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Research Article

A Novel Decision Algorithm for Vertical Handoff between UMTS and WiMAX

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Abstract: The benefits brought about by 3G networks such as UMTS, it is increasingly desirable to integrate 3G networks with WiMAX.. WiMAX is used to extend 3G networks at certain locations in order to provide improved services and address QoS issues. To achieve a beneficial vertical handover in a network, an algorithm that departs from the conventional RF based algorithm is necessary. An attempt is made in this study to provide an algorithm which aims to utilize location information stored in a WiMAX coverage database, and the location service entities of UTRAN as defined by 3GPP to determine a valuable/beneficial vertical handover between UMTS and WiMAX. RF based conventional downward vertical handovers can be inefficient and waste of resources. This study aims to correct the lapses associated with conventional RF based vertical handover across heterogeneous network.
Keywords: Vertical handover, UMTS, WiMAX, QoS.

INTRODUCTION

The next generation wireless networks will be characterized by the ability to integrate currently available heterogeneous networks. Network integration will not only bring about the realization of ubiquitous connectivity (anytime, anywhere), it will also achieve the dream of always best connected (ABC) network. This is because these heterogeneous networks are complementary, for example, the universal mobile telecommunications system (UMTS) networks have wide coverage area but with low data rate. On the other hand, worldwide interoperability for microwave access with high data rate suffers from limited coverage area. Only through the technology of network integration will a user derive the best that these networks have to offer at anywhere and at anytime. The glue for the integration of these networks is the process called vertical handoff (VHO). VHO is the seamless transfer of an ongoing user session between different heterogeneous radio access technologies. The success of any Vertical handoff process depends largely on the ability to make accurate and precise decisions about available wireless networks for connection. A considerable number of works have appeared in literature, each proposing techniques for VHO decision. These works have considered different number of decision policies under different scenarios. They used different approaches to demonstrate their solutions. A number of them made many useful contributions; however, there remain some limitations.

A decision for vertical handoff may depend on several issues relating to the current network that the mobile node is already connected to and to the network that it is going to handoff. Vertical handoff decision involves a tradeoff among many handoff metrics, such as network conditions, system performance, application types, power requirements, mobile node conditions, user preferences, security, and cost; that is, quality of service (QoS) parameters. Using these metrics involves the optimization of key parameters (attributes), including signal strength, network coverage area, data rate, service cost, reliability, security, battery power and network latency. These parameters may be of different levels of importance to the vertical handoff decision. The author present the design of a fuzzy logic based vertical handoff initiation scheme involving some key parameters, and the solution of the wireless network selection problem using a fuzzy multiple attribute decision making (FMADM) algorithm. In particular, an optimum access network is selected using a wireless network selection function defined on multiple attributes.

RELATED WORK

Abstract overlay system is a hierarchical architecture that uses large macro cells to overlay clusters of small microcells. Resource management in the overlay system is much more complex than in pure macro cell and microcell systems. A fixed parameter handoff algorithm cannot perform well in a complex and dynamic overlay environment. Author proposes an adaptive overlay handoff algorithm that allows a systematic trade off among the system design parameters and improves the overall system performance[1] However, the RS Salone cannot be used for vertical handoff decisions because of the overlay nature of heterogeneous wireless networks and the different characteristics of the networks involved. A proposal for mobility management in a packet-oriented multi-segment using Mobile IP and fuzzy logic concepts was proposed in [2]. However, the handover management is for vertical hand off between different wide area networks. An integrated analytic hierarchy process and grey relational analysis algorithm for network selection is presented in [3]. The authors propose a policy enabled hand off across a heterogeneous network environment using different parameters such as cost ,available bandwidth and power consumption. A cost function-based vertical handoff decision algorithm formulation services handoff was presented in [4].A fuzzi fier, a fuzzy rule base, a database, a fuzzy inference engine, and a defuzzifier are shown in fig1.The proposed network selection scheme involves decision making – a process of choosing among alternative courses of action for the purpose of attaining a goal or goals – in a fuzzy environment. It can be solved using FMADM which deals with theproblem of choosing an alternative from a set of alternatives based on the classification of the irimprecise attributes. The multiple attribute defined access network selection function selects the best access network that is optimized to the user's location, evice conditions, service and application requirements, cost of service and throughput. The block diagram shown in Figure 1 describes the vertical handoff decision algorithm[5].

COMPONENTS OF VHDA

Vertical handoff decision in a heterogeneous wireless environment depends on several factors. Our proposed vertical handoff scheme consists of two parts, with the one using a fuzzy logic inference system (FIS)to process a multi-criteria vertical handoff initiation metrics, while the second applies a unique fuzzy multiple attribute decision making (FMADM) access network selection function to select a suitable wireless access network. The handoff initiation algorithm determines when a handoff is required. We use a Mamdani FIS that is composed of the functional blocks[6]: a fuzzifier, a fuzzy rule base, a database, a fuzzy inference engine, and a defuzzifier .The proposed network selection scheme involves decision making – a process of choosing among alternative courses of action for the purpose of attaining a goal or goals – in a fuzzy environment. Itcan be solved using FMADM which deals with theproblem of choosing an alternative from a set of alternatives based on the classification of the irimprecise attributes. The multiple attribute defined access network selection function selects the best access network that is optimized to the user's location, device conditions, service and application requirements, cost of service and throughput.

The block diagram shown in Figure 1 describes the vertical handoff decision algorithm.

HANDOFF INITIATION ALGORITHM

We consider two handoff scenarios: handoff from UMTS to WIMAX, and handoff from WIMAX to UMTS.

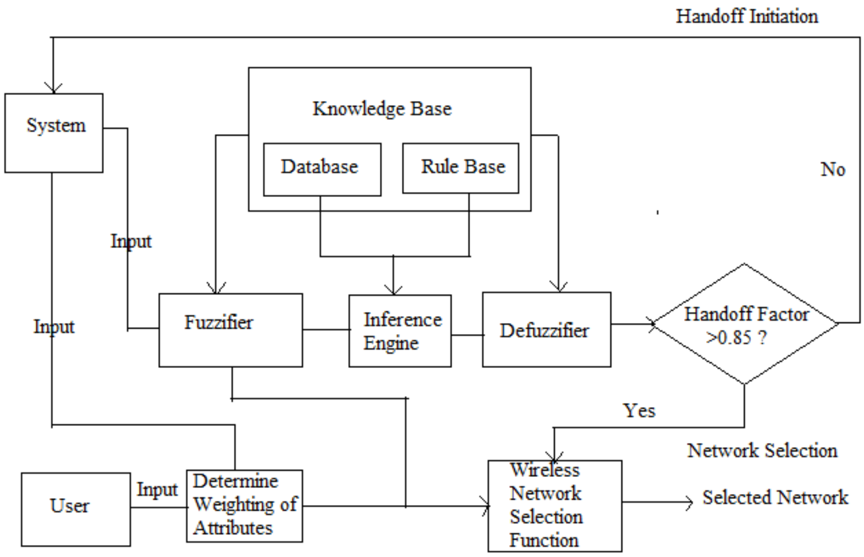

Figure 1. Block diagram for Vertical Handoff Decision

HANDOFF FROM UMTS TO WiMAX

A user connected to a UMTS network, which could be always on, would like to move into a WiMAX area and change the connection to the WiMAX to obtain a higher QoS at a lesser cost. The multimode mobile node (MN) associated with the UMTS monitors at repeated intervals and measures the RSSI of nearby WiMAXs to see whether or not a better high data rate WIMAX service is available. The RSSI of the target network must be larger than the RSSI threshold (say, -76 dBm) which enables quality WIMAX communication service for a period of time. The input parameters(RSSI, data rate, network coverage area, and perceived QoS of the target WIMAX network) are fed into a fuzzifier in a Mamdani FIS, which transforms them into fuzzy sets by determining the degree to which they belong to each of the appropriate fuzzy sets via membership functions (MFs). Next, the fuzzy sets are fed into a fuzzy inference engine where a set of fuzzy IF-THEN rules is applied to obtain fuzzy decision sets. The output fuzzy decision sets are aggregated into a single fuzzy set and passed to the defuzzifier to be converted into a precise quantity, the handoff factor, which determines whether a handoff is necessary. Each of the input parameters is assigned to one of three fuzzy sets; for example, the fuzzy set values for the RSSI consist of the linguistic terms: Strong, Medium ,and Weak. These sets are mapped to corresponding Gaussian MFs. The universe of discourse for the fuzzy variable RSSI is defined from -78 dBm to -66 dBm. The fuzzy set "Strong" is defined from -72 dBm to -66dBm with the maximum membership at -66 dBm. Similarly, the fuzzy set "Medium" for the RSSI is defined from -78 dBm to -66 dBm with the maximum membership at -72 dBm, and the fuzzy set "Weak" for the RSSI is defined from -78 dBm to -72 dBm with the maximum membership at -78 dBm. The universe of discourse for the variable Data Rate is defined from 0Mbps to 56 Mbps, the universe of discourse for the variable Network Coverage is defined from 0 m to 300m, and the universe of discourse for the variable Perceived QoS is defined from 0 to 10. The fuzzy set values for the output decision variable Handoff Factor are Higher, High, Medium, Low, and Lower. The universe of discourse for the variable Handoff Factor is defined from 0 to 1, with the maximum membership of the sets "Lower" and "Higher" at 0 and 1, respectively. The MF for the input variable RSSI shown in Fig 2.

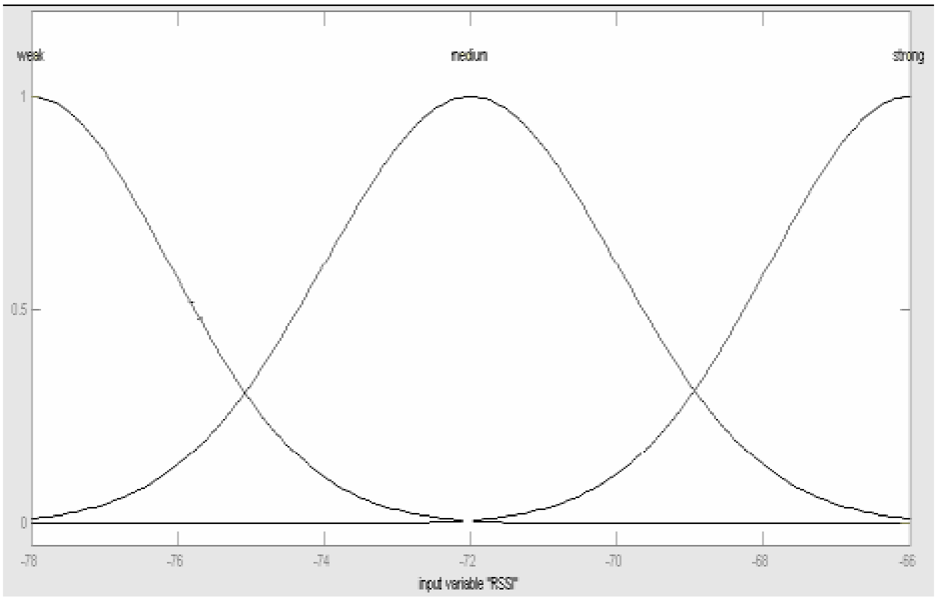

Figure 2: Membership Function for RSSI

Since there are four fuzzy input variables and three fuzzy sets for each fuzzy variable, the maximum possible number of rules in our rule base is 34 = 81.The fuzzy rule base contains IF-THEN rules such as:

IF RSSI is strong, and data rate is high, and network coverage area is good, and perceived QoS is desirable, THEN handoff factor is higher.

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

if handoff factor > 0.85, then initiate handoff;
otherwise do nothing.

HANDOFF FROM WIMAX TO UMTS

An accurate and timely handoff decision to maintain the connectivity before the loss of the WIMAX access. The parameters that we are using inthis directional handoff include the RSSI, data rate, network coverage area, and perceived QoS of the current WIMAX network. The design of the fuzzy inference system for this handoff scenario is similar to the design of the fuzzy inference system for the UMTS-to-WIMAX handoff.

The fuzzy rule base contains IF-THEN rules such as:

IF RSSI is weak, and data rate is low, and network coverage area is bad, and perceived QoS is undesirable, THEN handoff factor is higher.

RESULTS

- To analyze using fuzzy logic, FIS editor is used to obtain the waveforms as shown in the fig 3.

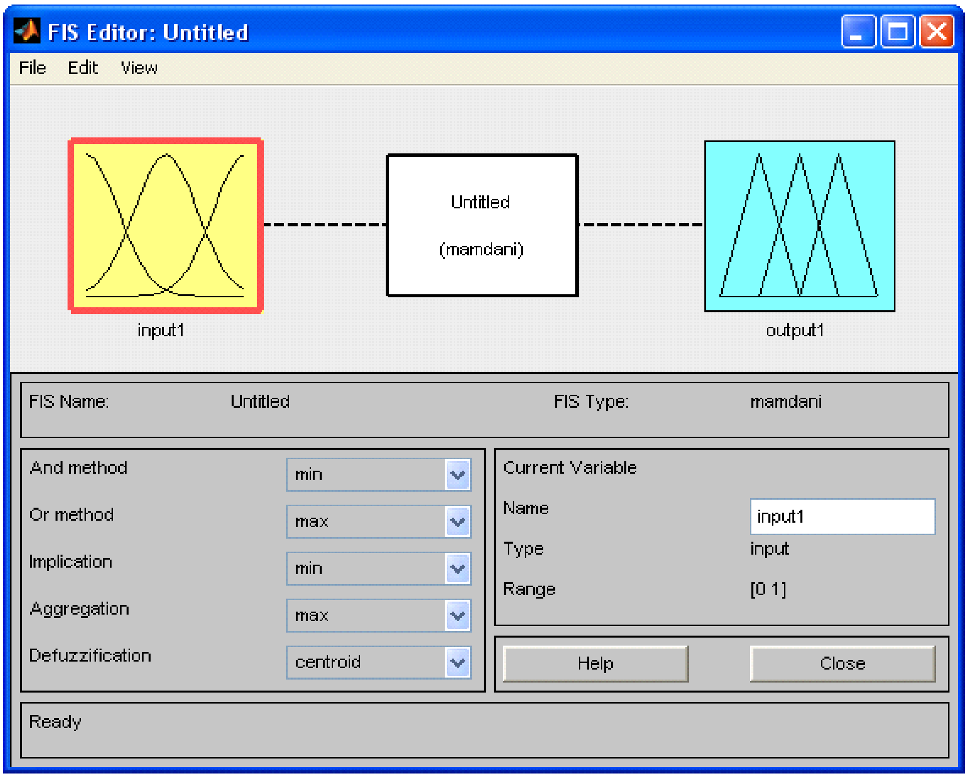

Figure 3: Fis Editor

- The parameters we consider for necessary Handoff is RSSI, Bandwidth, Network coverage, Qos as shown in fig 4

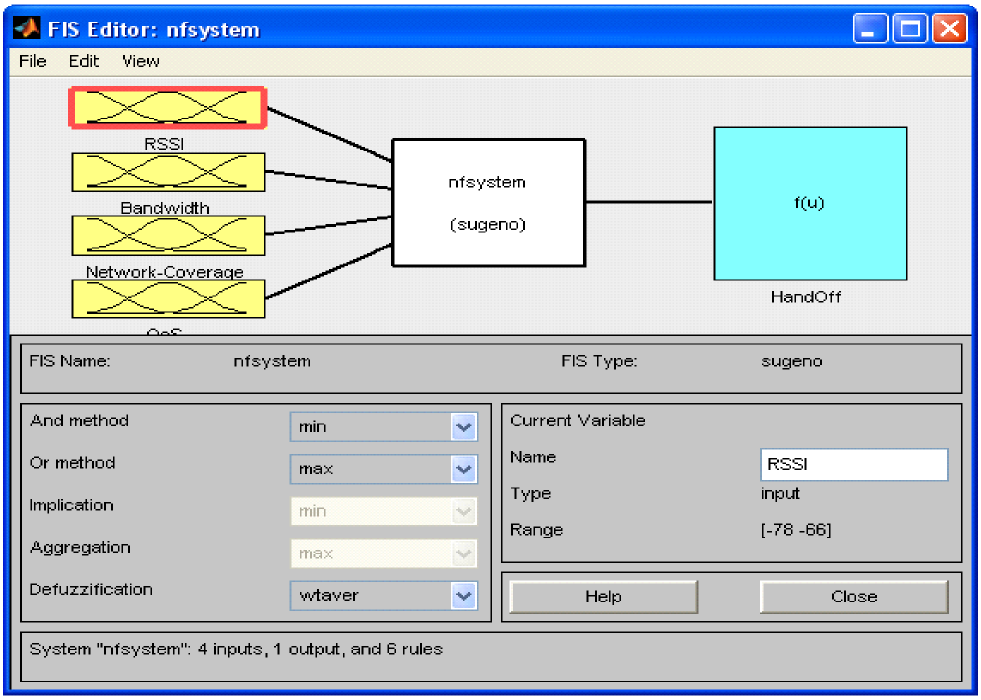

Figure 4: Input parameters

The parameter RSSI is first taken into consideration and its respective membership function is considered as shown in fig 5

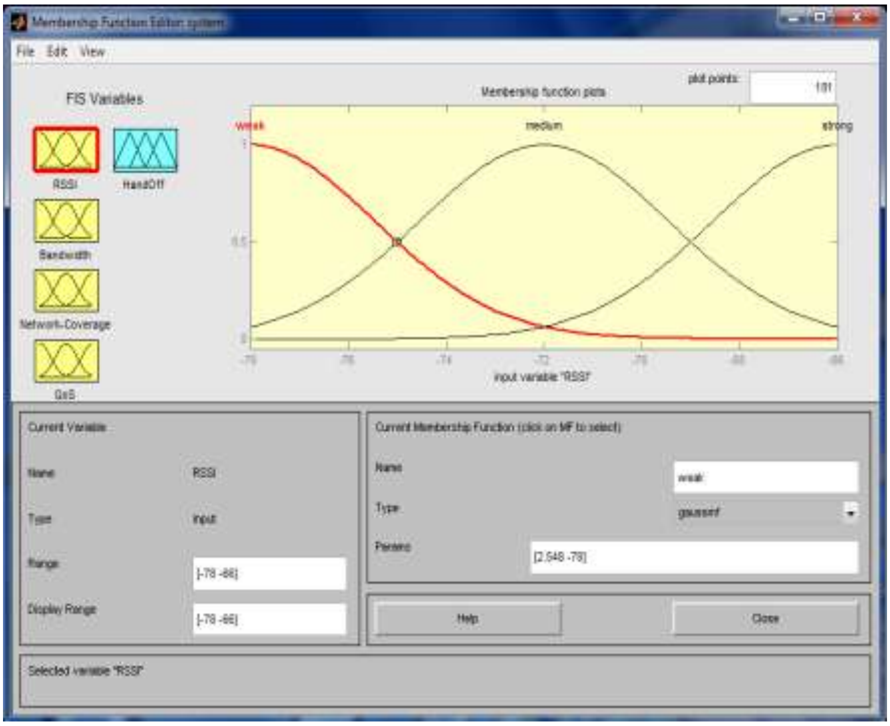

Figure 5: Input Parameter RSSI

OUTPUT:

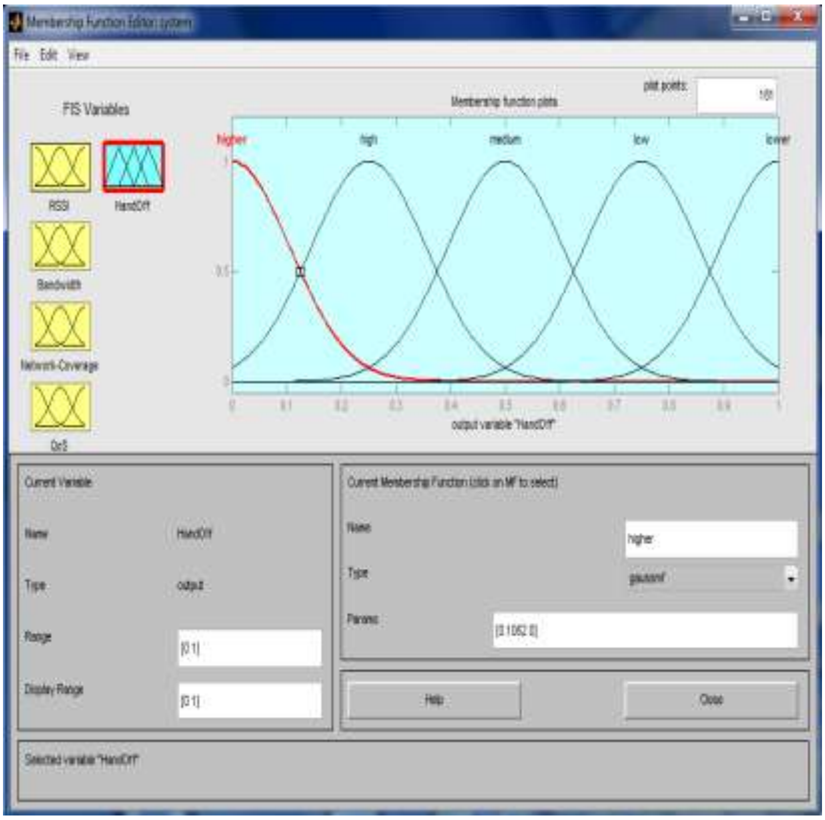

Figure 6: Output

CONCLUSION AND FUTURE WORK

This paper has presented the design of an adaptive multi-attribute vertical handoff decision algorithm that is both cost-effective and highly useful. We demonstrated the use of fuzzy logic concepts to combine multiple metrics from the network to obtain useful handoff initiation schemes and the selection of suitable access networks with a fuzzy multiple attribute defined wireless network selection function. Optimization of WSNF is can be considered as future avenue for research.

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