



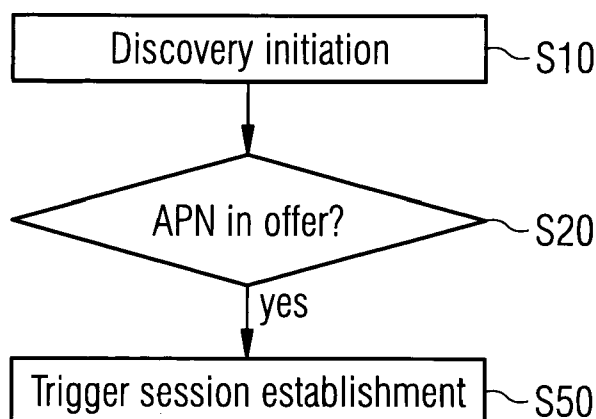
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(54) **Title:** USING PPPOE TO DISCOVER, REQUEST AND SET-UP ADDITIONAL PDN CONNECTIONS**FIG 3a**

(57) **Abstract:** It is provided a method, comprising triggering an establishment (S50) of an endpoint of a PPPoE session with a service device identified by a selected access point name (APN) through a packet network if at least one of a discovery offer message (PADO) and a session confirmation message (PADS) comprises the APN selected by the packet network; and at least one of a first, second, and third combination, wherein the first combination comprises a discovery initiation (S10) and an offer checking (S20); the second combination comprises the discovery initiation and a confirmation checking; and the third combination comprises a discovery request and the confirmation checking; wherein the discovery initiation comprises broadcasting a discovery initiation message (PADI) into the packet network, wherein the PADI message comprises a requested APN or a wildcard; the discovery request comprises providing a discovery request message (PADR) to the packet network, wherein the PADR message comprises the requested access point name or the wildcard; the offer checking comprises checking if a PADO message received in response to the PADI message comprises the selected APN; and the confirmation checking comprises checking if a PADS message

received in response to the PADR message and/or based on the PADI message, respectively, comprises the selected APN. Session establishment (S50). PPPoE Active Discovery messages, which may contain one or more tags, are used to exchange 3GPP specific parameters between a user entity (UE) and a Trusted WLAN Access Gateway (TWAG). Using the method, the network can start creating a GTP/PMIP tunnel over S2a interface earlier, which may result in faster PDN connection creation.

**Description****Title****Using PPPoE to discover, request and set-up additional PDN Connections**

5 Field of the invention

The present invention relates to an apparatus, a method, a system, and a computer program product related to trusted WLAN networks (TWAN). More particularly, the present invention relates to an apparatus, a method, a system, and a computer program product  
10 for discovering, requesting and setting-up additional PDN Connections over TWANs.

**Background of the invention****Abbreviations**

15	3GPP	3 <sup>rd</sup> Generation Partnership Project
	3GPP SA	3GPP System Architecture (group)
	3GPP TR	3GPP Technical Report
	3GPP TS	3GPP Technical Specification
	AAA	Authentication, Authorization, and Accounting
20	Ack	Acknowledgement
	AKA	Authentication and Key Agreement
	APN	Access Point Name
	DHCP	Dynamic Host Configuration Protocol
	DNS	Domain Name Server
25	EAP	Extensible Authentication Protocol -
	EPC	Evolved Packet Core
	EPS	Enhanced Packet System
	GPRS	General Packet Radio Service
	GSM	Global System for Mobile Communication
30	GTP	GPRS Tunneling Protocol
	HO	Handover
	HSS	Home Subscriber Server

	ID	Identifier
	IP	Internet Protocol
	IP-CAN	IP-Connectivity Access Network
	IPCP	IP Configuration Protocol
5	LAN	Local Area Network
	LCP	Link Control Protocol
	LTE	Long Term Evolution
	NSWO	Non-Seamless WLAN Offload
	PADI	PPPoE Active Discovery Initiation
10	PADO	PPPoE Active Discovery Offer
	PADR	PPPoE Active Discovery Request
	PADS	PPPoE Active Discovery Session-confirmation
	PCRF	Policy and charging rules function
	PDN	Packet Data Network
15	P-GW	Packet Data Network Gateway
	PMIP	Proxy Mobile IP
	PPP	Point-to-Point Protocol
	PPPoE	PPP Over Ethernet
	Rel	Release
20	RFC	Request For Comments
	SaMOG	S2a Mobility based On GTP & WLAN access to EPC
	SLAAC	Stateless Address Autoconfiguration
	TWAG	Trusted Wireless Access Gateway
	TWAN	Trusted WLAN Network
25	UE	User Equipment
	WiFi	Wireless Fidelity
	WLAN	Wireless LAN

The present application is related to the use of a WLAN network as Trusted WLAN Network (TWAN), more specifically to the solution specified for Trusted WLAN Access without UE impact (SaMOG\_wlan) in section 16 of 3GPP TS 23.402 for Rel-11 (version 11.5.0) and to the ongoing Rel-12 3GPP SA2 study documented in section 8 of TR 23.852. The S2a interface provides the user plane with related control and mobility support between trusted non 3GPP IP access (such as TWAN) and the PDN Gateway. S2a may be based on Proxy Mobile IP (PMIP) or General Tunneling Protocol (GTP).

Rel-11 specifications for trusted WLAN access enable the use of TWANs to access EPC with legacy UEs. Due to the lack of mechanism how the UE can send 3GPP specific parameters (e.g. requested APN and HO indication) to the EPC network via WLAN, the Rel-11 solutions has limitations, e.g., no handover with IP address preservation is supported, and only a single PDN connection to the default APN is possible. In order to remove these limitations a study is ongoing in 3GPP SA2. An important aspect of the work is to standardize a mechanism how a UE can send 3GPP specific parameters (e.g. requested APN and HO indication) to the EPC network via WLAN to enable handovers with IP address preservation, and multiple PDN connections for UEs.

In Section 8.2.7 of 3GPP TR 23.852, version 1.3.0, a solution is proposed which is based on the use of Point-to-Point Protocol (PPP) [RFC 1661] and PPP Over Ethernet (PPPoE) [RFC 2516]. Fig. 1 taken from 3GPP TR 23.852 depicts this procedure for creating a PDN connection. The signaling flow shows the steps carried out when a UE connects to a trusted WLAN (TWAN) and establishes a NSWO connection along with a PDN connection.

During the EAP-AKA authentication the UE becomes aware of the services offered by the trusted WLAN network, e.g. whether NSWO is supported, whether a single and/or multiple concurrent PDN connections are supported, etc. This can be accomplished by defining 3GPP-specific EAP-AKA attributes.

NSWO traffic comprises traffic not traversing the EPC, and is not considered any further in the present application.

When the UE decides to activate a PDN connection over the TWAN, it uses the normal PPPoE procedures to discover the TWAG and to establish a new PPPoE session with the TWAG. A new session ID is allocated by TWAG to this PPPoE session (for example:  
5 Session ID=0x065d, as shown in Fig. 1).

Subsequently, the UE initiates the establishment of a PPP session according to the normal PPP procedures. Note that after the LCP negotiation, there is no need to perform a PAP/CHAP or any other authentication, since the UE is already authenticated. Even when  
10 the UE sends a PPP authentication request the TWAG should always accept it.

In Fig. 1, it is assumed that during the IPCP configuration a new IPCP configuration option is used. This allows the UE to request a specific APN, attach type, etc. and allows the TWAG to respond with an offered APN and possibly other parameters. According to the  
15 proposal, for this purpose the PPP Vendor Extensions as specified in RFC2153 could be used.

#### Summary of the invention

20 It is an object of the present invention to improve the prior art. In detail, it is an object to provide a solution for setting up additional PDN connections over TWAN based on existing IP protocols, which is faster and avoids potential ambiguities of IPv4 and IPv6 protocol versions.

25 According to a first aspect of the invention, there is provided an apparatus, comprising session trigger means adapted to trigger an establishment of an endpoint of a session with a service device identified by a selected access point name through a packet network if at least one of a discovery offer message and a session confirmation message comprises the selected access point name; and at least one of a first, second, and third  
30 combination, wherein the first combination comprises a discovery initiation means and an offer checking means; the second combination comprises the discovery initiation means and a confirmation checking means; and the third combination comprises a discovery

request means and the confirmation checking means; wherein the discovery initiation means is adapted to broadcast a discovery initiation message into the packet network, wherein the discovery initiation message comprises a requested access point name or a wildcard; the discovery request means is adapted to provide a discovery request message  
5 to the packet network, wherein the discovery request message comprises the requested access point name or the wildcard; the offer checking means is adapted to check if a discovery offer message received in response to the discovery initiation message comprises the selected access point name; and the confirmation checking means is adapted to check if a session confirmation message received in response to the discovery  
10 request message and/or based on the discovery initiation message, respectively, comprises the selected access point name.

In the apparatus, the respective one of the discovery initiation message and the discovery request message may comprise a further parameter indicating a condition for the session  
15 to the service device; and the apparatus may further comprise parameter checking means adapted to check if the respective one of the discovery offer message and the session confirmation message comprises the further parameter; and preventing means adapted to prevent the establishment of the session if none of the discovery offer message and the session confirmation message comprises the further parameter.

20 In the apparatus, the further parameter may be a service indication of a service, and the apparatus may further comprise service determining means adapted to determine if the respective at least one of the session-confirmation message and the discovery offer message comprises the service indication; service invocation means adapted to invoke  
25 the service in the session.

In the apparatus, the further parameter may be specified according to a third generation partnership project specification.

30 In the apparatus, at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message may be based on a point-to-point over ethernet protocol, and/or the session may be a session of the point-to-point over ethernet protocol.

35 In the apparatus, at least one of the selected access point name and the respective one of the requested access point name and the wildcard may be comprised as a first tag in the

respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or the further parameter may be comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

The apparatus may further comprise attaching means adapted to attach the apparatus to a third generation partnership project network; and/or the packet network may be a wireless local area network.

According to a second aspect of the invention, there is provided an apparatus, comprising session trigger processor adapted to trigger an establishment of an endpoint of a session with a service device identified by a selected access point name through a packet network if at least one of a discovery offer message and a session confirmation message comprises the selected access point name; and at least one of a first, second, and third combination, wherein the first combination comprises a discovery initiation processor and an offer checking processor; the second combination comprises the discovery initiation processor and a confirmation checking processor; and the third combination comprises a discovery request processor and the confirmation checking processor; wherein the discovery initiation processor is adapted to broadcast a discovery initiation message into the packet network, wherein the discovery initiation message comprises a requested access point name or a wildcard; the discovery request processor is adapted to provide a discovery request message to the packet network, wherein the discovery request message comprises the requested access point name or the wildcard; the offer checking processor is adapted to check if a discovery offer message received in response to the discovery initiation message comprises the selected access point name; and the confirmation checking processor is adapted to check if a session confirmation message received in response to the discovery request message and/or based on the discovery initiation message, respectively, comprises the selected access point name.

In the apparatus, the respective one of the discovery initiation message and the discovery request message may comprise a further parameter indicating a condition for the session to the service device; and the apparatus may further comprise parameter checking processor adapted to check if the respective one of the discovery offer message and the session confirmation message comprises the further parameter; and preventing processor

adapted to prevent the establishment of the session if none of the discovery offer message and the session confirmation message comprises the further parameter.

In the apparatus, the further parameter may be a service indication of a service, and the apparatus may further comprise service determining processor adapted to determine if the  
5        respective at least one of the session-confirmation message and the discovery offer message comprises the service indication; service invocation processor adapted to invoke the service in the session.

10       In the apparatus, the further parameter may be specified according to a third generation partnership project specification.

In the apparatus, at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-  
15       confirmation message may be based on a point-to-point over ethernet protocol, and/or the session may be a session of the point-to-point over ethernet protocol.

In the apparatus, at least one of the selected access point name and the respective one of the requested access point name and the wildcard may be comprised as a first tag in the  
20       respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or the further parameter may be comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

25       The apparatus may further comprise attaching processor adapted to attach the apparatus to a third generation partnership project network; and/or the packet network may be a wireless local area network.

30       According to a third aspect of the invention, there is provided a user equipment comprising an apparatus according to any of the first and second aspects.

According to a fourth aspect of the invention, there is provided an apparatus, comprising at least one a first combination, a second combination, a third combination and a fourth  
35       combination, wherein the first combination comprises an initiation checking means, a tunnel determining means, and an offer means; the second combination comprises the



initiation checking means, the tunnel determining means, and a confirmation means; the third combination comprises the initiation checking means, an establishment checking means, and the confirmation means; and the fourth combination comprises a request checking means, the establishment checking means, and the confirmation checking means; wherein the initiation checking means is adapted to check if a discovery initiation message received from a user equipment comprises a requested access point name or a wildcard; the tunnel determining means is adapted to determine if a tunnel for a packet transmission to a service device identified by a selected access point name can be established through the apparatus, wherein the selected access point name is based on a respective one of the requested access point name and a scope of the wildcard; the offer means is adapted to provide a discovery offer message comprising the selected access point name to the user device if it is determined that the tunnel can be established; the request checking means is adapted to check if a discovery request message received from the user equipment comprises the requested access point name or the wildcard; the establishment checking means is adapted to check if the tunnel to the service device through the apparatus is established; and the confirmation means is adapted to provide a session confirmation message comprising the selected access point name to the user device if the tunnel is established.

In the apparatus, at least one of the request checking means and the initiation checking means is additionally adapted to check if the respective one of the discovery request message and the discovery initiation message comprises a further parameter indicating a condition for the session; and the apparatus may further comprise condition determining means adapted to determine if the condition can be fulfilled in the session; wherein the respective one of the confirmation means and the offer means may be adapted to provide the further parameter in the session-confirmation message and the discovery offer message, respectively, if it is determined that the condition can be fulfilled in the session.

In the apparatus, the further parameter may be an indication of a service to be provided by the service device.

In the apparatus, the further parameter may be specified according to a third generation partnership project specification.

The apparatus may further comprise selecting means adapted to select the selected access point name based on the respective one of the requested access point name and the scope of the wildcard.

- 5 In the apparatus, at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message may be based on a point-to-point over ethernet protocol, and/or the session may be a session of the point-to-point over ethernet protocol.
- 10 In the apparatus, at least one of the selected access point name and the respective one of the requested access point name and the wildcard may be comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or the further parameter may be comprised as a second tag in the respective one of the discovery
- 15 initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

The apparatus may belong to a wireless local area network, and the user equipment may belong to a third generation partnership project network.

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- According to a fifth aspect of the invention, there is provided an apparatus, comprising at least one a first combination, a second combination, a third combination and a fourth combination, wherein the first combination comprises an initiation checking processor, a tunnel determining processor, and an offer processor; the second combination comprises
- 25 the initiation checking processor, the tunnel determining processor, and a confirmation processor; the third combination comprises the initiation checking processor, an establishment checking processor, and the confirmation processor; and the fourth combination comprises a request checking processor, the establishment checking processor, and the confirmation checking processor; wherein the initiation checking
- 30 processor is adapted to check if a discovery initiation message received from a user equipment comprises a requested access point name or a wildcard; the tunnel determining processor is adapted to determine if a tunnel for a packet transmission to a service device identified by a selected access point name can be established through the apparatus, wherein the selected access point name is based on a respective one of the
- 35 requested access point name and a scope of the wildcard; the offer processor is adapted to provide a discovery offer message comprising the selected access point name to the

user device if it is determined that the tunnel can be established; the request checking processor is adapted to check if a discovery request message received from the user equipment comprises the requested access point name or the wildcard; the establishment checking processor is adapted to check if the tunnel to the service device through the apparatus is established; and the confirmation processor is adapted to provide a session confirmation message comprising the selected access point name to the user device if the tunnel is established.

In the apparatus, at least one of the request checking processor and the initiation checking processor is additionally adapted to check if the respective one of the discovery request message and the discovery initiation message comprises a further parameter indicating a condition for the session; and the apparatus may further comprise condition determining processor adapted to determine if the condition can be fulfilled in the session; wherein the respective one of the confirmation processor and the offer processor may be adapted to provide the further parameter in the session-confirmation message and the discovery offer message, respectively, if it is determined that the condition can be fulfilled in the session.

In the apparatus, the further parameter may be an indication of a service to be provided by the service device.

In the apparatus, the further parameter may be specified according to a third generation partnership project specification.

The apparatus may further comprise selecting processor adapted to select the selected access point name based on the respective one of the requested access point name and the scope of the wildcard.

In the apparatus, at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message may be based on a point-to-point over ethernet protocol, and/or the session may be a session of the point-to-point over ethernet protocol.

In the apparatus, at least one of the selected access point name and the respective one of the requested access point name and the wildcard may be comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the

discovery request message, and the session-confirmation message; and/or the further parameter may be comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

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The apparatus may belong to a wireless local area network, and the user equipment may belong to a third generation partnership project network.

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According to a sixth aspect of the invention, there is provided a wireless local area network comprising an apparatus according to any of the fourth and fifth aspects.

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According to a seventh aspect of the invention, there is provided a system, comprising a user apparatus according to any of the first and second aspects; a network apparatus according to any of the fourth and fifth aspects; wherein at least one of the discovery initiation message received by the network apparatus comprises the discovery initiation message broadcast by the user apparatus; and the recovery request message received by the network apparatus comprises the discovery request message provided by the user apparatus; and wherein at least one of the offer message received by the user apparatus comprises the offer message provided by the network apparatus; and the session confirmation message received by the user apparatus comprises the session confirmation message provided by the network apparatus.

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According to an eighth aspect of the invention, there is provided a method, comprising triggering an establishment of an endpoint of a session with a service device identified by a selected access point name through a packet network if at least one of a discovery offer message and a session confirmation message comprises the selected access point name; and at least one of a first, second, and third combination, wherein the first combination comprises a discovery initiation and an offer checking; the second combination comprises the discovery initiation and a confirmation checking; and the third combination comprises a discovery request and the confirmation checking; wherein the discovery initiation comprises broadcasting a discovery initiation message into the packet network, wherein the discovery initiation message comprises a requested access point name or a wildcard; the discovery request comprises providing a discovery request message to the packet network, wherein the discovery request message comprises the requested access point name or the wildcard; the offer checking comprises checking if a discovery offer message received in response to the discovery initiation message comprises the selected access

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point name; and the confirmation checking comprises checking if a session confirmation message received in response to the discovery request message and/or based on the discovery initiation message, respectively, comprises the selected access point name.

5 In the method, the respective one of the discovery initiation message and the discovery request message may comprises a further parameter indicating a condition for the session to the service device; and the method may further comprise checking if the respective one of the discovery offer message and the session confirmation message comprises the further parameter; and preventing the establishment of the session if none of the  
10 discovery offer message and the session confirmation message comprises the further parameter.

In the method, the further parameter may be a service indication of a service, and the method may further comprise determining if the respective at least one of the session-  
15 confirmation message and the discovery offer message comprises the service indication; invoking the service in the session.

In the method, the further parameter may be specified according to a third generation partnership project specification.  
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In the method, at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message may be based on a point-to-point over ethernet protocol, and/or the session may be a session of the point-to-point over ethernet protocol.  
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In the method, at least one of the selected access point name and the respective one of the requested access point name and the wildcard may be comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or the further  
30 parameter may be comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

The method may further comprise attaching an apparatus performing the method to a third  
35 generation partnership project network; and/or the packet network may be a wireless local area network.

According to a ninth aspect of the invention, there is provided a method, comprising at least one a first combination, a second combination, a third combination and a fourth combination, wherein the first combination comprises an initiation checking, a tunnel  
5 determining, and an offer; the second combination comprises the initiation checking, the tunnel determining, and a confirmation; the third combination comprises the initiation checking, an establishment checking, and the confirmation; and the fourth combination comprises a request checking, the establishment checking, and the confirmation checking; wherein the initiation checking comprises checking if a discovery initiation message  
10 received from a user equipment comprises a requested access point name or a wildcard; the tunnel determining comprises determining if a tunnel for a packet transmission to a service device identified by a selected access point name can be established through an apparatus performing the method, wherein the selected access point name is based on a respective one of the requested access point name and a scope of the wildcard; the offer  
15 comprises providing a discovery offer message comprising the selected access point name to the user device if it is determined that the tunnel can be established; the request checking comprises checking if a discovery request message received from the user equipment comprises the requested access point name or the wildcard; the establishment checking comprises checking if the tunnel to the service device through the apparatus is  
20 established; and the confirmation comprises providing a session confirmation message comprising the selected access point name to the user device if the tunnel is established.

In the method, at least one of the request checking and the initiation checking may comprise additionally checking if the respective one of the discovery request message and  
25 the discovery initiation message comprises a further parameter indicating a condition for the session; and the method may further comprise determining if the condition can be fulfilled in the session; wherein the respective one of the confirmation and the offer may be adapted to provide the further parameter in the session-confirmation message and the discovery offer message, respectively, if it is determined that the condition can be fulfilled  
30 in the session.

In the method, the further parameter may be an indication of a service to be provided by the service device.

35 In the method, the further parameter may be specified according to a third generation partnership project specification.

The method may further comprise selecting the selected access point name based on the respective one of the requested access point name and the scope of the wildcard.

- 5 In the method, at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message may be based on a point-to-point over ethernet protocol, and/or the session may be a session of the point-to-point over ethernet protocol.
- 10 In the method, at least one of the selected access point name and the respective one of the requested access point name and the wildcard may be comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or the further parameter may be comprised as a second tag in the respective one of the discovery
- 15 initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

The method may belong to a wireless local area network, and the user equipment may belong to a third generation partnership project network.

- 20 Each of the methods according to the eighth and ninth aspects may be a method of using point-to-point over ethernet.

- 25 According to a tenth aspect of the invention, there is provided a computer program product comprising a set of instructions which, when executed on an apparatus, is configured to cause the apparatus to carry out the method according to any one of the eighth and ninth aspects. The computer program product may be embodied as a computer-readable medium.

- 30 According to embodiments of the invention, at least one of the following advantages is achieved:
- No modifications to existing IP protocols are needed. Note that IPCP (and IPCPv6) were finalized more than 10 years ago with hardly any protocol expert still available.

- Avoids potential protocol ambiguities when providing both IPv4 and IPv6 on the same APN. IPCPv6 for IPv6 is different to IPCP for IPv4.
- No need to signal Multi-PDN connectivity in the EAP exchange as UE is able to learn about the offered functionality during discovery stage.
- 5     • The procedure is faster than that according to the prior art because the network learns sooner which APN the UE intend to use. Thus, the network can start creating the GTP/PMIP tunnel over S2a interface earlier, which may result in faster PDN connection creation.
- If PDN connection creation is not possible, the problem is discovered sooner.
- 10    • All the protocols used are available of-the-shelf.

It is to be understood that any of the above modifications can be applied singly or in combination to the respective aspects to which they refer, unless they are explicitly stated as excluding alternatives.

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#### Brief description of the drawings

Further details, features, objects, and advantages are apparent from the following detailed description of the preferred embodiments of the present invention which is to be taken in conjunction with the appended drawings, wherein

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Fig. 1 shows a message flow according to 3GPP TR 23.852.

Figs. 2a to c show apparatuses according to embodiments of the invention;

Figs. 3a to c show methods according to embodiments of the invention;

25     Figs. 4a to d show apparatuses according to embodiments of the invention; and

Figs. 5a to d show methods according to embodiments of the invention.

#### Detailed description of certain embodiments

30     Herein below, certain embodiments of the present invention are described in detail with reference to the accompanying drawings, wherein the features of the embodiments can be freely combined with each other unless otherwise described. However, it is to be expressly understood that the description of certain embodiments is given for by way of example only, and that it is by no way intended to be understood as limiting the invention

35     to the disclosed details.



Moreover, it is to be understood that the apparatus is configured to perform the corresponding method, although in some cases only the apparatus or only the method are described.

- 5 According to some embodiments of the invention, PPPoE Discovery messages (instead of PPP) are used to exchange 3GPP specific parameters between the UE and the TWAG.

There are the following PPPoE discovery messages:

- 10 – PADI: is used to identify an address of a device in the packet network if the address is not known; PADI is broadcast to all devices in the packet network;
- PADO: by PADO, the device provides its address in response to PADI, thus offering establishment of a PPPoE session;
- PADR: confirms acceptance of the offer for the PPPoE session made in PADO; and
- 15 – PADS: the device confirms the PADR message and provides a session number for the established session.

PADI, PADO, PADR, and PADS are examples of a discovery initiation message, a discovery offer message, a discovery request message, and a session establishment  
20 message, respectively.

The UE is attached to the 3GPP network and wants to set up a PDN connection to an arbitrary APN through the non-3GPP network such as a TWAN. TWAG is the gateway of the TWAN (non-3GPP network) to the PDG of the 3GPP network. PPPoE discovery  
25 messages can contain one or more tags that can be used for this purpose.

One of the tag types is Service-Name, whose intended usage is very much in line with the use of APN. Service-Name is a mandatory parameter in all PPPoE discovery messages. The UE can send the requested APN in the PADI and/or PADR messages, while the  
30 network can send the selected APN in PADO and/or PADS messages. If

TAG\_LENGTH=0 is set for Service-Name, it may indicate any service. Thus, a wildcard search for appropriate APNs may be realized.

5 PPPoE also supports the use of Vendor-Specific tag types, which can be used to transfer any additional 3GPP specific parameters, such as handover indication, PDN connection type.

10 In the following, a specific embodiment of the invention is described at greater detail: The UE sends a PADI message either with the desired APN included as Service-Name, or with an empty Service-Name to learn about the services offered by the TWAG and can check for the availability of the wanted APN and additional functionality before requesting the session set-up by sending a PADR with the requested Service-Names of the selected APN and additional functions and parameters. Upon receipt of the PADR message from the UE the TWAG verifies that the requested Service-Names can be provided and  
15 confirms the session establishment with a PADS message containing the unique session identifier.

In general, there are several options how the UE can exchange the APN with the WLAN using PPPoE according to embodiments of the invention, e.g.:

20 a. The UE sends the requested APN in PADI and the TWAG sends back the selected APN in PADO.

In some of these embodiments, the UE adds the selected APN to PADR message and the TWAG may repeat it in PADS message. However, according to some theses embodiments, one or both of PADR and PADS  
25 may not comprise the selected APN.

b. The UE sends the requested APN in PADI and the TWAG sends back the selected APN in PADS.

In this case the Service Tag in PADO and PADR may be anything or empty.

30 c. The UE sends the requested APN in PADR and the TWAG sends back the selected APN in PADS.

In this case the Service Tag in PADI and PADO can be anything or empty.

Correspondingly, according to embodiments of the invention, there are four options how the network may react on receiving a requested APN:

- 5        1. The APN is received in PADI. The network may select the received APN as a selected APN, or it may, based on the received APN and other parameters select an APN as the selected APN. Then, the selected APN is returned in PADO.
2. The APN is received in PADI. The network may select the received APN as the selected APN, or it may, based on the received APN and other parameters select  
10       an APN as the selected APN. Then, the selected APN is returned in PADS.
3. The APN is received in PADI. The network may select the received APN as selected APN, or it may, based on the received APN and other parameters select  
      an APN as the selected APN. Then, typically after exchange of PADO and PADR,  
      it is checked if the tunnel is established, and the selected APN is returned in  
15       PADS.
4. The APN is received in PADR. The network may select the received APN as selected APN, or it may, based on the received APN and other parameters select  
      an APN as the selected APN. Then, it is checked if the tunnel is established, and  
      the selected APN is returned in PADS.

20

If the network receives a wildcard instead of the APN, it may select an APN based on the scope of the wildcard and other parameters.

In some embodiments of the invention, the network checks if the UE has authorization to  
25       access the packet data network (service device) identified by the selected APN.

UEs and networks according to embodiments of the invention may be adapted to exchange the APN according to one or more of the options. Options a) and b) have an advantage that the network can start the tunnel creation earlier.

30

Figs. 2a to c show apparatuses according to embodiments of the invention. Each of the apparatuses may be a terminal such as a user equipment. Fig. 3a-c show methods according to embodiments of the invention. The apparatuses according to Figs. 2a to c may perform the corresponding methods of Fig. 3a to c but are not limited to these methods. The methods of Figs. 3a to c may be performed by the corresponding apparatuses of Figs. 2a to c but are not limited to being performed by these apparatuses.

Each of the apparatuses comprises session trigger means 50. In addition, it comprises at least one of the following combinations: (a) discovery initiation means 10 and offer checking means 20; (b) discovery initiation means 10 and confirmation checking means 30; and (c) discovery request means 40 and confirmation checking means 30.

The session trigger means 50 triggers an establishment of an endpoint of a session with a service device identified by a selected access point name through a packet network if at least one of a discovery offer message and a session confirmation message comprises the selected access point name (S50).

The discovery initiation means 10 broadcasts a discovery initiation message into the packet network (S10). The discovery initiation message comprises a requested access point name or a wildcard. E.g. a wildcard may be represented by leaving the requested access point name empty. The discovery initiation message is broadcast into a packet network such as a WLAN network.

The discovery request means 40 provides a discovery request message to the packet network (S40). The discovery request message comprises the requested access point name.

The offer checking means 20 checks if a discovery offer message received in response to the discovery initiation message comprises the selected access point name (S20).

The confirmation checking means 30 checks if a session confirmation message received in response to the discovery request message comprises the selected access point name (S30). The session confirmation message may comprise a session number.

Fig. 4a-d show apparatuses according to embodiments of the invention. Each of the apparatuses may be a gateway such as a TWAG. Fig. 5a-d show methods according to embodiments of the invention. The apparatuses according to Fig. 4a-d may perform the corresponding methods of Figs. 5a-d but are not limited to these methods. The methods of Figs. 5a-d may be performed by the corresponding apparatuses of Figs. 4a-d but are not limited to being performed by these apparatuses.

Each of the apparatuses comprises a combination selected out of initiation checking means 110, tunnel determining means 120, offer means 130, request checking means 140, establishment checking means 150, and confirmation means 160. Namely, the first combination comprises initiation checking means 110, tunnel determining means 120, and offer means 130; the second combination comprises the initiation checking means 110, the tunnel determining means 120, and the confirmation means 160; the third combination comprises the initiation checking means 110, establishment checking means 150, and the confirmation means 160; and the fourth combination comprises request checking means 140, the establishment checking means 150, and the confirmation means 160.

The initiation checking means 110 checks if a discovery initiation message received from a user equipment comprises a requested access point name or a wildcard (S110).

The tunnel determining means 120 determines if a tunnel for a packet transmission to a service device identified by a selected access point name can be established through the apparatus (S120). The selected access point name may be the requested access point name or may be created based on the requested access point name or the scope of the wildcard. E.g., access point name changing policies may be used in creating the selected access point name.

The offer means 130 provides an offer message to the user device, wherein the offer message comprises the selected access point name if it is determined that the tunnel can be established (S130).

The request checking means 140 checks if a discovery request message received from the user equipment comprises the requested access point name (S140).

The establishment checking means 150 checks if the tunnel to the service device is established (S150).

- 5 The confirmation means 160 provides a session confirmation message to the user device wherein the session confirmation message comprises the selected access point name if it is checked that the tunnel is established (S240).

10 Note that the discovery offer message is received in response to the discovery initiation message, whereas the session confirmation message is received in response to a discovery request message, which the apparatus transmits to the packet network after having received a discovery offer message from the packet network. If the session confirmation message comprises the selected access point name, each of the discovery offer message and the discovery request message may or may not comprise the selected  
15 access point name.

Typically, in embodiments of the invention, the full sequence of PADI - PADO – PADR – PADS is exchanged, and, on the network side, the session to the selected APN is established (by a session establishment means) after receipt of PADR and before  
20 transmitting PADS. Some or all of the exchanged PADI, PADO, PADR, and PADS messages may comprise the respective one of the requested access point name (or the wildcard) and the selected access point name.

Each of the discovery initiation message, the discovery offer message, the discovery  
25 request message, and the session confirmation message may comprise a further parameter indicating a condition for the session. Such a condition may be that the service device has to provide a certain service. Other conditions may be 3GPP specific, such as indications of handover or PDN type.

- 30 Preferably, the WLAN network is a trusted WLAN network (TWAN).

Also, the non-3GPP network may not be a WLAN-network. E.g., it may be a CDMA, WiFi network, or any other network type being capable of transmitting packet data.

Names of network elements, protocols, and methods are based on current standards. In other versions or other technologies, the names of these network elements and/or protocols and/or methods may be different, as long as they provide a corresponding functionality.

If not otherwise stated or otherwise made clear from the context, the statement that two entities are different means that they are differently addressed. It does not necessarily mean that they are based on different hardware. That is, each of the entities described in the present description may be based on a different hardware, or some or all of the entities may be based on the same hardware.

A terminal or a user equipment may be a mobile phone, a smart phone, a PDA, a laptop or any other terminal which may be attached to networks of the respective technologies such as 3GPP and WLAN. In particular, in some embodiments, the terminal or user equipment may be able to connect simultaneously to both technologies such as to 3GPP network and to WLAN.

According to the above description, it should thus be apparent that exemplary embodiments of the present invention provide, for example a storage means, or a component thereof, an apparatus embodying the same, a method for controlling and/or operating the same, and computer program(s) controlling and/or operating the same as well as mediums carrying such computer program(s) and forming computer program product(s). Furthermore, it should thus be apparent that exemplary embodiments of the present invention provide, for example a partitioner, or a component thereof, an apparatus embodying the same, a method for controlling and/or operating the same, and computer program(s) controlling and/or operating the same as well as mediums carrying such computer program(s) and forming computer program product(s).

Implementations of any of the above described blocks, apparatuses, systems, techniques or methods include, as non limiting examples, implementations as hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

It is to be understood that what is described above is what is presently considered the preferred embodiments of the present invention. However, it should be noted that the

description of the preferred embodiments is given by way of example only and that various modifications may be made without departing from the scope of the invention as defined by the appended claims.



**Claims:**

## 1. Apparatus, comprising

session trigger means adapted to trigger an establishment of an endpoint of a session with a service device identified by a selected access point name through a packet network if at least one of a discovery offer message and a session confirmation message comprises the selected access point name; and at least one of a first, second, and third combination, wherein

the first combination comprises a discovery initiation means and an offer checking means;

the second combination comprises the discovery initiation means and a confirmation checking means; and

the third combination comprises a discovery request means and the confirmation checking means; wherein

the discovery initiation means is adapted to broadcast a discovery initiation message into the packet network, wherein the discovery initiation message comprises a requested access point name or a wildcard;

the discovery request means is adapted to provide a discovery request message to the packet network, wherein the discovery request message comprises the requested access point name or the wildcard;

the offer checking means is adapted to check if a discovery offer message received in response to the discovery initiation message comprises the selected access point name; and

the confirmation checking means is adapted to check if a session confirmation message received in response to the discovery request message and/or based on the discovery initiation message, respectively, comprises the selected access point name.

2. The apparatus according to claim 1, wherein the respective one of the discovery initiation message and the discovery request message comprises a further parameter indicating a condition for the session to the service device; and the apparatus further comprises

parameter checking means adapted to check if the respective one of the discovery offer message and the session confirmation message comprises the further parameter; and

preventing means adapted to prevent the establishment of the session if none of the discovery offer message and the session confirmation message comprises the further parameter.

- 5 3. The apparatus according to claim 2, wherein the further parameter is a service indication of a service, and the apparatus further comprises
- service determining means adapted to determine if the respective at least one of the session-confirmation message and the discovery offer message comprises the service indication;
- 10 service invocation means adapted to invoke the service in the session.
4. The apparatus according to any of claims 2 and 3, wherein the further parameter is specified according to a third generation partnership project specification.
- 15 5. The apparatus according to any of claims 1 to 4, wherein at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message is based on a point-to-point over ethernet protocol, and/or
- the session is a session of the point-to-point over ethernet protocol.
- 20 6. The apparatus according to any of claims 1 to 5, wherein at least one of the selected access point name and the respective one of the requested access point name and the wildcard is comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-
- 25 confirmation message; and/or – if dependent on claim 2 - the further parameter is comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.
- 30 7. The apparatus according to any of claims 1 to 6, further comprising
- attaching means adapted to attach the apparatus to a third generation partnership project network; and/or wherein
- the packet network is a wireless local area network.
- 35 8. User equipment comprising an apparatus according to any of claims 1 to 7.

9. Apparatus, comprising at least one a first combination, a second combination, a third combination and a fourth combination, wherein

the first combination comprises an initiation checking means, a tunnel determining means, and an offer means;

5 the second combination comprises the initiation checking means, the tunnel determining means, and a confirmation means;

the third combination comprises the initiation checking means, an establishment checking means, and the confirmation means; and

10 the fourth combination comprises a request checking means, the establishment checking means, and the confirmation checking means; wherein

the initiation checking means is adapted to check if a discovery initiation message received from a user equipment comprises a requested access point name or a wildcard;

15 the tunnel determining means is adapted to determine if a tunnel for a packet transmission to a service device identified by a selected access point name can be established through the apparatus, wherein the selected access point name is based on a respective one of the requested access point name and a scope of the wildcard;

the offer means is adapted to provide a discovery offer message comprising the selected access point name to the user device if it is determined that the tunnel can be established;

20 the request checking means is adapted to check if a discovery request message received from the user equipment comprises the requested access point name or the wildcard;

the establishment checking means is adapted to check if the tunnel to the service device through the apparatus is established; and

25 the confirmation means is adapted to provide a session confirmation message comprising the selected access point name to the user device if the tunnel is established.

10. The apparatus according to claim 9, wherein

30 at least one of the request checking means and the initiation checking means is additionally adapted to check if the respective one of the discovery request message and the discovery initiation message comprises a further parameter indicating a condition for the session; and the apparatus further comprises

condition determining means adapted to determine if the condition can be fulfilled in the session; wherein

the respective one of the confirmation means and the offer means is adapted to provide the further parameter in the session-confirmation message and the discovery offer message, respectively, if it is determined that the condition can be fulfilled in the session.

5 11. The apparatus according to claim 10, wherein the further parameter is an indication of a service to be provided by the service device.

12. The apparatus according to any of claims 10 and 11, wherein the further parameter is specified according to a third generation partnership project specification.

10

13. The apparatus according to any of claims 9 to 12, further comprising  
selecting means adapted to select the selected access point name based on the respective one of the requested access point name and the scope of the wildcard.

15 14. The apparatus according to any of claims 9 to 13, wherein at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message is based on a point-to-point over ethernet protocol, and/or  
the session is a session of the point-to-point over ethernet protocol.

20

15. The apparatus according to any of claims 9 to 14, wherein at least one of the selected access point name and the respective one of the requested access point name and the wildcard is comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or – if dependent on claim 10 - the further parameter is  
25 comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

30 16. The apparatus according to any of claims 9 to 15, wherein the apparatus belongs to a wireless local area network, and the user equipment belongs to a third generation partnership project network.

17. Wireless local area network comprising an apparatus according to any of claims 9 to  
35 16.

## 18. System, comprising

a user apparatus according to any of claims 1 to 7;

a network apparatus according to any of claims 9 to 16; wherein at least one of

the discovery initiation message received by the network apparatus comprises the

discovery initiation message broadcast by the user apparatus; and

the recovery request message received by the network apparatus comprises the discovery request message provided by the user apparatus; and wherein at least one of

the offer message received by the user apparatus comprises the offer message provided by the network apparatus;

and

the session confirmation message received by the user apparatus comprises the session confirmation message provided by the network apparatus.

## 19. Method, comprising

triggering an establishment of an endpoint of a session with a service device identified by a selected access point name through a packet network if at least one of a discovery offer message and a session confirmation message comprises the selected access point name; and at least one of a first, second, and third combination, wherein

the first combination comprises a discovery initiation and an offer checking;

the second combination comprises the discovery initiation and a confirmation checking; and

the third combination comprises a discovery request and the confirmation checking; wherein

the discovery initiation comprises broadcasting a discovery initiation message into the packet network, wherein the discovery initiation message comprises a requested access point name or a wildcard;

the discovery request comprises providing a discovery request message to the packet network, wherein the discovery request message comprises the requested access point name or the wildcard;

the offer checking comprises checking if a discovery offer message received in response to the discovery initiation message comprises the selected access point name; and

the confirmation checking comprises checking if a session confirmation message received in response to the discovery request message and/or based on the discovery initiation message, respectively, comprises the selected access point name.

20. The method according to claim 19, wherein the respective one of the discovery initiation message and the discovery request message comprises a further parameter indicating a condition for the session to the service device; and the method further comprises

5           checking if the respective one of the discovery offer message and the session confirmation message comprises the further parameter; and

          preventing the establishment of the session if none of the discovery offer message and the session confirmation message comprises the further parameter.

10   21. The method according to claim 20, wherein the further parameter is a service indication of a service, and the method further comprises

          determining if the respective at least one of the session-confirmation message and the discovery offer message comprises the service indication;

          invoking the service in the session.

15   22. The method according to any of claims 20 and 21, wherein the further parameter is specified according to a third generation partnership project specification.

23. The method according to any of claims 19 to 22, wherein at least one of the respective  
20   ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message is based on a point-to-point over ethernet protocol, and/or

          the session is a session of the point-to-point over ethernet protocol.

25   24. The method according to any of claims 19 to 23, wherein at least one of the selected access point name and the respective one of the requested access point name and the wildcard is comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or – if dependent on claim 20 - the further parameter is  
30   comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

25. The method according to any of claims 19 to 24, further comprising

35           attaching an apparatus performing the method to a third generation partnership project network; and/or wherein

the packet network is a wireless local area network.

26. Method, comprising at least one a first combination, a second combination, a third combination and a fourth combination, wherein

5 the first combination comprises an initiation checking, a tunnel determining, and an offer;

the second combination comprises the initiation checking, the tunnel determining, and a confirmation;

10 the third combination comprises the initiation checking, an establishment checking, and the confirmation; and

the fourth combination comprises a request checking, the establishment checking, and the confirmation checking; wherein

the initiation checking comprises checking if a discovery initiation message received from a user equipment comprises a requested access point name or a wildcard;

15 the tunnel determining comprises determining if a tunnel for a packet transmission to a service device identified by a selected access point name can be established through an apparatus performing the method, wherein the selected access point name is based on a respective one of the requested access point name and a scope of the wildcard;

20 the offer comprises providing a discovery offer message comprising the selected access point name to the user device if it is determined that the tunnel can be established;

the request checking comprises checking if a discovery request message received from the user equipment comprises the requested access point name or the wildcard;

the establishment checking comprises checking if the tunnel to the service device through the apparatus is established; and

25 the confirmation comprises providing a session confirmation message comprising the selected access point name to the user device if the tunnel is established.

27. The method according to claim 26, wherein

30 at least one of the request checking and the initiation checking comprises additionally

checking if the respective one of the discovery request message and the discovery initiation message comprises a further parameter indicating a condition for the session; and the method further comprises

determining if the condition can be fulfilled in the session; wherein

the respective one of the confirmation and the offer is adapted to provide the further parameter in the session-confirmation message and the discovery offer message, respectively, if it is determined that the condition can be fulfilled in the session.

- 5     28. The method according to claim 27, wherein the further parameter is an indication of a service to be provided by the service device.

29. The method according to any of claims 27 and 28, wherein the further parameter is specified according to a third generation partnership project specification.

10

30. The method according to any of claims 26 to 29, further comprising  
selecting the selected access point name based on the respective one of the requested access point name and the scope of the wildcard.

- 15     31. The method according to any of claims 26 to 30, wherein at least one of the respective ones of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message is based on a point-to-point over ethernet protocol, and/or  
the session is a session of the point-to-point over ethernet protocol.

20

32. The method according to any of claims 26 to 31, wherein at least one of the selected access point name and the respective one of the requested access point name and the wildcard is comprised as a first tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message; and/or – if dependent on claim 27 - the further parameter is comprised as a second tag in the respective one of the discovery initiation message, the discovery offer message, the discovery request message, and the session-confirmation message.

25

- 30     33. The method according to any of claims 26 to 32, wherein the method belongs to a wireless local area network, and the user equipment belongs to a third generation partnership project network.

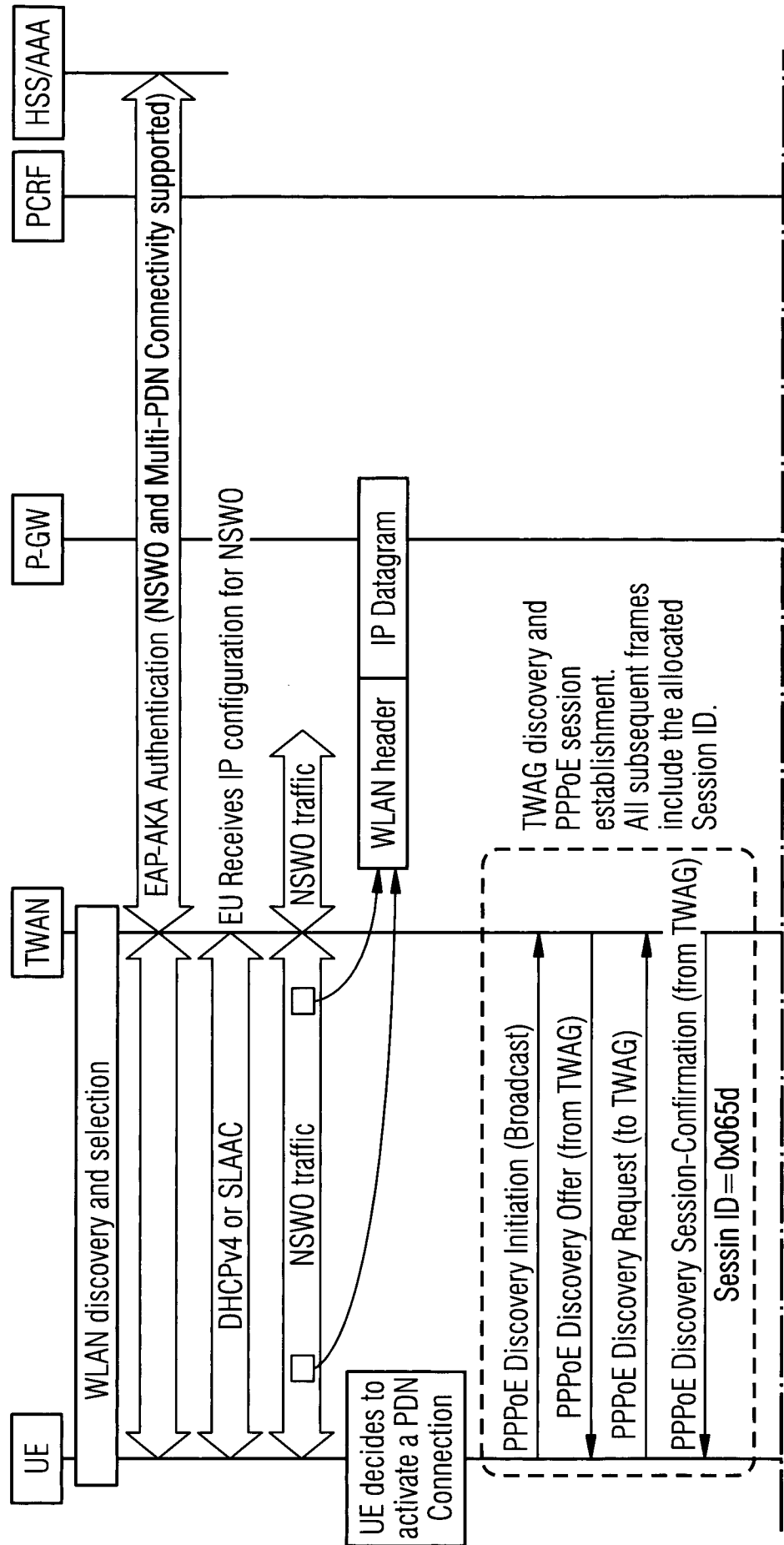


34. A computer program product comprising a set of instructions which, when executed on an apparatus, is configured to cause the apparatus to carry out the method according to any one of claims 19 to 33.

- 5 35. The computer program product according to claim 34, embodied as a computer-readable medium.

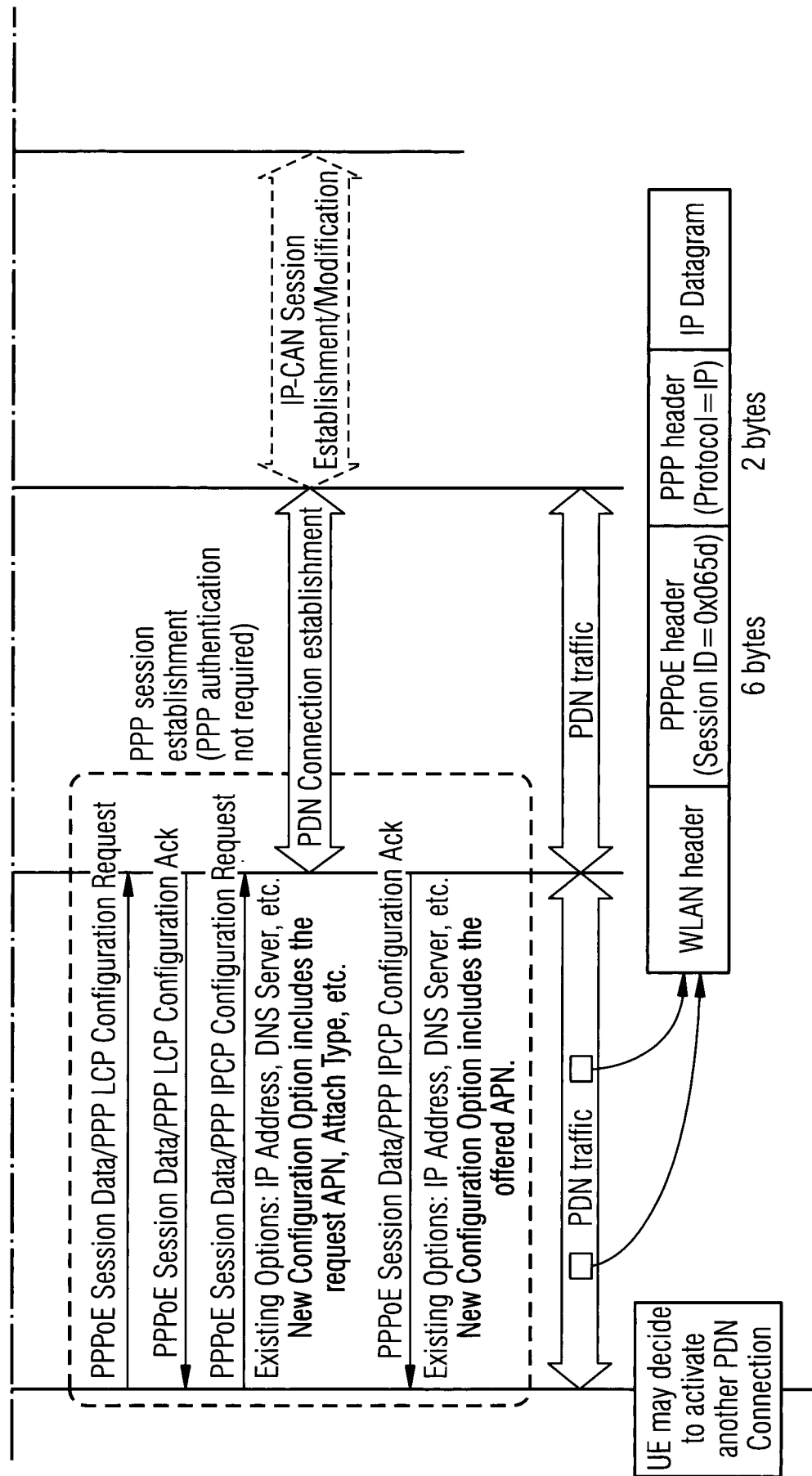
FIG 1  
FIG 1A  
FIG 1B

FIG 1A



2/5

FIG 1B



3/5

FIG 2a

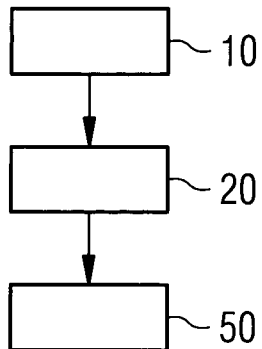


FIG 2b

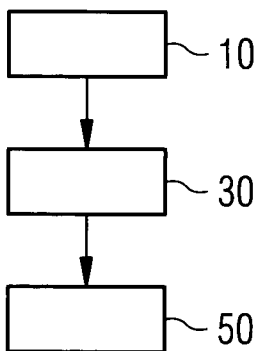


FIG 2c

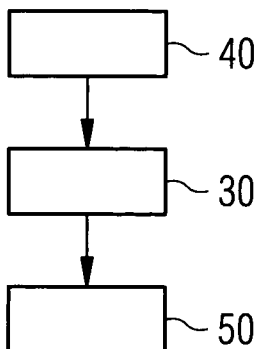


FIG 3a

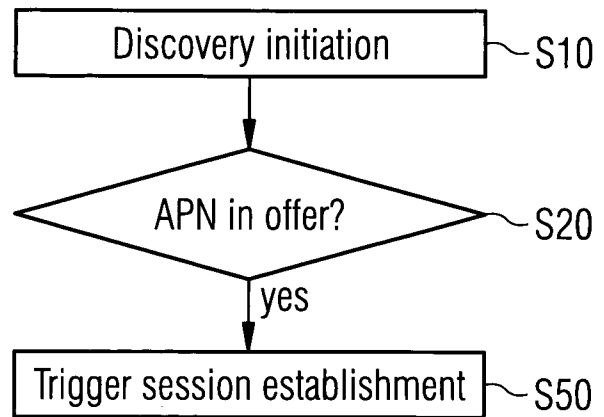


FIG 3b

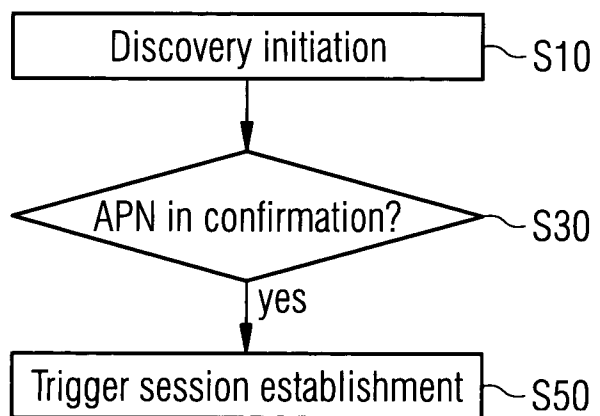
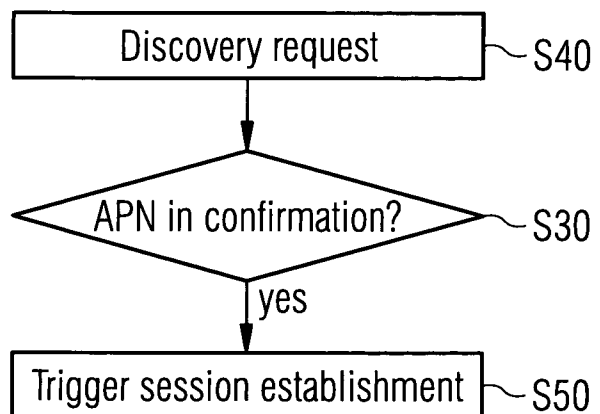


FIG 3c



4/5

FIG 4a

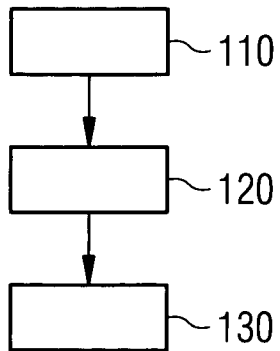


FIG 4b

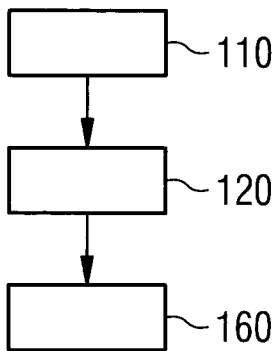


FIG 4c

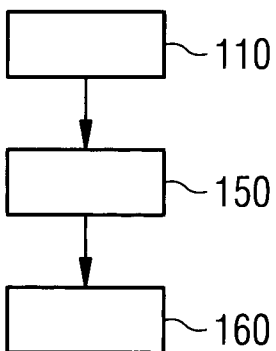


FIG 5a

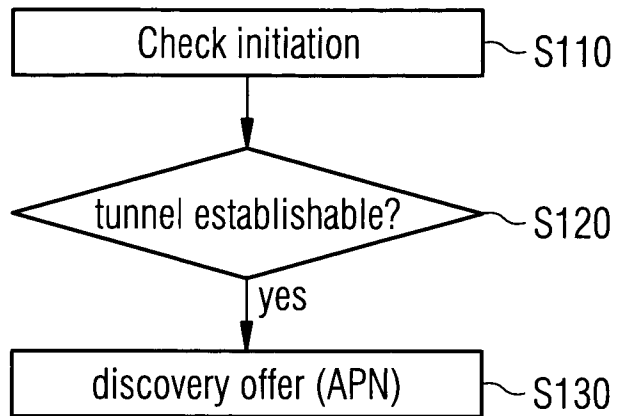


FIG 5b

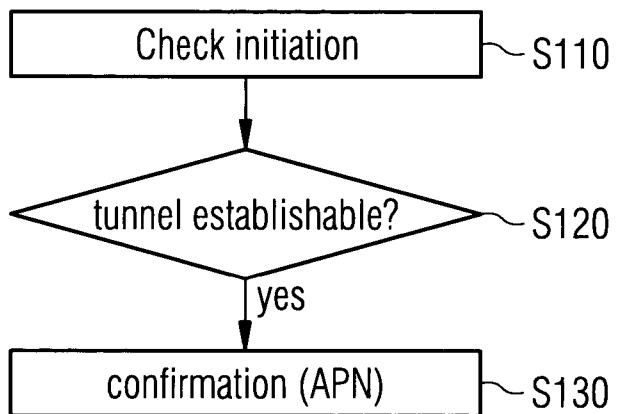
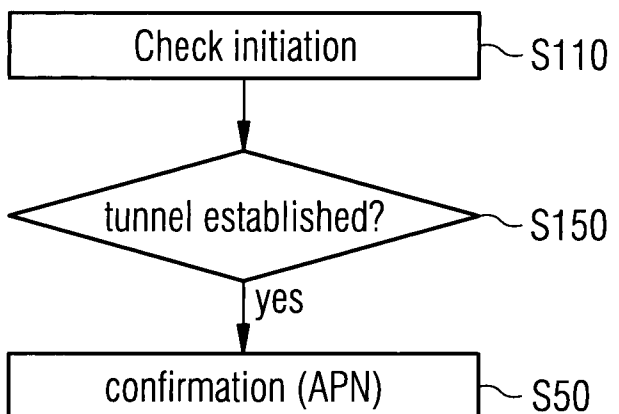


FIG 5c



5/5

FIG 4d

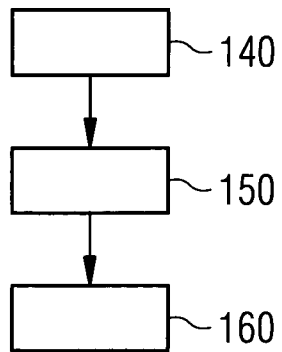
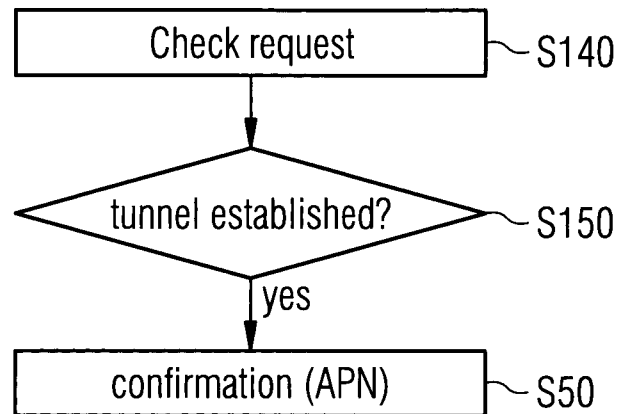


FIG 5d



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2013/051050

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H04W76/02 H04W76/04  
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on S2a Mobility based On GTP &amp; WLAN access to EPC (SaMOG); Stage 2 (Release 12)", 3GPP DRAFT; 23852-130 RM, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE</p> <p>, 26 November 2012 (2012-11-26), XP050682717, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_sa/WG2_Arch/Latest_SA2_Specs/Latest_draft_S2_Specs/[retrieved on 2012-11-26] cited in the application Section 8.1 "Requirements"</p> <p style="text-align: right;">-/--</p>	1-35



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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# INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>Section 8.1A "Key Issues"; pages 41,42 Section 8.2.7 "Solution 7: PPP over Ethernet (PPPoE)"; pages 104-109</p> <p>-----</p> <p>MAMAKOS K LIDL J EVARTS UUNET TECHNOLOGIES L ET AL: "A Method for Transmitting PPP Over Ethernet (PPPoE); rfc2516.txt", 19990201, 1 February 1999 (1999-02-01), XP015008299, ISSN: 0000-0003 cited in the application Section 5 "Discovery Stage"; pages 4-7</p> <p>-----</p>	1-35
A	<p>"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Architecture enhancements for non-3GPP accesses (Release 11)", 3GPP STANDARD; 3GPP TS 23.402, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), PAGES 1-31 AND 214-233, vol. SA WG2, no. V11.5.0, 18 December 2012 (2012-12-18), XP002714832, [retrieved on 2012-12-18] cited in the application Section 13.4 "Handling of Wild Card APN"; page 214 Section 16 "Architecture, Functional description and Procedures for GTP and PMIPv6 based S2a over Trusted WLAN Access"; pages 216-233</p> <p>-----</p>	1-35
T	<p>NOKIA SIEMENS NETWORKS ET AL: "Enhancement for Solution based on PPP/PPPoE", 3GPP DRAFT; S2-130236 (SAMOG_PPPOE)V1, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE ; vol. SA WG2, no. Prague, Czech Republic; 20130128 - 20130201 22 January 2013 (2013-01-22), XP050684786, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_95_Prague/Docs/ [retrieved on 2013-01-22] the whole document</p> <p>-----</p>	