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巢狀式行動網路下整合 SIP、HCoP-B 與第二層快速換手的跨層架構設計

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摘要

因應未來無線車輛網路快速的發展，我們所要探討的網路不在只是侷限於單一行動節點(MN)，而是管理整群巢狀式行動網路的高速移動。行動網路架構裡有行動路由器（MR），在 MR 裡的所有 MN 要傳送封包都必須經由此 MR。由於巢狀式行動網路換手時要執行複雜的行動網路流程，因此會延長換手延遲時間。所以為了維護 MN 執行中的 SIP 即時服務，如何減少巢狀行動網路換手時的換手延遲時間是非常重要的。在過去傳統上對於行動節點或行動網路上執行 SIP 應用的研究，可以分為幾部分探討：(1)各種第三層的行動網路協定; (2)第五層的 SIP 協定; (3)結合第二層觸發的 FMIPv6 快速換手。事實上這三部分的研究，都只分別解決了行動節點或行動網路換手時的部分問題，並不是一個全面性的解決方案。因此在本計畫中，我們將設計一個以往未曾提出的跨層架構，整合以下三個協定層，達成完整的支援巢狀式行動網路環境下 SIP 多媒體應用的快速與無縫式換手。本跨層巢狀式行動網路架構包含原本 TCP/IP 架構中的二、三與五層：

(1) 第二層的 802.11 與 802.16 協定:藉由這兩種主流無線網路第二層觸發幫助，可以協助第三層快速換手;(2) 第三層 HCoP-B 的流程與 BUT 的架構:藉由過去兩年計畫提出的 HCoP-B 架構與協定，提供巢狀式行動網路環境下封包傳送的路由最佳化、減少換手延遲與 BU 連結更新訊息負擔的優點; 在結合 FMIPv6 的快速換手機制後，整個巢狀式行動網路更能在新的第二層鍊結連線前提早取得 Care of Address，同時向所有 HA 與連線中的 CN 發出全域連結更新，進一步的縮短換手延遲的時間，並快速地將資料轉送到行動網路換手後的位置。(3) 第五層 SIP 通話中行動性(mid-call mobility)機制：延續過去相關對於行動節點與單層行動網路的研究成果，我們首先設計巢狀式行動網路環境下，減少 SIP 控制訊息的換手延遲、所傳送的 SIP 控制訊息數量與頻寬消耗。除了 SIP 控制訊息的處理之外，SIP 所傳送多媒體資料必須透過第三層網路層的 HCoP-B 處理，才能同時達到封包傳送的路由最佳化。因此在巢狀式行動網路換手時，透過我們所設計的跨層架構將 SIP 與 HCoP-B 類似性的設備、流程、資料結構的整合,SIP 控制訊息與 SIP 所傳送多媒體資料都能更快速的轉送到目的地，達成支援 SIP 應用的無縫式巢狀行動網路的目標。本計畫將分為兩年執行： 1. 第一年重點為整合 SIP 與 HCoP-B 相似的設備、流程與資料結構，完成巢狀行動網路下的第三層與第五層的

SIP＋HCoP-B 跨層架構。 2. 第二年重點為結合 FMIPv6 的快速換手機制於第一年整合的 SIP＋HCoP-B 架構，設計出 Fast SIP＋HCoP-B 的跨層架構，進一步的縮短換手延遲的時間，快速地將資料轉送到行動網路換手後的位置，完整的支援巢狀式行動網路環境下 SIP 多媒體應用的快速與無縫式換手。

關鍵字：車輛網路;巢狀式行動網路;跨層;無縫式換手;快速換手

Design of a Cross-Layer Architecture with Integrated SIP, HCOP-B and Layer 2 Fast Handoff for Nested Mobile Networks

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Abstract

As the rapid development of vehicular wireless networks (VANET), we have to face the problem of how to manage the mobility of the nested mobile network (NEMO), which contains a group of mobile nodes (MN) in its hierarchical structure moving together in high speed, instead of the mobility of a single MN. The NEMO must equip new network devices, which are called mobile routers (MR), to forward packets from or to MNs in the NEMO. Because traditional NEMO protocols, like the IETF NEMO Basic Support (NBS), have to execute their complex procedures when the nested NEMO hands over to a foreign network, they suffer from long handoff latencies such that ongoing real-time SIP services executed by MNs may be interrupted during the handoff process, which in turn degrades quality of services (QoS) of these SIP applications. Hence, it is very important to reduce the handoff latency of the NEMO protocol to maintain ongoing SIP services in the nested NEMO. There have been three kinds of researches for applying SIP on the MN or the NEMO. They focused on proposing protocols of different layers: (1) integrated layer two, i.e., L2, and layer three, i.e., L3, fast handoff protocol like Fast MIPv6 (FMIPv6); (2) L3 network protocol for mobility like mobile IPv6 (MIPv6); (3) layer five, i.e., L5, SIP protocol. However, these individual approaches only provide partial solutions for the nested NEMO handoff and ignore problems beyond their scopes. In this project, we will provide a total solution by proposing a novel cross-layer architecture to integrate aforementioned three kinds of researches. In this way, we can fully support the fast and seamless handoff of ongoing SIP services in the nested NEMO. This cross-layer nested NEMO architecture integrates related L2, L3 and L5 protocols in original TCP/IP protocol stack: (1) L2 802.11 and 802.16 protocols: With helps of L2 triggers in these two popular wireless networks, L3 network protocols can enhance their capabilities for fast handoff; (2) L3 HCoP-B and its BUT architecture: In the past two years, we have proposed our HCoP-B schemes to achieve route optimization (RO) with significantly reduced handoff latency and signaling overhead for packet transmission in the nested NEMO. If

HCoP-B can integrate the fast handoff mechanism incurred by L2 802.11 and 802.16 triggers from the protocol like FMIPv6, all MNs and MRs of the whole nested NEMO during handoff can acquire their new care-of addresses and execute global binding updates with their home agents (HA) and correspondent nodes (CN) before the nested NEMO has completed its association with the new L2 link. In this way, HCoP-B can further reduce its handoff latency and forward packets to the NEMO as fast as possible. (3) L5 SIP mid-call mobility: We will first extend results of related SIP researches on MNs and the single-layer NEMO to the nested NEMO for reducing handoff latency and the number and corresponding consumed network bandwidth of SIP control messages when handoff. Furthermore, we have to consider how to support RO of SIP media data, which is routed by L3 HCoP-B, at the same time. Hence, our cross-layer scheme will integrate similar equipments, flows and data structures of L5 SIP and L3 HCoP-B such that both SIP control messages and media data can relay to the destination in the nested NEMO through the optimal route to achieve SIP seamless mid-call mobility when handoff. Planned works of this two-year project are listed as follows: 1. In the first year of this project, we will focus on integrate similar equipments, flows and data structures of L5 SIP and L3 HCoP-B and then propose a cross-layer scheme called as SIP＋HCoP-B for the nested NEMO handoff. 2. In the second year of this project, we will propose our Fast SIP＋HCoP-B scheme by adopting the FMIPv6 fast handoff mechanism with L2 802.11 and 802.16 triggers on the integrated SIP＋HCoP-B scheme of this project. Consequently, this cross-layer Fast SIP ＋HCoP-B scheme fully integrates L2 802.11/802.16, L3 HCoP-B and L5 SIP such that it provides a total solution for supporting the fast and seamless mid-call mobility of SIP services for the nested NEMO.

Key words：VANET;Nested Mobile Network;Cross-Layer;Seamless Handoff;FastHandoff