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Zero Down 24*n Mobile Network Connectivity

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Abstract— Today, lots of connectivity problem in wireless mobile communication are due to weak signal strength. To overcome this problem a novel idea of utilizing and enabling the service mobility between heterogeneous mobile service providers has been explored. The basic idea behind the work is to make the heterogeneous providers to work together and to establish and extend the connection in a spontaneous fashion, without making pre-established roaming agreements. At present roaming agreements are set manually between the providers, but it is costly and time-consuming process. The idea is when the user moves out of the home coverage area or when the signal gets down in a mobile terminal even when the mobile terminal is not in use, the connections have to be extended to provide 100 % connectivity to the user by the available foreign network which eliminates the problem of "not reachable" condition in mobile network. So for, the related works focuses on extension of connectivity only while the call is in progress. But this paper fully concentrate on 24 hrs * N days connectivity whether the user call is on or off progress by proposing a model called the PAC(Pre-Authenticated Connection) and it is designed by using HFNF(High Frequency network first)technique which establish roaming agreements directly between operators before the connection is disconnected. This architecture ensures the connectivity except in the case of power loss. In future we plan to extend the connectivity even in power loss by balancing the power in spine hierarchy.

Keywords— PAC, HFNF, CTRESH, DTRESH, Handoff.

I. INTRODUCTION

The GSM systems have the ability to make and receive phone calls to and from other networks. For the consumers to get the desired service and high coverage the different network agent can join together to give the desired service. At present different network agent join together via static roaming procedure which is said in [21,22]. As pre-roaming agreements can't be established with all possible provider the users will be disconnected if service is unavailable in home network. To overcome the above problem, "instant agreement" for roaming between different various network agent is proposed so that the users can get services from multiple network agent. To overcome the same issue PAC mechanism is proposed to establish the connection before the pervious connection with home network gets disconnected. This paper address the ability to decide correctly the time to call PAC mechanism based on the strength of signal. This work also proposes a architecture with a modification in an physical layer of OSI model with Pre authentication connection module which establish an instant connection with foreign network. Knowledge based mechanisms are proposed to establish spontaneous roaming agreements.

This proposed architecture consists of knowledge based system with the databases that hold profile, intersystem handover control rules and the network management system. Based on this mechanism a Fuzzy-Based algorithm is designed which identifies the correct time to do the handover to the other foreign network to extend the service dynamically. The supportive idea of this work is presented in section 2.The architecture of proposed PAC mechanism is described in section 3.The open trust model is explained in section 4.The detailed working procedure and handoff is explained in section 5. Algorithm for rules and negotiation is explained in section 6.Section 7 explains about handoff initiation procedure. Section 8 explains about handoff monitoring procedure. Section 9 concludes the concept with future idea.

II. BACKGROUND AND RELATED WORK

The service portability across network boundaries has been dealt in detail in Reference [1] and the same concept in the virtual Home Environment [2],[3],[4],[5] has been described by emulating the behavior of the user home network. Reference [6] describes the access to mobile services over unlicensed network.UMA helps to perform handover between different wireless networks with the help of dual-mode handsets. The concept of Application-Layer Mobility is introduced by Schulzrinne [7] and Wedlund [8]. The roaming problem regarding network integration is described in Reference [9]. AMBIENT provide a way for devices to connect to each other via any network, through the instant agreements. To reduce scanning time Reference [10] is described and to reduce handover delay time reference [11,12] is used and [13,14] reduce the authentication delay during handover. All the above described mechanism does not or very weakly consider the weak signal strength problem, which requires a need of the solution. This paper provides a PAC (Pre Authentication Connection) model based on HFNF (High Frequency Network First) mechanism.

III. ARCHITECTURAL DESIGN OF PAC(PRE AUTHENTICATION CONNECTION) MECHANISM

To enable instant connection with foreign network, the new PAC module is designed and it is illustrated in the following fig 1. In the architecture a new module named pre-authentication connection is introduced which is used to establish connection before the connection between the two host gets disconnected.

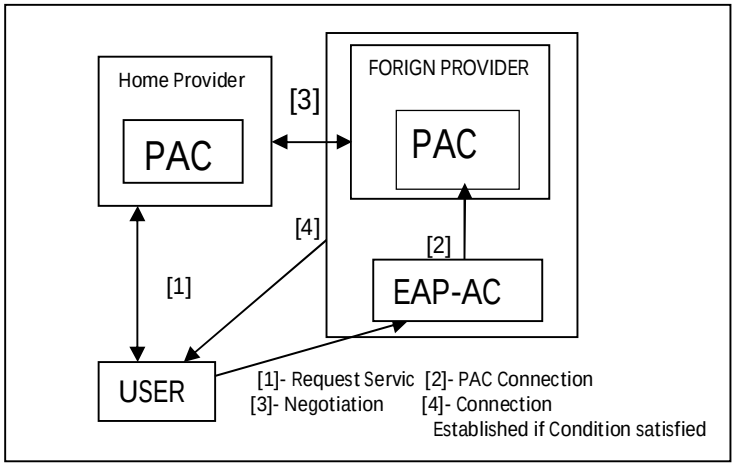

Fig.1. Pre-Authentication Connection with Partnership Negotiation

When the signal strength falls below the level, the EAP-AC passes the request of service to foreign network server. Once when the foreign network server identifies that the request is not from home network, the first level basic trust is established using the network id and as the second stage negotiation is done for instant connection.

IV. TRUST ESTABLISHMENT BETWEEN PROVIDERS – OPEN TRUST MODELS

For immediate, on-demand services, basic trust must be established between the providers before the start of the negotiation procedure .The trust models is used between two providers to establish trust between them to perform negotiation at the faster rate. If one network receives an request from unknown network for the usage of its service, the beginning level basic trust is established between the providers before the start of negotiation procedure. Here the network Id is enough to establish trust between the providers, as every network posses individual Id while establishing the network infrastructure. Once basic trust is established other negotiation is done in advance before the connection with home network is disconnected. In other words the providers exchange roaming agreement dynamically for settlement procedure, processes, agreement suspension and termination, airtime charges, wholesale rate, and other required features [24] .The novelty in this trust establishment is the use of network ID to identify the network provider.

V. WORKING PAC MECHANISM FOR INSTANT CONNECTION

A . Mobile Information Service and PAC

In Mobile device when signal gets weak while the call is in progress or the call is not in progress, the neighboring available network is to be identified and communicated to optimize the handover. The information of nearby networks is obtained by MIS using query-response mechanisms. The MIS information is used to make the decision for handover at appropriate time. Using this information intelligent handover decisions is done. The MIS represents information by standard XML (Extended Markup Language) format. MIS discovers information regarding all neighboring networks and exchanges information regarding network id to establish basic trust in HFNF basis .

Once the base trust is established with a neighboring providers, the other providers will be in FIFO stack. Before making negotiation with target provider to establish spontaneous connection, the foreign provider will check whether the home provider belongs to same list of providers to whom the spontaneous connection is already established earlier. If so then the negotiation is avoided with the home provider and connection is established based on the rules that is accepted in earlier negotiation .This reduces

the time and cost of negotiation and avoids repetition of same work. All this work will be done in advance once the signal falls below the D-thresh hold value, the service can be extended without any delay in time and data loss..

If the home provider is not the member of the foreign provider then negotiates.have to be initiated by Open Trust Model by using network id and negotiation is done between them by instantly framing the rules as needed to establish spontaneous connection with two network providers. The connection will be established before the connection gets disconnected because of poor signal. Up to this level the spontaneous connection is established but handoff doesn't take place. The hand off will occur only when needed, even though the pre-connection is established between the network. The hand off decision is done by fuzzy algorithm.

B. Handoff Types

The Handoff mechanism keeps the connection of MT active even when the signal strength gets weaker by changing the coverage area of one network attachment point to another. Here this work uses vertical handoff since handover is done between different network providers depending on received signal strength (RSS) .Handoffs can also be classified as soft or hard handoff. In soft handoff or a *make before break* handoff MT establish the new connection with the target point before the old connection gets dropped. The proposed work inherits the soft handoff concept since it establishes pre connection with the foreign provider before the old connection with the home network gets dropped.

C. Handoff Algorithm Features

An efficient handoff algorithm that is used must be fast so that the user must not experience low quality in their service by interruption. When the signal falls below the thresh value and no handoff is done, user may feel poor quality of service. A handoff algorithm must be efficient to make correct decision while calling handoff procedure. The user must feel the good quality of service after handoff procedure is initiated.

D. Handoff Process

The handoff process consists of 5 stages. 1. Network discovery, 2.Pre-Authenticated connection, 3.Handoff decision, and 4.Handoff execution 5. Handoff monitoring

- Network Discovery- The work of network discovery is to identify or search all the available reachable service broadcasted by different network providers. This process is always active all time even when no packets is transferred .This is because only then pre connection can be established when the signal of active network falls below the thresh value. This task is done and active spontaneous connection is established and the handoff will be done only when needed.

- Pre-Authentication Connection -Once the reachable network is discovered it is maintained in the stack in the High Frequency First order. In FIFO manner basic trust is established between the home network and foreign network. Once after basic trust is established, negotiation is performed between the providers and if negotiation succeeds connection is established else negotiation is done with the other network in the stack.

- Handoff Decision and Mechanism- Handoff is the technique of transferring the service from one coverage area to another coverage area. This transferring must be done only when the signal strength falls bellow and affects the quality of service. The calling of handoff procedure is invoked based on the signal strength of active network. The mechanism for handoff must present in the mobile terminal. In this type, the handoff time is of 0.1 sec. The Mobile searches all the available networks and measures the signal strengths from surrounding BSs and makes the evaluations to makes Pre Authentication connection.

- Handoff execution-The handoff procedure will be executed only when SNR is less then D Thresh value. If SNR is less then C Thresh value pre-connection is established with foreign network and communication between the networks will not be disconnected until SNR falls below the D thresh value. The handoff procedure will be invoked only when SNR value is less then D thresh value.

- Handoff Monitoring-The monitoring module will be present in both home network and foreign network. Once when the handoff execution procedure is invoked then monitoring also will be activated to monitor the signal strength of home network periodically

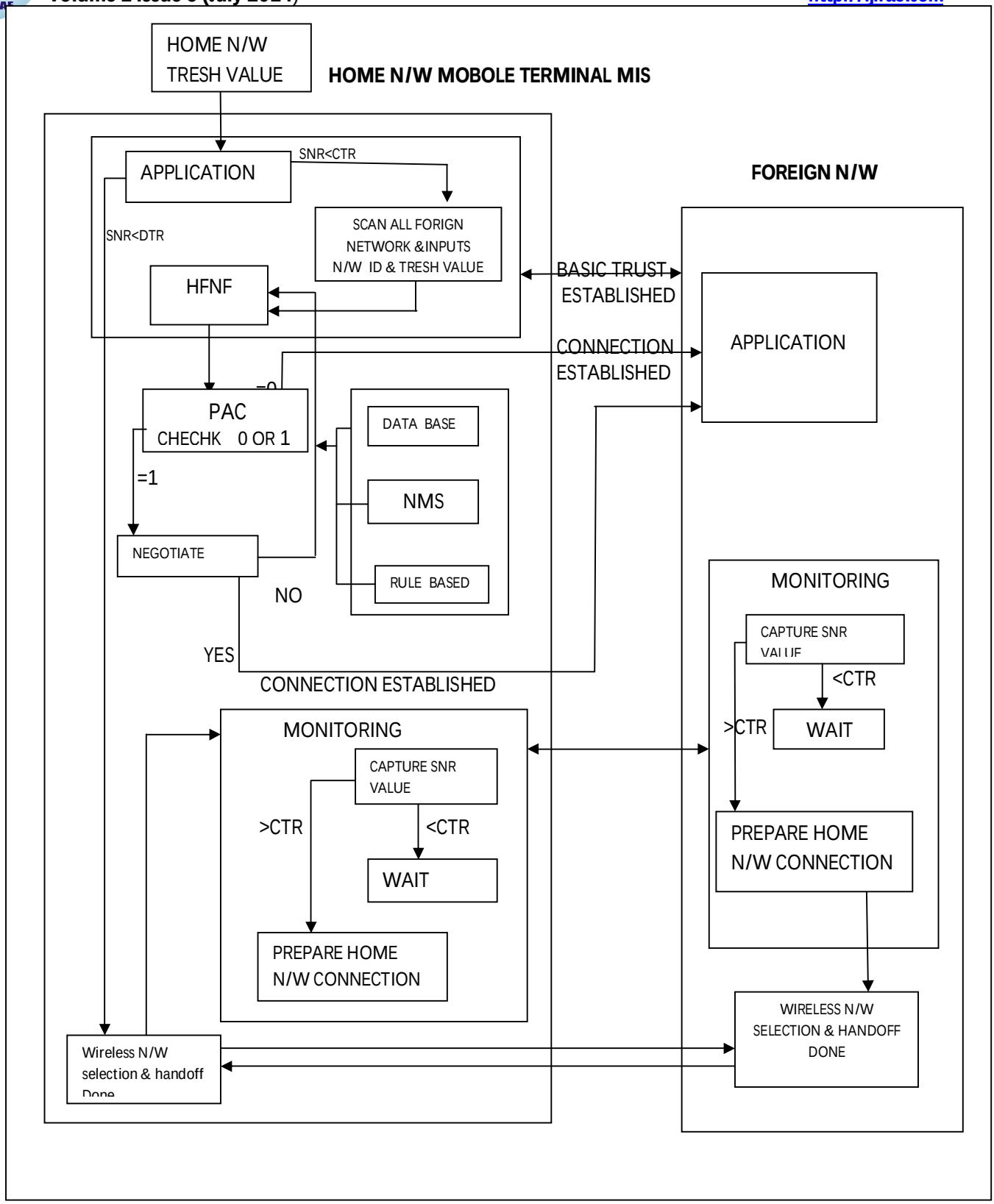

Fig.2. PAC and Monitoring System

VI. ALGORITHM FOR NEGOTIATION.

The Negotiation algorithm is used only after basic trust is established with the high frequency networks. Once the basic level trust is established with the strongest network which is identified by the mobile terminal the negotiation algorithm is invoked for performing negotiation with the foreign network. If negotiation gets succeed pre connection will be established else next high frequency network will taken in to account which available in stack for the negotiation. The process is continued until negotiation gets succeeded. Spontaneous connection is done in 5 stages as discovery, pre-connection, decision, execution and monitoring phases. Execution phase is performed using MIP, the concept of decision making and fuzzy logic is applied while performing pre connection with the foreign network. The algorithm consists of two parts:

- Pre-connection Initiation Algorithm which is present in fuzzy engine establish the connection with the foreign network before the service gets disconnected.
- An algorithm is present to perform negotiation which selects the Network from the available network.

A . Working Of Fuzzy Handoff Decision Algorithm

Only when the unavailability of an old network service is detected the handoff decision function is called. Then the two-part algorithm is executed to perform the handoff from old service to new foreign network. The algorithm consists of the following functional blocks.

- a *IPB* transforms the received signal strength as the inputs
- a *rule base structure block* contains a number of IF-THEN rules;
- a *database block contains the* membership functions which is used the fuzzy rules;
- The decision operation weather to perform negotiation or not are performed by interference engine by using fuzzy rules;
- A OPB performs the operation of displaying the final output.

VII. HANDOFF INITIATION ALGORITHM

The procedure to calculate and select an appropriate time to transfer the present service to other network for extending the service without any detonation in QOS is needed. To perform this, fuzzy concept is used for computing the handoff value which is used to decide whether handoff is needed from UMTS home network to UMTS foreign network. The work consists of two handoff technique. 1.Handoff from home UMTS provider to foreign UMTS provider, and 2. Handoff from foreign UMTS provider to from home UMTS provider

A. Handoff From Home UMTS Provider to Foreign UMTS

In mobile terminal, handoff initiation algorithm is implemented which provide rules for decision making. A MT which is connected to a UMTS network detects a new foreign UMTS network, and calculates the handoff factor to decide whether the MT should perform the handoff operation to the foreign UMTS. For intelligent handoff decision, parameters such as received signal strength is sent as input to establish the basic trust between the networks and then the negotiation procedure is invoked to establish the pre connection .Once after establishing pre connection the handoff initiation algorithm can be called any time to perform the handoff operation to extent the service without affection the service quality. The RSSI and data rate indicate the availability of the target network. The values of the RSSI input parameters are given as input to the initiate algorithm.

The algorithm then transforms the frequency value to pre connection function .The Pre connection function checks the membership of the network in the data base with the set of If-Then rules to identify weather the negotiation is to be initiated or it has already performed. If the network is the member, no negotiation is needed and pre connection can be established immediately else negotiation function must be called to perform the negotiation. Once after establishing pre connection the handoff can be performed any time when needed. If the signal strength falls below the D thresh value the handoff initiation procedure is invoked to perform the handoff from current network service to foreign network.

The variable Handoff Factor is defined from 0 to 1, with the maximum membership of the sets “Higher” and “Lower” at 0 and 1, respectively. The fuzzy rule base contains IF-THEN rules such as:

- IF RSSI is weak, network coverage area is bad, data rate is low, QoS is undesirable, THEN handoff factor is higher
- IF RSSI is medium, network coverage area is medium ,data rate is medium, QoS is acceptable, THEN hand off factor is average and pre-connection is done
- IF RSSI is strong, data rate is high, network coverage area is good, QoS is desirable, THEN handoff factor is lower

The crisp handoff factor computed after defuzzification is used to determine when a handoff and pre-connection is required as follows:

if *handoff factor* < 0.15, then initiate handoff;

if *handoff factor* < 0.60, then initiate Pre connection by negotiation;

if *handoff factor* > 0.60, do nothing;

B. Handoff from Foreign Network To Home Network

When home network extend its service by establishing spontaneous connection with foreign network, the monitoring module which is present in foreign network will Searches for home network signal periodically. If SNR value is above C Thresh, MT switches from foreign UMTS **to** Home UMTS. Two thresholds defined to avoid "Ping-Pong" effect. An exponential moving average of the SNR is used. Only SNR of the Home UMTS is monitored as MT prefers home network because of the short term spontaneous agreement. , we need to have an accurate and timely handoff decision to maintain the connectivity before the loss of service.

VIII. HANDOFF MONITORING

In the work Monitoring module is introduced both in Home and foreign provider which helps the Foreign provider to switch of the guest user to their home network when SNR value is above the C thresh value. The monitoring module will be initiated once the hand off is done with foreign provider. Both the Monitoring module that is present in home and foreign provider will ping pong and communicate each other and exchange the SNR value. The SNR value will be monitored periodically and hand off is initiated based on the C thresh value

IX. CONCLUSION

The PAC and monitoring architecture work together instantly and securely without pre-established formal roaming agreement. Instant and dynamic roaming are established through 2 stage process. In step1 only basic trust and pre-connection is established, handoff is not done. In step 2 handoff is performed only when needed by using fuzzy concepts. Once after initiating handoff monitoring is done to return the service to home network. As a future work power balancing approach using SPINE hierarchy can be adopted to avoid the dropping of connection due to power loss.

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