M2M Roaming Guidelines
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1 Introduction

1.1 Scope

The purpose of this document is to specify recommendations related to network aspects of managing roaming M2M devices in mobile networks. The document is intended to be used by mobile network operators (MNOs), and covers the following areas:

- Congestion and Overload Handling
- VPLMN specific features

This version is based on Rel. 10 specifications.

HPMN specific features of managing M2M devices and recommended features on the M2M UE are not covered.

1.2 Definitions

Term	Description
End user	A person using the M2M device functionality. This can be both 'private' users (consumer market) and business users. The corporate (purchasing) perspective is also considered from this point of view.
LTE	Long Term Evolution: OFDMA based radio access in 3GPP Release 8 referred to as Evolved UTRAN. Further evolution called also LTE-Advanced starting 3GPP Release 10.
Mobile Network Operator (MNO)	A mobile network providing the data communication service to an end user.
M2M	Machine-to-Machine: A family of devices and services that use wide-area mobile network technologies to enable communications between machines themselves and also with humans

1.3 Abbreviations

Term	Description
3GPP	Third Generation Partnership Project
AGCH	Access Grant Channel
APN	Access Point Name
BCCH	Broadcast Control Channel
BTS	Base Transceiver Station
EAB	Extended Access Barring
EPS	Evolved Packet System
ESM/SM	European Stability Mechanism
GERAN	GSM EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GMM/EMM	GPS Mobility Management/ EPS Mobility Management

Term	Description
GPRS	General Packet Radio Service
GTP	GPRS Tunnelling Protocol
HLR	Home Location Register
HPLMN	Home Public Land Mobile Network
HSS	Home Subscriber Server
LAPI	Low Access Priority Indicator
LAU	Location Area Update
LTE	Long Term Evolution
MME	Mobility Management Entity
NAS	Network Access Server
NMO	Network Mode of Operation
PCRF	Policy and Charging Rules Function
PDP	Packet Data Protocol
PDN	Public Data Network
P-GW	PDN Gateway
PLMN	Public Land Mobile Network
PRAU	Periodic Routing Area Update
PRD	Permanent Reference Document
PRU	Periodic Routing Update
PTU	Periodic Tracking Area Update
RACH	Random Access Channel
RAU	Routing Area Update
RRC	Radio resource Control
SDCCH	Standalone Dedicated Control Channel
SGSN	Serving GPRS Support Node
S-GW	Serving Gateway
TAU	Tracking Area Update
UE	User Equipment
UTRAN	UMTS Terrestrial Radio Access Network
VPLMN	Visited Public Land Mobile Network

1.4 References

Document Number	Title
GSMA PRD IR.33	"GRPS Roaming Guidelines"
GSMA PRD IR.88	"LTE and EPC roaming Guidelines"
GSMA PRD BA.48	"M2M roaming Principles"
3GPP TS 23.401	“GPRS enhancements for E-UTRAN access”

Document Number	Title
3GPP TS 23.060	"GPRS Service Description; Stage 2"
3GPP TS 24.008	“Mobile radio intergace Layer 3 specification;core network protocols; Stage 3”
3GPP TS 24.301	“NAS protocol for EPS; Stage 3”
3GPP TS 29.060	“GTP across the Gn and Gp interface”
3GPP TS 29.274	“GTPv2-C;Stage 3”

2 M2M Roaming Guidelines

2.1 Network Architecture for M2M Roaming

2.1.1 General

3GPP Release 10 provides a number of countermeasures for congestion and overload control in order to protect the network from excessive signalling from large numbers of devices. This document recommends that networks support the Release 10 features described in this PRD.

It is assumed that the network architecture for M2M roaming is same as that for non-M2M roaming. In this version, UE requirements are unspecified. However, it is implied that some features described in this PRD only work if the corresponding functionality is supported in the UE.

2.2 GPRS Roaming Architecture

0 shows the basic GPRS roaming network architecture. It is recommended that the GPRS roaming architecture follows the guidelines specified in GSMA PRD IR.33 **Error! Reference source not found.**.

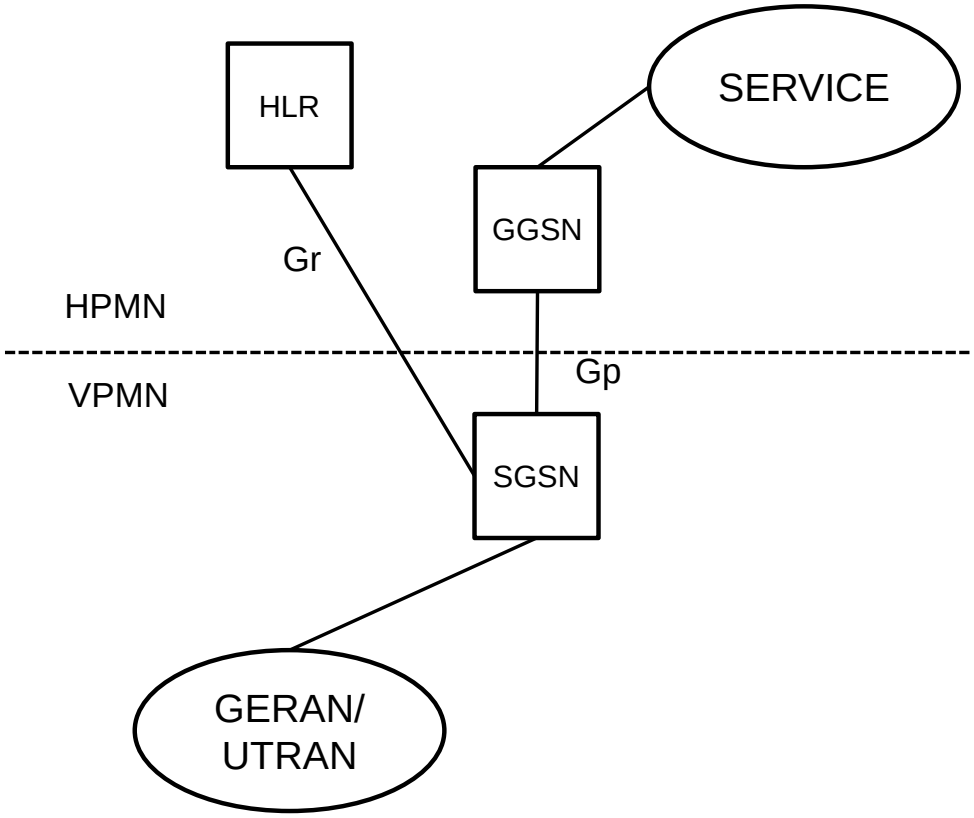

Figure 1- 2G/3G Roaming Architecture

2.3 LTE/EPS Roaming Architecture

The figures below show the basic LTE/EPS roaming network architecture with or without the S4 interface. It is recommended that the LTE/EPS roaming architecture follows the guidelines specified in GSMA PRD IR.88 **Error! Reference source not found.**.

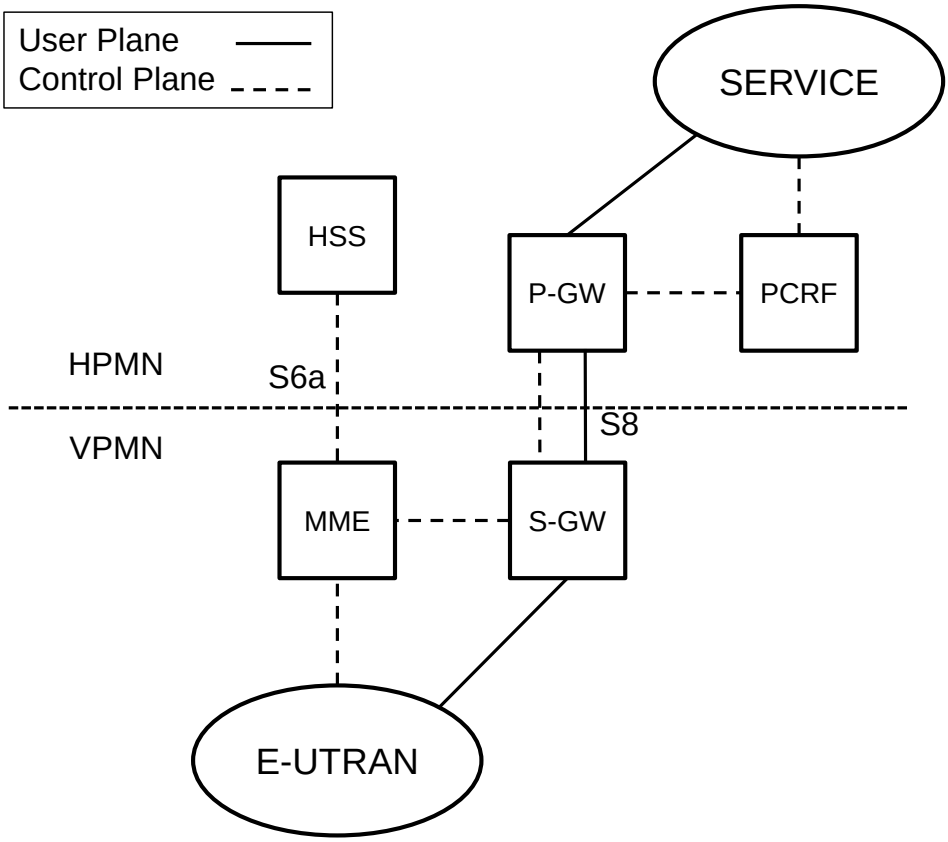

Figure 2 - LTE/EPS Roaming Architecture

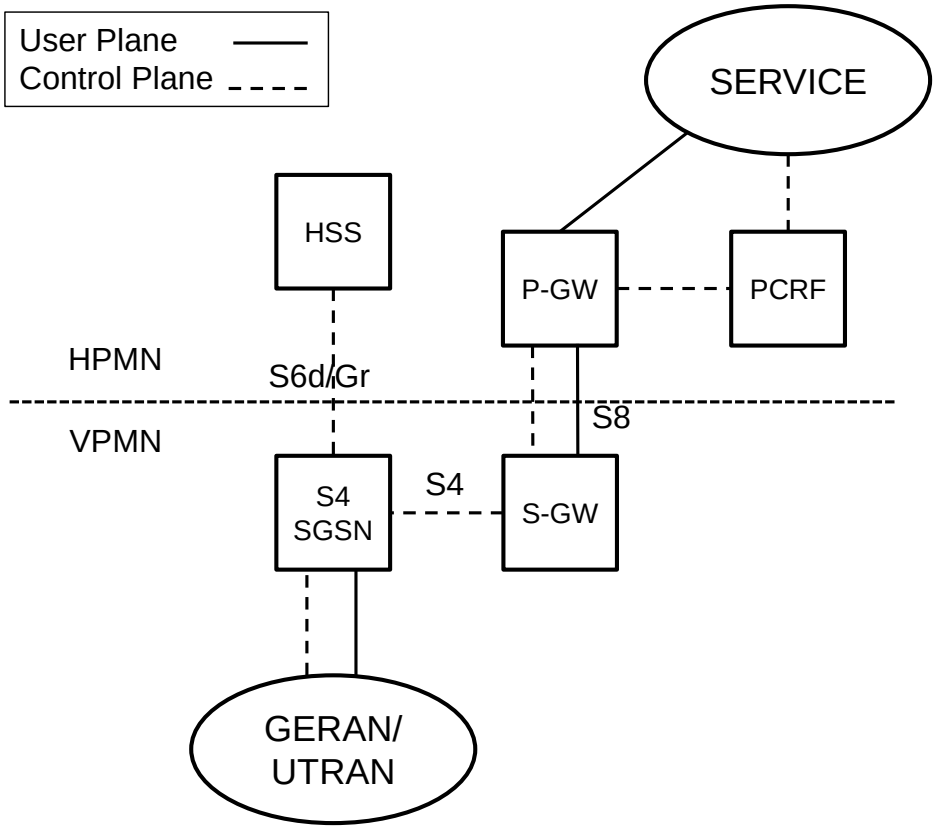

Figure 3 - LTE/EPS Roaming Architecture via EPS with S4 interface

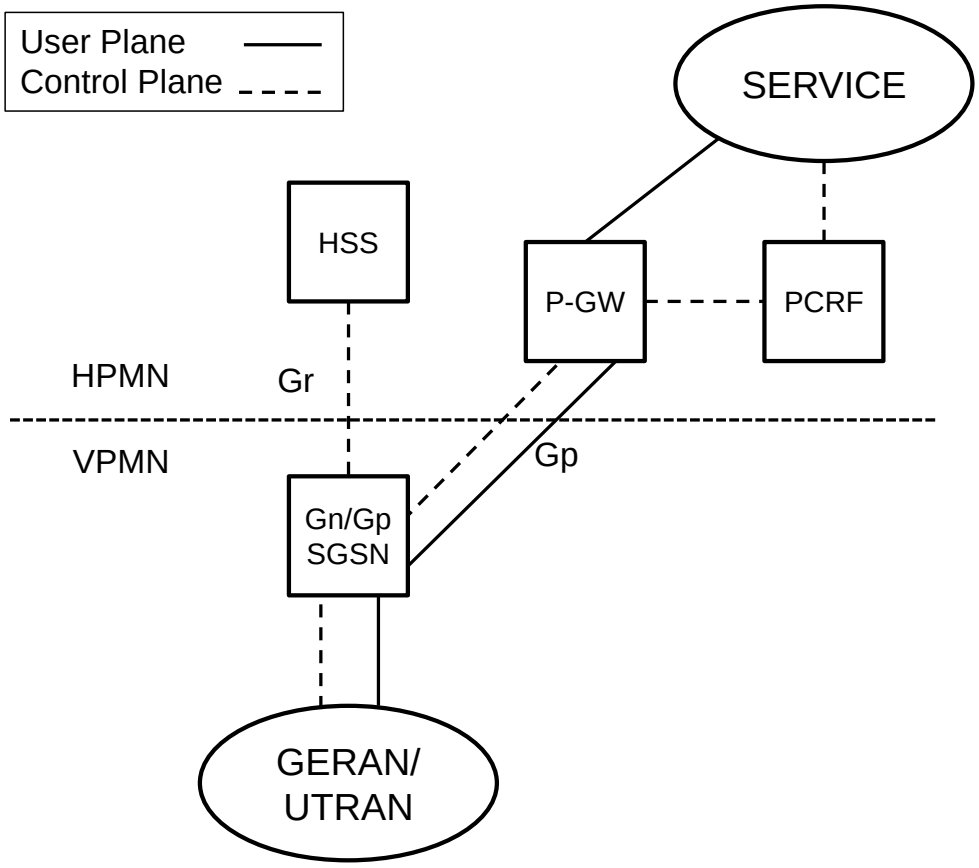

Figure 4 - 2G/3G Roaming Architecture via EPS with Gp interface

2.3.1 M2M Traffic Identification

The means of M2M traffic identification are specified in GSMA PRD BA.48 **Error! Reference source not found.**.

2.3.2 Congestion and Overload Handling

2.3.2.1 General

The signaling from large numbers of devices is a concern in at least two situations:

1. When an application (running in many devices) requests many devices to do "something" at the same time; and/or
2. When many devices are roamers and their serving network fails, then they can all move onto the local competing networks, and potentially overload the network(s) which have not (yet) failed.

2.3.2.1.1 This section specifies recommendations on features that are needed in roaming scenarios between HPLMN and VPLMN to avoid congestion caused by M2M UE.

Rejection of UE requests with Backoff Timer

When performing mobility management procedures (e.g. location update or routing area update procedures), or session management procedures (e.g. PDP context activation) the

core network can reject the UE request with a back-off timer to the UE, so that the UE does not re-attempt the request for the specific period of time indicated in the back-off timer.

In 3GPP TS23.401 **Error! Reference source not found.** and TS23.060 **Error! Reference source not found.**, two different types of control for the back-off timer are available:

1. APN based congestion control: The network may reject Session Management requests (e.g. Activate PDP Context Request, PDN Connectivity Request) from UEs to a certain APN. This can help the operator to control the amount of traffic using a specific APN.
2. Mobility management congestion control: The network may reject Mobility Management requests (e.g. Attach Request, Routing Area Update, Tracking Area Update) from UEs.

The SGSN and MME in VPLMN, and PGW and GGSN in HPLMN must support both APN based congestion control and mobility management congestion control.

For APN based congestion control, the SGSN and MME in VPLMN must support ESM/SM Cause #26, #27nd necessary GTP extension on Gp and S8 interfaces as specified in 3GPP TS24.008 **Error! Reference source not found.**, 3GPP TS24.301 **Error! Reference source not found.**, 3GPP TS29.060 **Error! Reference source not found.** and 3GPP TS29.274 **Error! Reference source not found.**.

For mobility management congestion control, the SGSN and MME in VPLMN must support GMM/EMM Cause #22 and T3346.

The features only apply to devices supporting above-mentioned NAS Cause values and NAS timers.

2.3.3 Handling of Low Access Priority Indicator

3GPP Release 10 introduces the concept Low Access Priority Indicator (LAPI). The operator can set LAPI in “low priority” devices, where the application(s) can tolerate longer access delays. The LAPI can be used by the network to reject such a device from access, and assign a back-off timer preventing the device from immediately repeating the access attempt, using the features described in Section 2.3.2. The mechanism is primarily intended to combat high network load in radio access network and core network nodes.

This feature only applies to devices supporting low access priority indication.

2.3.4 Implicit Reject in GSM Radio Network

The GSM base transceiver station (BTS) in the serving network can be used to dynamically and quickly control the (over)load from Low Access Priority devices on its RACH, AGCH and SDCCH channels.

Before requesting a signalling channel, a device that has LAP assigned will check the “Paging” and “Access Grant” broadcast channels for 20ms. If the BTS has set the “implicit reject” flag (one flag for circuit switched and one flag for packet switched) then the mobile will not request a signalling channel, but will back off for a locally generated random period.

2.3.5 Long Periodic LAU/RAU/TAU

The Periodic Routing Update (PRU) and Periodic Tracking Area Update (PTU) timers are used in the Packet Switched domain to control the frequency of PRAU and PTU.

In 3GPP Release 10, 3GPP TS23.401 **Error! Reference source not found.** and 3GPP TS23.060 **Error! Reference source not found.** specify that HSS/HLR can be configured with a long PRU/PTU timer per UE. During Attach/Routing Area Update/Tracking Area Update procedures, the subscribed PRU/PTU timer values are sent to the SGSN/MME in VPLMN. SGSN/MME then forwards the PRU/PTU timer values to the UE.

A relatively short PLU timer value is needed for applications which have a need for immediacy with mobile terminating communications, i.e. there is a need to contact the device as soon as possible once it comes back into coverage. The downside of using a large PLU timer is that if the nature of the device is that it can be expected to regularly move in and out of network coverage (for example a track & trace device), then the application may take longer to become aware of an attempted mobile terminating communication.

A recommend typical value of PLU for embedded mobile devices is 24 hours, unless the nature of the application calls for immediacy of mobile terminating CS domain (voice and/or SMS) communications. It is recommended that both the HPMN and the VPMN support this feature. If the SGSN or MME do not receive a timer value from the HLR/HSS, then the SGSN or MME should allocate default value to the UE.

2.4 VPLMN Specific Features that VPLMN may Implement

2.4.1 General

3GPP Release 10 specifies features that can be used within the VPLMN to avoid congestion and signalling load without HPLMN involvement.

The features described in this section are meant to be used by the VPLMN to protect the network by their own discretion.

2.4.2 Extended Access Barring

3GPP Release 10 Extended Access Barring (EAB), as specified in 3GPP TS23.060 [6], is a method for the network to selectively control access attempts from ‘UEs configured for EAB’ (which are considered more tolerant to access restrictions than other UEs) in order to prevent overload of the access network and/or the core network, without the need to introduce any new Access Classes.

In Release 10, EAB is only introduced for GERAN.

In the case of congestion, the network could restrict access from ‘UEs configured for EAB’ while permitting access from other UEs. When the network determines that it is appropriate to apply EAB, it broadcasts necessary information on the BCCH to provide EAB control for UEs.

This feature only applies to UEs supporting EAB feature.

2.4.3 Extended NMO-I

Network Mode of Operation I (NMO-I) enables a device to perform combined attach towards the packet switched domain. Otherwise, the device will perform individual attaches to the circuit switched and packet switched domains.

When a large number of roaming devices attach to a VPLMN, failure of one mobile network might have a domino effect on the other local competing networks, potentially leading to failure of all the networks. The use of combined attach reduces the signalling load on the serving network. However, this might not be beneficial for the operator to apply for all categories of devices.

Extended NMO-I is introduced in 3GPP Release 10 to allow the operator to control if a device should perform combined attach or not.

VPLMN using NMO-I is not required to deploy this feature. If this feature is used in NMO-II VPLMN, the serving network must broadcast that it supports “extended NMO-I” for this feature to work. This is specified in 3GPP TS 23.060 **Error! Reference source not found.**.This feature only applies to UEs supporting this feature.

2.5 RRC Backoff timer

3GPP Release 10 provides the ability for the radio access network to reject a request with a longer back-off timer than was defined previously, also called Extended Wait Timer.

The radio access network will only use the extended wait timer if the device had signalled LAP in its access request, see 3GPP TS 23.060 **Error! Reference source not found.**. The visited network must decide the back-off timer values to apply. Networks are recommended to spread the values given to the back-off timer over a range, to avoid the same access problem occurring at a predictable time in the future.

This feature only applies to UEs supporting this feature.

2.5.1 HPLMN Specific Features that HPLMN may Implement

NOTE: This section is a placeholder for future enhancement.

2.5.2 Recommended Features on the UE

NOTE: This section is a placeholder for future enhancement.

Annex A Document Management

A.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	1/04/2014	New PRD IR.49	IREG/PSMC	Motohiro Abe, NTT DOCOMO

Other Information

Type	Description
Document Owner	IREG PACKET
Editor / Company	Motohiro Abe, NTT DOCOMO

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