Location Acquisition – concepts

Reflecting the Latest Specifications

(& ideas to determine the AMF)

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Location Acquisition Concepts

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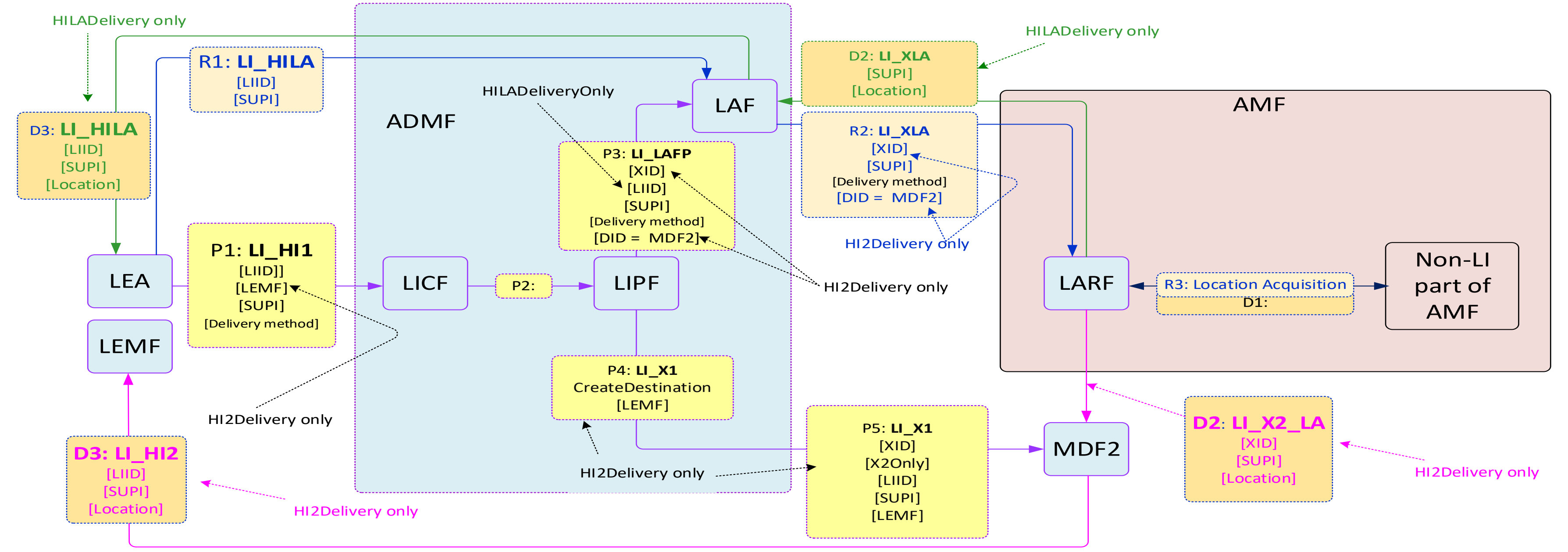
Concept - view



- HILADelivery
  - P1 → P2 → P3
  - R1 → R2 → R3
  - D1 → D2 → D3.

- HI2Delivery
  - P1 → P2 →P3 → P4, P5
  - R1 → R2 →R3
  - D1 → D2 → D3.

- HILADelivery + HI2Delivery
  - P1 → P2 →P3 → P4, P5
  - R1 → R2 →R3
  - D1 → D2 → D3 (HILADelivery)
  - D1 → D2 → D3 (HI2Delivery).

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Flow diagrams (easy cases)

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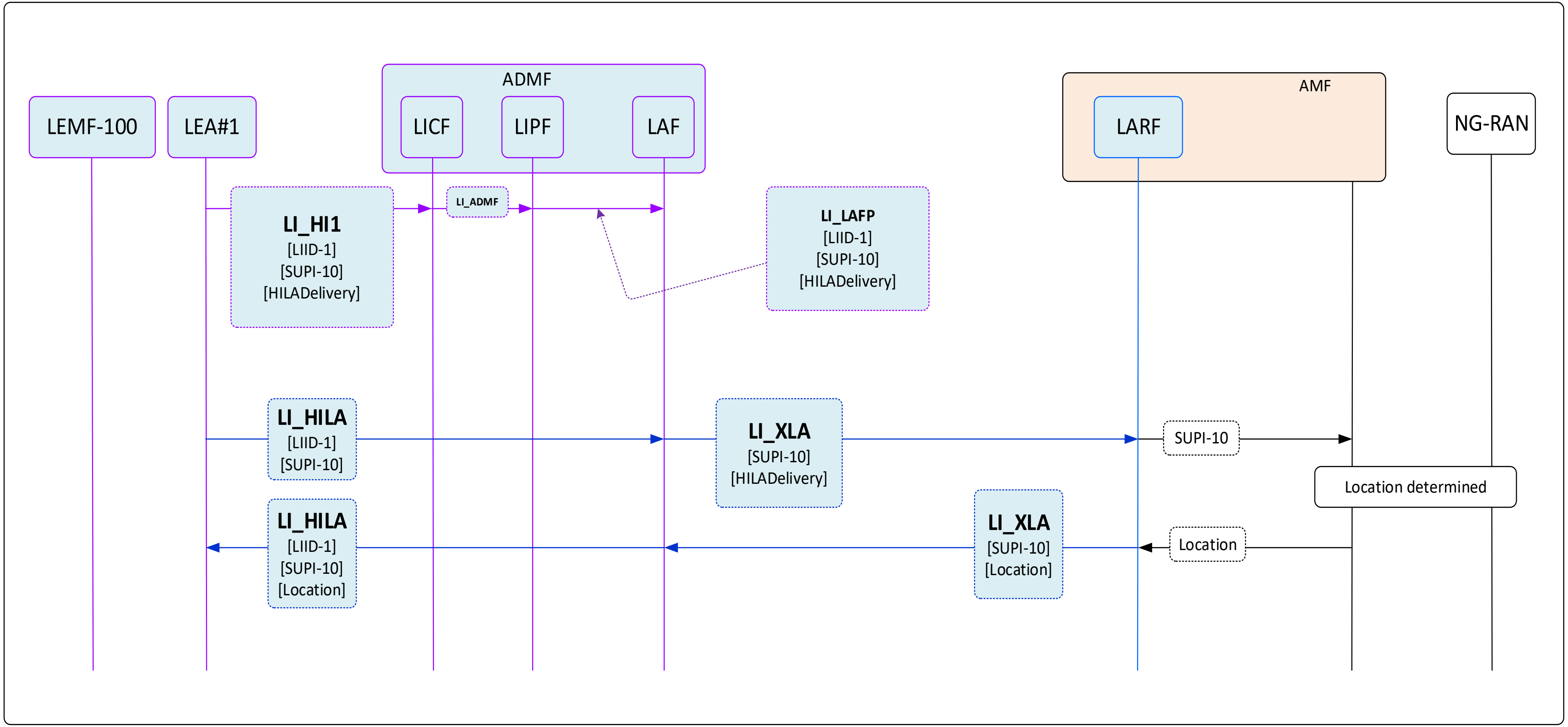
HILA Delivery



Assumed: no LMF interaction for location determination

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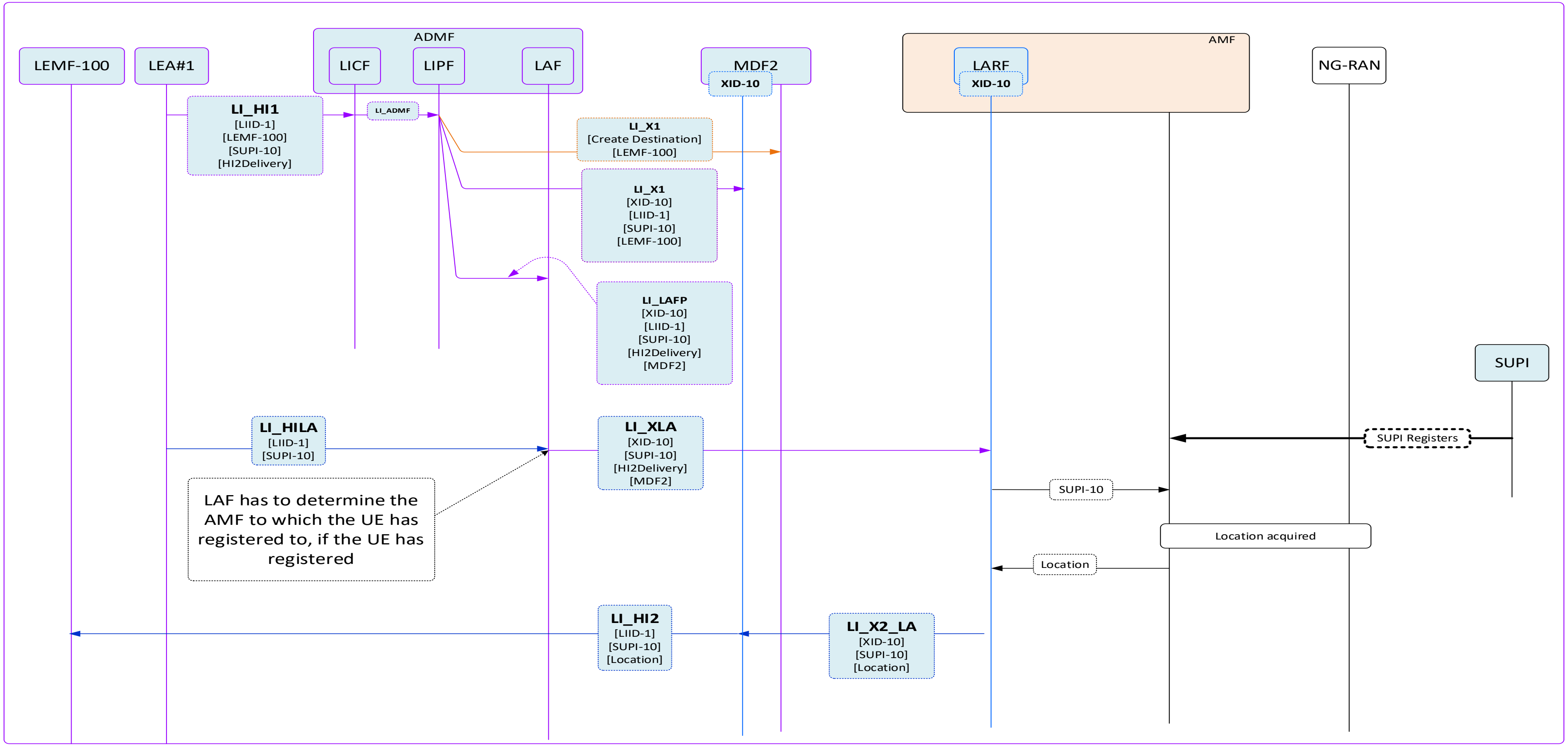
HI2 Delivery



LAF has to determine the AMF to which the UE has registered to, if the UE has registered

Assumed: no LMF interaction for location determination

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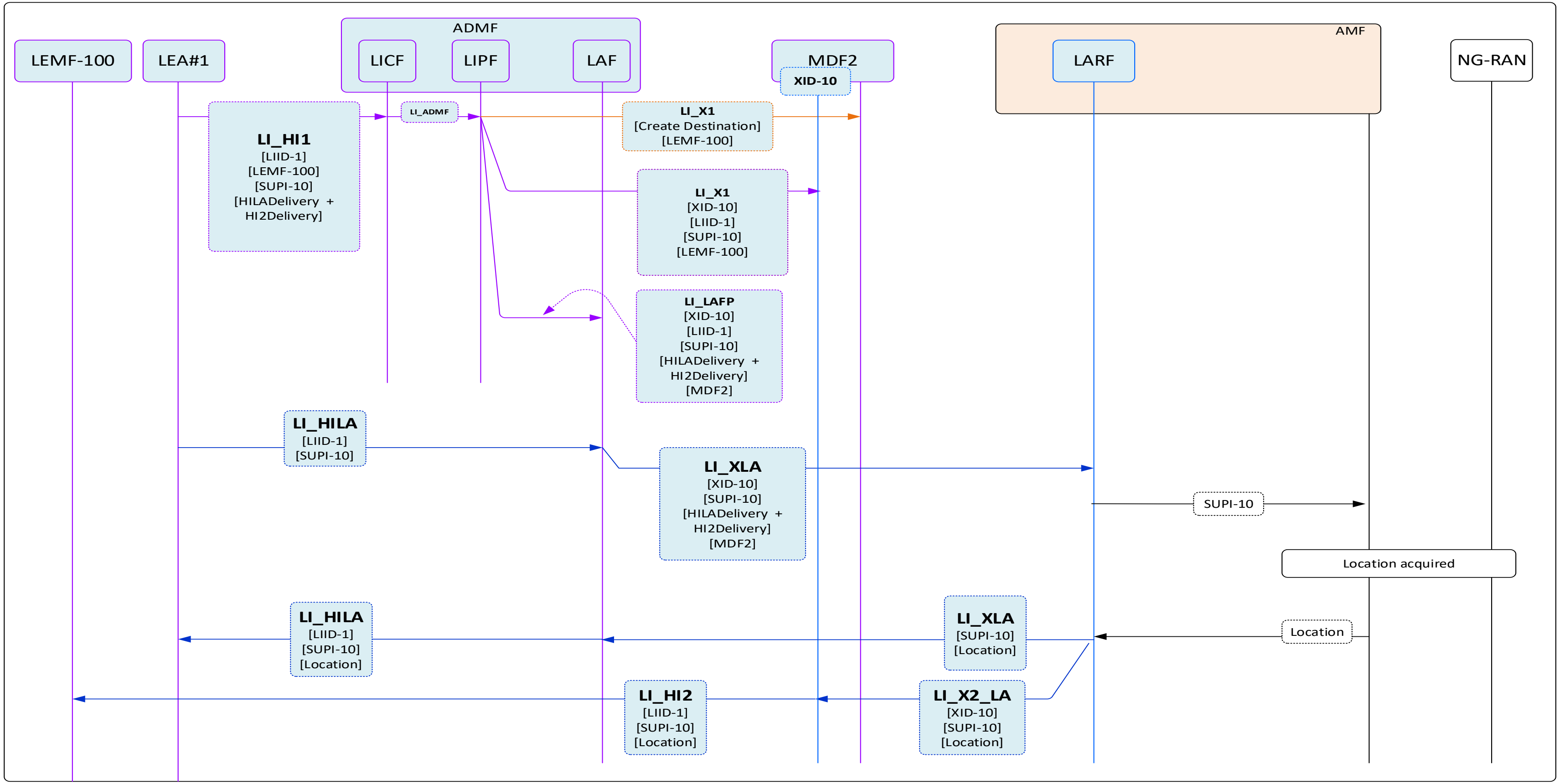
HILA Delivery + HI2 Delivery



Assumed: no LMF interaction for location determination

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Flow diagrams

(two LEAs – both Location Acquisition)

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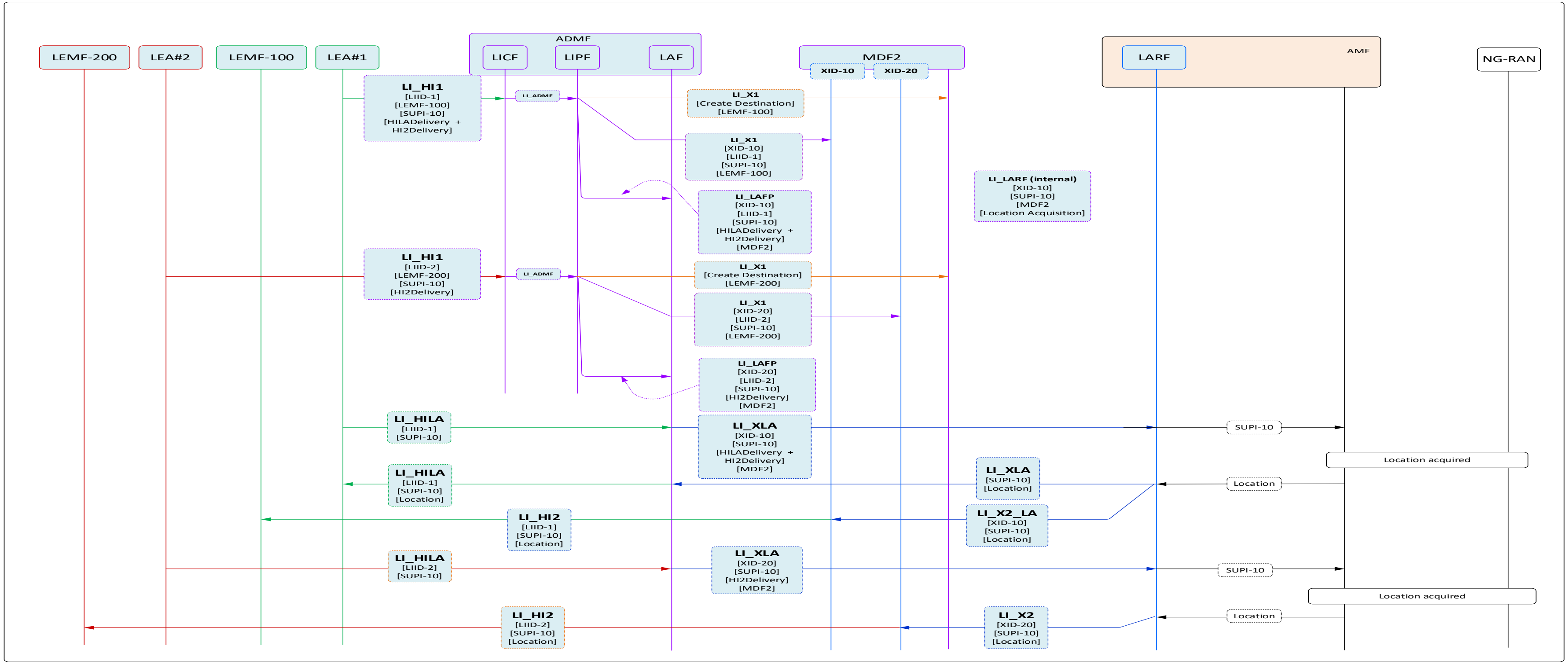
LEA#1: HILA Delivery + HI2 Delivery
LEA#2: HI2 Delivery



LEMF-200

LEA#2

LEMF-100

LEA#1

ADMF

LICF

LIPF

LAF

MDF2

XID-10

XID-20

LARF

AMF

NG-RAN

LI_HI1 [LIID-1] [LEMF-100] [SUPI-10] [HILADelivery + HI2Delivery]

LI_ADMF

LI_X1 [Create Destination] [LEMF-100]

LI_X1 [XID-10] [LIID-1] [SUPI-10] [LEMF-100]

LI_LARF (internal) [XID-10] [SUPI-10] [MDF2 [Location Acquisition]

LI_LAFP [XID-10] [LIID-1] [SUPI-10] [HILADelivery + HI2Delivery] [MDF2]

LI_HI1 [LIID-2] [LEMF-200] [SUPI-10] [HI2Delivery]

LI_ADMF

LI_X1 [Create Destination] [LEMF-200]

LI_X1 [XID-20] [LIID-2] [SUPI-10] [LEMF-200]

LI_LAFP [XID-20] [LIID-2] [SUPI-10] [HI2Delivery] [MDF2]

LI_HILA [LIID-1] [SUPI-10]

LI_XLA [XID-10] [SUPI-10] [HILADelivery + HI2Delivery] [MDF2]

SUPI-10

Location acquired

LI_HILA [LIID-1] [SUPI-10] [Location]

LI_XLA [SUPI-10] [Location]

Location

LI_HI2 [LIID-1] [SUPI-10] [Location]

LI_X2_LA [XID-10] [SUPI-10] [Location]

LI_HILA [LIID-2] [SUPI-10]

LI_XLA [XID-20] [SUPI-10] [HI2Delivery] [MDF2]

SUPI-10

Location acquired

LI_HI2 [LIID-2] [SUPI-10] [Location]

LI_X2 [XID-20] [SUPI-10] [Location]

Location

Assumed: no LMF interaction for location determination

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Flow diagrams

(two LEAs:

1) Location Acquisition

2) Regular w/ location)

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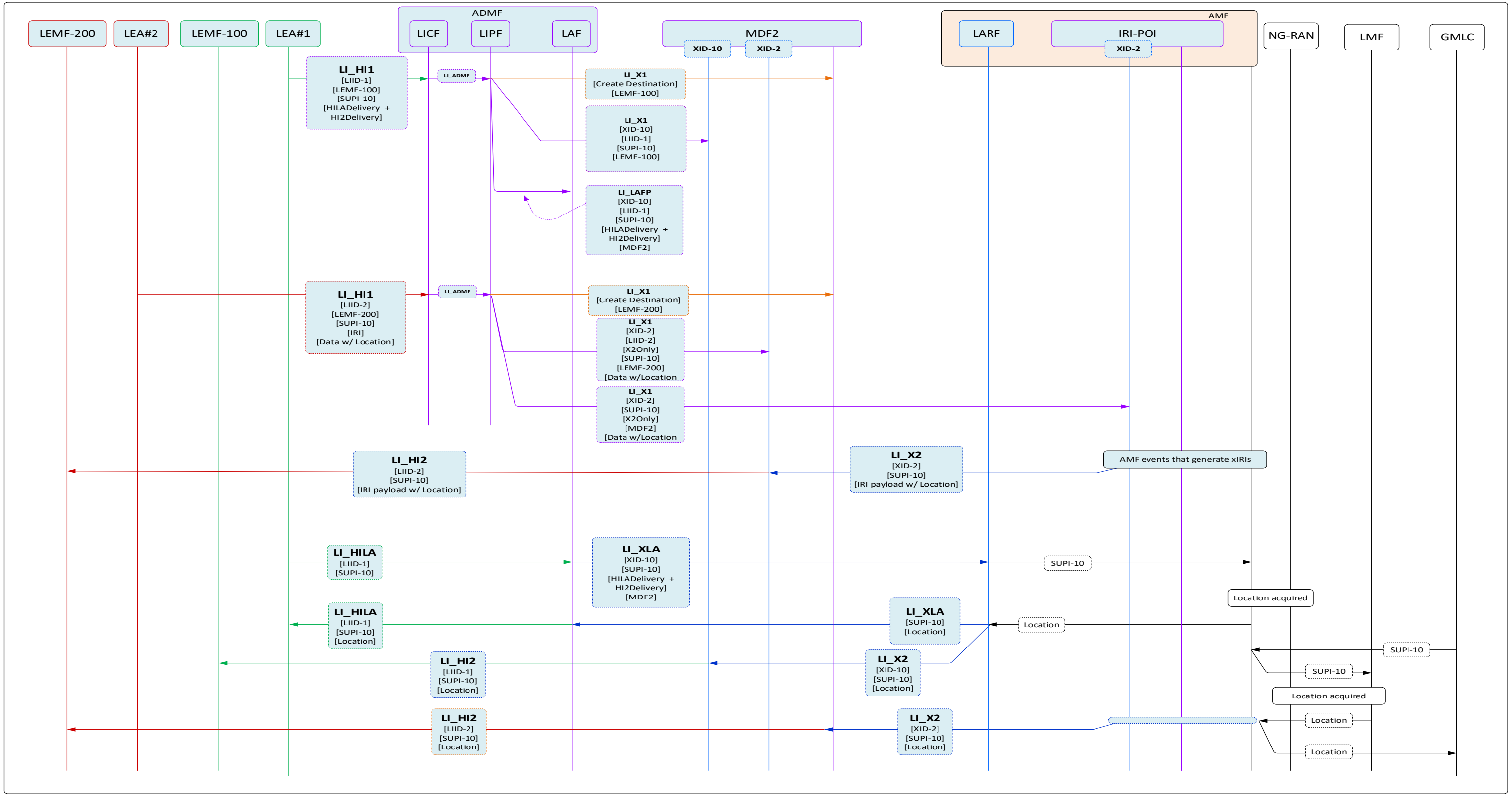
LEA#1: HILA Delivery + HI2 Delivery
LEA#2: Regular w/ location



Assumed: no LMF interaction for location determination

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Flow diagrams

Regular warrant + Location Acquisition (combined in the warrant)

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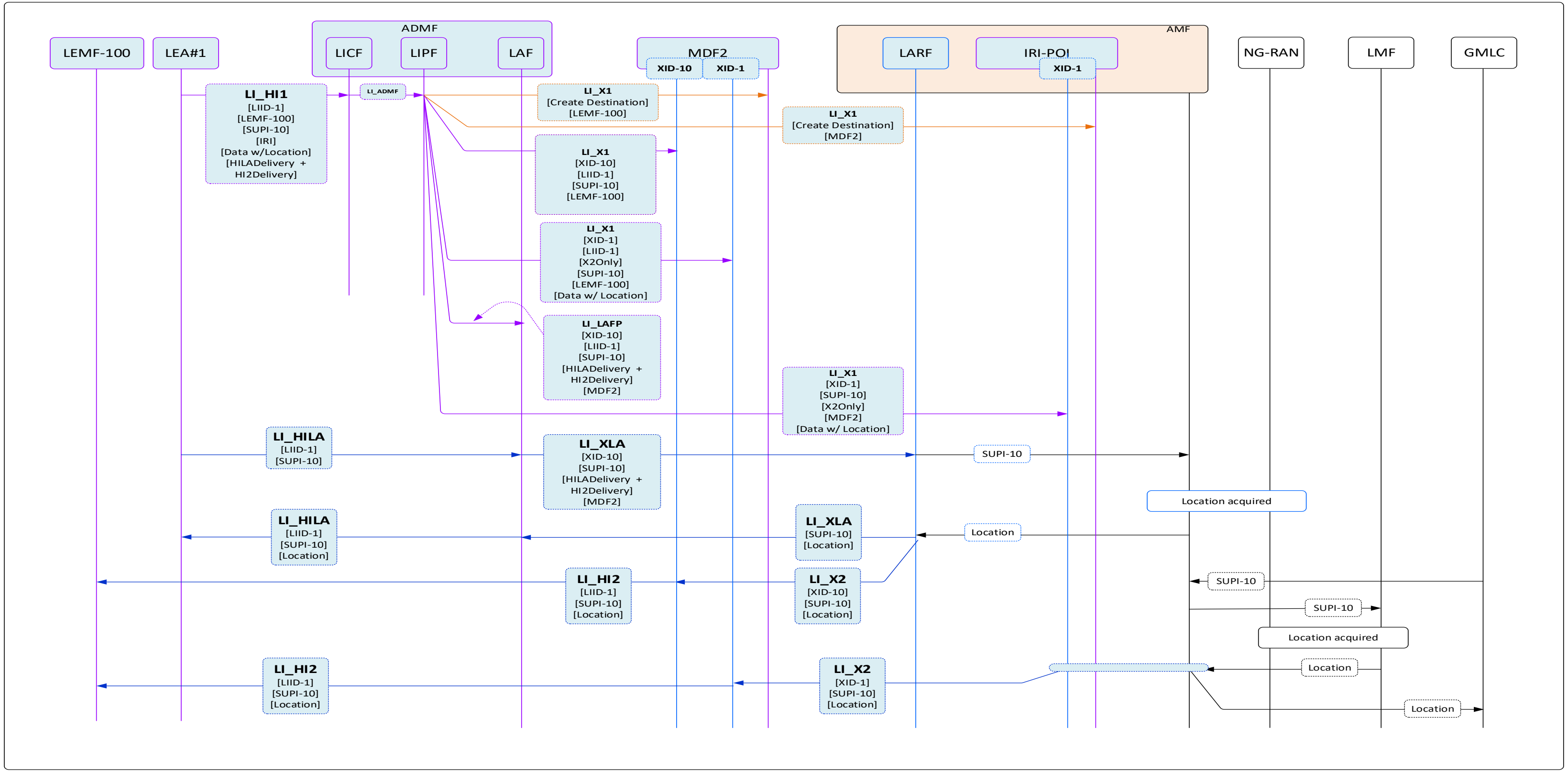
Data with Location + Location Acquisition [HILA Delivery + HI2 Delivery]



Assumed: no LMF interaction for location determination

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Flow diagrams

(two LEAs:

1) Regular w/o location + Location Acquisition

2) Regular w/ location)

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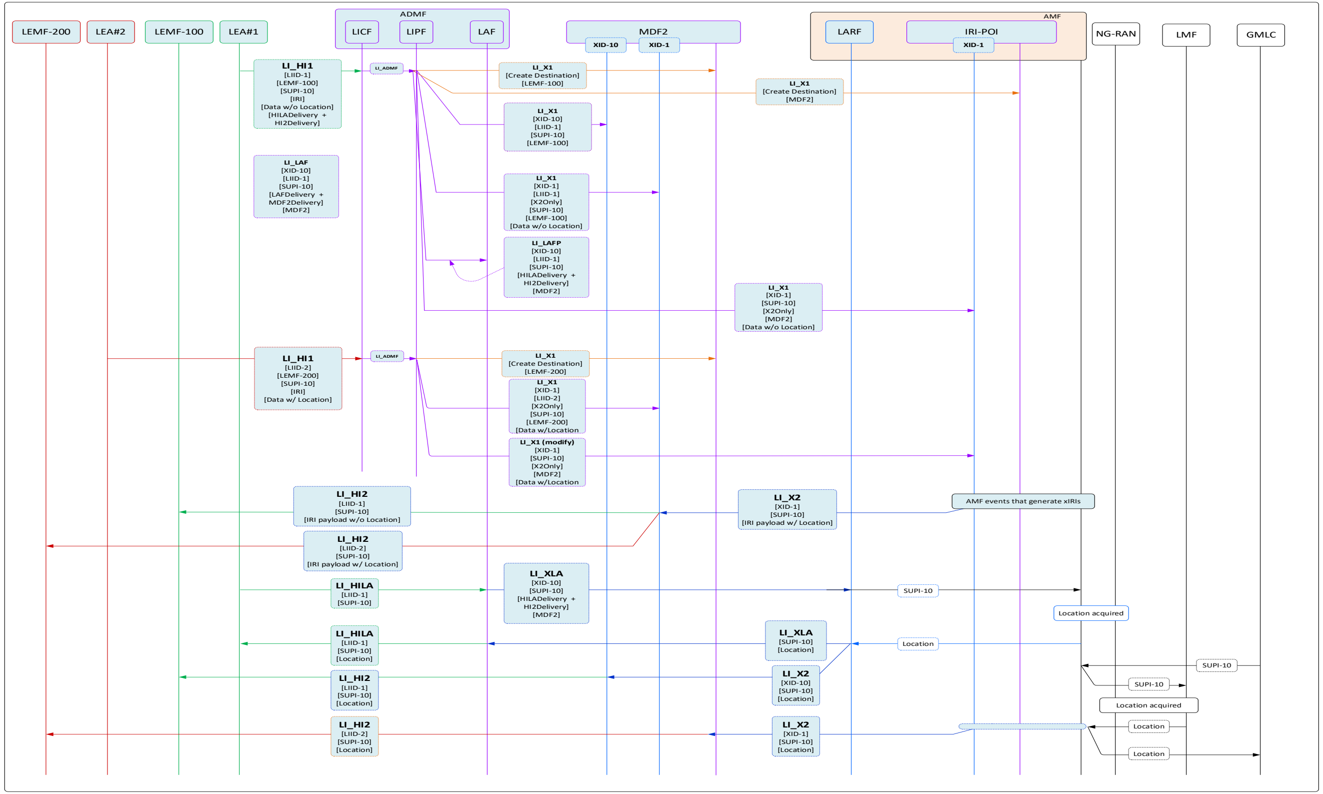
LEA#1: Regular w/o location, HILA Delivery + HI2 Delivery
LEA#2: Regular w/ location


LEMF-200
LEA#2
LEMF-100
LEA#1
ADMF
LICF
LIPF
LAF
MDF2
XID-10
XID-1
AMF
LARF
IRI-POI
XID-1
NG-RAN
LMF
GMLC
LI_HI1 [LIID-1] [LEMF-100] [SUPI-10] [IRI] [Data w/o Location] [HILADelivery + HI2Delivery]
LI_ADMF
LI_X1 [Create Destination] [LEMF-100]
LI_X1 [Create Destination] [MDF2]
LI_X1 [XID-10] [LIID-1] [SUPI-10] [LEMF-100]
LI_LAF [XID-10] [LIID-1] [SUPI-10] [LAFDelivery + MDF2Delivery] [MDF2]
LI_X1 [XID-1] [LIID-1] [X2Only] [SUPI-10] [LEMF-100] [Data w/o Location]
LI_LAFP [XID-10] [LIID-1] [SUPI-10] [HILADelivery + HI2Delivery] [MDF2]
LI_X1 [XID-1] [SUPI-10] [X2Only] [MDF2] [Data w/o Location]
LI_HI1 [LIID-2] [LEMF-200] [SUPI-10] [IRI] [Data w/ Location]
LI_ADMF
LI_X1 [Create Destination] [LEMF-200]
LI_X1 [XID-1] [LIID-2] [X2Only] [SUPI-10] [LEMF-200] [Data w/Location
LI_X1 (modify) [XID-1] [SUPI-10] [X2Only] [MDF2] [Data w/Location
LI_HI2 [LIID-1] [SUPI-10] [IRI payload w/o Location]
LI_X2 [XID-1] [SUPI-10] [IRI payload w/ Location]
AMF events that generate xIRIs
LI_HI2 [LIID-2] [SUPI-10] [IRI payload w/ Location]
LI_HILA [LIID-1] [SUPI-10]
LI_XLA [XID-10] [SUPI-10] [HILADelivery + HI2Delivery] [MDF2]
SUPI-10
Location acquired
LI_HILA [LIID-1] [SUPI-10] [Location]
LI_XLA [SUPI-10] [Location]
Location
SUPI-10
LI_HI2 [LIID-1] [SUPI-10] [Location]
LI_X2 [XID-10] [SUPI-10] [Location]
SUPI-10
Location acquired
LI_HI2 [LIID-2] [SUPI-10] [Location]
LI_X2 [XID-1] [SUPI-10] [Location]
Location
Location

Assumed: no LMF interaction for location determination

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IRI-POI algorithm

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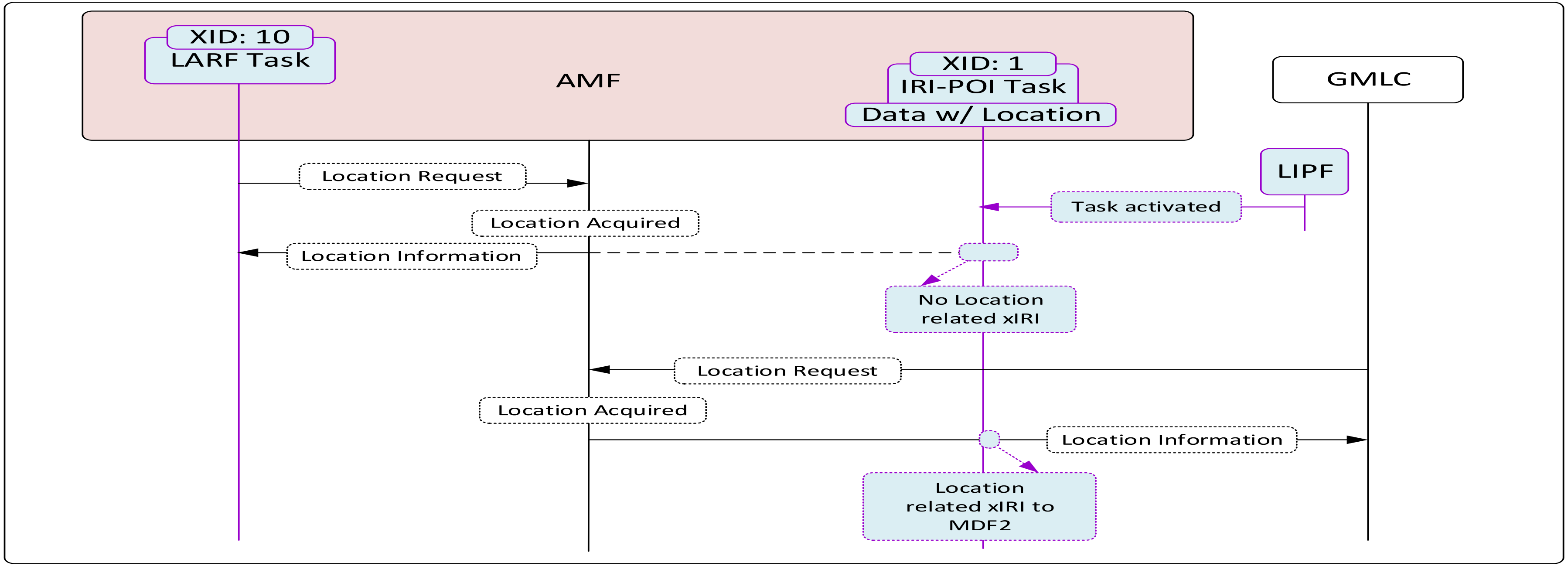
IRI-POI algorithm

- When the location information that AMF receives is due to an LARF query, the IRI-POI shall not generate the xIRI Location Update.



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LARF determination

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LARF determination

- Query AMFs:
  - This can take a long time to find the AMF that has the LARF for the UE.
  - If UE is not registered, the LAF will only know after querying all the AMFs in the network.
- Query UDM
  - If LAF and UDM are not in the same network, then this can have a problem.
- Query ICF
  - If ID Association Caching is not deployed. then this will not help.
- Location Acquisition IRI-POI in AMF
  - New approach

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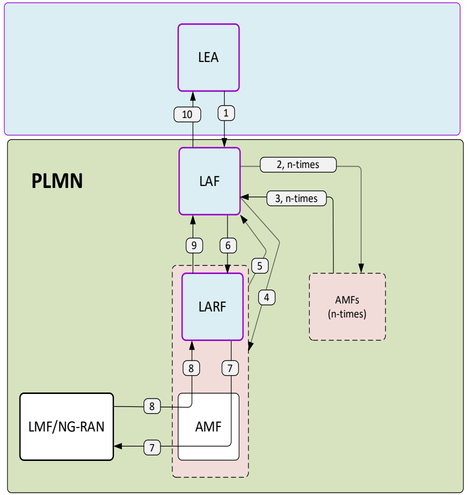
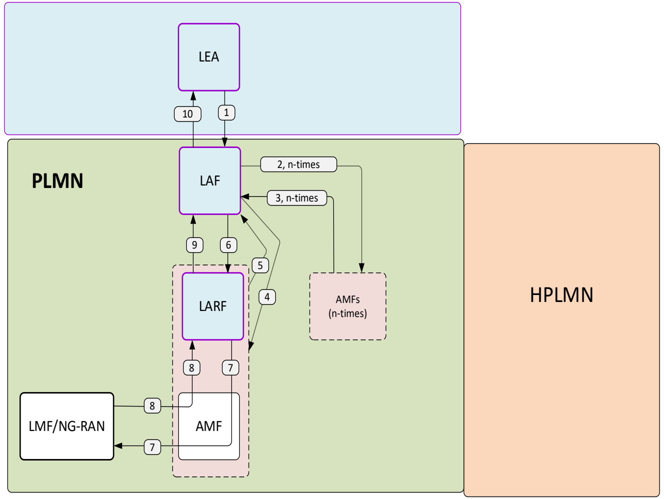
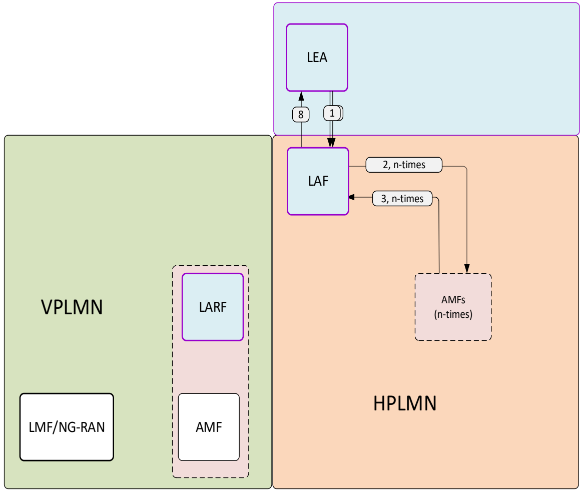
AMF Query







- Many queries may be required

- Many queries are required to conclude

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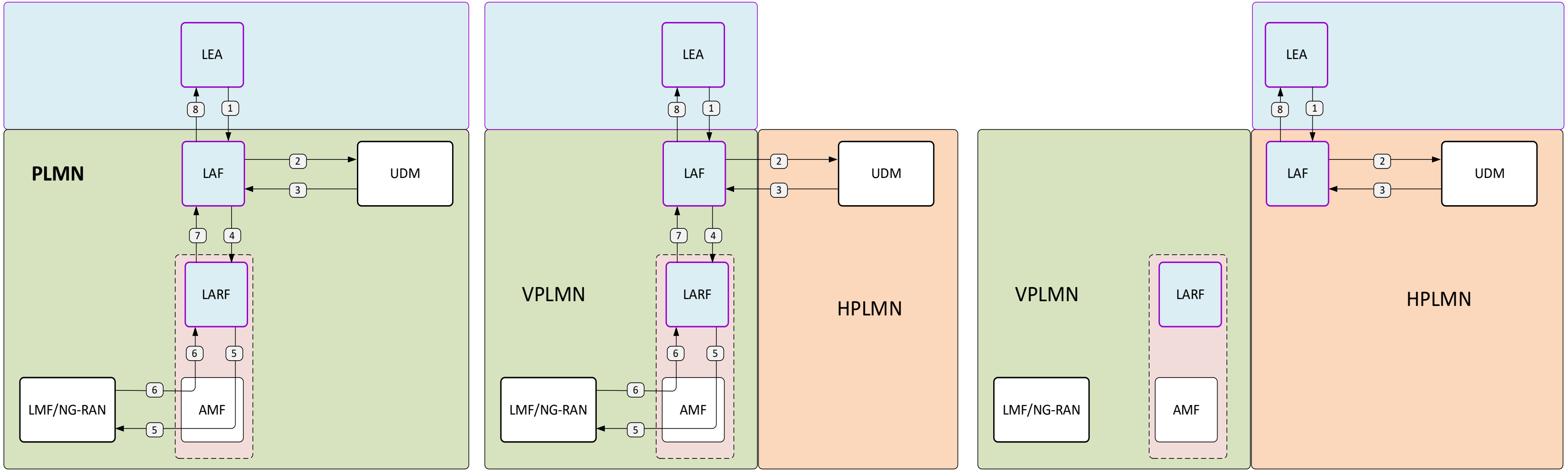
Query UDM



- Inter-PLMN interaction can be an issue

- AMF is not found

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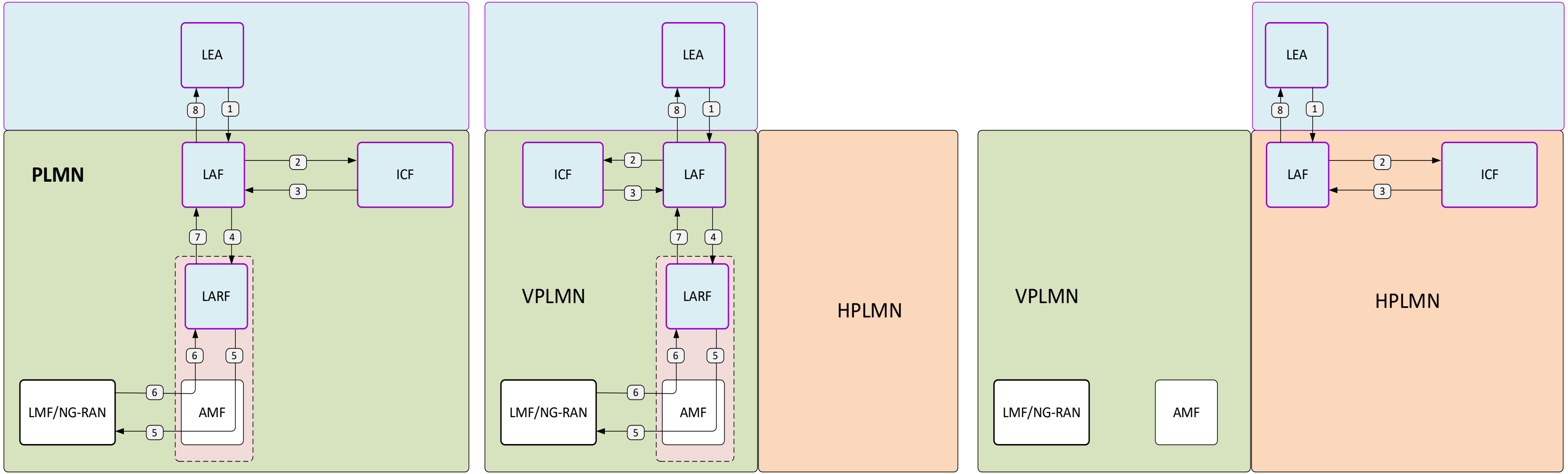
ICF Query



- LARF is not found.

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Location Acquisition IRI-POI

- A location Acquisition IRI-POI is activated in the AMFs with LAF as the DID.
- When the UE registers to the AMF, the Location Acquisition IRI-POI in that AMF notifies the LARF.
- If the UE is already registered to an AMF, then the Location Acquisition IRI-POI notifies the LAF when the Task is activated.
- LAF does not send any LI_XLA requests to an LARF, if no notification was received.

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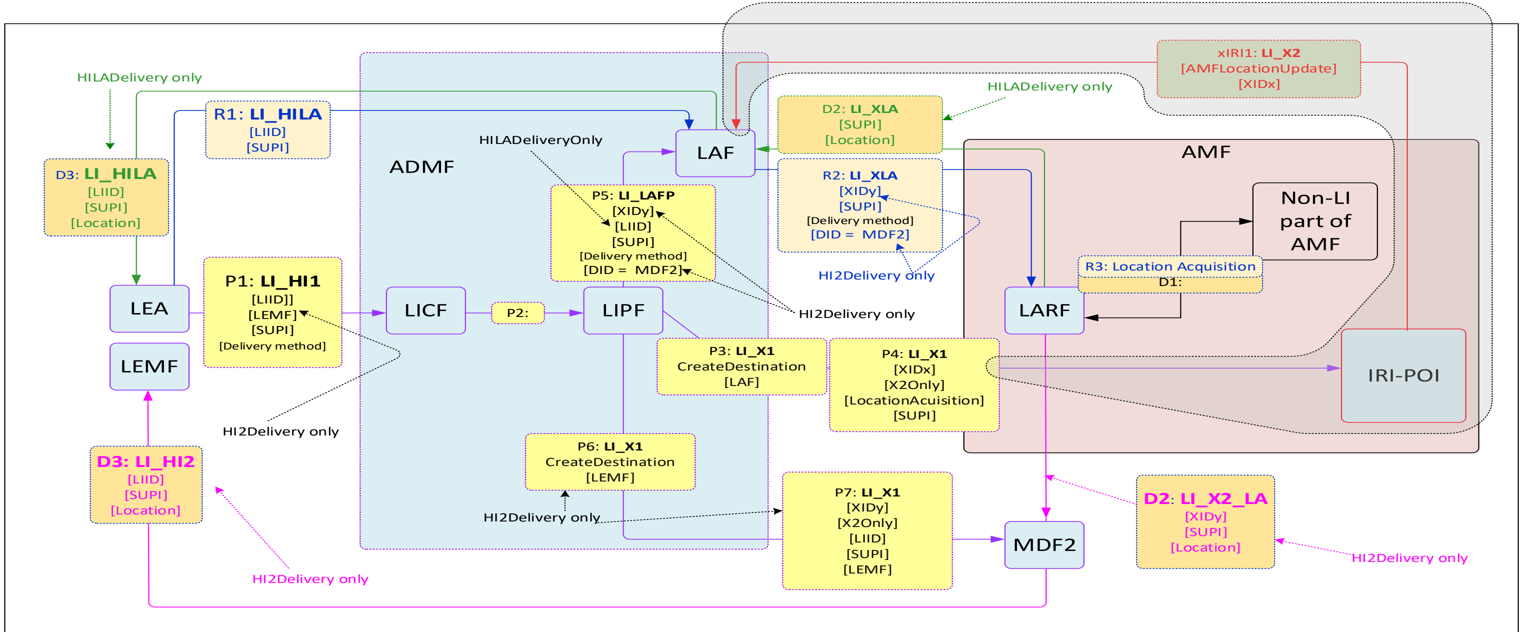
Location Acquisition IRI-POI



- HILADelivery
  - P1 → P2 → P3, P4, P5
  - xIRI1
  - R1 → R2 → R3
  - D1 → D2 → D3.

- HI2Delivery
  - P1 → P2 →P3, P4, P5 →, P6, P7
  - xIRI1
  - R1 → R2 →R3
  - D1 → D2 → D3.

- HILADelivery + HI2Delivery
  - P1 → P2 →P3, P4, P5 → P6, P7
  - xIRI1
  - R1 → R2 →R3
  - D1 → D2 → D3 (HILADelivery)
  - D1 → D2 → D3 (HI2Delivery).

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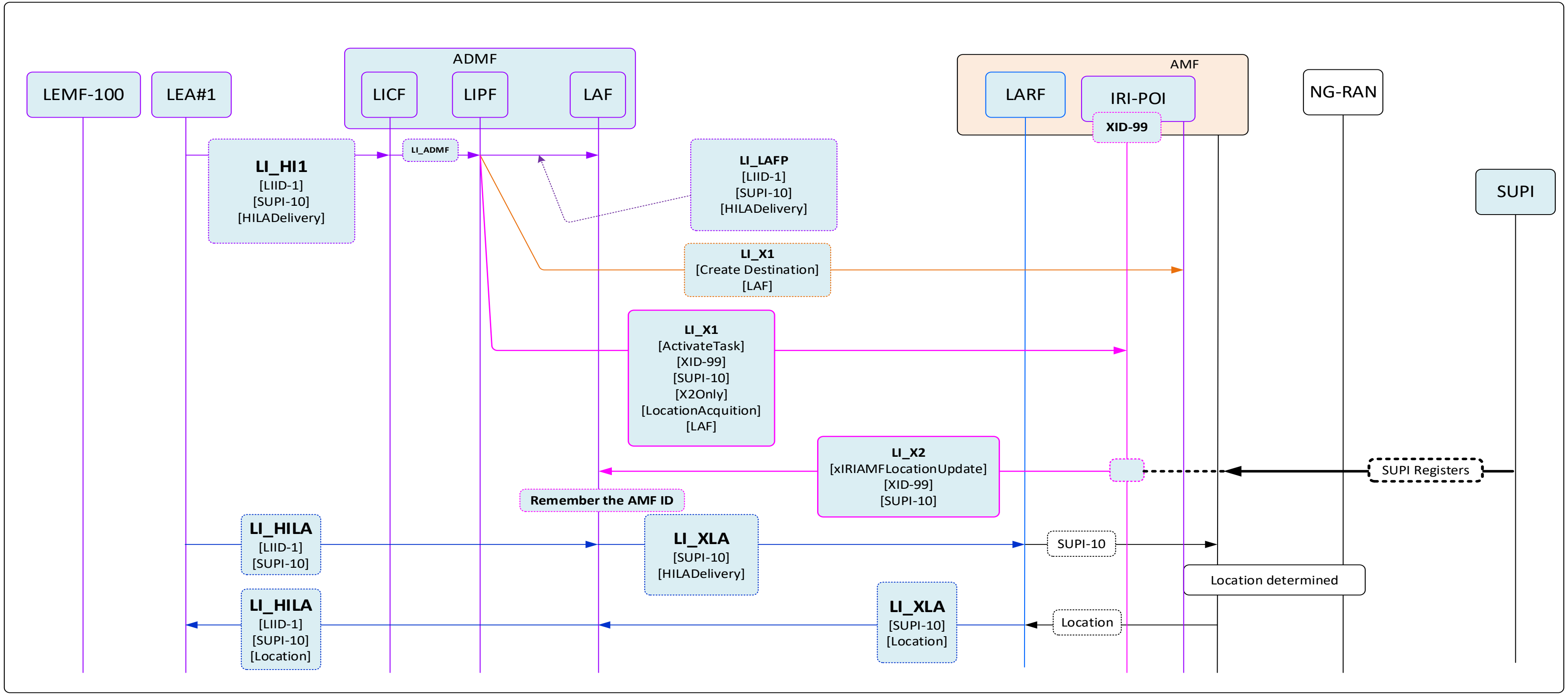
HILA Delivery with Location Acquisition IRI-POI



LEMF-100

LEA#1

ADMF

LICF

LIPF

LAF

AMF

LARF

IRI-POI

XID-99

NG-RAN

SUPI

LI_HI1
[LIID-1]
[SUPI-10]
[HILADelivery]

LI_ADMF

LI_LAFP
[LIID-1]
[SUPI-10]
[HILADelivery]

LI_X1
[Create Destination]
[LAF]

LI_X1
[ActivateTask]
[XID-99]
[SUPI-10]
[X2Only]
[LocationAcquition]
[LAF]

LI_X2
[xIRIAMFLocationUpdate]
[XID-99]
[SUPI-10]

SUPI Registers

Remember the AMF ID

LI_HILA
[LIID-1]
[SUPI-10]

LI_XLA
[SUPI-10]
[HILADelivery]

SUPI-10

Location determined

LI_HILA
[LIID-1]
[SUPI-10]
[Location]

LI_XLA
[SUPI-10]
[Location]

Location

Assumed: no LMF interaction for location determination

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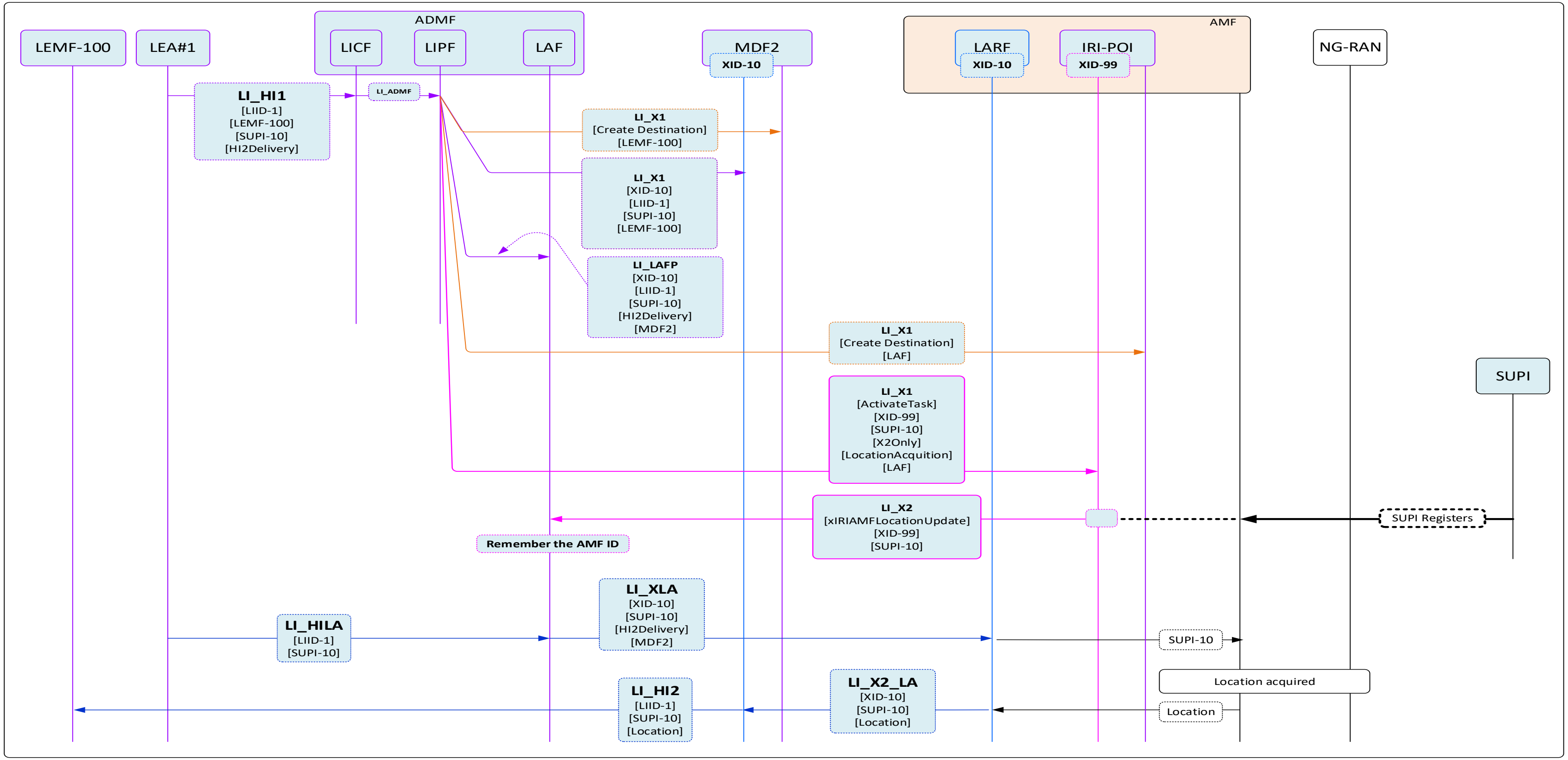
HI2 Delivery with Location Acquisition IRI-POI



LEMF-100

LEA#1

ADMF

LICF

LIPF

LAF

MDF2

XID-10

AMF

LARF

XID-10

IRI-POI

XID-99

NG-RAN

SUPI

LI_HI1
[LIID-1]
[LEMF-100]
[SUPI-10]
[HI2Delivery]

LI_ADMF

LI_X1
[Create Destination]
[LEMF-100]

LI_X1
[XID-10]
[LIID-1]
[SUPI-10]
[LEMF-100]

LI_LAFP
[XID-10]
[LIID-1]
[SUPI-10]
[HI2Delivery]
[MDF2]

LI_X1
[Create Destination]
[LAF]

LI_X1
[ActivateTask]
[XID-99]
[SUPI-10]
[X2Only]
[LocationAcquition]
[LAF]

LI_X2
[xIRIAMFLocationUpdate]
[XID-99]
[SUPI-10]

SUPI Registers

Remember the AMF ID

LI_XLA
[XID-10]
[SUPI-10]
[HI2Delivery]
[MDF2]

LI_HILA
[LIID-1]
[SUPI-10]

SUPI-10

Location acquired

LI_HI2
[LIID-1]
[SUPI-10]
[Location]

LI_X2_LA
[XID-10]
[SUPI-10]
[Location]

Location

Assumed: no LMF interaction for location determination

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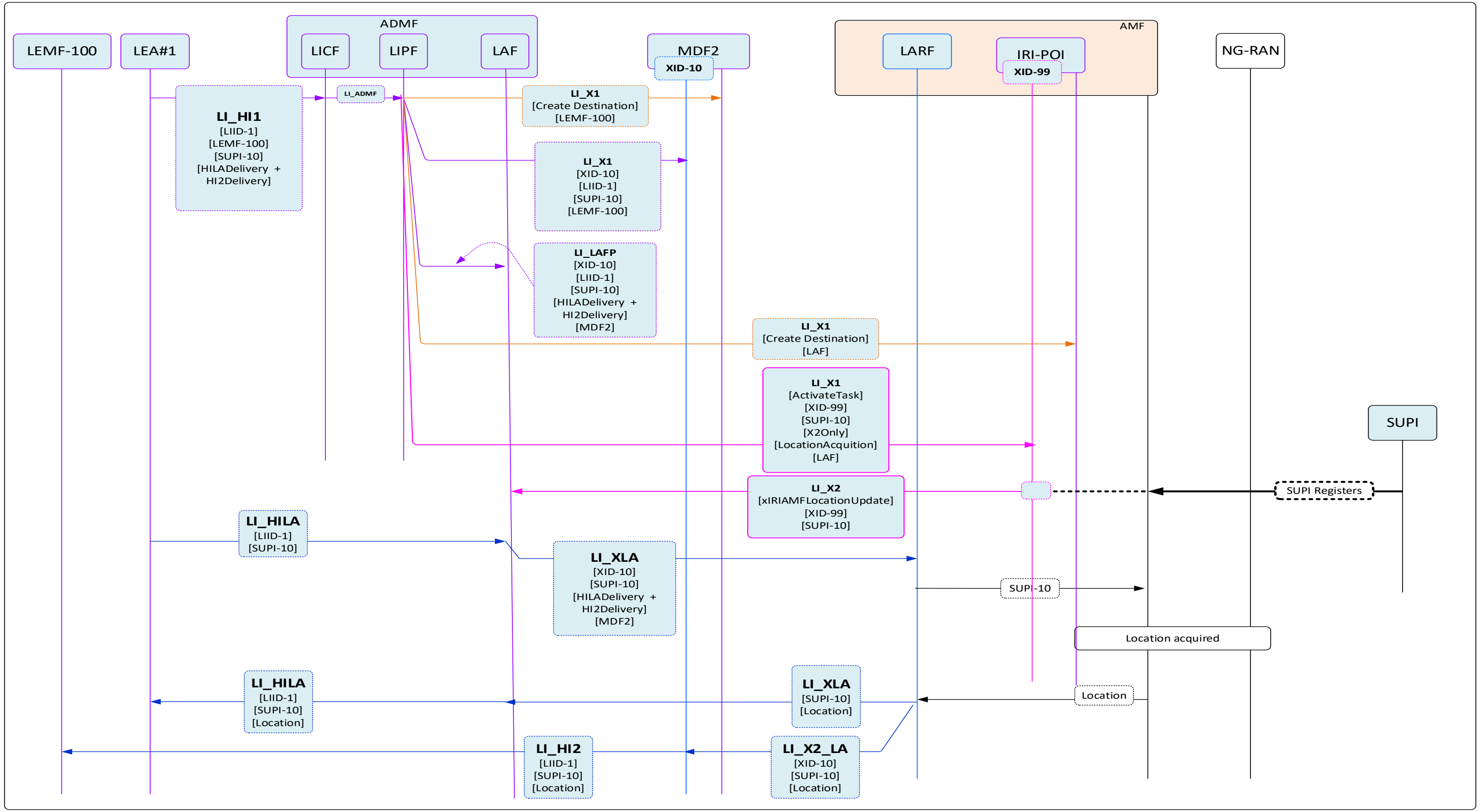
HILA Delivery + HI2 Delivery with Location Acquisition IRI-POI



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Assumed: no LMF interaction for location determination

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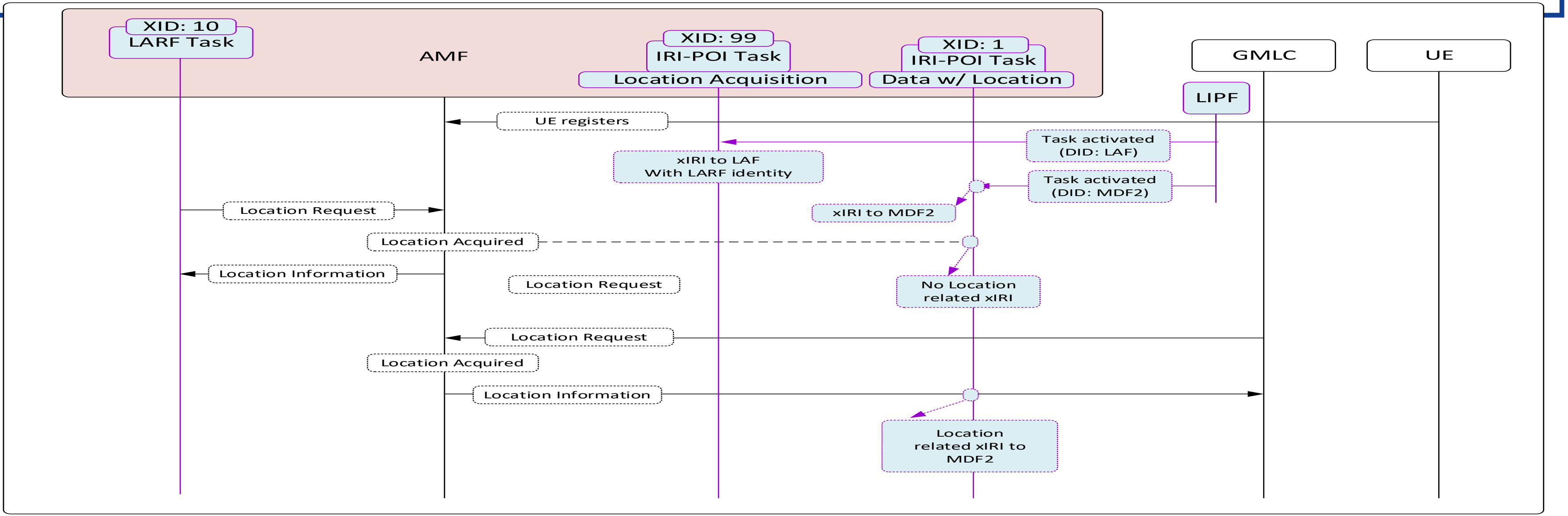
IRI-POI algorithm

- When the location information that AMF receives is due to an LARF query, the IRI-POI shall not generate the xIRI Location Update.
- When the UE registers (or when Task is activated for an already registered UE), the IRI-POI with Location Acquisition Task notifies the LAF



XID: 10
LARF Task
AMF
XID: 99
IRI-POI Task
Location Acquisition
XID: 1
IRI-POI Task
Data w/ Location
GMLC
UE
LIPF
UE registers
Task activated (DID: LAF)
xIRI to LAF With LARF identity
Task activated (DID: MDF2)
Location Request
xIRI to MDF2
Location Acquired
Location Information
Location Request
No Location related xIRI
Location Request
Location Acquired
Location Information
Location related xIRI to MDF2

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