

Paging Scheme for Interworking between WiBro and IMS

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Abstract— In order to overcome the drawbacks and combine the advantages of both 3G packet-switched mobile communication systems and WLAN, wireless broadband (WiBro) system based on 2.3GHz bandwidth and IEEE 802.16e has been developed in Korea. In this paper, we propose a new paging scheme helping provide various packet data services include internet services regardless of location for interworking between WiBro and IMS. WiBro system defines Idle mode for conserving power and operational resources. So we need to propose a paging mechanism for Idle mode.

Keywords— wireless broadband(WiBro), IMS, Paging, Location Server, Paging Controller

I. INTRODUCTION

Recently, the demand for Internet services through wireless medium has been increased. In order to meet this demand, packet-switched (PS) mobile communications systems, i.e., Global System for Mobile Communication/General Packet Radio Service (GSM/GPRS) or Universal Mobile Telecommunications Systems (UMTS), have been developed. Although these mobile communications support mobility to mobile users and users can enjoy Internet connectivity while they are moving, the bandwidth supported by these systems is limited and the price of bandwidth usage is rather expensive. Wireless local area network (WLAN), on the other hand, provides high speed Internet connectivity with low cost and is popular in hot spot areas such as campus or large building. However, WLAN does not support mobility and service area is geographically limited. In order to overcome the drawbacks and combine the advantages of both packet-switched mobile communication systems and WLAN, wireless broadband (WiBro) system based on 2.3GHz bandwidth and IEEE 802.16e[1] has been developed in Korea. The aim of WiBro system is to provide high data rate services to mobile users with cheap price and is expected to be commercialized within a few years.

In general, current paging scheme is paging using IP address. However in WiBro MS may release IP address at entering Idle mode. We may not use the IP address when paging the MS. So we consider IP paging and MAC paging.

II. RELATED WORK

A. Wibro System

The goal of developing WiBro system should provide portability, mobility, low-cost, and a variety of IP-based on wireless Internet services in 2.3GHz bandwidth.

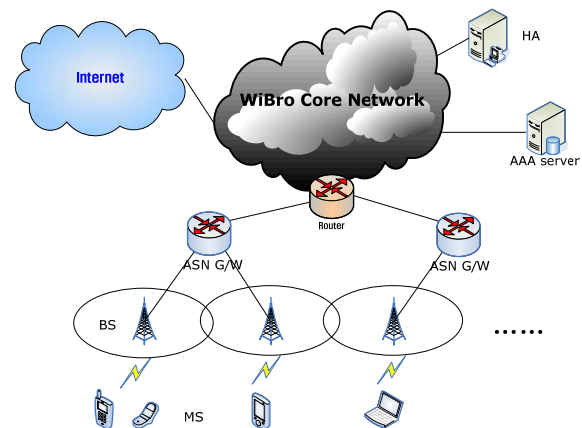


Figure 1. Network architecture for WiBro system.

Figure 1 shows network architecture for WiBro system. There are a mobile station (MS), a base station (BS), a access Service network gateway (ASN G/W), an authentication, authorization, and accounting (AAA) server and a home agent (HA). The MS can transfer and receive high packet data to and from the BS with proprietary wireless standards. The BS shall process wireless signals and handle wired signals. Additionally, the BS can perform a handoff control between sectors. The ASN G/W is able to connect a few of BSs based on IP and access IP core network. The ASN G/W can perform authentication routing, mobile IP, and handoff controls between BSs or ASN G/Ws. The AAA server performs an authentication, authorization, and accounting for a user. The HA effectively causes the MS is reachable at its home address even when the MS is not attached to its home network.

B. ASN G/W Sub System

Figure 2 shows processing blocks for ASN G/W sub system. There are a ASN G/W Information Management Block, a FA Authentication Block, Accounting Block, Operation And Management Block, a QoS Control Block, a Service Admission Control Block, a NASREQ Client Block, a NASREQ Client Block, a FA Control Block, a DHCP Relay Control Block, a Packet Routing Block, a BS Interface Block, a ASN G/W Interface Block and a Diameter Protocol Control Block.

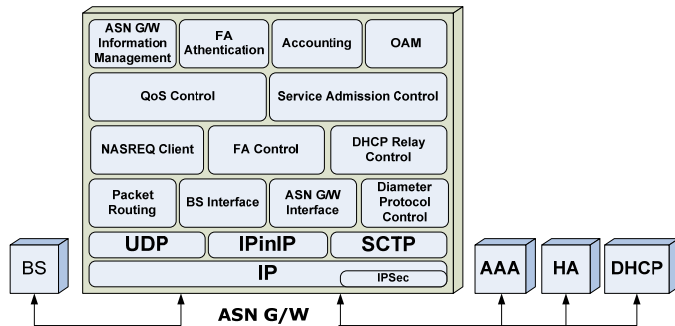


Figure 2. ASN G/W Sub System Structure.

III. NETWORK ARCHITECTURE

A. Paging Architecture

Figure 3 shows the network architecture for interworking between WiBro and IMS system. For paging MS, we need new node like Paging Controller and Location Server.

For MS terminating Normal Operation with the serving BS and entering Idle Mode, the Paging Controller(the serving BS or other network entity) administering Idle Mode activity for the MS may retain certain MS service and operational information useful for expediting a future MS network re-entry from Idle Mode. The MS may request Paging Controller retention of specific MS service and operational information for Idle Mode management purposes through inclusion of the Idle Mode Retain Information element in the DREG-REQ management message.

Location Server manages MS's Location Information. An MS in Idle mode shall perform a Location Update process operation if any Location Update condition is met. The MS shall perform Location Update process when the MS detects a change in paging group. The MS shall detect the change of paging group by monitoring the paging group identifier, which is transmitted by the Preferred BS.

If an MS in Idle Mode determines or elects to updates its location, depending on the security association the MS shares with the target BS.

B. Interworking with IMS

In order to interwork with IMS, we need a P-CSCF. P-CSCF (Proxy CSCF) is responsible for gateway function between IMS and WiBro system and The Proxy is the first contact point within the IM CN subsystem. The P-CSCF accepts requests and services them internally or forwards them on. The P-CSCF shall not modify the Request URI in the SIP INVITE message. The P-CSCF may behave as a User Agent,

i.e. in abnormal conditions it may terminate and independently generate SIP transactions.

P-CSCF also has role of Policy Decision Function (PDF). PDF maybe a logical entity of the P-CSCF and performs authorization of bearer resources and QoS management. Therefore, PDF provides final policy decisions controlling the allocated QoS resources for the authorized media stream. The decision shall be transferred from the PDF to the ASN G/W.

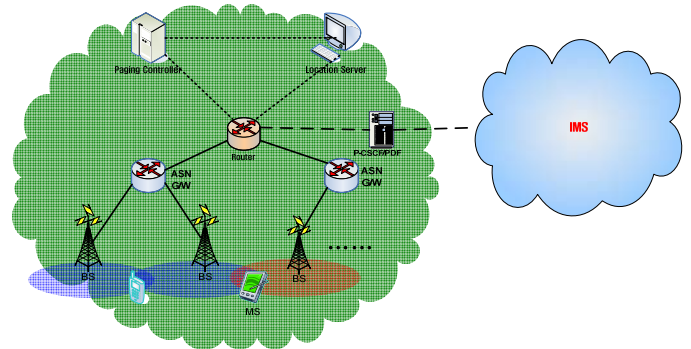


Figure 3. Network architecture for Paging.

IV. IDLE MODE

A. Idle Mode Initiation

Idle Mode Initiation may begin after MS De-Registration. During Normal Operation with its serving BS, an MS may signal intent to begin Idle Mode by sending a DREG-REQ. Similarly, a serving BS may signal for an MS to begin Idle Mode by sending a DREG-CMD.

As another case of BS initiated Idle Mode, the serving BS may send DREG-CMD, signaling for an MS to initiate an Idle Mode request through a DREG-REQ, request for MS De-Registration from serving BS and initiation of MS Idle Mode.

For MS terminating Normal Operation with the serving BS and entering Idle Mode, the Paging Controller the serving BS may retain certain MS service and operational information useful for expediting a future MS network re-entry from Idle Mode.

The MS shall maintain an Idle Mode Timer and Paging Controller shall maintain an Idle Mode System Timer to provide an interval timer to prompt MS Idle Mode Location Update activity and demonstrate MS continued network presence to re-validate Paging Controller retention of MS service and operational information.

B. Idle Mode Termination

Idle Mode may only be terminated through:

- MS re-entry to the network;
- through Paging Controller detection of MS unavailability through repeated, unanswered paging messages;
- through expiration of the Idle Mode System Timer.

An MS shall terminate Idle Mode and re-enter the network if it decodes a BS Broadcast Paging message that contains the MS own MS MAC Address hash. In the event that an MS

decodes a BS Broadcast Paging message that contains the MS own MS MAC Address hash, Perform Ranging, the MS shall conduct and complete Idle Mode Location Update to establish location to the network and acknowledge message decoding.

The BS at which the MS re-entered the network shall inform the appropriate element in the network of the re-entry of the MS.

C. Location Update

Location Update is comprised of condition evaluation and update processing.

An MS in Idle mode shall perform a Location Update process operation if any Location Update condition is met. There are four location update evaluation conditions: Paging Group Update, Timer Update, Power Down Update, and MAC Hash Skip Threshold Update. MS may also perform Location Update process at will.

The MS shall perform Location Update process when the MS detects a change in paging group. The MS shall detect the change of paging group by monitoring the paging group identifier.

The MS shall periodically perform Location Update process prior to the expiration of the Idle Mode Timer.

The MS shall attempt to complete a Location Update once as part of its orderly power down procedure. This mechanism enables the Paging Controller to update MS's exact status and to delete all information for the MS and discontinue Idle Mode Paging Control for the MS at the time of power down. At the time of successful Power Down Location Update, the Paging Controller shall release all Idle Mode retaining information related to the MS.

The MS shall perform Location Update process MS MAC Hash Skip Counter exceeds MAC Hash Skip Threshold successively. After successful Location Update, the BS and MS shall re-initialize their respective MAC Hash Skip Counters.

D. Network Re-Entry

For the Network Re-Entry from Idle Mode method, the MS shall initiate network re-entry with the target BS by sending a RNG-REQ including Ranging Purpose Indication TLV and Paging Controller ID TLVs.

If the MS shares a valid security context with the target BS such that the MS may include a valid HMAC/CMAC Tuple in the RNG-REQ, then the MS shall conduct initial ranging with the target BS by sending a RNG-REQ including HMAC/CMAC Tuple.

If MS RNG-REQ includes an Ranging Purpose Indication TLV and Paging Controller ID TLVs, and target BS had not previously received MS information over the backbone, then target BS may make an MS information request of Paging Controller over the backbone network and Paging Controller may respond. Regardless of having received MS information from Paging Controller, target BS may request MS information from another network management entity via the backbone network.

V. PAGING PROCEDURE

Figure 4 shows MS's Idle mode initiation procedure for interworking between IMS and WiBro system. In order to initiate entering Idle mode, MS sends DREG-REQ for de-registration. The BS receives DREG-REQ and informs entering Idle mode to ASN G/W by DREGreq message. After receiving message ASN G/W release the MS related resources. Then ASN G/W sends ATInfoRegister message to Paging Controller. Paging Controller assigns PGID and reports to Location Server. Location Server stores MS related information and response. When MS receive DREG-RSP, MS becomes Idle mode.

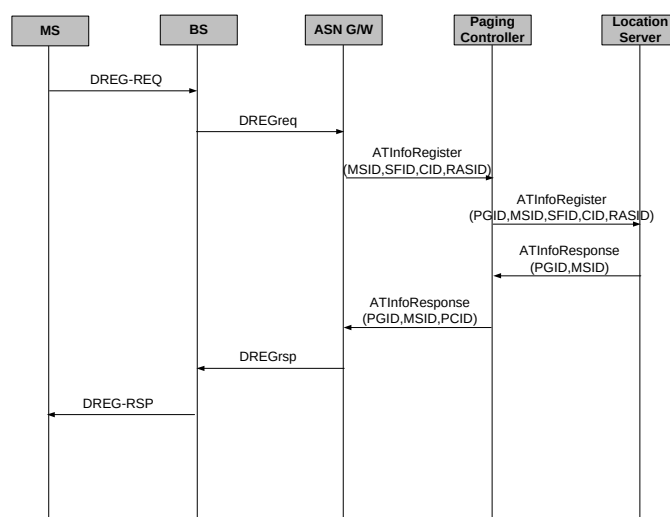


Figure 4. Entering IDLE mode

Figure 5 shows a paging procedure for interworking between IMS and WiBro system. All traffic or signal messages arrive at Proxy/AS and Proxy/AS forwards this to ASN G/W by DataRequest message. ASN G/W asks the location of MS by ATInfoRequest message to Location Server. If requested MS is Idle mode then Location Server send PagingRequest message to request paging to Paging Controller. Paging Controller requests paging to the ASN G/W which administrates the paging groups to which the MS belongs. When we page the MS we use MS's MAC address as identifier. Because MS did not know its IP address when it enter into IDLE mode. Location Server sends Paging Request with MAC address.

ASN G/W pages to the BS and the BS pages to the regions. MS shall initiate network re-entry with the target BS by sending RNG-REQ. In the process of network re-entry, Paging Controller may respond with BS's an MS information request over the backbone network. After finishing MS's network re-entry, Paging Controller shall perform a Location Update process operation. Location Server sends ATInfoResponse message to update the information of MS. ASN G/W send DataResponse in response to DataRequest. Finally WiBro begin services.

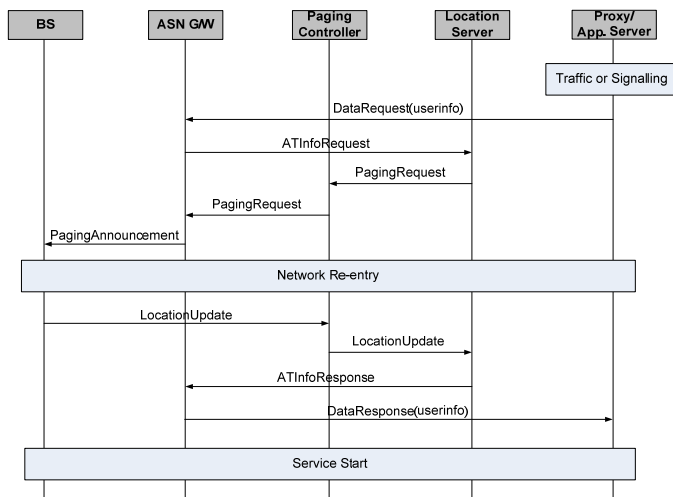
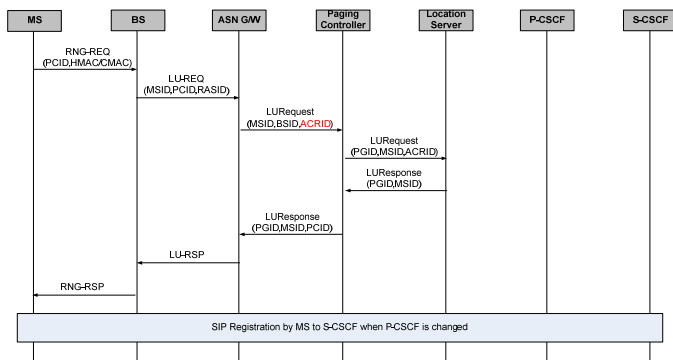


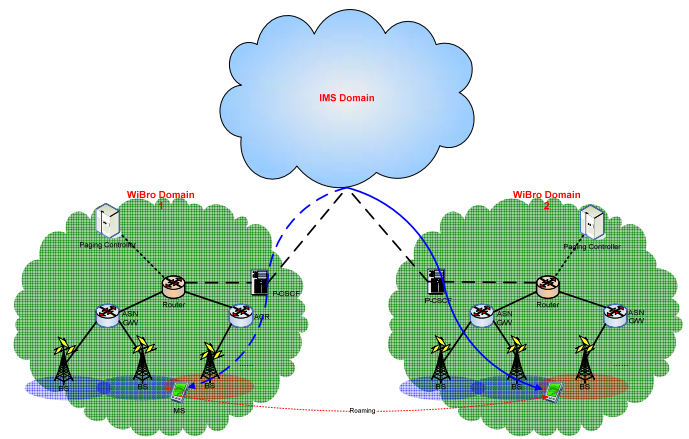
Figure 6 shows MS's location update procedure for interworking between IMS and WiBro system. MS in Idle mode shall perform a location update process if any location update condition is met. Location update condition is Paging Group Update, Timer Update, Power Down Update and MAC Hash Skip Threshold Update. When location update condition is met, MS sends RNG-REQ message to BS. BS sends LU-REQ including PCID and then ASN G/W requests location update to Paging Controller. When receiving LURequest from Paging Controller, Location Server updated its local database.

After completing location update procedure, P-CSCF may be changed. When P-CSCF is changed, MS shall perform SIP registration process to inform then location of P-CSCF to IMS Domain. In order to advertise new P-CSCF address, we may use Router Advertisement message.



VI. ROAMING

When a MS moves to another domain (new P-CSCF) in Figure 7, generally a MS don't process a registration procedure. Because MS's HoA is not changed during a session in MIP. Therefore, when new INVITE message arrived, IMS domain deliver a message to old P-CSCF and a message cannot reach the proper MS.



In order to resolve this problem a MS should know that P-CSCF is changed. For that, new mechanism is needed. A MS can register to IMS domain, when P-CSCF has changed.

We propose that Router Advertisement message includes new P-CSCF information in options field. When a MS receive Router Advertisement message, a MS can detects P-CSCF's change and then a MS can register to IMS domain. After this operation, new message is delivered to a proper MS.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
Type										Code										Checksum													
Cur Hop Limit										M	O	Reserved										Router Lifetime											
Reachable Time																																	
Retrans Timer																																	
Options ...																																	

Figure 8. Router Advertisement Message Format

VII. CONCLUSIONS

In this paper, we proposed a paging scheme for interworking between WiBro and IMS system. We need new node like Location Server and Paging Controller. In order to interwork with IMS we also introduce a P-CSCF. We explained a role of Location Server, Paging Controller and P-CSCF. Finally, in order to page a MS we suggested a paging related Procedure. Additionally, we propose new location registration method in inter P-CSCF roaming scenario.

REFERENCES

- [1] IEEE 802.16e-2005 "Part16: Air Interface for Fixed and Mobile Broadband Wireless Access System, Amendment2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands", 2005IEEE 802.16m, "Air Interface for Broadband Wireless Access Systems : Amendment 3 : Advanced Air Interface," May, 2011
- [2] 3GPP TS 23.207, "End-to-end Quality of Service(QoS) concept and architecture (Release 10)", March 2011.
- [3] 3GPP TS 23.228, "IP Multimedia System(IMS); Stage2 (Release 11)", March 2011.
- [4] Vladeta Vasilije Milenkovic, Nikola Milos Sekulovic, Mihajlo Caslav Stefanovic, and Mile Branko Petrovic, "Effect of Microdiversity and

Macrodiversity on Average Bit Error Probability in Gamma-Shadowed Rician Fading Channels," ETRI Journal, vol.32, no.3, pp.464-467, June 2010.