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# Handoff Management Using Msctp With Dar and Mip

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**KEYWORDS :** MIP, Mobile SCTP, Video Streaming, NS2, DAR and Handoff

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## ABSTRACT

Mobile Communication devices such as cellular phone, laptops, and PDAs are typically equipped with multiple radio access interfaces in the current trend. The opportunity to attach to more than one access network at a time makes users capable of roaming over access technologies and administrative domains seamlessly. Soft HO can easily be implemented and load balancing is possible to leverage when the amount of traffic exceeds the capacity of one single radio access interface. The aim of this Research work is to present the relative presentation of MIP and Seamless IP diversity based Generalised Mobility Architecture using the simulation setup using mSCTP for the video streaming.

## 1 INTRODUCTION

Using an IP overlay network and controlling mobility management at the layer 3 is important for tomorrow's networking architectures. MIPv6 with its extensions for fast hand-overs and hierarchies of mobility anchor points is a concrete implementation of such architecture. Adding multihoming functionality to Mobile IPv6, basically allowing an MN to link to more than one gateway in different subnets simultaneously, is yet a step towards the efficient implementation of the foreseen architecture.

This chapter describes an NS2 implementation of multi homed Mobile IPv6 using one IEEE 802.11 wireless access interface (WLAN) and one IEEE 802.16 (WiMAX) interface in the mobile node.

Handsets are equipped with multiple radio access network cards. Technologies including 2G, 2.5G, 3G, WLAN, and WiMAX will be available offering different throughput, delay characteristics, and coverage at various cost levels. 4G is not fully defined yet, but it will most likely consist of an IP overlay network offering its users seamless access to real-time MM services like VoIP, IPTV, video conferencing, and networked games. Important decisions on mobility management schemes and the structure of the IP overlay network still needs to be taken. A node model for a multihomed mobile node implementing simultaneous access to WLAN and WiMAX is implemented by using NS2 for the video streaming.

There has been significant growth in wireless networks in the last two decades that users are able to access the Internet even in mobility. The present Internet infrastructure was not originally intended for mobility. The IETF's MIP ( Perkins C.E., 2002) standard addresses the question of mobility at the Network layer, and ranges the current IP to support node mobility, including HO, by presenting two wireless network infrastructure units:1) HA (Home Agent) and 2) FA (Foreign Agent). Even if the MN has relocated out of its home network, a Correspondent Node (CN) communicates with it through its Home Agent in the home network. The MN should Handoff quickly between networks for Correspondent Node to have seamless connection with the Mobile Node.

The most important Handoff Performance parameters like HO delay and packet loss are experienced by MIP. The performance of real time application during HO is degraded by Large HO latency. For example, in a video conference session a large HO latency will introduce disruption due to breaks in MM transmission. Due to the adding of the Home Agent and Foreign Agent, change in the Internet infrastructure is required by Mobile IP. To address the limits of MIP, a HO system at the layer 4 called SIGMA is developed, which makes use of multi-homing and Internet Protocol diversity to attain seamless HO among networks.

The aim of this Research work is to present the relative presentation of MIP and Seamless IP diversity based Generalised Mobility Architecture using the simulation setup using mSCTP for the video streaming. To set the research work in background, it explains the latest work which has been complete to advance the capability of MIP.

Dynamic IP Address Reconfiguration (DAR), the unique feature of SCTP is suitable in removing inactive paths or building terminated paths, without disturbing the established link. It also deals applications with transport level fault tolerance. Robustness against network failure is provided.

## 2 BACKGROUND WORK

### 2.1 Current Research on MIP Handoff

Many methods have been proposed to moderate Mobile IP packet loss and HO latency. Wireless network IP (Perkins C. et al 1998) uses Hierarchical Foreign Agent (FA) configuration to decrease the frequency and handoff delay of binding updates by using most of the HOs locally. The chance that packets are directed to an obsolete Foreign Agent by many tunneling processes by a hierarchical Foreign Agent structure also decreases, thus reducing the packet loss rate.

Fast Handovers for Mobile IPv6 protocol (Gustafsson E et al 2001) removes the basic MIPv6 HO process in the mobility management, the new Care of Address configuration and Duplicate Address Detection delay. Improved smooth HO not only uses the hierarchical Foreign Agent structure, but also creates the earlier visited Foreign Agent buffer to forward packets to Mobile Node's new position.

When the MN performs a HO, an assured amount of handoff delay in data communication seems to be inevitable because of MIP's ability to connect with only single access point (AP) (Fu S. et al 2005) at any instant of time. Thus Mobile Node cannot send or receive message to or from Correspondent Node while Mobile Node is performing registration and HO, resulting in data disruption during HOs. This is because the MN cannot communicate with the Correspondent Node through the old connection path as it has changed its point of attachment (PoA) to a new AP or the new connection path, and the Home Agent has not yet decided its registration request through the HO. The break in data restricts the possibility of real time communication over wireless networks. The SIGMA is presented as alternative scheme for reducing the effect of disruption discussed above.

### 2.2 Contributions and Structure of the Research work

#### 2.2.1 Introduction to Seamless IP Diversity Based Generalised Mobility Architecture

A complete explanation can be found to support in this thesis a better appreciation of SIGMA, as it describes the many stages convoluted architecture of HO in this section. It is by using the mobile SCTP, which is a new emerging transport layer protocol, is explained this architecture.

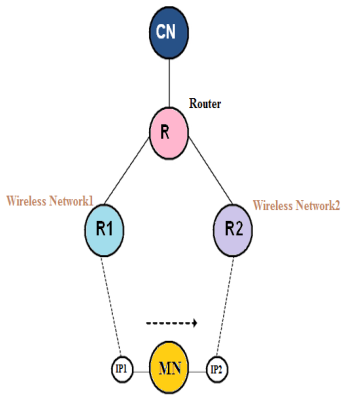



**Figure 1 mSCTP link featuring multi homing for NS2 simulation**

Multi-homing permits a link among two wireless networks to distance through multiple Internet Protocol addresses. In case of failure of the primary address, one of the addresses is selected as the primary while the other can be used as a backup, or when the higher layer application obviously requests the use of the backup. The secondary address can also be done by retransmission of lost packets. The speedup rescue from link failure positions without disturbing continuing data transmissions can be performed by a multi-homed mSCTP link.

Figure 1 gives an illustration of multi homing property to the mSCTP that the two nodes MN and CN are linked from end to end of two networks, with Mobile Node being multi homed. One of the Mobile Nodes(Goff T et al 2010) Internet Protocol addresses is allotted as the primary address for Correspondent N to be used when transmitting data packets and the other Internet Protocol address is used as a backup address in case of failure of primary address.

This chapter analyses the performance of SCTP HO which has the multi-homing feature. Ns-2 simulator and its SCTP module are used for this analysis. The SIGMA based SCTP module in ns-2 does not support any DAR parameters. Therefore to compensate this limitation, HO is introduced by changing dynamic session from one interface to another using force-source command in SCTP (Hala Eldaw Idris Jubara et al 2011) module. Standard SCTP with the DAR extension is known as mobile SCTP (mSCTP).

**a. Get new Internet Protocol address**

When the Mobile Node travels into the coinciding radio coverage area of two neighboring subnets the HO planning procedure starts. As soon as the MN receives the router announcement from the AR2 (NAR), it should start the process of attaining an IP2 (new IP address). That can be done through numerous procedures: Stateless Address Auto configuration (SAA), DHCP, featuring DHCPv6, or IPv6 (Thomson S. *et al* 1998). The differentiation between these approaches is the generation of IP address by a server (DHCP/DHCPv6) or by the MN itself (IPv6 SAA). IPv6 SAA is the best method for SIGMA to make a new address since it considerably reduces the necessary signaling time.

**b. Adding Internet Protocol address to mSCTP link**

The MN's first Internet Protocol address (IP1) and the CN's Internet Protocol address are swapped between MN and CN, and afterwards the mSCTP link is setup. Once the Mobile Node gets another IP address *i.e.*, IP 2, Mobile Node binds IP2 into the link (in addition to IP1) and reports CN about the simplicity of usage of the new IP address.

In this architecture, by sending an Address Configuration chunk Correspondent Node is notified by Mobile Node that IP 2 is available for data transmission to Correspondence Node with consideration type set to add IP location service. After receiving, Correspondent Node will include IP2 address to its home wireless network for the link and respond to Mobile Node with an Address Configuration - ACK chunk showing the completion of the IP adding. Now, IP1address and IP2 address are together prepared for getting data communicated from Correspondent Network to Mobile Node.

**c. Data packets forwarded to new Internet Protocol address**

As Mobile Node traverses through the area of coverage of wireless network 2, the data path 2 becomes gradually more trustworthy than data path 1. To improve the chance of data being conveyed effectively to the MN, the Correspondent Node forwards data traffic to the new IP address (IP 2). The job is done by the Mobile Node distribution, an ASCONF chunk along with Primary IP Address consideration. Then CN sets its main destination address to Mobile Node as IP2.

**d. Location manager updating**

In mSCTP based SIGMA for location managing, a manager of location is used to maintain a database which registers the correspondence between Mobile Nodes characteristics and present main IP location service. Mobile Node uses a public key well-defined in the (PKI) Public Key Infrastructure, domain name or the home address (as in MIP) as its identity. After completing the Primary Address action, the location manager's required record with the new IP address (IP2) should be updated by Mobile Node. The reason for this method is to make sure that Mobile Node changes from the network 1 to network 2. The requests for link setup can be transmitted to Mobile Nodes new Internet Protocol address IP2. This update does not influence the existing active links.

An important variance among SIGMA and Mobile IP has been observed. While the location management and data traffic forwarding functions are coupled together in Mobile IP, they are decoupled in SIGMA to speedup HO and make the positioning further flexible.

**e. Deletion of old IP address**

Mobile Node needs to take out the old IP address from mSCTP link after it completely moves into wireless access network 1. ASCONF chunks with delete IP parameters can discard the old IP address from the active link. CN on reception of this chunk will take out the old and inactive IP address from the link.

**2.2.2 Mobile SCTP**

An MN is permitted by SCTP feature of multi-homing to bind multiple IP addresses to its interfaces. This characteristic feature of SCTP enables it to carry out vertical HO processes. However, vertical HO is not supported by the architecture of SCTP due to the following reasons [Budzisz L*. et al*, 2008].

- During an active SCTP link , there is no possibility in standard SCTP to add new Point of Attachment (PoA).
- During a link the decision of change in a primary path depends only on a failover mechanism.

**2.2.3 Dynamic IP Address Reconfiguration (DAR)**

To cover the effectiveness and application scenarios of SCTP possible extensions to reconfigure IP address information on a present link are introduced. Dynamic IP Address Reconfiguration is:

- An elegant technique to add or delete to the interfaces of an existing link.
- A technique for a destination to appeal to its peer to set the target address.

**The following features empower SCTP to be used in the applications:**

- This feature can provide an elegant technique for computational or wireless networking area that permits inclusion or exclusion of PIC (Physical Interface Cards) to include to the interfaces of a present link. This extension permits number-

ing again of present links for IPv6.
- This offers a technique for a destination to appeal its peer set to its target address. This is useful when an address is about to be deleted. It is also useful when a destination has some prior information about the address which is prepared to receive SCTP packets.

**For dynamic IP address reconfiguration SCTP is used owing to two features delivered by it:**
- Multiple IP-addresses can be used by an endpoint for a single connection.
- These multiple addresses can be changed dynamically by an end point without disturbing the established link.

SCTP can extend to a supporting of mobility transport layer protocol with the help of Dynamic IP Address Reconfiguration (DAR) [R. Stewart *et al*, 2007]. However, DAR can only be used as an enabling of mobility feature, not a mobility solution as a whole [L. Budzisz *et al*, 2008]. The Dynamic IP Address Reconfiguration extension permits SCTP to add or delete Internet Protocol address dynamically, and request for a primary path modification during an active SCTP link with the help of three parameters: 1) Add Internet Protocol Address, 2) Delete Internet Protocol Address and 3) Set primary Internet Protocol Address. Two new chunks that can unfailingly transfer the control information regarding changes in the address are presented by the DAR extension. These are 1) ASCONF (Address Configuration chunks) and 2) ASCONF-ACK (Address Configuration Acknowledgment chunks). The SCTP with DAR extensions is known as mSCTP (mobile SCTP), this can be practiced to perform vertical HOs.

When comparing the simulation in terms of HO delay and throughput, SIGMA using mSCTP displays a better presentation than MIP. This Research work shows the present simulation results of performance evaluation of Seamless IP diversity based Generalised Mobility Architecture using mSCTP and MIP. MIP undergoes interruption in transmission during HO, whereas SIGMA using mSCTP has an insignificant HO Latency and hence seamless HO is achieved. The HO latency of SIGMA using mSCTP is 70 milliseconds which is very much less than 3.7 seconds in Mobile IP.

### 2.2.4 mSCTP Handoff Latency Analysis

The Handoff latency is the time at which the end node obtains a progression of end to end communication using the newly added Internet Protocol address.

$T_{HO_mSCTP}$ = mSCTP HO Delay
Tmd = Mobile nodes Movement Detection
Tac = Time delay of Address Configuration
$T_{DAR}$ = Time delay of Dynamic Address Configuration
$T_{add\text{-}IP}$ = Time delay of Add Internet Protocol Address Chunk Exchange
$T_{pc\text{-}IP}$ = Time delay of Primary Internet Protocol Address Change Chunk Exchange
$T_{del\text{-}IP}$ = Time delay of Delete Internet Protocol address Chunk Exchange
Tpic = Time delay of Primary Interfacing Change

The sum of Mobile nodes movement detection Time delay, Dynamic IP Address Reconfiguration (DAR) Time delay between CN and MN, and configuration of the newly attained Internet Protocol address account for mSCTP HO delay is the HO latency of mSCTP:

$$T_{HO_mSCTP} = Tmd + Tac + T_{DAR} \quad (1)$$

DAR contains the discussion of three metrics: 1) Add Internet Protocol address, 2) Delete Internet Protocol address and 3) Set primary Internet Protocol address information besides the giving out time necessary to transfer the procedure of this information. Then $T_{DAR}$ becomes,

$$T_{DAR} = T_{add\text{-}IP} + T_{pc\text{-}IP} + T_{del\text{-}IP} + T_{pic} \quad (2)$$

$$T_{add\text{-}IP} + T_{pc\text{-}IP} + T_{del\text{-}IP} + T_{pc} = (T_{MN\text{-}CN} + T_{CN\text{-}MN}) + (T_{MN\text{-}CN} + T_{CN\text{-}MN}) + (T_{MN\text{-}CN} + T_{CN\text{-}MN}) + T_{pic} \quad (3)$$

$$T_{add\text{-}IP} + T_{pc\text{-}IP} + T_{del\text{-}IP} + T_{pc} = 3(T_{MN\text{-}CN} + T_{CN\text{-}MN}) + T_{pic} \quad (4)$$

The primary crossing point to send out all data chunks could use in SCTP, as Mobile Node is a multi-homing device. The newly obtained IP address is configured using Secondary interface. Thus, $T_{md} + T_{ac}$ can be ignored, because during these procedures without session termination CN and MN can communicate.

Then the total HO delay can be written as,

$$T_{HO_mSCTP} = 3(T_{ac} + T_{md} + 3(T_{MN\text{-}CN} + T_{CN\text{-}MN}) + T_{pic} \quad (5)$$

$$T_{HO_mSCTP} = T_{MN\text{-}CN} + T_{CN\text{-}MN} + T_{pic} \quad (6)$$

Hence delay presented by exchanging Dynamic IP Address Reconfiguration control chunks among Mobile Node and Correspondence Node, $3(T_{MN\text{-}CN} + T_{CN\text{-}MN})$, can be ignored as no more time is spent in communicating these chunks from MN towards CN. The Address Configuration chunk can be transferred by bundling them through data chunks. Simply time delay considerable enough is the giving out time of an MN during DAR process, and it mainly includes handoff data communication from one crossing point to an additional.

Then the mSCTP total theoretical HO latency can be written as

$$T_{HO_mSCTP} = T_{md} + T_{ac} + T_{MN\text{-}CN} + T_{CN\text{-}MN}) + T_{pic} \quad (7)$$

$$T_{HO_mSCTP} \cong T_{pic} \quad (8)$$

The above equation illustrates that the mSCTP Handoff latency simply accounts for the giving out time of the mobile node that is necessary to change among nodes. Therefore, the mSCTP can capably present the necessary seamless motion with lowest HO latency.

## 3 COMPARING OF MSCTP HANDOFF AND MIP

Table 1 shows the comparison of the HO latency essential for MIP and mSCTP HO. In the table it appears that the total HO delays of Mobile IP for two setups are larger than those of mobile SCTP around by $2(2D_{MN\text{-}HA} + D_{HA\text{-}CN})$, which links to the binding update delay of MIP over Home Agent (*i.e.*, binding update among Home Agent and Correspondent Node). This is the reason why the MIP HO processes are in need of the binding update with Home Agent.

**Table 1 Evaluation of HO latency of mobile IP and mSCTP**

| | Mobile IP | mSCTP |
|---|---|---|
| Total HO Latency | $T_{Ho_MIP} = T_{MD} + T_{AC} + 2(2D_{MN\text{-}HA} + D_{HA\text{-}CN} + D_{MN\text{-}CN})$ | $T_{HO_mSCTP} \cong T_{pic}$ |

## 4 SIMULATION SETUP

MIP comprises four nodes such as 1) Home Agent (HA), 2) Correspondent Node (CN), 3) Foreign Agent (FA), and 4) Mobile Node (MN). The entire nodes follow the respective agents created by NS2. The Correspondent Node and the simulation setup running the Home Agent and Foreign Agent are linked, while the Mobile Node and APs are linked to two distinct private networks.

Except for the absence of Home Agent or Foreign Agent in SIGMA, it is similar to that of MIP in other respects such as network topology.

## 5 RESULTS

The results of HOs for Mobile IP and SIGMA using mSCTP for the video streaming are presented and compared in this section. For evaluation are used throughput and HO latency as the performance measures. Throughput is the average rate of successful packet transfer over a communication. The throughput

is usually measured in bits per second (bit/s or bps), the time duration between the mobile node that gets the last packet from wireless network 1 and the first packet from the wireless network 2 is called HO latency. HO latency can indicate how much HO upsets communication quality of services, which worries the users, managers and operators of a wireless network.

The simulation results are described below Figure 2.

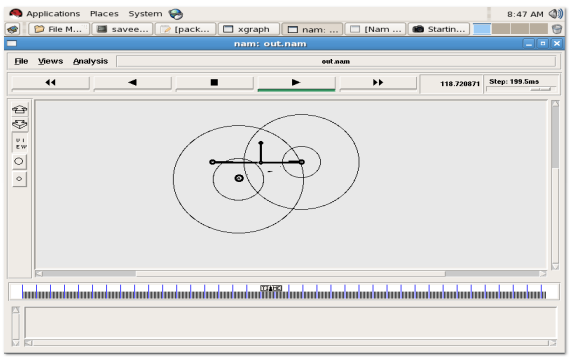



**Figure 2 Mobile IP simulation setup using NS-2.**

**Results for Mobile IP HO**

Figure 3 illustrates the throughput through Mobile IP HO among Wireless Network 1 and Wireless Network 2. The differences in throughput inside Home Agent and Foreign Agent are due to wireless network congestion rising from annoyed traffic in the production CN. For the HO that starts earlier the average throughput is 2.43 Mbps.

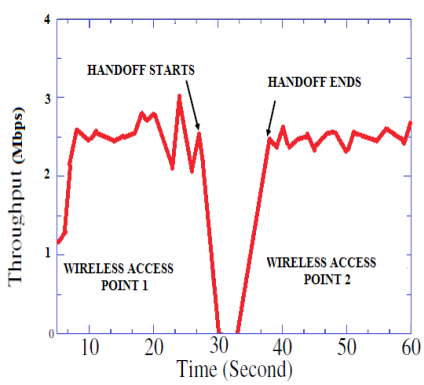



**Figure 3 Throughput of Mobile IP HO**

For the HO that ends the throughput is 2.39 Mbps. These are due to the triangular routing. But during HO period the average throughput is zero, which lasts for about 3.7 seconds from HO start time t= 30 seconds to HO end time t =33.7 seconds.

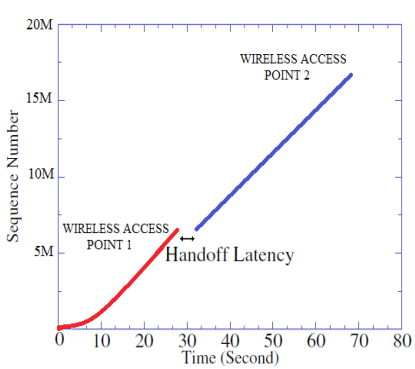



**Figure 4 MIP Handoff Packets trace**

Figure 4 illustrates the packets trace of the MIP HO. The real HO delay for Mobile IP can be obviously intended by having a zoomed in view of the packet trace graph. The obtained HO delay is 3.7 seconds for MIP.

The Registration delay is also a part of the HO delay in MIP. The time taken by the Mobile Node to register it with the Agents is called Registration Latency that is calculated as follows. The xgraph displays that the Mobile Node showed registration request to the Home Agent at time t =30.5123 second, and received reply from the Home Agent at about t= 30.5180 second, resulting in a registration time with Home Agent of 5.7 ms. The purpose is, when MN registers with the Home Agent, the registration can be directly performed with the Home Agent. Otherwise, if it registers with the Foreign Agent, the MN registers each new CoA with its Home Agent may be by way of the Foreign Agent. So the Registration delay is larger when the Mobile Node is in the Foreign Agent, which is added to the HO latency.

**Results from SIGMA HO**

Figure 5 and 6 illustrates the throughput result of SIGMA using Mobile SCTP and it is observed that during SIGMA HO the throughput does not go to zero.

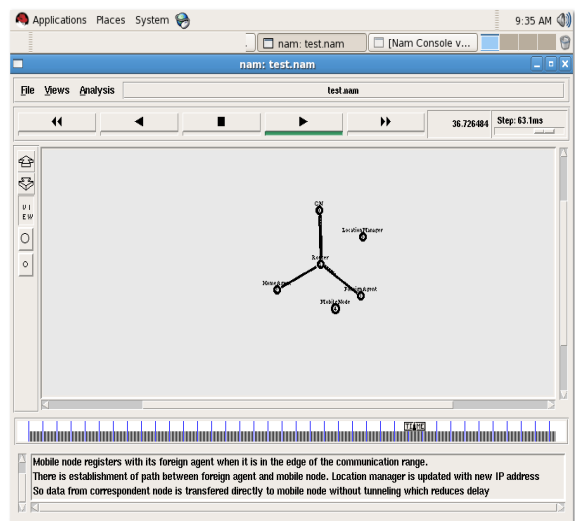



**Figure 5 SIGMA using mSCTP setup**

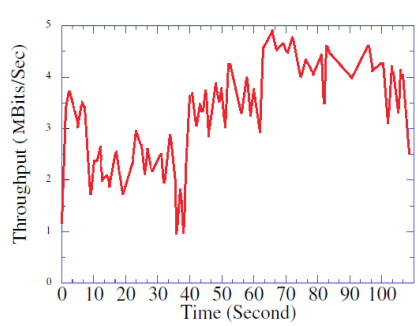



**Figure 6 Throughput of SIGMA Handoff**

The differences in the throughput are due to the network congestion rising from cross traffic in the CN. It does not show the gap caused by the HO in the throughput graph, since the latency is in milliseconds and the graph is in seconds. It should be noted that xgraph shows the HO beginning at t = 50.755 seconds and completion at t= 50.825 seconds, lasting for a total HO latency of about 70 milliseconds.

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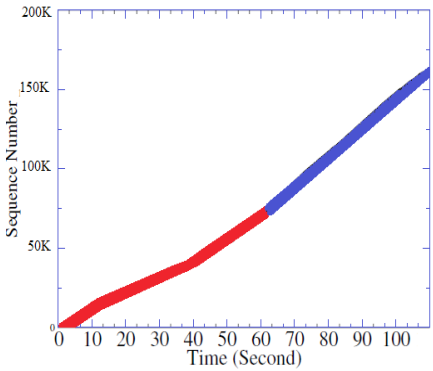



**Figure 7 The Packet trace of SIGMA using mSCTP Handoff**

Figure 7 illustrates the packet trace through SIGMA HO. It is shown that packets reach at the Mobile Node without any gap or interruption; this establishes SIGMA is smoother HO as matched to MIP. It's shown by simulation that a seamless HO can be apprehended through SIGMA.

**5.3 Comparison of Seamless Internet Protocol diversity based Generalised Mobility Architecture and MIP Handoffs**

The Simulation results of the MIPv6 and mobile SCTP HO processes that are implemented using NS2 simulator is described in this section. The results show that the mobile SCTP HO delay is smaller than the MIP Handoff delay. This is essentially the reason why the MIP binding update delays among Home Agent and Mobile Node are relatively enormous. The delays involved in the ADD Internet Protocol and Primary Alteration operations of mobile SCTP HO is compared. It is clear that the mSCTP ADD-IP and Primary Alternate processes are finished within 70 ms.

**Table 2 Results of HO Latencies of MIP and mSCTP**

| HO LATENCY | MIP | mSCTP |
|---|---|---|
| | 3.7 s | 70ms |

It's observed that the Mobile IP registration time is 100ms, and the HO delay of MIP is 3.7sec and HO delay of mobile SCTP based SIGMA is 70ms is shown in the table 2. The causes for Mobile IPs HO latency being much longer than its registration time are described below. The HO latency in MIP originates from three issues:

(1) Left over Home Registration Life Time after link layer handoff which can be from 0 to one Life Time, (2) The time duration of last time advertisement plus Foreign Agent advertisement interval which was not taken note of by MN, and (3) Registration delay. In the NS2 implementation of Mobile IP the MN takes a registration life time after every effective registration. It makes another registration on termination of this life time. So it is possible for the MN to delay the registration even after it has done a link layer HO and received Foreign Agent announcements. This can present some latency which can be up to the period of a life time.

The CN cannot transfer through either the earlier path because it has completed link layer HO to the Foreign Agent but the Mobile Node has not yet done the registration, due to the above three latency factors. So the throughput is zero in result. This has been removed in SIGMA for the use of Internet Protocol diversity and DAR in the decoupling of registration and data transmission. The data remains to flow among the MN and CN during the HO method in result.

## 6 CONCLUSION

In this work the HO presentation of SIGMA using mSCTP to the suggested seamless HO system, which is based on Internet Protocol diversity, is compared with MIP in a simulation setup. The HO latency, packet trace and throughput of MIP and SIGMA using mSCTP were evaluated, which gave the HO delay of MIP as 3.7sec and the HO delay of mobile SCTP based SIGMA as 70ms. The reason for lower HO latency of SIGMA is due to its use of Internet Protocol diversity in which the Mobile Node makes the new path like registration etc. while still connecting over the old path. This removes the communication interruption between MN and CN during HO. As a result, there is a very low Handoff delay and seamless HO in the instance of SIGMA using mSCTP.

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