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Introducing Stream Control Transmission Protocol in Vertical Handover

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Abstract: This study proposes a new method to facilitate seamless vertical hand over between UMTS and WLAN networks using stream control transmission protocol. Multi-homing, Single homing address reconfiguration methods are adopted here to improve throughput performance unlike mobile IP, session initiation protocol, SCTP does not require home and foreign agents to the existing networks. Performance evaluation of both single homing and multi homing features are studied and demonstrated here.

Key words: Handover, SCTP, FS, WLAN, UMTS

INTRODUCTION

Existing solutions to vertical hand over supporting the integration of UMTS and WLAN include network and application layer techniques based on mobile IP, SIP. MIP uses the home agent and foreign agent to bind the home address of mobile host to the care of address at the visited network. And mobility transparent packet forwarding when the MH is moving between IP subnets. However, MIP suffers from the problems of triangular routine, high hand over latency and large overhead of tunneling IP Packets. Compared with MIP, SIP based mobility support offers attractive benefits when used in mobile multimedia applications. However, some inherent problems with SIP based approach make this scheme difficult to adopt. Another issue is the interoperability of SIP and MIP because.

HA and FA registration process serves the same purpose as the SIP registration.

Function so using these methods may be problematic.

SCTP

Stream control transmission protocol is a next generation transport layer protocol for the Internet. The transport layer is the lowest layer to support end-to-end services (Perkins, 1996). In this study multi homing, single homing features are applied to the WLAN networks and performance are studied. Figure 1 shows SCTP architecture of a natwork. Compared with MIP and SIP based mobility support SCTP has the following advantages:

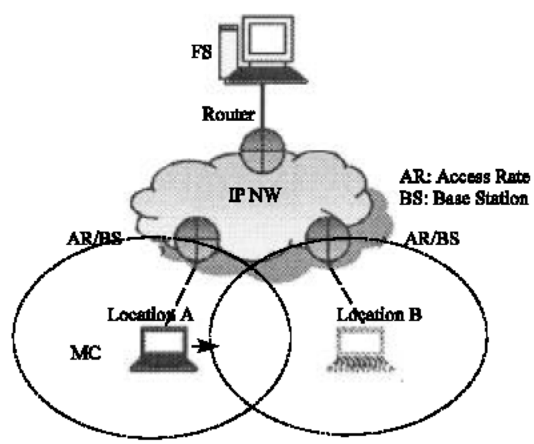

Fig. 1: Hand over using SCTP

- No third party other than the end points participates in the hand over.
- It can support concurrent usage of any type of access routers.
- Additional network components and modification of intermediate routers are not required.

Here, two types of configuration have been proposed to support hand over using SCTP.

LOOSELY AND TIGHTLY COUPLED ARCHITECTURE

There are two possible approaches to the design of an integrated UMTS/WLAN network architecture, defined as tight coupling and loose coupling inter-working. In a tight coupling inter-working architecture, the WLAN

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is connected to the UMTS core network in the same manner as other UMTS radio access networks. SGSN and GGSN need to be updated to be able to handle the much higher bit rates supported by the WLAN. The main advantage of this solution is that the mechanisms for mobility, QoS and security in the UMTS core network can be reused directly (Stewart *et al*., 2003). However, tightly coupled solutions will be highly specific to the UMTS technology and cause a larger impact in the form of extensive access interface standardization. Unlike the tight coupling approach, a loose coupling inter-working architecture introduces a new element called Inter-Working Unit (IWU) or Gateway in the WLAN. The objective of designing this scheme is to make the handover between the two networks as seamless and efficient as possible. Therefore, introducing Mobile SCTP (M-SCTP) to support UMTS/WLAN integration makes the entire network architecture simpler by working without additional entities added into the network (Moh *et al*., 1999). The architecture can be either tight coupling or loose coupling. The basic assumption for the seamless VHO between UMTS and WLAN cell is that the MC is able to obtain a new IP address when it moves into a WLAN cell, via either DHCP or Stateless Address.

The general requirements for SCTP to support seamless VHO are:

- Both MC and FS are equipped with M- SCTP implementation, i.e., SCTP with DAR extension;
- Dual-mode support of UMTS and WLAN at the physical and data link layers of the MC;
- Issues on AAA, subscriber identification and QoS provisioning due to change of access network have been resolved through roaming agreements between UMTS and WLAN under one or more operator (s) (One and Yaoku, 2002).

THE PROPOSED WORK

To support Vertical Handover the Fixed Server (FS) may be configured for: Single homing, i.e., FS provides only one IP address to support the handover; or dual homing, i.e., FS allows more than one (usually two) IP addresses to support the MC's mobility.

Single-homing FS: Figure 2 depicts the Vertical Handover procedure using Fixed Server in single homing Configuration. Initially MC will access the data via UMTS Networks When MC moves into a WLAN cell covered by a UMTS cell, it gets a new IP address *WLAN_IP*. It is provided with the primitives ASCONF

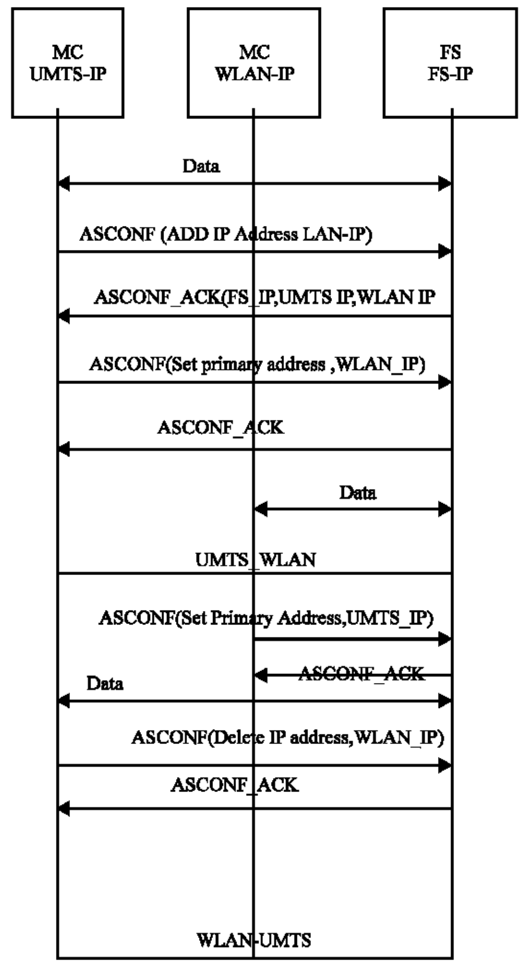


Fig. 2: Single homing configuration

(Add new IP-Address). Similarly ASCONF-ACK is received from the File Server. In this configuration, because of the handshake process, the VHO delay can be calculated as:

$$\text{Delay}_{overal} = T_{ASCONF} + T_{Handover,}$$

Where, T ASCONF=ASONF and ASCONF_ACK Transmission Time.

$T_{handover}$ = Change-over command delay and buffered data transferring time.

After WLAN/UMTS VHO Triggering process, if MC loses the signal from the WLAN cell, it enters in the Delete IP Address process. MC sends an ASCONF with parameter type set to "Delete IP Address" to request FS to release the address *WLAN_IP* from its host routing table. When MC receives ACK from FS, MC deletes *WLAN_IP* from its address list and *WLAN_IP* is released from the association.

Dual-homing FS: There are two differences between this procedure and that for single-homing FS. The first difference is the Add/Delete IP Address process. In the dual homing configuration, when FS responds to MC's adding/deleting IP address request with an ACK, FS bundles an ASCONF to request MC to add/delete the FS's secondary IP address into/from the association. MC sends ACK to confirm the completion of Add/Delete IP Address process. The second difference is in the VHO Triggering process. Since, both MC and FS are in dual homing configuration, MC can directly set the FS's secondary address as the primary destination in its host routing table and start to send data on the new link. In this case, there is no handshake process and the VHO delay becomes:

***T Delay handover overall* =_T handover**

Comparison of TCP and SCTP

- SCTP uses *Streams* to transmit data, which are appropriate for message-based applications (Madisetti and Argyrious, 2002). This differs from TCP's byte-stream method, which delivers a stream of bytes in the same order as it was presented by the application. SCTP is more sophisticated and the data can be divided up into different streams. Each stream can then be delivered with its own characteristics and largely independent from other streams. Streams can be defined as 'Strictly-Ordered and Reliable', like TCP, or just 'Reliable', so that data will be delivered to the application as soon as it arrives. Newer versions of SCTP have also introduced a third variation called 'Partially Reliable', which offers a service resembling UDP (Madisetti and Argyrious, 2002). The Head-of-Queue Blocking of TCP, which prevents it delivering subsequent data if data is lost, is avoided as each stream operates independently. SCTP can deliver data to the application while waiting for the retransmitted Protocol Data Unit (PDU) to be delivered.
- The second difference relates to the way SCTP interacts with the IP layer. TCP assumes that each host has only one IP address, while SCTP introduces the possibility that many different IP addresses are possible. For any transport protocol, it is important to be able to identify the source of incoming information and the application it is destined for. TCP uses a 4-tuple in order to do this; a source address and port number pair and a destination address and port number pair are used to uniquely identify each connection. SCTP allows an association to use a range of available IP addresses, so that it is possible to have *n x m* pairs of valid IP addresses, where n and m are the number of available IP addresses at each end-point (Stewart and Xie, 2001). The main reason for doing this is to make an Association more resilient to network failures, since the signaling community expects a higher level of reliability than is generally available from the Internet. This study is concerned with the single and multi-homing feature of SCTP. Also SCTP single and double homing methods were implemented in WLAN networks and the data transfer rate is plotted in the Fig. 3 and 4. The performance comparison of few statistical data is given in the Table 1.

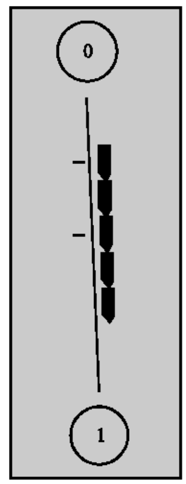


Fig. 3: Single homing movements of packets

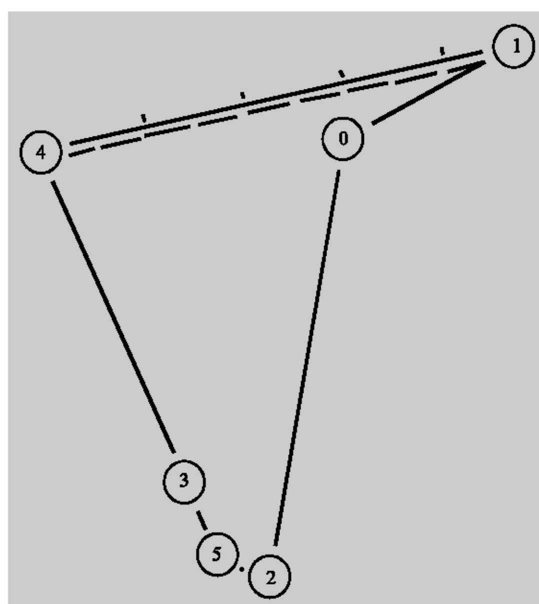


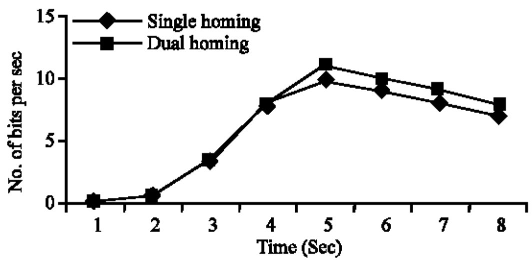
Fig. 4: Dual homing movements of packets

Table 1: TCP and SCTP Throughput comparison

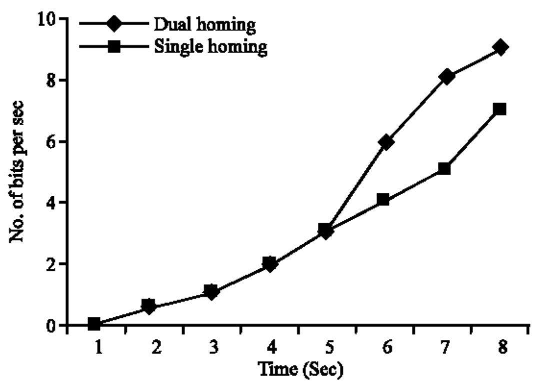
	Throughput in Mb s^{-1}		% of 1.6 Mb s^{-1}		
Error	TCP	STCP	TCP	STCP	% change SCTP to TCP
0%	1.32	1.525	82.5%	95.3%	15.5
1%	1.08	1.225	67.5%	76.6%	13.4
2%	0.72	0.855	45.1%	54.3%	18.8
5%	0.35	0.481	21.9%	30.0%	37.4

Table 2: Performance delay

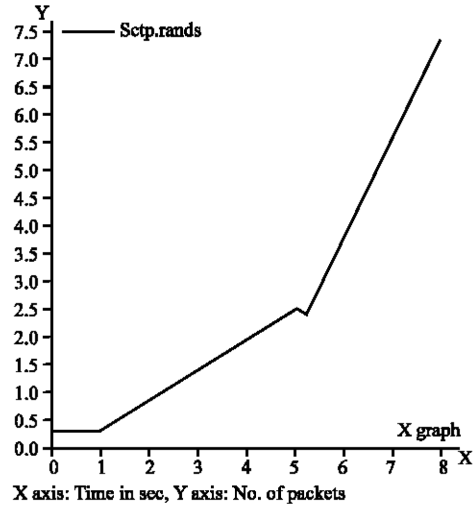
Types	Node	Single homing	Dual homing
UMTS-WLAN	Fixed server	533 ms	234 ms
WLAN-UMTS	Fixed server	513 ms	212 ms



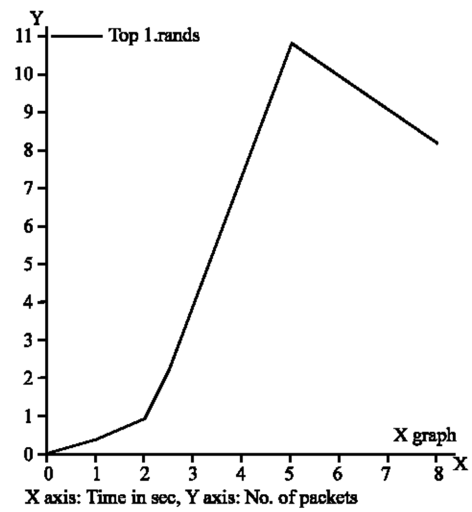
Graph 1: WLAN To UMTS



Graph 2: UMTS to WLAN



Graph 3: Overall throughput UMTS to WLAN (Dual homing)



Graph 4: Overall throughput WLAN to UMTS (Dual homing)

RESULTS AND DISCUSSION

We extend the SCTP module so that the single homing and double homing feature can work over WLAN Networks. The bandwidth is set to 2 Mbps for WLAN link. Compared to Mobile IP, the packet transmission rate is very high in SCTP.The delay a characteristic which is encountered during simulation process is shown in the Table 2.

The Graph 1 and 2 shows the throughput performance of a Network, which uses SCTP protocol in Single and Dual homing during handover from WLAN to UMTS and UMTS to WLAN respectively. Graph 3 and 4 shows the throughput performance of a Network, which uses Dual homing features, So that the delay and packet lose, is reduced and is approximately to zero.

CONCLUSION

A method support UMTS/WLAN Vertical Handover using SCTP has been proposed in this study. We have studied different scenarios employing single-homing and dual-homing FS to support VHO. Simulation results showed that delay and throughput performance can be improved significantly using the dual homing configuration. In dual homing configuration, duplicated buffered data transmission over both old and new paths may help receiver and sender to adapt to a sudden change of link characteristics easily and quickly during and after a vertical handover.

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