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Distributed Mobility Management Protocol for WiFi Users in Fixed Network <u>draft-sarikaya-dmm-for-wifi-00.txt</u>

Abstract

As networks are moving towards flat architectures, a distributed approach is needed to mobility management. This document defines a distributed mobility management protocol. Protocol is based on mobility aware virtualized routing system with software-defined network support. Routing is in Layer 2 in the access network and in Layer 3 in the core network. Smart phones access the network over IEEE 802.11 (Wi-Fi) interface and can move in home, hotspot and enterprise buildings.

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1. Introduction

Centralized mobility anchoring has several drawbacks such as single point of failure, routing in a non optimal route, overloading of the centralized data anchor point due to the data traffic increase, low scalability of the centralized route and context management [I-D.ietf-dmm-requirements].

In this document, we define a routing based distributed mobility management protocol. The protocol assumes a flat network architecture as shown in Figure 1. No client software is assumed at the mobile node.

IP level mobility signaling needs to be used even when MN is connected to a home network or a hotspot. Distributed anchors in the protocol are called Unified Gateways and they represent an evolution from the Broadband Network Gateway (BNG) currently in use.



Figure 1: Architecture of Wi-Fi DMM Protocol

2. Terminology

This document uses the terminology defined in [<u>I-D.matsushima-stateless-uplane-vepc</u>].

3. Overview

This section presents an overview of the protocol. See also Figure 1.

Access routers (AR) are Unified Gateways (UGW) that are the access network gateways that behave similarly as Evolved packet Core (EPC) Edge Router (EPC-E) in [<u>I-D.matsushima-stateless-uplane-vepc</u>]. UGW is configured an anycast address on the interface facing the Residential Gateway (RG). RGs use this address to forward packets from the users. The fixed access network delivers the packets to geographically closes UGW.

Wi-Fi smart phone, the mobile node (MN) is assigned a unique prefix using either Stateless Address Auto Configuration (SLAAC) or by a

DHCP server which could be placed in the cloud. In case of SLAAC, RG is delegated the prefixes by DHCP server using [<u>RFC3633</u>].

Prefix assignments to MNs are consistent with the prefixes assigned to UGWs that are shorter than /64. These prefixes are part of the operator's prefix(es) which could be /32, /24, etc.

The mobile node can move at home or in a hot spot from one Access Point (AP) to another AP and MN mobility will be handled in Layer 2 using IEEE 802.11k and 802.11r.

When MN moves from one UGW into another UGW, IP mobility signaling needs to be introduced. In this document we use Handover Initiate/ Handover Acknowledge (HI/HAck) messages defined in [RFC5949]. Handover Initiate message can be initiated by either previous UGW (predictive handover) or the next UGW (reactive UGW). In reactive handover, RG establishes a new connection with the next UGW when MN moves to this RG and provides previous UGW address. This will trigger the next UGW to send HI message to the previous UGW. Previous UGW sends HAck messages which establishes a tunnel between previous and next UGWs. Previous UGW sends packets destined to MN to the new UGW which in turn sends them to MN.

Note that the mobility signaling just described is control plane functionality. Control plane in our document is moved to the cloud, thus mobility signaling happens at the cloud, possibly between two virtual machines (VM).

Upstream packets from MN at the new UGW are sent as usual but downstream packets may need special path establishment if MN's prefix is not hosted at the new UGW. In this case Software-Defined Networking (SDN) is used. SDN allows Routing Information Bases (RIB) in a subset of the upstream routers to be modified to enable the downstream packets to be routed to the new UGW but not to the previous UGW.

<u>4</u>. Detailed Protocol Operation

In this section, Layer 2 and Layer 3 mobility procedures are explained.

4.1. Layer 2 Mobility in Access Network

In the access network, RG MAC address acts as an identifier for the MN. Access network switches are controlled by SDN. Controller to Switch interface uses Extensible Messaging and Presence Protocol (XMPP)[<u>RFC6121</u>]. XMPP is based on a general subscribe-publish message bus. SDN controller publishes forwarding instructions to the

subscribing switch. Forwarding instructions could be Open Flow like match-forward instructions.

Access network is organized as interconnected switches. The switch connected to the RG is called egress switch. The switch connected to the UGW is called ingress switch. IEEE 802.1ad standard for VLAN (Q-in-Q) is used in the access network, where S-VLAN denotes RG groups, and C-VLAN determines traffic classes. One S-VLAN tag is assigned to create one or more VLAN paths between egress and ingress switches.

MN mobility in the access network can be tracked by keeping a table consisting of MN IP address and RG MAC address pairs. In this document SDN controllers keep the mobility table. This table is used to select proper S-VLAN downstream path from ingress switch to egress switch and upstream path from egress switch to ingress switch.

After a new MN with WiFi associates with RG, RG sends an Unsolicited Neighbor Advertisement (NA) messages upstream. This NA message is constructed as per [RFC4861] but the Source Address field is set to a unicast address of MN. NA message is received by SDN controller and it enables SDN controller to update the mobility table. SDN controller selects proper path including S-VLAN and ingress switch to forward the traffic from this MN. The controller establishes the forwarding needed on these switches.

4.2. Layer 3 Mobility and Routing in Core Network

MN moving from one RG to another may eventually require MN moving from one UGW to another. This is Layer 3 mobility.

Predictive handover happens when MN just before leaving the previous RG (pRG) for the next RG (nRG) MN is able to send an 802.11 message containing MN MAC address and nRG MAC address, e.g. learned from beacons to the pRG (called Leave Report in Figure 2. pRG then sends a handover indication message to pUGW providing MN and nRG addresses (called Leave Indication) and this could happen between two respective virtual machines in the cloud. This message results in pUGW getting nUGW information and then sending Handover Initiate message to nUGW, which also could happen in the cloud. nUGW replies with Handover Acknowledge message. pUGW sends any packets destined to MN to nUGA after being alerted by the control plane. MN moves to nRG and nUGW is informed about this from Layer 2 mobility Section 4.1. uGW delivers MN's outstanding packets to MN.



Figure 2: Predictive Handover

Reactive handover handover happens when MN attaches the new RG from the previous RG (called Join Report in Figure 3. MN is able to signal in 802.11 association messages previous RG MAC address. nUGW receives new association information together with pRG information, possibly in the cloud (called Handover Indication). nUGW finds pUGW address and sends HI message to pUGW, again happening between two virtual machines in the cloud. pUGW after receiving indication from the cloud server delivers any outstanding MN's packets to nUGW which in turn delivers them to MN.

	MN	P-RG	N-RG	(P-UGW)	(N-UGW)	Cloud
	Join		I		I	
(a)	Report		>			
			I	Handover		
(b)				-Indication	>	
			I			
(c)			I	<h< td=""><td>I </td><td></td></h<>	I	
			I			
(d)			I	HA	ck>	
			I			
(e)			I	<	>	
			I		C	lata
(f)				=====	=====	

Figure 3: Reactive Handover

Note that Handover Initiate and Handover Acknowledge messages used in this document carry only a subset of parameters defined in [RFC5949]. Also no involvement with the Local Mobility Anchor (LMA) is needed.

After handover, SDN route establishment in upstream routers needs to take place. I2RS Agent as XMPP Client in nUGW and in pUGW inform the handover to I2RS Clients as XMPP Server upstream. I2RS Agent at pUGW removes any routing information for MN. XMPP Clients and Servers engage in structured request-response interactions. These interactions are needed for these purposes: I2RS Client publishes the new route for this MN to nUGW at the router upstream. I2RS Agent at nUGW adds new routing information for this MN into its RIB.

As a result for MNs that handover, upstream routing that takes place is not modified up to the lowest level of routers. The lowest level of routers handle the mobility but proper modifications so that the packets reach the right Unified Gateway. One way to achive this could be using host routes.

5. IPv4 Support

IPv4 can be supported similarly as in vEPC [<u>I-D.matsushima-stateless-uplane-vepc</u>]. UGW stays as IPv6 node receiving from all RGs IPv6 packets and forwarding them upstream.

IPv4 MN is supported at the RG. RG has B4 functionality of DS-Lite [<u>RFC6333</u>] or CLAT entity for 464XLAT [<u>RFC6877</u>]. RG encapsulates IPv4 packets in DS-Lite or translates IPv4 packets in 464XLAT into IPv6 packets making sure that UGW stays IPv6 only.

6. Security Considerations

TBD.

7. IANA Considerations

TBD.

8. Acknowledgements

TBD.

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