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A Novel Approach for Always Best Connected in Future Wireless Networks

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Kailash Chander[α], Dr. Dimple Juneja[Ω]

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I. Introduction

The ultimate goal of ABC is to provide QoS to the end users where QoS is defined with respect to various parameters as given in Table1.

Table 1 : QoS Parameters

Parameters	Meaning
Speed	The time period required for a packet to reach its destination
Reliability	Reliability depends on the Bit Error Rate (BER)
Packet Loss	The probability of loss of packets during transmission.
Signal Strength	Available signal strength during transaction.
Services	Type of services supported by a network.

In addition to the above mentioned parameters A network selection also depends upon the type of service (such as Internet Surfing, Voice Data, and Video streaming) it offers, which in turn depends upon various factors such as Cost of Service, Data Rate, Mobility of Mobile Node, Signal Strength, Present Network Traffic, Security Parameter, and Drainage rate of Battery.

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It is obvious that selection of network is initially dependent on the end user requirements, but since a user is provided with many choices, the choice becomes QoS dependent. An obvious choice would be the network that offers maximum QoS. This work analyzes QoS parameters for the type of service offered by network and factors on which a network selection depends. The work aims to assign weight to each parameter and factor as well. Our earlier work proposed deployment of agent in 4G networks and hence we propose that deployed agents shall do all weight computations, reducing the overhead of service providers and enhancing the QoS to service users.

The paper has been organized in four sections. Section II presents the related work. Section III discusses the proposed solution and compares the results. Finally conclusions and future scope are presented in Section IV.

II. Related Work

In fourth generation (4G) communication [26], selection of the best access network is the major challenge for future research. Many researchers [19, 20, 21, 22] proposed different solution for achieving "Always Best Connected". Authors [5] proposed Game theoretical modelling to solve the network selection problem. Game theory is the study of a mathematical model of conflict and co-operation between intelligent reasonable decision makers [6]. According to a Game theoretical Model [7], the players of the game are the individual access network (WLAN, GSM, WCDMA, WiMAX, WiFi etc.) each of which contends to win a service request.

Another solution to select an appropriate network is based on distance function [8]. Distance function generates an ordered list of various access technologies called networks in a particular region according to multiple user preferences and level of interest. The proposed algorithm works on the user-specified parameters i.e. Bandwidth Utilization, Call Drop during Handoff, Cost of Services, Battery Power etc.

Work in [9] provided an efficient load balancing based access point selection algorithm which consider the direction of advancement of the mobile node and hence is able to extract the best possible network for the user equipment to link up, as it moves.

Exploiting ants in telecommunication [23, 24, and 25] has been the interest of researchers and it has been proved that such agent based frameworks have been instrumental in improving the performance of existing networks.

Weighted distance function [10] is obtained based on multiple QoS parameters as per user needs. The proposed algorithm shows better results compared to single parameter based system, under a heterogeneous network system.

Another solution of network selection is through QoS Broker [11]. This Broker monitors the QoS performance actively for each wireless network, and then the result of this monitoring will be passed to analysis statistics of all the QoS parameters in each network to get the best network.

In [12] authors developed a process to evaluate three packet-switched networks (UMTS, WLAN and GPRS) in reference to the QoS offered. It also identifies the weak points of a network and finally selects the network that offers the highest standard for QoS.

Further, focusing on the use of mobile agents in telecommunication section, Literature [1, 2, 15] indicates communication applications are modeled as a collection of agents and each agent occupies different locations at different times since it can move from one place to another.

Mobile AGeNt Architecture (MAGNA) [2] is being developed by GMD-Fokus for future telecommunications applications, in which the conventional client server concept is cordially complemented by agent concepts. This framework is used for the development of agent-based telecommunications applications which exhibit rapid, decentralized provisioning of intelligent services on demand.

Among the different paradigms of intelligent agents, Reinforcement Learning (RL) [17] appears to be particularly appropriate to address a number of the challenges of the future mobile communication. RL involves learning what to do and how to map situations with actions to maximize a numerical value signal [3]. A Reinforcement Learner Agent (RLA) ascertains on its own which actions to take to get the maximum weight value. The agent learns from its mistakes and come up with a policy based on its experience to maximize the attained weight value [4].

Focusing our attention to agent-based solutions, it is apparent that there is a scope of an agent based solution for ABC network in future. Next section presents such a solution.

III. Proposed Solution

The process of network selection refers to the process of deciding over which network to connect at any point in time. On the other hand user wants the selection of service among the available networks according to his/her requirements. Thus a novel network selection mechanism is being proposed such that the selected network satisfies the current session's QoS requirements. Each network would be assigned a weight which is based on the QoS parameters and factors that it provides and satisfies the end user requirements. The agent is then required to compute the sum of all weight assigned to a particular network which is then normalized within the range of 0-1. A network scoring maximum (i.e. 1) shall be the best available network while a network scoring less than a specified threshold (<.5) shall be ignored and similarly, a network gaining a zero weight shall be straightaway discarded. Following section presents the rule set that must be followed by agent for assigning weights.

Rule Set

a. *Cost of Service :* Maximum value is given if cost of service is either zero or very less, because every user wants better service always at lowest price.

b. *Data Transfer Rate :* Present data transfer speed of the available network.

c. *Mobility of Mobile Node:* The value will be calculated on the basis of present status of movement of mobile node. If mobile is static the maximum value i.e. 1.0 is assigned and if node is in moving state then 0.0 is allocated.

d. *Signal Strength :* It involves the minimum or maximum signal strength supported by a particular network. It will provide us the net signal strength of that network.

e. *Present Network Traffic :* Every network provides services to its user based on contention ratio such as 1:1 or 1:10 or 1:50. Therefore the total bandwidth is divided based on this ratio. If a network is providing service with a content ratio of 1:20 and presently only four users are logged in then user will get more bandwidth and higher speed.

f. *Security Parameter :* A secure network is always treated as a best network because of security threats. Selecting best secure network is a challenging task. A good network is that which supports maximum security layers. Some of security layers are Network Intrusion Detection System, Firewall, Email Scanning, Internet Security, Server Level Virus Scanning, Workstation Virus Scanning, and Updated Communication Software. Agents calculate the weight value based on number of layers supported by a network.

Table 2 : Weight Rules

Parameters → / Weight (W) ↓	Cost of Service Offered (A)	Data Transfer Rate (DTR) (B)	Mobility of Node (C)	Signal Strength (D)	Network Traffic (E)	Security (F)	Drainage Rate of Battery (G)
1.0	Zero	11mbps-100mbps	Static	Excellent	Very few users/ Single User	Fully Secure	Very Light Application
0.75	Negligible	2mbps-11mbps	Walking	High	Moderate	High	Light Application
0.50	Moderate	128kbps-2mbps	--	Good	High	Moderate	Moderate
0.25	High	<128kbps	--	Low	Very High	Low	Heavy
0.0	Unaffordable	--	Very High Mobility	Nil	Extreme (All routes are busy)	None	Very Heavy Application

g. ***Drainage rate of Battery :*** An algorithm in [15] proposes to shift to the lesser power demanding network in case the present battery status of mobile node is not sufficient for current transaction. Here, again the value is calculated on the basis of consumption of battery life for a particular application for a particular network by comparing present battery life of mobile node i.e. drainage of battery is application dependent for instance heavy application implies more consumption of battery.

The weights assigned as per the rules mentioned above are being listed in Table 2. The above factors compute the weight-age for available networks. Some of the above factors have higher impact while others have less for network selection decision. For an ABC network, the user agent computes the sum of all weights (computed as per the rule set given above) as per the following formula:

$$ABC = \sum_{i=1}^{n} W_i$$

Where, n represents the numbers of parameters taken into consideration and W_i represents the corresponding weight computed for a respective parameter.

IV. Sequence Diagram

A user agent is invoked whenever a user demands for ABC network. An individual user agent cannot evaluate the complete rule set for different types of network. Therefore, it broadcasts the request and in response to this request, various network agents respond with bid to the user agents.

The bid comprises of weights which have been computed on the basis of rule set as already defined. User agent then computes the sum of weights to find out the ABC network shown in Figure 1. It is obvious that a network having maximum weight will be selected and rest would be discarded. Each network agent is responsible for providing the data on the basis of their rule set and all agents are set to move and execute state as every network service provider would intend to provide service to a mobile user.

The following algorithm for MAGagent given below provides the details of working of the proposed framework for its implementation.

Algorithm :

```
Algorithm: MAG_agent
----------------------------------------------------------------------
begin
    i=0
    invoke MNagent
    aN[ ] = <Available Networks>
    while (i <= aN[ ] )
        j=0
        while (j <= 7)
            Invoke MAG_agent[j]
            ds= getDataSet(f)
            w_i=<<assign as per Rule Set>>
            sw[j]=sw[j]+w_i
            j++;
        wend
        MNagent← aN[i].sw[j];
        i++;
    wend
    ABC= sort (aN[].sw[])→descending order
end
```

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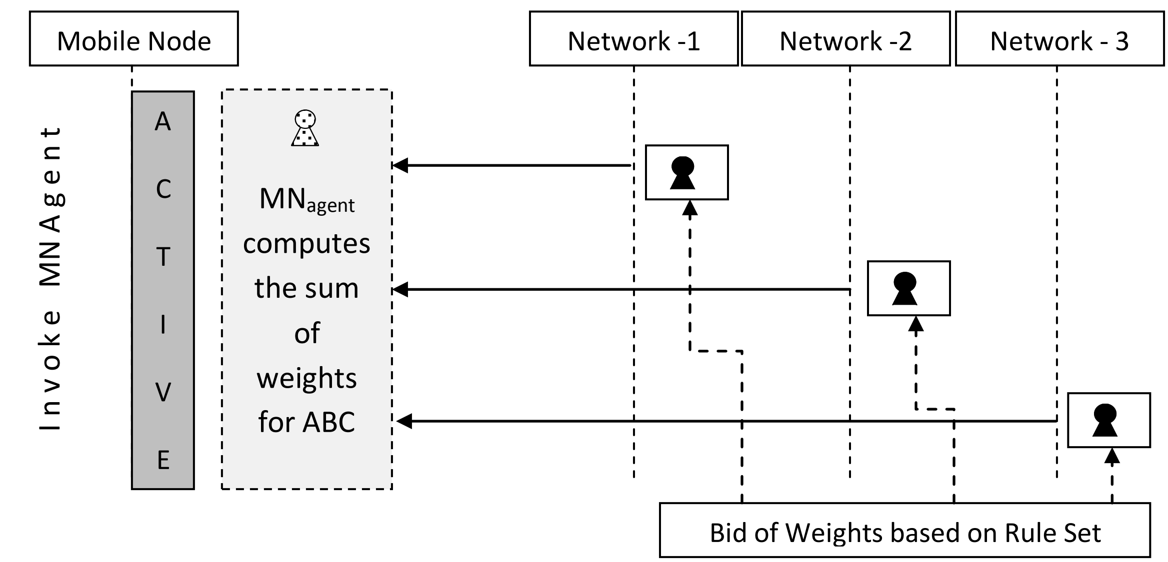

Figure 1: [Working of Network and Mobile Node Agents for ABC]

V. Demonstration and Proof of Concept

In this section the concept is demonstrated by taking different possible weight values for the parameters and sum of all the parameter values is computed to decide on the best network at any point. The algorithm will process the input provided in this format and will decide which network can provide best services to the subscriber at that time.

CASE-1								
(Available Network)	Parameters							
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(Sum)
Net – 1	0.75	0.50	1.00	0.50	0.50	0.25	0.50	4.00
Net – 2	1.00	0.50	1.00	0.25	0.25	0.50	1.00	4.50
Net – 3	0.25	1.00	1.00	1.00	0.75	0.75	0.25	5.00
CASE-2								
(Available Network)	Parameters							
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(Sum)
Net – 1	0.25	0.75	0.75	0.50	1.00	1.00	0.5	4.75
Net – 2	0.75	0.50	0.75	0.50	0.75	0.75	0.5	4.50
Net – 3	0.50	0.75	0.75	0.50	0.75	0.50	0.25	4.00

In the first case the mobile node is in static mode, thus Net-3 will be selected since it is providing high data at low cost while in the second case mobile node will prefer Net-1 because of its security although the cost of network is high. In the second case status being mobile the node will prefer secure transaction, even with more cost.

VI. Conclusion

In future 4G mobile environments, various access technologies will coexist, complementing each other. Therefore, a network selection mechanism is required to help mobile users choose the best network; that is, one that provides always best connected (ABC) that suits users needs, and changes, if conditions changes. Thus a novel network selection mechanism using intelligent agents has been proposed, which select the best network based on QoS parameters. The security aspect of agents has been ignored and would be taken up in future works.

References Références Referencias

1. Marie-Pierre Gervais and et.al. "Enhancing Telecommunications Service Engineering with Mobile Agent Technology and Formal Methods" IEEE Communications Magazine, July 1998.
2. S. Krause and T. Magedanz, Mobile Service Agents Enabling, "Intelligence on Demand in Telecommunications," Proc, IEEE GLOBECOM '96, London, UK, Nov. 1996.
3. Abdulhai, B. and Kattan L. "Reinforcement learning: Introduction to theory and potential for transport applications" Canadian Journal of Civil Engineering, Volume 30, Number 6 (11), 981-991. 2003.
4. Sutton, Richard S. and Barto, Andrew G. . Reinforcement Learning. MIT Press, Massachusetts USA, 322 pp. 2000.
5. Mohammod Sazid Zaman Khan et. al. "A Network Selection Mechanism for Fourth Generation Communication Networks" Journal of Advances in Information Technology, Vol.1 No.4 p.p. 189-196, 2010.

6. Roger Myerson "Game Theory: Analysis of Conflict," Harvard University Press, 1997.
7. J. Antoniou, A. Pitsillides, "4G Converged Environment: Modeling Network Selection as a Game," Proc. of IST Mobile Summit 2007, Budapest, Hungary.
8. T. Nisha Devi et. al. "A Novel Approach for Optimal Network Selection in Heterogeneous Wireless Networks", Proceedings of the International Joint Journal Conference on Engineering and Technology (IJJCET) p.p. 158-161, 2010.
9. I.S. Misra, A. Banerjee "A Novel Load Sensitive Algorithm for AP selection in 4G Networks"
10. Amit Sehgal, Rajeev Agrawal, "QoS Based Network Selection Scheme for 4G Systems", IEEE Transactions on Consumer Electronics Vol. 56, No. 2, p.p. 560-565, May 2010.
11. Mr. Mohammed Saeed Jawad, et. al. "Optimizing Network Selection to Support End-User QoS Requirements for Next Generation Network" International Journal of Computer Science and Network Security, Vol. 8 No.6, p.p. 113-117, June 2008.
12. Dimitris Charilas et. al. "Packet-switched network selection with the highest Qos in 4G networks" Computer Networks 52(2008) p.p. 248-258, Science Direct, Elsevier.
13. Chen Yiping and Yang Yuhang "A New 4G Architecture providing Multimode Terminals Always Best Connected Services" IEEE Wireless Communications, 2007 p.p. No 36-4.
14. EVA Gustafsson and Annika Jonsson, "Always Best Connected" IEEE Wireless Communications, 2003 p.p. no. 49-55.
15. Kailash Chander, Dr. Dimple Juneja "Mobile Agent based Emigration Framework for 4G: MAEF " communicated to International Journal of Information and Computing Science, UK.
16. Torsten Braun "Ant-Based Mobile Routing Architecture in Large-Scale Mobile Ad-Hoc Networks".
17. Richard S. Sutton "Generalization in Reinforcement Learning: Successful Examples Using Sparce Coarse Coding.
18. F. Ahdi, B. H. Khalaj, "Vertical Handoff Initiation Using Road Topology and Mobility Prediction". IEEE 2006.
19. Gabor Fodor, Anders Eriksson, et. al. "Providing Quality of Service in Always Best Connected Network". IEEE July 2003.
20. Chen Yiping And Yang Yuhang, "A New 4G Architecture Providing Multimode Terminals Always Best Connected Services". IEEE Wireless Communications, April 2007.
21. Tein-Yaw Chung, Fong-Ching Yuan, "Extending Always Best Connected Paradigm for Voice Communications in Next Generation Wireless Network". IEEE 2008.
22. Yiping Chen, Chen Deng, "Access Discovery in Always Best Connected Networks". IEEE 2008.
23. Lu guoying Zhang subing Liu zemin "Distributed Dynamic Routing Using Ant Algorithm For Telecommunication Networks". IEEE 2000.
24. Mohammad Mursalin Akon and Dhrubajyoti Goswami, "A New Routing Table Update and Ant Migration Scheme for Ant Based Control in Telecommunication Networks". Proceedings of the 7th International Symposium on Parallel Architectures, Algorithms and Networks (ISPAN'04), IEEE 2004.
25. Heesang Lee, Gyuwoong Choi, "An Ant-Assisted Path-Flow Routing Algorithm for Telecommunication Networks". IEEE 2004.
26. Ronal van Eijk, Jacco Brok, Jeroen van Bemmel and Bryan Busropan, "Access Network Selection in a 4G Environment and the Roles of Terminal and Service Platform" In Wireless World Research Forum.

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