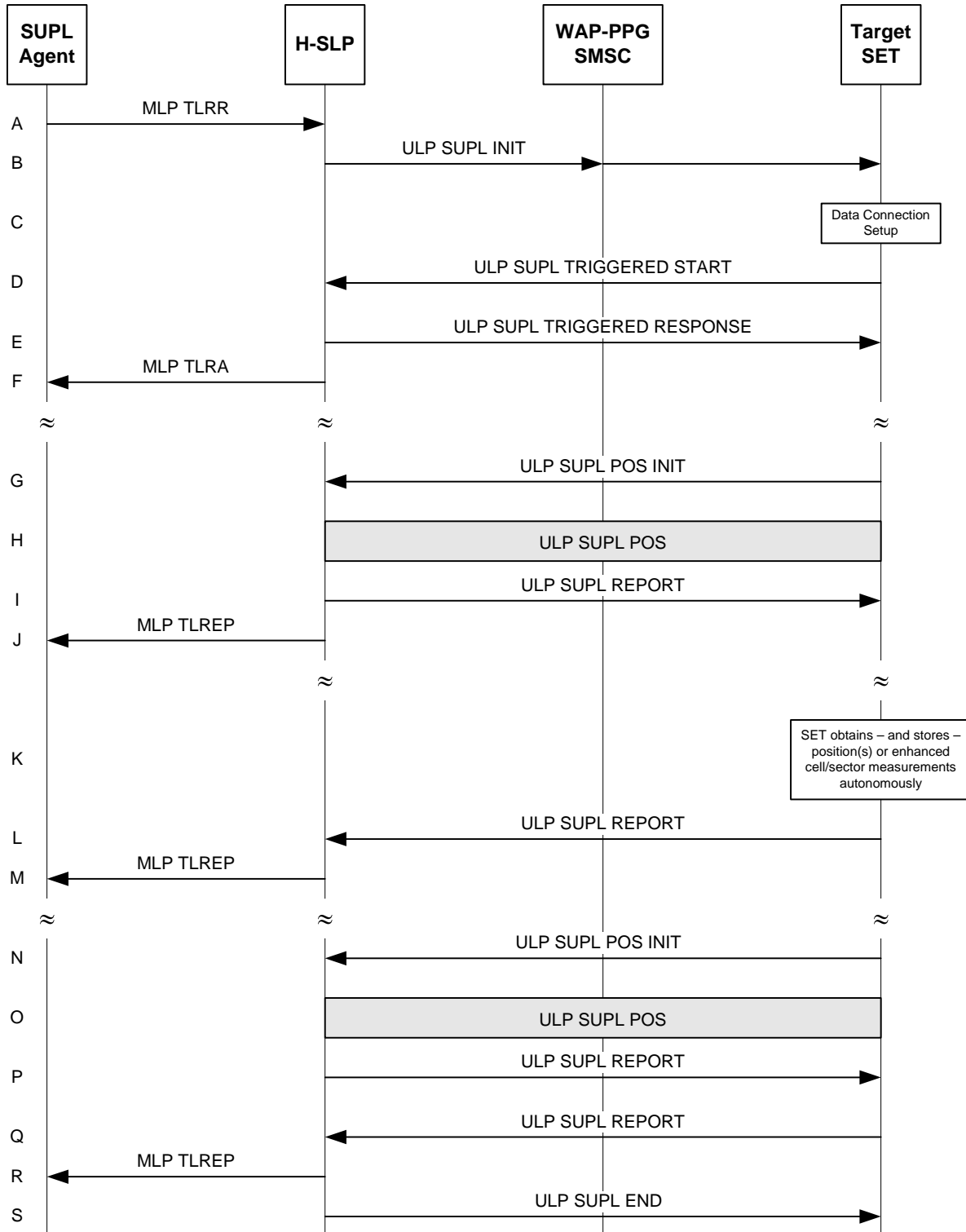


Figure 11: NW Initiated Periodic Triggered Service Non-Roaming Successful Case – Proxy Mode

A. The SUPL Agent issues an MLP TLRR to the H-SLP.

- B. The H-SLP initiates the periodic trigger session with the SET using the ULP SUPL INIT message. The message contains the intended positioning method.

Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- C. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLP.
- D. The SET then sends a ULP SUPL TRIGGERED START message to start a periodic triggered session with the H-SLP.
- E. The H-SLP selects the positioning method to be used for the periodic triggered session and responds with a ULP SUPL TRIGGERED RESPONSE message. This message contains the positioning method and periodic trigger parameters.
- F. The H-SLP informs the SUPL Agent in an MLP TLRA message that the triggered location response request has been accepted. The SET and the H-SLP may release the secure IP connection.
- G. When the periodic trigger in the SET indicates that the first position fix has to be performed, the SET sends a SUPL POS INIT message to start a positioning session with the H-SLP. Note: if there is no secure connection between the SET and the H-SLP, the SET establishes a secure connection before sending the SUPL POS INIT to the H-SLP.
- H. The SET and the H-SLP MAY exchange several successive positioning procedure messages (e.g., RRLP, RRC, TIA-801) as needed to determine the position.
- I. If the reporting mode is batch reporting and SET Assisted mode is used, the position calculated by the H-SLP is reported back to the SET for storage.
- J. When the position calculation is complete the H-SLP sends a MLP TLREP message to the SUPL Agent. This message contains the positioning result. The SET and the H-SLP may release the secure IP connection.
- K. If the SET cannot communicate with the H-SLP (e.g. no radio coverage available) and if batch reporting or quasi-real time reporting is used, the SET performs either SET Based position fixes or enhanced cell/sector measurements.
- L. The SET sends the stored position estimates and/or the stored enhanced cell/sector measurements in an unsolicited ULP SUPL REPORT message to the H-SLP. This message contains the position result(s). Note: if there is no secure connection between the SET and the H-SLP, the SET establishes a secure connection before sending the ULP SUPL REPORT to the H-SLP.
- M. If enhanced cell/sector measurements are received in step L, the H-SLP calculates corresponding position estimates. The H-SLP forwards the reported and/or calculated position estimate(s) to the SUPL Agent in an MLP TLREP message.

Steps N-to-P are a repeat of steps G-to-I. Step K might be repeated if necessary.

- Q. The SET sends the stored position estimates and/or the stored enhanced cell/sector measurements in an unsolicited ULP SUPL REPORT message to the H-SLP. This message contains the stored position result(s) and/or stored enhanced cell/sector measurements not previously reported to the H-SLP. Note: if there is no secure connection between the SET and the H-SLP, the SET establishes a secure connection before the sending ULP SUPL REPORT to the H-SLP.
- R. If enhanced cell/sector measurements are received in step Q, the H-SLP calculates corresponding position estimates. The H-SLP forwards the reported and/or calculated position estimate(s) to the SUPL Agent in an MLP TLREP message.
- S. After the last position result has been reported to the SUPL Agent in step R, the H-SLP ends the periodic triggered session by sending a SUPL END message to the SET. The SET then releases the secure connection to the H-SLP.

5.4.6 Network Initiated Proxy Mode – Triggered Services: Event Triggers

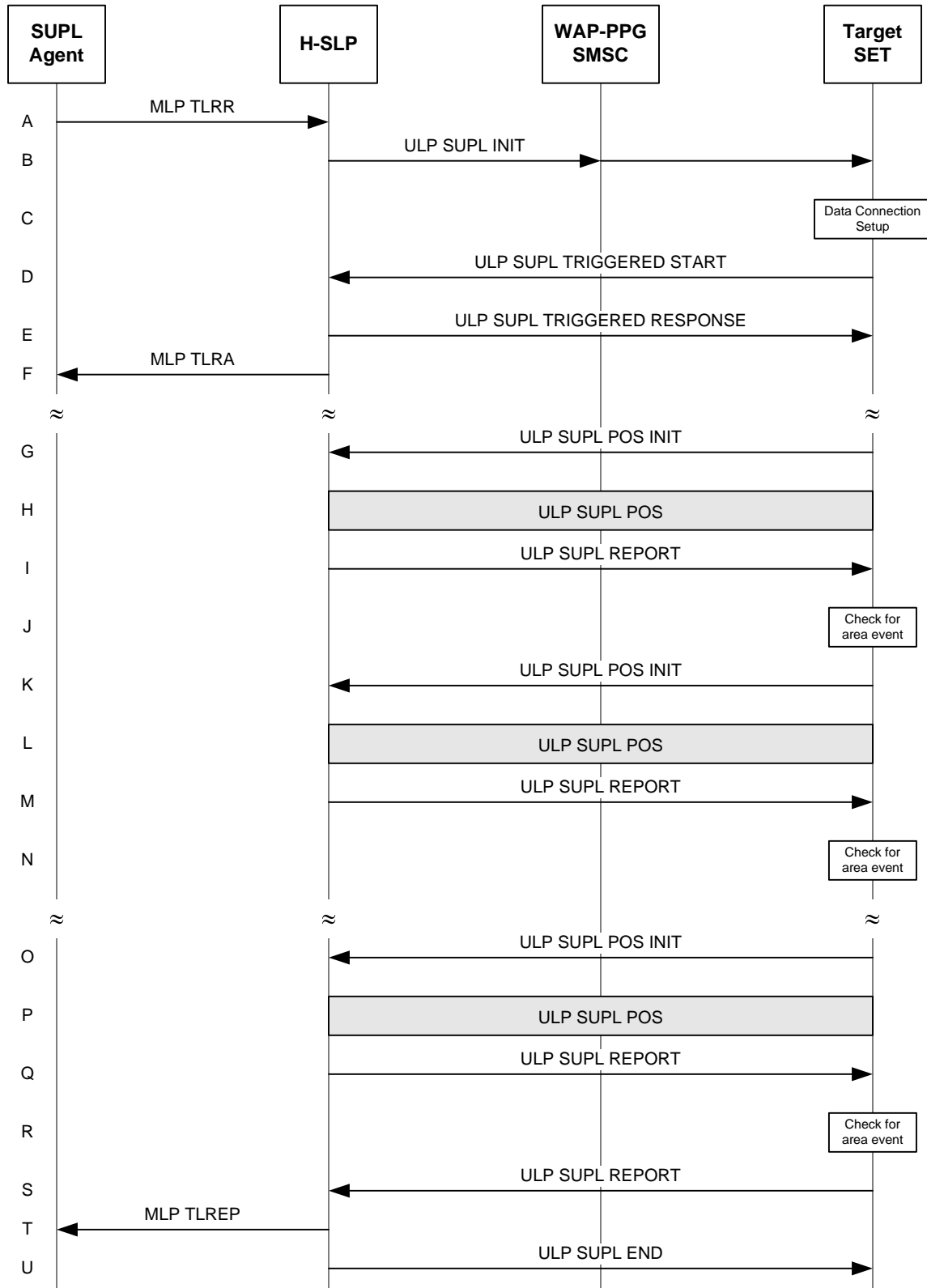


Figure 12: NW Initiated Area Event Triggered Service Non-Roaming Successful Case – Proxy Mode

- A. SUPL Agent issues an MLP TLRR to the H-SLP.
- B. The H-SLP initiates the area event trigger session with the SET using the ULP SUPL INIT message. The message contains the intended positioning method.

Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- C. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLP.
- D. The SET then sends a ULP SUPL TRIGGERED START message to start an area event triggered session with the H-SLP.
- E. The H-SLP selects a positioning method to be used for the area event triggered session and responds with a ULP SUPL TRIGGERED RESPONSE message. This message contains the positioning method and area event trigger parameters. The SUPL TRIGGERED RESPONSE message may contain the area ids of the specified area for the area event triggered session
- F. The H-SLP informs the SUPL Agent in an MLP TLRA message that the triggered location response request has been accepted. The SET and the H-SLP may release the secure IP connection.
- G. When the area event trigger mechanism in the SET or the comparison of the current area id to the downloaded area ids (if any) indicates that a position fix is to be executed, the SET sends a SUPL POS INIT message to start a positioning session with the H-SLP. Note: if there is no secure connection between the SET and the H-SLP, the SET establishes a secure connection before the sending the SUPL POS INIT to the H-SLP.
- H. The SET and the H-SLP MAY exchange several successive positioning procedure messages (e.g., RRLP, RRC, TIA-801) as needed to determine the position.
- I. When the positioning procedure is complete the H-SLP sends a ULP SUPL REPORT message to the SET. This message may contain the positioning result. The SET and the H-SLP may release the secure IP connection.
- J. The SET compares the calculated position estimate with the event area to check if the event trigger condition has been met. In this case no area event is triggered.

Whenever the area event trigger mechanism in the SET indicates that a new position fix has to be performed, steps G-to-J are repeated (e.g., steps K-to-N are a repeat of steps G-to-J).

- R. The SET compares the calculated position with the event area to check if the event trigger condition has been met. In this case the area event is triggered.
- S. If there is no secure connection between the SET and the H-SLP, the SET establishes a secure connection with the H-SLP. The SET sends a ULP SUPL REPORT message to the H-SLP. This message contains the position estimate.
- T. The H-SLP sends a MLP TLREP message to the SUPL Agent. This message contains the position estimate.
- U. The H-SLP ends the area event triggered session by sending a ULP SUPL END message to the SET. The SET then releases the secure IP connection.

5.4.7 Network Initiated flows – Roaming Proxy Mode with H-SLP Positioning – Immediate Service

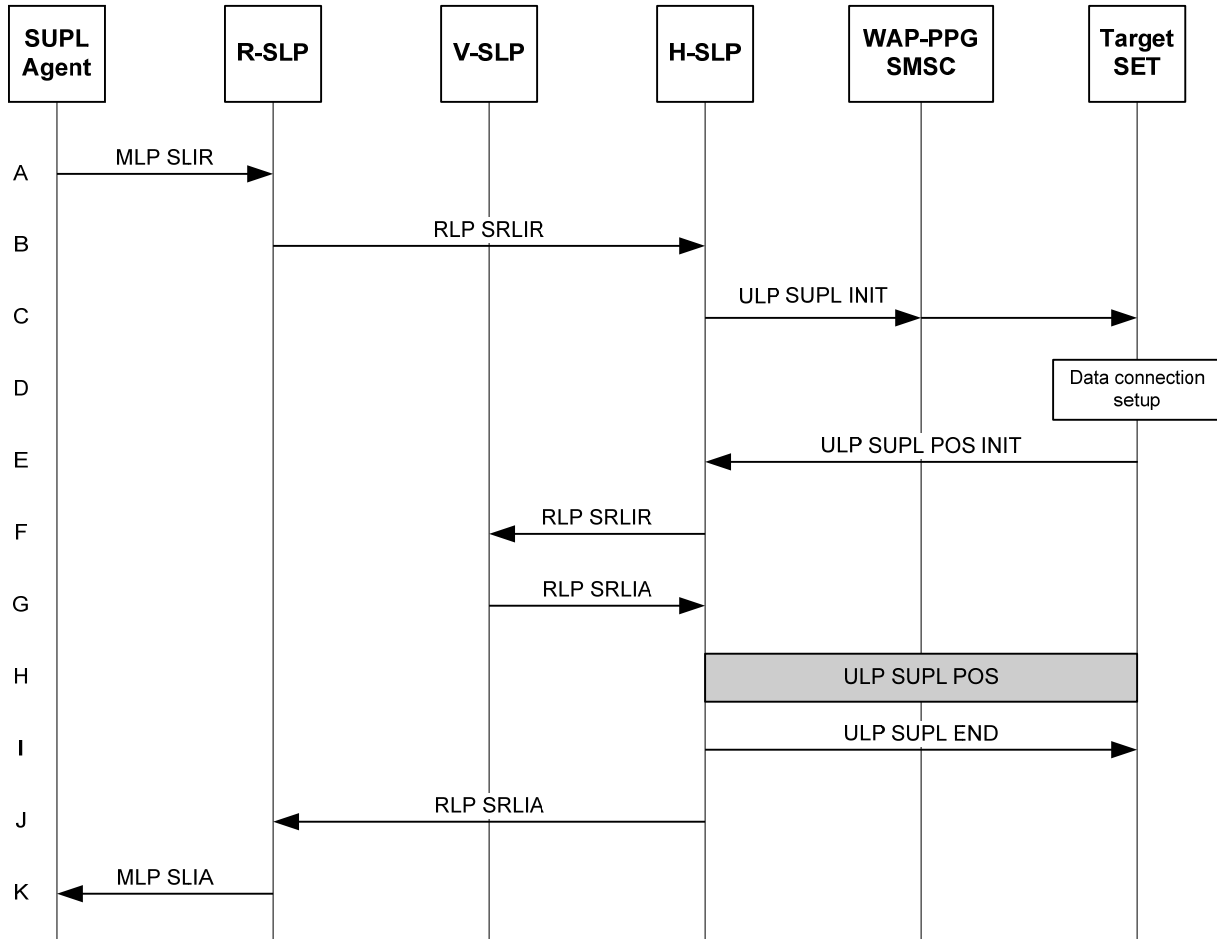


Figure 13: NW Initiated Roaming Successful Case – Proxy Mode with H-SLP

- A. SUPL Agent issues an MLP SLIR message to the R-SLP.
 - B. The R-SLP forwards the location request to the H-SLP of the target subscriber, using an RLP SRLIR. The message contains the requested QoP.
 - C. The H-SLP initiates the location session with the SET using the ULP SUPL INIT message. The message contains the requested positioning method.
- Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.
- D. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLP.
 - E. The SET then sends a ULP SUPL POS INIT message to start a positioning session with the H-SLP. The message contains the SET capabilities.
 - F. The H-SLP then decides that the H-SLP will provide assistance/position calculation and the H-SLP sends an RLP SRLIR to the V-SLP to determine a coarse position for further exchange of ULP SUPL POS messages between SET and H-SLP.
 - G. The V-SLP returns an RLP SRLIA. This message contains the position result (e.g., coarse position for A-GPS positioning).

- H. The H-SLP then determines the positioning method and exchanges several successive ULP SUPL POS messages. These messages contain the used positioning protocol messages (e.g., RRLP, RRC, TIA-801) as needed to determine the position.
- I. When the position calculation is complete the H-SLP sends the ULP SUPL END message to the SET. The SET then releases the secure IP connection to the H-SLP.
- J. The H-SLP sends an RLP SRLIA message to the R-SLP. This message contains the position estimate.
- K. The R-SLP sends an MLP SLIA message to the SUPL Agent. This message contains the position estimate.

5.4.8 Network Initiated flows – Roaming Proxy Mode with V-SLP Positioning – Immediate Service

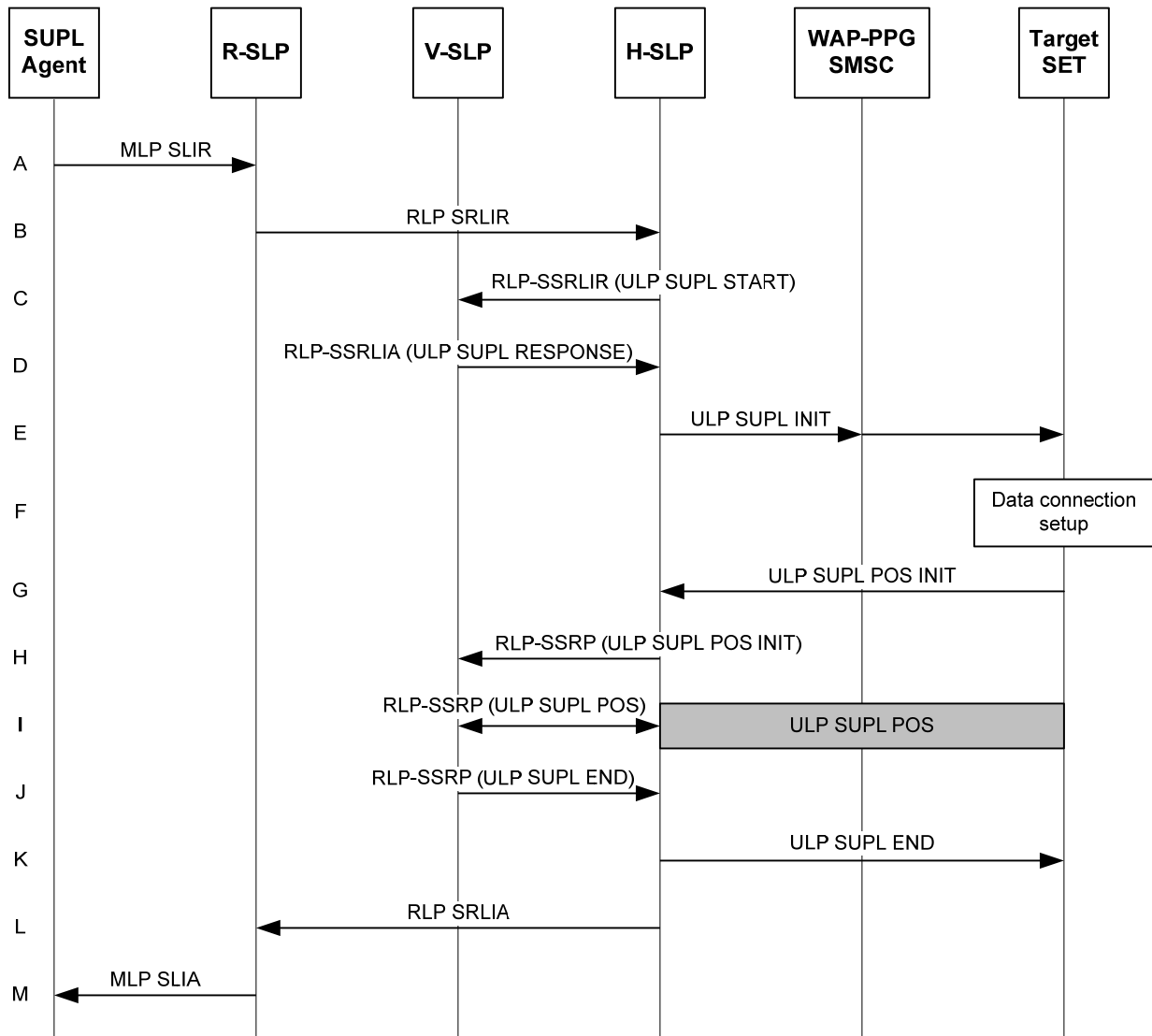


Figure 14: NW Initiated Roaming Successful Case – Proxy Mode with V-SLP

- A. A SUPL Agent issues an MLP SLIR message to the R-SLP
- B. The R-SLP forwards the location request to the H-SLP of the target subscriber, using an RLP SRLIR. The message contains requested QoP.

- C. The H-SLP sends an RLP SSRLIR to the V-SLP to inform the V-SLP that the target SET will initiate a SUPL positioning procedure. The message contains the requested QoP.
- D. The V-SLP acknowledges that it is ready to initiate a SUPL positioning procedure with an RLP SSRLIA Answer back to the H-SLP.
- E. The H-SLP initiates the location session with the SET using the ULP SUPL INIT message. The message contains the intended positioning method.

Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- F. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLP.
- G. The SET then sends a ULP SUPL POS INIT message to start a positioning session with the H-SLP. The message contains the SET capabilities.
- H. The H-SLP then tunnels the ULP SUPL POS INIT message to the V-SLP.
- I. The V-SLP then determines the positioning method and exchanges several successive ULP SUPL POS messages, tunneled over RLP via the H-SLP. These messages contain the used positioning protocol (e.g., RRLP, RRC, TIA-801) as needed to determine the position.
- J. When the position calculation is complete the V-SLP sends the ULP SUPL END message towards the SET, tunneled over RLP via the H-SLP.
- K. The H-SLP forwards the ULP SUPL END to the SET informing it that the SUPL Session is finished. The SET then releases the secure connection to the H-SLP.
- L. When the position calculation is complete the H-SLP sends an RLP SRLIA message to the R-SLP. This message contains the position estimate.
- M. The R-SLP sends an MLP SLIA message to the SUPL Agent. This message contains the position estimate.

5.4.9 Network Initiated flows – Roaming Non Proxy Mode with H-SPC Positioning – Immediate Service

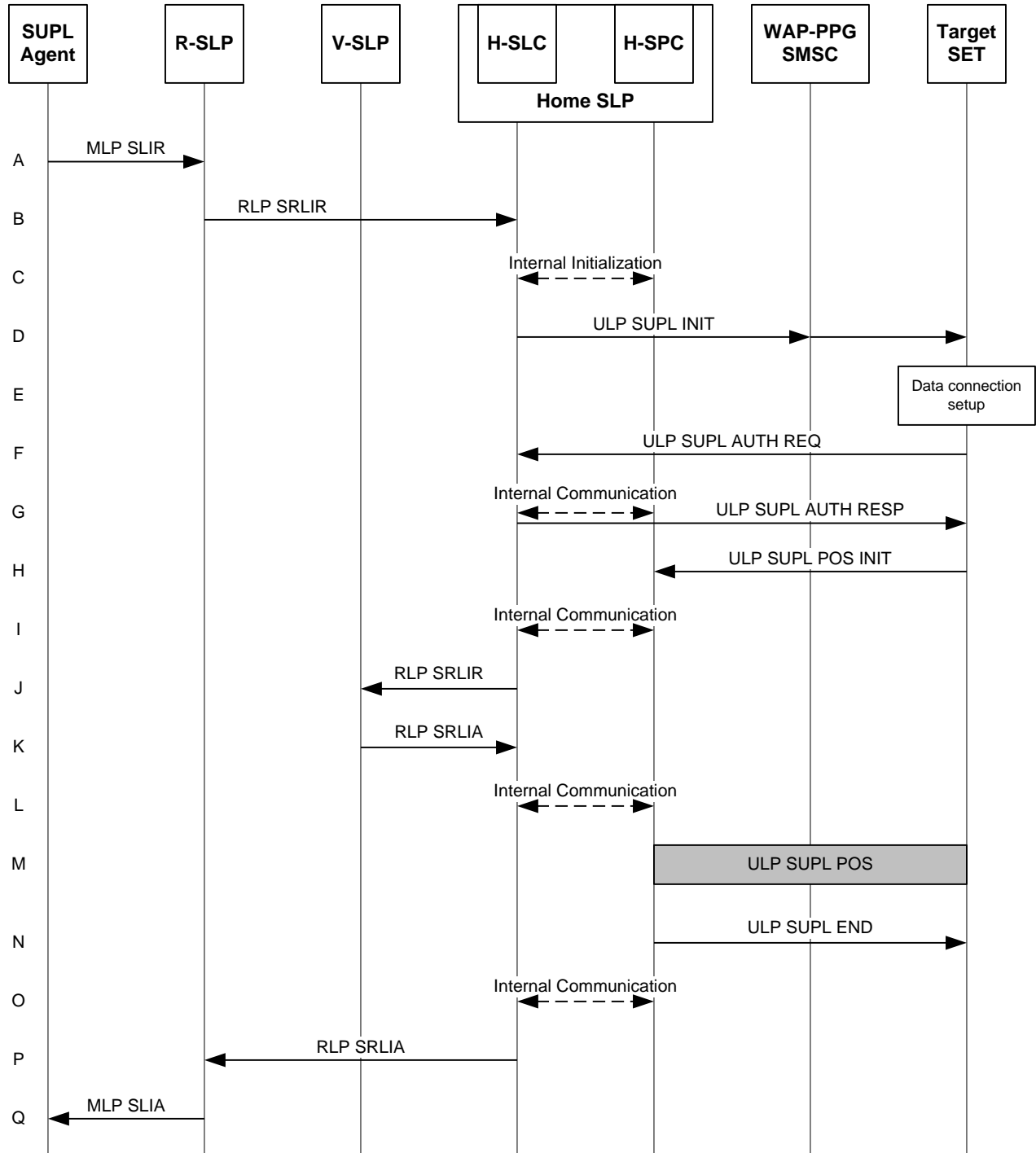


Figure 15: NW Initiated Roaming Successful Case – Non-Proxy Mode with H-SPC

- A. A SUPL Agent issues an MLP SLIR message to the R-SLP.
- B. The R-SLP then forwards the location request to the H-SLC of the target subscriber, using an RLP SRLIR. The message contains the requested QoP.

- C. The H-SLC informs the H-SPC of the pending SUPL positioning session.
- D. The H-SLC initiates the location session with the SET using the ULP SUPL INIT message. The message contains the intended positioning method.

Note: the WAP-PPG/SMSC network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- E. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLC.
- F. The SET sends a ULP SUPL AUTH REQ message to the H-SLC.
- G. The H-SLC creates a key to be used for mutual H-SPC/SET authentication. The H-SLC forwards the key to the H-SPC and returns a ULP SUPL AUTH RESP message to the SET.
- H. The SET then sends a SUPL POS INIT message to start a positioning session with the H-SPC. The message contains the SET capabilities.
- I. The H-SPC informs the H-SLC that the target SET has established the session and informs the H-SLC of the location id.
- J. The H-SLC sends an RLP SRLIR to the V-SLP to determine a coarse position for further exchange of ULP SUPL POS messages between SET and H-SPC.
- K. The V-SLP returns a RLP SRLIA. This message contains the position result (e.g., coarse position for A-GPS positioning).
- L. The H-SLC informs the H-SPC of the initial position.
- M. The H-SPC then determines the positioning method and exchanges several successive ULP SUPL POS messages. These messages contain the used positioning protocol messages (e.g., RRLP, RRC, TIA-801) as needed to determine the position.
- N. When the position calculation is complete the H-SPC sends the ULP SUPL END message to the SET.
- O. The H-SPC informs the H-SLC that the positioning procedure is completed and returns the position result.
- P. The H-SLC sends an RLP SRLIA message to the R-SLP. This message contains the position estimate.
- Q. The R-SLP sends an MLP SLIA message to the SUPL Agent. This message contains the position estimate.

5.4.10 Network Initiated flows – Roaming Non Proxy Mode with V-SPC Positioning – Immediate Service

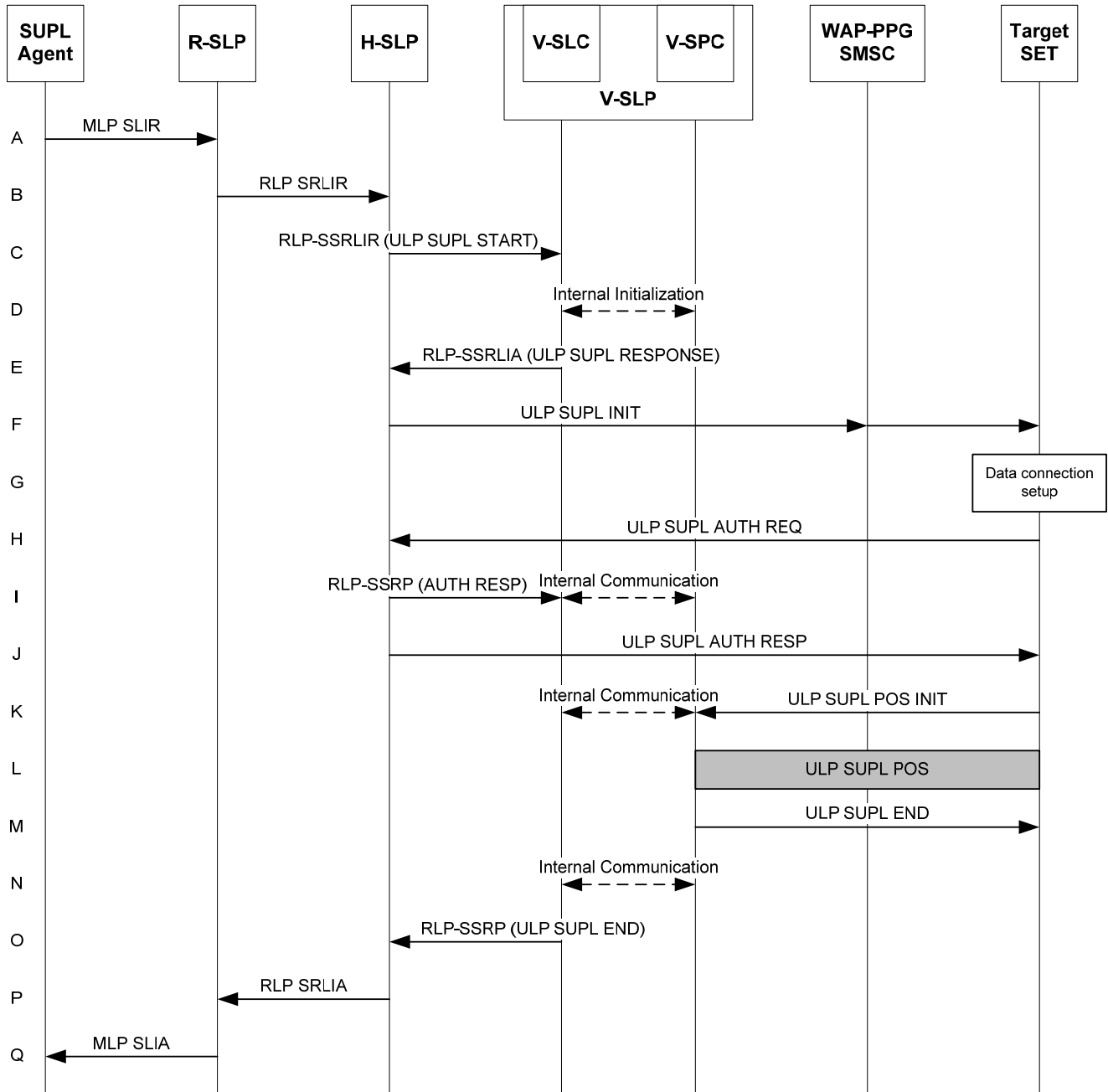


Figure 16: NW Initiated Roaming Successful Case – Non-Proxy Mode with V-SPC

- A. A SUPL Agent issues an MLP SLIR to the R-SLP.
- B. The R-SLP then forwards the location request to the H-SLP of the target subscriber, using an RLP SRLIR. The message contains the requested QoP.
- C. The H-SLP then decides that the V-SPC will provide assistance data or perform the position calculation. The H-SLP sends an RLP SSRLIR to the V-SLC to inform the V-SLC that the target SET will initiate a SUPL positioning procedure.

- D. The V-SLC informs the V-SPC of an incoming SUPL positioning session.
- E. The V-SLC returns an RLP SSRLIA. The message contains the requested positioning method.
- F. The H-SLP initiates the location session with the SET using the ULP SUPL INIT message. The message contains the address of the V-SPC.

Note: the WAP-PPG/SMS-C network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- G. When the SUPL INIT is received by the SET it will establish a secure connection to the H-SLP.
- H. The SET sends a ULP SUPL AUTH REQ message to the H-SLP.
- I. The H-SLP creates a key to be used for mutual V-SPC/SET authentication. The H-SLP forwards the key to the V-SLC through an RLP SSRP message. The V-SLC forwards the key to the V-SPC through internal communication.
- J. The H-SLP returns a ULP SUPL AUTH RESP to the SET.
- K. The SET establishes a secure IP connection to the V-SPC. The SET sends a ULP SUPL POS INIT message to start a SUPL positioning session with the V-SPC. The message contains the SET capabilities. The SET releases the secure IP connection to the H-SLP. The V-SPC informs the V-SLC that the positioning procedure is started.
- L. The V-SPC determines the positioning method and exchanges several successive positioning procedure messages (e.g., RRLP, RRC, TIA-801) with the SET as needed to determine the position.
- M. When the position calculation is complete the V-SPC sends the ULP SUPL END message. The SET then releases the secure IP connection to the V-SPC.
- N. The V-SPC informs the V-SLC that the positioning procedure is completed and returns the position result.
- O. The V-SLC sends a RLP SSRP message to the H-SLP. This message contains the position estimate.
- P. The H-SLP sends an RLP SRLIA message to the R-SLP. This message contains the position estimate.
- Q. The R-SLP sends an MLP SLIA message to the SUPL Agent. This message contains the position estimate.

5.4.11 Historical Positions

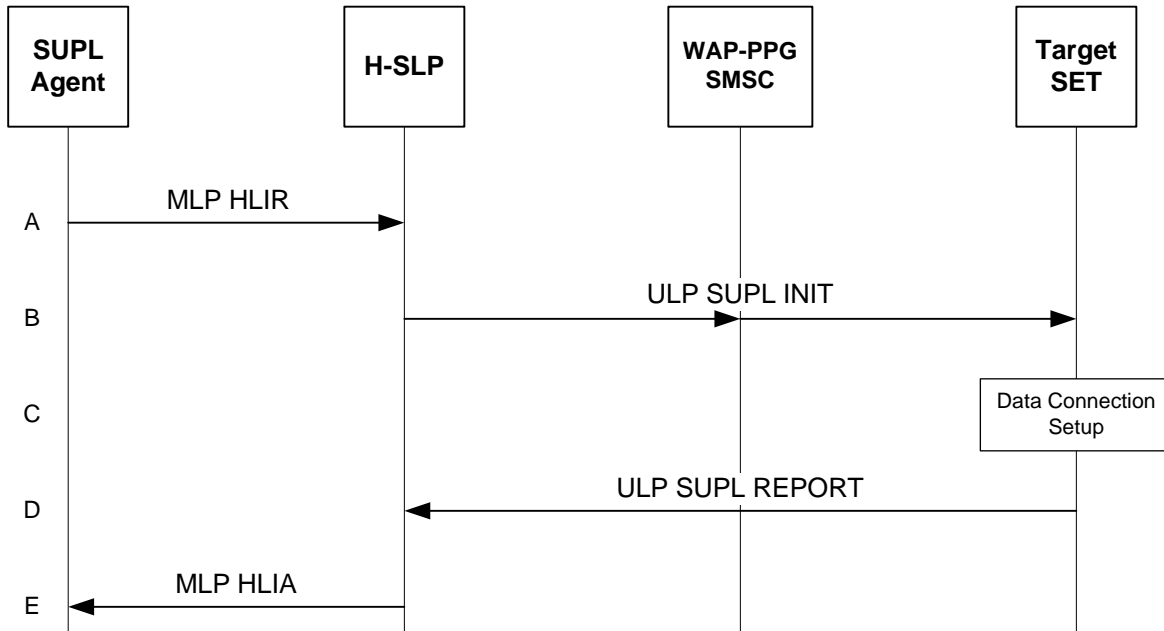


Figure 17: Retrieval of Historical Position Gathering – Non-Roaming Proxy Mode

- A. The SUPL Agent issues an MLP HLIR message to the H-SLP, which may contain selection criteria such as QoP, positioning methods.
- B. The H-SLP initiates the retrieval of historical positions with the SET using the ULP SUPL INIT message. The ULP SUPL INIT message contains criteria for selecting stored historical position estimates and/or stored enhanced cell/sector measurements.

Note: the WAP-PPG/SMS-C network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- C. When the ULP SUPL INIT is received by the SET it will establish a secure data connection to the H-SLP.
- D. The SET selects historical position estimates and/or historic enhanced cell/sector measurements and sends the positions and/or measurements in a ULP SUPL REPORT message to the H-SLP.
- E. The H-SLP reports the historical position estimates to the SUPL Agent in a MLP HLIA message.

5.4.12 SET-Initiated Request for Transfer of Location to a Third party

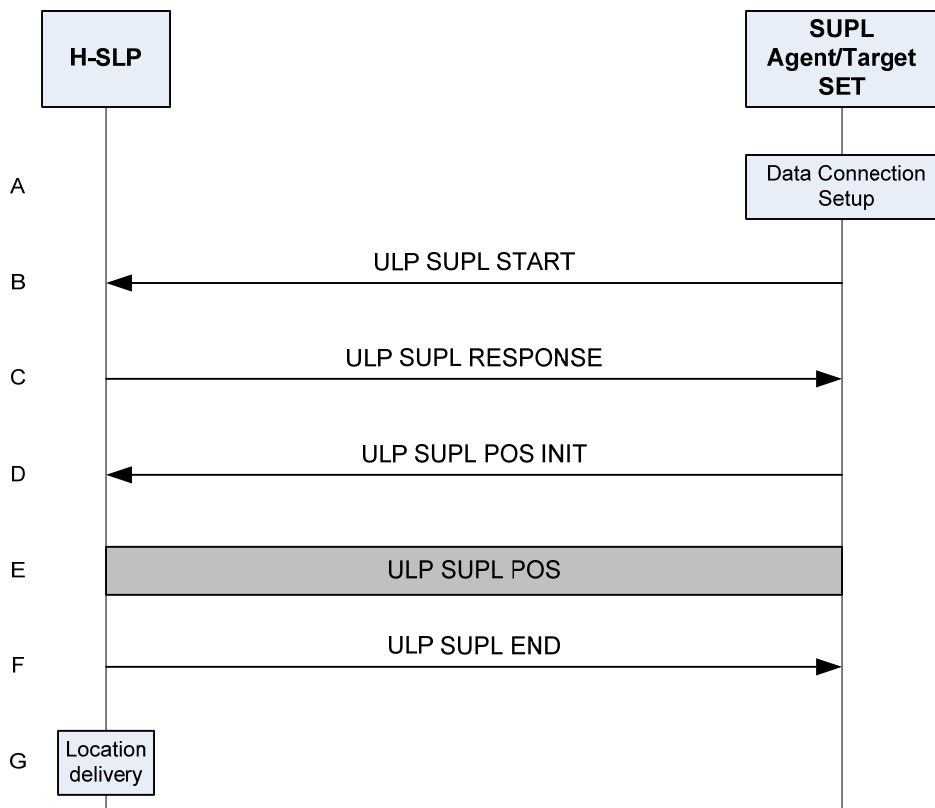


Figure 18: SET Initiated Request for Transfer of Location to a Third party

- A. The SUPL Agent on the SET receives a request from an application running on the SET for transfer of the SET’s location to a third party. The Target SET establishes a secure connection to the H-SLP.
- B. The SUPL Agent on the Target SET sends a ULP SUPL START message to start a positioning session with the H-SLP. The message contains the SET capabilities, including the supported positioning methods, location identifier and third party identity.
- C. The H-SLP responds with the ULP SUPL RESPONSE message to the SET. The message contains the positioning method determined by the H-SLP.
- D. The SET sends a ULP SUPL POS INIT message to the H-SLP. The message contains the SET capabilities, including the supported positioning methods, and location identifier.
- E. The SET and the H-SLP may exchange several successive positioning procedure messages. The H-SLP or the SET calculates the position depending on positioning calculation mode (SET-based or SET-assisted).
- F. The H-SLP sends the ULP SUPL END message to the Target SET informing it that no further positioning procedure will be started and that the session is ended. The SET then releases the secure connection.
- G. The H-SLP delivers the SET location information to the third party

5.5 Llp Reference Point Flows

The flows shown in this chapter show the Llp interface message exchange. The flows can be divided into two scenarios: Network initiated and SET initiated. Only the single fix successful non-roaming scenarios are shown. Roaming and triggered scenarios are not presented here since they follow the same architectural concept.

A Network initiated flow occurs when the positioning is requested by an SUPL Agent in the network.

A SET initiated flow occurs when the positioning is requested by the SET.

A high level description is given below by showing a typical flow for each scenario. These flows are intended to illustrate basic concepts and are not an exhaustive list. These flows are only illustrative. Refer to [OMA ILP] for detailed flows.

5.5.1 SET Initiated Proxy Mode flows – Non-Roaming

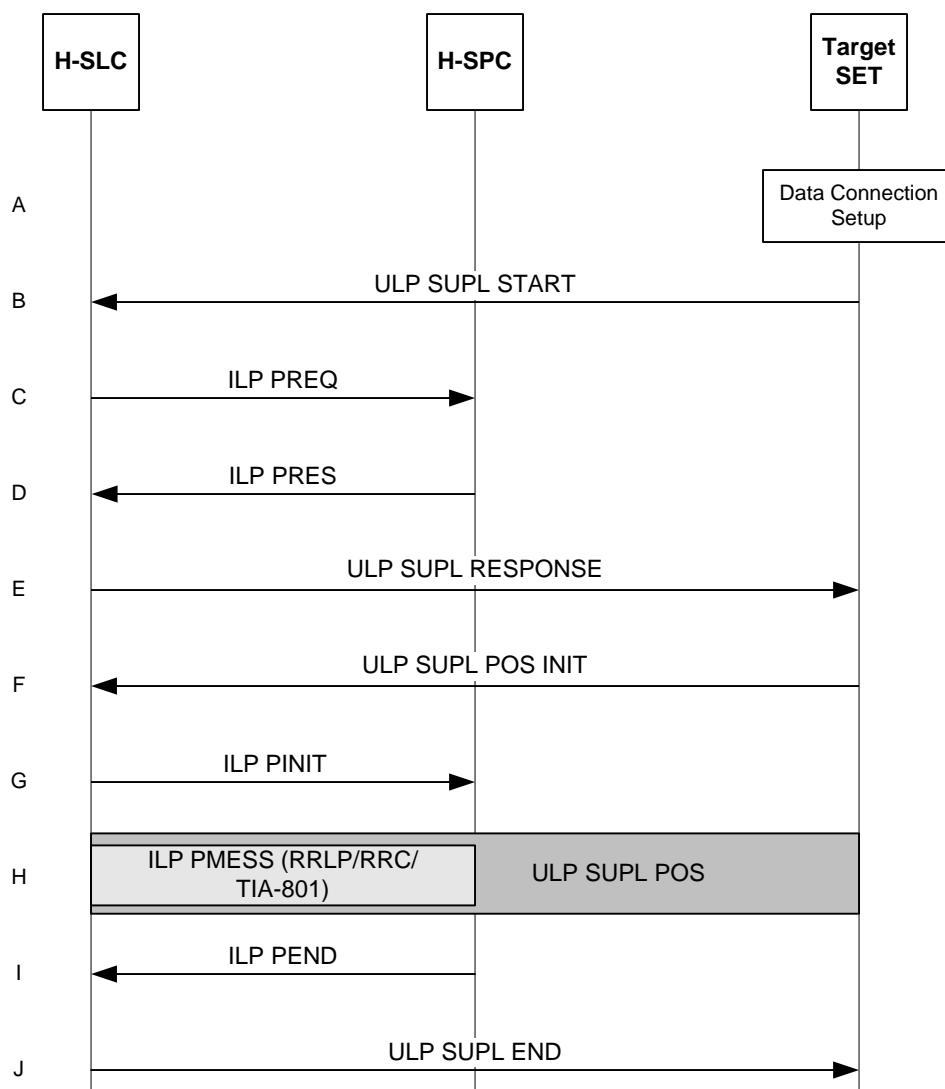


Figure 19: SET Initiated Non-Roaming Proxy Mode flow with Llp Interface

- A. The SUPL Agent on the SET receives a request for position from an application running on the SET. The SET establishes secure connection to the H-SLC.

- B. The SET sends a ULP SUPL START message to start a SUPL Session with the H-SLP. The ULP SUPL START message contains SET capabilities and location identifier.
- C. The H-SLC requests service from the H-SPC. It MAY also request location information not meeting the QoP, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message.
- D. The H-SPC responds to the service request from the H-SLC. It MAY also contain location information not meeting the QoP, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message.
- E. The H-SLC sends a ULP SUPL RESPONSE message to the SET. The message contains the requested positioning method and QoP. It MAY also contain location information not meeting the QoP, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message.
- F. The SET sends a ULP SUPL POS INIT message to start a positioning session with the H-SLP. The message contains the SET capabilities and location identifier.
- G. The H-SLC sends an ILP PINIT message to the H-SPC to start the SUPL POS session.
- H. The H-SPC determines the positioning method and engages in a SUPL POS session with the SET. Thereby the positioning payload (RRLP/RRC/TIA-801) is transferred between the H-SPC and the H-SLC using ILP PMESS messages, and between the H-SLC and the SET using SUPL POS messages.
- I. When the position calculation is complete the H-SPC sends an ILP PEND message to the H-SLC.
- J. The H-SLC sends a ULP SUPL END message to the SET. The SET then releases the secure connection to the H-SLC.

5.5.2 SET Initiated Non-Proxy Mode flows – Non-Roaming

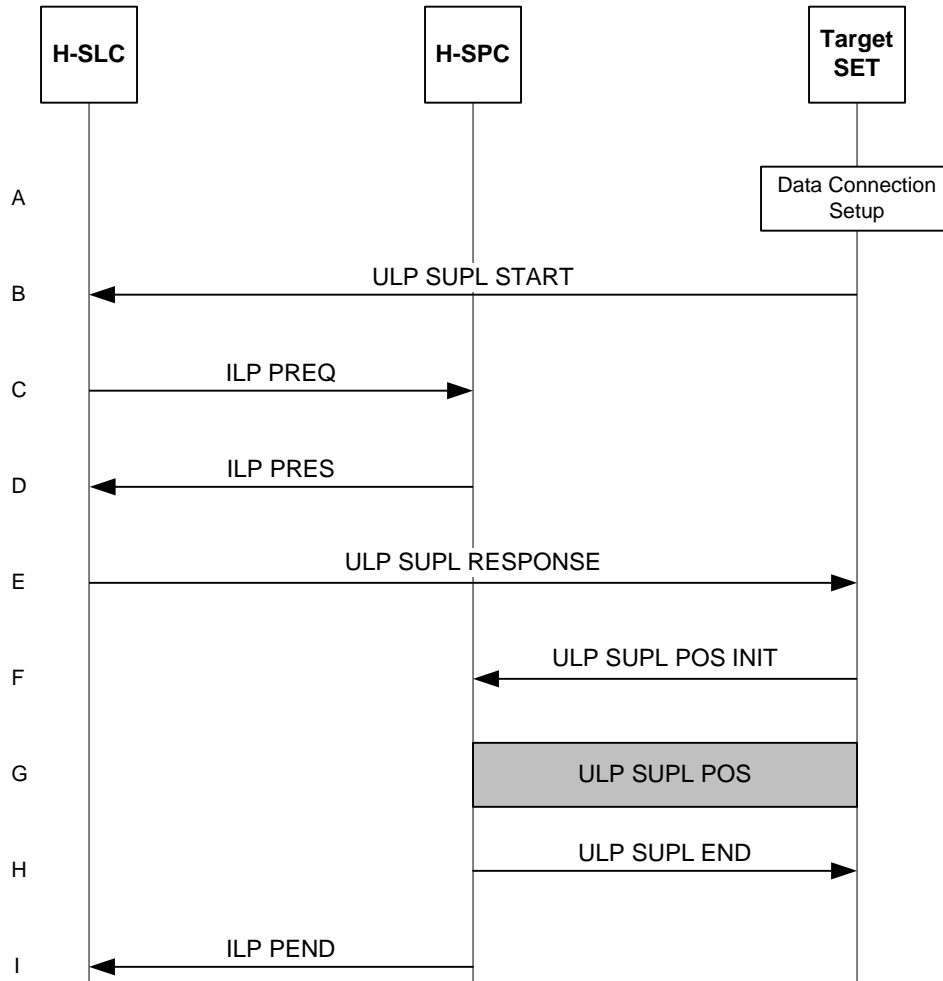


Figure 20: SET Initiated Non-Roaming Non-Proxy Mode flow with Llp Interface

- A. The SUPL Agent on the SET receives a request for position from an application running on the SET. The SET establishes secure connection to the H-SLC.
- B. The SET sends a ULP SUPL START message to start a SUPL Session with the H-SLP. The ULP SUPL START message contains SET capabilities and location identifier.
- C. The H-SLC requests service from the H-SPC. It MAY also request location information not meeting the QoP, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message.
- D. The H-SPC responds to the service request from the H-SLC. It MAY also contain location information not meeting the QoP, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message.
- E. The H-SLC sends a ULP SUPL RESPONSE message to the SET. The message contains the requested positioning method, the H-SPC address and the QoP, and the key to be used for mutual SET/H-SPC authentication. The message MAY also contain location information not meeting the QoP, but giving a coarse approximation of the position, based on information received in the ULP SUPL START message. The SET then releases the secure connection to the H-SLC.

- F. The SET establishes a secure connection to the H-SPC using the key received from the H-SLC. The SET sends a ULP SUPL POS INIT message to start a positioning session with the H-SPC. The message contains the SET capabilities and location identifier.
- G. The H-SPC determines the positioning method and exchanges several successive ULP SUPL POS messages with the SET, containing the used positioning protocol (i.e., RRLP, RRC, TIA-801), as needed to determine the position.
- H. When the position calculation is complete, the H-SPC sends a ULP SUPL END message to the SET. The ULP SUPL END message is to inform the SET that the SUPL Session is finished. The SET then releases the secure connection to the H-SPC.
- I. The H-SPC informs the H-SLC about the end of the SUPL Session.

5.5.3 Network Initiated Proxy Mode flows – Non-Roaming

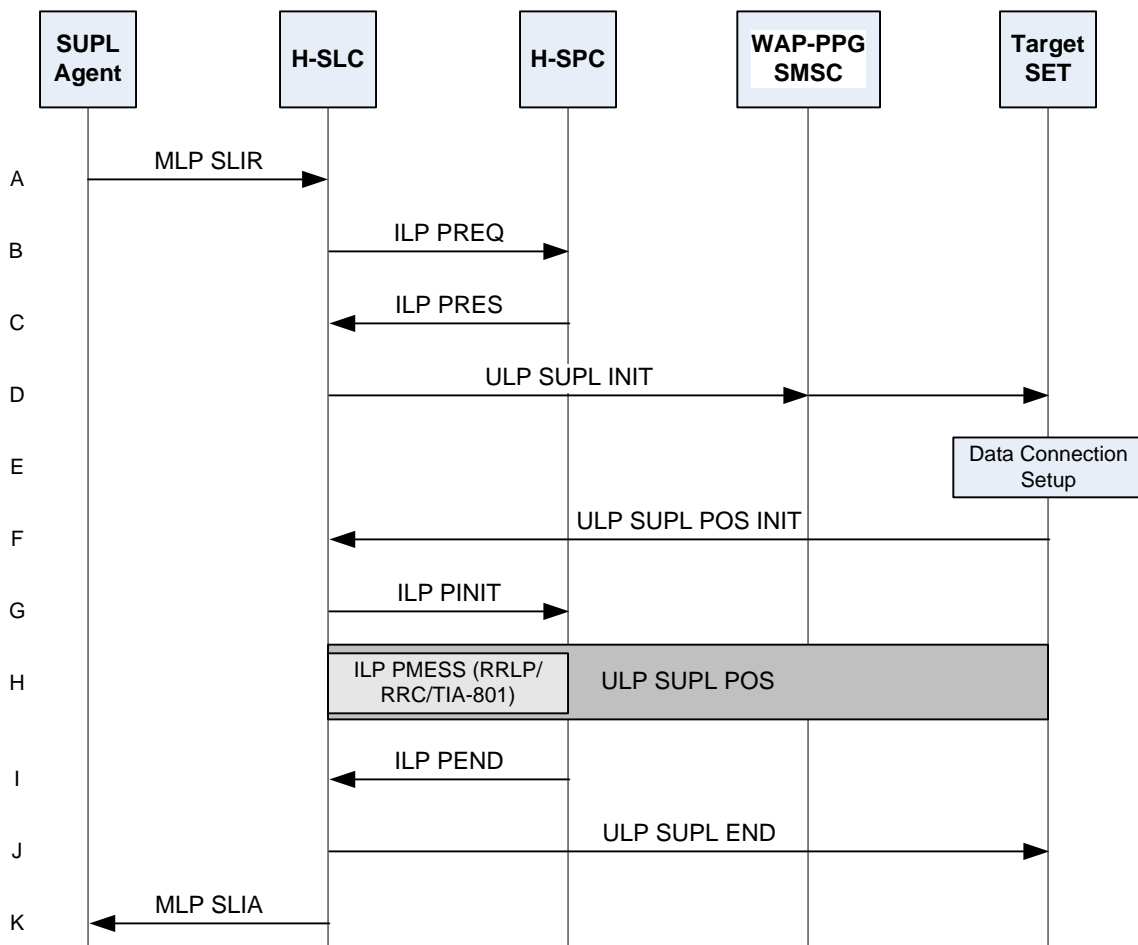


Figure 21: NW Initiated Non-Roaming Proxy Mode flow with L1p Interface

- A. SUPL Agent issues an MLP SLIR message to the H-SLC.
- B. The H-SLC requests service from the H-SPC.
- C. The H-SPC responds to the service request from the H-SLC.
- D. The H-SLC initiates the SUPL Session with the SET by sending a ULP SUPL INIT message. The message contains requested positioning method and QoP.

Note: the WAP-PPG/SMS-C network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- E. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLC.
- F. The SET sends a ULP SUPL POS INIT message to start a positioning session with the H-SLP. The message contains the SET capabilities and location identifier.
- G. The H-SLC sends an ILP PINIT message to the H-SPC to start the SUPL POS session.
- H. The H-SPC determines the positioning method and engages in a SUPL POS session with the SET. Thereby the positioning payload (RRLP/RRC/TIA-801) is transferred between the H-SPC and the H-SLC using ILP PMESS messages, and between the H-SLC and the SET using SUPL POS messages.
- I. When the position calculation is complete the H-SPC sends an ILP PEND message to the H-SLC including the position estimate.
- J. The H-SLC sends a ULP SUPL END message to the SET. The SET then releases the secure connection to the H-SLC.
- K. The H-SLC sends the position estimate back to the SUPL Agent by means of an MLP SLIA.

5.5.4 Network Initiated Non-Proxy Mode flows – Non-Roaming

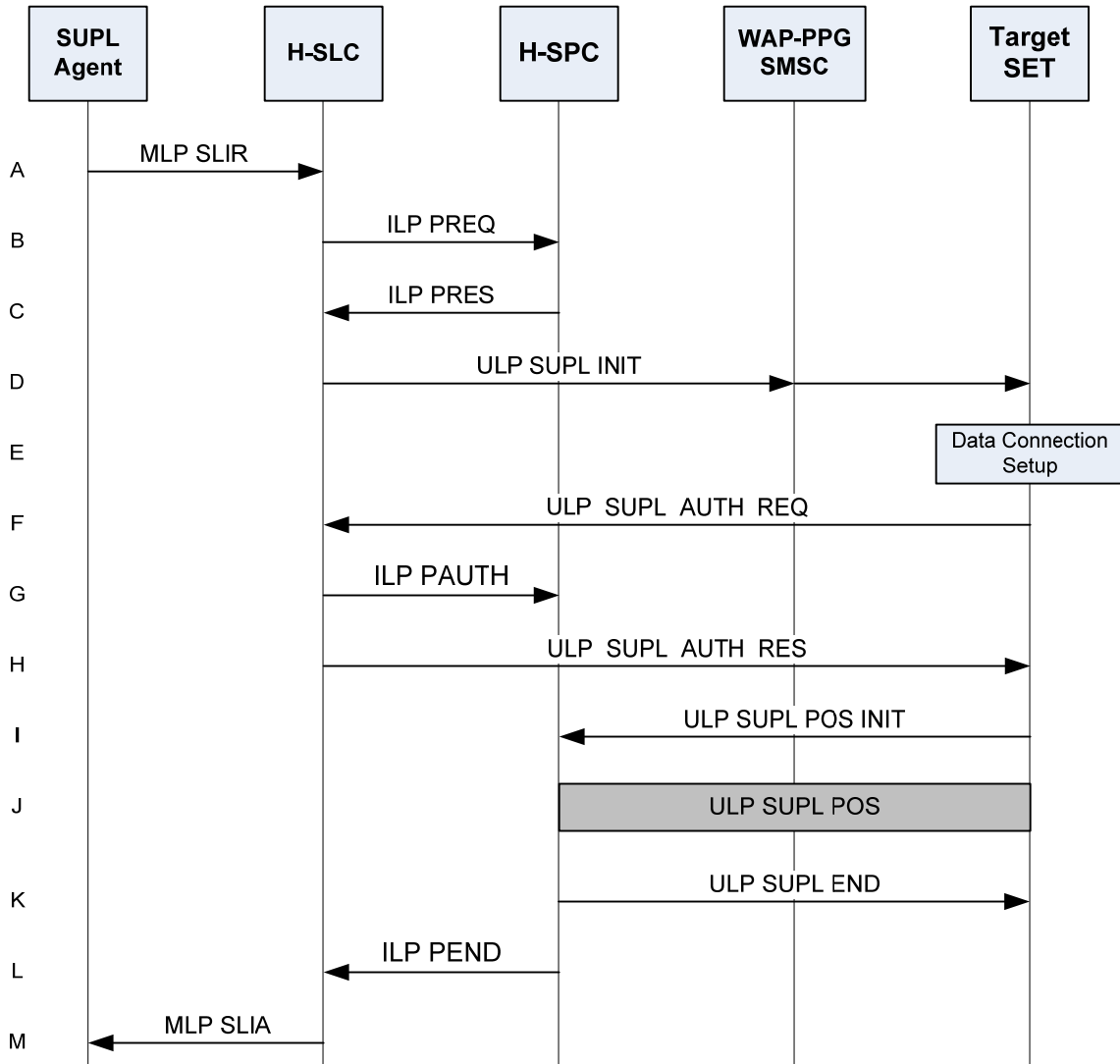


Figure 22: NW Initiated Non-Roaming Non-Proxy Mode flow with Llp Interface

- A. SUPL Agent issues an MLP SLIR message to the H-SLC.
- B. The H-SLC requests service from the H-SPC.
- C. The H-SPC responds to the service request from the H-SLC.
- D. The H-SLC initiates the SUPL Session with the SET by sending a ULP SUPL INIT message. The message contains requested positioning method and QoP.

Note: the WAP-PPG/SMS-C network element is only involved if OMA Push or MT SMS is used for delivering the ULP SUPL INIT message to the SET.

- E. When the ULP SUPL INIT is received by the SET it will establish a secure connection to the H-SLC.
- F. For authentication purposed, the SET sends a ULP SUPL AUTH REQ message to the H-SLC.
- G. The H-SLC generates an authentication key that it sends to the H-SPC.

- H. The H-SLC responds with a ULP SUPL AUTH RES message including the authentication keys required for SET communication with the H-SPC.
- I. The SET sends a ULP SUPL POS INIT message to start a positioning session with the H-SPC. The message contains the SET capabilities and location identifier.
- J. The H-SPC determines the positioning method and exchanges several successive ULP SUPL POS messages with the SET, containing the used positioning protocol (i.e., RRLP, RRC, TIA-801), as needed to determine the position.
- K. When the position calculation is complete, the H-SPC sends a ULP SUPL END message to the SET. The ULP SUPL END message is to inform the SET that the SUPL Session is finished.
- L. The H-SPC informs the H-SLC about the end of the SUPL Session and includes the position estimate.
- M. The H-SLC sends the position estimate to the SUPL Agent in an MLP SLIA.

Appendix A. Change History

(Informative)

A.1 Approved Version History

Reference	Date	Description
OMA-AD-SUPL-V2_0-20120417-A	17 Apr 2012	Status changed to Approved by TP Ref TP Doc # OMA-TP-2012-0170-INP_SUPL_20_for_Final_Approval