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FUZZY LOGIC BASED INTELLIGENT APPROACH FOR VERTICAL HANDOVER DECISION IN HETEROGENEOUS WIRELESS NETWORKS

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***ABSTRACT** : Next generation communications will offer a broad range of services accessible to users any place at any time. Vertical handoff is the rudimentary requirement of the convergence of distinct access technologies. The dream is that users will not be joined down to a long-term contract with one lone operator and will rather than be adept to dynamically choose access provision on a per call basis. The evolving comparable marketplace will supply a alternative of access networks in any granted location, each offering distinct network technologies with varying characteristics to transport the user's communications application. Most existing upright handoff conclusion schemes are designed to rendezvous individual desires that may not achieve a good scheme presentation. In this paper a smart approach and network selection conclusion scheme is used. The understanding is founded on the fuzzy reasoning approach that chooses the best available network.*

***KEYWORDS :** Vertical Handoff decision, Events and Triggers, Fuzzy logic, Fuzzification, Crisp value*

I. INTRODUCTION

As the technology improvement in wireless communication, the services of wireless connection networks are quickly growing very promptly. Presently, there are numerous types of wireless systems available to fulfil distinct needs and requirements of mobile users. When users are roaming among diverse wireless networks, such as Wireless LANs and 3G, the interconnection of these distinct systems has become a problem. While a mobile fatal (MT) crosses the treatment boundary of two distinct schemes, its ongoing attachment should be seamlessly swapped to a new network with a assured QoS. Such a cross-system transfer of an ongoing connection is generally mentioned to as inter-system, or vertical handover. Vertical handoff is asymmetric method where wireless fatal moves between two systems with distinct get access to technologies to supply relentless services for the wireless terminal.

In a homogeneous environment, handover decision is advised as handover initiation step. It represents the decision of starting or not the handover, and over which cell to hand over in cellular networks for instance. Conventionally, it is sharp out that the need for level handover arises when the signal strength (SS) of the serving base position (BS) deteriorates underneath a certain threshold value.In a heterogeneous natural environment, users can move between distinct access systems. They will advantage from distinct network characteristics (coverage, bandwidth, latency, power consumption, cost, etc.) that will not be contrasted directly. The handover method shown comes more convoluted in such an environment contrasted to the homogeneous one.Therefore, the more demanding problem is the handover conclusion and resolving it can leverage the handover presentation. It is referred to vertical handover conclusion which desires more criteria (not only SS) contrasted to level handover. In our paper, we mean by handover initiation the decision for the befitting instant to start the handover and by network selection the conclusion for the most suitable get access to network. The first alternative can minimize for example the signalling overhead, avoid unnecessary handovers and forecast disconnections. The second alternative must satisfy network and client obligations by deciding over which access network to attach at any issue of time when many when many access networks are available for a specific service.

Thus, in each handover conclusion making method, we can face the following questions: How does vertical handover decision method works? What are the handover conclusion criteria used? How the needed criteria can be accumulated? What is the handover conclusion principles applied? Who (terminal or network) is making the conclusion? What are the handover performance optimizations that can be made? In our vision, the major issues are: blending decision criteria, comparing them and responding client needs anytime and anyplace. So, we must identify the conclusion factors (criteria, principle, schemes, etc.) and we should use them in order to optimize handover performance (e.g., throughput, handover delay). Vertical handoff is a three stage method namely Handoff initiation stage, Handoff decision stage, Handoff execution stage [1]. In this paper we have presented upright handoff conclusion founded on fuzzy logic to select the best mesh during handover.

II. RELATED WORK

Some papers have addressed designing architecture for hybrid systems, such as the application-layer session initiation protocol (SIP) [2], the hierarchical mobility management architecture suggested in [3], and the P-handoff protocol [4]. Although, these papers concentrated on architecture design and did not address the handoff decision issue or the vertical handoff presentation matters. W. Zhang, in [5], proposes that the vertical handoff conclusion is formulated as a fuzzy multiple ascribe conclusion-making (MADM) problem. Fuzzy reasoning is utilized to represent the imprecise information of some attributes of the systems and the preferences of the user.

III. PROPOSED MODEL

3.1 Trigger Management System

A mobile apparatus is affected by numerous events in heterogeneous wireless environment. There are distinct kinds of network events that concern to mobility administration that are recognized in [6] - [8]. Though connection expertise varies, all these initiates and events can be clustered, founded on groups of events associated to changes in network topology and routing, available access to media, wireless link situation, client activities and preferences, context data, operator principles, quality of service (QoS) parameters, network composition, and security alerts.

In the mobility administration, initiates can be classified and filtered based on five criteria: type, source, occurrence/frequency, happening persistence, and temporal constraints [9]. For example, we recognized three initiate kinds based on if an event may, will, or should force a handoff. Source corresponds to the entity that makes the trigger, for example, the wireless access constituent. With esteem to frequency of incident, an happening may be either periodic (such as, mesh measurements) or asynchronous (such as, the accessibility of a new network access or a security alert). Eventually, events can be either transient or continual, and they may be associated with a real-time constraint. There are different kinds of events associated to mobility administration and vertical handover. The events that concern to application layer mobility management encompass alterations in QoS parameters, user preferences and security alerts.

The events of network topology and routing information relates to transport and network layer. The events of wireless connection situation, connection parameters and available media bandwidth are some of the events that relate to the data connection and personal layers. The figure 1 displays the events and initiates of distinct levels in mobility management [9]. Initiate management in mobility management gives a facility to improve hold ups and mistakes.

Now address the case where wireless has listed for a set of events, like accessible bandwidth, link rank, network burden etc. Now when the network burden starts exceeding then after a certain threshold grade, a initiate will be generated to describe the status of the network load. This will make the mobile node to take a prior conclusion to switch to other accessible network.

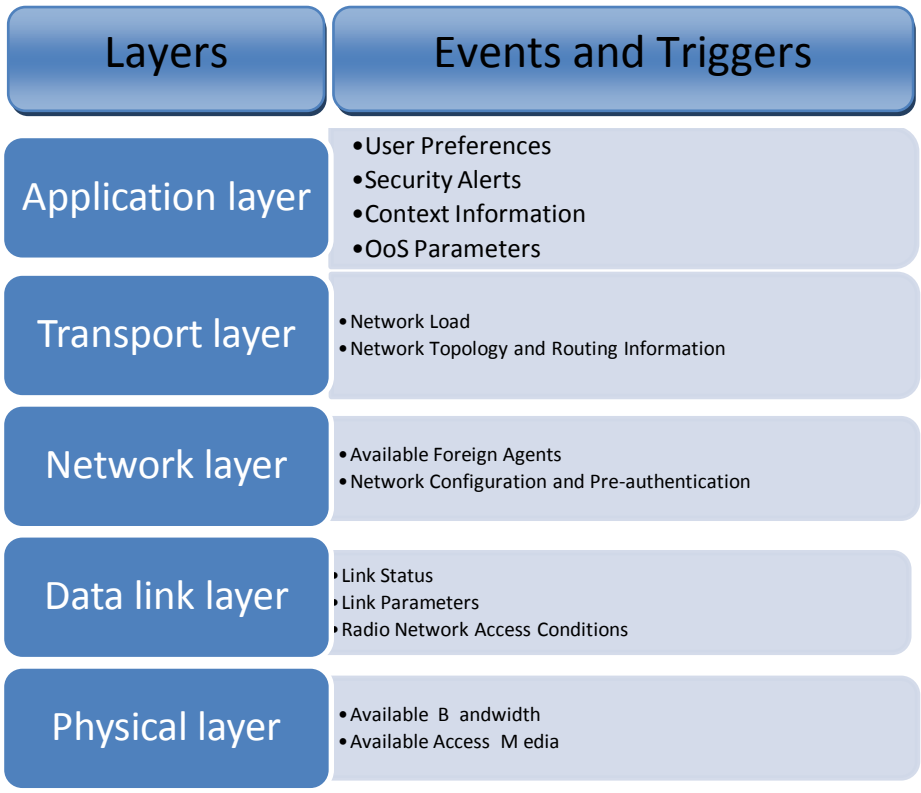


Fig 1: Events and Triggers of Different Layer in Mobility Management

3.2 Fuzzy Inference System

Fuzzy reasoning scheme is utilized for mapping of non linear input data set to scalar output facts and figures. When the problem is with doubt, then to forecast the correct value among all uncertainties' we select fuzzy logic. Fuzzy logic is used to choose the optimal network amidst given systems for handoff conclusion founded on the multiple parameters as crisp inputs and give the best possible answer to choose the best network..

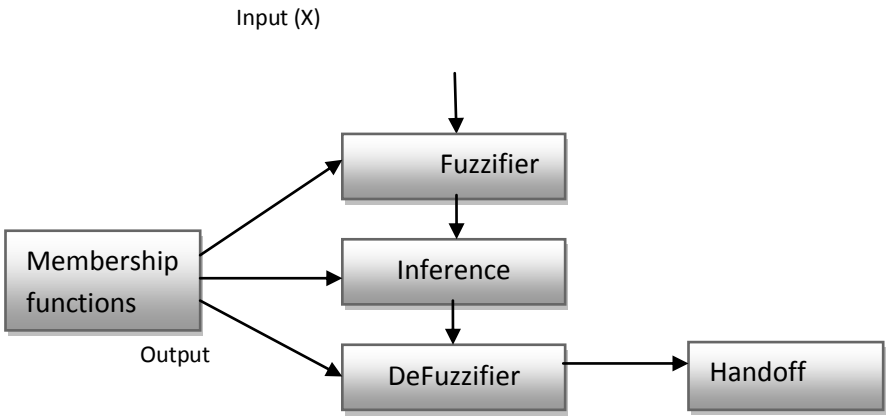


Fig 2: Block Diagram of Fuzzy Logic System.

The fuzzy algorithm in [10] is as pursues.

1) Characterize the linguistic variables and periods for inputs and yields.
2) Assemble membership functions to the input and yield variables.
3) Construct the Rule groundwork.
4) Convert crunchy input facts and figures to fuzzy standards utilizing membership functions (fuzzification).
5) Assess the directions in the direct base. (Inference)

6) Combine the outcomes of each direct. (Inference)
7) Alter the output facts and figures to non-fuzzy directions. (Defuzzification)

3.3 Architecture of Proposed Handover Decision Model

In the next generation, wireless apparatus are equipped with multiple network interfaces in order to access heterogeneous wireless networks. So it is a demanding task to organize the complexity of different access technologies in multi interface wireless apparatus. For multiple wireless apparatus it is essential to provide seamless connectivity for apparatus which roam not only between cells in homogeneous network but also between distinct accesses technologies. So we need vertical handover to use the best characteristic of any technology at one time and another at any other time. This handover decision should be smart enough to take the conclusion spontaneously. As for genuine time submissions we need more bandwidth and connection should be alive all the time so conclusion should be smart which supply QoS obligations and witching among networks should be at right time. Here we propose a form which assembles events from connection level, mesh level and transport level and takes conclusion based on fuzzy directions. For our model we choose distinct variables, i.e. signal strength, network burden and accessible bandwidth.

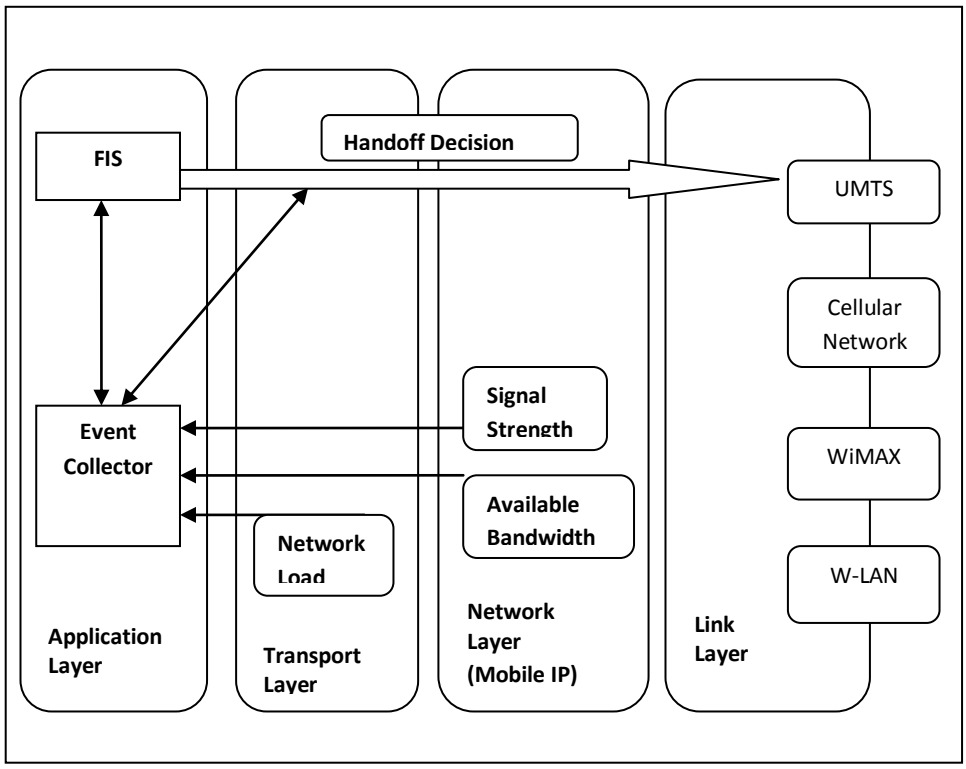
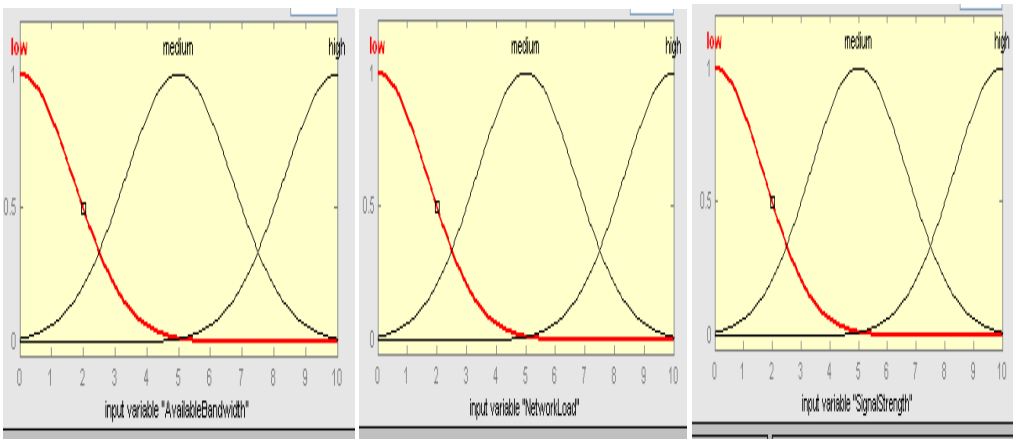


Fig 3: Proposed Intelligent Handover Decision System

Figure 3 displays the form for handover decision scheme. It comprises 4 levels of the OSI form. Link layer triggers the alterations in interface signal strength and the bandwidth provided by the operator business. Mesh level carries mobility in heterogeneous natural environment and transport level represents network burden. Network burden can be observed by ascertaining congestion or flow of packets at transport level. The standards of the events developed by event generator are feed to the fuzzy inference system. The output of the fuzzy scheme is the handover decision. Event collector in submission level will assemble events from distinct levels, i.e., if the accessible bandwidth is less than the required bandwidth then that interface will generate event that will be collected by happening collector. Then all these events and initiates are forwarded to fuzzy professional system as crunchy input, then the data from the direct base is taken and inputs are assessed. Event collector sustains states of every interface variable for farther processing and also maintains last yield assortment that is returned from fuzzy professional system.

III. SIMULATION AND RESULTS

For scheme replication we use Sugeno Fuzzy Inference System. Fuzzy inference collects input values of signal strength, mesh burden and accessible bandwidth from happening collector as crisp inputs and then assesses them according to directions. The crisp input is then assessed utilizing direct groundwork. The created and aggregated yield of directions evaluation is defuzzified and crisp yield is obtained. Figures 4, 5 and 6 show the fuzzy input variable for the accessible bandwidth, network burden and signal power respectively. Each of the fuzzy variables has three subsets. These sets are mapped to the corresponding Gaussian member's purposes. Since here we are utilizing the fuzzy input variables and each of them has three subsets so there are 27 directions. These directions are granted in the Appendix.



4. Available Bandwidth **5. Network Load** **6. Signal Strength**

Figure 4, 5, 6: Fuzzy Input Variables

The fuzzy set standards for the yield decision variable handoff conclusion are NO, Probably Yes (PY) and Yes (Y). The universe of discourse for the variable handoff is characterized from 0 to 1.

Now let us consider a wireless apparatus currently in a W-LAN mesh. The entire network interface variables, i.e. accessible bandwidth, mesh burden, and signal strength of the current mesh are known. Now as the apparatus moves from one location to another where cellular mesh and UMTS systems are available, the apparatus interface for cellular mesh and UMTS starts receiving pointers. As the new pointers are obtained, the triggers of its variable will be developed. The apparatus will evaluate network variables of the present network with the new one making a conclusion of vertical handover counting on current submission requirement. Now the crisp inputs of mesh variables are entered in the fuzzy inference scheme through which they overtake to the direct groundwork to evaluate the yield crunchy worth for network assortment.

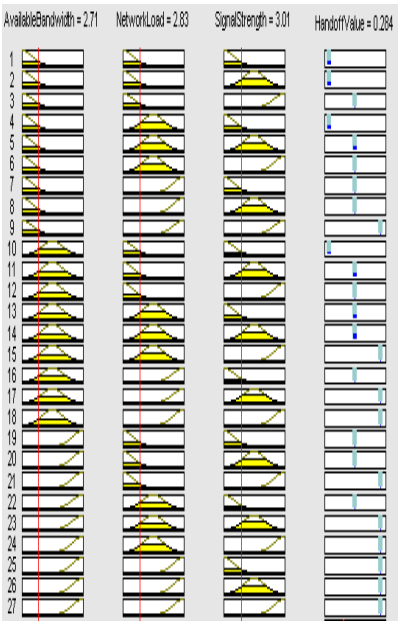


Fig 7: Rule Base for W-LAN network

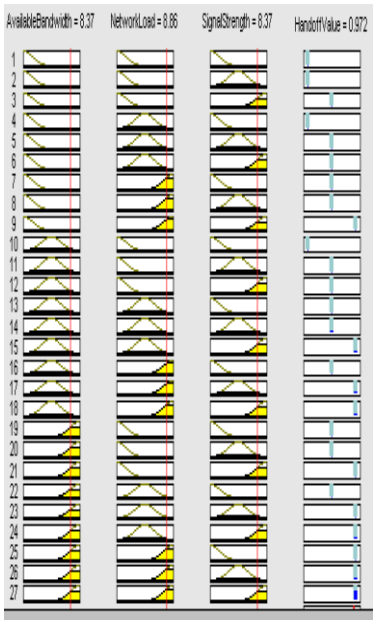


Fig 8: Rule Base for UMTS network network

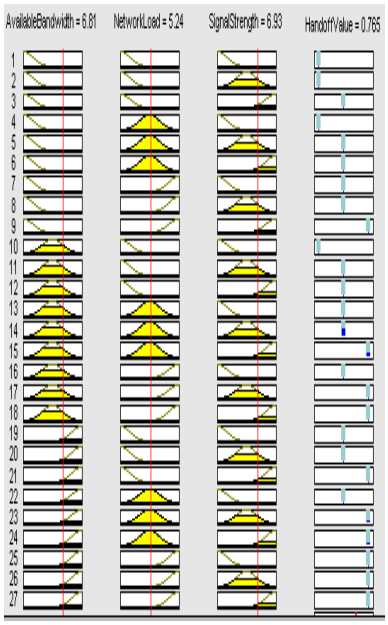


Fig 9: Rule Base for Cellular

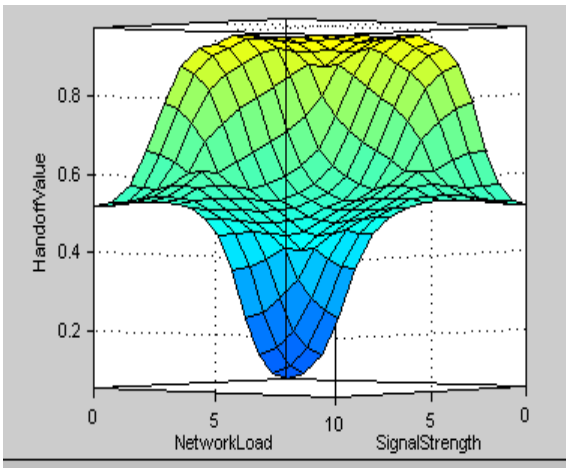


Fig 10: Network Load, Signal Strength and Handoff Value Handoff

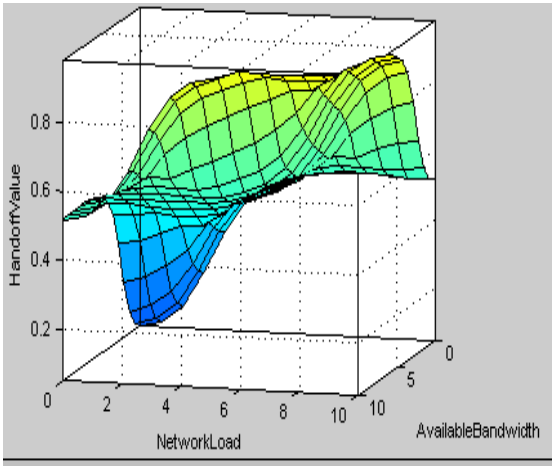


Fig 11: Network Load, Available Bandwidth and Value

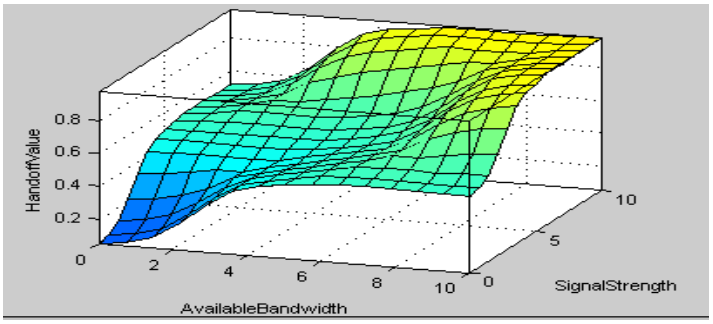


Fig 12: Available Bandwidth, Signal Strength and Handoff Value

Fig: Surface Curves

Now consider for demonstration, that the crisp input value of present W-LAN mesh for mesh variable bandwidth, mesh burden and pointer strength be 2.71, 2.83 and 3.01 respectively. As the apparatus moves from one location to another where cellular network and UMTS are available. The input crisp worth of new mesh i.e. for UMTS the worth for mesh variables bandwidth, network load and pointer power is 8.37, 8.86 and 8.37 and similarly for cellular mesh the input crunchy value are 6.81, 5.24 and 6.93 respectively. Now putting these standards to the Sugeno fuzzy professional system, the crisp output for network selection is got for W-LAN, UMTS and Cellular mesh. Figure 7, 8 and 9 displays the directions evaluation phase of fuzzy expert system for W-LAN, UMTS and Cellular systems respectively. Figures 10, 11 and 12 displays the surface bends between mesh load, available bandwidth, and pointer power and handoff values. Crisp yield got from systems from fusilier is forwarded to the comparator to make last conclusion about the interface assortment. From the overhead demonstration, the crisp value of handoff yield for W-LAN is 0.284 (No), for UMTS is 0.972 (Yes) and for Cellular mesh is 0.765 (PY). So UMTS will be chosen.

V. CONCLUSION

In this paper an smart approach is utilized to find the best accessible mesh throughout vertical handover in heterogeneous wireless mesh environment. The Sugeno Fuzzy Inference scheme is utilized to find the conclusion for vertical handover. The inference scheme uses the crisp input standards for mesh parameters such as available bandwidth, network burden and signal strength. The standards of these mesh parameters are collected by event collector and are feed to fuzzy inference scheme. The yield of the fuzzy system is handover conclusion. In this way a smart approach will be taken founded on yield standards (handoff standards) to select the best network.

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Appendix

Rules: The rule blocks contain the control strategy of a fuzzy logic system. The rules 'if' part describes the situation, for which the rules are designed. The 'then' part describes the response of the fuzzy system in this situation.

IF			**THEN**
Available	**Network**	**Signal**	**Handoff**
Low	Low	Low	NO
Low	Low	Medium	NO
Low	Low	High	PY
Low	Medium	Low	NO
Low	Medium	Medium	PY
Low	Medium	High	PY
Low	High	Low	PY
Low	High	Medium	PY
Low	High	High	YES
Medium	Low	Low	NO
Medium	Low	Medium	PY
Medium	Low	High	PY
Medium	Medium	Low	PY
Medium	Medium	Medium	PY
Medium	Medium	High	YES
Medium	High	Low	PY
Medium	High	Medium	YES
Medium	High	High	YES
High	Low	Low	PY
High	Low	Medium	PY
High	Low	High	YES
High	Medium	Low	PY
High	Medium	Medium	YES
High	Medium	High	YES
High	High	Low	YES
High	High	Medium	YES
High	High	High	YES