Distributed Mobility Management::
(Architectural Considerations)

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Jouni Korhonen (Broadcom)
Marco Liebsch (NEC Labs)
Sri Gundavelli (Cisco) (Presenter)

Stated Assumptions

- We do know about IP mobility protocols, states and attributes

- We do know about SDN technology details (Open Flow, Netconf, BGP, ..)

- We do NOT know about which transport network and SDN technology will be deployed

- We do NOT want to tailor a DMM solution to a particular IP mobility management, transport network and SDN technology

- <u>Objective</u>: Describe generic control primitives and attributes to perform DMM and transport network programming to enable traffic steering
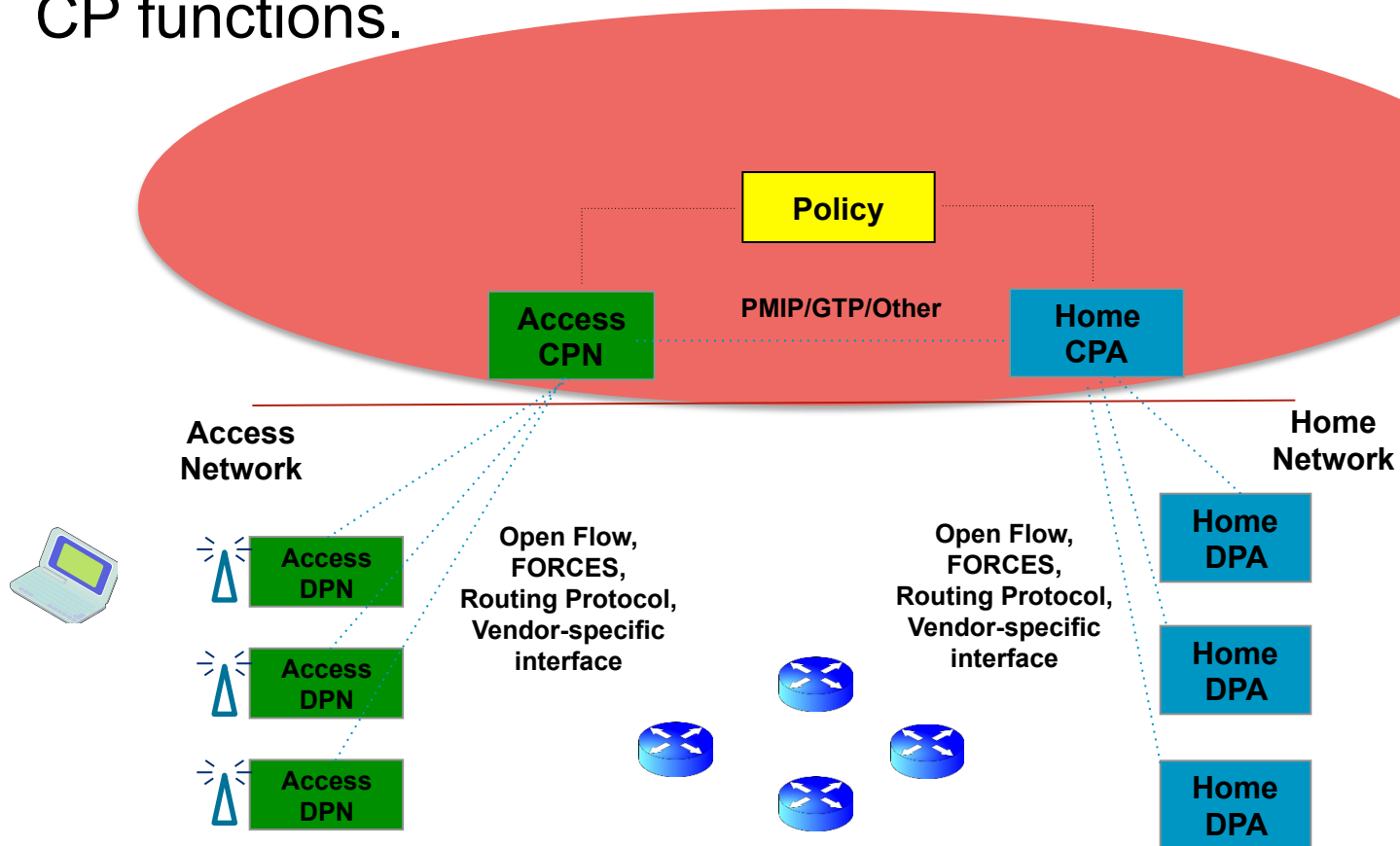
Architectural Models

DMM – Functional Elements

- Home Control Plane Anchor (Home-CPA)

- Home Data Plane Anchor (Home-DPA)

- Access Control Plane Node (Access-CPN)

- Access Data Plane Node (Access-DPN)

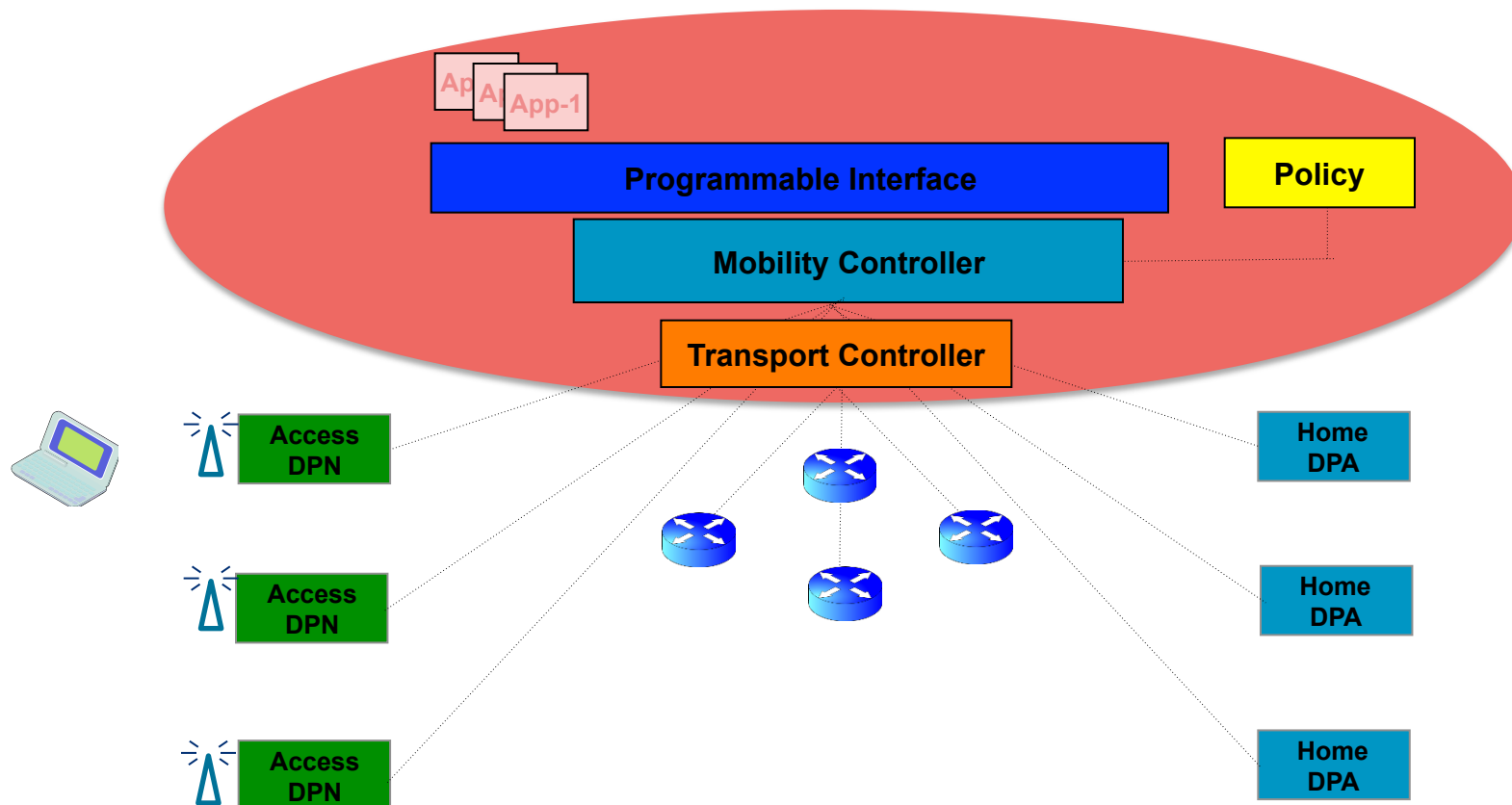- Mobility Controller (MC) = { Home-CPA + Access-CPN}

Functional Architecture with Home and Access Distinction

- Split Control and Data Plane; The functions CPN, DPN or both can be virtualized. An IP node can host both Home-DPA and Access-DPN functions; Simplified data-plane with no mobility state; Classic mobility protocol-use localized to CP functions.

Policy

Access CPN

PMIP/GTP/Other

Home CPA

Access Network

Home Network

Access DPN

Access DPN

Access DPN

Open Flow, FORCES, Routing Protocol, Vendor-specific interface

Open Flow, FORCES, Routing Protocol, Vendor-specific interface

Home DPA
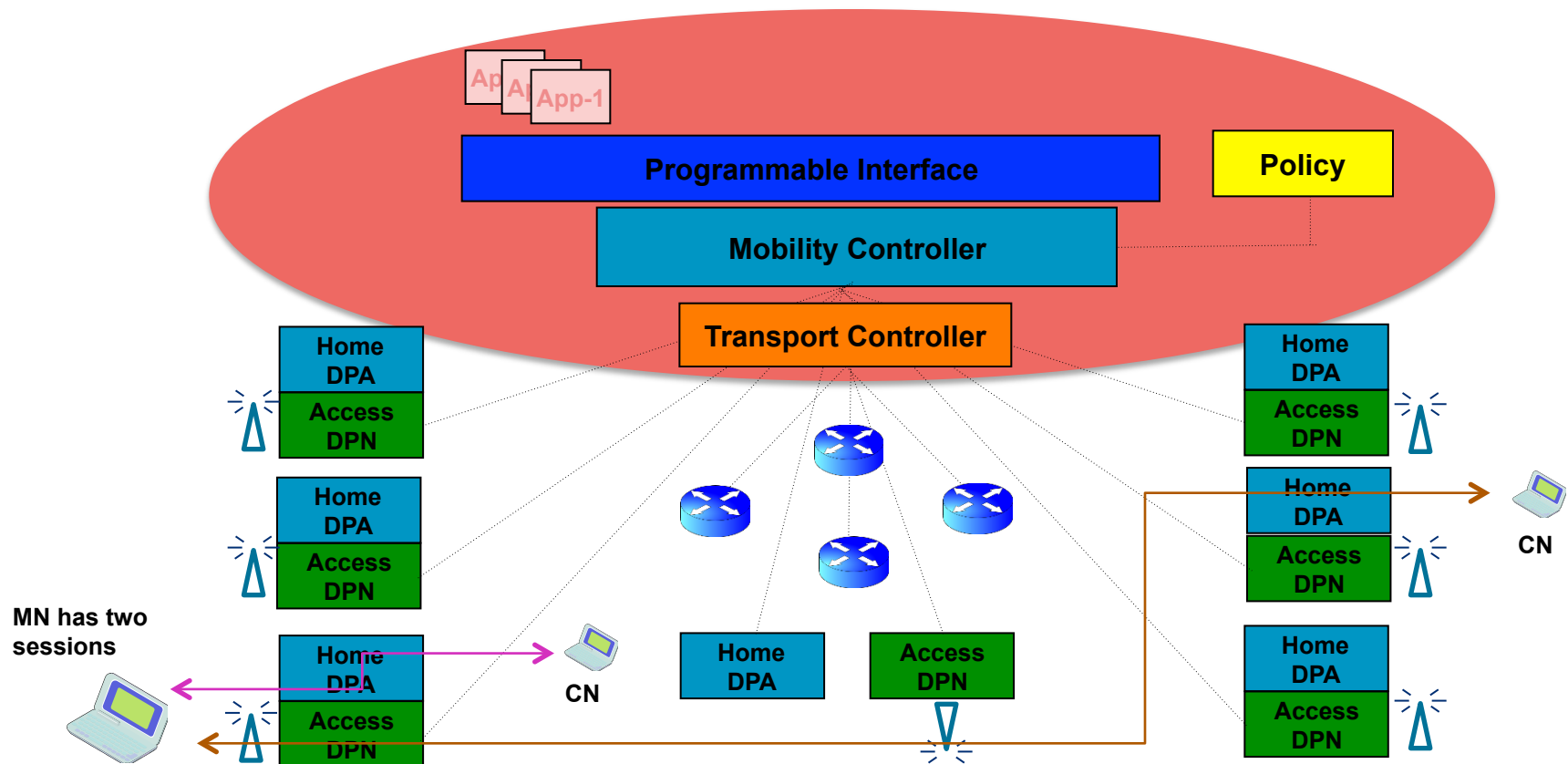
Home DPA

Home DPA

Home and Access Distinction Removed from the Control Plane functions

- The Control-plane functions for Home-DPA and Access DPN are converged into a single entity, Mobility Controller. The distinction, "Access" and "Home" is removed for CP functions. The chosen Home-DPA can be based on the proximity to CN, Access, or other considerations.

App-1 App-1 App-1

Programmable Interface

Policy

Mobility Controller

Transport Controller

Access DPN

Access DPN

Access DPN

Home DPA

Home DPA

Home DPA

Home-DPA/Access-DPN Collocation

- The Access-DPN and Home DPA functions can be hosted on the same node.

- On a session basis, the respective functions are activated for a given MN's session.

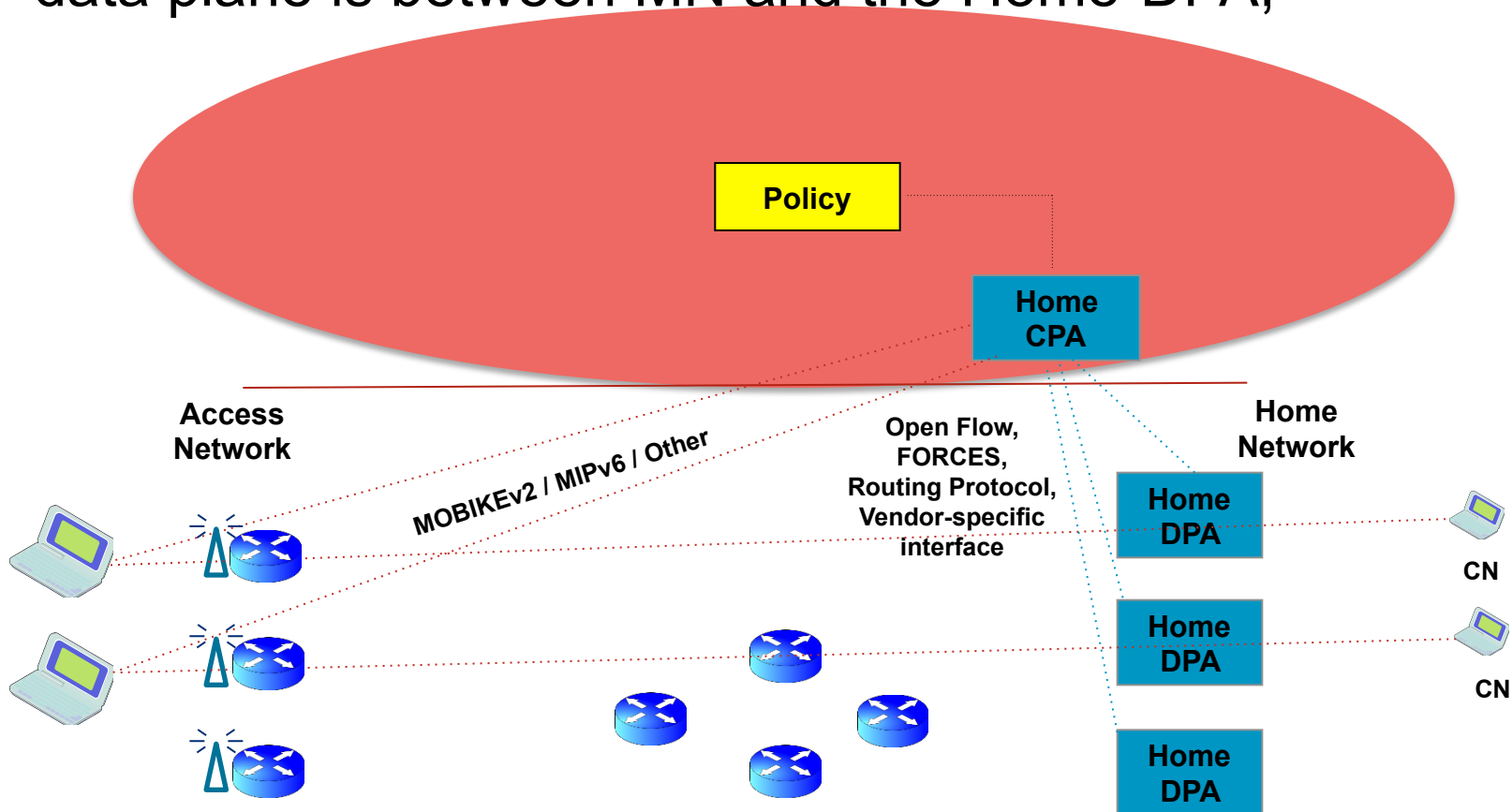# Home and Access Distinction Removed from both Control / Data Plane functions

- The Home-DPA always follows the mobile node. The access gateway always assumes the Home-DPA role. The converged Home-DPA and Access-DPA is referred to as the "DPA".
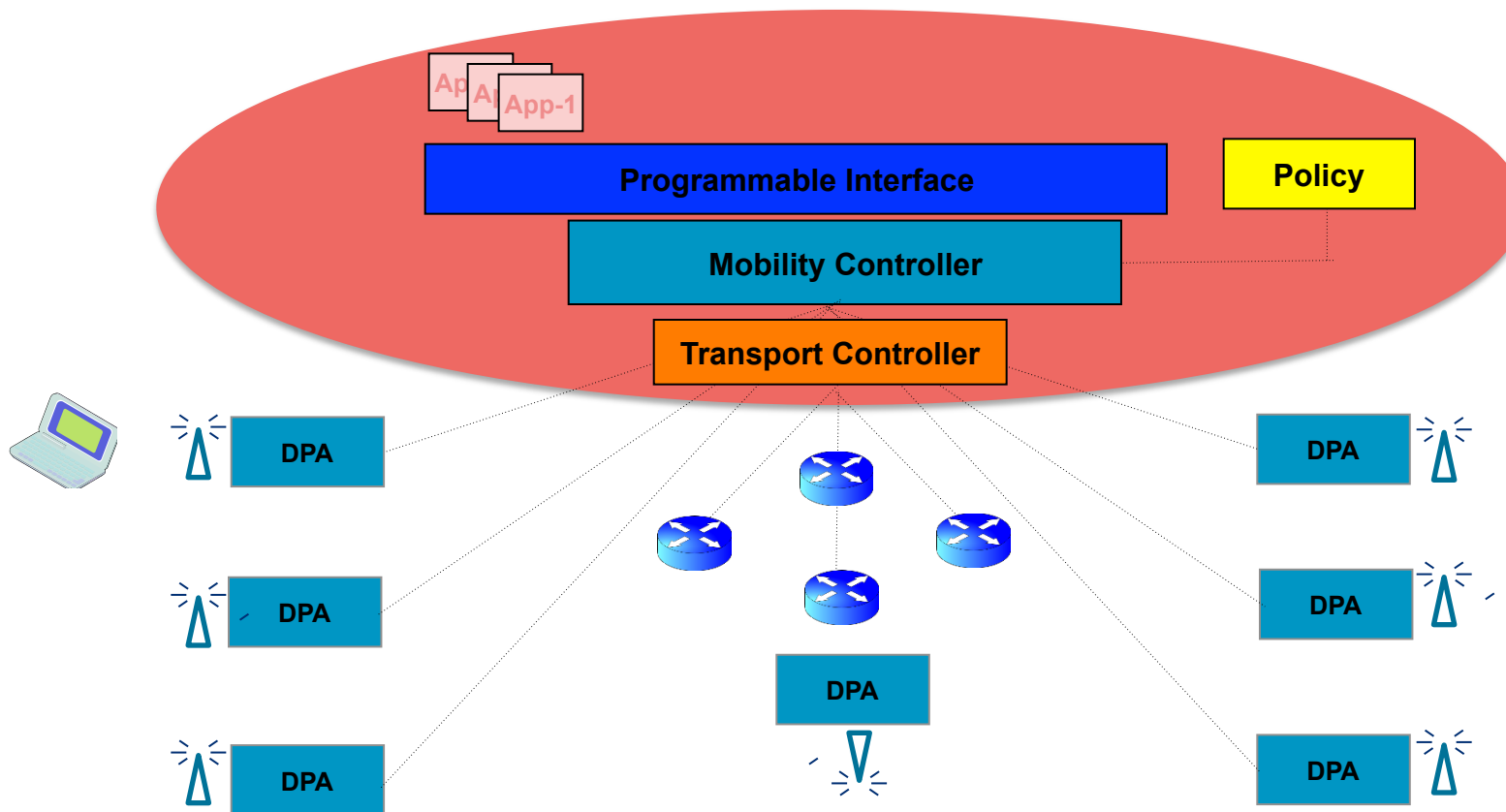
Supporting Classic Client Mobility Protocols

- The access gateway will not provide any special functionality to devices that have client-based mobility support.

- The signaling is between the MN and the Home-CPA; The data plane is between MN and the Home-DPA;

Policy

Home CPA

Access Network

MOBIKEv2 / MIPv6 / Other

Open Flow, FORCES, Routing Protocol, Vendor-specific interface

Home Network

Home DPA

CN

Home DPA

CN

Home DPA

Functional Elements

Home Control Plane Anchor (Home-CPA)

- The Home-CPA function is responsible for hosting mobile node's control plane session. There can be more than one mobile node's control plane sessions hosted on the same H-CPA. Each session is managed separately.

- 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.

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.

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/MC.

- The Access-CPN is responsible for the mobile node's Home-CPA selection based on:
  - Mobile Node's Attach Preferences
  - Access & 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.

Access Data Plane Node (Access-DPN)

- The Access-DPN function is hosted on the first-hop router where the mobile node is attached.

- The function is NOT hosted on a layer-2 bridging device such as a eNode(B) or Access Point. It is possible the layer-3 device is also collocated on a layer-2 termination function.

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

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

Mobility Controller (MC)

- Mobility Controller (MC) = { Home-CPA + Access-CPN}

- In the flat architecture the "Home" and "Access" distinction is removed from the functional elements. The Home-CPA and the Access-CPN functions will converge and the node is referred to as the Mobility Controller.

- The MC interfaces with DPN, Access-DPN, or Home-DPA for managing the forwarding state.

Home-CPA

Access-CPN

Mobility Controller
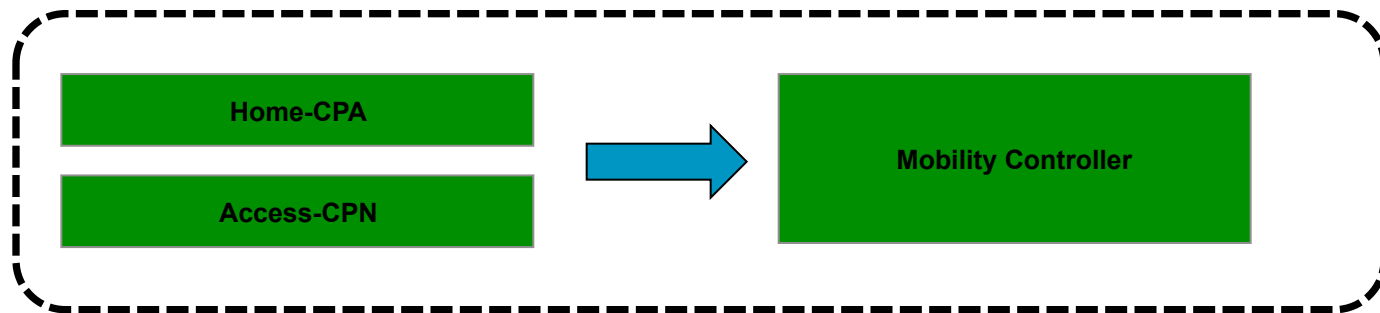
Functional Mapping (Example)

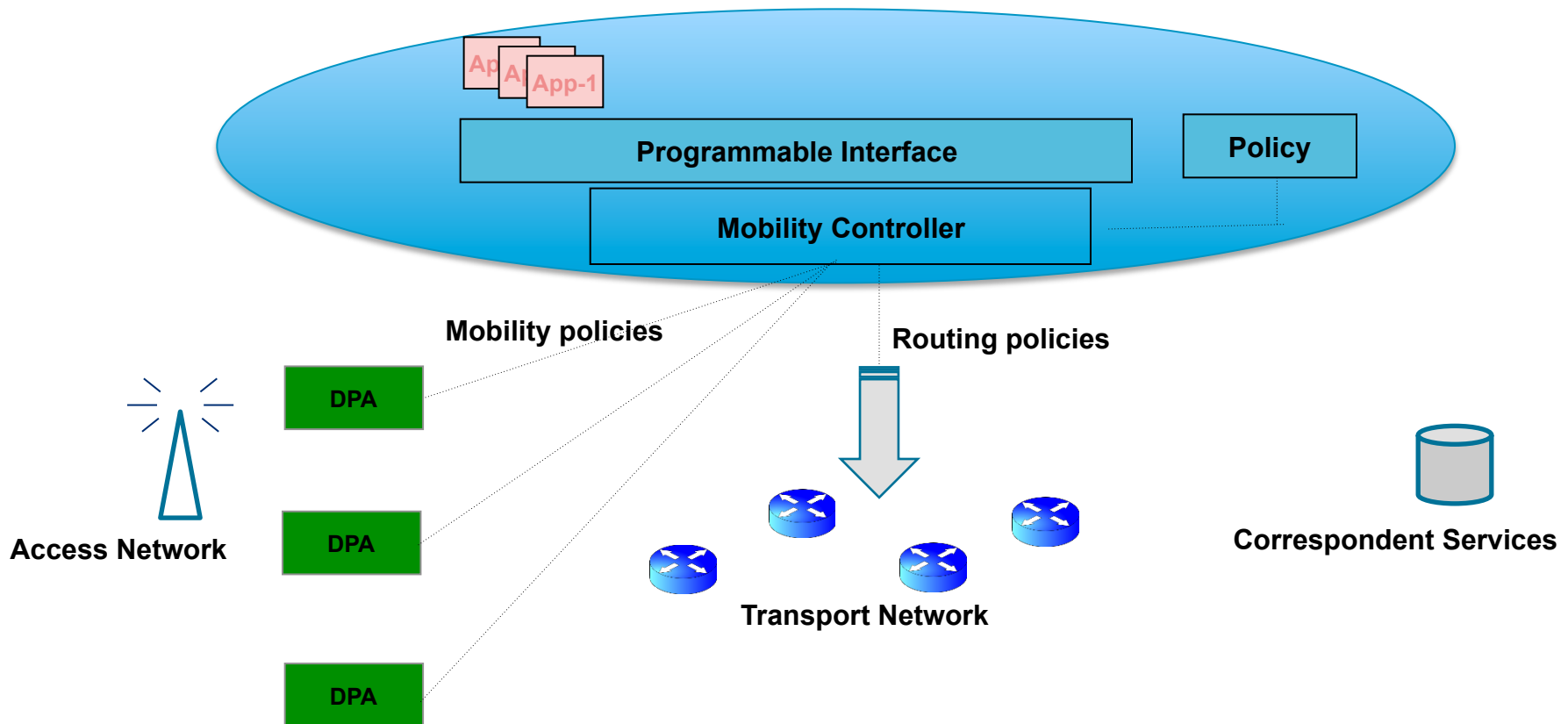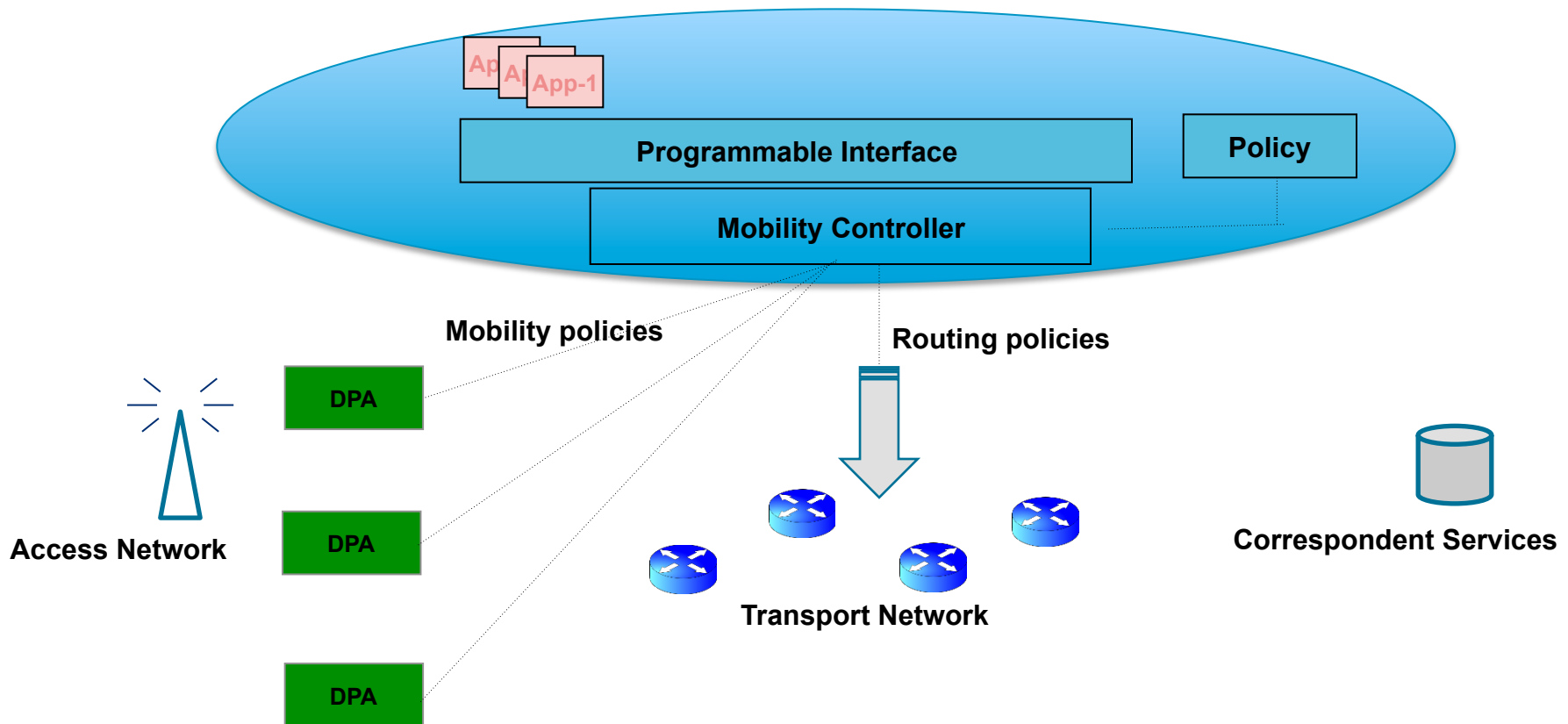| Function	IETF (PMIPv6)	IETF (MIPv6)	IETF (IKEv2/IPsec)	3GPP	Wi-Fi	BBF
H-CPA						
H-DPA						
A-CPN						
A-DPN						
MC						
DPN						

Key Extensions

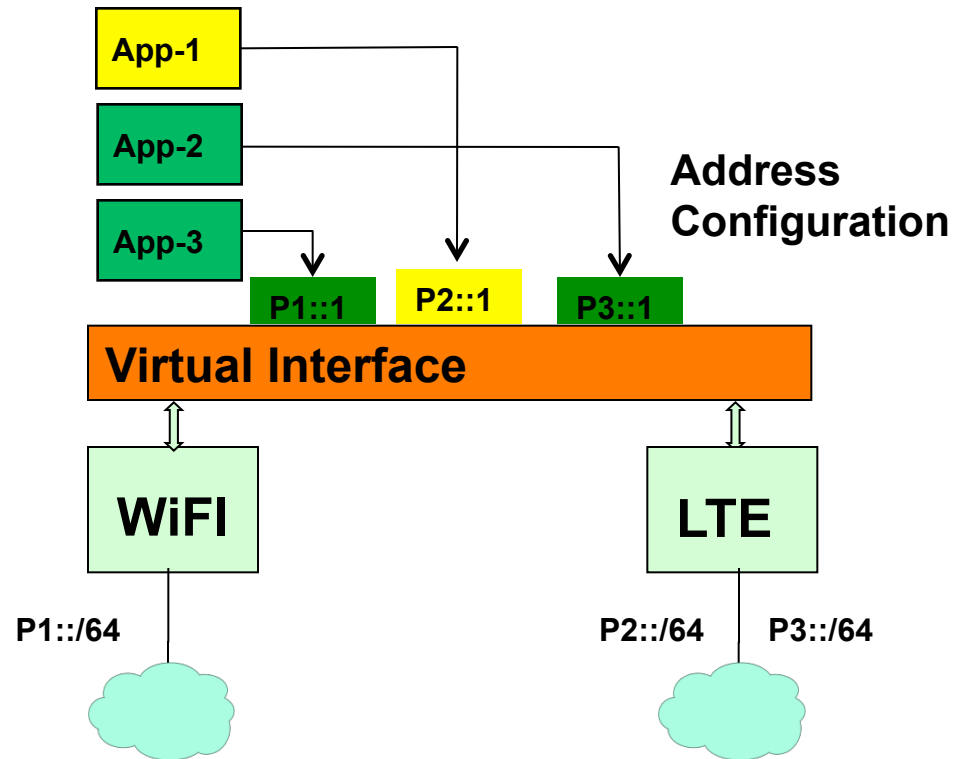# Demand for the exposure of states to the transport network

Demand for the exposure of states to the transport network

Exposing Address Properties to UE

- Deliver DMM specific IP address properties to the mobile node as part of the address assignment procedures.

- Enable the application to select the address based on the DMM network properties

Policy Table	
Prefix	**Attribute**
P1::/64	Attribute-1 (Home Bound)
P2::/64	Attribute-2 (Local Breakout)
P3:/64	Attribute-3 (Home Bound)

App-1

App-2

App-3

Address Configuration

P1::1   P2::1   P3::1

Virtual Interface

WiFI

LTE

P1::/64

P2::/64   P3::/64

Interface Control and Semantics

Interface Name	Action	Parameters
Tunnel State	• Add / DeleteTunnel	• Source IP Address, Destination IP Address, SPORT, DPORT, Encapsulation Mode, UL-GRE-Key, DL-GRE-Key, Tunnel Identifier
Forwarding State	• Add/Delete PBR Route • Add/Delete IP Route • Add/Delete Flow Ta	• Traffic Flow Template for IP flow identification • Tunnel Identifier • IP Route • Flow Tag, GRE Key
QoS Policing	• Add/Delete GBR Bearer on Flow/Session/Application basis	• Traffic Flow Template for IP flow identification • AMBR • GBR • Traffic Class

Commands Mobility Controller → Transport

▪ Add : 	Set up routing policy for MN's Routing Address (HoA/HNP) to deliver packets towards Routing Locator (DPA)

▪ Modify : ..

▪ Delete : ..

Commands Transport → Mobility Controller

▪ Query : Request Routing Locator (e.g. DPA address) for given MN Routing Address (HoA/HNP)

▪ Notify : Inform about state change, e.g. ..

Interface Control and Semantics

Attributes

- MN_RID : Routing Identifier – MN stable Identifier, may serve as key for state lookup

- MN_RADDR : Routing Address – HoA, HNP

- MN_TRLOC_ID: Identifier of topologically correct locator, e.g. DPA name

- MN_TRLOC_ADDR : Topologically correct address of Routing Locator, e.g. Anchor IP address, Tunnel IP address

- MN_TRNET_ID : Topologically correct name of the network providing locator/anchor

- MN_TRNET_ADDR : Topologically correct network address/prefix of the network, which provides the locator/anchor

- Lifetime : lifetime of policy rule

Gateway Selection

- Selection of the Home-CPA based on the following considerations:

- UE Indicated Preferences

- Network Policy

- Proximity to Access Network, CN Services

- Network Conditions

Comments ?