USIM based Authentication Test-bed For UMTS-WLAN Handover

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Abstract

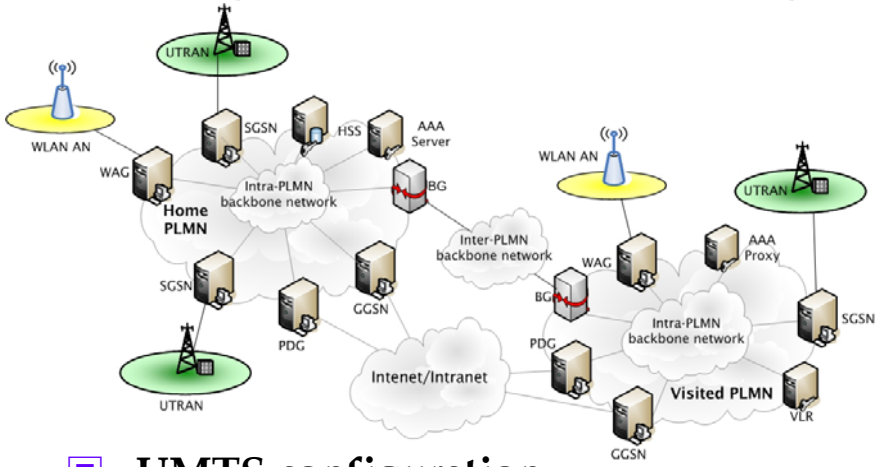
- In view of mutual complementary feature of wide coverage and high data rate, the interworking between 3G cellular network and WLAN is a global trend of wireless communications.
- In this paper, we analyze an authentication mechanism for 3GPP-WLAN seamless mobility by USIM-based authentication test-bed.
- In handover between heterogeneous networks, authentication is the main factor of handover delay. So authentication processing time should be firstly reduced.
- This paper describes an USIM-based EAP-AKA Test-bed implemented for handover in UMTS and WLAN interworking systems. For considering the fast re-authentication mechanism during handover, we show the analytic results of EAP-AKA processing in our test-bed.

Introduction

- Recently, due to the mutual complementary feature of wide coverage and high data rate, the interworking between 3G mobile networks and Wireless LAN (WLAN) is a global trend of wireless communications.
- For the seamless mobility between 3G and WLAN, low handover delay has to be achieved. Main factor of handover delay between these heterogeneous networks is authentication.
- For the purpose of reducing authentication processing time in 3G-WLAN handover, the application of fast re-authentication mechanism during handover is considered [1][2].
- This paper describes the USIM based EAP-AKA Test-bed implemented for handover in UMTS and WLAN interworking systems and shows the analytic results by measuring and comparing the delay of fast re-authentication and full authentication of EAP-AKA in our test-bed

UMTS-WLAN Interworking Architecture

Example of UMTS and WLAN Interwoking architecture following the 3GPP specification [3].



WLAN configuration

- WLAN AN
  - WLAN access network having more than one WLAN AP (Access Point).
- 3GPP AAA Proxy
  - A proxying and filtering function in the visited network.
- 3GPP AAA Server
  - Retrieves authentication information and subscriber profile from the HSS in 3GPP subscriber's home network.
- WAG (WLAN Access Gateway)
  - A gateway for the data to/from the WLAN AN and the UE (User Equipment).
- PDG (Packet Data Gateway)
  - A gateway for accessing the 3GPP PS (Packet Service) based services.

Common

- HSS (Home Subscriber Server)
  - Same functionality of AuC (Authentication Center) and HLR (Home Location Register).

UMTS configuration

- SGSN (Serving GPRS Support Node)
  - A gateway for accessing the packet core network.
- GGSN (Gateway GPRS Support Node)
  - A gateway for accessing the 3GPP PS based services or external IP based network, the PDG has the same functionality as that of the GGSN.

UE Configuration

- WLAN UE
  - A dual-mode mobile terminal with USIM (User Subscriber Identity Module

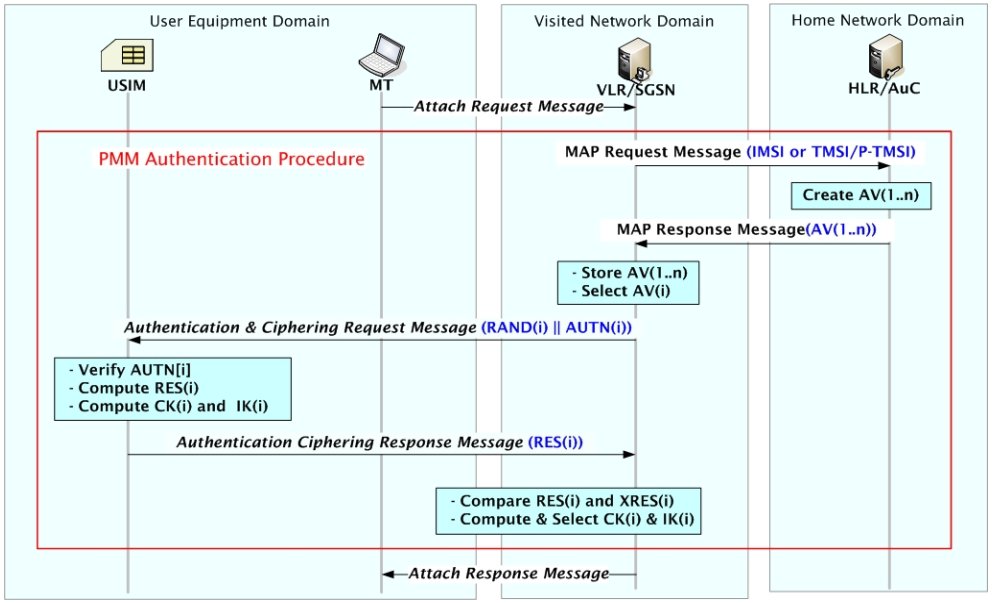
Authentication Mechanism in UMTS (1/2)

UMTS AKA [4]

- Mutual authentication and all key agreement mechanism based on symmetric keys in USIM module of UE in UMTS.
- USIM and network have a common secret key beforehand.

- Authentication entities
  - AuC, VLR and USIM

- Authentication vector (AV)
  - *RAND* : A random number
  - *XRES* : An expected response
  - *CK* : A cipher key
  - *IK* : An integrity key
  - *AUTN* : An authentication token



- Each AV is only valid for one AKA between the VLR and the USIM
- Each AV is ordered by the sequence number *SQN*.

Authentication Mechanism in WLAN Access System (1/2)

EAP-AKA [5][6]

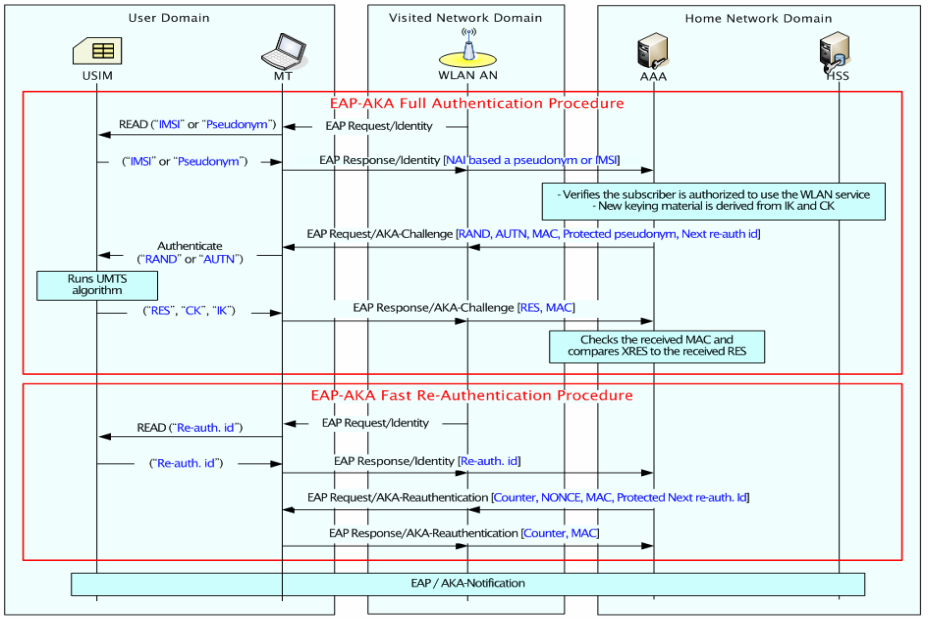
- An EAP [7] mechanism for authentication and session key distribution using the AKA mechanism used in the 3G mobile networks such as UMTS and cdma2000.
- EAP contains a negotiation sequence where the authenticator requests information about which authentication method would be used.
- EAP server is located on a backend authentication server using an AAA protocol, i.e. 3GPP AAA server.

Full authentication

- An initial authentication procedure where new keys are generated in the USIM card and the network.

Fast re-authentication

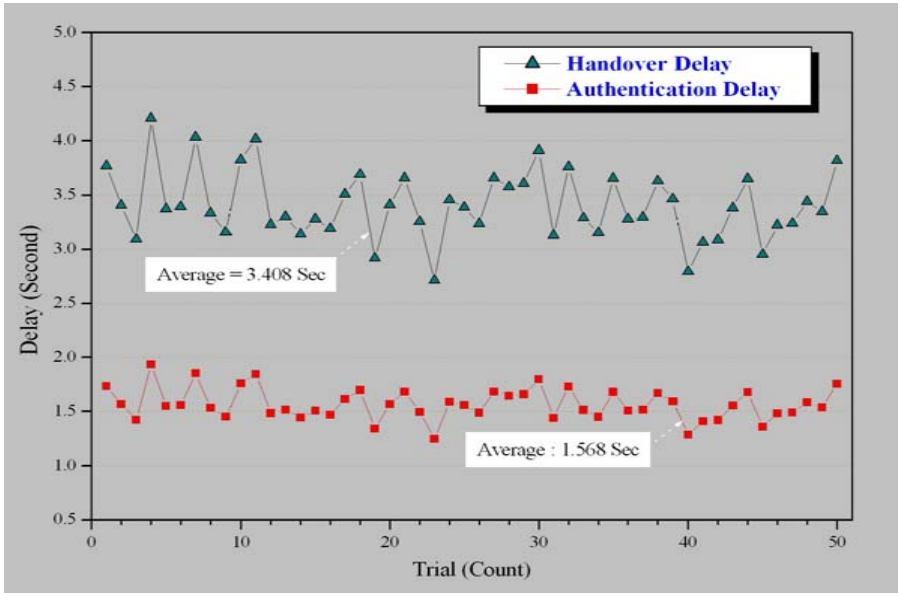
- Reuse the keys generated from the previous authentication process.
- Save processing time in the WLAN UE and the AAA server
- Save power consumption in the UE.
- The use of fast re-authentication depends on the operator's policies.



Analysis of Handover Delay

- **Handover delay is caused by connection establishment to each network and authentication procedure while handover is performed.**
- **For measuring the handover delay from UMTS to WLAN, the simulation performing the handover procedure was conducted 50 times under network simulator.**

- **Simulation Results**
  - Average handover delay from UMTS to WLAN: 3.408sec.
  - Average authentication processing time: 1.568sec
    - 46% of overall handover delay
  - Less authentication processing time, Less handover delay
  - One of the good solutions
    ➔ Fast re-authentication.



USIM based Authentication Test-bed (1/2)

Goal of USIM-based EAP-AKA test-bed

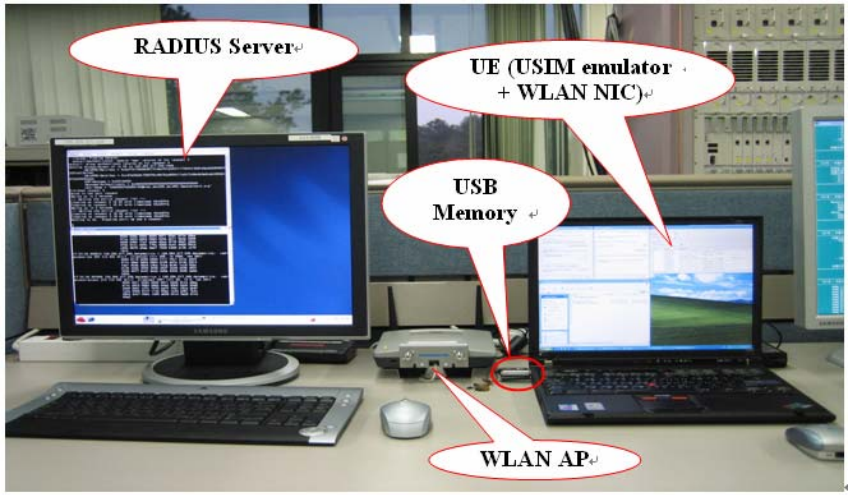
- Measure and compare the processing time of full authentication and fast re-authentication in our test-bed
- Analyze the efficiency of fast re-authentication.

USIM emulator

- USB (or PCMCIA) memory and emulator program in a notebook computer
  - USIM functions specified in 3GPP TS 21.111[8]
  - 3GPP subscriber information and functions of managing subscriber authentication data specified in 3GPP TS 33.102[4]
  - Execution of EAP AKA authentication algorithm specified in 3GPP TS 33.234[8]
  - User interfaces between USIM and 3GPP wireless module/WLAN module, and USIM control function
- USB memory was used instead of an IC card as USIM
  - It seems that Read/Write delay of USB memory caused much more delay compared with IC card type USIM.
  - Therefore, the delay can be more reduced by using an IC card type USIM.

USIM based Authentication Test-bed (2/2)

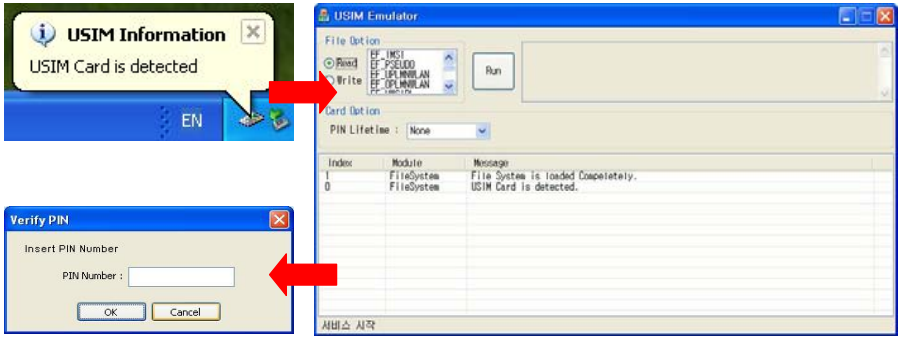
Configuration of authentication Test-bed



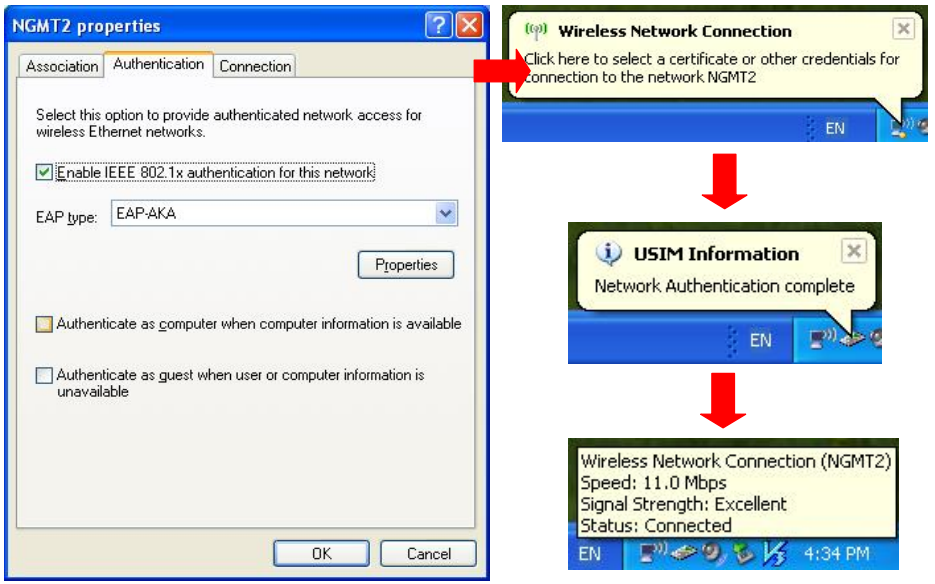
Environment of Test-bed

	Client	AP	AAA Server
OS	Windows XP	Cisco AP 1200	Linux
Language	C/C++	None	C/C++
Protocol	EAP-AKA	RADIUS/EAP	RADIUS/EAP/AKA
Remarks	WLAN Mini PCI Adapter	Cisco Aironet 1200	Open RADIUS

PIN Input for USIM Access



EAP-AKA Operation

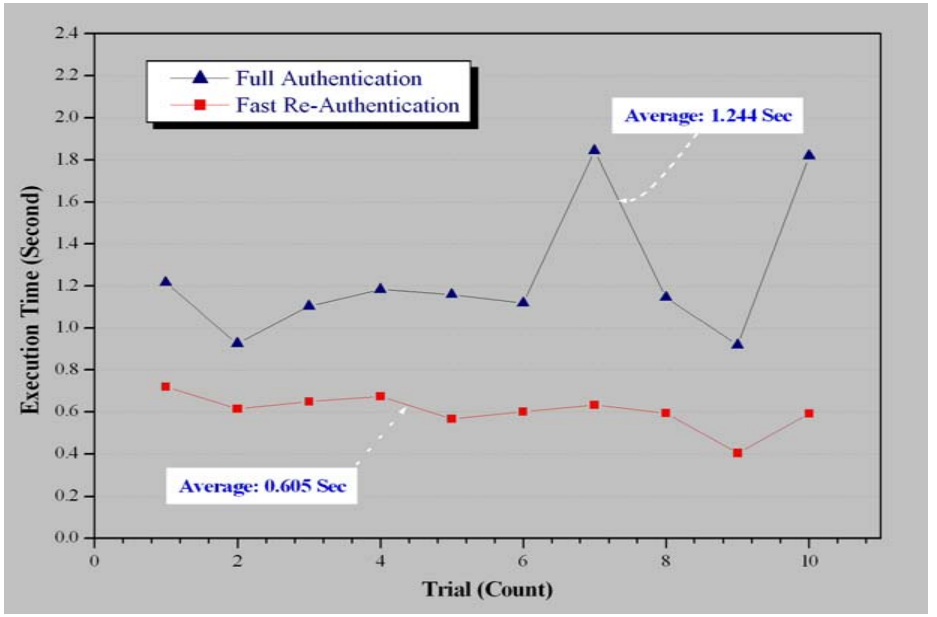


Results & Analysis

Experimental Results by Test-bed execution

- 10 times trial of authentication processing in test-bed
  - Including UE's association with WLAN AP, reception and response of EAP Request/ Identity, authentication with AAA server and reception of EAP success message.
- Average RTT between UE and AAA server : 0.0004 sec
- Average full authentication processing time : 1.244 sec
- Average fast re-authentication processing time : 0.605 sec.
  - 48.6% saving time by fast re-authentication

Handover delay can be enough minimized by using of the fast re-authentication mechanism during handover !!!



Conclusion and Future Works

- **This paper**
  - analyzed how much authentication costs processing time of overall handover delay
  - Analyzed how much the fast re-authentication can reduces the authentication latency.
  - Showed that handover latency during UMTS-WLAN handover can be considerably reduced by minimizing authentication processing time
- **Future Works**
  - EAP-AKA test-bed will be applied to our UMTS-WLAN handover system under development.
- **References**

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