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Simplified Handover Procedure for Seamless Roaming Across 4G Heterogeneous Networks

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Abstract: This paper presents a simplified handover procedure (SHP) which enables the users to freely and securely move across different network architectures. The user does not require any additional permission for roaming. Seamless roaming across different access systems in a multi-operator environment with different facilities is made possible by this approach. The proposed SHP demonstrates seamless roaming, network provisioning, mobility and security context transfer between existing networks. The SHP contains three different entities to ensure seamless roaming across different networks. Signaling agent (SA) which act as a gateway between different network systems in the interworking. The SA can be implemented as a separate entity or integrated with existing networks. The link agent (LA) is an intermediate agent for interconnecting access networks of different independent operators. It is an independent entity located outside the 3GPP core network and can be deployed by network operators and providers. The processing agent (PA) handles the handover effectively.

Keywords: seamless roaming, security, handover control, mobility

I. INTRODUCTION

This architecture takes into account the different contractual relationships between operators while designing the interworking & roaming among different access systems. The WiMAX/WLAN access network can be owned by a mobile operator or by a internet service provider. In a multi-operator environment, different interworking/roaming scenarios can co-exist[1]. A mobile operator can deploy WLAN and WiMAX access technologies as an extension of its 3GPP network to best utilize its existing infrastructure and best serve its subscribers. In this case, in order to facilitate the inter-system mobility, the operator can implement SHP for each non-3GPP access network separately.

A. SHP architecture:

SHP architecture allows the mobility between operators that have no direct specified link.. The inter-system mobility is achieved through the signaling agent. Connecting the signaling and link agent to the processing agent the particular access system can achieve the roaming to any other network using the SHP processing agent. In the global interworking and roaming architecture, the coordination between two interconnected networks is based on information ex changed between SHP. Providing the required information between the networking components related to handover and roaming is done by the link agent. The details of such relation will be presented through the handover procedure.

B. Handover control:

The SA is responsible for preparing the handover by triggering the network selection. The request based on the information from the user the target access network is selected. Assigning the connection setup information for a handover is provided by link agent. It makes the handover decision and notifies the handover to the user. The intersystem mobility is managed by processing agent. The signaling agent act as a replacement for the new network parameters.

There is no need to implement the new connection TCP component if it has already deployed within the same administrative domain. In addition to above functionalities, the signaling agent of a global network contains the operator database which stores the details.

C. Authentication:

In addition, the processing agent can manage and communicate the user's security context information like authentication details, user identity, authorization certificates for the roaming and inter-system handover preparation. It is in charge of authenticating and authorizing users based on subscriber profiles retrieved from the subscriber. The processing agent plays the mediator role between the roaming establishment and for the mobility context transfer. It optimizes the handover latency caused by the re-authentication procedure.

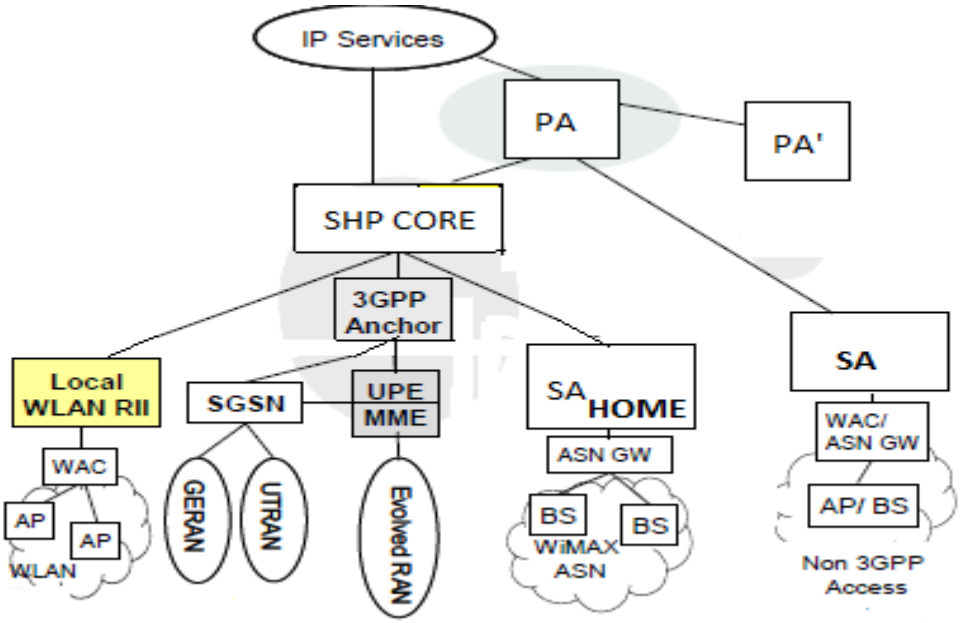
II. DESTINATION NETWORK

The SA provides the provisioning information to serving users. Once the LA receives a list of possible target networks from the PA during the handover preparation, the LA communicates with the SA to eliminate undesirable access networks. The PA stores and manages the presence information of users which describes how to reach them. The presence information specifies the serving access network, the present location of users. Whenever a user roams to a different access network, at the end of the handover procedure, the user's presence information is updated in the processing agent.

III. HANDOVER MANAGEMENT

The proposed architecture allows users to roam among different access systems while maintaining on-going

communication sessions. When user equipment moves within WLAN/WiMAX systems or within 3GPP access systems, the handover will be managed by the signaling agent easily[2]. When the handover occurs between two different access technologies or two different operator domains, the procedure will depend on their relationship and the specific need of the user.



PA-PROCESSINGAGENT
SA-SIGNALLINGAGNET
PA'-DESTINAITON(PA)

Figure 3.1 Architecture of SHP

Figure 3.1 show s the architecture of SHP. During the communication, the serving agent sends the provisioning information to the user to indicate the radio information of available neighboring cells. Such information helps the user to synchronize with the neighboring cells and to monitor their signal strength. The networking component of the serving/home SHP can provide the user information such as preferable or undesirable access networks.

A. Destination network selection:

The user equipment selects preferred available access networks for the measurement purpose. The user measures their link quality and send the measurement report to the network either periodically or event-based. The user equipment can also perform the scanning to discover new available access networks. The handover can be initiated by the terminal or the network [3]. An inter-system handover is triggered when *the* coverage of the same access system is not available. The user specific handover can be initiated when the current system is heavily loaded or the current system cannot satisfy user requirements. Once the vertical handover is initiated, the serving SHP will perform the handover preparation. It checks whether the candidate target access network can support the imminent handover and performing the resource reservation in advance.

B. Handover request:

The handover preparation request message including possible target networks and the required QoS is sent to the serving SHP. The request is then routed to the indicated target through link agent. If the target network can allocate resources successfully then the target SHP will return a acknowledgement message through its link agent. This message includes connection setup information[4]. The serving SHP sends the user a message which includes recommended target network associated with their corresponding connection setup information. The serving SHP may select one target network preferences, and send information about target cell. The user receives a list of recommended entities from the target SHP and it will select a suitable one and send acceptance message through link agent.

Upon receiving the indication from the user equipment the target network SHP will send a notification to the user processing for traffic redirection. Also the serving SHP sends the user's security context to the target SHP to support the fast authentication. Transferring the existing context from the serving network to the target network and reusing it with necessary adaptation ensures full security. It reduces the handover latency which is significant in a roaming scenario between independent operators.

IV. COMPARISON

A. Seamless handover:

Most of existing solutions have focused on the authentication, authorization and billing when users move outside their subscribed network and connect to a visited network. These solutions care more about guaranteeing the access in the visited network rather than maintaining on-going communications. Despite much research effort has been done in designing the interworking solution between WLAN/WiMAX and 3GPP cellular networks, there is no solution for handover between two access systems of two independent operators[5]. One of the main advantages of the SHP based architecture is to enable the handover across different access systems without need of pre-existing

agreement between operators. Compared to existing tight-coupling schemes, the SHP based interworking does not require many changes to access system architectures. Compared to existing loose-coupling solutions, the RII-based architecture supports make-before-break mobility even between access systems of two independent operators.

B. Security:

The SHP provides a secure mechanism for exchanging handover signaling among different access systems. The signaling exchanges between the SHP entities secure roaming agreement and billing control over the established network in an automatic manner. The roaming is completely transparent to users. The security context is transferred from the serving access network to the target access network to enable the fast re-authentication.

C. Scalability:

Systems deployed by the same operator or different operators that may not necessarily have direct connection among them. The SHP can be employed in a hierarchical structure to integrate heterogeneous access networks. The interconnect first tier SHPs with the second level SHPs enables the global roaming. By establishing a connection with the global SHP an operator can provide global roaming service to any other operators that connect to this global SHP Therefore, the wireless system interoperability using SHP is scalable and flexible.

D. Economical:

Though the solution is in line with the 3GPP LTE architecture, it does not preclude the implementation of SHPs in the current network environment for integration among 2G/3G and WLAN systems. The solution is feasible and economical since it does not require many changes in the existing network infrastructure. An operator who wants to benefit from interworking and roaming facilities only needs to implement the local/core SHP functionalities in its access gateway. With the adoption of the proposed SHP architecture, the network availability will be widely extended. First, users will have great interest since they can connect to any available access network. Second, the network infrastructure utilization will increase, which will give opportunities to operators to improve their profitability.

V. CONCLUSION

The proposed simplified handover procedure provides a way for effective seamless roaming across various 4G networks. It can provide mobility across networks which are not connected. To maintain better connection quality it utilizes the user collected information. The security aspects are also taken into account by processing agent by transferring the existing context information from the serving network to the target network. The SHP can be implemented in the existing network environment itself.

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