TS23.401 to TS23.402 Roaming

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S2-072942

This presentation…

> Examines the problem of TS 23.401 and TS 23.402 co-existence and evaluate potential solutions in the context of:

- Technical feasibility
  - How hard will it be to build and standardise a solution
- Deployment Pain
  - How difficult will it be to deploy this solution
- Commercial Availability
  - How likely is someone to build the solution and when?
- Operational Costs
  - How much will it cost to deploy and operate the solution?

> Proposes to document the alternative solutions in an Annex of TS 23.402

Assumptions

> It is assumed that QoS/Policy information for IETF interfaces (S2, S5/S8b) is signalled on per-SDF basis via a Diameter Gx-like application

- NOTE: some of the diagrams were drawn with the additional assumption that QoS/Policy is signalled “off path” (via S7/S9); this additional assumption is not relevant for the issue discussed here

> It is assumed that Charging Rules *MAY* be signalled along the IETF interfaces (S2, S5/S8b)

- This would allow operators of non-3GPP background to preserve their paradigm of flow-based charging in the Visited network
- Whether or not charging rules are dynamically signalled across the roaming interfaces is considered to be a deployment option and is determined on bi-lateral basis in the roaming agreement

> Some of the solutions in this presentation rely on a proxy functionality located in the evolved GRX backbone – the IP Packet Exchange (IPX)

- It is assumed that IPX Proxy services will be available before deployment of EPS/E-UTRAN networks

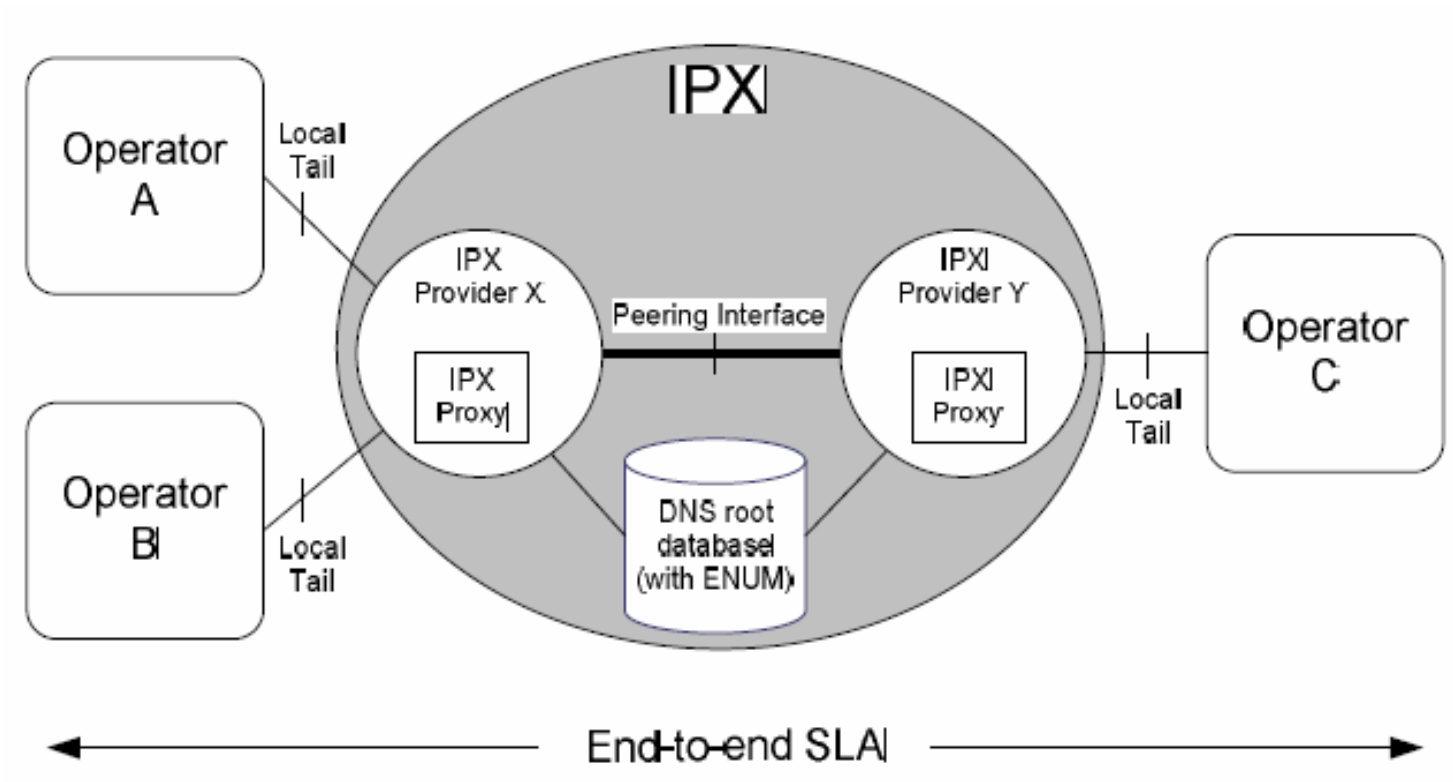
IP Packet Exchange (IPX - Evolved GRX)

> Defined in GSMA IR.34
  - ongoing pre-commercial implementation trials

> Building on the features of the GRX, the IPX also is able to support the following:
  - Connectivity between any type of Service Provider (MNOs, FNOs, ISPs, ASPs)
  - End-to-end QoS for roaming and interworking
  - Any IP services on a bilateral basis with end-to-end QoS and interconnect charging

> An IPX may also use the service-aware functionality of the IPX Proxies to support:
  - Further interconnect charging models such as Service-Based Charging in addition to the volume-based model of GRX
  - Inter-operable interworking for specified IP services
  - Multilateral interworking support for these specified services over a single Service Provider to IPX connection

IPX Network Reference Model

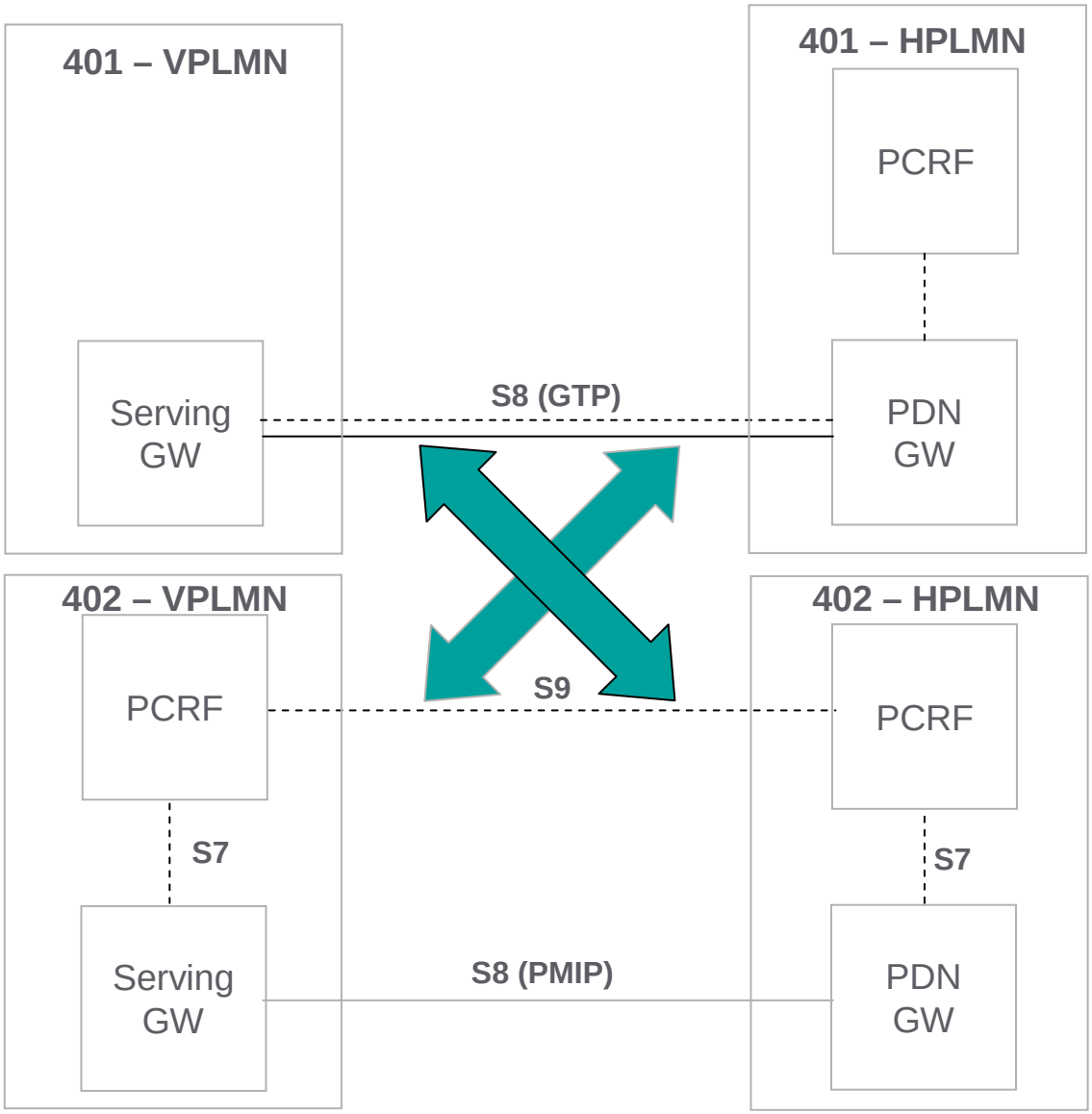


TS23.401 and TS24.402 Discussion

> Two related cases:

- Roaming in a TS23.402 (402) VPLMN with a TS23.401 (401) HPLMN
- Roaming in a TS23.401 (401) VPLMN with a TS23.402 (402) HPLMN

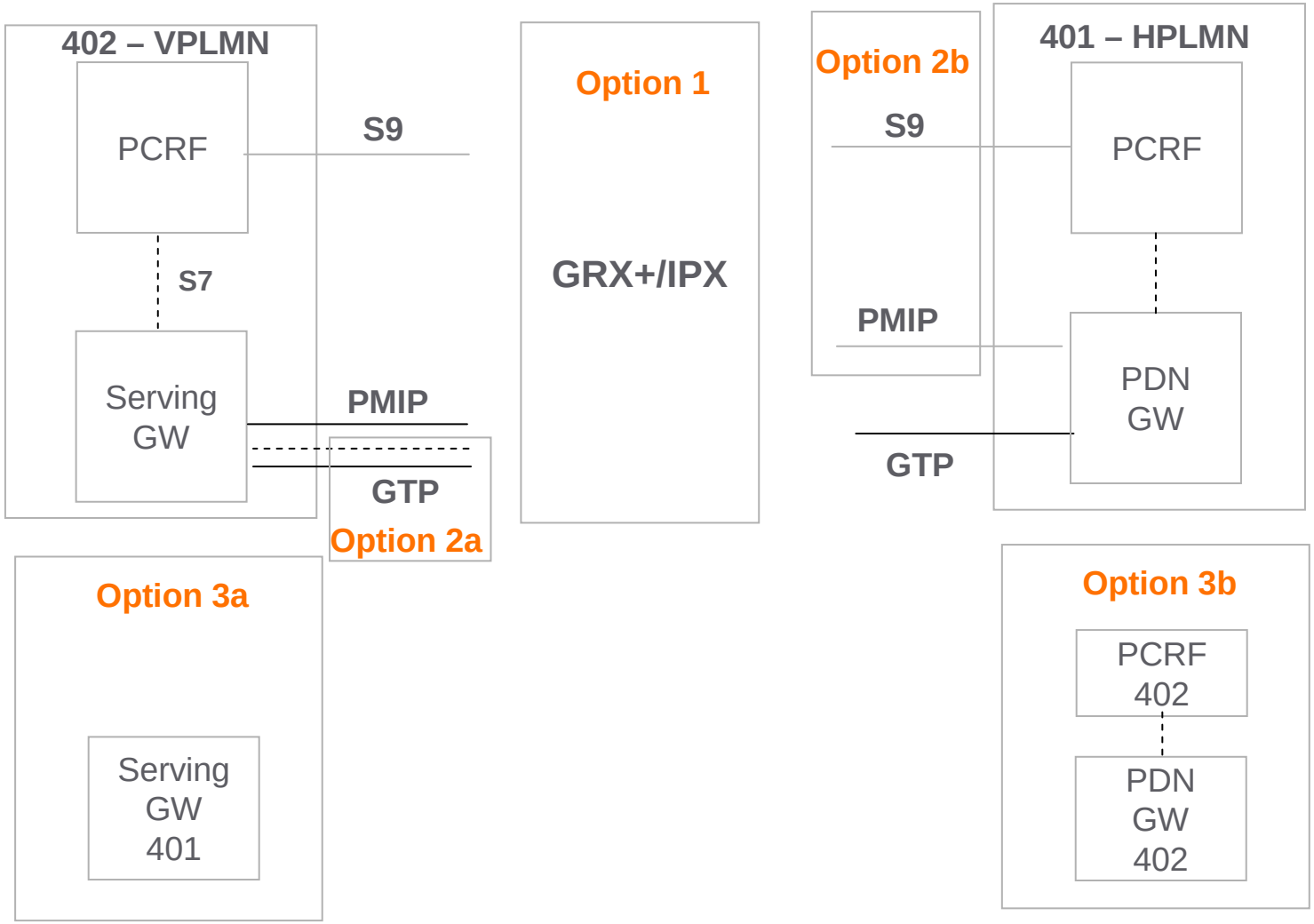
The TS23.401 <-> TS23.402 Co-existence Problem



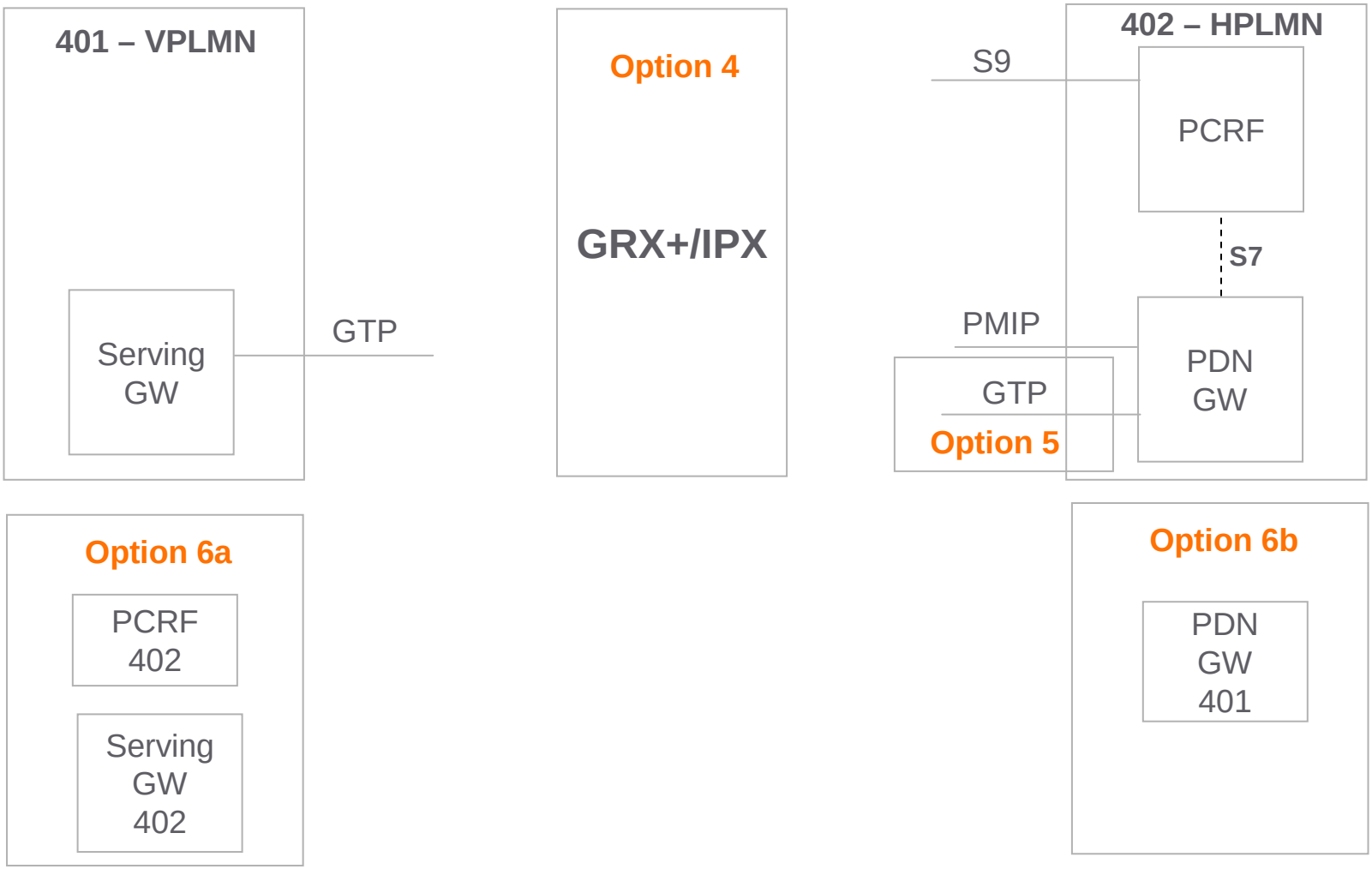
- Home based control
- Bearer binding @ PDN GW
- Serving GW has only 'EPS bearer' ('PDP context') visibility and no access to SDF information

- Home & Visited network control
- Bearer binding at Serving GW
- Serving GW has access to SDF information

401 HPLMN – 402 VPLMN



402 HPLMN and 401 VPLMN



Focus on IPX-based options

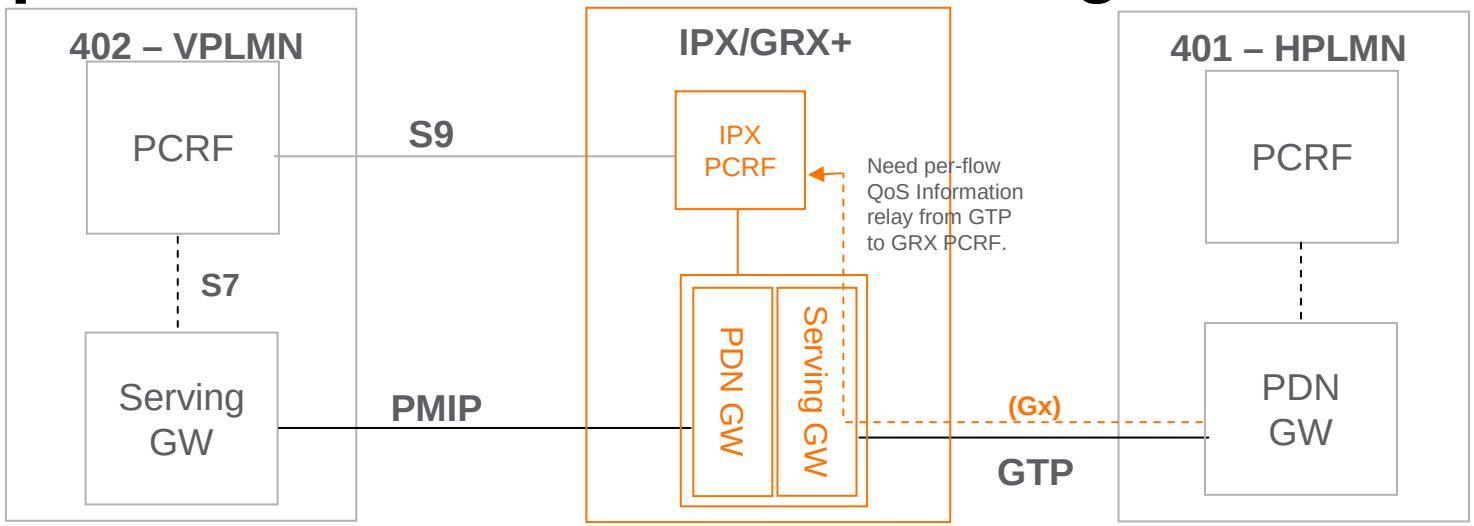
> Option 2, 3, 5 and 6 are straightforward

- Based on direct peering
- Rely on having one of the operators support “the other” roaming flavour, either as an implementation option or a deployment option
- Refer to the backup slides for each of these

> Focus on the IPX-based options

- Option 1 and Option 4

Option1: IPX/GRX+ Inter-working



Mobility and Network Access:
- IP address sourced from HPLMN, registered with PDN-GW interwoking function in the IPX/GRX+
- Mobility occurs across S8b as per normal operation

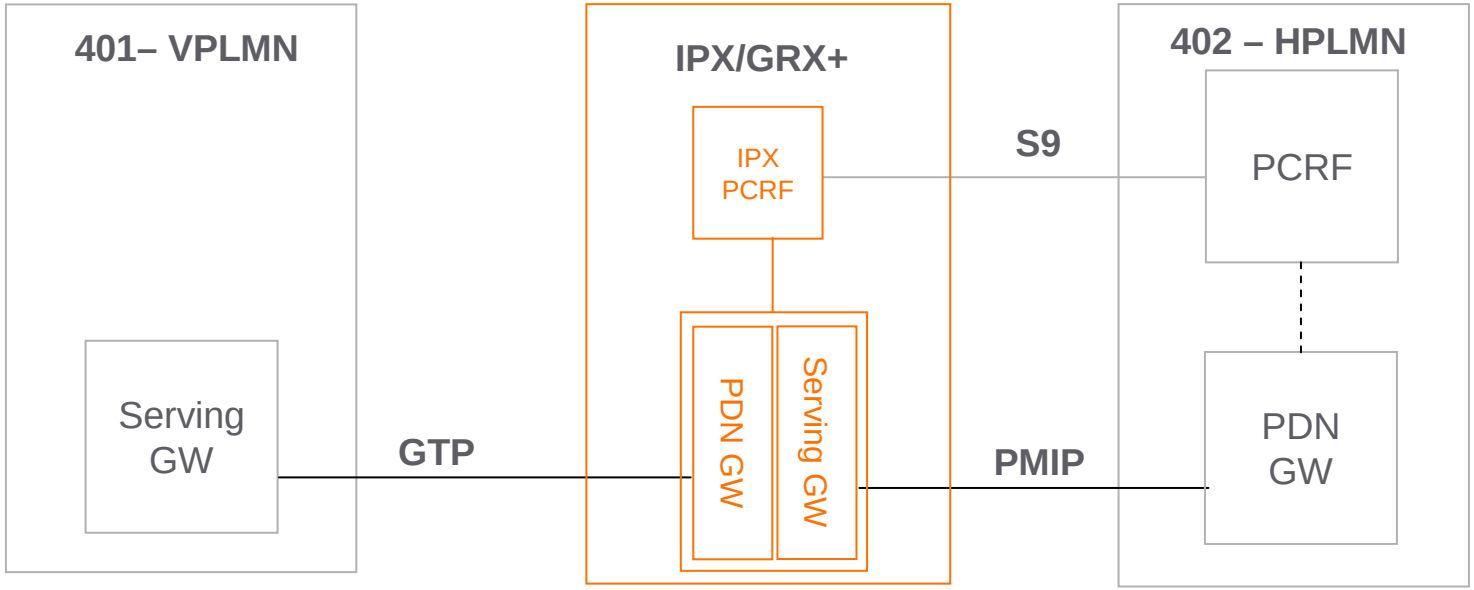
QoS:
- Need a method to convey downlink TFTs and charging rules information between 401 HPLMN and a PCRF function in the IPX/GRX+

Charging:
- Agreement can be reached between operators to determine where charging is going to be performed
- IPX/GRX+ can provide charging as required

Advantages:
- Neither operator needs to redefine their selected network model
- An HPLMN operator would be motivated to do this since this option will work for non-3GPP access in the visited network as well. Solution for non-3GPP access could be aligned with roaming.

Drawbacks:
- Need to pay fees to IPX/GRX+ operator
- Need to adopt a forwarding of Gx information (downlink TFT + charging rules)

Option 4: IPX/GRX+ Inter-working



Mobility and Network Access:
- IP address sourced from HPLMN, registered with PDN GW interworking function in the IPX/GRX+
- Mobility occurs across S8a as per normal operation

QoS:
- The IPX/GRX+ network retrieves the QoS information across the S9 interface. This is easier than the reciprocal case described in Option 1

Advantages:
- Neither operator needs to redefine their selected network model
- No modifications to standards are required

Drawbacks:
- Need to pay fees to IPX/GRX+ operator

Comparison

Easiest to deploy

Lowest cost

Shortest TTM

Criteria	H401 – V402 (Option 1) GRX	H401 – V402 (Option 2a/b) Add Interfaces	H401-V402 (Option 3a/b) Add Nodes	H402 – V401 (Option 4)	H402 – V401 (Option 5) Add Interfaces	H402 – V401 (Option 6) Add Nodes
Technical Feasibility	Need charging and TFT Information extracted from HPLMN across the GTP tunnel at GRX.	Adding GTP to 402 GW should be simple. Adding PMIP and S9 to 401 should also be simple enough.	Adding 401 nodes to 402 VPLMN or 402 nodes to HPLMN. No issues.	Simpler than Option 1. Per-flow QoS information can be extracted from S9.	Can only add GTP interface to 402 PDN. There is no V-PCRF so reciprocal case is not possible.	Adding 401 nodes to 402 HPLMN or 402 nodes to 401 VPLMN. No issues.
Deployment Issues	None	None	Need to add infrastructure to support roaming relationships.	None	None	Same as 3.
Commercial Availability	IPX/GRX providers already exist. Offering inter-standard roaming may be an attractive business opportunity.	Depends on vendor motivation to introduce both types of interfaces on their gateway and PCRF products.	No issue. Will be available at the same time as 401 and 402 equipment.	Same as Option 1.	Same as Option 2	Same as 3.
Operational Costs	Cost to GRX operator for managing interworking. No CapEx costs.	Management of two different types of interfaces.	Higher CaPex, Higher OAM costs.	Same as Option 1.	Same as Option 2	Costs are higher for Option 6a – adding 402 nodes (PCRF + S-GW) to V401 PLMN.

Conclusion and proposal

> Only Option 1 requires additional standardisation effort

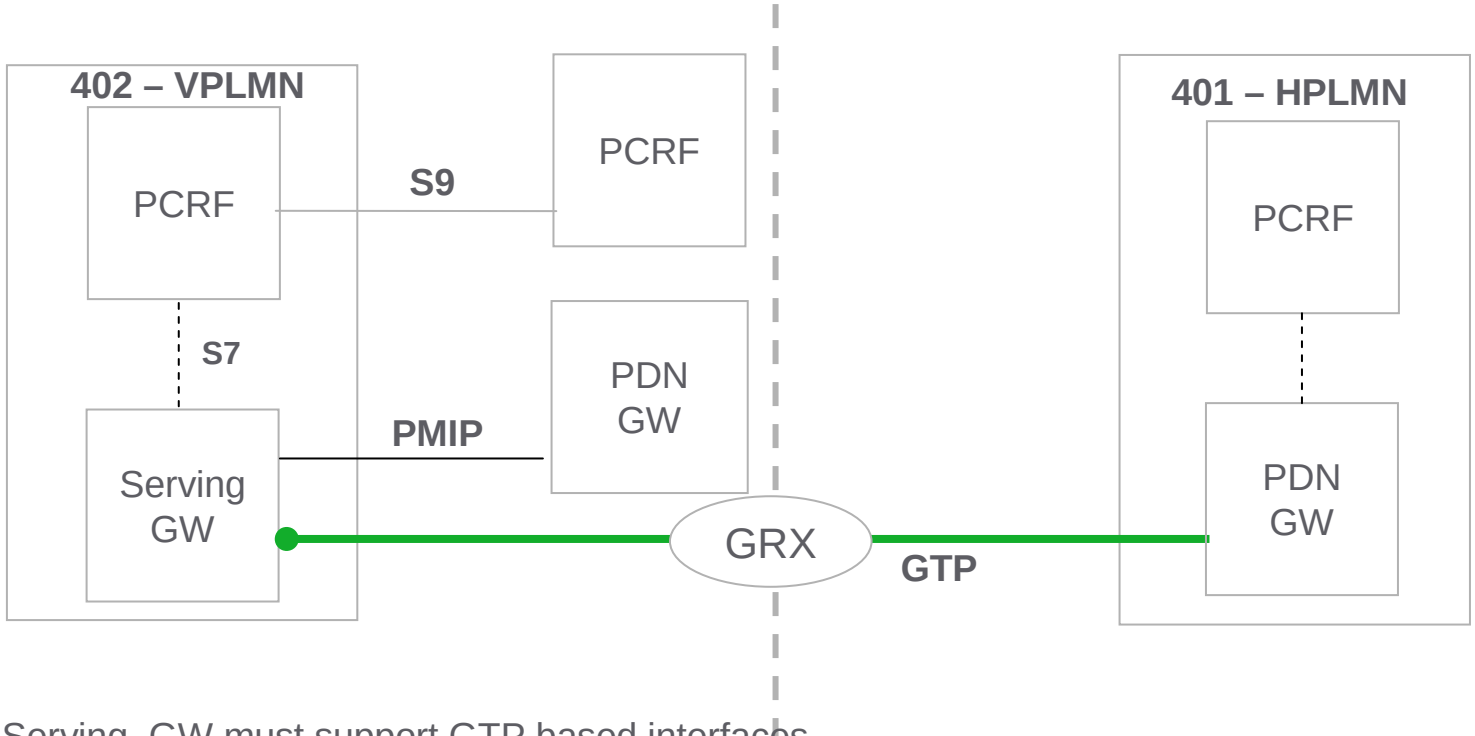
- Requires an optional capability to signal full Gx (or Gx-like) information across GTP-based S8a

> It is proposed to document the alternative solutions in an Annex of TS 23.402

- Text proposal submitted in a companion paper for this meeting S2-072769

Backup slides…

Option 2a: GTP interface on 402 Serving GW

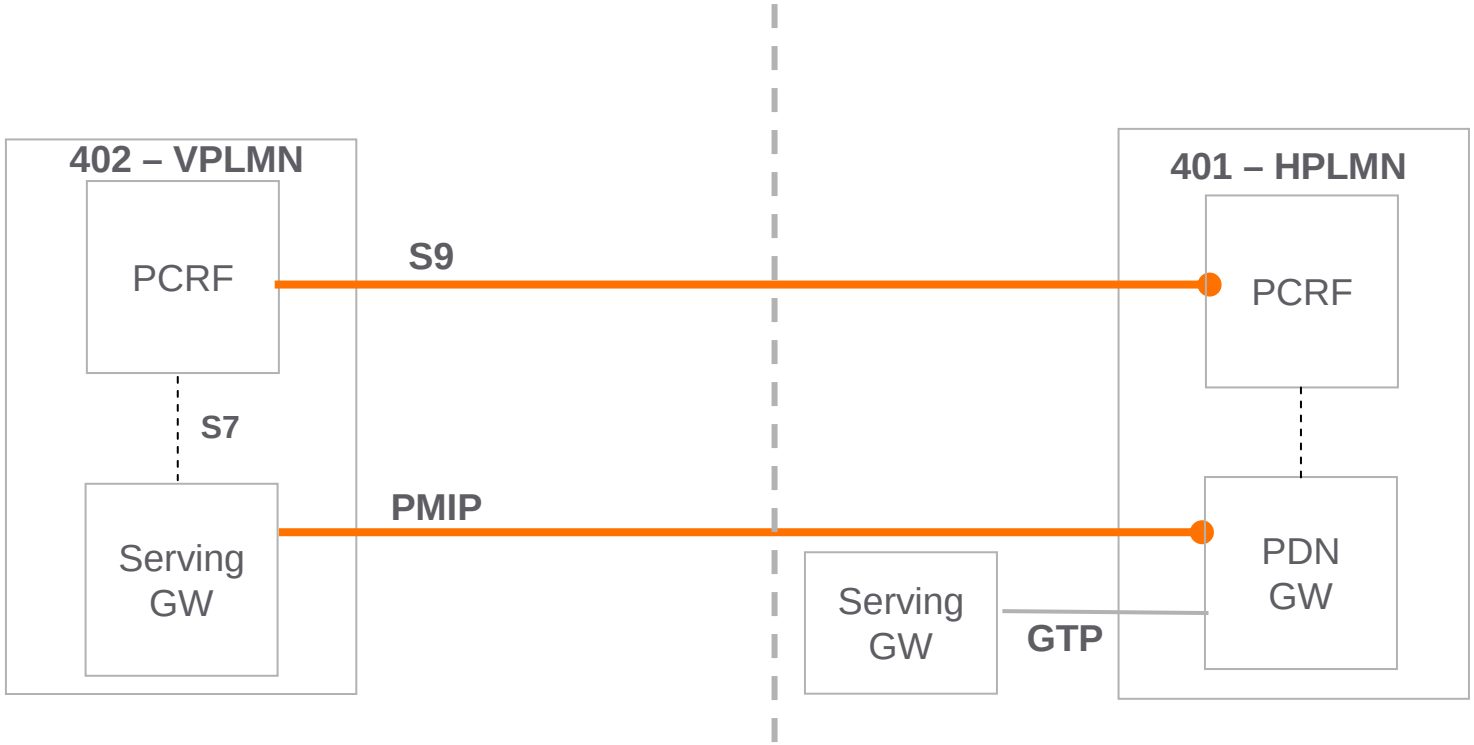


Serving GW must support GTP based interfaces
- PDN GW is selected at the time of network attachment which determines which interface is used.
- Based on the roaming partner, connectivity is invoked via a GTP or a PMIP interface

Advantages:
- Low operational cost. Low CapEx

Drawbacks:
- Two different charging models at Serving GW
- Complex implementation of Serving GW

Option 2b: S9 + PMIP interfaces in 401



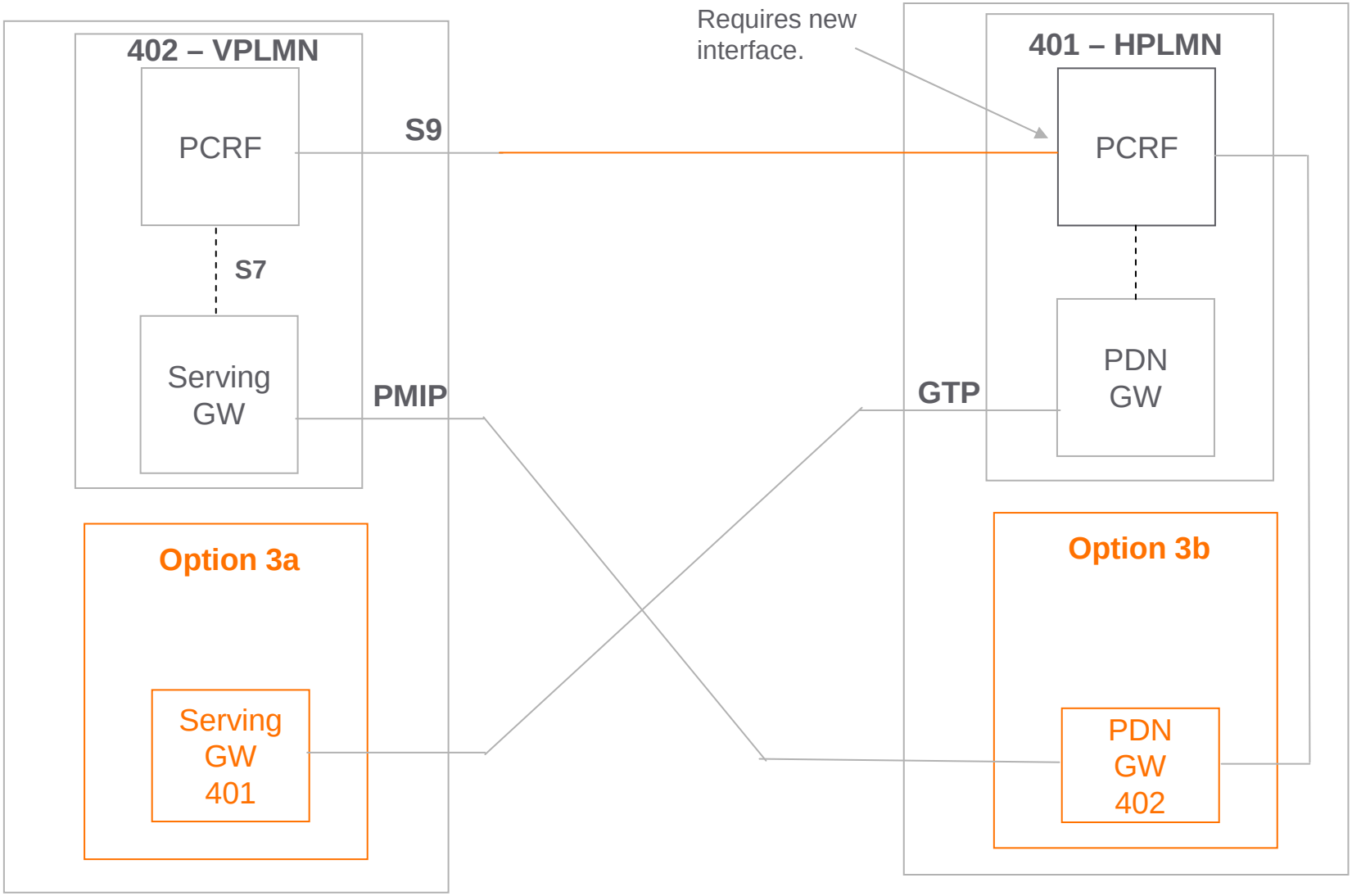
Home PCRF and PDN GW support S9 and PMIP interfaces respectively

- The home PCRF must be capable of relaying S9 signaling between visited system
- The PDN GW will support different inter-faces for forwarding traffic. The L3 forwarding table must be link layer agnostic

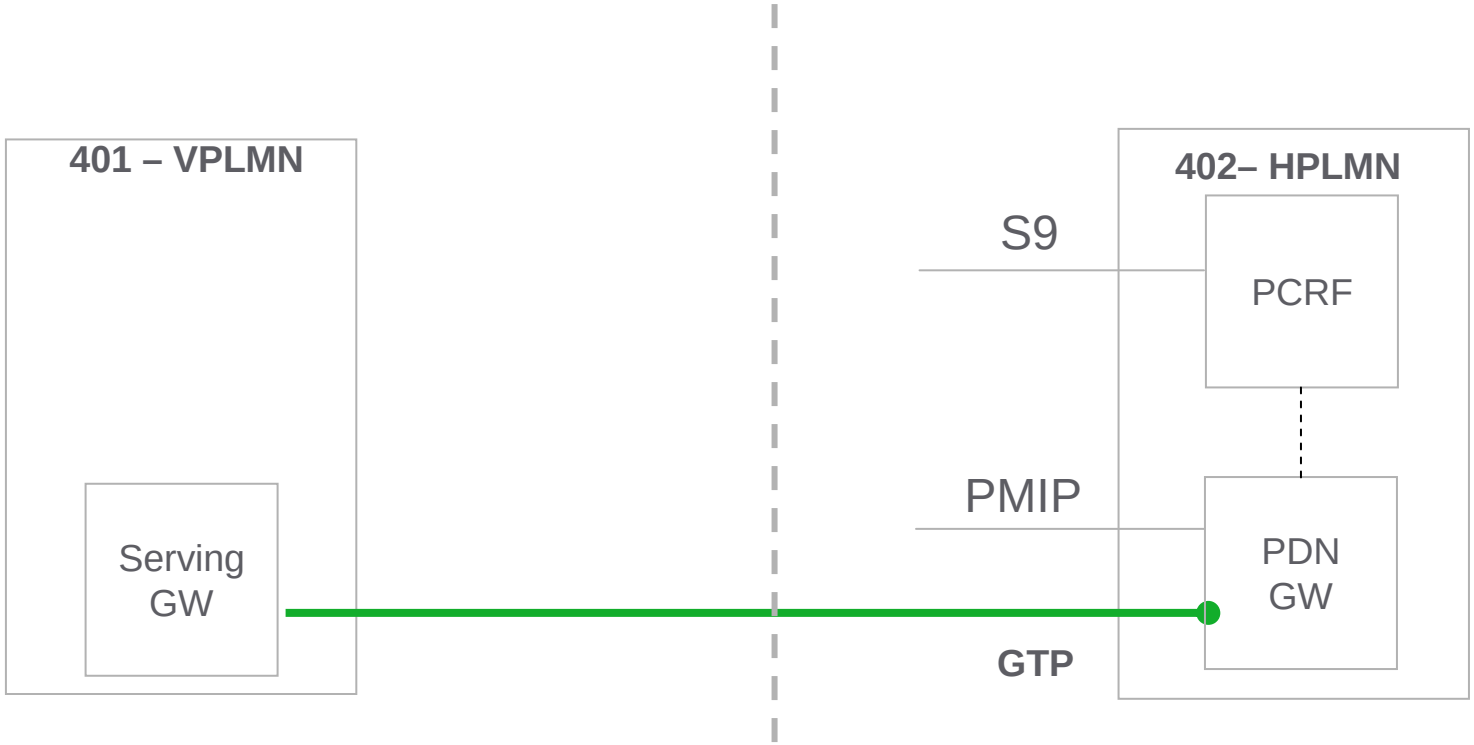
Drawbacks:

- Not a realistic scenario

Option 3 – Implement reciprocal gateways for roaming access

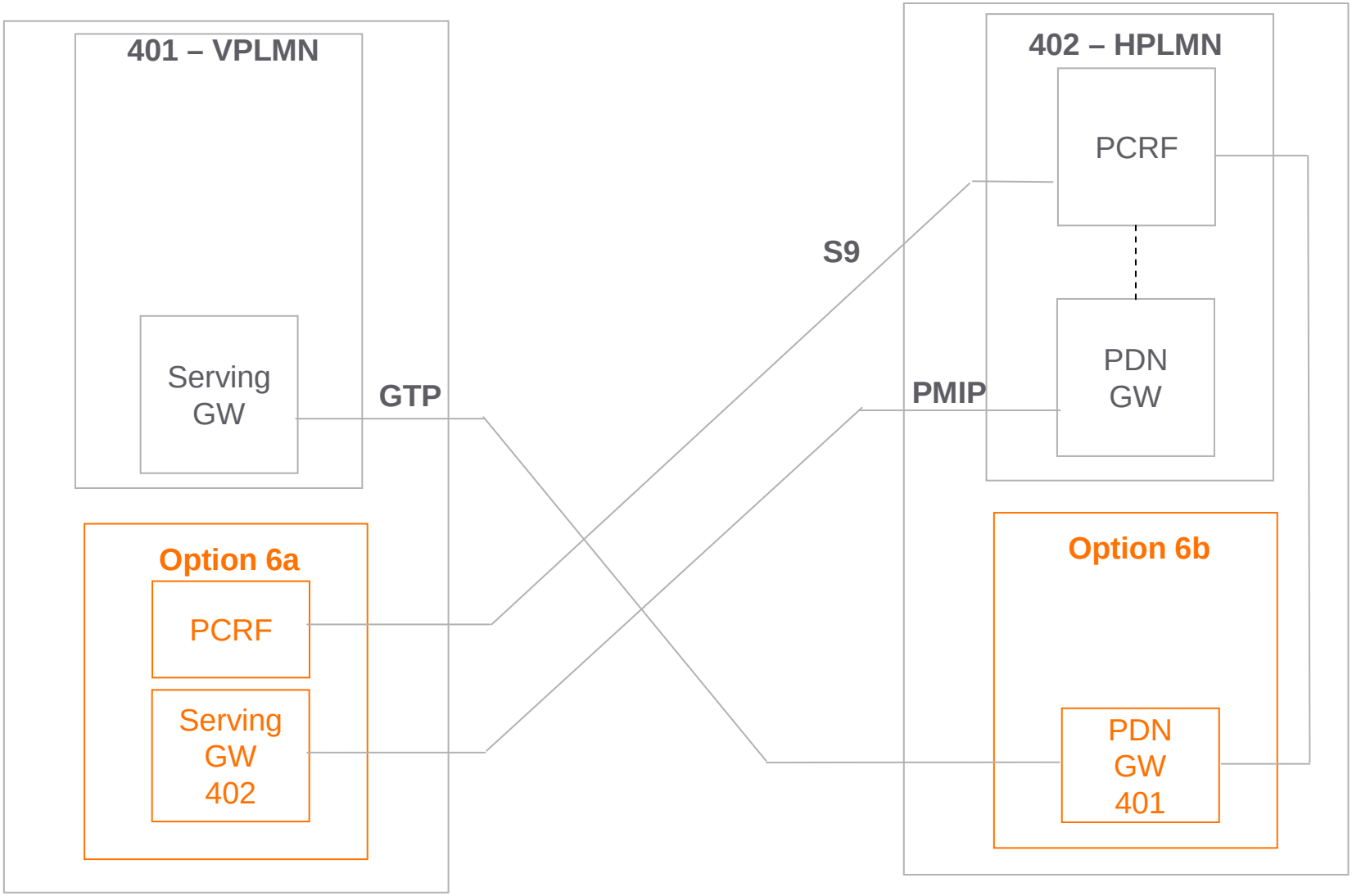


Option 5: Add GTP interface to 402 PDN GW

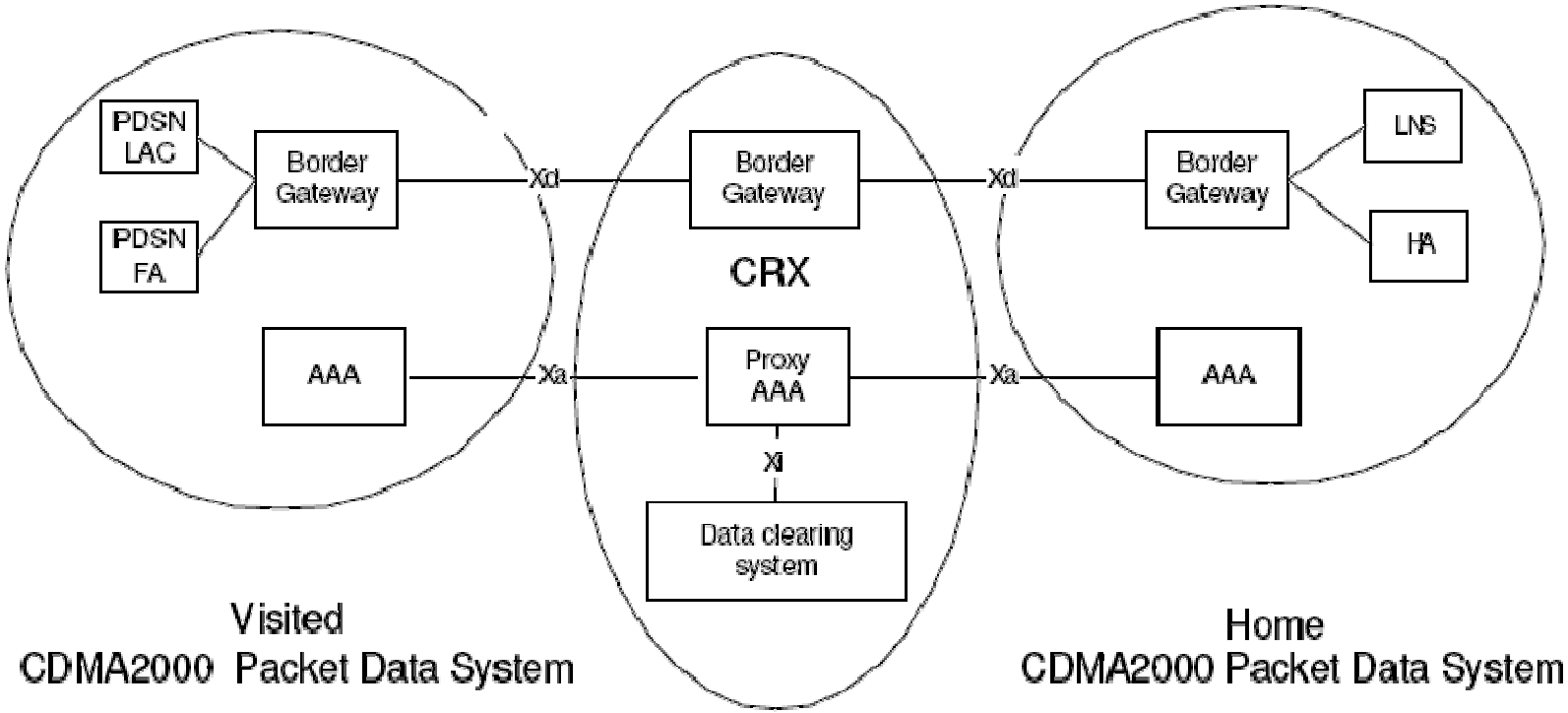


- PDN GW must support GTP based interfaces
- Same as option 2a
- There is no similar Option 2b since the VPLMN does not have a V-PCRF Adding a PCRF to the VPLMN is explored in Option 6a/b

Option 6 – Implement reciprocal gateways for roaming access

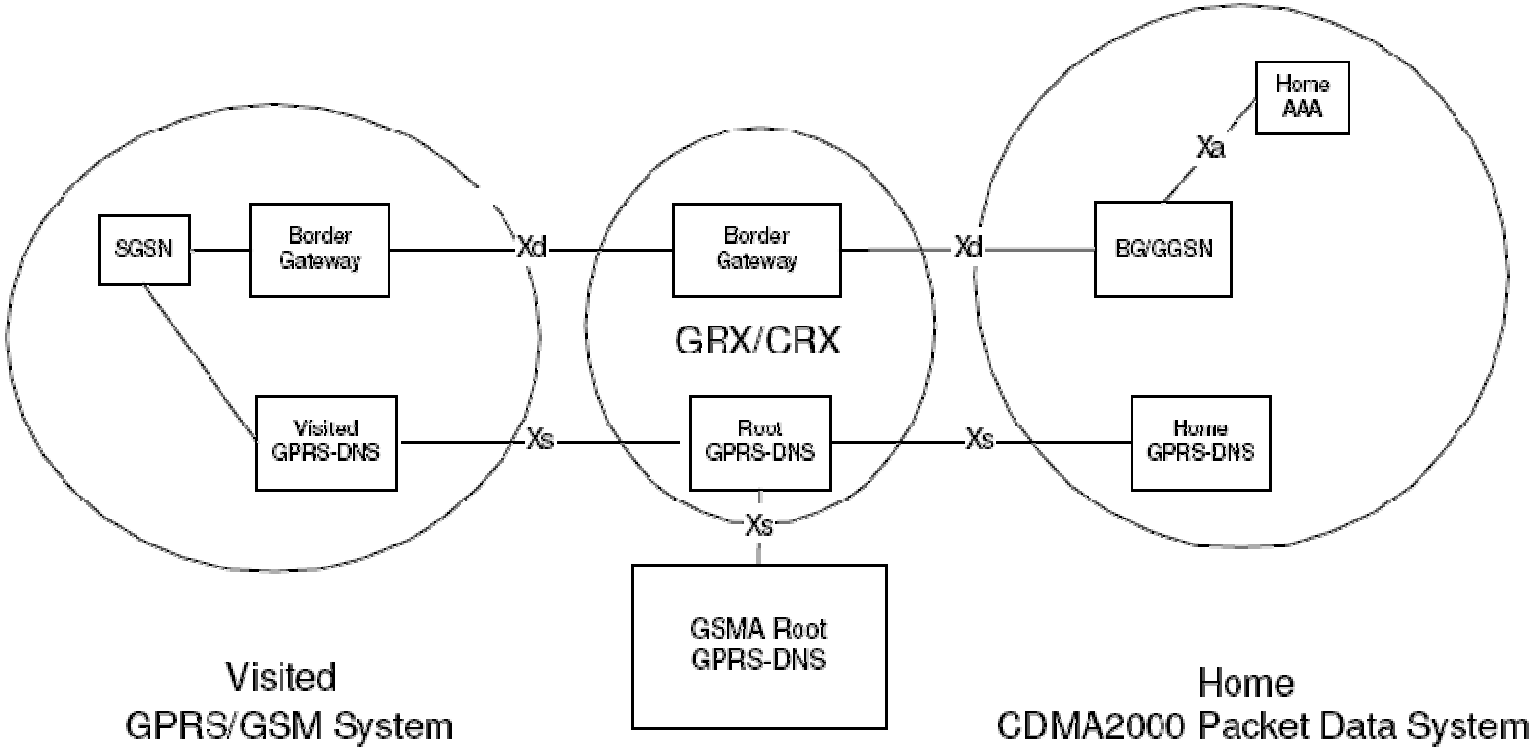


CRX Reference Model



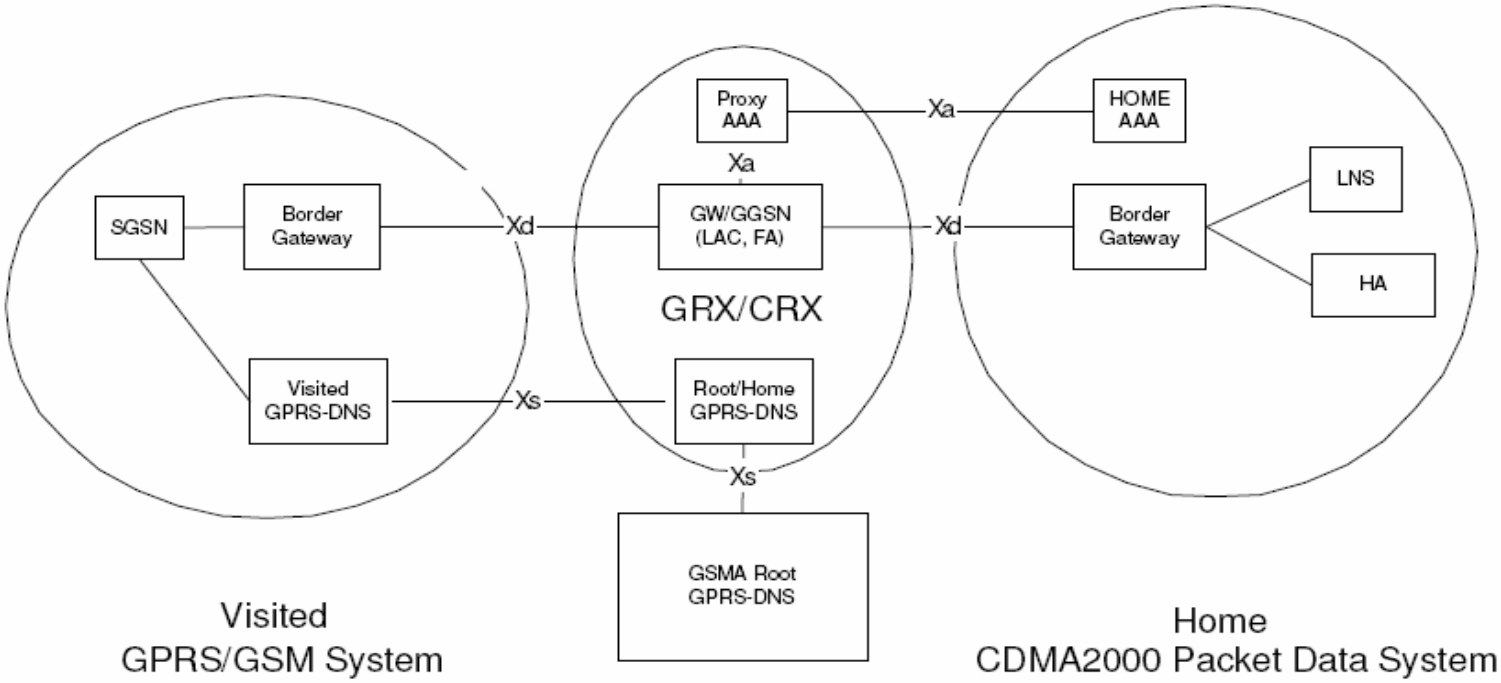
Xd: IP layer interface for IP data transport
Xa: Application layer interface for AAA messages
Xi: Application layer interface for accounting data to data clearing system

CRX: Inter-standard Roaming
GGSN in home CDMA PDS



- Replicates the required 3GPP functionality in the CDMA2000 PDS
- CRX network is used to provide transit connectivity.
- The **Xs** interface is used to query the IP address of the home GGSN. This reference model requires the home GPRS-DNS server to maintain a record of the home GGSN's IP address, understand the GPRS domain, and comply with the GSMA PRD IR35 specification.

GGSN in GRX/CRX (Inter-working HUB)



- CRX provides the inter-working between the two domains
- CRX GGSN provides ‘home’ control, while at the same time provides ‘visited’ control through FA functionality
- No QoS defined for this solution, but should be easy to extend since TFTs made available to FA (PDSN) can be reused by the GGSN

From GSMA IR 34: IPX Connectivity Services

> **Transport-Only Connectivity Option**

- A bilateral agreement between two Service Providers using the IPX transport layer with guaranteed QoS end-to-end. As with the GRX, this model is not service aware and it can be used to transport any protocol between the two Service Providers (provided compliance with security requirements is maintained)

> **Bilateral Service Transit Connectivity Option**

- A bilateral agreement between two Service Providers using the IPX Proxy functions and the IPX transport layer with guaranteed QoS end-to-end. This model provides the opportunity to include **service-based interconnect charging** in addition to the transport charging of the transport-only model

> **Multilateral Service Hub Connectivity Option**

- A model providing multilateral interconnect with guaranteed end-to-end QoS and including service-based interconnect charging. Hubbing/multilateral connectivity is where traffic is routed from one Service Provider to many destinations or interworking partners via a single agreement with the IPX Provider. The hub functionality is provided by **IPX Proxies**.

From GSMA IR 34: IPX Proxy Services

> Interworking between Service Providers can be established without proxy services when using the Transport-Only Connectivity Option. However proxy services are required to support the hub and transit connectivity models described above, where they facilitate a Service Provider's configuration and agreement management and the cascading of charging

> The IPX will include a number of proxies that support specified IP service interworking. IPX Proxies are not mandatory but will be needed to support Service Transit and Hubbing Connectivity options. Note that the use of an IPX Proxy does not necessarily imply the adoption of a multilateral connectivity model; Proxies may also be used to support services on a bilateral basis.