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Contents

Foreword

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

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1 Scope

The scope of this document is to specify the support of NBIFOM (Network based IP Flow Mobility) i.e. IP flow mobility based on network mobility protocols. This feature supports PDN connections that are simultaneously connected over 3GPP access (i.e. S5/S8 connection to a PDN GW) and a WLAN access (i.e. S2a or S2b connection to the same PDN GW).

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

[2]   3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".

[3]   3GPP TS 23.203: "Policy and Charging Control Architecture".

[4]   3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network(E-UTRAN) access".

[5]   3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[6]   3GPP TS 33.402: "3GPP System Architecture Evolution (SAE); Security aspects of non-3GPP accesses".

[7]   3GPP TS 23.261: "IP flow mobility and seamless Wireless Local Area Network (WLAN) offload; Stage 2".

[8]   3GPP TS 23.380: "IMS Restoration Procedures".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Routing filter: A set of packet flow IP header parameter values/ranges used to identify IP flows for routing purposes.

Routing access type: Type of access network (e.g. 3GPP or WLAN) over which to route a set of IP flows of a PDN connection.

Routing Rule (RR): A set of information enabling the association of a routing filter with a routing access type.

NBIFOM: IP Flow Mobility based on network mobility protocols (GTP or PMIP).

UE-initiated NBIFOM: IP Flow Mobility based on network mobility protocols (GTP and PMIP) where the UE initiates the IP flow mobility.

Network-initiated NBIFOM: IP Flow Mobility based on network mobility protocols (GTP and PMIP) where the network initiates the IP flow mobility.

Multi-access PDN connection: A PDN connection whose traffic can be routed over either a 3GPP access or a WLAN access or both. Each IP flow is routed at any single time only over one access.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

MCM	Multi-connection mode (as defined in TS 23.402 [2] clause 16)
NBIFOM	Network-based IP flow mobility
RCLWI	RAN Controlled WLAN Interworking
RR	Routing Rule
SCM	Single-connection mode (as defined in TS 23.402 [2] clause 16)
TSCM	Transparent Single-connection mode (as defined in TS 23.402 [2] clause 16)

4 Architecture model and concepts

4.1 General concepts

A PDN connection supporting NBIFOM provides simultaneous access to a single PDN via different access networks: a 3GPP access network and a WLAN access network. It is used by multi-radio (i.e. 3GPP and WLAN) capable UEs that are able to simultaneously connect to a given PDN via different access systems (3GPP and WLAN).

In order to enable NBIFOM, the UE can establish and maintain a PDN connection over both 3GPP access and WLAN access simultaneously. This is supported for both S2b and S2a connectivity. The UE can add an access to a PDN connection even if traffic is not immediately routed over the added access. When a PDN connection is established over both 3GPP access and WLAN access simultaneously there is one default bearer for each access.

On a PDN connection established over both 3GPP access and WLAN access, it is possible to move individual IP flows from one access network to another, when policies determine that flows should be moved and the target access is available for the UE.

The PDN GW performs IP flow routing of downlink traffic. The UE performs IP flow routing of uplink traffic.

A mechanism is defined for the UE and the network to discover whether the network and the UE respectively support NBIFOM and to decide whether NBIFOM will be applied for a given PDN connection. This mechanism works on a per-PDN connection basis.

The UE and the PDN GW shall always be aware of which access IP flows of the PDN connection shall use.

For NBIFOM, the UE and the PDN GW exchange Routing Rules (RR). Routing Rules (RR) describe the mapping between a set of IP flows (identified by a Routing filter) and a Routing access type (e.g. 3GPP or WLAN) over which to route these IP flows.

Routing rules are exchanged over control plane protocols (NAS over a 3GPP access, WLCP / IKE over WLAN access, S2a/S2b/S5/S8 control protocol).

The following NBIFOM modes are supported:

- UE-initiated NBIFOM: In the UE-initiated NBIFOM mode only the UE controls the traffic routing within the multi-access PDN connection. The UE determines the Routing rules and provides them to the PDN GW. The network may either accept or reject the Routing Rules requested by the UE, but does not provide Routing rules itself.

- Network-initiated NBIFOM: In the Network-initiated NBIFOM mode, the network controls the traffic routing within the multi-access PDN connection The PDN GW determines the Routing rules and provides them to the

UE. The UE may either accept or reject the network's request for Routing rules (e.g. based on the suitability of the WLAN link conditions), but does not provide Routing Rules itself.

The NBIFOM mode that applies to a PDN connection is determined during the PDN connection establishment.

Routing Rule installation is possible at any time during the lifetime of a PDN connection. Routing Rules can be installed even if there is no IP flow currently matching the routing filter in the Routing Rule.

For a UE with active flows on both 3GPP access and WLAN access, in case one of the accesses is lost or no longer usable, a mechanism is provided to move the IP Flows to the other (target) access in order to minimise service disruption. When an access is recovered, a mechanism is provided to move over this recovered access the IP Flows which are associated with policies giving precedence to this access. For UE-initiated NBIFOM mode, the UE-initiated IP flow mobility procedures described in clause 6.3.3 are used. For network-initiated NBIFOM mode, the procedures described in clause 6.6 are used.

When PCC is deployed and supports NBIFOM, the PCRF provides the PDN GW with Access information which is part of PCC rules. The Access information controls the access over which the traffic that matches the Service data Flow template of this PCC rule should be sent.

When PCC is not deployed or active for a PDN Connection, the PDN GW may apply static NBIFOM related policies. The PCEF static policy and control functionality is not based on subscription / user quota information.

The PDN GW translates Access information received in PCC rules into Routing Rules to be used between the UE and the PDN GW. In case UE initiated NBIFOM is applied and PCC is deployed for this PDN connection, the PDN GW provides, upon subscription of the PCRF, the PCRF with notifications of UE requests for IP flow mapping to an Access Type. In that case, the PCRF analyses the received information (requested IP flow mapping to an Access Type), makes a policy decision and provides PCC rules to the PDN GW with corresponding Access Type values.

In a PLMN all MME(s), SGSN(s) and SGW(s) are assumed to have the same level of support of NBIFOM. If the PDN GW detects a change in the support of NBIFOM on the 3GPP access of a PDN connection, it removes the 3GPP access from the multi-access PDN connection.

NOTE 1: This may happen in the case of inter PLMN mobility.

For S2a case, NBIFOM applies in both Multi-Connection Mode (MCM) and Single-Connection Mode (SCM) modes but not in Transparent Single-Connection Mode (TSCM). In SCM mode:

-    Routing Rules are exchanged only on the 3GPP access. Delivery of Routing Rules delivery is further described in clause 5.3.

-    No dedicated bearers are supported on the S2a access of the PDN connection.

-    There is no way to indicate the loss of 3GPP access to the PGW in SCM. There is no support for the indication of loss of 3GPP access in SCM.

NOTE 2: Following features are not supported in this release of the specification:

-    The support of Routing rules referring to an Application Id,

-    The support of Network Based Mobility based on PMIP.

4.2   Architecture reference model

The same architecture than defined in TS 23.402 [2] clause 4.2 (S2b case) and clause 16 (S2a case) applies. No new functional entity or reference point is defined for NBIFOM.

More details on the NBIFOM impacts on the various network functions are provided in clause 5.10.

5 NBIFOM High level functions

5.1 NBIFOM capability discovery/negotiation and change detection

During initial PDN connection establishment over the first access (or in the corresponding EAP-AKA' signalling in S2a/SCM case), the UE includes a NBIFOM request. The intermediate nodes (e.g. MME, SGSN, TWAG, ePDG, etc.) indicate to the PDN GW whether they support NBIFOM in the corresponding Create Session Request. When PCC is deployed, the PDN GW communicates to the PCRF whether the UE and network support NBIFOM. The PCRF then takes the decision on whether NBIFOM may apply to a PDN connection and communicates this decision to the PDN GW. If the network (i.e. all the EPC elements in the signalling chain from UE to PDN GW) supports NBIFOM and is willing to accept NBIFOM for this PDN connection, the PDN GW confirms the NBIFOM support in a "NBIFOM accepted" indication sent back to the UE in the PDN connection establishment accept message (or in the corresponding EAP-AKA' signalling in S2a/SCM case).

> NOTE: It is assumed that intermediate nodes (e.g. MME, SGSN, TWAG, ePDG, etc.) do not need to know whether NBIFOM finally applies to the PDN connection.

The UE shall enforce that NBIFOM applies either to none or to all PDN connections set by an UE on a given APN; this e.g. applies when the UE decides whether to require NBIFOM at the activation of a PDN connection, or when the UE decides whether adding or removing an access to or from a PDN connection.

During the inter PLMN mobility, the new MME, SGSN and S-GW also indicate to the P-GW whether they support the NBIFOM. If the PDN GW detects a change in the support of NBIFOM, the P-GW shall initiate the procedure to remove the 3GPP access from the multi-access PDN connection.

The UE sends also to the network the NBIFOM mode it has selected (as described in clause 5.4) as part of the initial PDN connection establishment over the first access.

5.2 Routing rules

A Routing Rule contains the following parameters:

- Routing Filter.

- Routing Access Information.

- Routing Rule Priority.

- Routing Rule identifier.

A Routing Filter consists of IP header parameter values/ranges used to identify one or more IP flows as defined in clause 3.1.

The Routing Access Information identifies the access type where the IP flow shall be routed.

For the purpose of matching user traffic against routing rules, the filters are applied in the order of the Routing Rule Priority.

The Routing Rule identifier uniquely identifies a Routing Rule for one PDN Connection. The Routing Rule identifier is allocated by the entity creating the routing rule, i.e. by the UE in UE-initiated NBIFOM mode and by the PDN GW in Network-initiated NBIFOM mode.

When NBIFOM applies to a PDN Connection, between UE and the PDN GW there is always a default access via which packets not matching any specific routing filter (of any Routing Rule) are routed. In the case of 3GPP access, MCM/S2a and S2b, the UE and the network determine as follows the default access for a PDN Connection during the procedure of addition of one access to a PDN connection:

- In UE-initiated NBIFOM mode, the UE proposes a default access to the network. The network may accept the default access if it complies with the subscription. The default access replied by the network may be different than the default access requested by the UE.

- In Network-initiated NBIFOM mode, the network decides the default access and indicates it to the UE.

In the case of SCM/S2a, the UE and the network determine as follows the default access for a PDN Connection during the first procedure of IP flow mobility within a PDN connection:

- In UE-initiated NBIFOM mode, the UE proposes a default access to the network during the first UE-initiated IP flow mobility procedure via 3GPP. The network may accept the default access if it complies with the subscription. The default access replied by the network may be different than the default access requested by the UE.

- In Network-initiated NBIFOM mode, the network decides the default access and indicates it to the UE during the first Network-initiated IP flow mobility procedure via 3GPP.

NOTE: Whether the default access corresponds to an explicit parameter or to a default Routing Rule is to be defined as part of Stage 3.

The default access for a PDN Connection only applies when it is active over both 3GPP and WLAN access networks. When the connectivity over one access is not active, the UE and the network shall ignore the default access.

The PCRF may learn about the accesses that support a PDN connection via event triggers it sets on the PDN GW.

5.3 Delivery of routing rules and IP Flow mapping

Routing rules are exchanged between the UE and the PDN GW via control plane signalling.

IP Flow mapping is used in Network-initiated NBIFOM mode when the UE wants to request the network to apply specific IP mappings to IP flows to 3GPP/WLAN access. The network provides Routing Rules to the UE for these IP flows unless the request from the UE is not allowed by the subscription. IP Flow mapping is sent via control plane signalling.

In the case of 3GPP access, MCM/S2a and S2b, a Routing Rule and IP Flow mapping are sent on the destination access as indicated by the Routing Access information in the Routing Rule or IP Flow mapping. In the case of SCM/S2a, Routing Rules and IP Flow mapping are only sent on the 3GPP access.

For the UE-initiated NBIFOM procedure, the routing rules are provided from the UE to the network as follows:

- For untrusted WLAN access, via IKEv2 procedure from the UE to the ePDG.

- For 3GPP access, via 3GPP NAS signalling from the UE to the MME/SGSN and then over GTP-c to S-GW.

- For trusted WLAN access in MCM mode, via WLCP procedure from the UE to the TWAG.

And then:

- via GTP-c signalling from the TWAG (MCM) / ePDG / SGW to the PDN GW.

- via Gx procedure from the PDN GW to the PCRF.

The UE does not apply new routing rules until the PDN GW has acknowledged them.

For the network-initiated NBIFOM procedure, the PCRF makes the decision on when and what flows should be moved to which access. The PCRF learns about the multiple accesses supporting a PDN connection via event triggers from the PDN GW.

- The PCRF triggers an update of routing rules by sending PCC rules to the PDN GW via an IP-CAN Session Modification procedure. The PDN GW builds Routing Rules corresponding to PCC rules received from the PCRF. The PDN GW does not apply the new routing rules until the UE has acknowledged them.

- The routing rules are sent by the PDN GW to S-GW / TWAG (for MCM mode) / ePDG via GTP-c signalling.

- The routing rules are then relayed:

- from SGW to the MME/SGSN via GTP-C and further to the UE via the 3GPP access specific signalling (i.e. NAS) defined in TS 23.401 [4].

- from ePDG to the UE via IKE signalling over SWu.

- from TWAG to the UE via WLCP signalling over trusted TWAN defined in TS 23.402 [2] clause 16.

If updated routing rules result in that no IP flow is left for a particular access, the PDN GW should not release the PDN connection for that particular access unless the PDN connection is explicitly torn down by the UE or by the network as described in clause 6.5.

5.4 NBIFOM Modes of Operations

5.4.1 General

A multi-access PDN connection can operate either in UE-initiated NBIFOM mode or in Network-initiated NBIFOM mode. This NBIFOM mode is selected when the PDN connection is established and remains the same as long as the PDN connection is active. The following clauses specify (a) what the functional characteristics of each mode are and (b) how the operation mode is selected.

5.4.2 UE-initiated NBIFOM Mode

In the UE-initiated NBIFOM mode only the UE controls the traffic routing within the multi-access PDN connection by applying its ANDSF for IFOM rules and/or the user-configured routing rules. When ANDSF for IFOM rules are used, the UE decides the Routing Rules for downlink traffic.

NOTE: If the UE has valid ANDSF rules for NSWO, for IARP and/or MAPCON, then the UE can also control traffic routing outside the multi-access PDN connection.

The UE can request to move selected IP flows from an old access to a new access within the PDN connection by sending one or more routing rules to the network. These routing rules specify the selected IP flows and the new access.

The network may reject IP flow mobility requests from UE due to subscription (or quota) limitations. When the network rejects an IP flow mobility request, the network shall provide to UE a certain cause value indicating why the request was rejected. This cause value may be used by UE to determine when/if this IP flow mobility operation can be requested again.

The network cannot request IP flow mobility. The IP flow mobility procedures used in UE-initiated NBIFOM mode are described in clause 6.

5.4.3 Network-initiated NBIFOM mode

In the Network-initiated NBIFOM mode, the network controls the traffic routing within the multi-access PDN connection.

NOTE: However, if the UE has valid ANDSF rules for NSWO, for IARP and/or MAPCON, then the UE can still control traffic routing outside the multi-access PDN connection.

The network can request to move selected IP flows from an old access to a new access within the multi-access PDN connection by sending one or more routing rules to the UE. These routing rules specify the selected IP flows and the new access.

The UE may reject (e.g. due to Local Operating Environment information) an IP flow mobility request from the network. When the UE rejects an IP flow mobility request from the network, the UE shall provide a cause value indicating why the request was rejected. This cause value may be used by the network to determine when/if this IP flow mobility operation can be requested again.

If the UE wants to request a mapping of IP flows to an access type, the UE provides the requested mapping from to the network. This is however not considered a routing rule provision as the network is the decision point for Routing Rules in Network-initiated NBIFOM mode. The network then provides new or updated routing rules to the UE based on the request received from the UE, unless the request is against what is allowed by the subscription. IP Flow mapping information contains the same parameters as the Routing Rule. When the UE uses the IP flow mapping procedure to add a new Routing Filter, the Routing Rule identifier is assigned by the network. When the UE uses the IP flow mapping procedure to request the network to modify or delete an existing Routing Rule, the UE includes the same

Routing Rule identifier as the one previously assigned by the network. The UE is not allowed to modify/remove a Routing Filter that the network has previously added using network-initiated IP flow mobility procedure. The corresponding call flows are provided in clause 6.4.

The UE can indicate to the network when an access of a multi-access PDN connection can or cannot be used for traffic routing. For example:

- When the UE loses the WLAN signal and the UE has active IP flows over WLAN, then the UE indicates to the network that WLAN cannot be used for traffic routing. This triggers the network to stop sending downlink traffic for these IP flows over WLAN access and provide updated routing rules to the UE. The UE and the network re-route one or more of these IP flows to 3GPP access, if the existing routing rules do not prevent them from using 3GPP access.

- When the UE recovers the WLAN signal and the existing routing rules in the UE require some active IP flows to be routed over WLAN, the UE indicates to the network that WLAN can again be used for traffic routing within the PDN connection. The network provides updated routing rules to the UE for the IP flows that are moved to WLAN access. The UE and the network re-route these active IP flows to WLAN access.

- The UE uses its Local Operating Environment (as defined in TS 23.261 [7]) to decide when the above indications should be sent to the network.

The network may provide to UE a "RAN rules / RCLWI handling" parameter during the PDN connection establishment procedure via 3GPP if the Network-initiated mode is selected (as specified in clause 5.4.4). When this parameter is set, it indicates that the UE shall use the "move traffic to/from WLAN" indications from Access Stratum under the conditions specified in bullet (a) below. When this parameter is not set or is not provided, it indicates that the UE shall not use the "move traffic to/from WLAN" indications. The UE uses the "RAN rules / RCLWI handling" parameter as specified below:

(a) If the "RAN rules / RCLWI handling" is set, the UE has no ISRP rule valid in the registered PLMN and the UE supports RAN-assisted WLAN interworking and/or and RCLWI, then the UE shall use the "move traffic to/from WLAN" indications from Access Stratum as follows:

- When Access Stratum indicates that traffic should be moved to 3GPP access, the UE shall send a move-from-WLAN indication to the network. The network then shall provide updated routing rules to the UE for traffic routing within the multi-access PDN connection.

- When Access Stratum indicates that traffic should be moved to WLAN access and the Local Operating Environment Information in the UE does not contain non-radio-related conditions that prohibit the use of WLAN access, the UE shall send a move-to-WLAN indication to the network. The network then shall provide updated routing rules to the UE for traffic routing within the multi-access PDN connection.

- The UE shall ignore the WLAN offloadability indication sent by MME.

(b) In all other cases, the UE shall not use the "move traffic to/from WLAN" indications from the Access Stratum. The UE shall perform traffic routing within a multi-access PDN connection by using the NBIFOM routing rules provided by the network.

5.4.4 Mode Selection

A multi-access PDN connection can operate in one of the following modes:

- UE-initiated mode;

- Network-initiated mode.

The details of UE-initiated mode are specified in clause 5.4.2 and the details of Network-initiated mode are specified in clause 5.4.3.

The NBIFOM mode is selected by the network (i.e. the PCRF, if PCC is deployed; or the PGW, otherwise) with the following procedure:

When an NBIFOM-capable UE supports ANDSF and has an ISRP rule valid in the registered PLMN then:

- If the ISRP rule includes at least one "ISRP for IFOM" rule (irrespectively of its validity), the UE requests UE-initiated mode;

- in non-roaming scenario, the network selects the UE-initiated mode;

- in roaming scenario:

    - If the visited network selects the NBIFOM mode according to description in clause 5.5, the visited network shall select UE-initiated mode; otherwise

    - If the home PLMN has not provided the UE with "ISRP for IFOM" rules, the home network makes the final decision of the NBIFOM mode, i.e., the home network may select either UE-initiated or NW-initiated mode according to home operator's policy;

    - otherwise, the network selects UE-initiated mode.

- Otherwise, the UE requests Network-initiated mode and the network selects Network-initiated mode.

When an NBIFOM-capable UE does not support ANDSF or supports ANDSF but does not have an ISRP rule valid in the registered PLMN then:

- The UE requests Network-initiated mode and the network selects Network-initiated mode.

Figure 5.4.4-1 provides a schematic illustration of the NBIFOM mode selection procedure as specified above. This figure assumes that the UE supports both ANDSF procedures and RAN-assisted WLAN interworking.
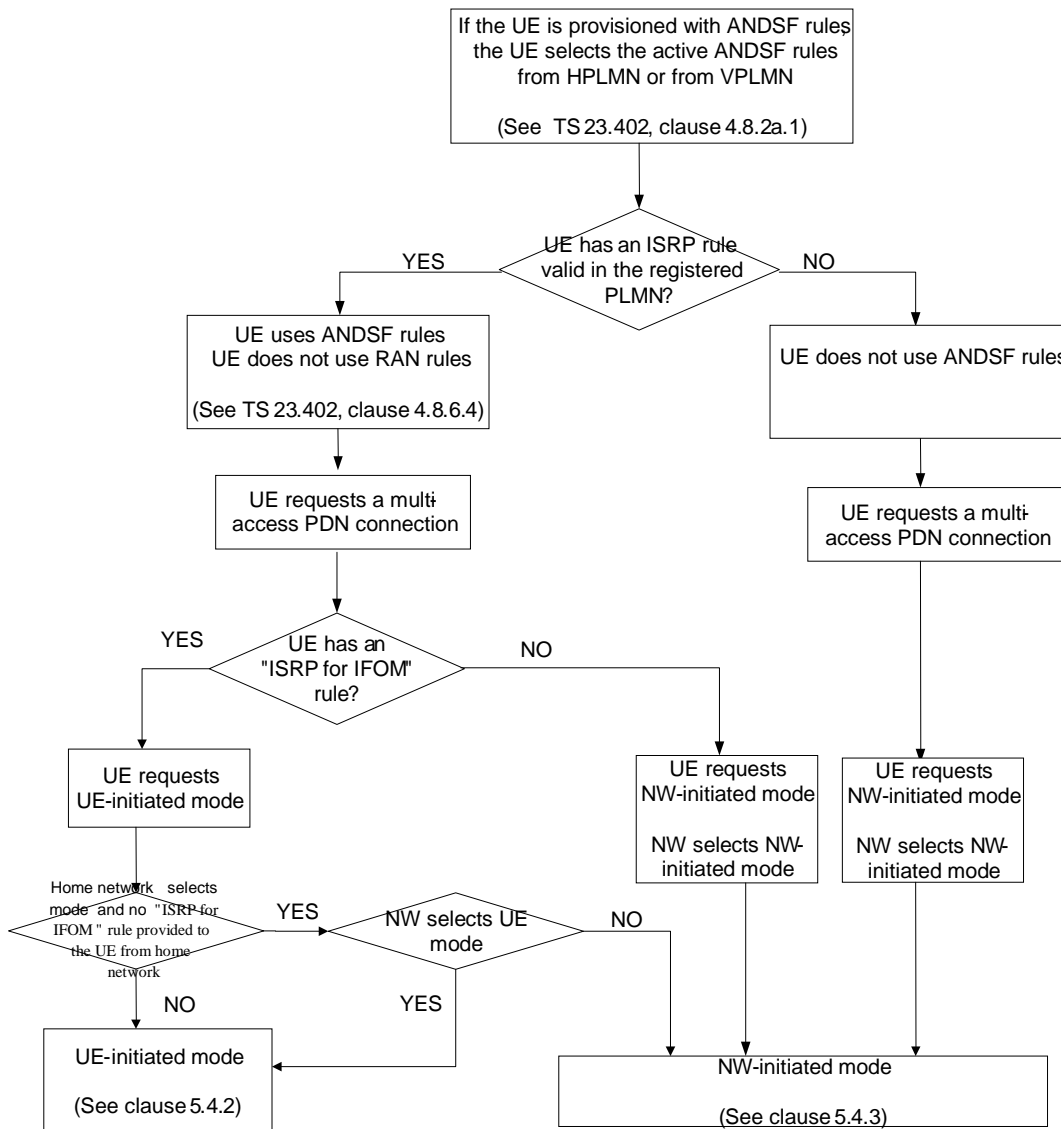

Figure 5.4.4-1: NBIFOM Mode Selection

5.5 PCC Interactions

When PCC applies for NBIFOM support on a PDN connection:

- The PCRF controls whether NBIFOM may apply to a PDN connection.

- The PCRF selects the NBIFOM mode.

- The PDN GW shall notify the PCRF when an access is added or removed for the PDN connection.

- The PDN GW shall notify the PCRF when an access becomes no more Usable or Usable again. This allows the PCRF to be aware when the UE losses or recovers connectivity on an access and to react accordingly in network-initiated NBIFOM mode.

- Multiple IP-CAN types (3GPP EPS and Non 3GPP EPS) may be simultaneously associated with the same IP-CAN session.

- The PCRF can send PCC rules including access type routing information per PCC rule to the PDN GW.

- For UE-initiated NBIFOM mode, the PDN GW may notify the PCRF about the Routing Rules received from the UE. When the Routing Rules received from the UE comply with the user subscription the PCRF installs / modifies PCC rules based on these notifications.

- For network-initiated NBIFOM mode, the PCRF determines the desired access type routing information for a PCC rule and accordingly installs / modifies PCC rules to the PDN GW. The PCRF request may be rejected by the UE due to local radio conditions. In that case the PCRF gets notified that the PCC rule cannot be fulfilled.

In following conditions the PCRF mentioned above is the Home PCRF:

- The UE is served by its HPLMN, or

- The PDN connection is served by a PGW in the Home PLMN (Home Routed configuration), or

- The PDN connection is served by a PGW in the V-PLMN (LBO configuration), and S9 is deployed and the V-PCRF supports NBIFOM.

The PCRF mentioned above is the Visited PCRF in the case when, through roaming agreement, the HPLMN operator allows the VPLMN operator to operate the V-PCRF without S9; this includes authorization of roamers to use NBIFOM. In that case, policy control based on subscription policy information from the HPLMN cannot apply.

NOTE: If the Home operator wants to enforce control by its own PCRF of the NBIFOM functionality on a PDN connection, the Home operator should ensure that the Home Routed roaming configuration applies to this PDN connection.

PCC impacts of NBIFOM are further described in TS 23.203 [3].

5.6 Addition of one access to a Multi-access PDN connection

During PDN connection establishment over an access, the UE may provide to the network a Handover Indication and a NBIFOM indication (in the PCO in the case of 3GPP access or TWAN access) in order to request that the PDN connection is to be used for NBIFOM: in this case the PDN connection establishment corresponds to the addition of an access to an already established PDN connection.

NOTE 1: In case a Handover Indication and no NBIFOM indication in the PCO are provided by the UE the PDN connection is handed over to the new access per the procedures described in TS 23.402 [2]

NOTE 2: In case No Handover Indication is provided by the UE, the PDN connection establishment corresponds to the set-up of a new PDN connection per the procedures described in TS 23.402 [2]

Intermediate node (e.g. MME/SGSN, SGW, TWAG or ePDG) indicate in the Create Session Request whether they support NBIFOM regardless of whether the Create Session Request set-up carries a Handover Indication. In the case of 3GPP access and WLAN access with S2a, NBIFOM is not supported by an intermediate node (i.e. MME/SGSN, SGW, TWAG) while the UE requests to add an additional access to a PDN connection, the network should reject the PDN

connectivity request with the appropriate cause value to indicate the failure of adding an additional access for NBIFOM. However, the previously established PDN connection shall be maintained on the first access.

NOTE 3: In the case of WLAN access with S2b, when NBIFOM is not supported by an ePDG, the addition of WLAN access is treated by the PGW as handover request. If the UE successfully connects with the ePDG but does not receive an NBIFOM indication in IKEv2 signalling from the network, the UE determines that its PDN connection over 3GPP access was handed over to WLAN.

When PCC applies, the PDN GW initiates an IP-CAN Modification Procedure to inform the PCRF about the UE request to add an access to an already established IP-CAN session and about the added RAT type and IP-CAN type. The PDN GW confirms the NBIFOM support in a "NBIFOM accepted" indication sent back to the UE in the PDN connection establishment accept message (or in the corresponding EAP-AKA' signalling in S2a/SCM case)

The Addition of one access to a Multi-access PDN connection is further described in clause 6.2

5.7 IP flow mobility within a Multi-access PDN connection

In UE-initiated NBIFOM mode, the IP flow mobility within a Multi-access PDN connection relies on the UE request to move selected IP flows from an old access to a new access by sending one or more routing rules to the network. This is further described in clauses 5.4.2 and 6.3.3

In Network-initiated NBIFOM mode, the IP flow mobility within a Multi-access PDN connection relies on the network request to move selected IP flows from an old access to a new access by sending one or more routing rules to the UE. The procedures IP flow mobility in Network-initiated NBIFOM mode are further described in clauses 5.4.3 and 6.3.2. The network decision for IP Flow Mobility may be based on notifications received from the UE that an access has become Unusable or has become Usable again as described in clauses 5.4.3, 6.6 and 6.7.

5.8 Removal of an access from a PDN connection

Both the UE and the network may initiate removal of an access procedure in both UE-initiated NBIFOM mode and network-initiated NBIFOM mode. When an access is removed from a multi-access PDN connection,

- In the UE-initiated removal of an access procedure, the PCEF (in the PDN GW) notifies the PCRF about the removal of an access. The PCRF determines the affected PCC rules and replies with updated PCC Rules or informs about the PCC Rules that are to be removed. The UE shall delete the Routing Rules locally

- In the Network-initiated removal of an access procedure, the PCRF should indicate the removed access to the PCEF by updating or removing all PCC rules that are bound to this access. In UE-initiated NBIFOM mode, the UE shall delete the Routing Rules locally.

The Removal of an access from a PDN connection is further described in clause 6.5.

5.8a Network-initiated release of NBIFOM PDN connection

The network may need to release a NB-IFOM PDN connection over both 3GPP and WLAN accesses, e.g. for SIPTO as defined in TS 23.401 [4] or for P-CSCF restoration as defined in TS 23.380 [8].

In this procedure, the network, after initiating the release of the PDN connection over one access, also initiates the release of the PDN connection over the other access thus avoiding the dependence on the UE-initiated PDN connection disconnect procedure.

The network-initiated release of a NBIFOM PDN connection is further described in clause 6.8.

5.9 Void

5.10 Functional entities

5.10.1 UE

To support NBIFOM the UE needs to be capable to:

- Indicate support and request for NBIFOM for a PDN connection as well as to request NBIFOM mode to the network.

- Send a default access for NBIFOM to the network in UE-initiated NBIFOM mode.

- Receive from the network decisions about whether NBIFOM applies to a PDN connection, about the NBIFOM mode and about the default access.

- Provide handover indication and NBIFOM indication when an access is added for a PDN connection.

- Exchange routing rules with the network over control plane protocols.

- Route IP flow(s) by using the default access for NBIFOM and routing access information which is part of the routing rules.

- Notify the network that an access becomes "usable" or "unusable" in Network-initiated NBIFOM mode.

5.10.2 PDN GW

To support NBIFOM the PDN GW needs to be capable to:

- Negotiate the support of NBIFOM and confirm the NBIFOM mode when the UE requests PDN connectivity over the first access. This negotiation includes receiving UE request for NBIFOM as well as receiving indication of support from entities in the network (MME, ePDG, etc.)

- Negotiate the support of NBIFOM and of the default access for NBIFOM when the UE requests PDN connectivity over an additional access. This negotiation includes receiving UE request for NBIFOM as well as indication of support from entities in the network (MME, ePDG, etc.)

- Support a PDN connection using multiple accesses.

- Provide the Charging Id for the PDN Connection to the S-GW/TWAN/ePDG in a separate information element.

- Receive UE request on a default access for NBIFOM in UE-initiated NBIFOM mode.

- Route the IP flow(s) by using the default access and the routing access information which is part of the routing rules.

- Exchange routing rules with the UE over control plane protocols.

- Receive UE notification that an access has become "usable" or "unusable" in Network-initiated NBIFOM mode.

- Support PCC interactions described in clause 5.5 and TS 23.203 [3] when PCC is enabled for the PDN connection.

5.10.3 MME

To support NBIFOM, the MME needs to be capable to:

- Provide an indication to the PDN GW for its support for NBIFOM during the PDN connection establishment over the first access and over an additional access.

- Forward the routing rules between the network (S-GW) and the UE via NAS and S11.

- Forward over S11 notifications received over NAS from the UE that an access has become "usable" or "unusable".

5.10.4   S-GW

To support NBIFOM, the S-GW needs to be capable to:

- Provide an indication to the PDN GW for its support for NBIFOM and relays the support indication from the MME/SGSN during the PDN connection establishment (over the first access and over an additional access).

- Forward the routing rules between the PDN GW and the MME/SGSN via S4/S11 and S5/S8.

- Forward over S5/S8 notifications received over S4/S11 from the SGSN/MME that an access has become "usable" or "unusable".

- Maintain the Charging Id for the PDN Connection as an information element independent from the Charging Id for a bearer.

5.10.5   ePDG

To support NBIFOM, the ePDG needs to be capable to:

- Receive the UE indication to negotiate NBIFOM support and NBIFOM mode in SWu during the initial and additional access and forward it over S2b;

- Receive over S2b the negotiation result of NBIFOM support from the PDN GW and forward it to the UE via SWu signalling;

- Provide an indication to the PDN GW for its support for NBIFOM during the PDN connection establishment (over the first and over an additional access);

- Forward the routing rules between the PDN GW and the UE via SWu and S2b;

- Forward over S2b notifications received over SWu from the UE that an access has become "usable" or "unusable".

- Handle the Charging Id for the PDN Connection as an information element independent from the Charging Id for a bearer.

5.10.6   TWAN

To support NBIFOM, the TWAN needs to be capable to:

- Provide an indication to the PDN GW for its support for NBIFOM, during the PDN connection establishment over the first access and over an additional access,

- Provide indication to the PDN GW whether the PDN connection is being established as SCM or MCM.

- Handle the Charging Id for the PDN Connection as an information element independent from the Charging Id for a bearer.

In the case of MCM, the TWAG:

- Forwards the routing rules between the PDN GW and the UE via WLCP and S2a,

- Forwards over S2a notifications received over WLCP from the UE that an access has become "usable" or "unusable".

5.10.7   SGSN

To support NBIFOM, the SGSN needs to be capable to:

- Provide an indication to the PDN GW for its support for NBIFOM, during the PDN connection establishment over the first access and over an additional access.

- Forward the routing rules between the network (S-GW) and the UE via NAS and S4.

- Forwards over S4 notifications received over NAS from the UE that an access has become "usable" or "unusable".

5.10.8 PCRF

PCC Enhancements are described in clause 5.5 and TS 23.203 [3].

6 NBIFOM Signalling Flows

6.1 Initial PDN connection establishment over first access

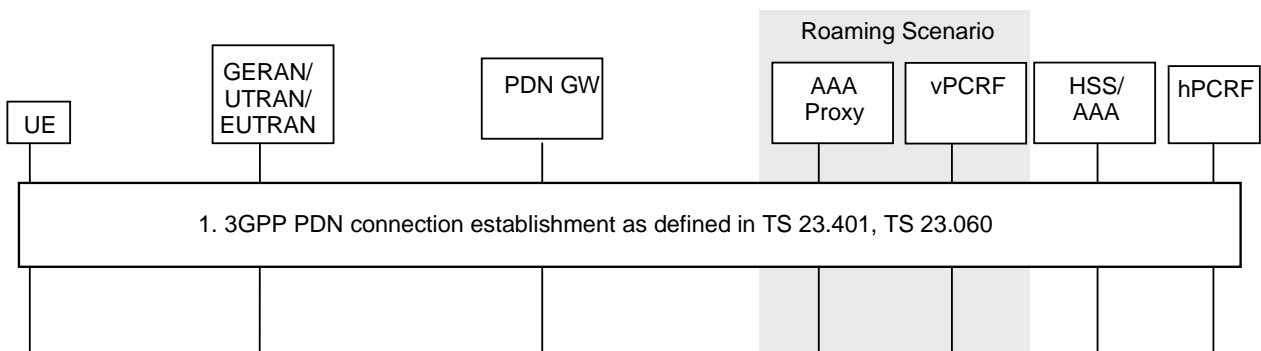## 6.1.1 Initial PDN connection establishment over 3GPP access

Figure 6.1.1-1: PDN connection establishment over 3GPP access with GTP based S5/S8

In the case of E-UTRAN, the UE performs the PDN connection establishment over EUTRAN access as specified in TS 23.401 [4] clause 5.3.2.1 for Initial Attach, and as specified in TS 23.401 [4] clause 5.10.2 for UE requested PDN connectivity, with the following additions:

Step 1:   In the case of initial attach, the UE includes an NBIFOM indication in the PCO in the Attach Request. In the case of UE requested PDN connectivity, the UE sends PDN Connectivity Request, including an NBIFOM indication in the PCO.

- In addition, UE requests the NBIFOM mode of this PDN connection in the PCO according to the consideration based on clause 5.4.4 Mode Selection.

Step 2-3: In the Create Session Request, the MME and SGW notify PDN GW of their support for NBIFOM.

Step 4:   If dynamic PCC is applied for the PDN connection, during the IP-CAN session establishment, the PDN GW informs the PCRF about the UE and network support of NBIFOM capability, the requested NBIFOM mode, IP-CAN type and the RAT type; and if the UE and the network support NBIFOM, the H-PCRF informs the PDN GW about its decision on whether to allow NBIFOM for the PDN connection. If PCC does not apply, the PDN GW takes the local decision on whether to allow NBIFOM for the given PDN connection.

Step 5:   The PDN GW indicates the NBIFOM support and the NBIFOM mode in the PCO and includes the Charging Id for the PDN Connection in the Create Session Response. The PCO is forwarded to the UE as described in TS 23.401 [4].

For UTRAN, the UE performs the initial PDN connection establishment over GERAN/UTRAN access as specified in TS 23.060 [5] clause 9.2.2.1A (PDP context activation using S4) and addition of a new PDN connection as specified in TS 23.060 [5] clause with the following additions:

Step 1: As described in TS 23.060 [5] clause 9.2.2.1, the UE sends Activate PDP context Request, including an NBIFOM indication as well as the requested NBIFOM mode in the PCO. UE requests the NBIFOM mode of this PDN connection in the PCO according to the consideration based on clause 5.4.4 Mode Selection.

Step A-B: As described in TS 23.060 [5], clause 9.2.2.1A, the SGSN and S-GW inform the PDN GW their support of NBIFOM:

- If PCC applies, during the IP-CAN session establishment procedure, the PDN GW informs the PCRF about the UE and network support of NBIFOM capability, about the requested NBIFOM mode and about the IP-CAN type and RAT type; and if the UE and network support NBIFOM, the H-PCRF informs the PDN GW about its decision on whether to allow NBIFOM for the PDN Connection. If PCC does not apply, the PDN GW takes a local decision on whether to allow NBIFOM for the PDN Connection.

Step 9: As described in TS 23.060 [5] clause 9.2.2.1A, the PDN GW indicates the NBIFOM support and the NBIFOM mode in the PCO and includes the Charging Id for the PDN Connection in the Create Session Response. The PCO is forwarded to the UE as described in TS 23.401 [4].

6.1.2 PDN connection establishment over S2a

This clause describes PDN connection establishment for S2a with single-connection mode and S2a with multi-connection mode.

6.1.2.1 Single-connection mode

This procedure is used to establish a PDN Connection over trusted WLAN access in single-connection mode.
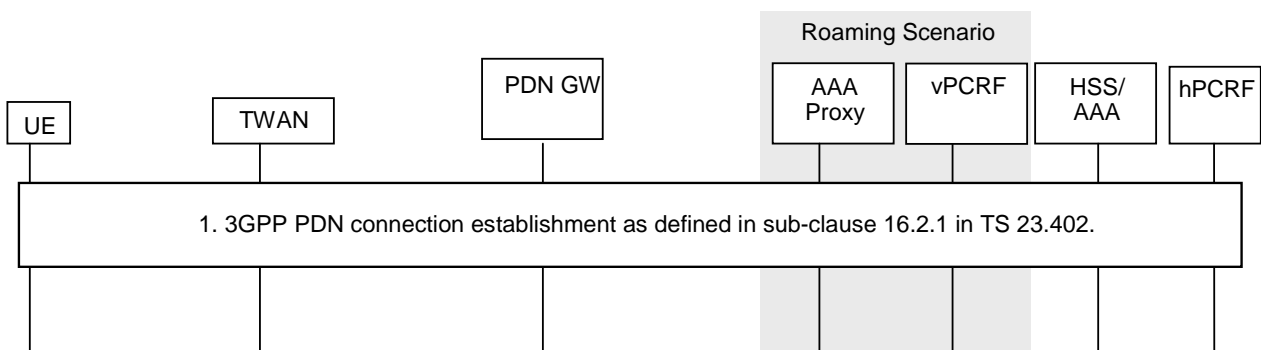
Figure 6.1.2.1-1: PDN connection establishment procedure over TWAN access for SCM

For SCM, a new PDN connection is established as described in TS 23.402 [2] clause 16.2 for Initial Attach, with the following additions:

- During the EAP authentication, the UE negotiates single-connection mode and requests EPC access. The UE also indicates NBIFOM support in the PCO provided during the EAP authentication. The UE also provides the requested NBIFOM mode in the PCO according to the conditions for NBIFOM mode selection in clause 5.4.4.

- The TWAN includes an NBIFOM support indication in the Create Session Request to the PDN GW.

- If dynamic PCC is applied for the PDN Connection, the PDN GW initiates an IP-CAN session establishment procedure. As part of this procedure the PDN GW informs the PCRF about the UE and network support of NBIFOM capability, about the requested NBIFOM mode and about the IP-CAN type. If the UE and network support NBIFOM, the PCRF informs the PDN GW about its decision on whether to allow NBIFOM for the PDN Connection. If dynamic PCC is not applied, the PDN GW takes a local decision on whether to allow NBIFOM for the PDN Connection.

- The PDN GW includes the Charging Id for the PDN Connection separately in the Create Session Response to the TWAN. The PDN GW indicates the network support of NBIFOM in the PCO in the Create Session Response. The PCO is forwarded to the UE as described in clause 16.2, TS 23.402 [2].

6.1.2.2 Multi-connection mode

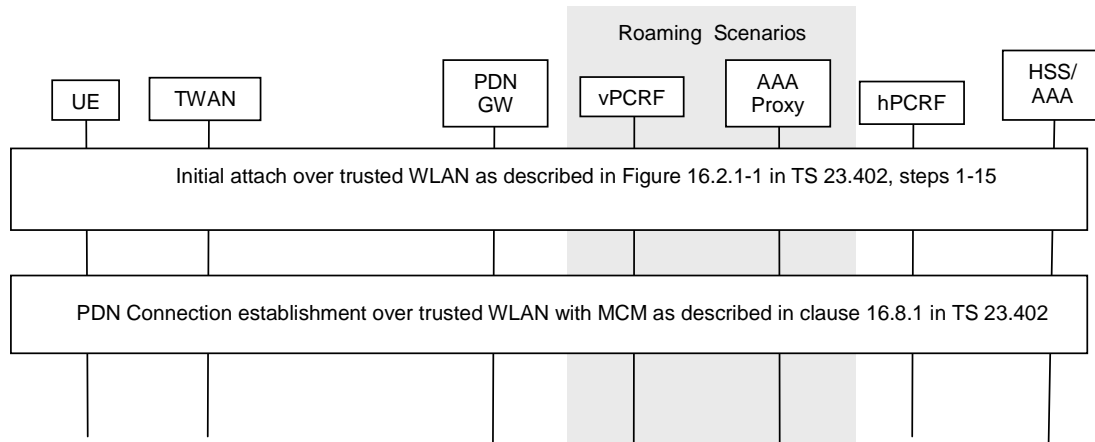This procedure is used to establish a PDN Connection over trusted WLAN access in multi-connection mode.

Figure 6.1.2.2-1: **PDN connection establishment procedure over TWAN access for MCM**

For MCM, the UE attaches to TWAN using the procedure described in steps 1-15 in clause 16.2.1 of TS 23.402 [2] and negotiates for multi-connection mode. If multi-connection mode is authorized by the network, the UE performs the PDN Connection establishment procedure in clause 16.8.1 of TS 23.402 [2] with the following additions:

- The UE indicates NBIFOM support in PCO in the WLCP PDN Connection Request to the TWAN. The UE also provides the requested NBIFOM mode in PCO according to the conditions for NBIFOM mode selection in clause 5.4.4.

- The TWAN includes an NBIFOM support indication in the Create Session Request sent to the PDN GW.

- If dynamic PCC is applied for the PDN Connection, in the PDN GW initiates an IP-CAN session establishment procedure. As part of this procedure the PDN GW informs the PCRF about the UE and network support of NBIFOM capability, about the requested NBIFOM mode and about the IP-CAN type. If the UE and network support NBIFOM, the PCRF informs the PDN GW about its decision on whether to allow NBIFOM for the PDN Connection. If dynamic PCC is not applied, the PDN GW takes a local decision on whether to allow NBIFOM for the PDN Connection.

- The PDN GW includes the Charging Id for the PDN Connection separately in the Create Session Response to the TWAN. The PDN GW indicates the NBIFOM support in the PCO in the Create Session Response. The PCO is forwarded to the UE as described in clause 16.2, TS 23.402 [2].

6.1.3 PDN connection establishment over S2b

This procedure is used to establish a PDN Connection over untrusted WLAN access.
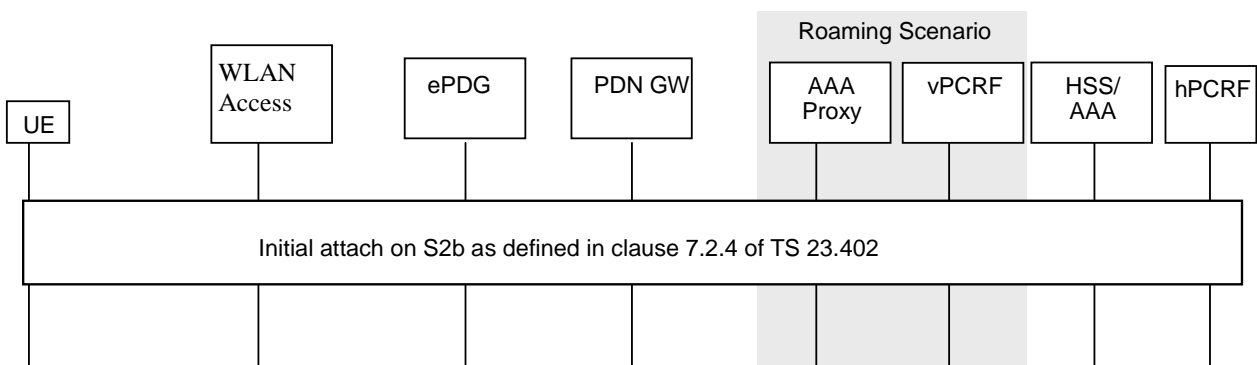

Figure 6.1.3-1: PDN connection establishment over WLAN access

The procedure is the same as described in clause 7.2.4 of TS 23.402 [2], with the following additions:

- The UE uses Configuration Payload in IKEv2 signalling to indicate its support for NBIFOM. The UE also provides in the IKEv2 Configuration Payload the requested NBIFOM mode for this PDN connection according to the conditions on NBIFOM mode selection in clause 5.4.4.

- If the ePDG supports NBIFOM, the ePDG shall indicate its NBIFOM capability in the Create Session Request sent to the PDN GW. The ePDG also transfers the UE support for NBIFOM and the UE request for the NBIFOM operation mode to the PDN GW.

- If dynamic PCC is applied for the PDN Connection, the PDN GW initiates an IP-CAN session establishment procedure. As part of this procedure the PDN GW informs the PCRF about the UE and network support of NBIFOM capability, about the requested NBIFOM mode and about the IP-CAN type. If the UE and network support NBIFOM, the PCRF informs the PDN GW about its decision on whether to allow NBIFOM for the PDN Connection. If PCC is not applied, the PDN GW takes a local decision on whether to allow NBIFOM for the PDN Connection.

- The PDN GW includes the Charging Id for the PDN Connection separately in the Create Session Response to the ePDG The PDN GW indicates the NBIFOM support in the APCO in the Create Session Response.

- The ePDG shall forward the negotiated result of NBIFOM support to the UE via Configuration Payload in IKEv2 signalling.

6.2 Addition of one access to a PDN connection

6.2.1 General

This clause specifies the additional procedures for adding an access to an existing PDN connection over a 3GPP access, a Trusted WLAN access or an Untrusted WLAN when the NBIFOM is supported. In these flows it is assumed that the UE has performed a PDN Connection establishment procedure through one access as specified in clause 6.1. The procedure results in that the UE is simultaneously connected via both accesses and a set of traffic flows can be routed through one access while the remaining traffic flows are routed through the other access.

Each of the accesses has its own default bearer where each bearer has its own Charging Id. The Charging Id for the PDN connection will differ from the Charging Id for the default bearer. The PDN GW shall provide the Charging Id for the PDN connection separately to the SGW/TWAN/ePDG for both the default and any dedicated bearer.

6.2.2 Addition of a 3GPP access

In the case of E-UTRAN, the UE has established a PDN connection over WLAN as described in clause 6.1.2 or 6.1.3 above. Subsequently, the UE requests to establish a PDN connection using the same APN on E-UTRAN, and attempts to use both accesses for the same PDN connection simultaneously. For EUTRAN, the procedure is the same as specified in TS 23.401 [4] clause 5.3.2.1 (Initial attach procedure) and clause 5.10.2 (UE requested PDN Connectivity procedure) with the following additions:

Step 1: The UE indicates handover and includes NBIFOM indication in the PCO in Attach Request (Initial attach) or PDN Connectivity Request (UE requested PDN Connectivity procedure) for the same APN as for the PDN connection established over the Trusted or Untrusted WLAN access previously.

Step 2: Since the handover indication is provided by the UE, the MME selects the same PDN GW that is already assigned for the UE and the PDN connection, and indicates its NBIFOM capability in the Create Session Request to the Serving GW.

Step 3: The Serving GW sends the Create Session Request to the PDN GW, including its NBIFOM capability.

Step 4: When the PDN GW receives handover and NBIFOM indication, the PDN GW does not remove the bearers over the WLAN access for the corresponding PDN connection. The PDN GW initiates an IP-CAN Modification Procedure to notify the PCRF about the additional of 3GPP access together with the RAT type of the access, if dynamic PCC applies. The PCRF may reject the addition of the access if the multi-access IP-CAN session would correspond to an invalid combination of IP-CAN and RAT Types or is not allowed by the subscription.

- The same IP address is allocated for the PDN connection as the one used in WLAN.

    - If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment, the UE may include Routing Rules and indicates the default access to the PCRF via PDN GW during this procedure. The PCRF takes a final decision on the default access based on the subscription, and indicate the default access for the PDN Connection to the PDN GW. The default access replied by the network may be different than the default access requested by the UE.

    - If network-initiated NBIFOM mode was selected at initial PDN connection establishment, the network does not provide any Routing Rules to the UE during this procedure. The PCRF shall indicate the default access to the PDN GW. The PDN GW indicates the default access to the MME via SGW. The MME indicates the default access to the UE in PDN Connectivity Accept message.

  - Appropriate 3GPP bearer setup or modification procedures are executed for the resources associated with the flows that were moved onto the 3GPP access.

Step 5:   If the MME, SGW and the PDN GW support NBIFOM and the addition of an access is accepted by the PCRF, the PDN GW generates a Charging Id for the Default Bearer and includes the Charging Ids for the PDN Connection and the Default Bearer in the Create Session Response to the SGW. The PDN GW indicates the support of NBIFOM in the PCO included in Attach Accept / PDN Connectivity Accept to be sent to the UE.

In the case of GERAN/UTRAN, the UE performs the initial PDN connection establishment over GERAN/UTRAN access and addition of a new PDN connection as specified in TS 23.060 [5] clause 9.2.2.1A (PDP context activation using S4) with the following additions:

Step 1:   The UE sends Activate PDP context Request, including an NBIFOM indication in the PCO and handover indication.

Step 2:   Since the handover indication is provided by the UE, the SGSN selects the same PDN GW that is already assigned for the UE and the PDN connection, and indicates its NBIFOM capability in the Create Session Request to the Serving GW. The SGSN and SGW inform the PDN GW their support of NBIFOM in Create Session Request.

Step 3:   The Serving GW sends the Create Session Request to the PDN GW, including its NBIFOM capability.

Step 4:   When the PDN GW receives handover and NBIFOM indication, the PDN GW does not remove the bearers over the WLAN access for the corresponding PDN connection. The PDN GW initiates an IP-CAN Modification Procedure to notify the PCRF about the additional of 3GPP access together with the RAT type of the access, if dynamic PCC applies. The PCRF may reject the addition of the access if the multi-access IP-CAN session would correspond to an invalid combination of IP-CAN and RAT Types or is not allowed by the subscription.

  - The same IP address is allocated for the PDN connection as the one used in WLAN.

    - If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment, the UE may include Routing Rules and indicates the default access to the PCRF via PDN GW during this procedure. The PCRF takes a final decision on the default access based on the subscription, and indicate the default access for the PDN Connection to the PDN GW. The default access replied by the network may be different than the default access requested by the UE.

    - If network-initiated NBIFOM mode was selected at initial PDN connection establishment, the network does not provide any Routing Rules to the UE during this procedure. The PCRF shall indicate the default access to the PDN GW. The PDN GW indicates the default access to the MME via SGW. The MME indicates the default access to the UE in PDN Connectivity Accept message.

  - Appropriate 3GPP bearer setup or modification procedures are executed for the resources associated with the flows that were moved onto the 3GPP access.

Step 5:   If the SGSN, SGW and the PDN GW support NBIFOM and the addition of an access is accepted by the PCRF, the PDN GW generates a Charging Id for the Default Bearer and includes the Charging Ids for the PDN Connection and the Default Bearer in the Create Session Response to the SGW. The PDN GW indicates the support of NBIFOM in the PCO included in Activate PDP context Accept to be sent to the UE.

6.2.3 Addition of an access using S2a

6.2.3.1 Single-connection mode

This procedure is used to add trusted WLAN access in single-connection mode to an existing PDN Connection. The decision to use the single-connection mode is made during authentication as described in clause 16.2.
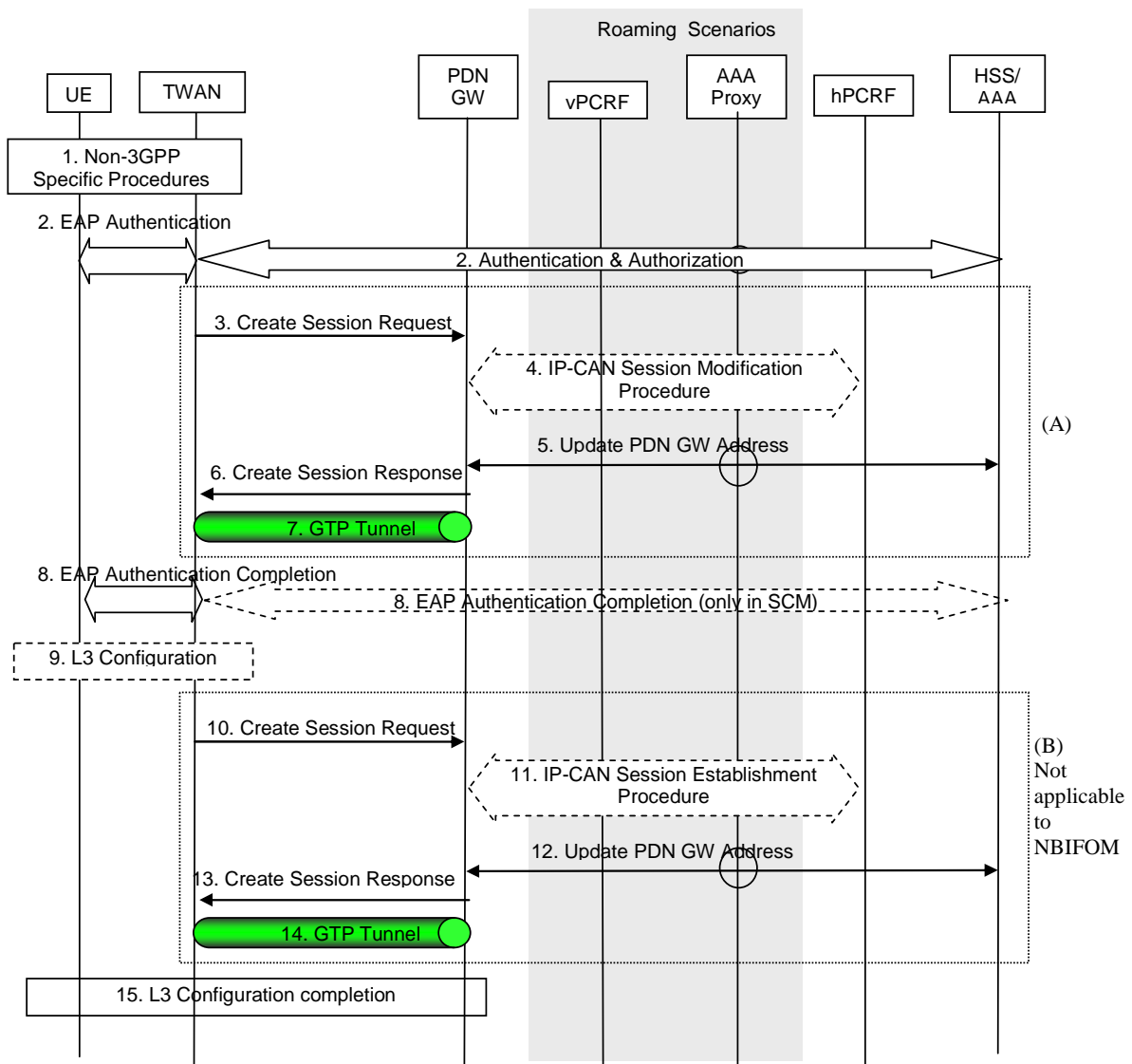

Figure 6.2.3.1-1: Addition of trusted WLAN access with SCM and GTP S2a for roaming, LBO and non-roaming scenarios

It is assumed that the UE has established a PDN connection over a 3GPP access and has received from the network an indication that NBIFOM is supported to this PDN connection. In order to use the TWAN access with SCM for the same PDN connection simultaneously, the UE now performs the procedure TS 23.402 [2] clause 16.2 (Initial Attach) with the following additions:

Step 2: During the EAP authentication, the UE negotiates single-connection mode and requests EPC access. The UE indicates handover and the same APN as for the PDN connection established over the 3GPP access. The UE also includes an NBIFOM indication in the PCO that the procedure is for the addition of an access to the PDN connection. The UE cannot include routing rule(s) during the EAP authentication procedure in single-connection mode. If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment, the UE may include an indication for default access for the PDN Connection.

Step 3: Since the handover indication is included, the TWAN selects the same PDN GW as it is already allocated for the PDN connection. The TWAN includes an NBIFOM capability indication in the Create Session Request.

Step 4: Instead of an IP-CAN Session Establishment procedure, the PDN GW performs an IP-CAN Session Modification procedure. The PDN GW indicates to the PCRF the addition of an access for the PDN connection and informs the PCRF about the additional RAT type. The PCRF may reject the addition of the access if the multi-access IP-CAN session would correspond to an invalid combination of IP-CAN and RAT Types or is not allowed by the subscription.

Step 8: If the TWAN and the PDN GW support NBIFOM and the addition of an access is accepted by the PCRF, the PDN GW generates a Charging Id for the Default Bearer and includes the Charging Ids for the PDN Connection and the Default Bearer in the Create Session Response to the TWAN. The PDN GW indicates the support of NBIFOM in the PCO to be sent to the UE.

In network-initiated NBIFOM mode, the network does not provide any routing rules to the UE during this procedure.

NOTE: The reason is that there would be no way for the UE to acknowledge the network-provided Routing Rules during the addition of an access. Instead, Routing Rules need to be provided from the network using a separate IP flow mobility procedure.

NBIFOM is not supported for Transparent Single Connection Mode. Therefore only scenario (A) in Figure 6.2.3.1-1 is applicable to NBIFOM.

6.2.3.2 Multi-connection mode

This procedure is used to add trusted WLAN access in multi-connection mode to an existing PDN Connection. The decision to use the multi-connection mode is made during authentication as described in clause 16.2.

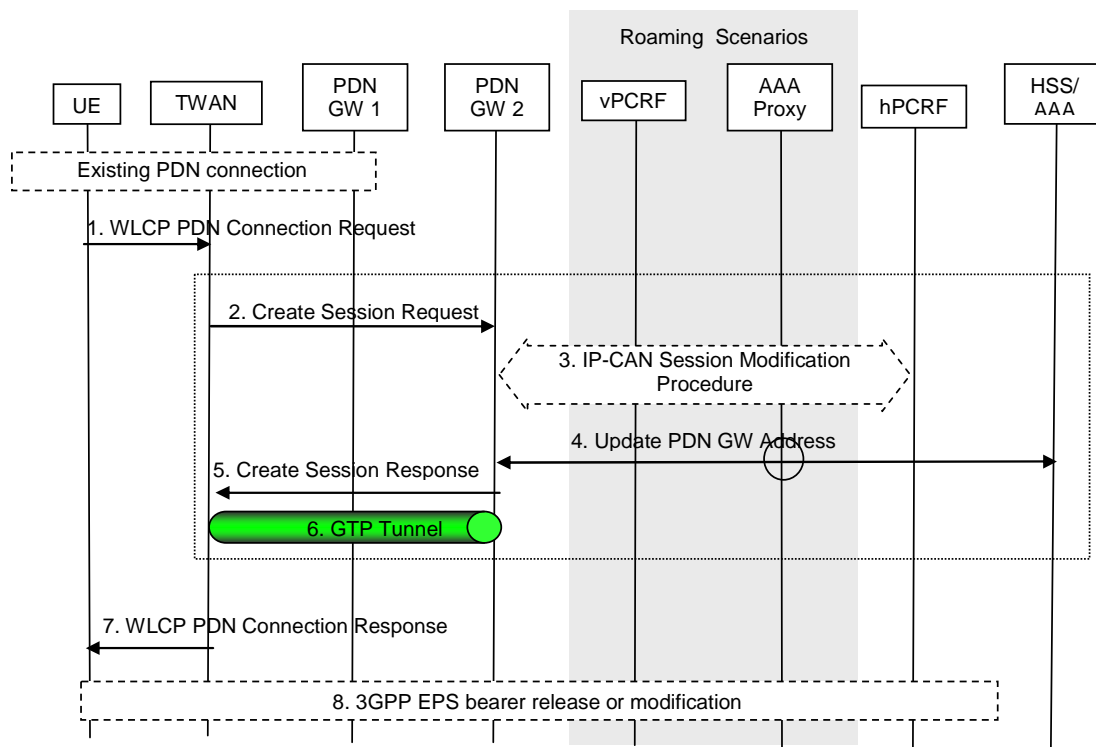**Figure 6.2.3.2-1: UE-Initiated Connectivity to PDN in WLAN on GTP S2a**

It is assumed that the UE has established a PDN connection over a 3GPP access and has received from the network an indication that NBIFOM is supported for to this PDN connection.

It is also assumed that the UE has made initial attach in trusted WLAN access and negotiated MCM during EAP authentication, as described in clause 16.2.1 in TS 23.402 [2].

In order to use the TWAN access with MCM for the same PDN connection simultaneously, the UE now performs the procedure TS 23.402 [2] clause 16.8.1 (PDN Connection establishment) with the following additions:

Step 1:   In the WLCP PDN Connection Request, the UE indicates handover and the same APN as for the PDN connection established over the 3GPP access. The UE also includes an indication in the PCO that the procedure is for addition of an access for the PDN connection.

            If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment, the UE may include Routing Rules in the WLCP PDN Connection Request, as well as an indication for default access for the PDN Connection.

Step 2:   Since the handover indication is included, the TWAN selects the same PDN GW as is already allocated for the PDN Connection. The TWAN includes an NBIFOM capability indication in the Create Session Request. The TWAN also includes Routing Rules(s) and the indication for default access if provided by the UE in step 2.

            When the PDN GW receives the Create Session Request indication, the PDN GW does not remove the bearers over 3GPP access for the corresponding PDN connection. The same IP address is allocated for the PDN connection as the one used in 3GPP access network

Step 3:   Instead of an IP-CAN Session Establishment procedure, the PDN GW performs an IP-CAN Session Modification procedure. The PDN GW indicates to the PCRF of addition of an access for the PDN connection and informs the PCRF about the additional RAT type. The PCRF may reject the addition of the access if the multi-access IP-CAN session would correspond to an invalid combination of IP-CAN and RAT Types or is not allowed by the subscription.

            If network-initiated NBIFOM mode was selected at initial PDN Connection establishment, the PCRF shall indicate the default access for the PDN Connection to the PDN GW.

            If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment and the UE included an indication for default access for the PDN Connection, the PDN GW provides the indication to the PCRF. The PCRF takes a final decision on the default access based on the subscription, and indicate the default access for the PDN Connection to the PDN GW. The default access replied by the network may be different than the default access requested by the UE.

Step 5:   The PDN GW indicates the default access for the PDN Connection to the TWAG via S2a.

Step 7:   The TWAG indicates the new default access to the UE as part of the WLCP PDN Connection Response. If the TWAN and the PDN GW support NBIFOM and the addition of an access is accepted by the PCRF, the PDN GW generates a Charging Id for the Default Bearer and includes the Charging Ids for the PDN Connection and the Default Bearer in the Create Session Response to the TWAN. The PDN GW indicates the support of NBIFOM in the PCO included in WLCP PDN Connectivity Accept to be sent to the UE.

In network-initiated NBIFOM mode, the network does not provide any routing rules to the UE during this procedure.

NOTE: The reason is that there would be no way for the UE to acknowledge the network-provided Routing Rules during the addition of an access. Instead, Routing Rules need to be provided from the network using a separate IP flow mobility procedure.

Step 8:   In UE-initiated NBIFOM mode, if the UE provided Routing Rules to the network when adding trusted WLAN access to the PDN Connection, the PDN GW executes appropriate 3GPP resource release procedures for the resources associated with the flows that were moved away from the 3GPP source access, based on the routing rules provided by the UE, as specified in TS 23.402 [2].

6.2.4   Addition of an access using S2b

6.2.4.1   Addition of Untrusted WLAN access

This procedure is used to add untrusted WLAN access to an existing PDN Connection.
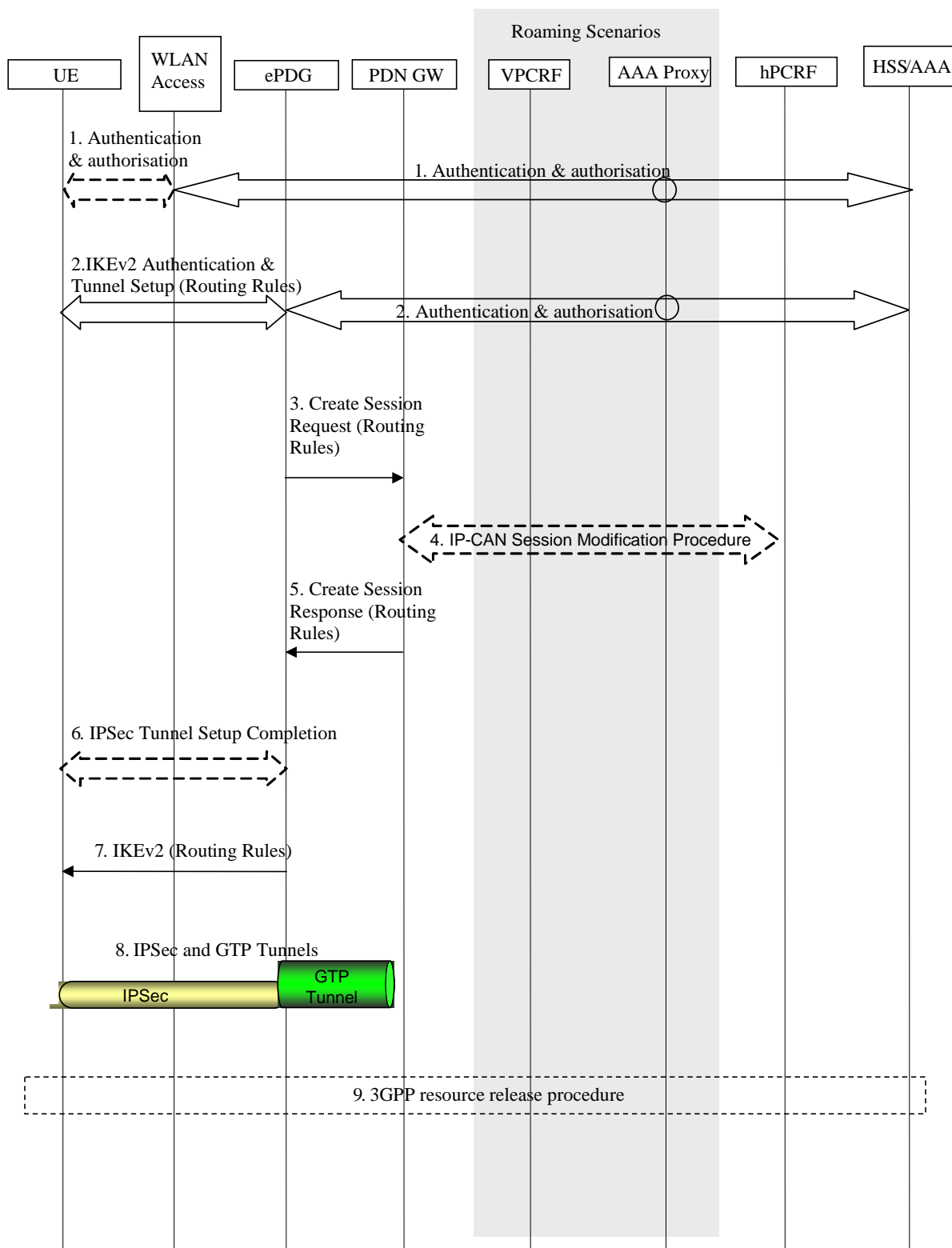
Figure 6.2.4.1-1: Addition of WLAN access to the PDN connection

Figure 6.2.4.1-1 shows the particular case when the UE is first connected to a 3GPP access and then it requests addition of a WLAN access.

It is assumed that the UE has successfully attached to 3GPP access and established a PDN connection over 3GPP access using GTP as described in clause 6.1.1 and that the UE has received from the network an indication that NBIFOM is supported for this PDN connection.

Subsequently the UE performs the untrusted WLAN attachment, and requests to establish a PDN connection using the same APN, and attempts to use both accesses for the same PDN connection simultaneously.

1. The UE discovers a WLAN and performs the authentication and authorization procedure with 3GPP EPC via the WLAN access as specified in TS 23.402 [2] clause 7.2.1 step 1.

2. IKEv2 authentication and tunnel setup procedure are performed via the WLAN access between the UE, ePDG and 3GPP AAA Server/HSS as specified in TS 33.402 [6]. For IP address preservation, the UE includes the same address (IPv4 address or IPv6 prefix/address or both) that was allocated during its attachment to 3GPP access. A new access can be added to a multi-access PDN connection without an associated routing rule.

   If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment, the UE may include Routing Rules in this step, as well as an indication for default access for the PDN Connection.

3. Since the handover indication is included, the TWAN selects the same PDN GW as is already allocated for the PDN Connection. The ePDG includes an NBIFOM indication in the Create Session Request message to the PDN GW. The ePDG also includes Routing Rules(s) and the indication for default access if provided by the UE in step 2.

4. When the PDN GW receives the Create Session Request with NBIFOM indication, the PDN GW does not remove the bearers over 3GPP access for the corresponding PDN connection. The same IP address is allocated for the PDN connection as the one used in 3GPP access network. If dynamic PCC is applied, the PDN GW initiates the IP-CAN Session Modification Procedure with the PCRF. The PDN GW indicates to the PCRF the addition of an access for the PDN connection and informs the PCRF about the additional RAT type. The PCRF may reject the addition of the access if the multi-access IP-CAN session would correspond to an invalid combination of IP-CAN and RAT Types or is not allowed by the subscription.

   If routing rules were received, the PDN GW provides the PCRF with notification of the UE requested IP flow mapping to an Access Type. The PCRF may accept or reject the routing rules. . If network-initiated NBIFOM mode was selected at initial PDN Connection establishment, the PCRF shall indicate the default access for the PDN Connection to the PDN GW.

   If UE-initiated NBIFOM mode was selected at initial PDN Connection establishment, the UE indicates the default access to the PCRF via PDN GW during this procedure. The PCRF takes a final decision on the default access based on the subscription, and indicate the default access for the PDN Connection to the PDN GW. The default access replied by the network may be different than the default access requested by the UE.

5. The PDN GW sends a Create Session Response message to the ePDG that includes the routing rules. The PDN GW generates a Charging Id for the Default Bearer and includes the Charging Ids for the PDN Connection and the Default Bearer in the Create Session Response to the ePDG. The PDN GW also indicates the default access for the PDN Connection to the ePDG.

6. The ePDG indicates to the UE that the authentication and authorization with the external AAA server is successful.

7. If routing rules were included in step 2 above, the ePDG notifies the UE whether the routing rules were accepted or rejected. In network-initiated NBIFOM procedure, the network does not provide any routing rules to the UE during this procedure. The ePDG indicates the default access to the UE as part of the IKEv2 signalling.

8. IP connectivity from the UE to the PDN GW is now setup. Any packet in the uplink direction complying with the routing rules is tunnelled to the ePDG by the UE using the IPSec tunnel. The ePDG then tunnels the packet to the PDN GW. From the PDN GW normal IP-based routing takes place. In the downlink direction, the packet for UE arrives at the PDN GW. The PDN GW tunnels the packet to the ePDG based on the routing rules. The ePDG then tunnels the packet to the UE via the IPsec tunnel.

9. If routing rules were included in step 2 above, the appropriate 3GPP resource release procedures are executed for the resources associated with the flows that were moved onto the WLAN access as specified in TS 23.402 [2].

6.3 IP flow mobility within a PDN connection

6.3.1 General

6.3.2 Network-initiated IP flow mobility

6.3.2.1 Routing Rules signalled via 3GPP access

In the case of network-initiated NBIFOM mode, the following procedures are applicable for S2a-SCM, S2a-MCM or S2b when target network is 3GPP access.

In the following signalling flow, the PDN GW moves one or more IP flow(s) by providing a Routing Rule with access type 3GPP. The routing rule is sent via E-UTRAN in this case.
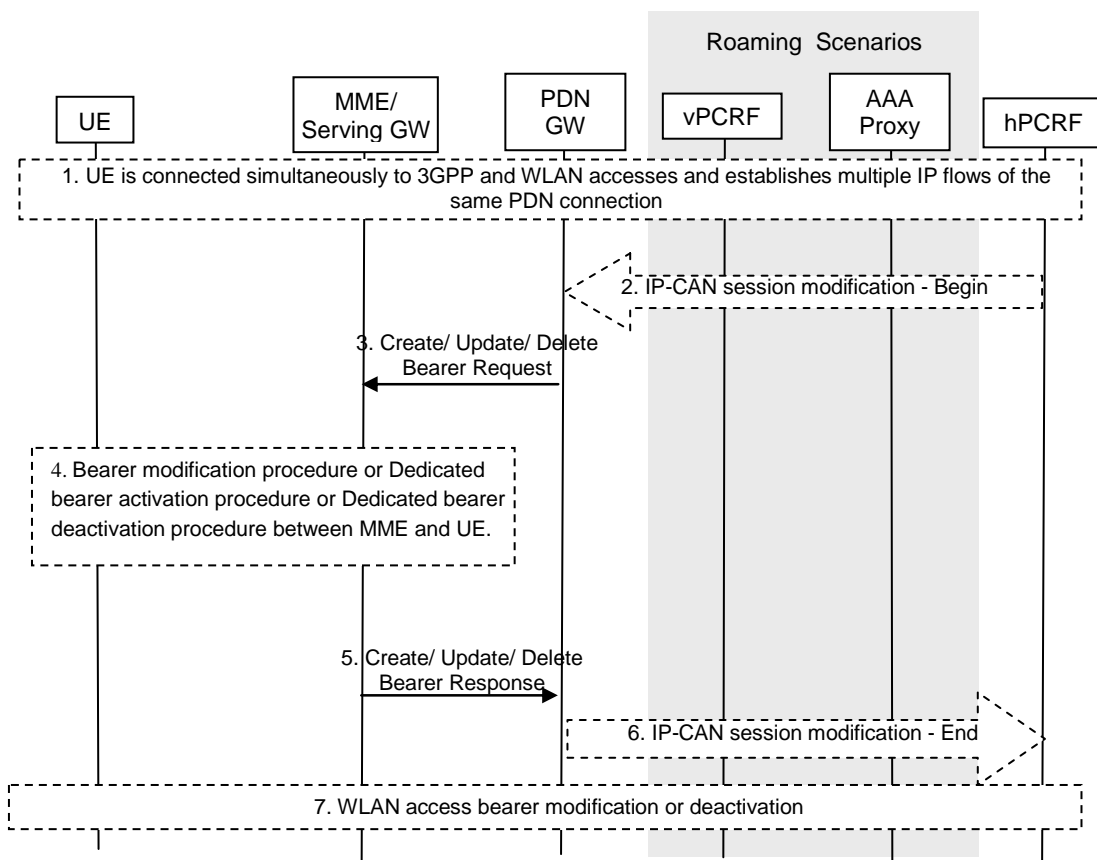

Figure 6.3.2.1-1: Network-initiated IP flow mobility within a PDN connection via E-UTRAN using GTP

1. The UE is connected simultaneously to 3GPP and Trusted/Untrusted WLAN access.

2. When dynamic PCC is applied for the PDN connection, the H-PCRF determines based on policy information and current UE state that session modification should be initiated to move specific flows. The PCRF provides PCC Rules with access type information to the PDN GW during an IP-CAN session modification procedure. The PDN GW determines that new Routing Rules / Modified Routing Rules need to be sent to the UE based on the received PCC Rules.

   When dynamic PCC is not applied, the PDN GW may determine based on local policies that new Routing Rules / Modified Routing Rules need to be sent to the UE.

3. The PDN GW sends the Created /Modified Routing Rules within Create/Update/Delete Bearer Request to the Serving GW. If bearer resources need to be established or modified due to the PCC rules received in step 2, the bearer operations may be performed in this step

4. The bearer modification,dedicated bearer activation or dedicated bearer deactivation procedure between the MME and the UE is performed as described in TS 23.401 [4]. The UE may accept or reject the Routing Rules. When the UE rejects the Routing Rules, the UE provides a cause value indicating why the request was rejected. This cause value may be used by the network to determine when/if this IP flow mobility operation can be requested again. The UE applies the accepted routing rules and acknowledges the applied rules in the message sent to the MME.

5. The MME sends Create/Update/Delete Bearer Response indicating the accepted Routing Rules to the PDN GW via the Serving GW.

6. The PDN GW indicates to the PCRF whether the PCC Rule could be enforced or not. This corresponds to the completion of the PCEF-initiated IP-CAN session modification procedure as defined in TS 23.203 [3], proceeding after the completion of IP-CAN bearer signalling.

7. Appropriate S2a/S2b resource release/modification procedures are executed for the resources associated with the flows that were removed from the Trusted or Untrusted WLAN access as described in TS 23.402 [2]. For S2a-SCM, dedicated bearer over S2a is not supported when IP flow mobility is used.
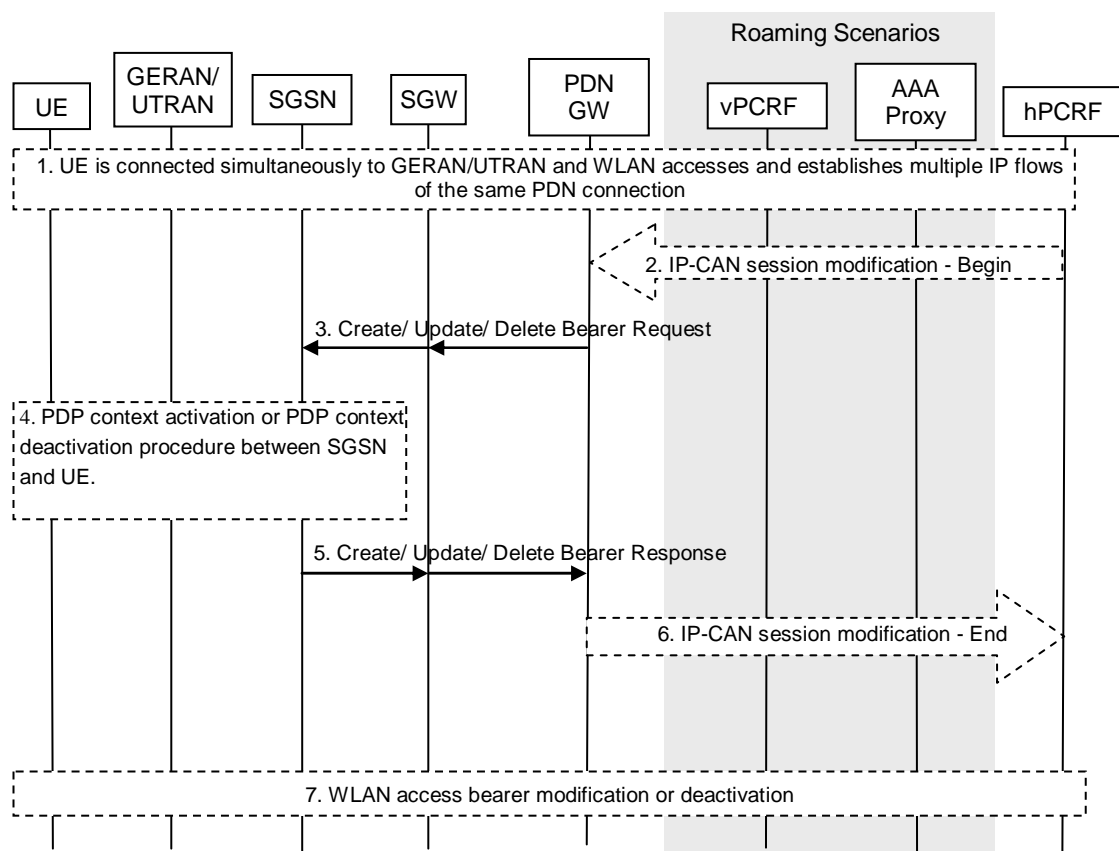

Figure 6.3.2.1-2: Network-initiated IP flow mobility within a PDN connection via GERAN/UTRAN using GTP

1. The UE is connected simultaneously to GERAN/UTRAN and Trusted/Untrusted WLAN access.

2. When dynamic PCC is applied for the PDN connection, the H-PCRF determines based on policy information and current UE state that session modification should be initiated to move specific flows. The PCRF provides PCC Rules with access type information to the PDN GW during an IP-CAN session modification procedure. The PDN GW determines that new Routing Rules / Modified Routing Rules need to be sent to the UE based on the received PCC Rules.

   When dynamic PCC is not applied, the PDN GW may determine based on local policies that new Routing Rules / Modified Routing Rules need to be sent to the UE.

3. The PDN GW sends the Created /Modified Routing Rules within Create/Update/Delete Bearer Request to the Serving GW/SGSN. If bearer resources need to be established or modified due to the PCC rules received in step 2, the bearer operations may be performed in this step.

4. The dedicated bearer activation or bearer modification or dedicated bearer deactivation procedure between the MME and the UE is performed as described in TS 23.060 [5]. The UE may accept or reject the Routing Rules. When the UE rejects the Routing Rules, the UE provides a cause value indicating why the request was rejected. This cause value may be used by the network to determine when/if this IP flow mobility operation can be requested again. The UE applies the accepted routing rules and acknowledges the applied rules in the message sent to the SGSN.

5. The SGSN sends Create/Update/Delete Bearer Response indicating the accepted Routing Rules to the PDN GW via the Serving GW.

6. The PDN GW indicates to the PCRF whether the PCC Rule could be enforced or not. This corresponds to the completion of the PCEF-initiated IP-CAN session modification procedure as defined in TS 23.203 [3], proceeding after the completion of IP-CAN bearer signalling.

7. Appropriate S2a/S2b resource release/modification procedures are executed for the resources associated with the flows that were removed from the Trusted or Untrusted WLAN access as described in TS 23.402 [2]. For S2a-SCM, dedicated bearer over S2a is not supported when IP flow mobility is used.

6.3.2.2　Routing Rules signalled via Trusted WLAN access

6.3.2.2.1　Single-connection mode

In single-connection mode, the PDN GW sends the routing rules over 3GPP access independent of access type, as described in clause 6.3.2.1.

6.3.2.2.2　Multi-connection mode

In the following signalling flow, the PDN GW provides new or updated Routing Rule(s) with access type WLAN via GTP and WLCP procedures. The routing rule is sent via TWAN access in this case. This may result in that IP flows routed over 3GPP access are now routed over WLAN, or vice versa.
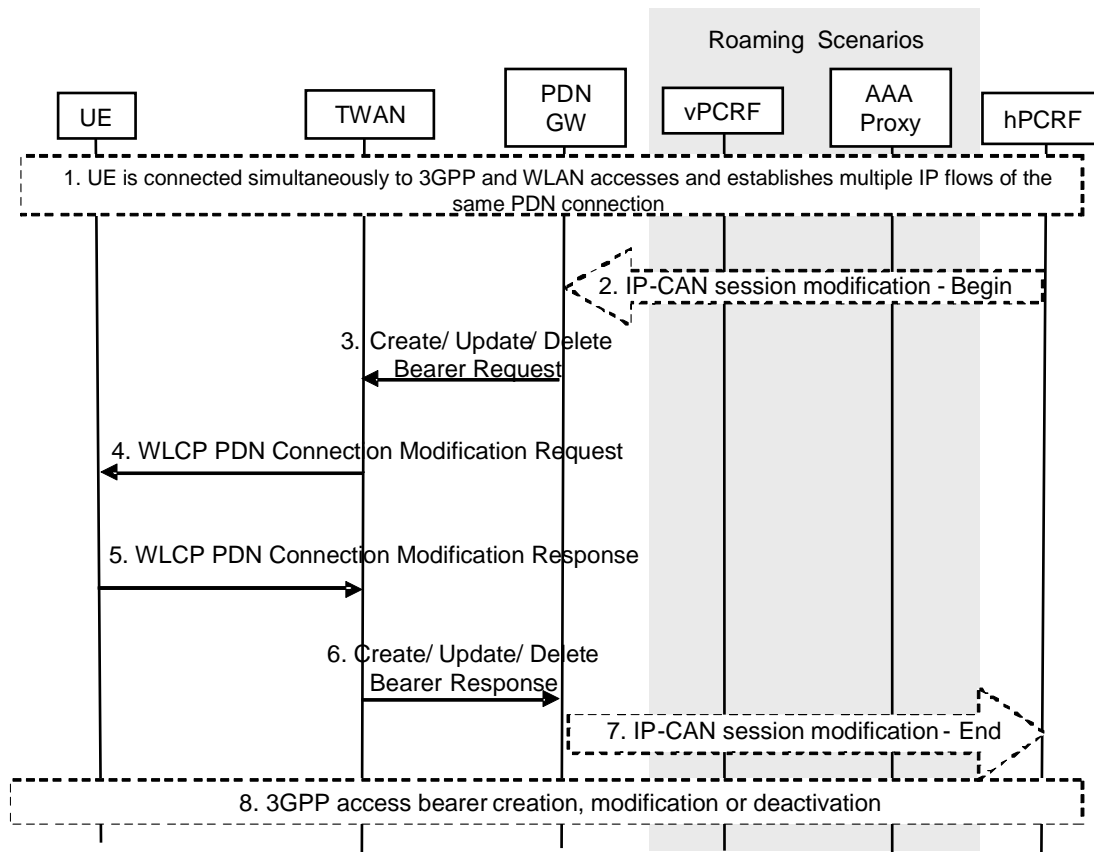
Figure 6.3.2.2.2-1: Network-initiated IP flow mobility within a PDN connection over TWAN access using GTP

1. The PDN Connection is active simultaneously over 3GPP access and TWAN access.

2. If dynamic PCC is applied for the PDN Connection the PCRF determines based on policy information and current UE state that session modification should be initiated to move specific flows. The PCRF provides PCC Rules with access type information to the PDN GW during an IP-CAN session modification procedure. The PDN GW determines that new Routing Rules / Modified Routing Rules need to be sent to the UE based on the received PCC Rules.

   If dynamic PCC is not applied the PDN GW may determine based on local policies that new Routing Rules / Modified Routing Rules need to be sent to the UE.

3. The PDN GW sends the new or updated Routing Rules within Create/Update/Delete Bearer Request to the TWAN. If bearer resources need to be established or modified due to the PCC rules received in step 2, the bearer operations may be performed in this step.

4. The TWAN sends a WLCP PDN Connection Modification Request message to the UE, including the Routing Rules.

5. The UE may decide to accept or reject the Routing Rules. When the UE rejects the Routing Rules the UE provides a cause value indicating why the request was rejected. This cause value may be used by the network to determine when/if this IP flow mobility operation can be requested again. The UE applies the accepted routing rules and acknowledges the applied rules in a WLCP PDN Connection Modification Response message to the TWAN.

6. The TWAN sends Create/Update/Delete Bearer Response to the PDN GW.

7. The PDN GW indicates to the PCRF whether the PCC Rules could be enforced or not. This corresponds to the completion of the PCEF-initiated IP-CAN session modification procedure as defined in TS 23.203 [3].

8. Appropriate 3GPP resource release/modification procedures are executed as described in TS 23.401 [4] for the resources (bearers) associated with the Routing Rules that were removed from 3GPP access.

6.3.2.3 Routing Rules signalled via Untrusted WLAN access

In the following signalling flow, the PCRF identifies and moves specific flows from 3GPP to WLAN.
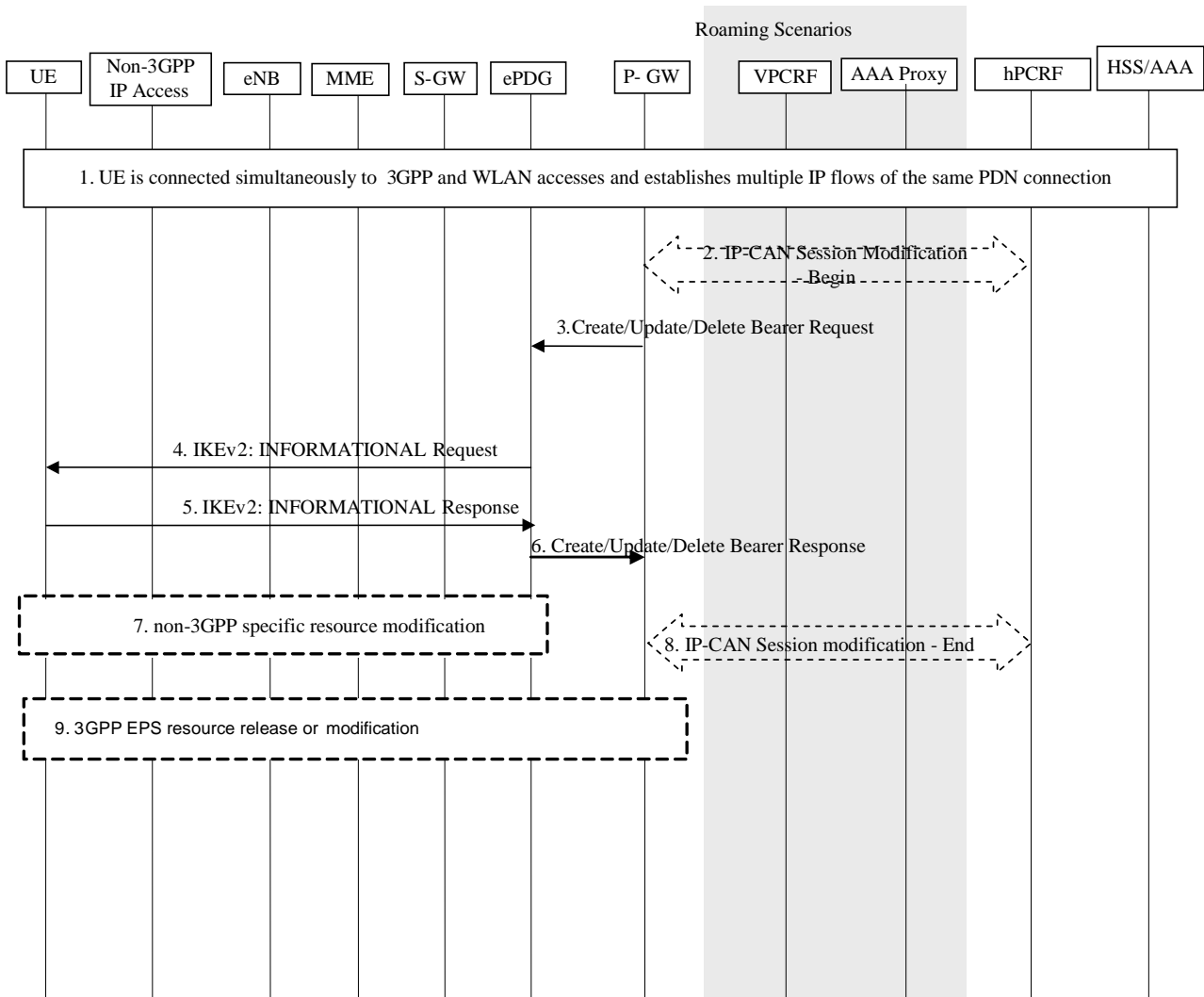

Figure 6.3.2.3-1: IP flow mobility within a PDN connection with negotiation via untrusted WLAN access

1. The UE is connected simultaneously to 3GPP and WLAN accesses and establishes multiple IP flows of the same PDN connection.

2. If dynamic PCC is applied for the PDN Connection, the PCRF determines based on policy information and current UE state that session modification should be initiated to move specific flows. The PCRF provides PCC Rules with access type information to the PDN GW during an IP-CAN session modification procedure.

3. The PDN GW determines that new or modified Routing Rules need to be sent to the UE based on the received PCC Rules. The PDN GW sends the new or updated Routing Rules within Create/Update/Delete Bearer Request to the TWAN. If bearer resources need to be established or modified due to the PCC rules received in step 2, the bearer operations may be performed in this step.

4. The ePDG initiates an IKEv2 INFORMATIONAL request, which includes the modified routing rule to indicate the updated routing rule to be used by the UE. The UE may accept or reject the Routing Rules. When the UE rejects the Routing Rules the UE provides a cause value indicating why the request was rejected. This cause value may be used by the network to determine when/if this IP flow mobility operation can be requested again.

5. The UE responds with a IKEv2 INFORMATIONAL response, acknowledging the new routing rules and applies the corresponding filters

6. The ePDG sends a Create/Update/Delete Bearer Response to the PDN GW.

7. The WLAN access specific resource release, setup or modification may be performed based on the modified traffic selector in WLAN access network.

8. The PDN GW indicates to the PCRF whether the Routing Rules could be enforced or not.

9. Appropriate 3GPP resource release/modification procedures are executed for the resources associated with the new or updated PCC rules.

6.3.3   UE-initiated IP flow mobility

6.3.3.1   Routing Rules signalled via 3GPP access

In the following signalling flows, they are applied to UE-initiated NBIFOM mode. The UE moves one or more IP flow(s) by providing a Routing Rule with access type 3GPP to update the routing rules via NAS and GTPv2 procedures. The routing rule is sent via E-UTRAN in this case.
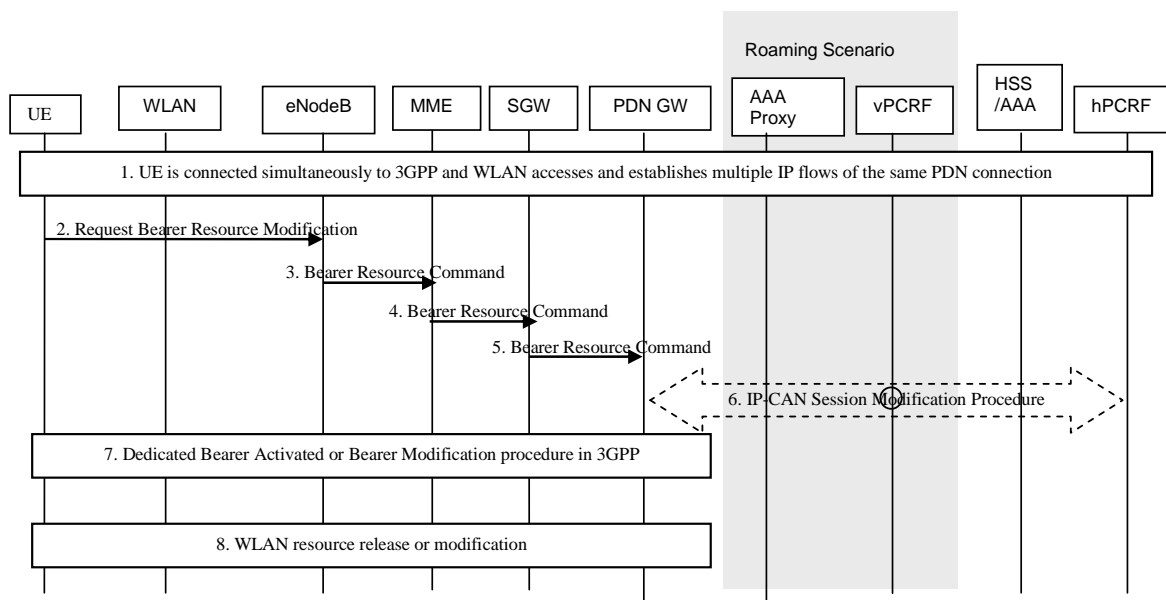

Figure 6.3.3.1-1: UE-initiated IP flow mobility within a PDN connection via E-UTRAN using GTP

1. The UE is connected simultaneously to 3GPP and WLAN accesses and establishes multiple IP flows of the same PDN connection.

2. The UE sends to the MME a Request Bearer Resource Modification message, which includes the Routing Rules requested by the UE.

4-5.   The MME forwards the Routing Rules to the PDN GW via the Serving GW.

6. When dynamic PCC is applied for the PDN connection, the PDN GW initiates an IP-CAN Modification procedure and provides the Routing Rules in a notification to the PCRF. The PCRF may reject the IP flow mobility requests from UE due to subscription limitations. When the network rejects an IP flow mobility request, the network provides a certain cause value to the UE indicating why the request was rejected. This cause value may be used by the UE to determine when/if this IP flow mobility operation can be requested again.

7. The PDN GW performs the dedicated Bearer activation procedure or bearer modification procedure as described in TS 23.401 [4], and indicates which the Routing Rule has been accepted.

8. Appropriate S2a/S2b resource release / modification procedures are executed for the resources associated with the flows that were removed from the Trusted or Un-trusted WLAN access as described in TS 23.402 [2]. For S2a-SCM, dedicated bearer over S2a is not supported when IP flow mobility is used.

In the following signalling flows, they are applied to UE-initiated NBIFOM mode. The UE moves one or more IP flow(s) by providing a Routing Rule with access type 3GPP to update the routing rules via PDP context and GTPv2 procedures. The routing rule is sent via GERAN/UTRAN in this case.
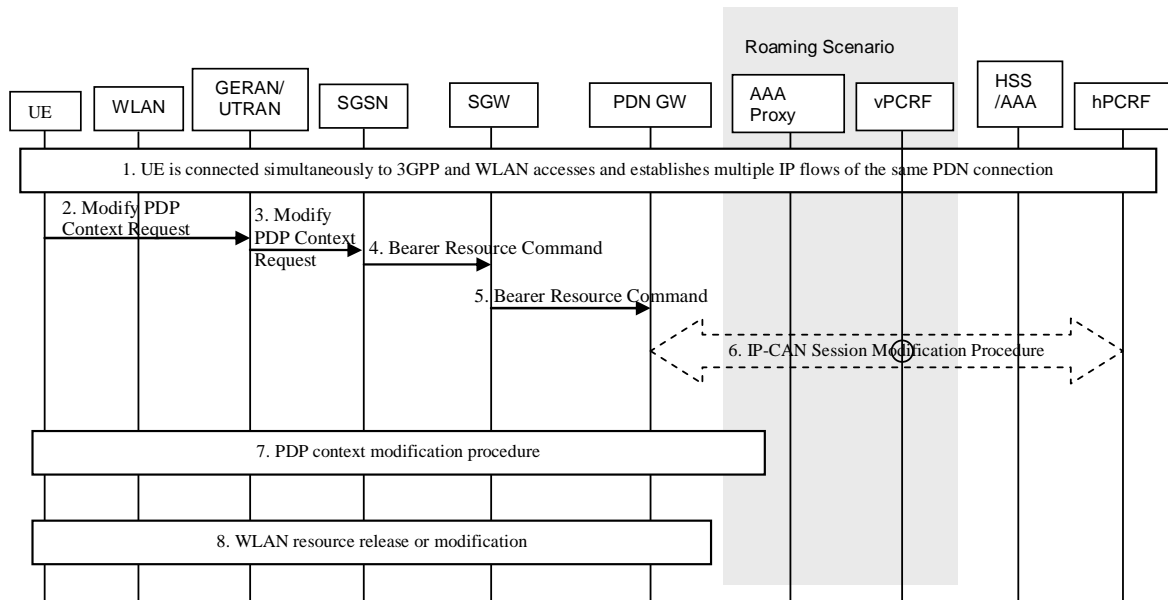

Figure 6.3.3.1-2: UE-initiated IP flow mobility within a PDN connection via GERAN/UTRAN using GTP

This procedure is similar to 6.3.3.1-1 with the following differences:

2-3. The UE sends to the SGSN a Modify PDP Context Request message, which includes the Routing Rules requested by the UE.

7. The PDN GW performs the Secondary PDP context activation or PDP context modification procedure as described in TS 23.060 [5], and indicates the Routing Rule has been accepted.

6.3.3.2 Routing Rules signalled via Trusted WLAN access

6.3.3.2.1 Single-connection mode

In single-connection mode, the UE sends the routing rules over 3GPP access as described in clause 6.3.3.1.

6.3.3.2.2 Multi-connection mode

In the following signalling flow, the UE provides new or updated routing rules with access type WLAN to the PDN GW via WLCP and GTPv2 procedures. The routing rule is sent via TWAN access in this case.
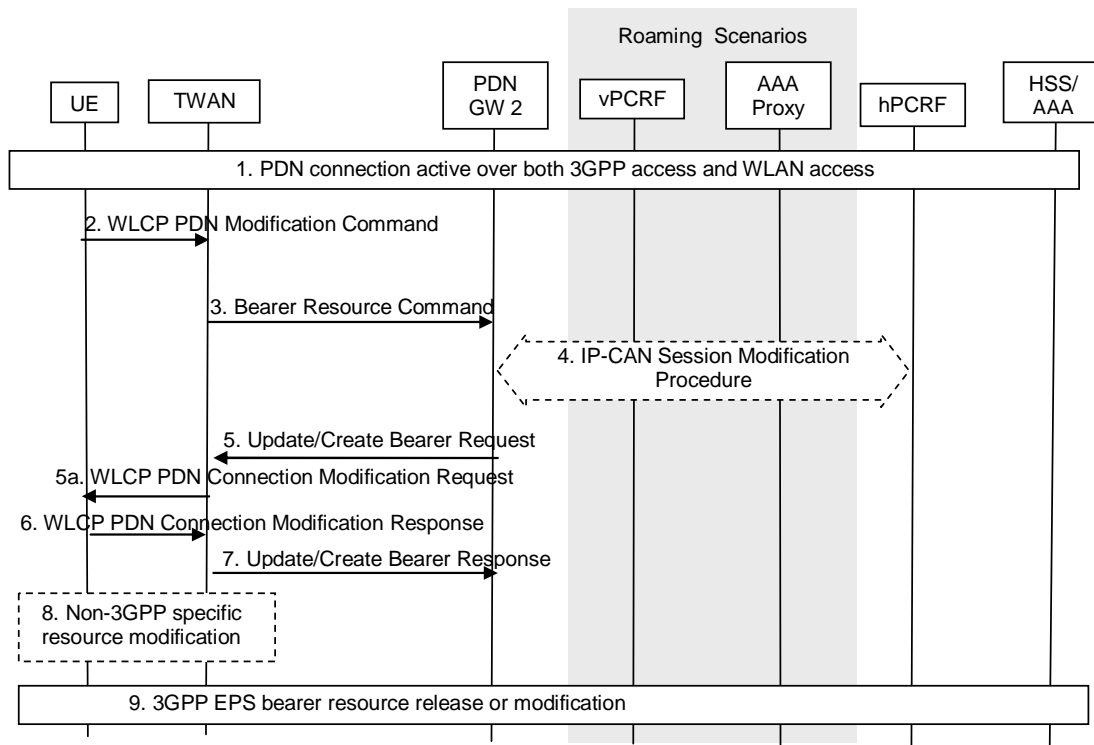
Figure 6.3.3.2.2-1: UE-initiated IP flow mobility within a PDN connection from 3GPP access to TWAN access using GTP

1. The PDN Connection is active simultaneously over 3GPP access and WLAN accesses.

2. The UE sends a WLCP PDN Modification Command message to the TWAN, which includes the Routing Rules requested by the UE.

3. The TWAN sends a Bearer Resource Command message to the PDN GW. The message includes the Routing Rules.

4. The PDN GW initiates the IP-CAN Session Modification Procedure with the PCRF. In this request, the PDN GW provides the Routing Rules to the PCRF. The PCRF analyses the received Routing Rules, makes a policy decision and provides new or updated PCC rules to the PDN GW with corresponding access type information. The PCRF may reject the IP flow mobility requests from UE. When the network rejects an IP flow mobility request, the network provides a cause value to the UE indicating why the request was rejected. The UE should be able to determine, based on the cause value provided with the rejection, how to handle the flow mapping, e.g. whether or not the request may be retried at a later stage.

5. The PDN GW sends to the TWAN an Update/Create Bearer Request which acknowledge of the Routing Rules. If bearer resources need to be established or modified due to the PCC rules received in step 4, the bearer operations may be performed in this step.

5a. The TWAN sends a WLCP PDN Connection Modification Request to the UE which acknowledge of the Routing Rules.

6 The UE sends a WLCP PDN Connection Modification Response to the TWAN.

7. The TWAN sends an Update/Create Bearer Response to the PDN GW.

8. A TWAN specific resource allocation/modification procedure may be executed in this step. The details of this step are out of the scope of 3GPP.

9. Appropriate 3GPP resource release / modification procedures are executed for the resources associated with the flows that were removed in the 3GPP access as described in TS 23.401 [4].

6.3.3.3 Routing Rules signalled via Untrusted WLAN access

The UE can move one or more IP flow(s) from the 3GPP access to the WLAN access. The UE should update the routing rules via the WLAN access.
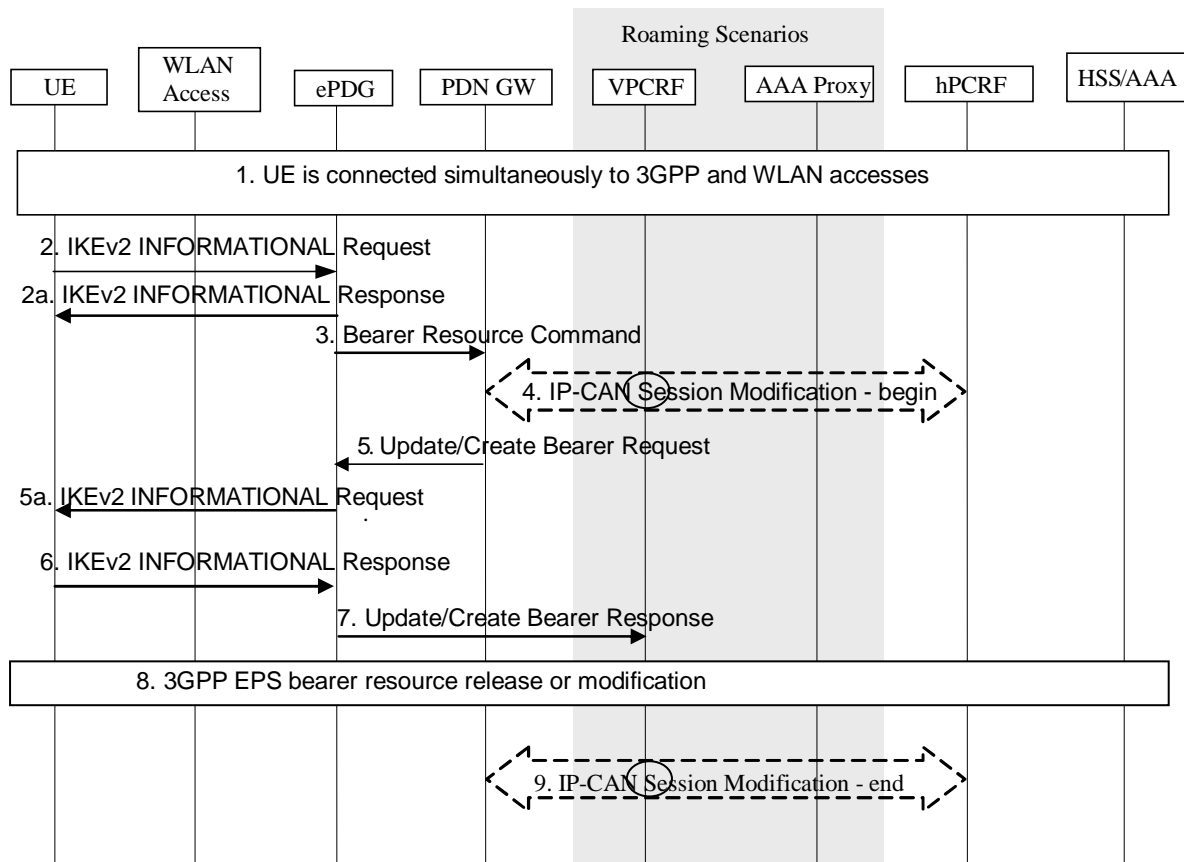

Figure 6.3.3.3-1: IP flow mobility within a PDN connection initiated over WLAN access

1. The UE is connected simultaneously to 3GPP and WLAN accesses and establishes multiple IP flows of the same PDN connection as described in clauses 6.2.

2. The UE sends the IKEv2 INFORMATIONAL request to the ePDG, which includes the updated routing rules requested by the UE.

2a. The ePDG sends an IKEv2 INFORMATIONAL Response message to the UE.

3. The ePDG sends a Bearer Resource Command message to the PDN GW. The message includes the updated routing rules. The ePDG includes the default EPS bearer ID (i.e. Linked Bearer ID) based on the mapping between the Security Association and the PDN connection. The ePDG sends the updated routing rules to the PDN GW.

4. The PDN GW initiates the IP-CAN Session Modification Procedure with the PCRF. In this request, the PDN GW provides the updated routing rules to the PCRF. The PCRF may reject the IP flow mobility requests from UE. When the network rejects an IP flow mobility request, the network provides a certain cause value to the UE indicating why the request was rejected. The UE should be able to determine, based on the cause value provided with the rejection, how to handle the flow mapping, e.g. whether or not the request may be retried at a later stage.

5. The PDN GW sends an Update/Create Bearer Request message to the ePDG which includes the accepted routing rules.

5a. The ePDG sends an IKEv2 INFORMATIONAL Request message to the UE which includes the accepted routing rules.

6. The UE sends the IKEv2INFORMATIONAL response to the ePDG.

7. The ePDG sends an Update/Create Bearer Response message to the PDN GW.

8. Appropriate 3GPP resource release/modification procedures are executed for the resources associated with the flows that were modified or removed in the 3GPP access.

9. The PDN GW indicates to the PCRF whether the PCC decision could be enforced or not.

6.4 NBIFOM IP Flow Mapping

6.4.1 UE Requested IP Flow Mapping via 3GPP access

This procedure is only used in Network-initiated NBIFOM mode when the UE wants to request the network to apply specific mappings of IP flows to 3GPP access. The network provides Routing Rules to the UE for this IP flow unless the request from the UE is not allowed by the subscription.
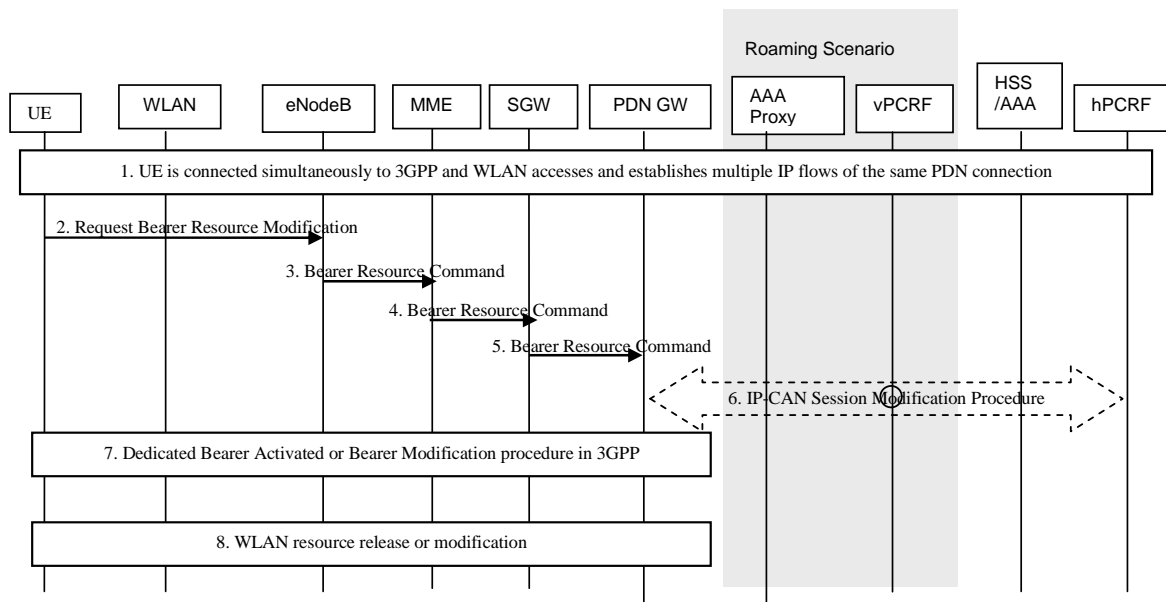

Figure 6.4.1-1: UE requested IP flow mapping via E-UTRAN

This procedure is similar to 6.3.3.1-1 with the following differences:

Step 2-5: The UE sends a Request Bearer Resource Modification message to the network, which includes the mapping information of an IP flow to 3GPP access.

Step 6: When dynamic PCC is applied for the PDN connection, the PDN GW initiates an IP-CAN Modification procedure and provides the Routing Rule(s) for this IP flow according to the mapping information in a notification to the PCRF. The PCRF may reject the IP flow mapping request from UE. When the network rejects an IP flow mapping request, the network provides a certain cause value to the UE indicating why the request was rejected. This cause value may be used by the UE to determine when/if this IP flow mapping can be requested again.

The PDN GW sends corresponding Routing rule(s) to the UE in Bearer Modification response.
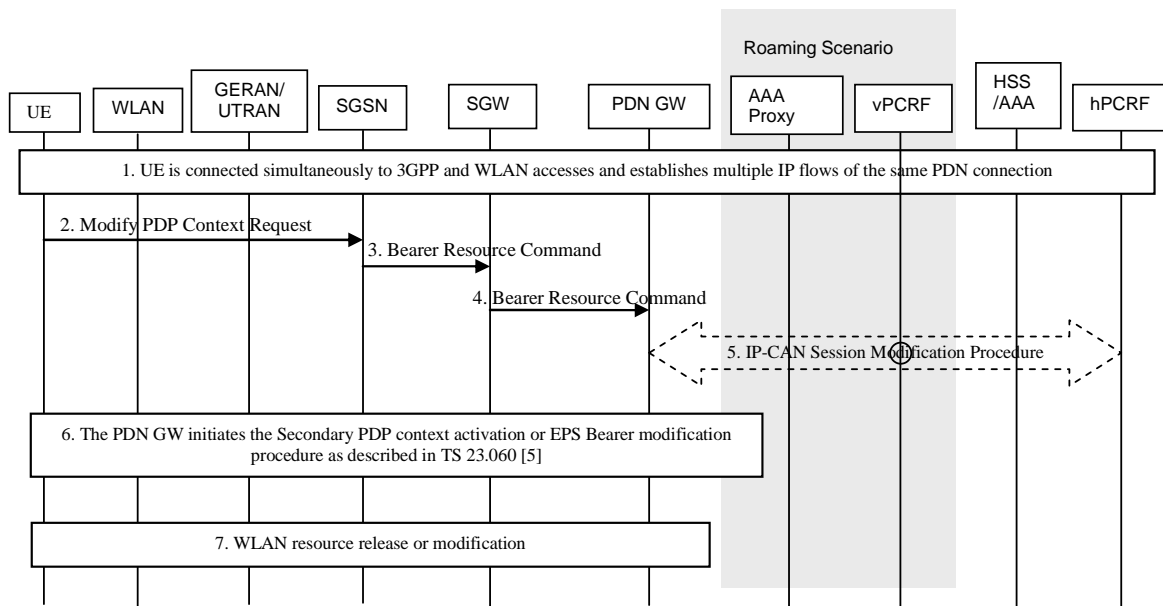
Figure 6.4.1-2: UE requested IP flow mapping via GERAN/UTRAN access

This procedure is similar to 6.3.3.1-2 with the following differences:

Step 2-5: The UE sends a Modify PDP Context Request message to the network, which includes the mapping information of an IP flow to 3GPP access.

Step 5: When dynamic PCC is applied for the PDN connection, the PDN GW initiates an IP-CAN Modification procedure and provides the Routing Rule(s) for this IP flow according to the mapping information in a notification to the PCRF. The PCRF may reject the IP flow mapping request from UE. When the network rejects an IP flow mapping request, the network provides a certain cause value to the UE indicating why the request was rejected. This cause value may be used by the UE to determine when/if this IP flow mapping can be requested again.

Step 6. The PDN GW initiates the Secondary PDP context activation or EPS Bearer modification procedure as described in TS 23.060 [5], and including the Routing Rule(s).

When the SGSN receives Create Bearer Request or Update Bearer Request message from the SGW, the SGSN sends Request Secondary PDP Context Activation or Modify PDP Context Request to the UE as described in TS 23.060 [5], including the Routing Rules received from the SGW. The SGSN also sends a Modify PDP Context Accept message to the UE in order to stop the timer which is set after Step 2.

The UE may accept or reject the Routing Rules. When the UE rejects the Routing Rules, the UE provides a cause value indicating why the request was rejected. The UE applies the accepted routing rules and acknowledges the applied rules in Activate Secondary PDP Context Request or Modify PDP Context Accept message.

The PDN GW sends corresponding Routing rule(s) to the UE in Bearer Modification response.

6.4.2   UE Requested IP Flow Mapping via Trusted WLAN access

6.4.2.1   Single-connection mode

In single-connection mode, the UE sends the request for IP flow mapping over 3GPP access as described in clause 6.4.1.

6.4.2.2   Multi-connection mode

This procedure is only used in NW-initiated NBIFOM mode when the UE wants to request the NW to apply a specific mapping of an IP flow to TWAN access. The NW provides Routing Rules to the UE for this IP flow.
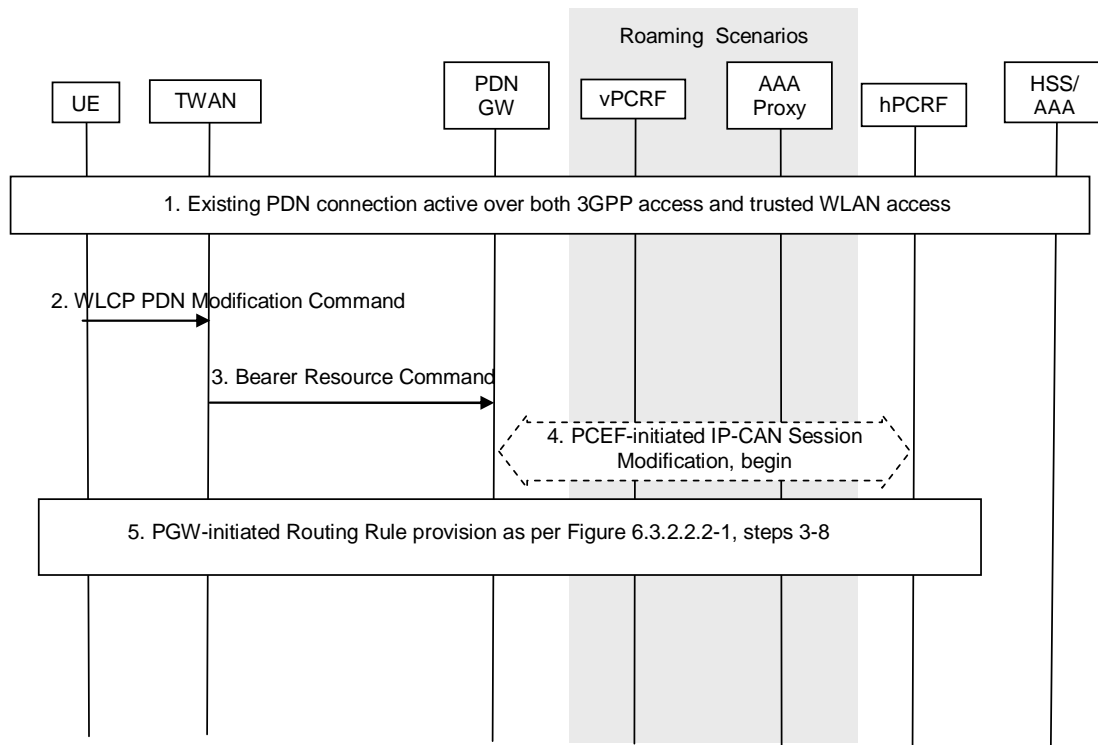
Figure 6.4.2.2-1: UE Requested IP Flow Mapping via Trusted WLAN access using GTP

1. The PDN Connection is active simultaneously over 3GPP access and WLAN accesses.

2. The UE sends a WLCP PDN Modification Command message to the TWAN, which includes the IP Flow mapping information requested by the UE.

3. The TWAN sends a Bearer Resource Command message to the PDN GW. The message includes the requested IP Flow mapping information.

4. The PDN GW initiates the IP-CAN Session Modification Procedure with the PCRF. In this request, the PDN GW provides the requested IP Flow mapping information to the PCRF. The PCRF analyses the received Routing Rules, makes a policy decision and provides new or updated PCC rules to the PDN GW with corresponding access type information. The PCRF may reject the requests from UE. When the network rejects a request, the network provides a cause value to the UE indicating why the request was rejected. The UE should be able to determine, based on the cause value provided with the rejection, how to handle the flow mapping, e.g. whether or not the request may be retried at a later stage.

5. The PDN GW decides to update the Routing Rules based on the received PCC Rules. This step is the same as steps 3-8 in Figure 6.3.2.2.2-1.

6.4.3 UE Requested IP Flow Mapping via Untrusted WLAN access

This procedure is only used in network-initiated mode when the UE wants to request the network to apply a specific mapping of an IP flow to untrusted WLAN access. The network provides Routing Rules to the UE for this IP flow.
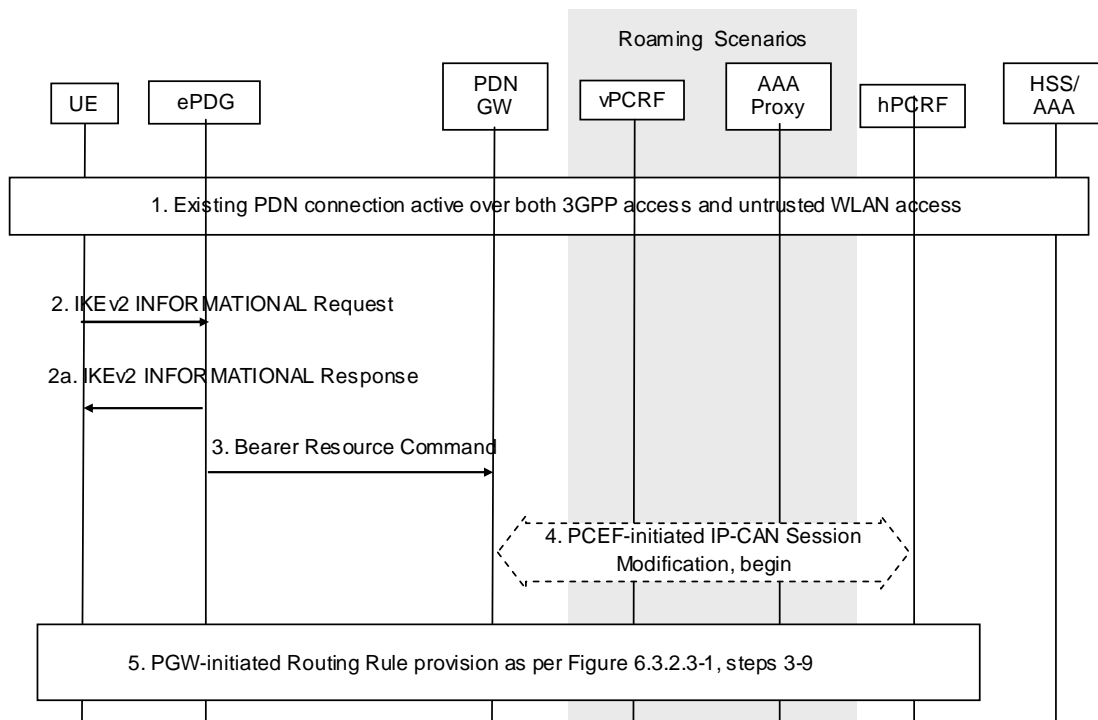
Figure 6.4.3-1: UE Requested IP Flow Mapping via untrusted WLAN access using GTP

1. The PDN Connection is active simultaneously over 3GPP access and WLAN accesses.

2. The UE sends an IKEv2 INFORMATIONAL Request message to the ePDG, which includes the IP Flow mapping information requested by the UE.

2a. The ePDG sends an IKEv2 INFORMATIONAL Response message to the UE.

3. The ePDG sends a Bearer Resource Command message to the PDN GW. The message includes the requested IP Flow mapping information.

4. The PDN GW initiates the IP-CAN Session Modification Procedure with the PCRF. In this request, the PDN GW provides the requested IP Flow mapping information to the PCRF. The PCRF analyses the received Routing Rules, makes a policy decision and provides new or updated PCC rules to the PDN GW with corresponding access type information. The PCRF may reject the requests from UE. When the network rejects a request, the network provides a cause value to the UE indicating why the request was rejected. The UE should be able to determine, based on the cause value provided with the rejection, how to handle the flow mapping, e.g. whether or not the request may be retried at a later stage.

5. The PDN GW decides to update the Routing Rules based on the received PCC Rules. This step is the same as steps 3-9 in Figure 6.3.2.3-1.

6.5 Removal of an access from a PDN connection

6.5.1 Removal of 3GPP access

6.5.1.1 UE-initiated removal of 3GPP access from the PDN connection

In the case of E-UTRAN, when the UE removes the 3GPP access for the multi-access PDN connection and the multiple-access PDN connection is not the last PDN connection for 3GPP access, procedures as described in TS 23.401 [4] clause 5.10.3 are referred with the following modifications.
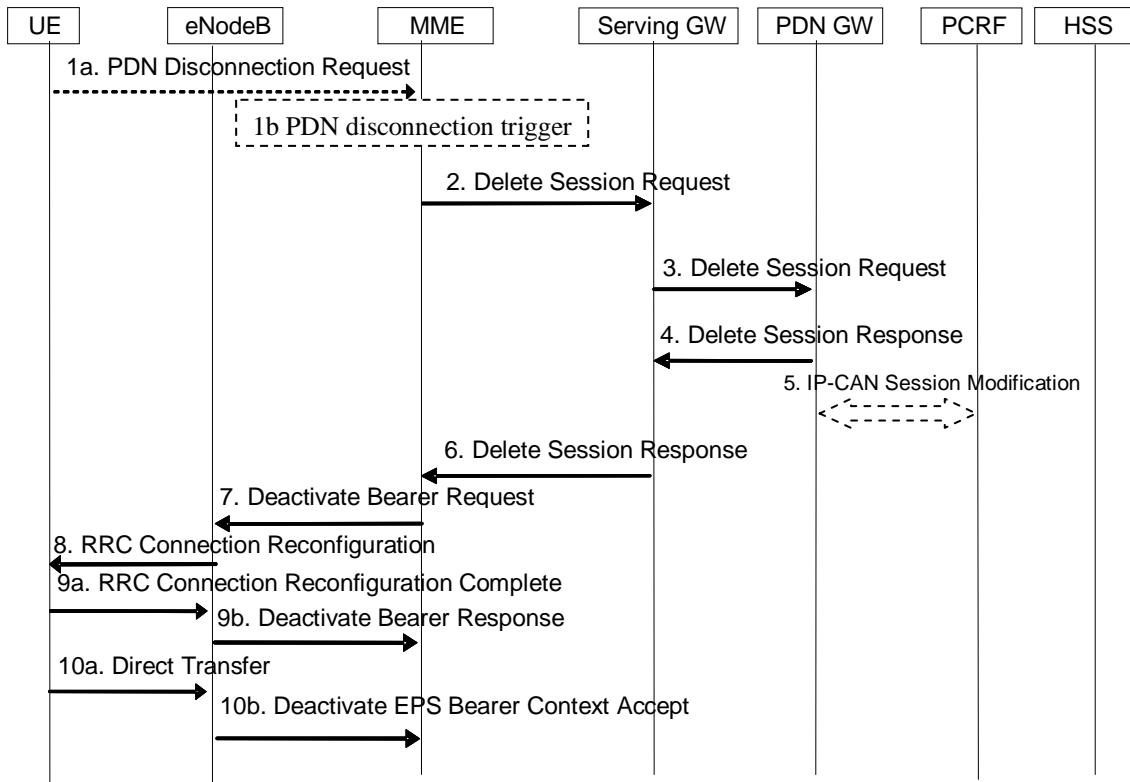
Figure 6.5.1.1-1: UE-Initiated Removal of 3GPP access via E-UTRAN

Step 5: PDN GW shall indicate to the PCRF the removal of 3GPP access for the multi-access PDN connection via IP-CAN Session Modification procedure, if dynamic PCC is applied for the PDN connection.

In the case of E-UTRAN, when the UE removes the 3GPP access for the multi-access PDN connection and the multiple-access PDN connection is the last PDN connection for 3GPP access, procedures as described in TS 23.401 [4] clause 5.3.8.2.1 are referred with the following modifications.
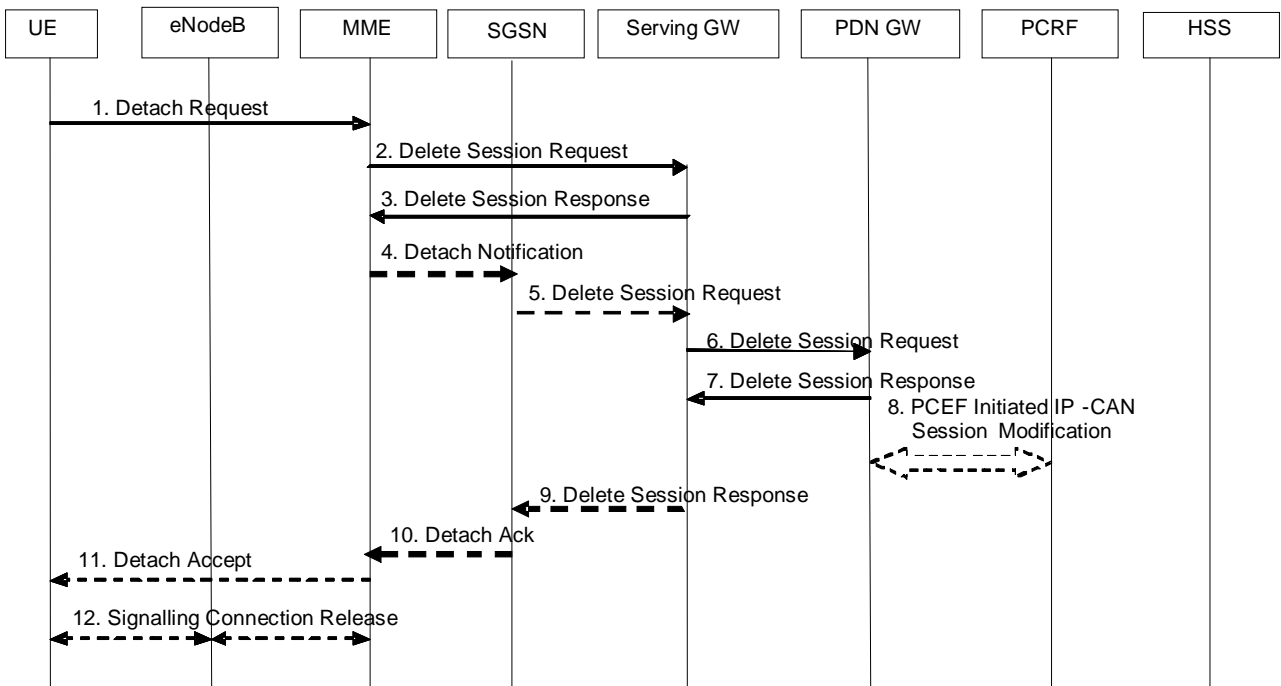

Figure 6.5.1.1-2: UE-Initiated Removal of 3GPP access via E-UTRAN for last PDN connection

Step 8:   PDN GW shall indicate to the PCRF the removal of 3GPP access for the multi-access PDN connection via IP-CAN Session Modification procedure, if dynamic PCC is applied for the PDN connection.

In the case of GERAN/UTRAN, when the UE removes the 3GPP access for the multi-access PDN connection, procedures as described in TS 23.060 [5] clause 9.2.4 are referred with the following modifications.
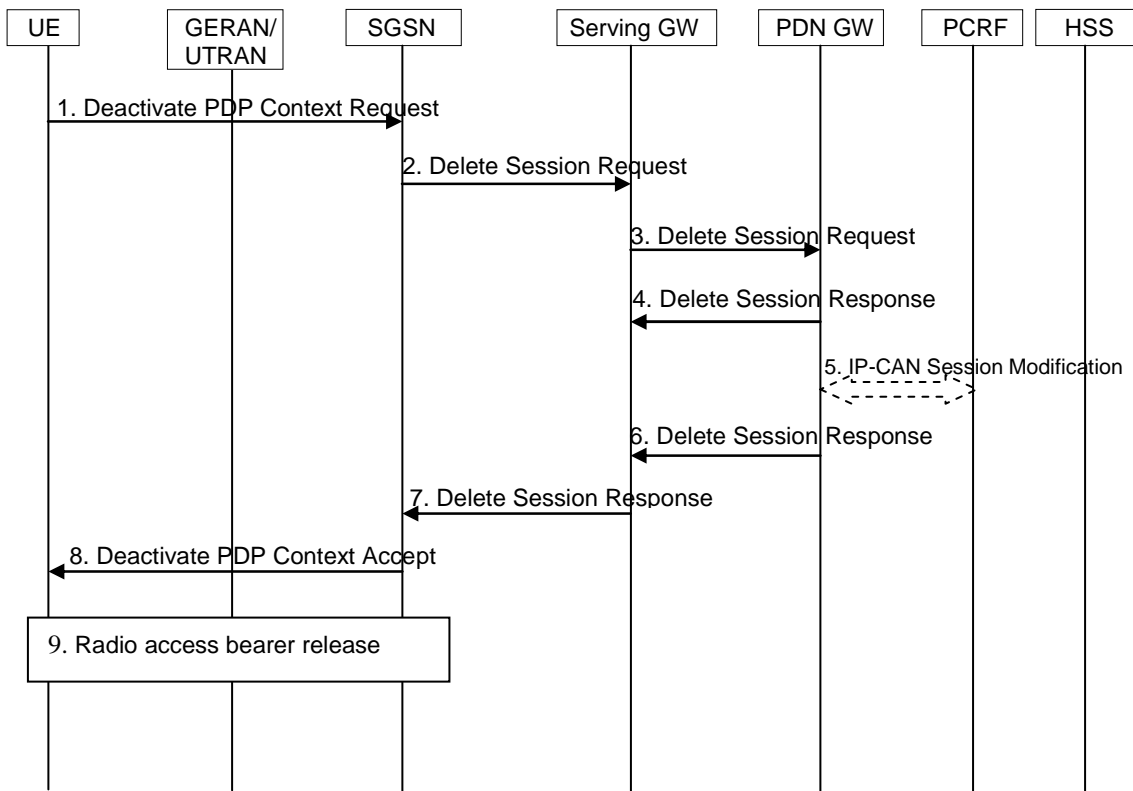

Figure 6.5.1.1-3: UE-Initiated Removal of 3GPP access via GERAN/UTRAN

Step-5:   PDN GW shall indicate to the PCRF the removal of 3GPP access for the multi-access PDN connection via IP-CAN Session Modification procedure, if dynamic PCC is applied for the PDN connection.

6.5.1.2   Network-initiated removal of 3GPP access from the PDN connection

In the case of E-UTRAN, when the network removes the 3GPP access for the multi-access PDN connection, the following procedures are referred.
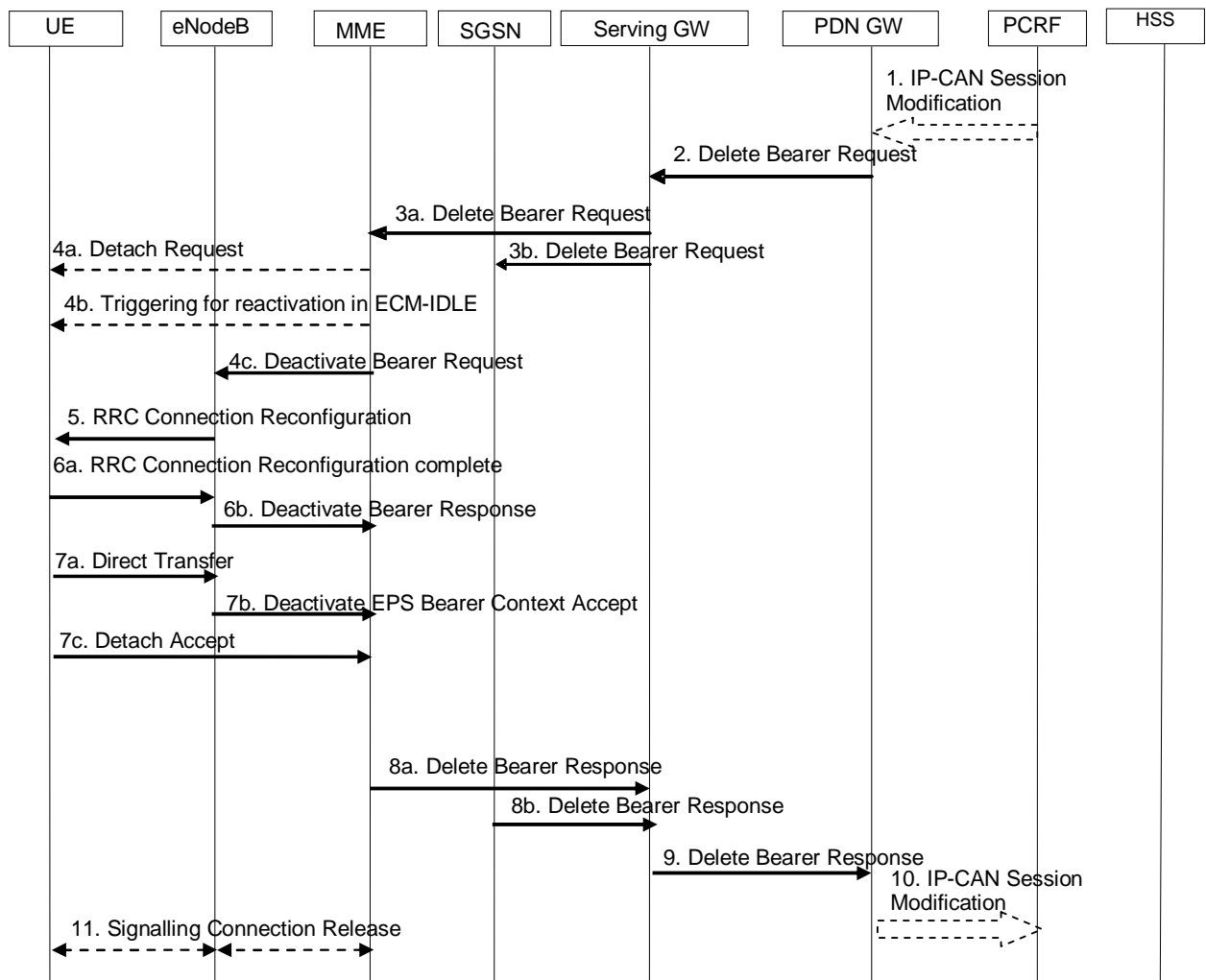
Figure 6.5.1.2-1: Network initiated removal of 3GPP access via E-UTRAN from the PDN connection

1. The PCRF shall indicate to the P-GW the removal of 3GPP access for the multi-access PDN connection via IP-CAN Session Modification procedure by updating or removing all PCC rules that are bound to this access.

2-9. The description of these steps is the same as for steps 2-9 in TS 23.401 [4], clause 5.4.4.1. The P-GW deactivates the default bearer of this access.

10. The P-GW shall indicate to the PCRF the 3GPP access is removed from the multi-access PDN connection.

11. The description of these steps is the same as for steps 11 in TS 23.401 [4], clause 5.4.4.1.

The optional interaction steps between the PDN GW and the PCRF in the procedures only occur if dynamic PCC is applied for the PDN connection.

In the case of GERAN/UTRAN, when the network removes the 3GPP access for the multi-access PDN connection, the following procedures are referred.
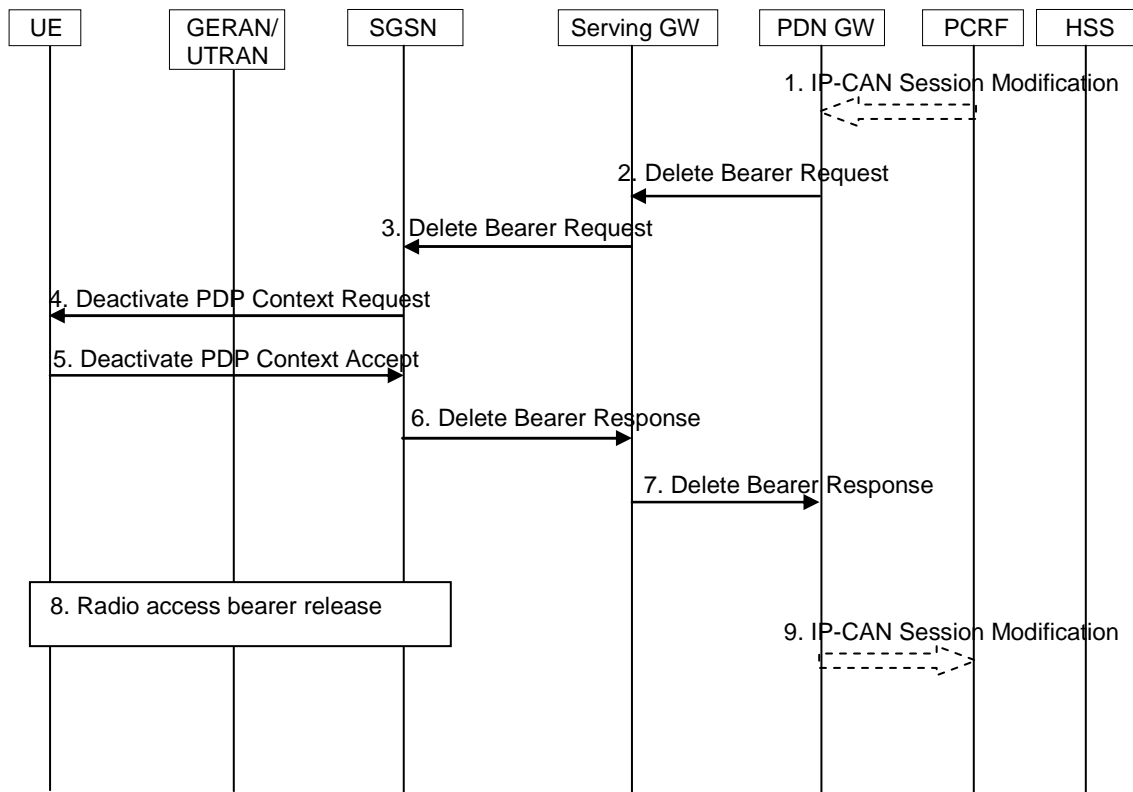
Figure 6.5.1.2-2: Network initiated Removal of 3GPP access via GERAN/UTRAN

1. The PCRF shall indicate to the P-GW the removal of 3GPP access for the multi-access PDN connection via IP-CAN Session Modification procedure by updating or removing all PCC rules that are bound to this access.

2-3. The description of these steps is the same as for steps A-B in TS 23.060 [5], clause 9.2.4.3A.

4-5. The description of these steps is the same as for steps 2 in TS 23.060 [5], clause 9.2.4.3.

6-7. The description of these steps is the same as for steps A-B in TS 23.060 [5], clause 9.2.4.3B.

8. The description of these steps is the same as for steps 4-5 in TS 23.060 [5], clause 9.2.4.3.

9. The P-GW shall indicate to the PCRF the 3GPP access is removed from the multi-access PDN connection.

The optional interaction steps between the PDN GW and the PCRF in the procedures only occur if dynamic PCC is applied for the PDN connection.

6.5.2 Removal of Trusted WLAN access

6.5.2.1 UE-initiated removal of Trusted WLAN access from a PDN connection

When the UE removes the TWAN access for the multi-access PDN connection in single-connection mode, procedures as described in TS 23.402 [2] clause 16.3.1.1 are referred with the following modification.
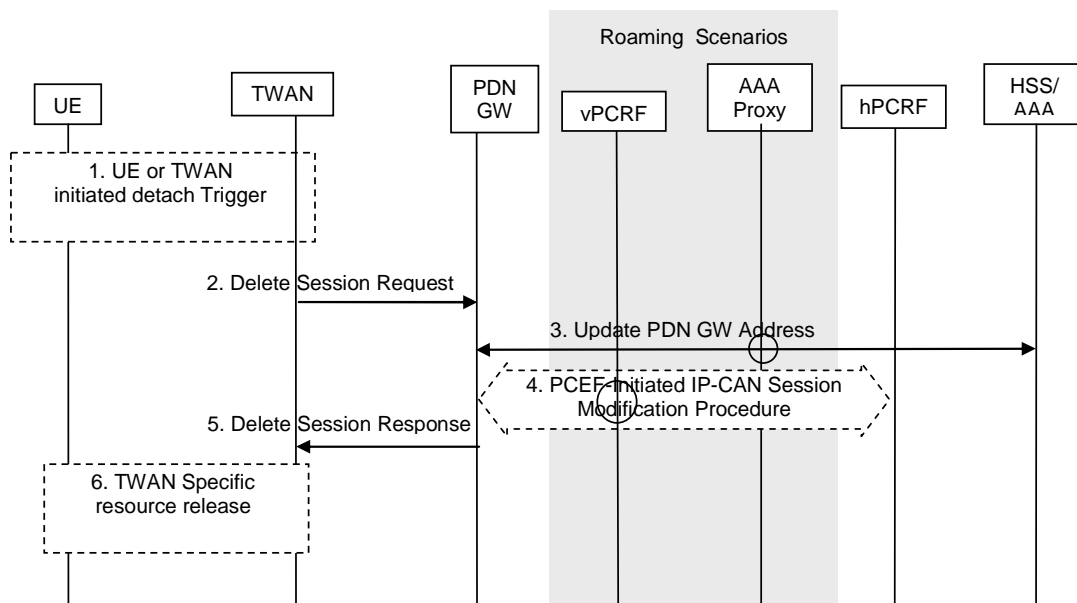
Figure 6.5.2.1-1: UE-initiated Removal of Trusted WLAN access from the PDN connection for single-connection mode

Step 4: PDN GW shall indicate to the PCRF the removal of TWAN access for the multi-access PDN connection via IP-CAN Session Modification procedures, if dynamic PCC is applied for the PDN connection.

When the UE removes the TWAN access for the multi-access PDN connection for multi-connection mode and the multi-access PDN connection is not the last PDN connection in TWAN, procedures as described in TS 23.402 [2] clause 16.9.1 are referred with the following modification.

Figure 6.5.2.1-2: UE-initiated Removal of Trusted WLAN access from the PDN connection for multi-connection mode

Step 4:   PDN GW shall indicate to the PCRF the removal of TWAN access for the multi-access PDN connection via IP-CAN Session Modification procedures, if dynamic PCC is applied for the PDN connection.

When the UE removes the TWAN access for the multi-access PDN connection for multi-connectoin mode and the multi-access PDN connection is not the last PDN connection in TWAN, procedures as described in TS 23.402 [2] clause 16.7.1.1 are referred with the following modification.
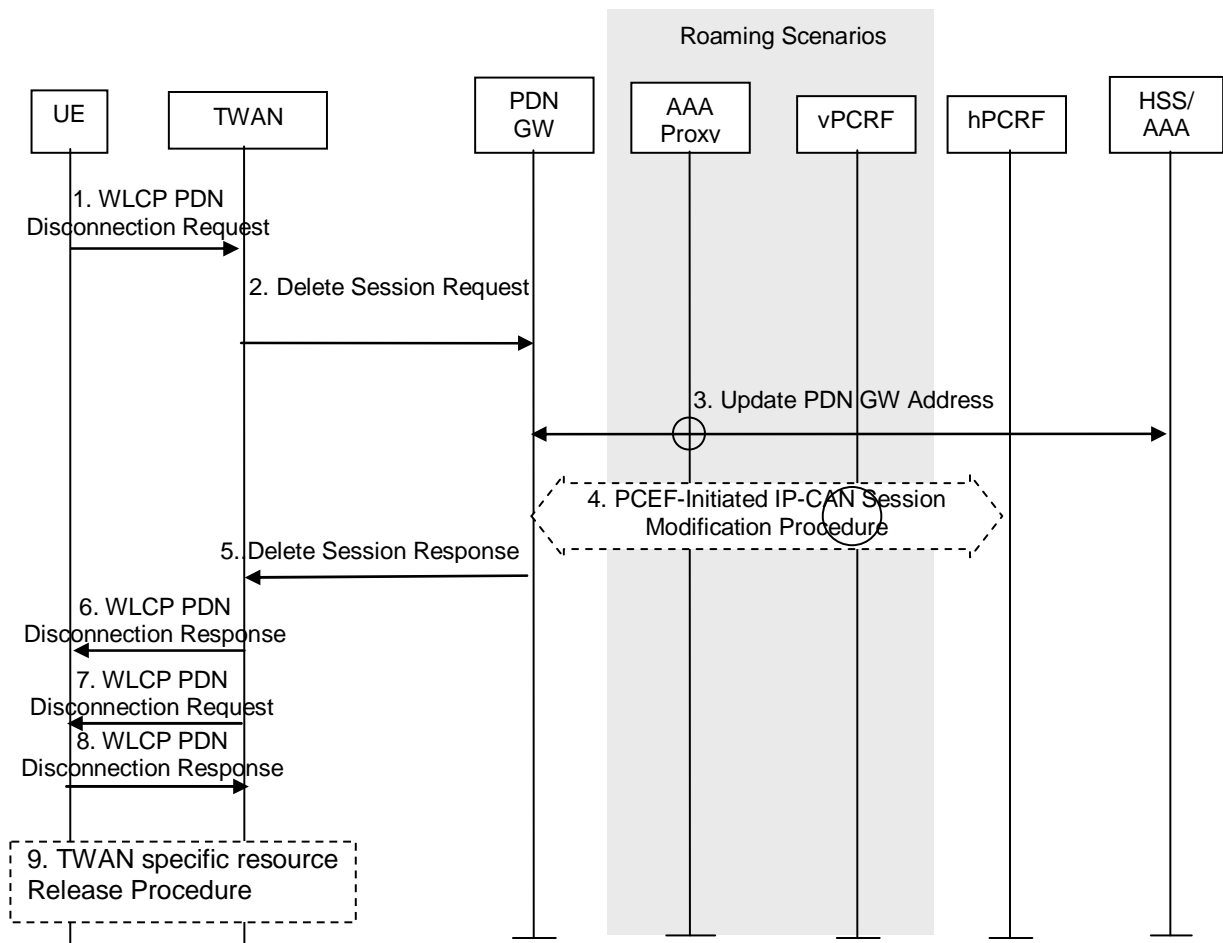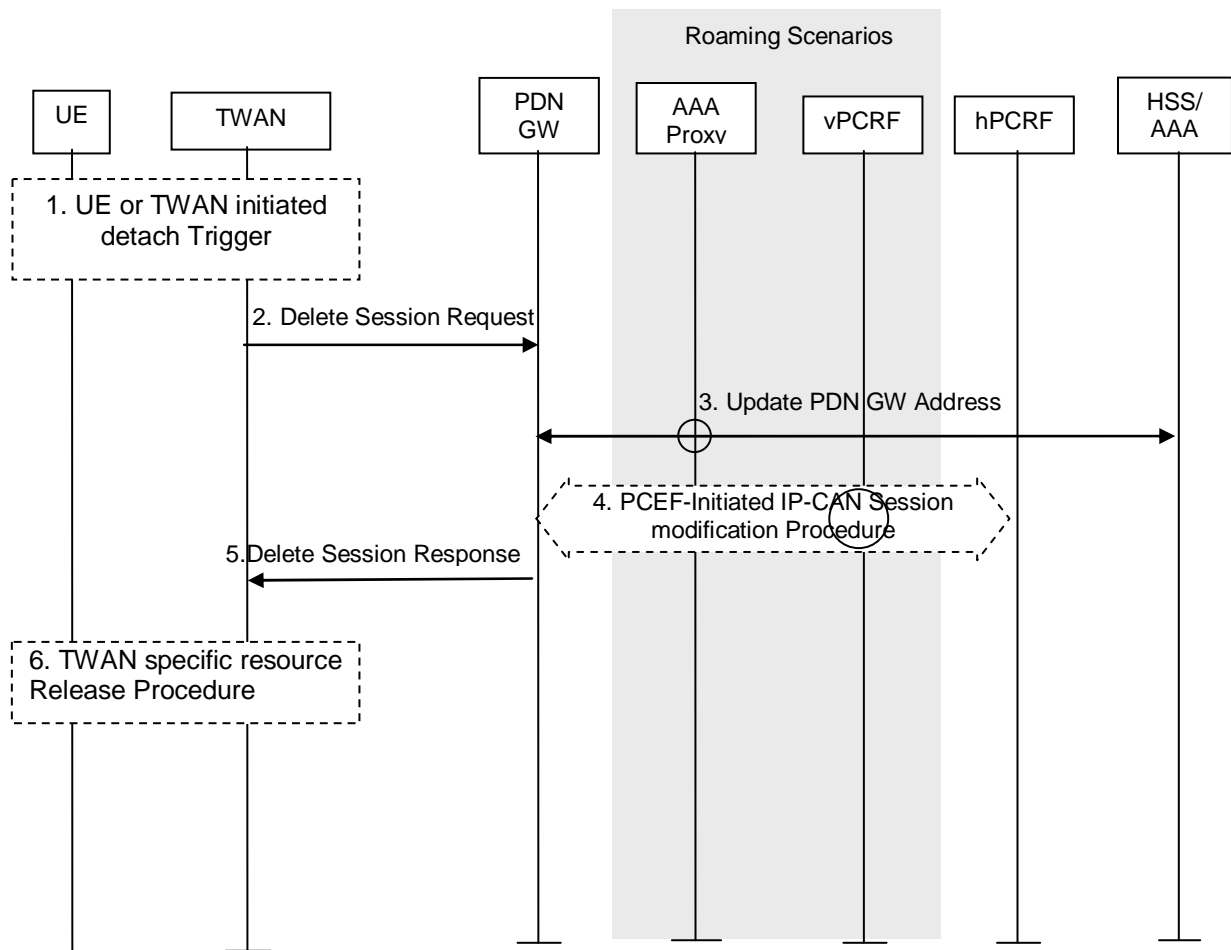
Figure 6.5.2.1-3: UE-initiated Removal of Trusted WLAN access from the last PDN connection for multi-connection mode

Step 4:   PDN GW shall indicate to the PCRF the removal of TWAN access for the multi-access PDN connection via IP-CAN Session Modification procedures, if dynamic PCC is applied for the PDN connection.

6.5.2.2   Network-initiated removal of Trusted WLAN access from a PDN connection

When the network removes the TWAN access for the multi-access PDN connection, the following procedures shall be applied.

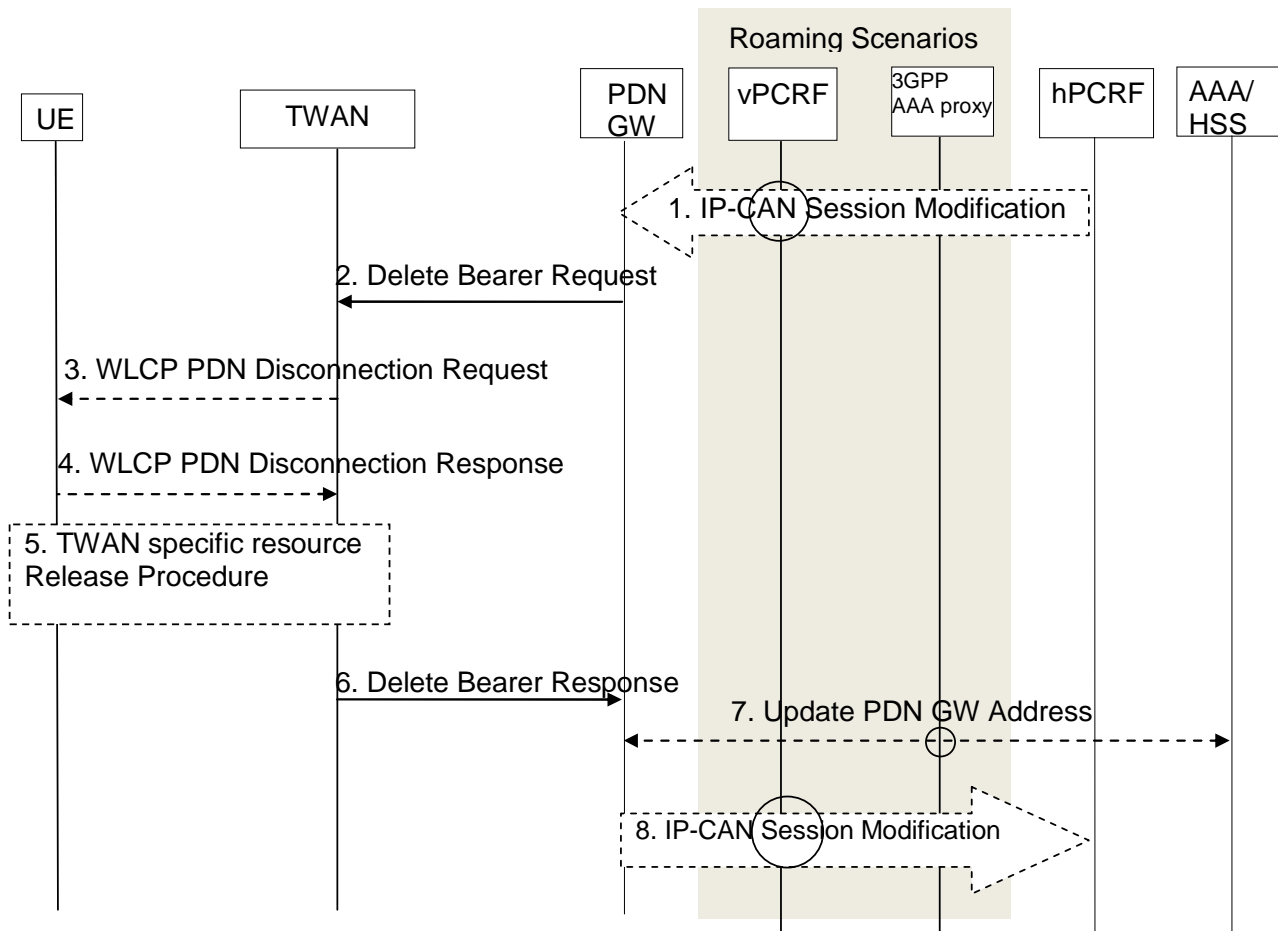**Figure 6.5.2.2-2: Network-initiated Removal of Trusted WLAN access from the PDN connection**

1. The PCRF shall indicate to the P-GW the removal of WLAN access for the multi-access PDN connection via IP-CAN Session Modification procedure by updating or removing all PCC rules that are bound to this access.

2-7.   The description of these steps is the same as for steps 2-7 in TS 23.402 [2], clause 16.4.1. The P-GW deactivates the default bearer of this access.

8. The P-GW shall indicate to the PCRF the WLAN access is removed from the multi-access PDN connection.

The optional interaction steps between the PDN GW and the PCRF in the procedures only occur if dynamic PCC is applied for the PDN connection.

6.5.3   Removal of Untrusted WLAN access

6.5.3.1   UE-initiated removal of Untrusted WLAN access from the PDN connection

When the UE remove from the WLAN access for the multi-access PDN connection, the following procedures shall be applied.
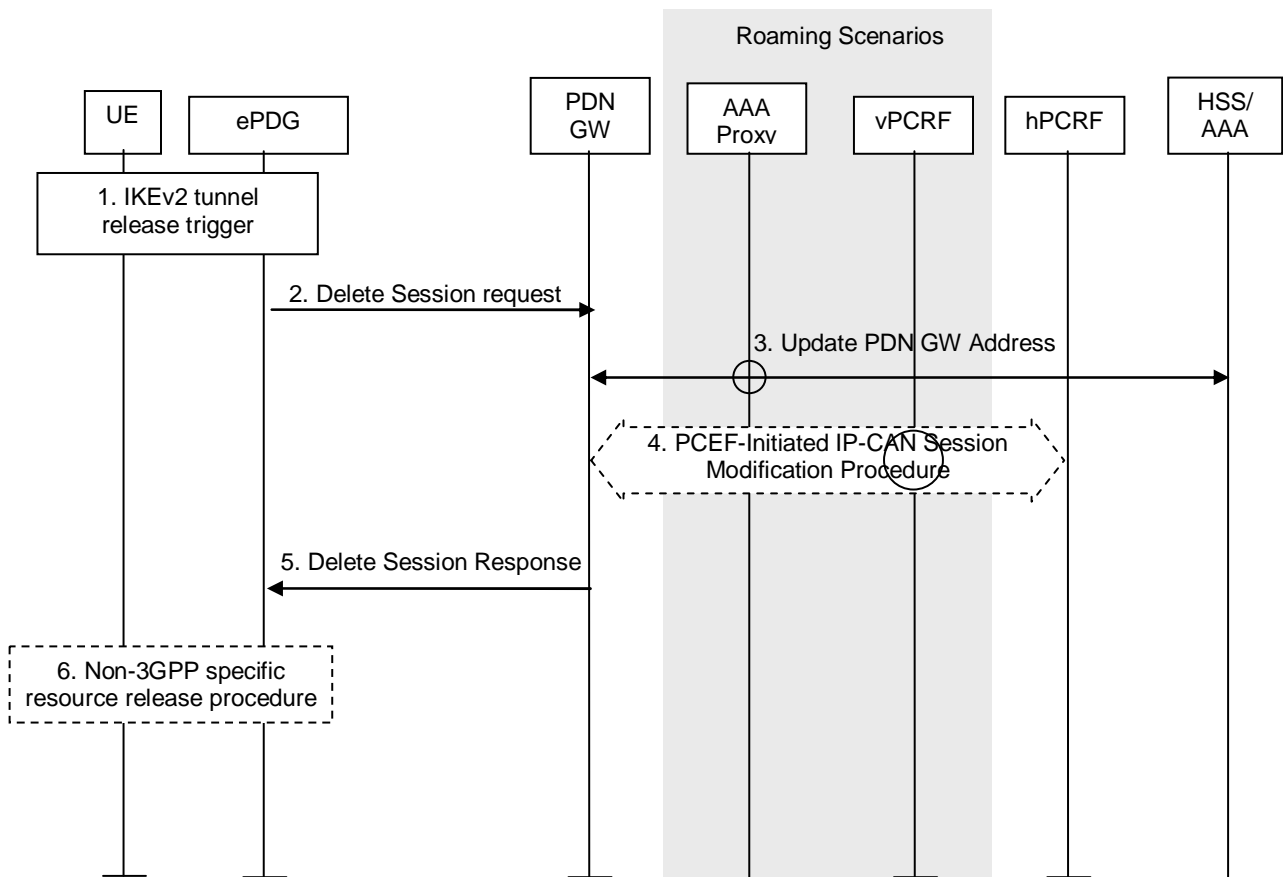
Figure 6.5.3.1-1: UE-initiated Removal of Untrusted WLAN access from the PDN connection

1. The description of these steps is the same as for steps 1 in TS 23.402 [2], clause 7.4.1.1.

2-3. The description of these steps is the same as for steps A.1-A.2 in TS 23.402 [2], clause 7.4.3.1.

4. The P-GW indicates to the PCRF the WLAN access is removed from the multi-access PDN connection, if dynamic PCC is applied for the PDN connection.

5. The description of these steps is the same as for steps A.3 in TS 23.402 [2], clause 7.4.3.1.

6. The description of these steps is the same as for steps 6 in TS 23.402 [2], clause 7.4.1.1.

6.5.3.2 Network-initiated removal of Untrusted WLAN access from a PDN Connection

When the Network removes the Untrusted WLAN access for the multi-access PDN connection, the following procedures shall be applied.
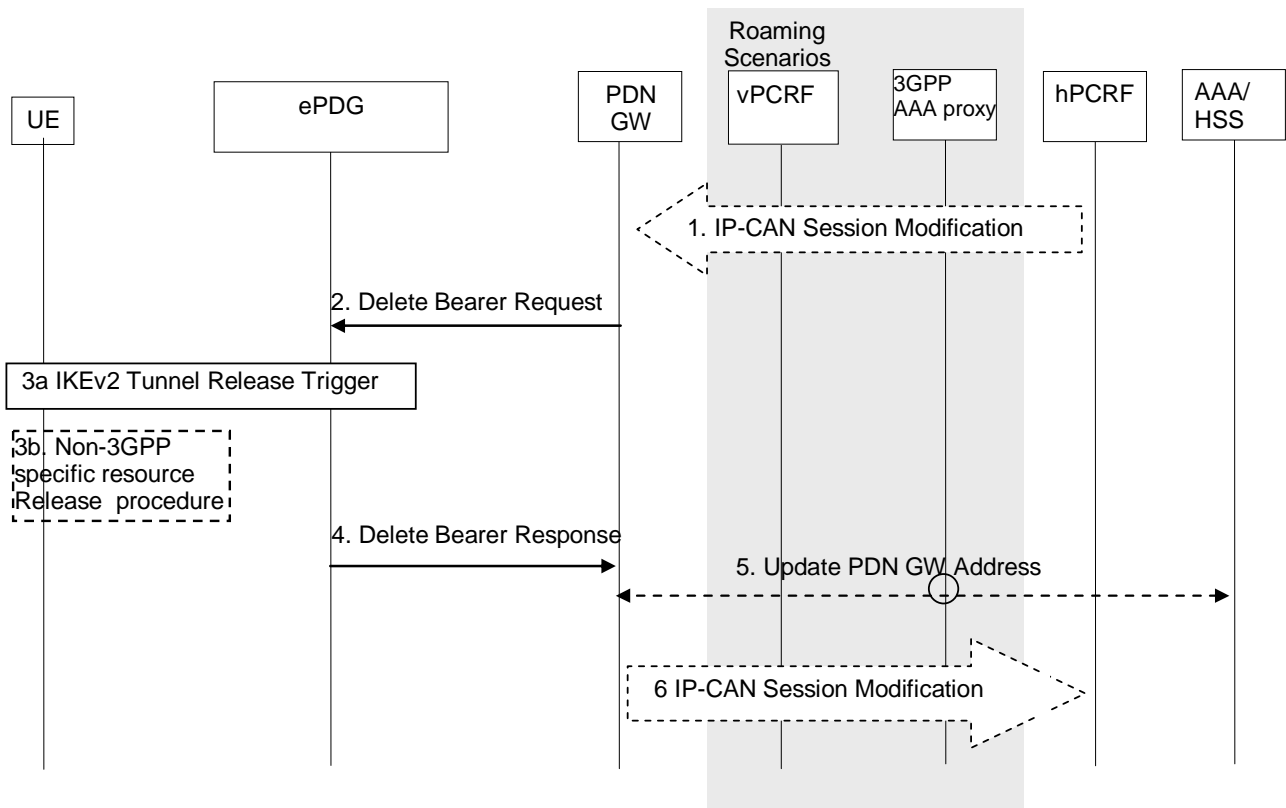
Figure 6.5.3.2-1: Network-initiated Removal of Untrusted WLAN access from the PDN connection

1. The PCRF shall indicate to the P-GW the removal of WLAN access for the multi-access PDN connection via IP-CAN Session Modification procedure by updating or removing all PCC rules that are bound to this access.

2-5. The description of these steps is the same as for steps 2-5 in TS 23.402 [2], clause 7.9.2. The P-GW deactivates the default bearer of this access.

6. The P-GW shall indicate to the PCRF the WLAN access is removed from the multi-access PDN connection.

The optional interaction steps between the PDN GW and the PCRF in the procedures only occur if dynamic PCC is applied for the PDN connection.

6.6 Access becomes Unusable and Usable

6.6.1 An access of a PDN connection becomes unusable

6.6.1.1 3GPP access of the PDN connection becomes unusable in Trusted WLAN access

When the UE detects that the 3GPP access becomes unusable, the UE shall report this event to the network via WLAN access. The 3GPP access unusable procedure is used when the UE determines that the 3GPP access is not usable anymore for carrying the IP flows. The UE determines that the 3GPP link is not usable when it detects loss of 3GPP coverage, or 3GPP radio quality preventing the usage of this access based on UE implementation mechanism. This procedure is applied in Network-initiated NBIFOM mode.

Figure 6.6.1.1-1: Procedure for 3GPP access becomes unusable for GTP S2a

1. The UE is connected simultaneously to 3GPP and TWAN accesses and establishes multiple IP flows of the same PDN connection.

2. The UE detects that the 3GPP link is not usable.

3. The UE sends the WLCP Modification Command message including a 3GPP unusable indication.

4. The TWAN sends the indication to the PDN GW within a Bearer Resource Command.

5. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF.

   The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provide the updated PCC rules to the PDN GW. The PCRF does not provide updated PCC rules for those IP flows which are forbidden to be routed in the WLAN access.

6. The PDN GW moves all the IP flows from 3GPP to WLAN except those IP flows which are forbidden to be routed via WLAN.

   The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF.

   The PDN GW may initiate dedicated bearer activation and/or modification procedure in WLAN according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. The PDN GW may release the resource in the 3GPP access network for the IP flows which are moved to WLAN but does not release the access from the multi-access PDN connection. Steps 3 to 8 as per Figure 6.3.2.2.2-1 will be invoked.

6.6.1.2 3GPP access of the PDN connection becomes unusable in Untrusted WLAN access

When the UE detects that the 3GPP access becomes unusable, the UE shall report this event to the network via WLAN access. The 3GPP access unusable procedure is used when the UE determines that the 3GPP access is not usable anymore for carrying the IP flows. The UE determines that the 3GPP link is not usable when it detects loss of 3GPP coverage, or 3GPP radio quality preventing the usage of this access based on UE implementation mechanism. This procedure is applied in Network-initiated NBIFOM mode.
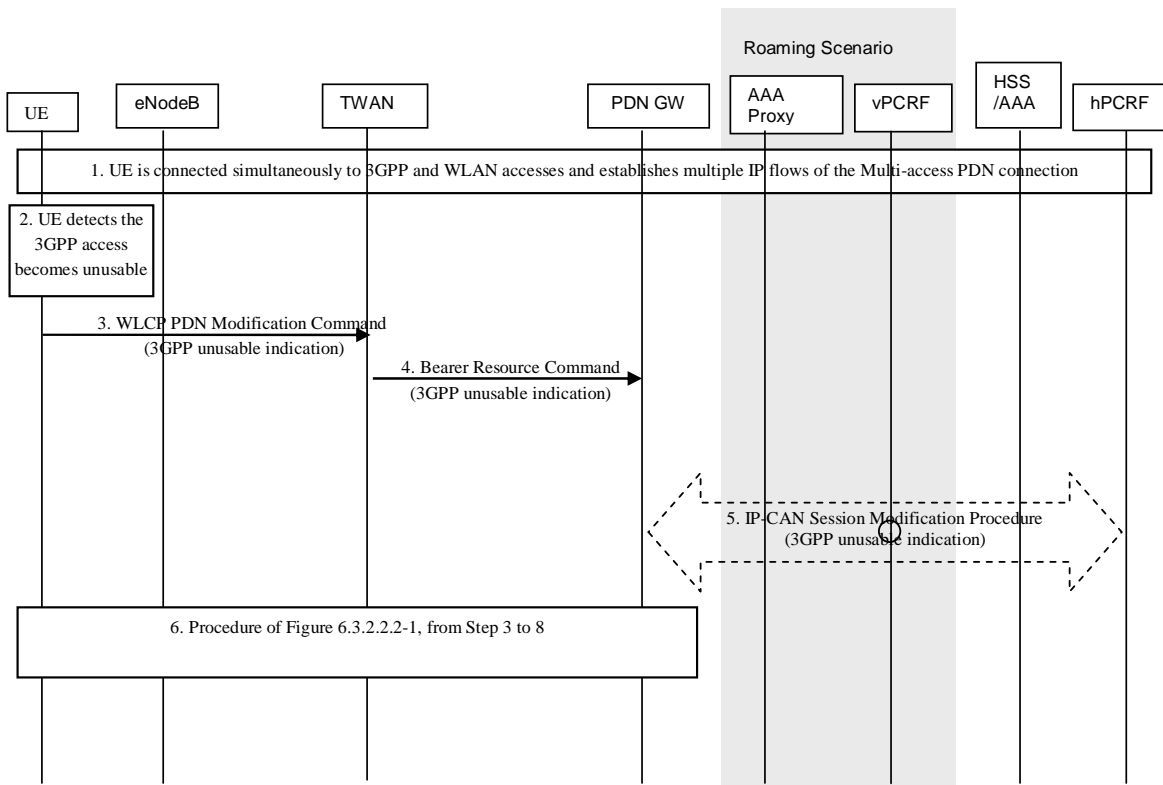
Figure 6.6.1.2-1: Procedure for 3GPP access becomes unusable for GTP S2b

1. The UE is connected simultaneously to 3GPP and untrusted WLAN accesses and establishes multiple IP flows of the same PDN connection.

2. The UE detects that the 3GPP link is not usable.

3. The UE sends the IKEv2 INFORMATIONAL Request message including a 3GPP unusable indication.

3a. The ePDG sends an IKEv2 INFORMATIONAL Response message to the UE.

4. The ePDG sends the indication to the PDN GW within a Bearer Resource Command.

5. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF..

   The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provide the updated PCC rules to the PDN GW. The PCRF does not provide updated PCC rules for those IP flows which are forbidden to be routed in the WLAN access.

6. The PDN GW moves all the IP flows from 3GPP to WLAN except those IP flows which are forbidden to be routed via WLAN.

   The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF.

   The PDN GW may initiate dedicated bearer activation and/or modification procedure in WLAN according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. The PDN GW may release the resource in the 3GPP access network for the IP flows which are moved to WLAN but does not release the access from the multi-access PDN connection. Step 3 to 9 as per Figure 6.3.2.3-1 will be invoked.

6.6.1.3 Trusted WLAN access becomes unusable

When the UE detects the TWAN access unusable, the UE shall report this event to the network via 3GPP access. The TWAN access unusable procedure is used when the UE determines that the TWAN access is not usable anymore for carrying the IP flows. The UE determines that the TWAN link is not usable when it detects loss of TWAN coverage, or TWAN radio quality preventing the usage of this access based on UE implementation mechanism. This procedure is applied in Network-initiated NBIFOM mode.
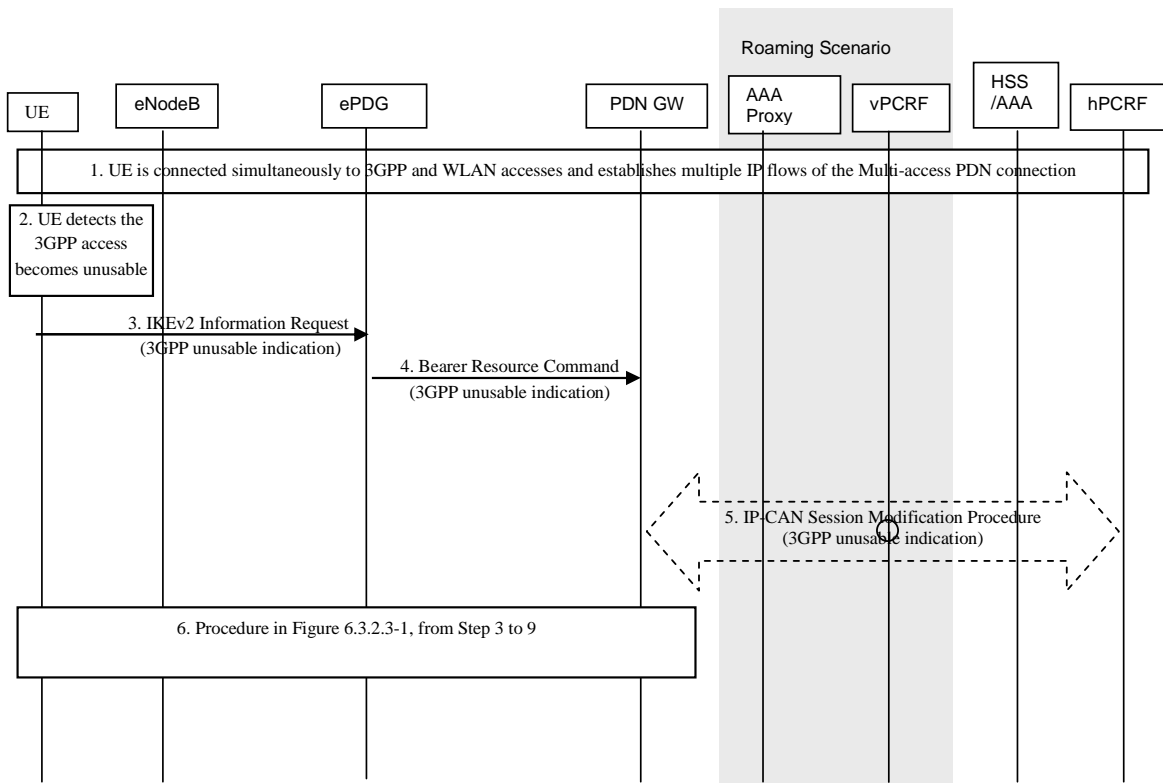
Figure 6.6.1.3-1: Procedure for Trusted WLAN becomes unusable access for GTP S5/S8

1. The UE is connected simultaneously to 3GPP and WLAN accesses and establishes multiple IP flows of the same PDN connection.

2. The UE detects that the WLAN link is not usable.

3. The UE sends the Request Bearer Resource Modification message including a WLAN unusable indication.

4-5.   The MME sends the indication to the PDN GW via the SGW within a Bearer Resource Command.

6. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF. The PCRF may generate new Routing Rules later and should not generate Routing Rules for WLAN.

   The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provide the updated PCC rules to the PDN GW. The PCRF does not provide updated PCC rules for those IP flows which are forbidden to be routed in the 3GPP access.

7. The PDN GW moves all the IP flows from WLAN to 3GPP except those IP flows which are forbidden to be routed via 3GPP.

   The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF.

   The PDN GW may initiate dedicated bearer activation and/or modification procedure in 3GPP according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. The PDN GW may release the resource in the WLAN access network for the IP flows which are moved to 3GPP but does not release the access from the multi-access PDN connection. Steps 3 to 7 as per Figure 6.3.2.1-1 will be invoked.

6.6.1.4   Untrusted WLAN access becomes unusable

When the UE detects the untrusted WLAN access unusable, the UE shall report this event to the network via 3GPP access. The untrusted WLAN access unusable procedure is used when the UE determines that the untrusted WLAN access is not usable anymore for carrying the IP flows. The UE determines that the untrusted WLAN link is not usable when it detects loss of untrusted WLAN coverage, or untrusted WLAN radio quality preventing the usage of this access based on UE implementation mechanism. This procedure is applied in Network-initiated NBIFOM mode.
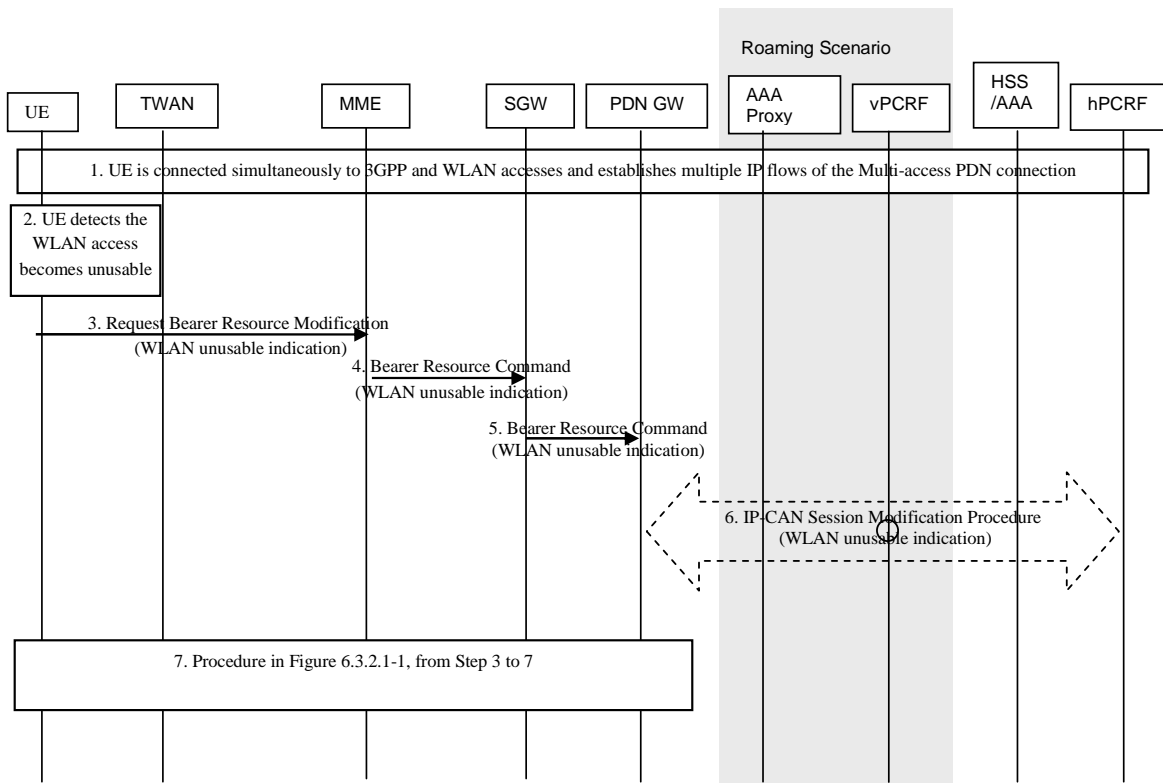
Figure 6.6.1.4-1: Procedure for Untrusted WLAN becomes unusable access for GTP S5/S8

The procedure is the same as described in clause 6.6.1.3.

6.6.2 An access of a PDN connection becomes usable

6.6.2.1 3GPP access for the PDN connection becomes usable

When the UE detects that the 3GPP access becomes usable, the UE shall report this event to the network via 3GPP access. The UE determines that the 3GPP link is usable again when it detects recovery of 3GPP coverage, or 3GPP radio quality allowing the usage of this access based on UE implementation mechanism. This procedure is applied in Network-initiated NBIFOM mode.
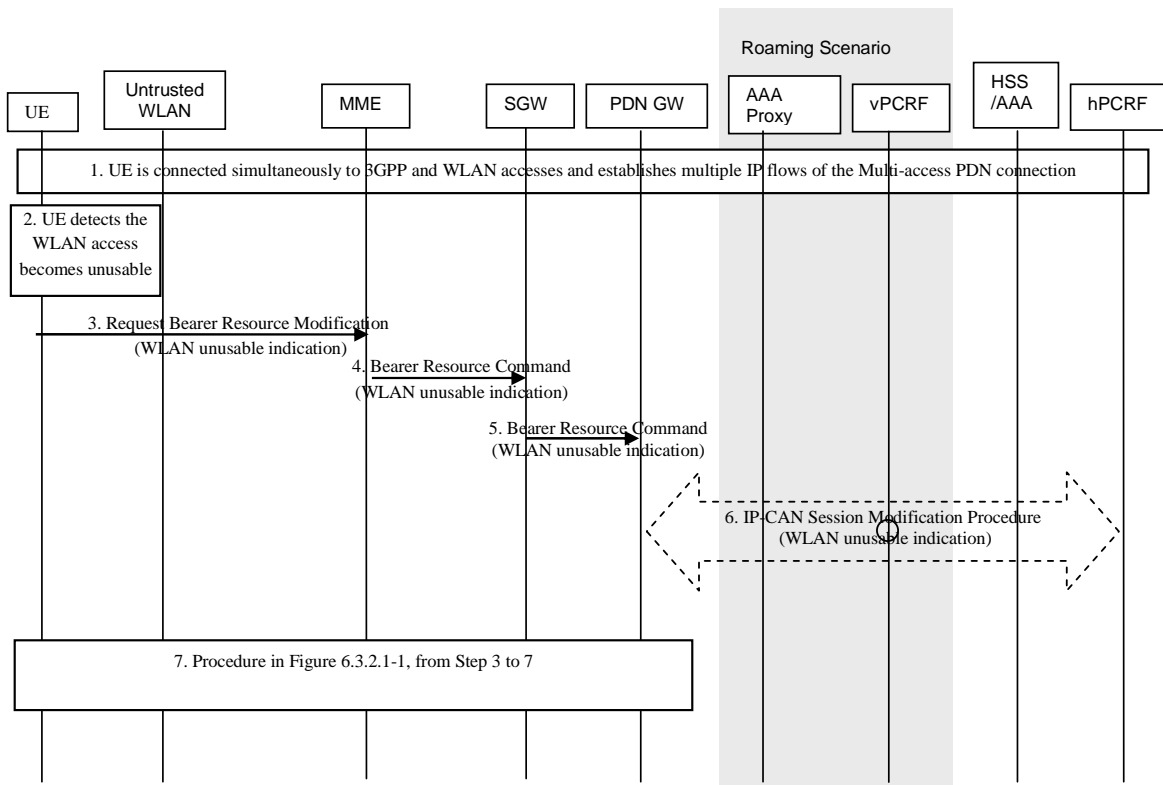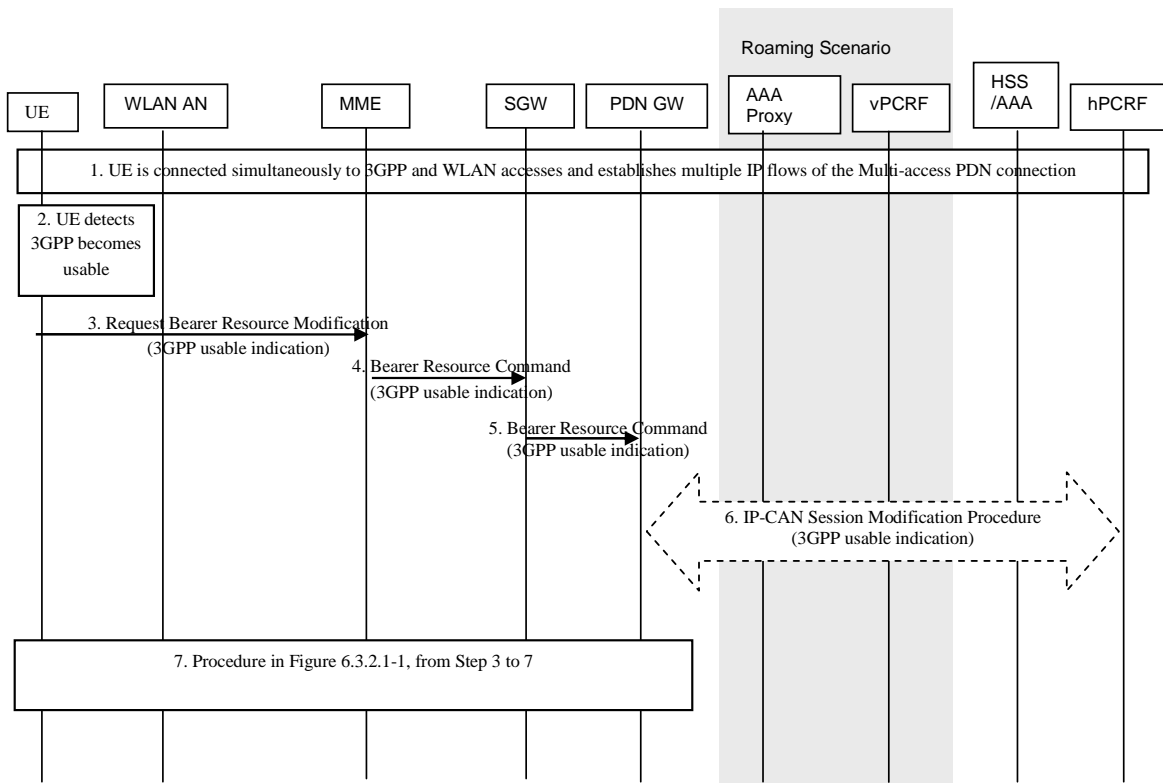
Figure 6.6.2.1-1: Procedure for 3GPP access becomes usable for GTP S5/S8

1. The UE is connected simultaneously to 3GPP and WLAN accesses and the UE has previously reported that the 3GPP access link is not usable for routing IP flows.

2. The UE detects that the 3GPP link becomes usable.

3. The UE sends the Request Bearer Resource Modification message including a 3GPP usable indication.

4-5. The indication is sent to the PDN GW via the SGW within a Bearer Resource Command.

6. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF.

    The PCRF updates the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW. The PCRF does not provide updated PCC rules for those IP flows which are forbidden to be routed in the 3GPP access.

7. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF.

    The PDN GW may initiate dedicated bearer activation and/or modification procedure according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. In case IP flows are moved from WLAN access to 3GPP, the PDN GW may release the resource in the WLAN access network but do not release the access from the multi-access PDN connection. Step 3 to 7 as per Figure 6.3.2.1-1 will be invoked.

6.6.2.2 Trusted WLAN access for the PDN connection becomes usable

6.6.2.2.1 Single-connection mode

After the UE connects to WLAN access and SCM mode is used, the UE shall report to the network, via 3GPP access, that TWAN is usable. This procedure is applied in Network-initiated NBIFOM mode.

Figure 6.6.2.2.1-1: Procedure for Trusted WLAN access becomes usable for GTP S5/S8 in SCM

The procedure is similar to 3GPP access becomes usable call flows in clause 6.6.2.1, with the following differences:

- Step 2 the UE detects TWAN becomes usable.

- Step 3 to Step 6, the TWAN usable indication is sent from the UE to the PCRF instead of 3GPP usable indication.

6.6.2.2.2 Multi-connection mode

After the UE connects to WLAN access and MCM mode is used, the UE shall report to the network, via 3GPP access, that TWAN is usable. This procedure is applied in Network-initiated NBIFOM mode.
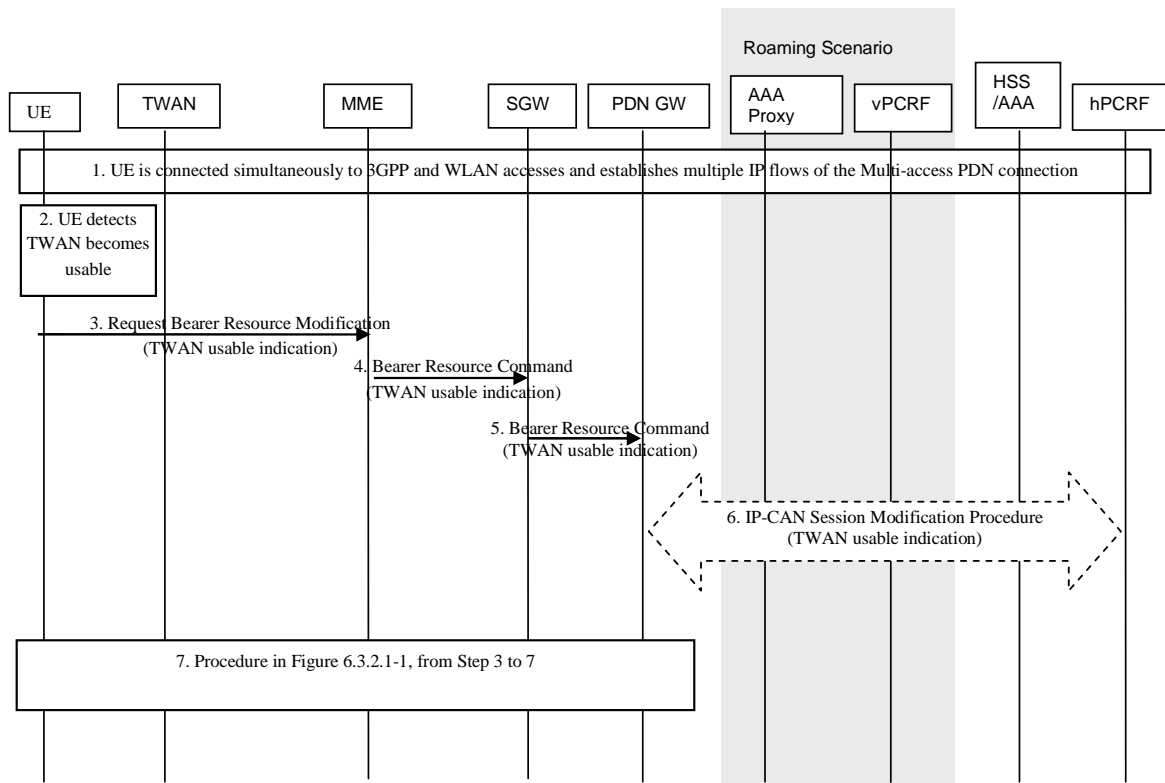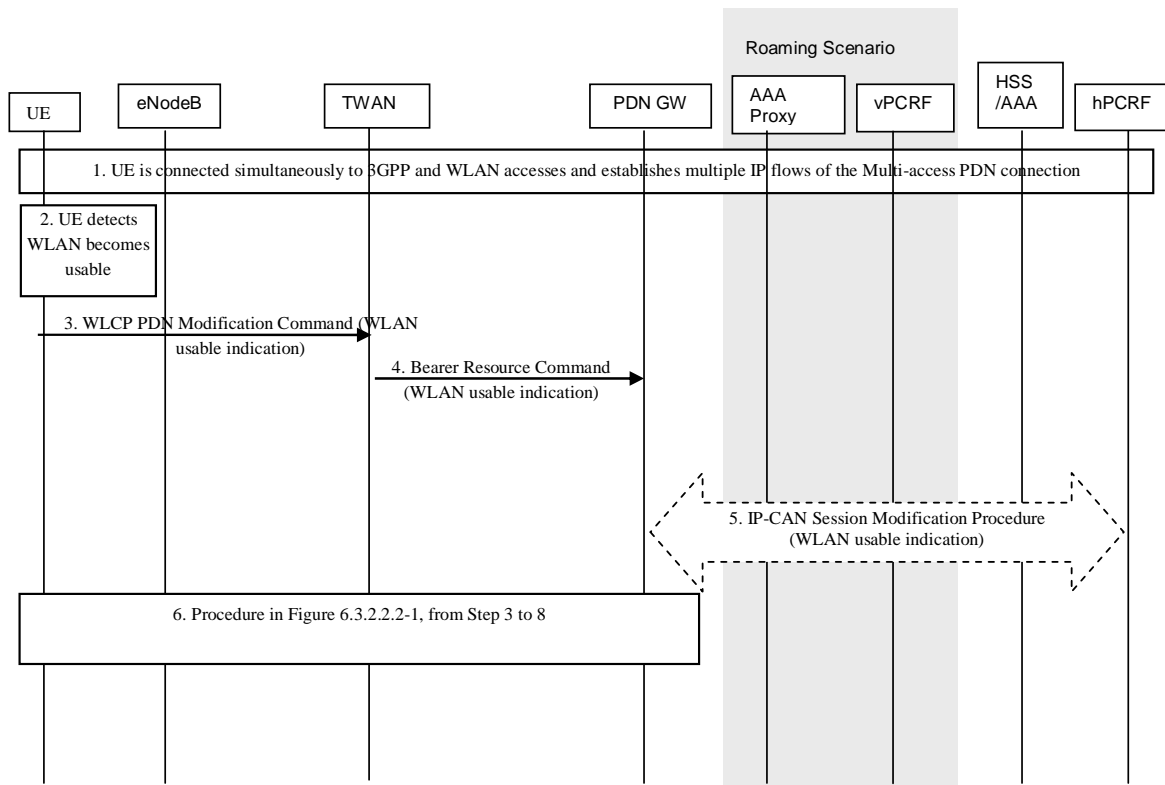
Figure 6.6.2.2.2-1: Procedure for Trusted WLAN access becomes usable for GTP S2a in MCM

1. The UE is connected simultaneously to 3GPP and TWAN accesses and has previously reported that the 3GPP access link is not usable for routing IP flows.

2. The UE detects that the WLAN link is again usable for carrying IP flows.

3. The UE sends the WLCP PDN Modification Command message including a WLAN usable indication.

4. The indication is sent to the PDN GW within a Bearer Resource Command.

5. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF.

   The PCRF updates the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW. The PCRF does not provide updated PCC rules for those IP flows which are forbidden to be routed in the TWAN access.

6. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF.

   The PDN GW may initiate dedicated bearer activation and/or modification procedure according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. In case IP flows are moved from 3GPP access to WLAN, the PDN GW may release the resource in the 3GPP access network. Steps 3 to 8 as per Figure 6.3.2.2.2-1 will be invoked.

6.6.2.3 Untrusted WLAN access for the PDN connection becomes usable

When the UE detects that the untrusted WLAN access becomes usable, the UE shall report this event to the network via WLAN access. The UE determines that the untrusted WLAN link is usable again when it detects recovery of untrusted WLAN coverage, or untrusted WLAN radio quality allowing the usage of this access based on UE implementation mechanism. This procedure is applied in Network-initiated NBIFOM mode.
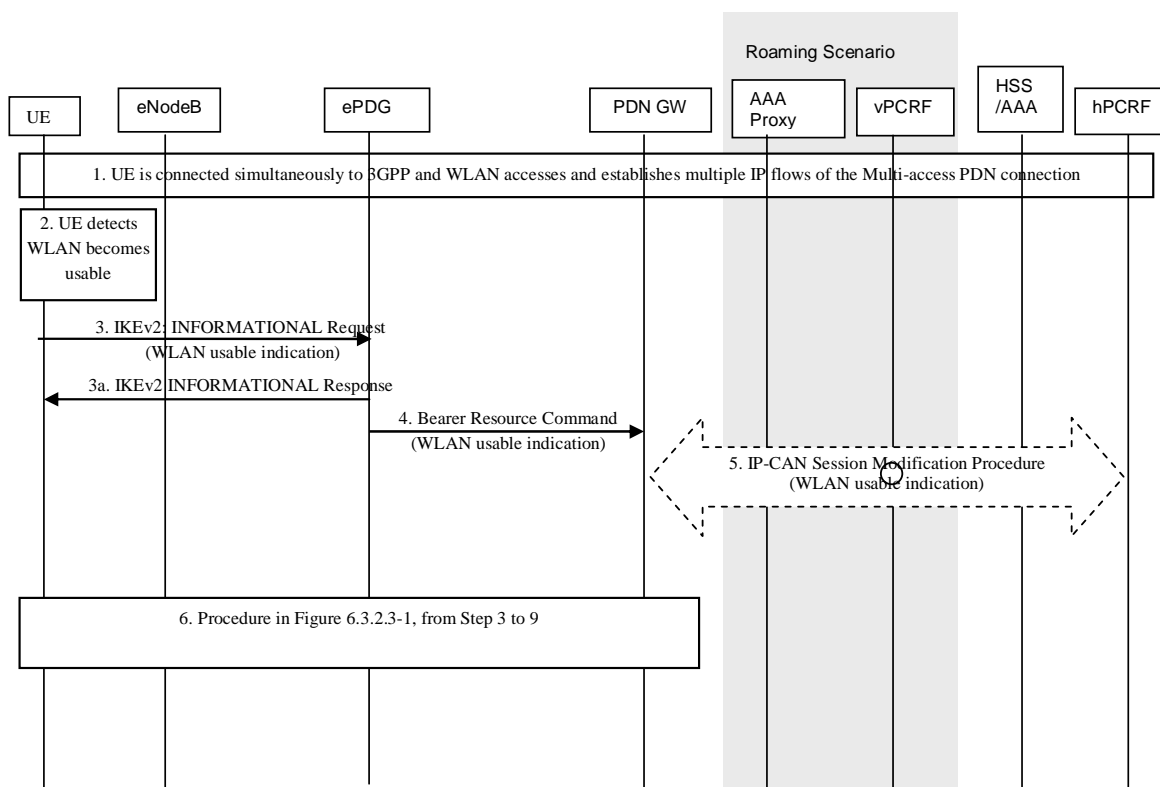
Figure 6.6.2.3-1: Procedure for Untrusted WLAN access becomes usable for GTP S2b

1. The UE is connected simultaneously to 3GPP and untrusted WLAN accesses and has previously reported that the 3GPP access link is not usable for routing IP flows.

2. The UE detects that the WLAN link is again usable for carrying IP flows.

3. The UE sends the IKEv2 INFORMATIONAL Request message to the ePDG including a WLAN usable indication.

3a. The ePDG sends an IKEv2 INFORMATIONAL Response message to the UE.

4. The WLAN usable indication is sent from the ePDG to the PDN GW within a Bearer Resource Command.

5. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF.

   The PCRF updates the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW.

6. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF.

   The PDN GW may initiate dedicated bearer activation and/or modification procedure according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. In case IP flows are moved from 3GPP access to WLAN, the PDN GW may release the resource in the 3GPP access network. Steps 3 to 9 as per Figure 6.3.2.3-1 will be invoked.

6.7 IP flow mobility triggered by RAN WLAN interworking

6.7.1 IP flow mobility triggered by Access Stratum indication move-to-WLAN in Trusted WLAN access

6.7.1.0 General

The procedure is used in Network-initiated NBIFOM mode when the UE applies RAN-assisted WLAN interworking (i.e. RAN Rules) or RCLWI and the Access Stratum indicates that the UE shall move traffic to WLAN when the UE is connected simultaneously to 3GPP and TWAN access.

6.7.1.1 Single-connection mode

Figure 6.7.1.1-1: Procedure for Access Stratum indication move-to-WLAN via E-UTRAN using GTP S2a in SCM

The procedure is similar to IP flow mobility triggered by indication move-from-WLAN call flows in Figure 6.7.3-1, with the following differences:

- Step 2 Access Stratum indicates move-to-WLAN.

- Step 3 to Step 6, the move-to-WLAN indication is sent from the UE to the PCRF instead of move-from-WLAN indication.

Figure 6.7.1.1-2: Procedure for Access Stratum indication move-to-WLAN via UTRAN using GTP S5/S8 in SCM

The procedure is similar to IP flow mobility triggered by Access Stratum indication move-from-WLAN call flows in Figure 6.7.3-2, with the following differences:

- Step 2 Access Stratum indicates move-to-WLAN.

- Step 3 to Step 6, the move-to-WLAN indication is sent from the UE to the PCRF instead of move-from-WLAN indication.

6.7.1.2 Multi-connection mode

Figure 6.7.1.2-1: Procedure for Access Stratum indication move-to-WLAN for GTP S2a in MCM

1. The UE is connected simultaneously to 3GPP and TWAN accesses. If, based on clause 5.4, the UE determines for non-radio related reasons that the WLAN access cannot be used, steps 3 to 6 are not performed.

2. Access Stratum indicates move-traffic-to-WLAN.

3. The UE sends the WLCP PDN Modification Command message including a move-to-WLAN indication.

4. The indication is sent to the PDN GW within a Bearer Resource Command.

5. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF.

   The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW.

6. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF. The PDN GW may initiate dedicated bearer activation and/or modification procedure as described in WLAN according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. In case IP flows are moved from 3GPP access to WLAN, the PDN GW may release the resource in the 3GPP access network. These procedures are described as per Figure 6.3.2.2.2-1 from Steps 3 to 8.

6.7.2 IP flow mobility triggered by Access Stratum indication move-to-WLAN in Untrusted WLAN access

The procedure is used in Network-initiated NBIFOM mode when the UE applies RAN-assisted WLAN interworking (i.e. RAN Rules) or RCLWI, and the Access Stratum indicates that the UE shall move traffic to WLAN when the UE is connected simultaneously to 3GPP and untrusted WLAN access.
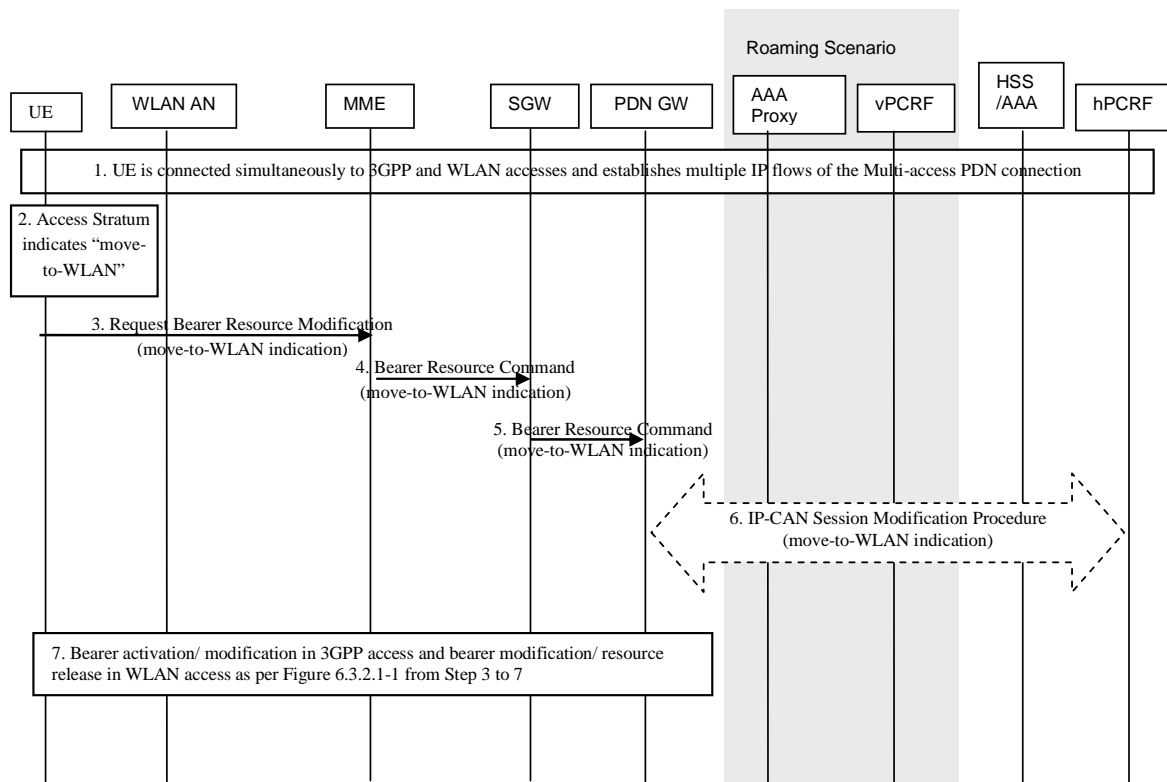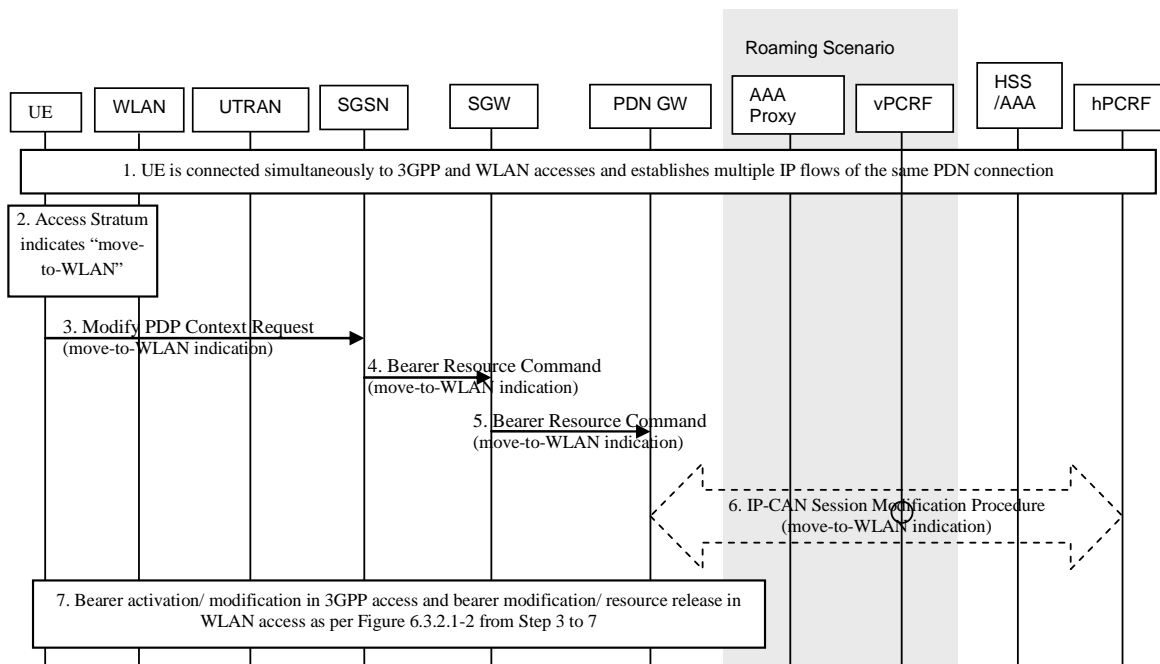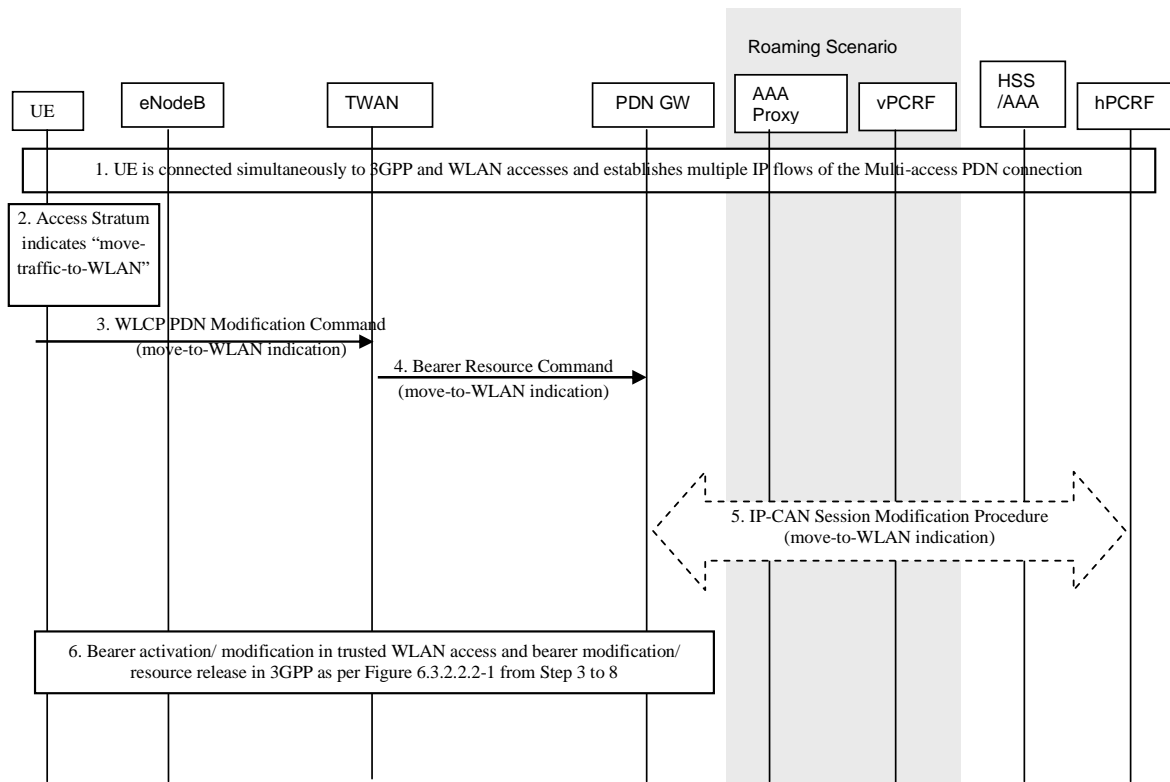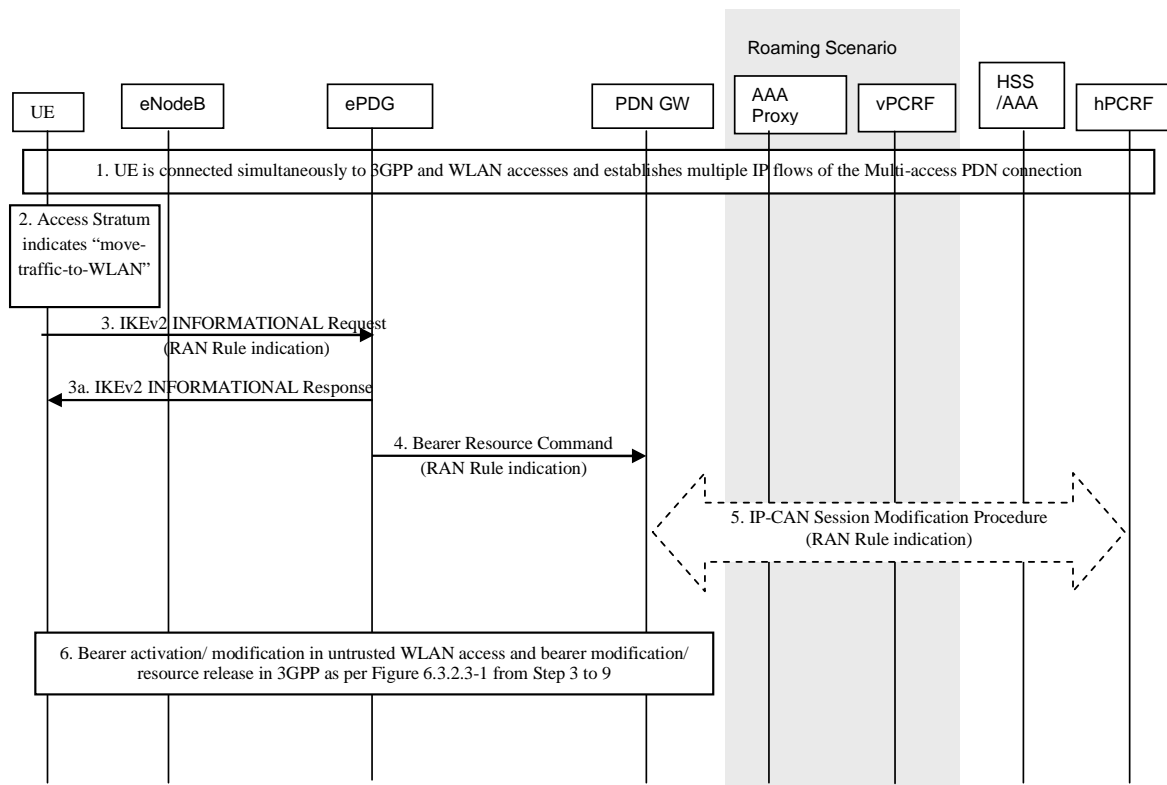
Figure 6.7.2-1: Procedure for Access Stratum indication move-to-WLAN for GTP S2b

1. The UE is connected simultaneously to 3GPP and untrusted WLAN accesses.

2. Access Stratum indicates move-traffic-to-WLAN. If, based on clause 5.4, the UE determines for non-radio related reasons that the WLAN access cannot be used, steps 3 to 6 are not performed.

3. The UE sends the IKEv2 INFORMATIONAL Request message including a move-to-WLAN indication.

3a. The ePDG sends an IKEv2 INFORMATIONAL Response message to the UE.

4. The ePDG sends the indication to the PDN GW within a Bearer Resource Command.

5. When the PCRF has subscribed to such notification, the PDN GW sends the indication to the PCRF.

    The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW.

6. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF. The PDN GW may initiate dedicated bearer activation and/or modification procedure in untrusted WLAN access according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. In case IP flows are moved from 3GPP access to WLAN, the PDN GW may release the resource in the 3GPP access network. These procedures are described as per Figure 6.3.2.3-1 from Steps 3 to 9.

6.7.3   IP flow mobility triggered by indication move-from-WLAN

The procedure is used in Network-initiated NBIFOM mode when the UE applies RAN-assisted WLAN interworking (i.e. RAN Rules) or RCLWI, and the Access Stratum indicates that the UE shall move traffic from WLAN.

Figure 6.7.3-1: Procedure for Access Stratum indication move-from-WLAN via E-UTRAN using GTP S5/S8

1. The UE is connected simultaneously to 3GPP and WLAN accesses.

2. Access Stratum indicates move-traffic-from-WLAN.

3. The UE sends the Request Bearer Resource Modification message including a move-from-WLAN indication.

4. The MME sends the indication the SGW within a Bearer Resource Command.

5. The SGW transfers the indication to the PDN GW within a Bearer Resource Command.

6. The PDN GW sends the indication to the PCRF.

   The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW.

7. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF. The PDN GW may initiate dedicated bearer activation and/or modification procedure in WLAN access according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. In case IP flows are moved from WLAN access to 3GPP, the PDN GW may release the resource in the WLAN access network. These procedures are described as per Figure 6.3.2.3-1 from Steps 3 to 7.
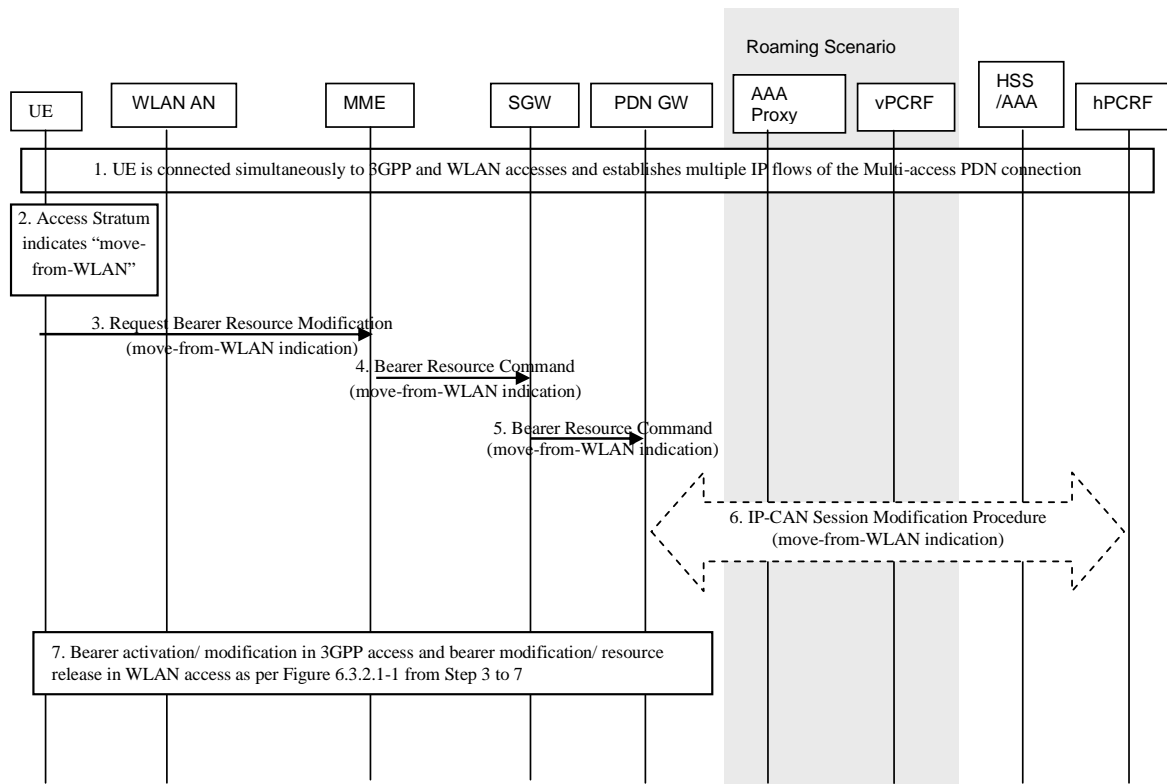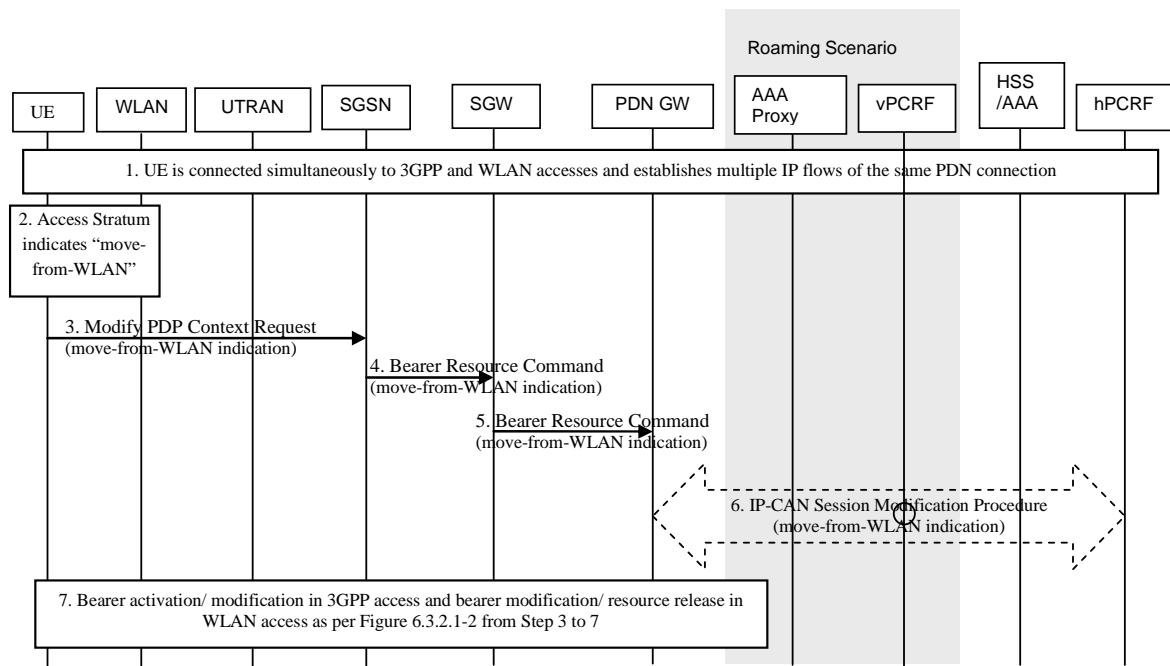
Figure 6.7.3-2: Procedure for Access Stratum indication move-from-WLAN via UTRAN using GTP S5/S8

1. The UE is connected simultaneously to 3GPP and WLAN accesses.

2. Access Stratum indicates move-traffic-from-WLAN.

3. The UE sends the Modify PDP Context Request message including a move-from-WLAN indication.

4. The SGSN sends the indication the SGW within a Bearer Resource Command.

5. The SGW transfers the indication to the PDN GW within a Bearer Resource Command.

6. The PDN GW sends the indication to the PCRF.

   The PCRF may update the PCC rules, e.g. by changing the Routing Access Type of PCC Rules and provides the updated PCC rules to the PDN GW.

7. The PDN GW provides updated Routing Rules to the UE based on the updated PCC rules received from PCRF. The PDN GW may initiate dedicated bearer activation and/or modification procedure in WLAN access according to if the IP flow shall be transported to new dedicated bearer or to existing bearer. If IP flows are moved from WLAN access to 3GPP, the PDN GW may release the resource in the WLAN access network. These procedures are described according to Figure 6.3.2.1-2 from Steps 3 to 7.

6.8 Network-initiated release of NBIFOM PDN connection

6.8.1 General

The Network-initiated release of NBIFOM PDN connection procedure may be triggered by SIPTO, as defined in TS 23.401 [4]. In this case, the PDN GW initiates Bearer Deactivation procedure upon receiving a Release Over Any Access indication from the MME.

The Network-initiated release of NBIFOM PDN connection procedure may also be triggered due to P-CSCF Restoration, as defined in TS 23.380 [8]. In this case,

- The PDN GW initiates Bearer Deactivation procedure as described in clause 6.8.2 upon receiving a P-CSCF Restoration indication from the PCRF, the 3GPP AAA server, or the MME/SGSN, or

- The PDN GW initiates Bearer Deactivation procedure in WLAN upon receiving the Release Over Any Access indication from the MME/SGSN as described in clause 6.8.2.

- The MME sends the Release Over Any Access indication during the MME requested PDN disconnection procedure or MME-initiated Detach procedure upon receiving a P-CSCF Restoration indication from the HSS. Or,

- The SGSN sends the Release Over Any Access indication during the SGSN Initiated PDN connection Deactivation Procedure using S4 upon receiving a P-CSCF Restoration indication from the HSS.

6.8.2   PDN GW initiated procedures

6.8.2.1   PDN GW initiated bearer deactivation procedure

The PDN GW initiated bearer deactivation procedure defined in TS 23.401 [4] clause 5.4.4.1 shall be used with the following exceptions:

- Step 2:

  If the PDN GW has received a P-CSCF restoration indication from the PCRF, the 3GPP AAA server, or the MME/SGSN, it shall select one access supporting the basic mechanism, based e.g. on whether the access supports the basic P-CSCF restoration mechanism defined in TS 23.380 [8]. If the PDN GW has selected the 3GPP access, it shall include the Reactivation Requested indication in the Delete Bearer Request to the MME. If the PDN GW has selected the WLAN access, it shall include the cause "local release" in the Delete Bearer Request to the MME.

- Steps 4 to 7 are not performed if the Cause in the Delete Bearer Request message is "local release".

6.8.2.2   PDN GW initiated Resource Allocation Deactivation with GTP on S2b procedure

For untrusted WLAN, the PDN GW initiated Resource Allocation Deactivation with GTP on S2b procedure defined in TS 23.402 [2] clause 7.9.2 shall be used with the following modifications:

- Step 2 applies with the following addition:

  - If the PDN GW has received a P-CSCF restoration indication from the PCRF, the 3GPP AAA server, or the MME/SGSN, it shall select one access supporting the basic mechanism as defined in TS 23.380 [8]. If the PDN GW has selected the untrusted WLAN access, it shall include the Reactivation Requested indication in the Delete Bearer Request to the ePDG. If the PDN GW has selected the 3GPP access, it shall include the cause "local release" in the Delete Bearer Request to the ePDG.

  - If this procedure is triggered by a Release Over Any Access indication from the MME, the PDN GW shall include the cause "local release" in the Delete Bearer Request to the ePDG.

- Step 3 is modified as follows: The IKEv2 tunnel release is triggered from the ePDG to the UE if all bearers belonging to the PDN connection are released and if the Cause in the Delete Bearer Request message is different from "local release". If the Delete Bearer Request message contains the Reactivation Requested indication, the ePDG includes the cause "Reactivation Requested" in the IKEv2 message to the UE.

6.8.2.3   PDN GW initiated Resource Allocation Deactivation in WLAN on GTP S2a procedure

For trusted WLAN, the PDN GW initiated Resource Allocation Deactivation in WLAN on GTP S2a procedure defined in TS 23.402 [2] clause 16.4.1 shall be used with the following modifications:

- Step 2 applies with the following addition:

  - If the PDN GW has received a P-CSCF restoration indication from the PCRF, the 3GPP AAA server, or the MME/SGSN, it shall select one access supporting the basic mechanism as defined in TS 23.380 [8]. If the IMS PDN connection is established on both accesses with the single connection mode over the trusted WLAN, the PGW shall select the 3GPP access. Otherwise,

    - If the PDN GW has selected the trusted WLAN access, it shall include the Reactivation Requested indication in the Delete Bearer Request to the TWAN;

- If the PDN GW has selected the 3GPP access, it shall include the cause "local release" in the Delete Bearer Request to the TWAN.

- If this procedure is triggered by a Release Over Any Access indication from the MME, the PDN GW shall include the cause "local release" in the Delete Bearer Request to the TWAN.

- Step 3 is modified as follows:

  In multi-connection mode, if all bearers belonging to a PDN connection are released and if the Cause in the Delete Bearer Request message is different from "local release", then the UE is informed of the PDN connection release by means of a WLCP PDN Disconnection Request (PDN Connection ID). If the Delete Bearer Request message contains the Reactivation Requested indication, the TWAN includes the cause "Reactivation Requested" to the WLCP PDN Disconnection Request message to the UE.

6.8.2.4 PDN GW initiated Bearer Deactivation Procedure using S4

The PDN GW initiated bearer deactivation procedure using S4 defined in TS 23.060 [5] clause 9.2.4.3A shall be used with the following additions:

- Step A:

  If the PDN GW receives a P-CSCF Restoration indication from the PCRF, the 3GPP AAA server, or the MME/SGSN, it shall select one access supporting the basic mechanism as defined in TS 23.380 [8]. If the PDN GW has selected the 3GPP access, it shall include the Reactivation Requested indication in the Delete Bearer Request to the SGSN. If the PDN GW has selected the WLAN access, it shall include the cause "local release" in the Delete Bearer Request to the SGSN.

- In addition, if the Cause in the Delete Bearer Request message is "local release", the message Deactivate PDP Context Request in step 2 of figure 77 in clause 9.2.4.3 is not sent to the UE.

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2015-09-08	SP#69	SP-150508	-	-	-	MCC Editorial Update for presentation to TSG SA for Information and Approval	1.0.0
2015-09-08	SP#69	-	-	-	-	MCC Editorial Update to version 13.0.0 after TSG SA approval	13.0.0
2015-12	SP#70	SP-150607	0001	1	F	Access becomes usable/unusable in UE-initiated NBIFOM mode	13.1.0
2015-12	SP#70	SP-150607	0002	2	F	Clarification of addition of WLAN access in S2b	13.1.0
2015-12	SP#70	SP-150607	0003	-	F	Corrections to NBIFOM charging related descriptions	13.1.0
2015-12	SP#70	SP-150607	0004	2	F	Add missing RAN Rule indication procedures for UTRAN in Network-initiated NBIFOM mode	13.1.0
2015-12	SP#70	SP-150607	0006	3	F	Procedure updates for default access in UE-initiated NBIFOM mode	13.1.0
2015-12	SP#70	SP-150607	0007	3	F	Update of functional entities	13.1.0
2015-12	SP#70	SP-150614	0008	1	F	Clarification of the resource modification during Routing Rule exchange for SCM	13.1.0
2015-12	SP#70	SP-150607	0009	2	F	Assigning destination access for IP flow mapping	13.1.0
2015-12	SP#70	SP-150607	0011	3	F	Clarification for the information of IP Flow mapping	13.1.0
2016-03	SP#71	SP-160172	0012	-	F	Charging identities with multiple default bearers	13.2.0
2016-03	SP#71	SP-160172	0013	-	F	Correction to unusability indication	13.2.0
2016-03	SP#71	SP-160172	0015	1	F	Correction of NBIFOM procedure in SCM and RAN Rules handling parameter	13.2.0
2016-03	SP#71	SP-160172	0016	2	F	Correction to UE-initiated IP flow mapping/access usability change/RAN rule indication procedures in S2a MCM and S2b	13.2.0
2016-03	SP#71	SP-160172	0017	3	F	The procedure of removal of one access from the Multi-access PDN connection	13.2.0
2016-06	SP#72	SP-160294	0018	1	F	Correction of the decision of NBIFOM mode	13.3.0
2016-06	SP#72	SP-160294	0019	1	F	Correction of UE-initiated IP flow mapping procedure in GERAN/UTRAN	13.3.0
2016-06	SP#72	SP-160294	0020	2	F	Correction to the event triggers of NBIFOM	13.3.0
2016-06	SP#72	SP-160294	0021	1	F	Clarification of removal of one access from the PDN connection	13.3.0
2016-09	SP#73	SP-160641	0022	2	F	Clarifications and Corrections for NBIFOM	13.4.0
2016-09	SP#73	SP-160644	0023	5	C	Network-initiated release of NB-IFOM PDN connections	13.4.0
2016-12	SP#74	SP-160813	0024	2	F	NBIFOM with RAN Controlled WLAN Interworking	13.5.0
2017-03	-	-	-	-	F	Update to Rel-14 version (MCC)	**14.0.0**
2018-06	SP-80	-	-	-	-	Update to Rel-15 version (MCC)	**15.0.0**
2020-07	SP-88E	-	-	-	-	Update to Rel-16 version (MCC)	**16.0.0**

History

Document history		
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