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DMM Deployment Models and Architectural Considerations
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Abstract

This document identifies the deployment models for Distributed Mobility Management architecture.

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[1. Overview](#)

One of the key aspects of the Distributed Mobility Management (DMM) architecture is the separation of control plane (CP) and data plane (DP) functions of a network element. While data plane elements continue to reside on customized networking hardware, the control plane resides as a software element in the cloud. This is usually referred to as CP-DP separation and is the basis for the IETF's DMM Architecture. This approach of centralized control plane and distributed data plane allows elastic scaling of control plane and efficient use of common data plane that is agnostic to access architectures.

This document identifies the functions in the DMM architecture and the supported deployment models.

2. Conventions and Terminology

2.1. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

2.2. Terminology

All the mobility related terms are to interpreted as defined in [[RFC6275](#)], [[RFC5213](#)], [[RFC5844](#)], [[RFC7333](#)], [[RFC7665](#)], [[RFC7429](#)], [[RFC8300](#)] and [[I-D.ietf-dmm-fpc-cpdp](#)]. Additionally, this document uses the following terms:

Home Control-Plane Anchor (Home-CPA or H-CPA)

The Home-CPA function hosts the mobile node (MN)'s mobility session. There can be more than one mobility session for a mobile node and those sessions may be anchored on the same or different Home-CPA's. The home-CPA will interface with the home-DPA for managing the forwarding state.

Home Data Plane Anchor (Home-DPA or H-DPA)

The Home-DPA is the topological anchor for the MN's IP address/prefix(es). The Home-DPA is chosen by the Home-CPA on a session-basis. The Home-DPA is in the forwarding path for all the mobile node's IP traffic.

Access Control Plane Node (Access-CPN or A-CPN)

The Access-CPN is responsible for interfacing with the mobile node's Home-CPA and with the Access-DPN. The Access-CPN has a protocol interface to the Home-CPA.

Access Data Plane Node (Access-DPN or A-DPN)

The Access-DPN function is hosted on the first-hop router where the mobile node is attached. This function is not hosted on a layer-2 bridging device such as a eNode(B) or Access Point.

Routing Controller (RC)

The Routing Controller is a centralized control entity, which is able to instruct the forwarding behavior for mobility management in Home-DPA and Access-DPN.

Mobility Controller (MC)

The Mobility Controller is a function entity, which is able to manage the orchestration of Home-CPA and Access-CPN functions.

3. DMM Architectural Overview

Following are the key goals of the Distributed Mobility Management architecture.

1. Separation of control and data Plane
2. Aggregation of control plane for elastic scaling
3. Distribution of the data plane for efficient network usage
4. Elimination of mobility state from the data plane
5. Dynamic selection of control and data plane nodes
6. Enabling the mobile node with network properties
7. Relocation of anchor functions for efficient network usage

3.1. DMM Service Primitives

The functions in the DMM architecture support a set of service primitives. Each of these service primitives identifies a specific service capability with the exact service definition. The functions in the DMM architecture are required to support a specific set of service primitives that are mandatory for that service function. Not all service primitives are applicable to all DMM functions. The below table as shown in Fig. 1 identifies the service primitives that each of the DMM function SHOULD support. The marking "X" indicates the service primitive on that row needs to be supported by the identified DMM function on the corresponding column; for example, the IP address management MUST be supported by Home-CPA function. The NSH Classifier denotes the SFC entity that performs the classification of a service flow, defined in [[RFC7665](#)].

Service Primitive	H-CPA	H-DPA	A-CPN	A-DPN	MC	RC
IP Management	X				X	
IP Anchoring		X				
MN Detection			X	X		
Routing		X		X		
Tunneling		X		X		
QoS Enforcement		X		X		
FPC Client	X		X		X	
FPC Agent		X		X		X
NSH Classifier		X		X		

Figure 1: Role or capability of DMM functions

3.2. DMM Functions and Interfaces

3.2.1. Home Control-Plane Anchor (Home-CPA):

The Home-CPA function hosts the mobile node's mobility session. There can be more than one mobility session for a mobile node and those sessions may be anchored on the same or different Home-CPA's. The home-CPA will interface with the home-dpa for managing the forwarding state.

There can be more than one Home-CPA serving the same mobile node at a given point of time, each hosting a different control plane session.

The Home-CPA is responsible for life cycle management of the session, interfacing with the policy infrastructure, policy control and interfacing with the Home-DPA functions.

The Home-CPA function typically stays on the same node. In some special use-cases (Ex: Geo-Redundancy), the session may be migrated to a different node and with the new node assuming the Home-CPA role for that session.

3.2.2. Home Data-Plane Anchor (Home-DPA):

The Home-DPA is the topological anchor for the mobile node's IP address/prefix(es). The Home-DPA is chosen by the Home-CPA/MC on a session-basis. The Home-DPA is in the forwarding path for all the mobile node's IP traffic.

As the mobile node roams in the mobile network, the mobile node's access-DPN may change, however, the Home-DPA does not change, unless the session is migrated to a new node.

The Home-DPA interfaces with the Home-CPA/MC for all IP forwarding and QoS rules enforcement.

The Home-DPA and the Access-DPN functions may be collocated on the same node.

3.2.3. Access Control Plane Node (Access-CPN)

The Access-CPN is responsible for interfacing with the mobile node's Home-CPA and with the Access-DPN. The Access-CPN has a protocol interface to the Home-CPA.

The Access-CPN is responsible for the mobile node's Home-CPA selection based on: Mobile Node's Attach Preferences, Access and Subscription Policy, Topological Proximity and Other Considerations.

The Access-CPN function is responsible for MN's service authorization. It will interface with the access network authorization functions.

3.2.4. Access Data Plane Node (Access-DPN)

The Access-DPN function is hosted on the first-hop router where the mobile node is attached. This function is not hosted on a layer-2 bridging device such as a eNode(B) or Access Point.

The Access-DPA will have a protocol interface to the Access-CPA.

The Access-DPN and the Home-DPA functions may be collocated on the same node.

3.2.5. DMM Functions Mapping to Other Architectures

Following table identifies the potential mapping of DMM functions to protocol functions in other system architectures.

Func.	PMIPv6	MIPv6	IPsec	3GPP-SAE	BBF	5GC
H-CPA	LMA-CPA	HA-CPA	IKE-CPA	PGW-CPA/MME	BNG-CPA	AMF/SMF
H-DPA	LMA-DPA	HA-DPA	IKE-DPA	PGW-DPA	BNG-DPA	UPF
A-CPN	MAG-CPN	-	-	SGW-CPN	RG-CPN	SMF
A-DPN	MAG-DPN	-	-	SGW-DPN	RG-DPN	UPF

Figure 2: Mapping of DMM functions in other system architectures

Mapping from the DMM functions to network components in PMIPv6, MIPv6, IPsec, Broadband Forum (BBF) can be given straight-forward. In the 3GPP System Architecture Evolution (SAE), H-CPA functionality is charged by PGW-CPA and Mobility Management Entity (MME), as MME is the key control-plane node involving in such as location management, handoff management, selection of SGW/PGW as well as authorization of UEs. But PGW-CPA is in charge of tunnel control based on UE's subscription and policy between SGW and PGW. The rest of the 3GPP SAE network components are as given in Fig. 2.

The 3GPP Release 15 introduces the Service-Based Architecture (SBA) for 5G networks. The 3GPP 5G architecture can be represented by reference point or service-based interfaces [[3GPP.23.501](#)]. Allowing the service-based interface provides greater flexibility for updates and extensions of the 5G control plane system by operator's need or request. The architecture introduces various kinds of network functions granularized in the CP/DP separation concept. In Fig. 2, Access and Mobility Management Function (AMF), Session Management Function (SMF), and User Plane Function (UPF) are picked up among all the network functions introduced in the 5G SBA for mapping to the DMM functions.

AMF and SMF take major roles for mobility management in control plane. AMF manages access control and mobility and includes network slice selection functionality. SMF manages sessions based on UE's subscription and network policy and is in charge of IP address allocation management. UPF is the data plane node, which works for data packet handling based on forwarding policy regulated by control plane nodes such as AMF and SMF, etc.

4. Deployment Models

This section identifies the key deployment models for the DMM architecture.

4.1. Model-1: Split Home Anchor Mode

In this model, the control and the data plane functions of the home anchor are separated and deployed on different nodes. The control plane function of the Home anchor is handled by the Home-CPA and where as the data plane function is handled by the Home-DPA. In this model, the access node operates in the legacy mode with the integrated control and user plane functions.

The FPC interface defined in [I-D.ietf-dmm-fpc-cpdp] allows the control plane functions to interact with the data plane for the subscriber's forwarding state management.

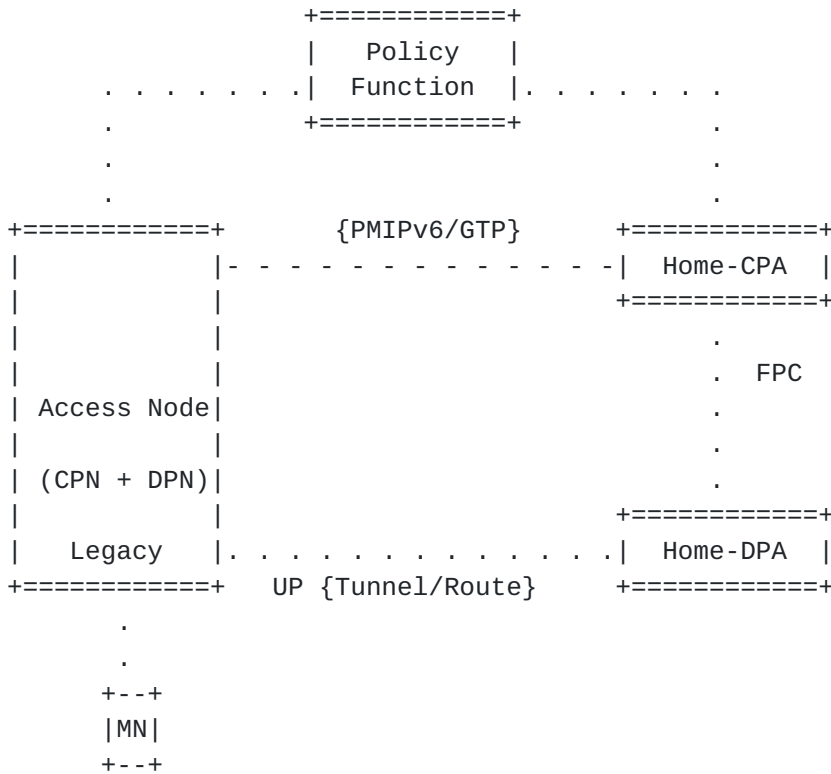


Figure 3: Split Home Anchor Mode

4.2. Model-2: Separated Control and User Plane Mode

In this model, the control and the data plane functions on both the home anchor and the access node are separated and deployed on different nodes. The control plane function of the Home anchor is handled by the Home-CPA whereas the data plane function is handled by the Home-DPA. The control plane function of the access node is handled by the Access-CPN and where as the data plane function is handled by the Access-DPN.

The FPC interface defined in [I-D.ietf-dmm-fpc-cpdp] allows the control plane functions of the home and access nodes to interact with the respective data plane functions for the subscriber's forwarding state management.

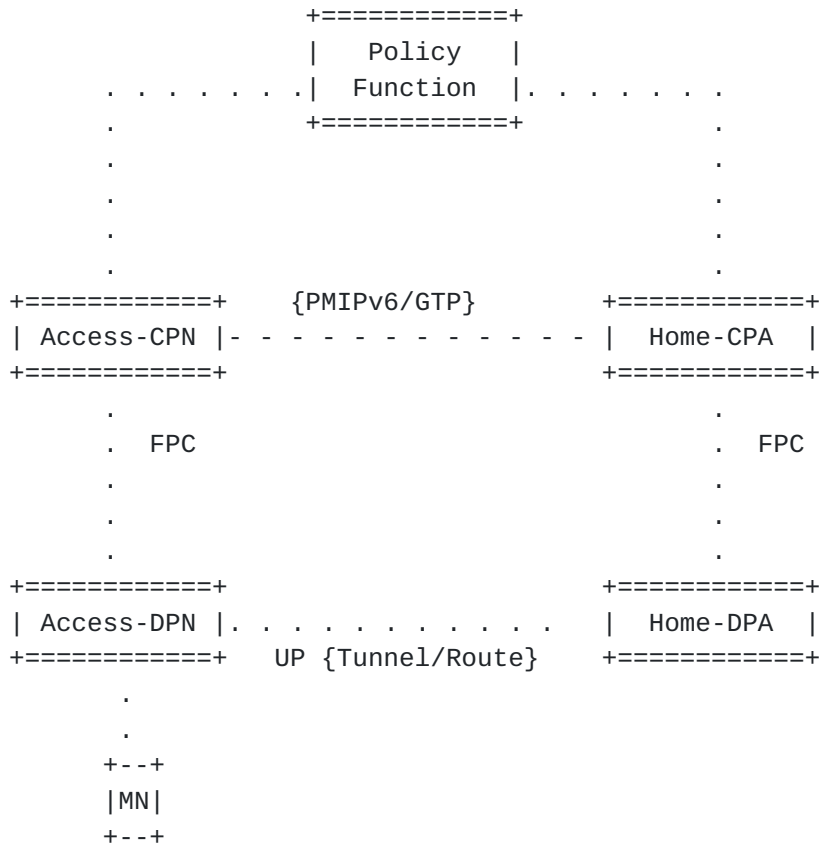


Figure 4: Separated Control and User Plane Mode

4.3. Model-3: Centralized Control Plane Mode

In this model, the control-plane functions of the home and the access nodes are collapsed. This is a flat architecture with no signaling protocol between the access node and home anchors. The interface between the Home-CPA and the Access-DPN is internal to the system.

The FPC interface defined in [I-D.ietf-dmm-fpc-cpdp] allows the mobility controller to interact with the respective data plane functions for the subscriber's forwarding state management.

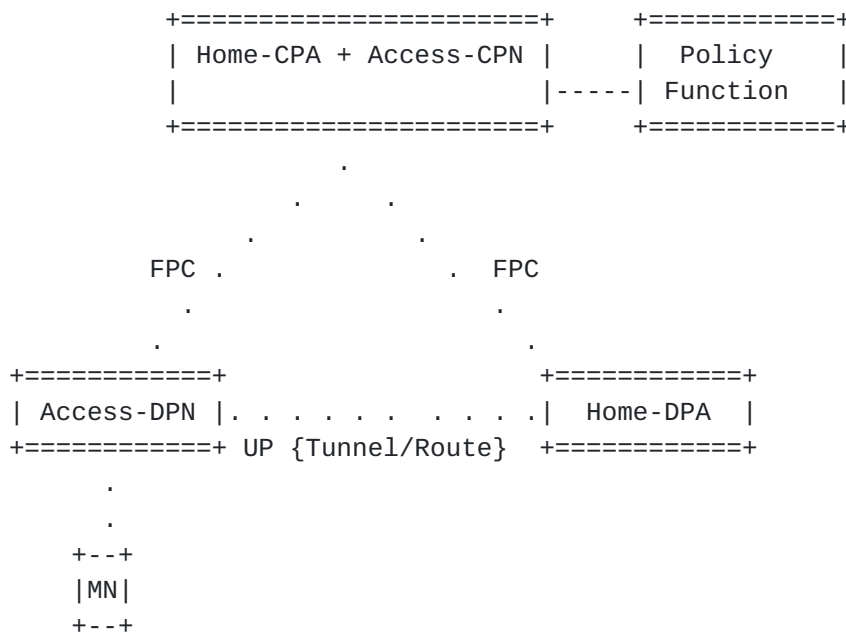


Figure 5: Centralized Control Plane Mode

4.4. Model-4: Data Plane Abstraction Mode

In this model, the data plane network is completely abstracted from the control plane. There is a new network element, Routing Controller which abstracts the entire data plane network and offers data plane services to the control plane functions. The control plane functions, Home-CPA and the Access-CPN interface with the Routing Controller for the forwarding state management.

The FPC interface defined in [I-D.ietf-dmm-fpc-cpdp] allows the Home-CPA and Access-CPN functions to interface with the Routing Controller for subscriber's forwarding state management.

6. Security Considerations

The control-plane messages exchanged between a Home-CPA and the Home-DPA must be protected using end-to-end security associations with data-integrity and data-origination capabilities.

IPsec ESP in transport mode with mandatory integrity protection should be used for protecting the signaling messages. IKEv2 should be used to set up security associations between the Home-CPA and Home-DPA.

There are no additional security considerations other than what is presented in the document.

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