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Associative Intensification for Handoff Management in Wireless Mobile Data Networks

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ABSTRACT

The past days of static locality telephone networks are slowly vanishing now by the emerging wireless mobile data networks. Mobility is the primary key term in the field of next generation wireless data networks. The static communication medium with higher level of standards towards multiple modes is an old fashioned strategy in the field of Information technology. Nowadays the standard service of Dynamicity in the Wireless Mobile Data Network defines the Service Provider to give their best competitiveness especially in India which proves it in the recent years with the reduced count of best service provider for customer satisfaction. This paper deals with the associative handling structure for Handoff efficiency in voice and data over a wireless mobile network which is the primal factor in deciding the Service capability of the service provider. The proposed associative method is a combinatorial approach with the unique individual implementation towards the fine tuning of Handoff improvements. The results and discussions of our proposed method lead to the implementation of intensification of Handoff in wireless mobile data networks.

Keywords: Mobile, Wireless networks, Handoff, Service provider, Intensification.

1. INTRODUCTION

The primary concept of mobility in mobile data networks not only guarantees the quality in its term of variable location functioning but also with the process of smooth transition from one locality to another without any interference, termination or hanging[8].The approach for smooth transfer of data transmission from one bounded locality to another bounded locality is called as the Handoff in mobile data networks. The challenges associated

with providing Handoff service guarantees are numerous, but the biggest challenge for traditional networks has been availability and proper allocation of resources[6]. However, many more challenges exist for wireless and mobile networks above those in traditional networks[10]. For this reason, a completely different set of Handoff techniques are required for wireless networks than for wired networks[5]. The Mobile network service architecture and role of Handoff are represented in Figure 1.1 and Figure 1.2 respectively.

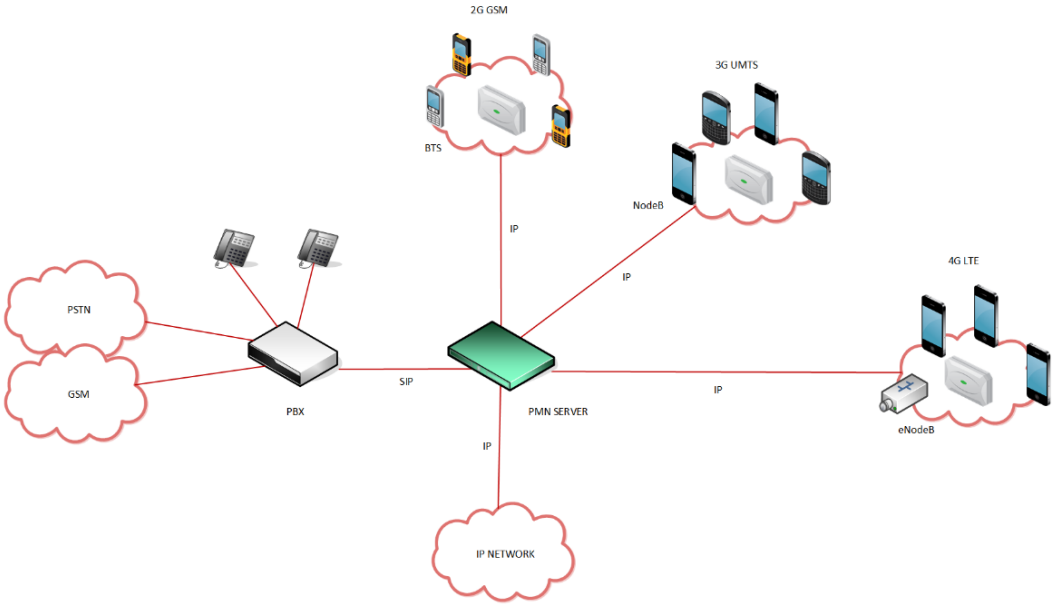

Figure 1: Mobile Network Service Architecture (www.privatemobilenetworks.com)[7]

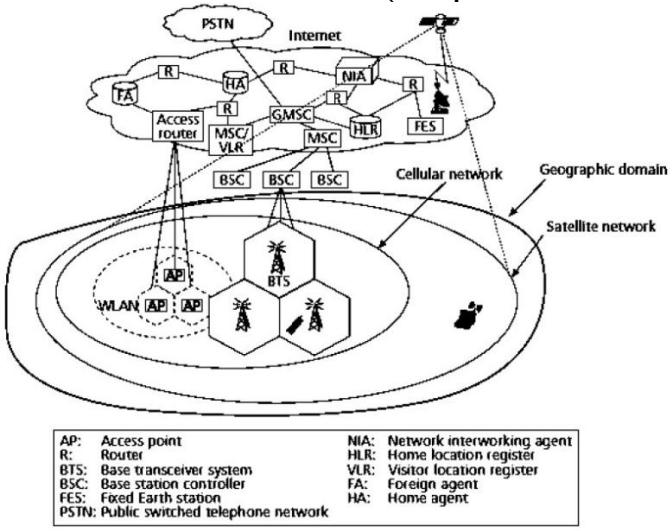

Figure 2: Mobility Management Architecture [Source: (Akyildiz *et al.*, 2005)[11]

2. METHODOLOGY

The mobile handoffs are explained with the following figure 2.1 as follows,

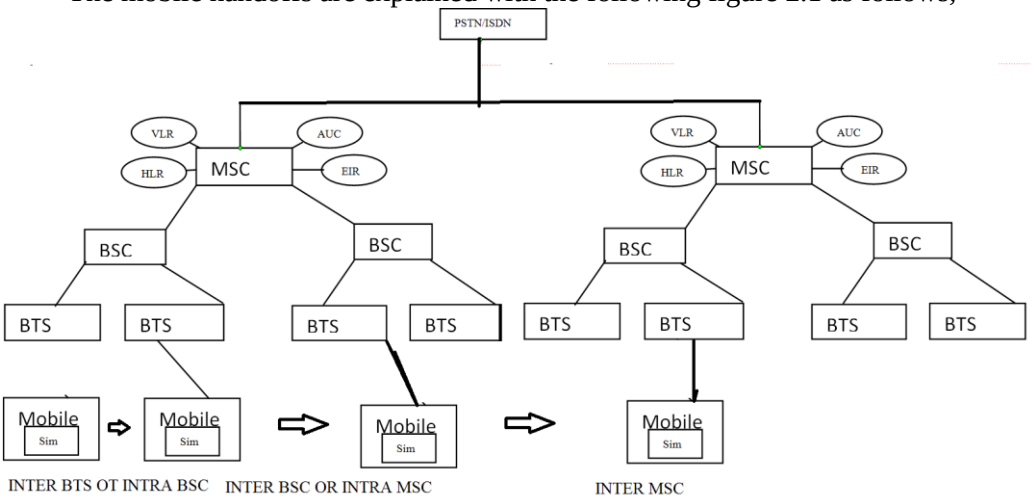

Figure 3: Mobile Network Service Handoff Architecture diagram

The Mobile Handoff system consist of several functional elements including mobile switching centers (MSC), base stations (BSC) with associated base transceivers (BTS), an operation and maintenance centre (OMC) and gateway SC. GSM mobile terminal or mobile stations communicates across the Um interface, known as the air interface, with a base BTS in the small cell in which the mobile unit is located[1]. This communication with a BTS takes place through the radio channels. The network coverage area is divided into small regions called cells. Multiple cells are grouped together form allocations area (LA) for the mobility management. BSC are connected are connected to MSC through dedicated line or radio communication link[3]. The BSC reserves radio frequencies, manages the handover of mobile station from one cell to another within the BSS (base station subsystem). MSC interface to the PSTN (public switched telephone network) is called the gateway MSC. MSC incorporate functions including home location register (HLR), visitor location register (VLR), authentication register (AuC) and equipment identity register (EIR). The HLR and VLR together with MSC provide the call routing and roaming capabilities of GSM[2]. The HLR stores information both permanent and temporary about each of the mobile station that belongs to it[9]. The VLR register maintains information about mobile station that is currently physically in the region covered by MSC. VLR becomes important when user leaves the area served by his home MSC. The two registers are used for authentication and security purpose. The EIR is a database that contains list of all valid mobile equipment on the network, where each mobile station is identified by its international mobile equipment identity (IMEI). It Helps in security and prevents uses of network by mobile station that have been approved[4]. The (AuC) holds the authentication and encryptions keys that are stored in each user SIM card for authentication and encryption over radio channel.

3. IMPLEMENTATION

3.1 Proposed Methodology:

Consider the Mobile equipment A is in online mode with the transporting nature from one locality to another. Then the following proposed methodology will be implemented in order to attain the enhancement in Handoff Management from the service provider. Figure 3.3 represents the associative intensification for Handoff Management.

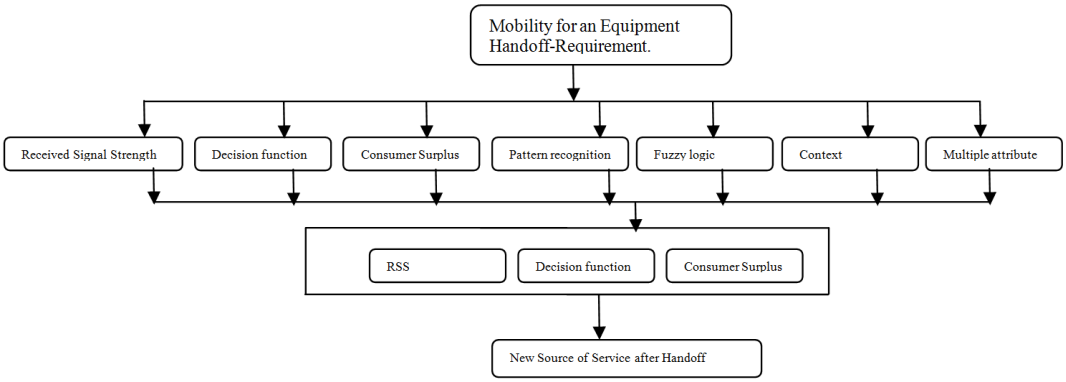

Figure 4: Proposed Methodology for Handoff intensification in Mobile Data Networks

3.2 Received Signal Strength based Handoff

The Handoff is executed based on the signal strength received at the user end without any logical circumstances such as cost, quality, future demands and reservation etc.

Table 1: Received Signal strength based handoff Evaluation

Node	Location	Signal Strength			Cost units
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2
	Inter BSC/Intra MSC	Avg(BT-1)	Low(BT-1 TO BT-2)	Low(BT-1 TO BT-2)	5
	Inter MSC	Avg(BT-1)	Avg(BT-1 TO BT-2)	Avg(BT-1 TO BT-2)	15
	Inter BTS/Intra BSC	Avg(BT-1)	Good(BT-1 TO BT-2)	Good(BT-1 TO BT-2)	35
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70
	Inter MSC	**Avg(BT-1)**	**Best(BT-1 TO BT-2)**	**Best(BT-1 TO BT-2)**	**100**

The total cost incurred for this schema consumes 100 units. But the Handoff executed successfully.

3.3 Decision function based Handoff

The Handoff is executed based on the decision function at the Home network end with certain logical circumstances such as cost, quality, future demands and reservation etc.

Table 2: Decision function based handoff Evaluation

Node	Location	Signal Strength			Cost units	N/w Load
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2	99%
	Inter BSC/Intra MSC	Avg(BT-1)	Low(BT-1 TO BT-2)	Low(BT-1 TO BT-2)	5	98%
	Inter MSC	**Avg(BT-1)**	**Avg(BT-1 TO BT-2)**	**Avg(BT-1 TO BT-2)**	**15**	**97%**
	Inter BTS/Intra BSC	Avg(BT-1)	Good(BT-1 TO BT-2)	Good(BT-1 TO BT-2)	35	50%
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70	35%
	Inter MSC	Avg(BT-1)	Best(BT-1 TO BT-2)	Best(BT-1 TO BT-2)	100	10%

The total cost incurred for this schema consumes 15 units with more N/w load, ready to affect the QoS anytime. But the Handoff executed successfully.

3.4 Consumer surplus based Handoff

The Handoff is executed based on the Consumer count at the destination network end with certain logical circumstances such as cost, quality, future demands and reservation etc.

Table 3: Consumer Surplus based handoff Evaluation

Node	Location	Signal Strength			Cost units	Consumer Surplus
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2	49%
	Inter BSC/Intra MSC	Avg(BT-1)	Low(BT-1 TO BT-2)	Low(BT-1 TO BT-2)	5	48%
	Inter MSC	**Avg(BT-1)**	**Avg(BT-1 TO BT-2)**	Avg(BT-1 TO BT-2)	15	**47%**
	Inter BTS/Intra BSC	Avg(BT-1)	Good(BT-1 TO BT-2)	Good(BT-1 TO BT-2)	35	5%
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70	4%
	Inter MSC	Avg(BT-1)	Best(BT-1 TO BT-2)	**Best(BT-1 TO BT-2)**	**100**	0%

The total cost incurred for this schema consumes < 100 units (99 or less) by avoiding consumer surplus, now the QoS in terms of signal is best with expensive mode. But the Handoff executed successfully.

3.5 Pattern recognition based Handoff

This hand off will be executed based on the time interval history of the individual equipment(Office to Home and vice versa for specific time gaps),group of equipments based on the events towards destination environment(Function/parties etc),Daily routine pattern mapping for the location register entities with peak intervals etc.

Table 4: Pattern recognition based handoff Evaluation

Node	Location	Signal Strength			Cost units	Pattern
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2	Unexpected
	Inter BSC/Intra MSC	Avg(BT-1)	Low(BT-1 TO BT-2)	Low(BT-1 TO BT-2)	5	Abnormal
	Inter MSC	**Avg(BT-1)**	**Avg(BT-1 TO BT-2)**	**Avg(BT-1 TO BT-2)**	**15**	**Normal**
	Inter BTS/Intra BSC	Avg(BT-1)	Good(BT-1 TO BT-2)	Good(BT-1 TO BT-2)	35	Frequent
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70	Rare
	Inter MSC	Avg(BT-1)	Best(BT-1 TO BT-2)	Best(BT-1 TO BT-2)	100	Very Rare

The total cost incurred for this schema consumes an average of 15 units by allotting the optimal service, for the new comers the QoS in terms of signal is best with expensive mode for attraction; also the unexpected scenario spoils the entire network QoS if the pattern structure is wrong. But the Handoff executed successfully.

3.6 Fuzzy logic based Handoff

Here the Fuzzy logic membership function $\mu\varepsilon[0,1]$ will be used for the implementation based on the Visitor and Home location data from History of data in the stored information's against the cost incurred and the affect in QoS for which the customers Quality of Experience holds good.

Table 5: Fuzzy Logic based handoff Evaluation

Node	Location	Signal Strength			Cost units	Fuzzy-μ
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2	0.15
	Inter BSC/Intra MSC	Avg(BT-1)	Low(BT-1 TO BT-2)	Low(BT-1 TO BT-2)	5	0.17
	Inter MSC	**Avg(BT-1)**	**Avg(BT-1 TO BT-2)**	**Avg(BT-1 TO BT-2)**	**15**	**0.68**
	Inter BTS/Intra BSC	Avg(BT-1)	Good(BT-1 TO BT-2)	Good(BT-1 TO BT-2)	35	0.41
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70	0.35
	Inter MSC	Avg(BT-1)	Best(BT-1 TO BT-2)	Best(BT-1 TO BT-2)	100	0.1

The total cost incurred for this schema consumes 15 units by allotting the optimal service with nominal cost, this approach gives negligible choices for the best service experience to the customer at the destination with balanced coverage for the customer and cost effective for the service provider(Non optimal). But the Handoff executed successfully.

3.7 Context based Handoff

The context based handoff resembles the situation based procedure which will be used for the implementation based on the network architecture transfer complexities. For Eg BTS to MSC is complex when compared with BTS to BTS or BSC. The vertical structure context complexity affects the system stabilization for the future transmissions.

Table 6: Context Level based handoff Evaluation

Node	Location	Signal Strength			Cost units	Context Level
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2	Very Ease
	Inter BSC/Intra MSC	Avg(BT-1)	**Low(BT-1 TO BT-2)**	**Low(BT-1 TO BT-2)**	**5**	**Ease**
	Inter MSC	**Avg(BT-1)**	Avg(BT-1 TO BT-2)	**Avg(BT-1 TO BT-2)**	**15**	**Nominal**
	Inter BTS/Intra BSC	Avg(BT-1)	Good(BT-1 TO BT-2)	Good(BT-1 TO BT-2)	35	High
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70	Very High
	Inter MSC	Avg(BT-1)	Best(BT-1 TO BT-2)	Best(BT-1 TO BT-2)	100	Abnormal

The total cost incurred for this schema consumes 5 to 15 units by allotting the ease architecture with least customer satisfaction importance. But the Handoff executed successfully.

3.8 Multiple Attribute Based Handoff

The attributes contributed for this approach includes the following,

1. Data rate in terms of cost,
2. Battery Status,
3. User preference,
4. QoS parameters,
5. Network load,
6. Coverage,
7. Mobility,
8. Packetloss,
9. Received Signal
10. Latency levels are considered for the implementation of Handoff mechanism.

Table 7: Multiple Attributes based handoff Evaluation

Node	Location	Signal Strength			Cost units	Attributes count
A	Inter BTS/Intra BSC	Avg(BT-1)	Very Low(BT-1 TO BT-2)	Very Low(BT-1 TO BT-2)	2	2
	Inter BSC/Intra MSC	Avg(BT-1)	Low(BT-1 TO BT-2)	Low(BT-1 TO BT-2)	5	3
	Inter MSC	Avg(BT-1)	Avg(BT-1 TO BT-2)	Avg(BT-1 TO BT-2)	15	5
	Inter BTS/Intra BSC	**Avg(BT-1)**	**Good(BT-1 TO BT-2)**	**Good(BT-1 TO BT-2)**	**35**	**8**
	Inter BSC/Intra MSC	Avg(BT-1)	Very Good(BT-1 TO BT-2)	Very Good(BT-1 TO BT-2)	70	6
	Inter MSC	Avg(BT-1)	Best(BT-1 TO BT-2)	Best(BT-1 TO BT-2)	100	4

The total cost incurred for this schema consumes 35 units by allotting the optimal features for customer satisfaction importance and service provider marginal profit in the current and in the near future. But the Handoff executed successfully.

4. RESULTS AND DISCUSSION

The following table 7 illustrates the enhancement results obtained through the proposed methodology.

Table 7: Proposed Methodology for Handoff Management Enhancement

Approach/Cost	Cost
Received Signal Strength	100
Decision Function	15
Consumer Surplus	99
Pattern Recognition	15
Fuzzy Logic Based	15
Context Based	5
Multiple Attribute Based	35

The handoff management enhancement using proposed methodology in mobile data network is as follows,

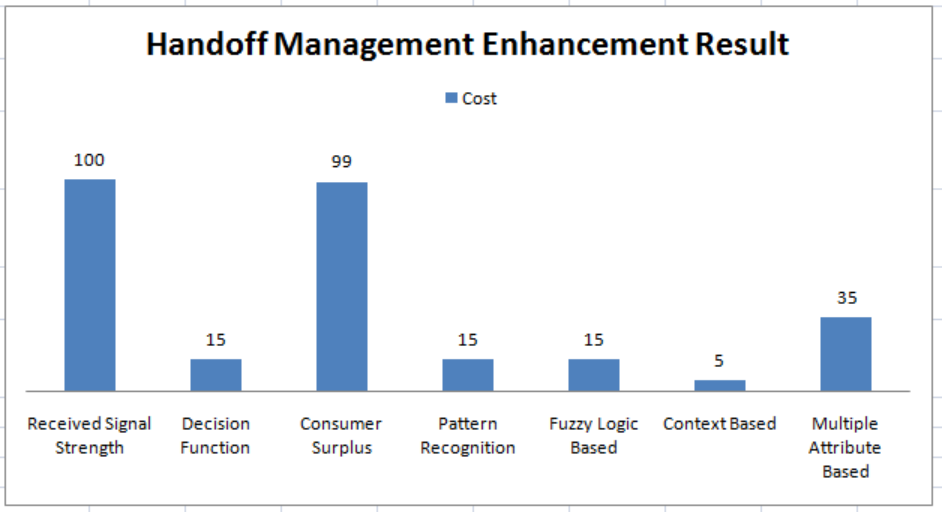

Figure 5: Resultant graph for the Handoff Management effectiveness.

The proposed methodology yields the cost effectiveness by nearly 65% for Mobile data networks.

5. CONCLUSION

The Handoff in wireless Mobile Data networks deals with smooth transition from one tower to another or from one Base station to another or from one MSC to another without any service interruption or termination. The best Handoff plays the vital role in customer satisfaction for 4G-LTE or 5G networks. The proposed methodology focuses on the Handoff management improvement or enhancement in the wireless mobile data networks. The stage by stage wise implementation of Received Signal Strength, Decision function, Consumer surplus, Pattern recognition, Fuzzy logic based ,Context based, Multiple attribute based approaches

results with various levels of implications in Cost effectiveness and customer satisfaction taking both at the nominal rate along with network service and handoff enhancement. The Handoff management enhancement produces nearly 65% gain in the proposed research methodology. The fine tuning of Handoff management in wireless mobile data networks can also be enhanced by identifying the specific amount of guaranteed time for transferring the voice and data between sender and the receiver through 4G-LTE or 5G networks. In near future this proposed methodology will be extended to deal with Neural Networks and Artificial Intelligence.

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