



**InLocation  
Alliance**

*Bringing Mobile Positioning Indoors*

# ILA System Architecture Overview

Andreas Wachter,  
Qualcomm

& Ian Blair, Qualcomm



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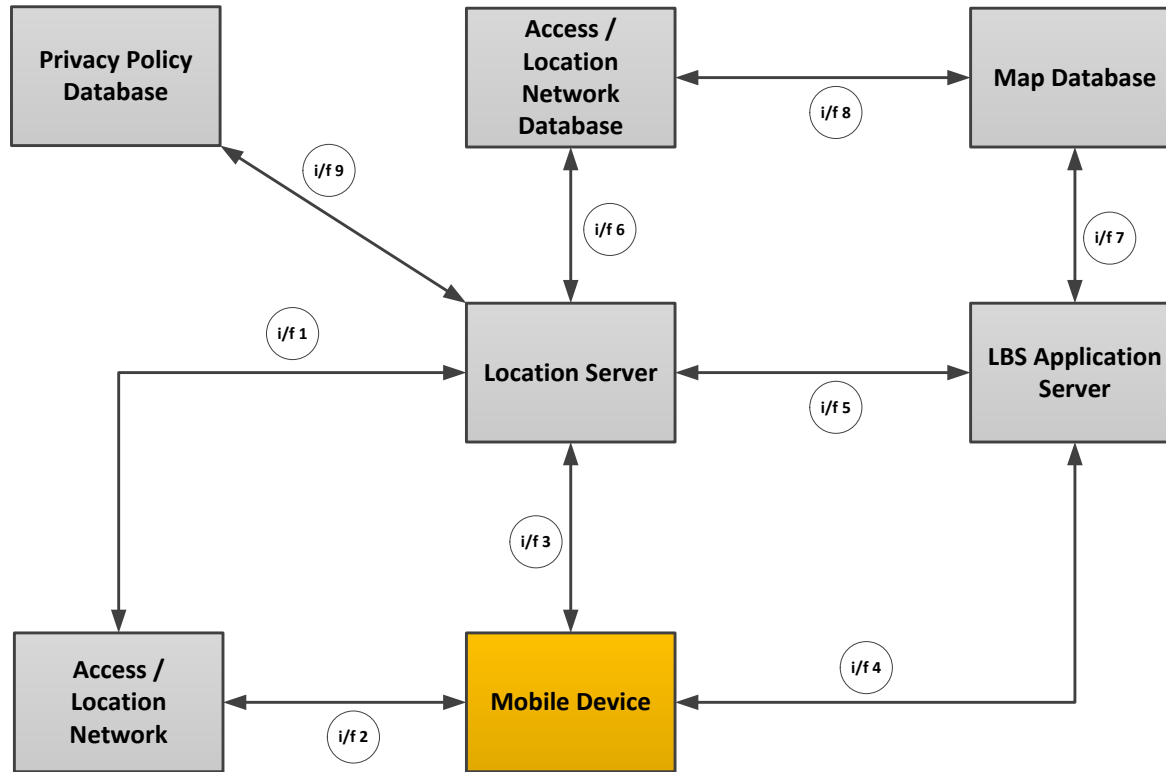
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- Positioning Modes
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- Status of System Architecture Work in ILA
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# System Architecture - Introduction

- The ILA System Architecture (SA) specifies the main components and interface requirements of a technology-independent system architecture for indoor location.
- The SA has been designed to support a wide range of venues: from the very small (e.g. stand-alone business) to the very large (e.g. corporate campus) to the very distributed (e.g. worldwide retail chain).
- The SA is based on open interfaces in order to support multi-vendor environments for indoor location.
- While the SA in itself is generic and technology agnostic, the focus of the first public release of the SA was on Wi-Fi and BT.

# System Architecture



The system architecture is designed around functional blocks (network elements) required to support positioning of a *Mobile Device*. These functional blocks and the open interfaces through which they interact constitute the *ILA Ecosystem*.

# Network Elements

- **Mobile Device (MD)**
  - An electronic device (nomadic or mobile) whose location within a venue is of interest to a location client residing on the Mobile Device or in the network.
- **Location Server (LS)**
  - A network server that provides a Mobile Device's location to a location client and/or provides assistance data to the Mobile Device. A Location Server generally supports both position calculation as well as assistance data provision.
- **Access/Location Network (ALN)**
  - Any network that can be used for location but with current focus on Wi-Fi and BT.
- **Access Location Network Database (ALN DB)**
  - A network database that stores and provides an Access/Location Network almanac to the Location Server. The Location Server may use this information to calculate the Mobile Device's position and/or to provide assistance data to the Mobile Device.

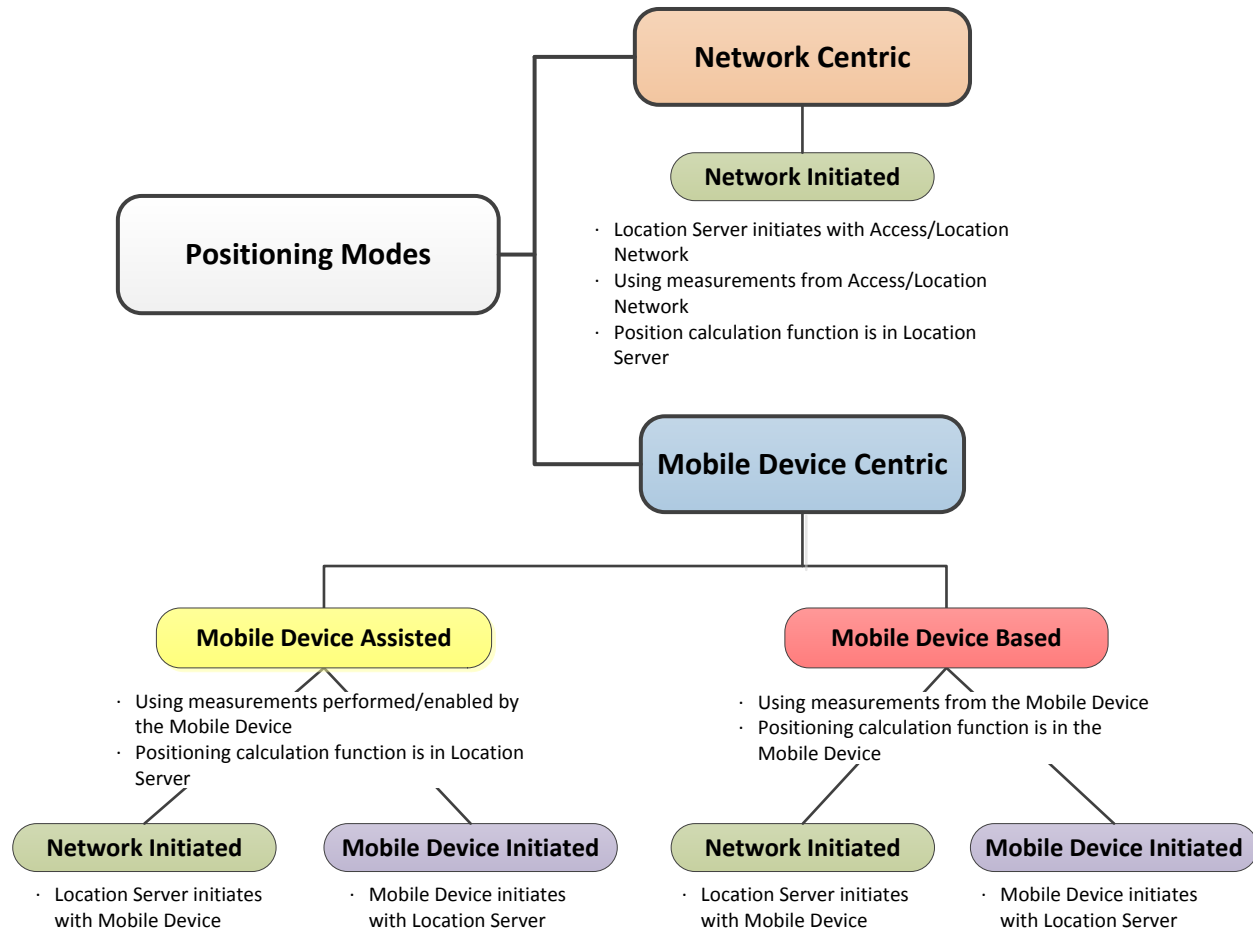
# Network Elements

- **Map Database (Map DB)**
  - A network database that stores and provides map data used for location and/or presentation.
- **LBS Application Server (LBS AS)**
  - A network server that provides location related content and services to a requesting entity and that is able to request and receive the position of a Mobile Device whose position is the subject of the location related content.
- **Privacy Policy Database (PPD)**
  - A network data base that records and provides to the Location Server the privacy policies affecting a Mobile Device.

# Positioning Modes

- Network Centric:
  - The network initiates and performs positioning of the Mobile Device.
  - The Mobile Device's position is determined by the network based on measurements of the Mobile Device performed by the network.
- Mobile Device Centric:
  - Either the network or the Mobile Device initiates positioning of the Mobile Device.
  - The Mobile Device is actively involved in the positioning process by performing measurements (optionally) aided by the network.
  - The Mobile Device's position is determined based on the measurements by either the network (MD assisted) or the Mobile Device (MD based).

# Positioning Modes

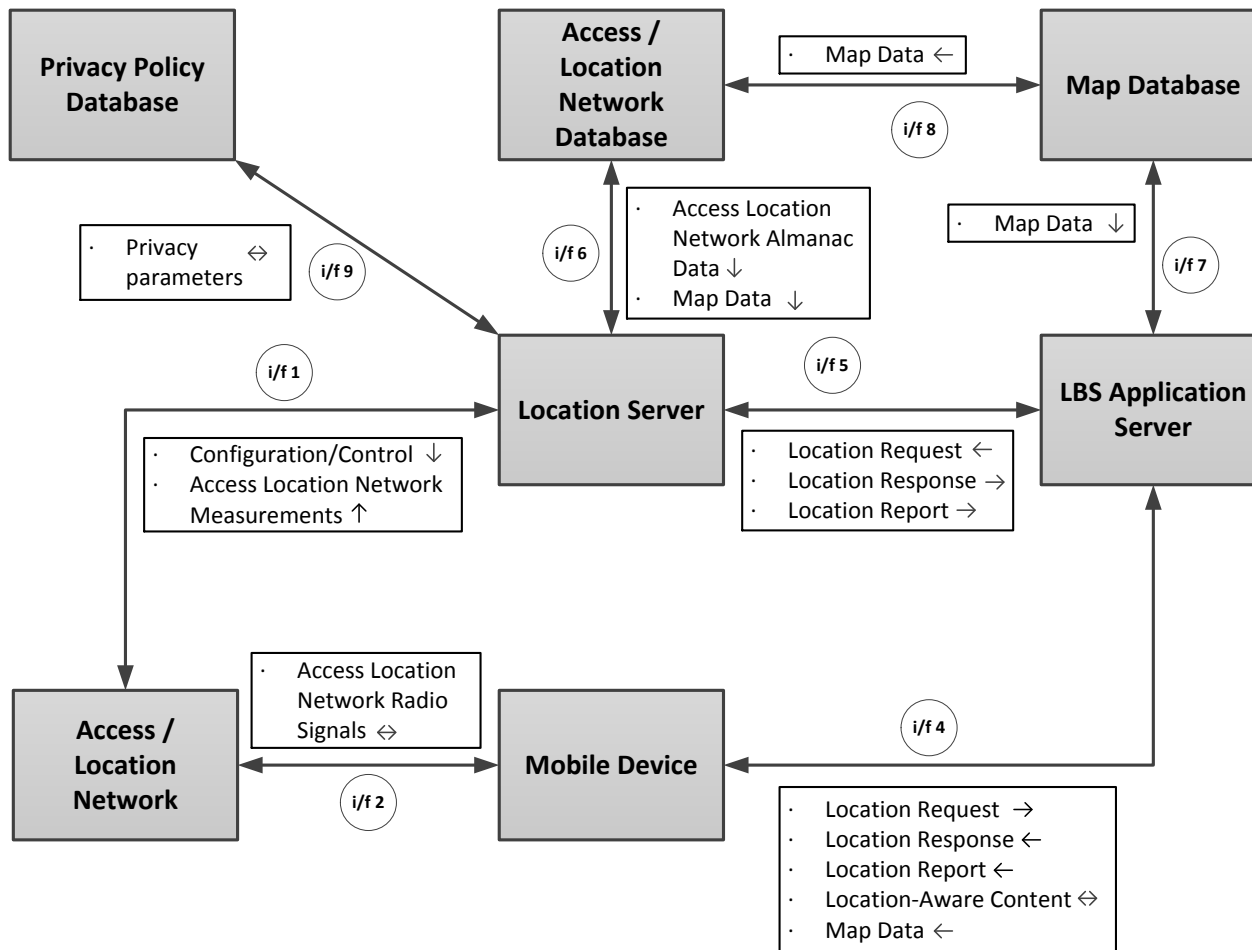




# Interfaces

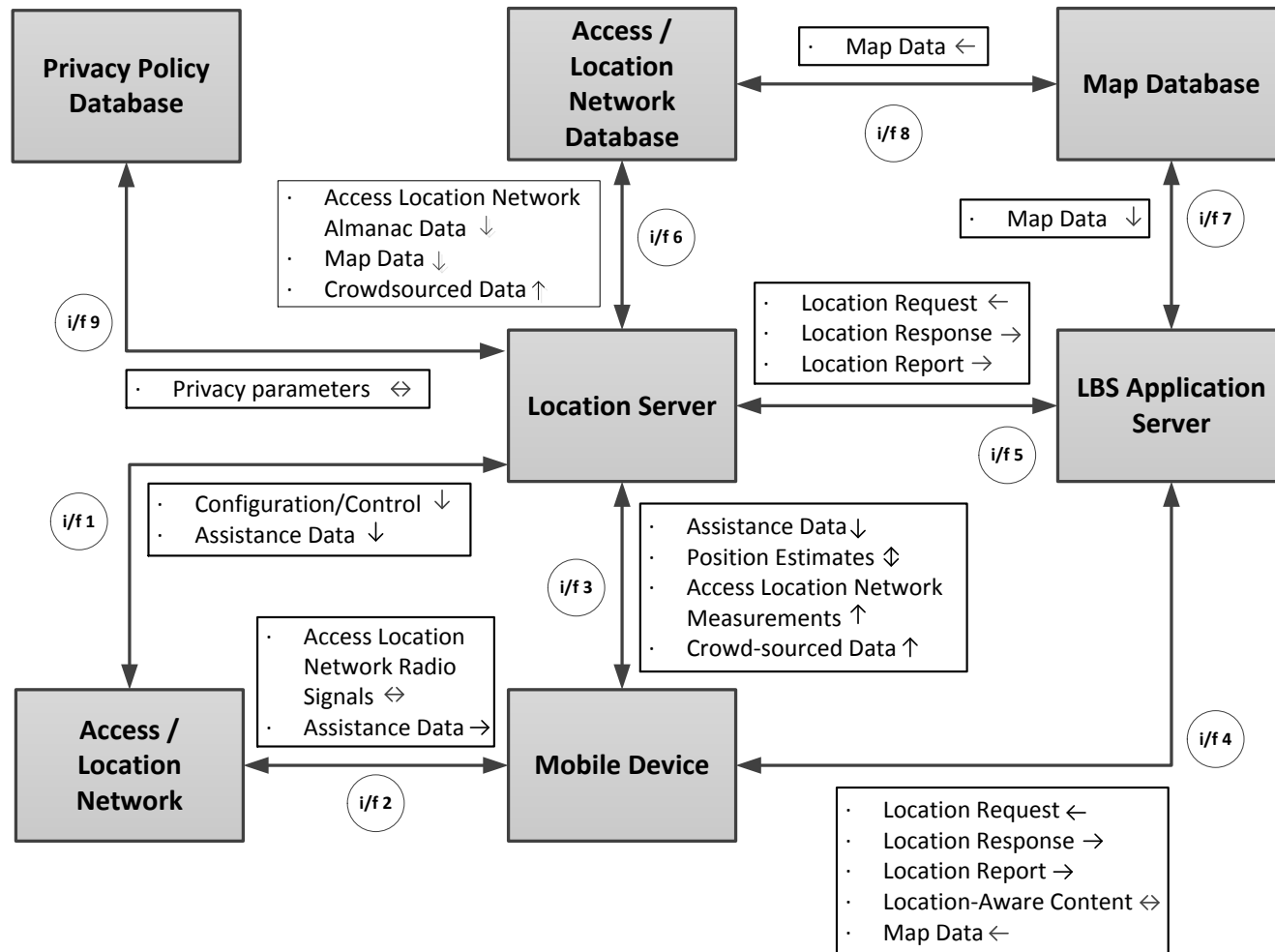
- The ILA SA Interfaces are intended to be open interfaces enabling interoperability in a multi-vendor environment.
- The ILA SA White Paper provides a high level definition of the information that ILA Network Elements exchange across these interfaces.
- The ILA does not define the ILA SA Interfaces itself but is working with external Standards Developing Organizations to develop these interfaces (e.g. OMA for Interface 3 and 5, IEEE and BT SIG for Interface 2).

# Interfaces - Information Flow in Network Centric Mode



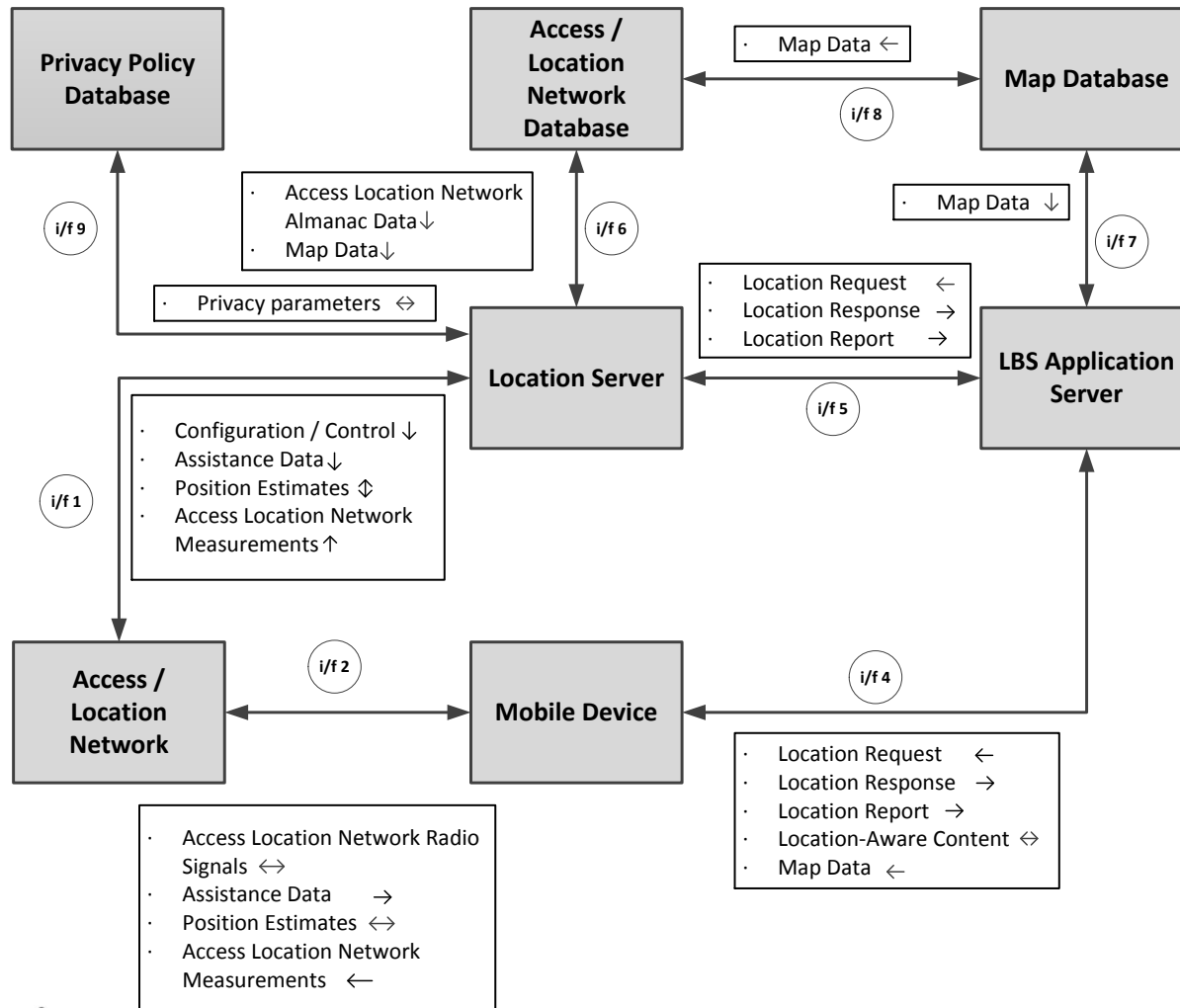
# Interfaces – Information Flow in Mobile Centric Mode

## ALN Independent Signaling



# Interfaces – Information Flow in Mobile Centric Mode

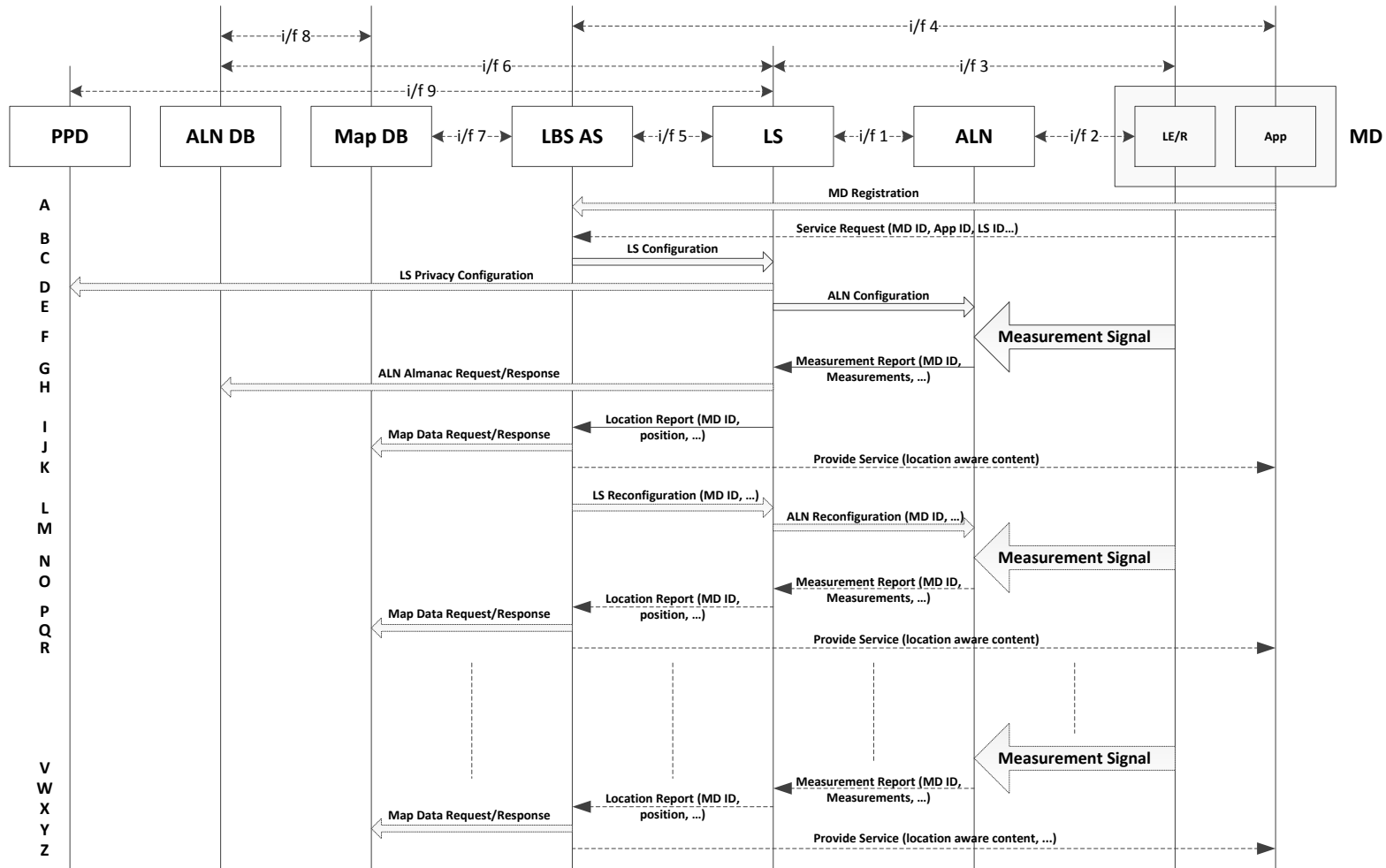
## ALN Dependent Signaling



# Privacy & Security

- Privacy is supported through the Privacy Policy Database.
- Before accessing a Mobile Device's location (or location related data such as Access Location Network measurements), a Location Server needs to obtain the Mobile Device user's privacy policy.
- If a request for location is of lower priority than the user's privacy, the user is notified and given the opportunity to grant or deny the location request.
- The privacy policy describes the data being collected, the collector, the collection purpose, and the retention policy.
- The privacy policy may also describe how a user can opt-in/out of identified/anonymous tracking temporarily/until further notice, and/or request deletion of their location history.
- Security is supported by the SA by using secure data connections on all interfaces.

# E2E Message Flows – Network Centric Generic



# E2E Message Flows – Network Centric Generic

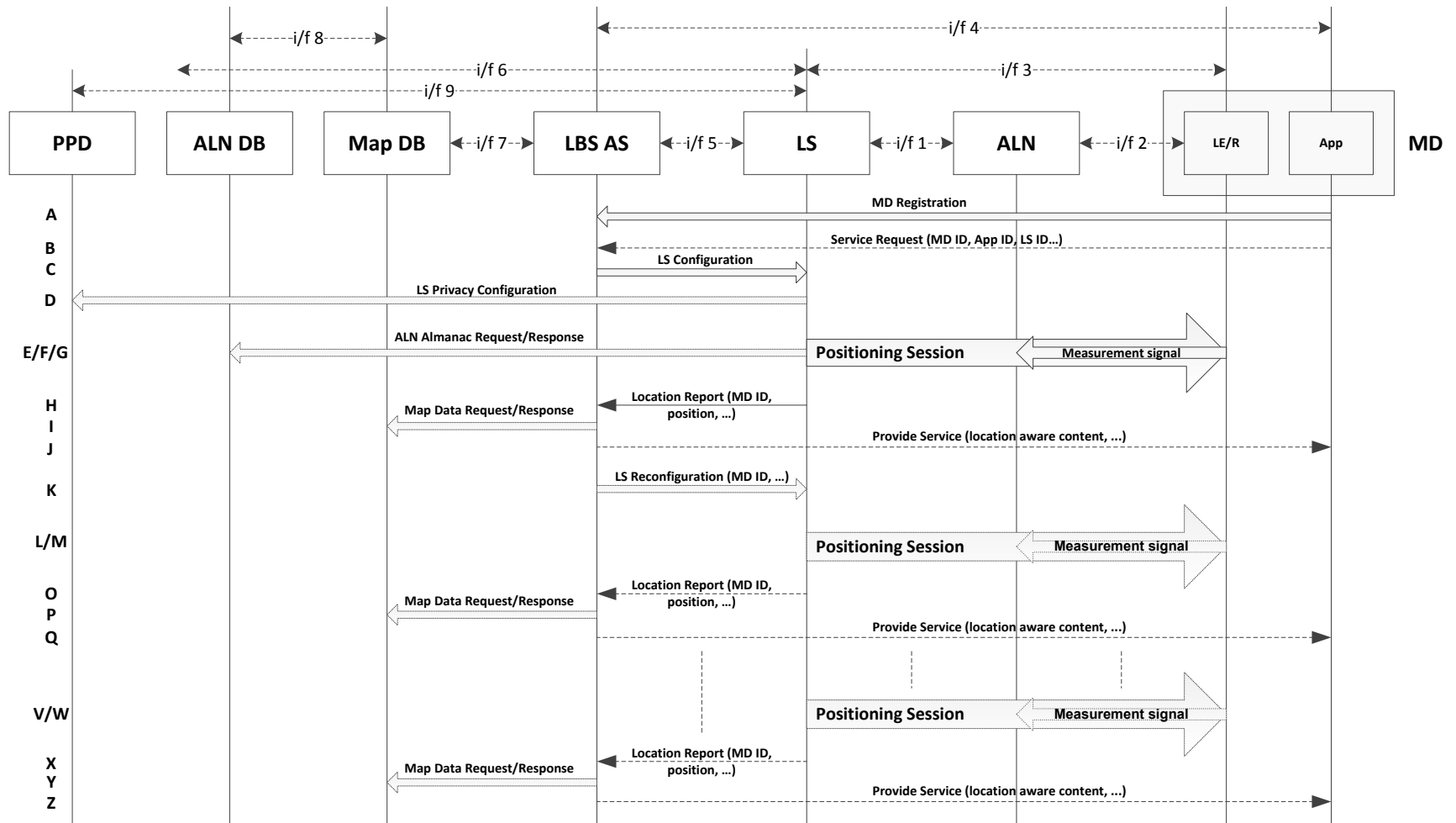
- A. The App on the MD registers with the LBS AS. This step is optional and may occur as needed. Depending on the scenario, this step may occur before or after LS and ALN Configuration.
- B. The App on the MD requests service (in this case location aware content) from the LBS AS. The Service Request contains the MD ID, the App ID and optionally the MD's position and LS's URI (if available at the MD). Possible triggers for this step include the App detecting it is within the venue or the User invoking the App in response to the User being aware of entering the venue.
- C. If the MD's service request in step B contained the MD's current position, the LBS AS directly proceeds to step K. Otherwise, the LBS AS instructs the LS to report position results by invoking an LS Configuration procedure. The LS Configuration procedure can request a single position or multiple positions for particular trigger events and can address a single MD (e.g. the MD in steps A and B), a set of MDs (e.g. all MDs currently registered with the LBS AS) or all MDs detected inside the venue. For Network Centric positioning, this step may occur before step A (e.g. to configure position results for all MDs), after step A but before step B (e.g. to configure position results for all registered MDs) as well as after step B (e.g. to configure specific position results for the service request in step B).
- D. LS and PPD exchange MD privacy information in order to ensure that the MD's privacy policy is complied with, in the course of the location session. This step occurs if and as needed (e.g. after LS Configuration requests).
- E. In line with LS Configuration performed in the previous step, the LS performs an ALN Configuration procedure to instruct the ALN to perform Measurements in order to detect the presence and possibly location of MD(s).
- F. The ALN performs Measurements of MD(s).
- G. After the ALN obtains Measurements from the MD in step F, it reports the Measurements to the LS in a Measurement Report. The Measurement Report contains the MD ID and Measurements.
- H. After receiving the Measurements in step G, the LS may require ALN Almanac data from the ALN DB in order to calculate the position of the MD (this step is optional and only performed if the LS requires ALN Almanac data and has not already obtained this data from the ALN DB and stored it for later use). The ALN DB may require Map Data in order to be able to provide the LBS AS with the Almanac Data. In this case the ALN DB requests (and obtains) the required Map Data from the Map DB.

# E2E Message Flows – Network Centric Generic

- I. The LS calculates the MD's position based on the Measurements received in step G. and sends a Location Report to the LBS AS. The Location Report contains the MD ID and position.
- J. If the LBS AS requires Map Data in order to respond to the initial service request (i.e., step B) and did not previously obtain and store the data, it requests (and obtains) the required Map Data from the Map DB.
- K. This step is optional and is only performed if location aware content needs to be provided to the MD (App) in which case the LBS AS sends a Provide Service to the MD (App). The Provide Service contains the location aware content (e.g. venue map data).
- L. This step is optional and is only performed if the LBS AS wants to reconfigure the LS (e.g., to obtain location reports for the MD more frequently or for different trigger events than instructed in step C).
- M. This step is optional and only performed if step L. was performed. In this case the LS reconfigures the ALN (if needed) in line with the LBS AS reconfiguration of step L.
- N. - Z are a repeat of previous steps (steps F, G, I, J and K - assuming no additional ALN Almanac data is needed) in order to obtain additional Location Reports after reconfiguration. These steps are optional and only shown for illustration.



# E2E Message Flows – Mobile Device Centric Network Initiated Generic



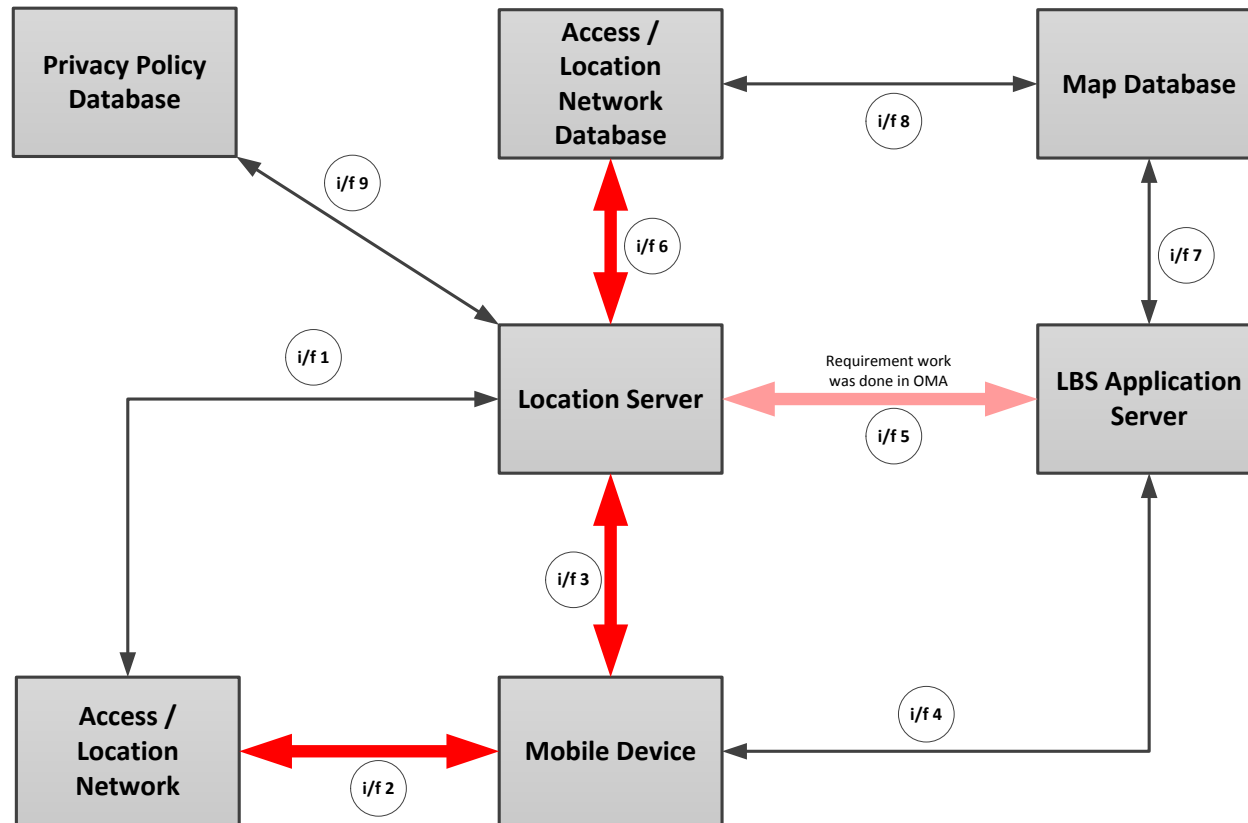
# E2E Message Flows – Mobile Device Centric Network Initiated Generic


- A. The App on the MD registers with the LBS AS. Depending on the scenario, this step may occur before or after LS and ALN Configuration.
- B. The App on the MD requests service (in this case location aware content) from the LBS AS. The Service Request contains the MD ID, the App ID and optionally the MD's position and the LS's URI (if available at the MD). Possible triggers for this step include the App detecting it is within the venue or the User invoking the App in response to the User being aware of entering the venue.
- C. If the MD's service request in step B contained the MD's current position, the LBS AS directly proceeds to step J. The LBS AS instructs the LS to report position results by invoking an LS Configuration procedure. The LS Configuration procedure can request a single position or multiple positions for particular trigger events and can address a single MD (e.g. the MD in steps A and B), a set of MDs (e.g. all MDs currently registered with the LBS AS) or all MDs detected inside the venue.
- D. LS and PPD exchange MD privacy information in order to ensure that the MD's privacy policy is complied with, in the course of the location session. This step occurs if and as needed (e.g. after LS Configuration requests).
- E. The LS initiates a Positioning Session with the MD (LE/R) in order to obtain the MD's position. During the Positioning Session, the LE/R may interact with the ALN in order to perform Measurements (refer to step G).
- F. In the course of the Positioning Session, the LS may require ALN Almanac data from the ALN DB in order to calculate the position of the MD and/or provide ALN data to the MD to assist Measurements and possibly location derivation by the MD. This step is optional and only performed if the LS or MD requires ALN Almanac data and if the LS has not already obtained this data from the ALN DB and stored it for later use. The ALN DB may require Map Data in order to provide the LS with the Almanac Data. In this case the ALN DB requests (and obtains) the required Map Data from the Map DB.

# E2E Message Flows – Mobile Device Centric Network Initiated Generic

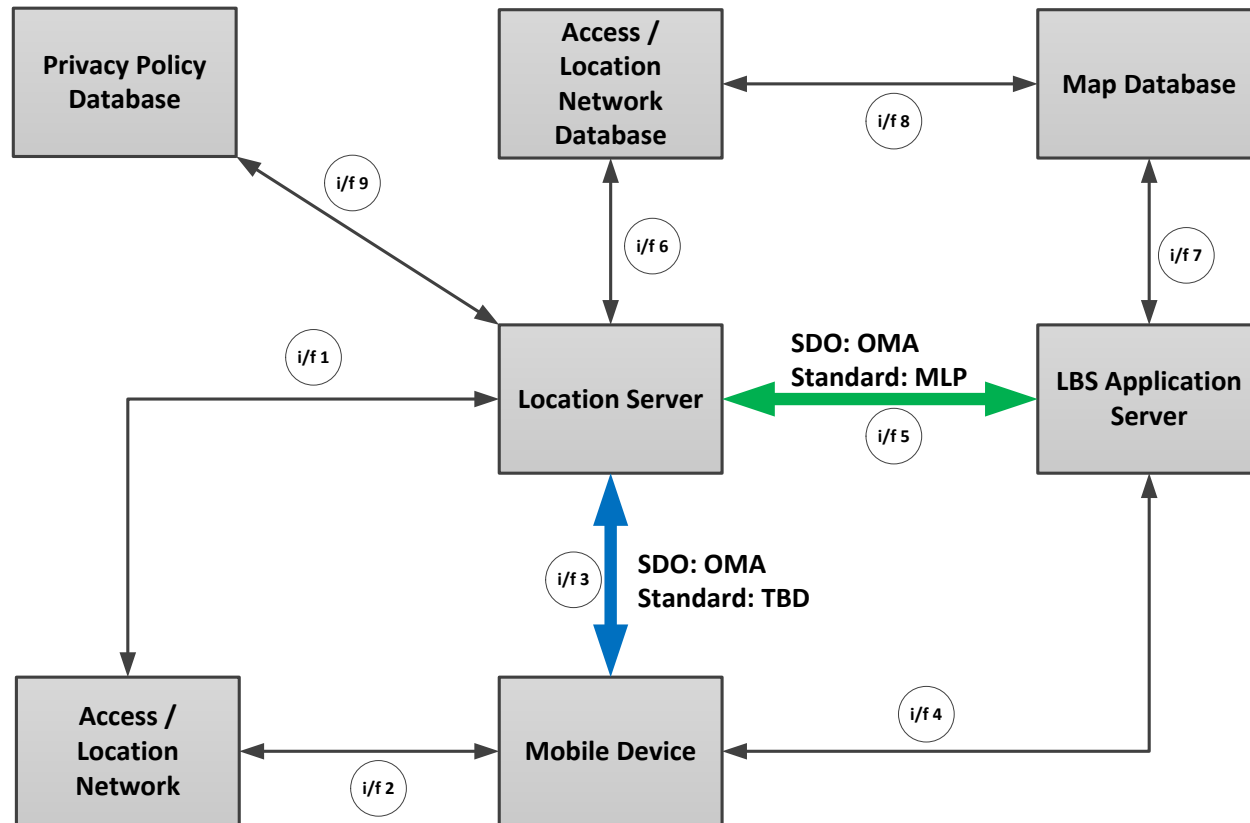
- G. The LE/R exchange position measurement signals with the ALN, calculates its position to provide position for the Positioning Session.
- H. The LS reports the position result to the LBS AS in a Location Report. The Location Report includes the MD ID and the position result.
- I. If the LBS AS requires Map Data in order to respond to the initial service request (step B) and did not previously obtain and store the data, it requests (and obtains) the required Map Data from the Map DB.
- J. This step is optional and is only performed if location aware content needs to be provided to the MD (App) in which case the LBS AS sends a Provide Service to the MD (App). The Provide Service contains the location aware content.
- K. This step is optional and is only performed if the LBS AS wants to reconfigure the LS in order to e.g., obtain additional position fixes, change the parameters for existing positioning procedures such as the periodicity of expected location reports, etc.
- L. - Z. are a repeat of previous steps (steps E, F and H-J – assuming no additional ALN Almanac data is needed) in order to obtain Location Reports after reconfiguration. These steps are optional and only shown for illustration.


# Status of System Architecture Work in ILA: Interface Requirements




Interfaces with agreed, consolidated requirements:   
 All other interfaces have agreed, high level functional descriptions but no consolidated requirements yet.

# Status of System Architecture Work in ILA: Interface Standardization

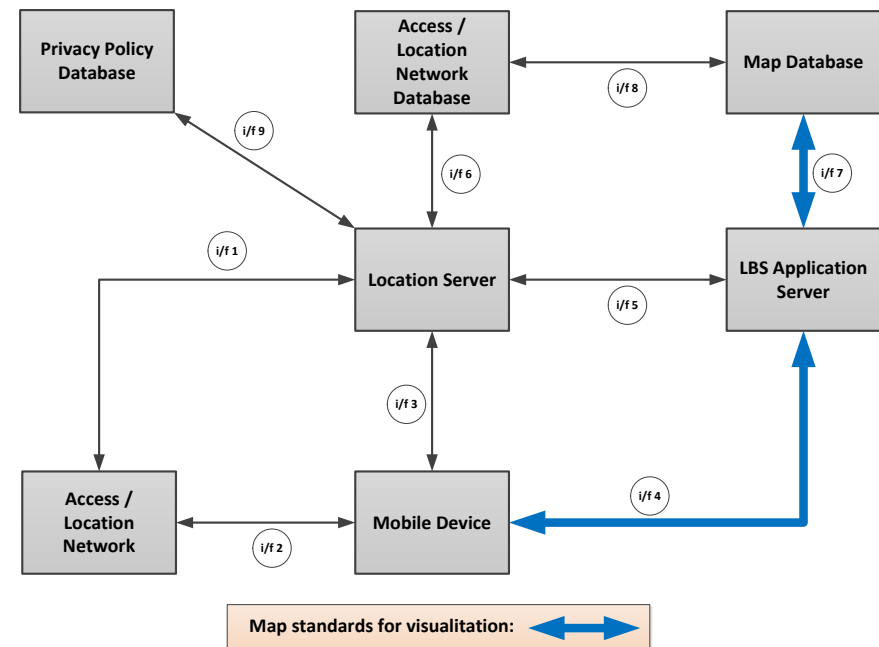
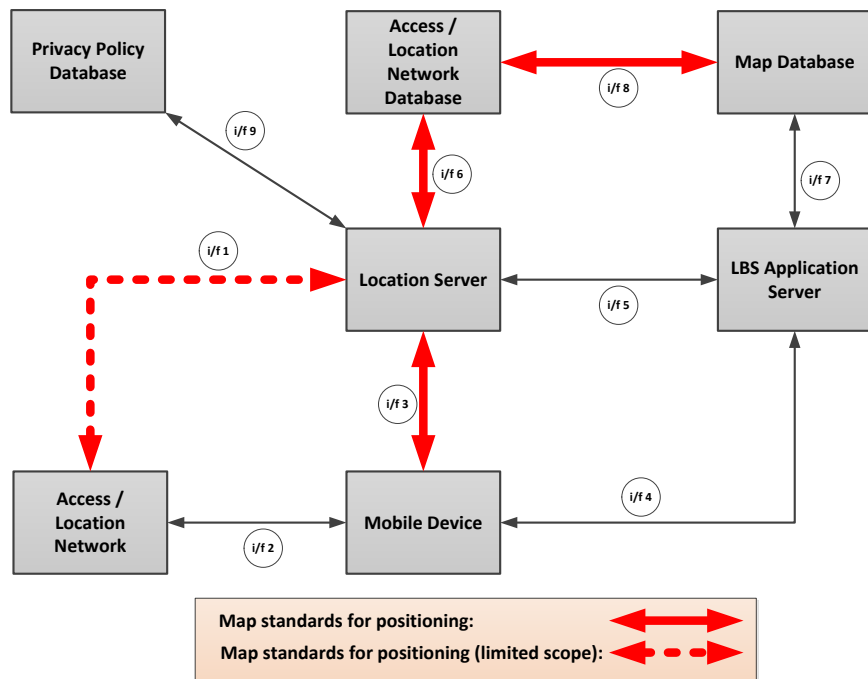


Interfaces where SDO has been selected and standardization completed: 

Interfaces where SDO has been selected but standardization not been completed: 

# Status of System Architecture Work in ILA: Open Issues currently under Discussion

- Selecting Indoor Map standards for use on the following two branches of the System Architecture:



# Status of System Architecture Work in ILA:

## Open Issues regarding Map Standards

In the context of the ILA/OGC cooperation, the ILA would like to:

- Identify existing or generate new map standards that meet the ILA's requirements with regard to positioning:
  - Heatmap support (e.g. RSSI and/or RTT maps covering venues)
  - Venue maps providing positioning relevant information (e.g. location of ALN access points, building material properties, wall dimensions (height, thickness), wall openings (windows, doors, etc.), space navigability, etc.)
- Identify existing or generate new map standards that meet the ILA's requirements with regard to visualization:
  - Venue maps
- Ensure that these map standards can be used seamlessly across different ILA Interfaces (e.g. from the ALN Data Base on Interface 6 to the Location Server and on to the Mobile Device on Interface 3).

# OGC Feedback - Naming

- ILA and OGC nomenclature needs alignment
  - ILA and OGC terminologies have developed independently – consequently some alignment is needed
  - In particular the ILA term MAP is corresponds to Geospatial Content or Location Enabled in OGC terms. (Note also that OGC Geospatial content can include navigation information)
  - Coordinate System (ILA) is Coordinate Reference System (OGC)
- On next iteration of ILA System Architecture white paper ILA will seek to align the terminology



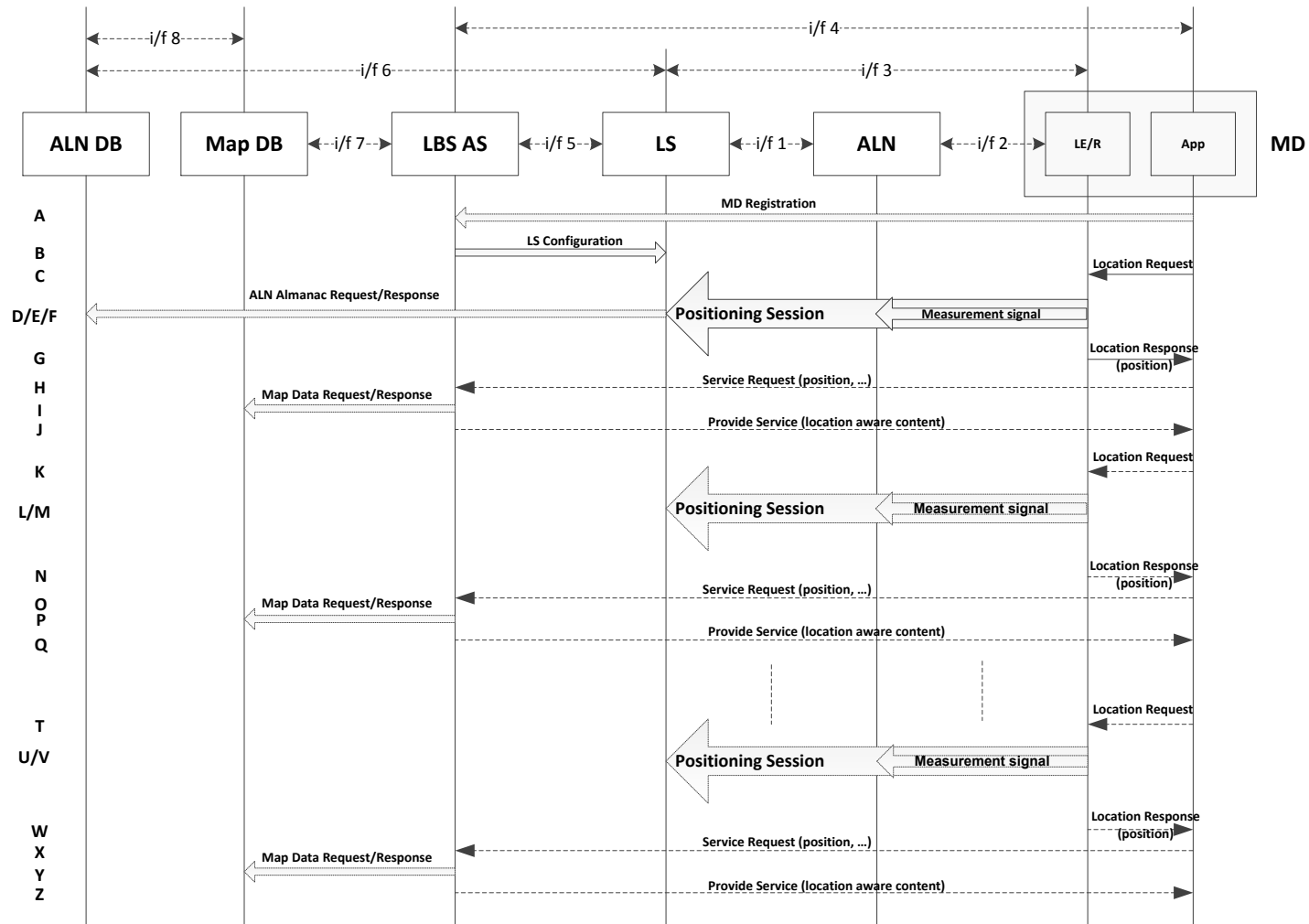
# OGC Feedback - Interfaces

The ILA are grateful for the feedback that we have received from OGC:

- Additional standards to consider:
  - Interface 2: Many IETF RFCs may be applied – HELD, LoST, LE SIP
  - Interface 3: Suggestions for further specifications – e.g. SWE, SensorThings, above IETF RFCs
  - Interface 4: OLS, SWE, InDoorGML, IETF URI mapping RFCs
  - Interface 5: OLS, Open GeoSMS?, WPS, 3dPS?
  - Interface 6: MS, InDoorGML, CityGML, Simple Features, GML, SLD. (Also, even if data is proprietary, the format need not be).
  - Interface 7: InDoorGML, CityGML, Simple Features, GML
- As the ILA System Architecture is developed, the potential contribution from these additional standards will be considered

# Appendix – Additional E2E Message Flows

# E2E Message Flows – Mobile Device Centric Mobile Device Initiated Generic



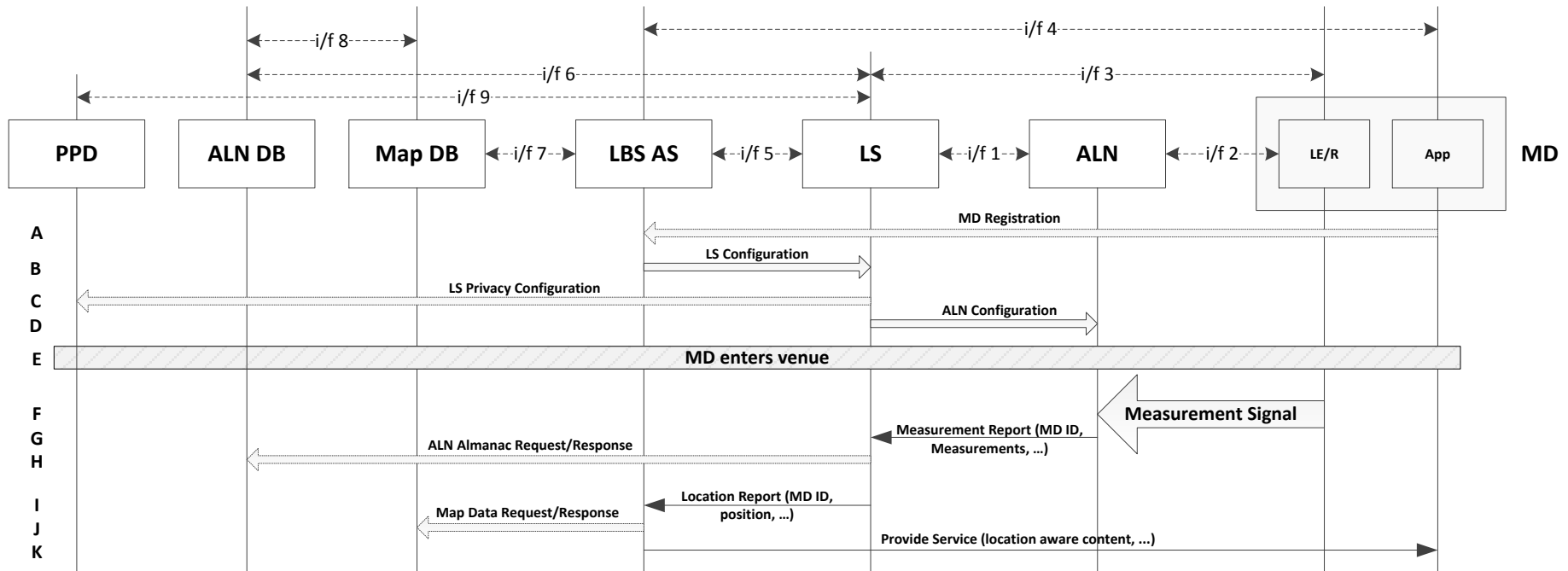
# E2E Message Flows – Mobile Device Centric Mobile Device Initiated Generic

- A. The App on the MD registers with the LBS AS. This step is optional and may occur as needed. Depending on the scenario, this step may occur before or after LS and ALN Configuration.
- B. The LBS AS instructs the LS to report position results by invoking an LS Configuration procedure. The LS Configuration procedure in this scenario can prepare the LS for single position or multiple positions for particular trigger event sessions and can address a single MD (e.g. the MD in step A), a set of MDs (e.g. all MDs currently registered with the LBS AS) or all MDs detected inside the venue. In this scenario, the configuration request prepares the LS for the MD initiated position session in step E.
- C. The App on the MD requires a position and sends a Location Request to the LE/R on the MD. Possible triggers for this step include the App detecting it is within the venue or the User invoking the App in response to the User being aware of entering the venue. The App is also aware that it can obtain the MD position locally on the MD.
- D. The MD (LE/R) initiates a Positioning Session with the LS in order to obtain the MD's position. The MD would first need to discover the LS – e.g. from the ALN. During the Positioning Session, the LE/R may interact with the ALN in order to perform Measurements (refer to step F).
- E. In the course of the Positioning Session, the LS may require ALN Almanac data from the ALN DB in order to calculate the position of the MD and/or provide ALN data to the MD to assist Measurements and possibly location derivation by the MD. This step is optional and only performed if the LS or MD requires ALN Almanac data and if the LS has not already obtained this data from the ALN DB and stored it for later use. The ALN DB may require Map Data in order to provide the LS with the Almanac Data. In this case the ALN DB requests (and obtains) the required Map Data from the Map DB.

# E2E Message Flows – Mobile Device Centric Mobile Device Initiated Generic

- F. The LE/R exchange position measurement signals with the ALN, calculates its position to provide position for the Positioning Session.
- G. After obtaining the position of the MD, the LE/R sends the position result to the App in a Location Response.
- H. This step is optional and may be performed if the App on the MD requires location aware content from the LBS AS (e.g. based on the position result obtained in step G or based on the trigger that invoked step C). In this case the MD (App) sends a Service Request to the LBS AS indicating the type of service required. The service request includes the MD position obtained in step G.
- I. This step is optional and may be performed if the LBS AS requires Map Data as a result of the Service Request received in step H and did not previously obtain and store the data. In this case the LBS AS requests (and obtains) Map Data from the Map DB.
- J. This step is optional and only performed if step H was performed in which case the LBS AS sends a Provide Service with the requested location aware content to the MD (App).
- K. - Z. are a repetition of previous steps (steps C, D and F-J - assuming no additional ALN Almanac data is needed). These steps are optional and only shown for illustration.

# E2E Message Flows – Use Case Specific: Location Aware Content – Network Centric



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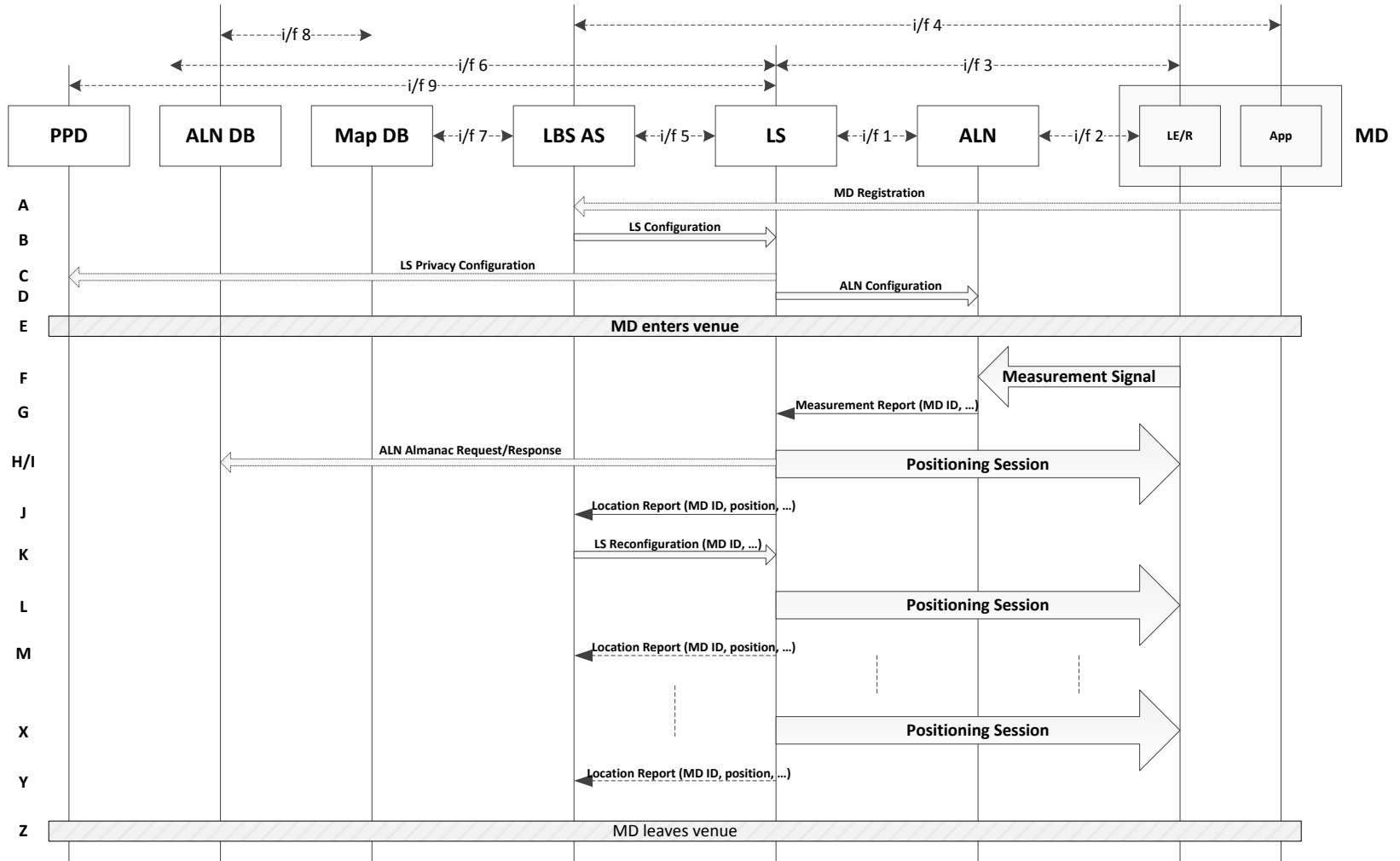
- A. The App on the MD registers with the LBS AS. This step is needed in order to provide the LBS AS with the information required to return the location aware content to the MD (App).
- B. The LBS AS configures the LS for detecting and positioning of all MDs that enter the store. Steps B, C and D may occur before step A.
- C. LS and PPD exchange MD privacy information in order to ensure that the MD's privacy policy is complied with, in the course of the location session. This step occurs if and as needed (e.g. after LS Configuration requests or MD Registrations).
- D. The LS configures the ALN for detecting and performing Measurements of all MDs that enter the store.
- E. The MD enters the venue.
- F. The ALN detects the presence of the MD in the venue and performs Measurements of the MD.
- G. After obtaining Measurements, the ALN sends a Measurement Report to the LS. The Measurement Report contains the MD's ID and the Measurements.
- H. After receiving the Measurements in step G, the LS may require ALN Almanac data from the ALN DB in order to calculate the position of the MD. This step is optional and only performed if the LS requires ALN Almanac data. The ALN DB may require Map Data in order to provide the LBS AS with the Almanac Data. In this case the ALN DB requests (and obtains) the required Map Data from the Map DB.
- I. The LS calculates the MD's position based on the Measurements received in step G and sends a Location Report to the LBS AS. The Location Report contains the MD ID and position.

# E2E Message Flows – Use Case Specific: Location Aware Content – Network Centric

- J. Depending on the type of location aware content to be provided to the App on the MD, the LBS AS may require Map Data. In this case the LBS AS requests (and obtains) the required Map Data from the Map DB (this step is optional and is only performed if the LBS AS requires Map Data).
- K. The LBS AS provides the location aware content to the MD (App).



# E2E Message Flows – Use Case Specific: Visitor Analytics – Mobile Device Centric, Network Initiated



# E2E Message Flows – Use Case Specific: Visitor Analytics – Mobile Device Centric, Network Initiated

- A. The App on the MD registers with the LBS AS. This step is optional and only performed if the LBS AS requires the MD's ID.
- B. The LBS AS configures the LS for detecting and positioning of all MDs that enter the store. Steps B, C and D may occur before step A.
- C. LS and PPD exchange MD privacy information in order to ensure that the MD's privacy policy is complied with, in the course of the location session. This step occurs if and as needed (e.g. after LS Configuration requests or MD Registrations).
- D. The LS configures the ALN for detecting and performing Measurements of all MDs that enter the store.
- E. The MD enters the venue.
- F. Measurements performed by the ALN indicate that the MD has entered the venue.
- G. The ALN sends a Measurement Report to the LS including the MD ID.
- H. With the MD ID now known, the LS invokes a Positioning Session with the MD (LE/R) for that particular MD in order to obtain its position. During the Positioning Session, the LE/R may interact with the ALN in order to perform Measurements.
- I. In the course of the Positioning Session, the LS may require ALN Almanac data from the ALN DB in order to calculate the position of the MD and/or provide ALN data to the MD to assist Measurements and possibly location derivation by the MD. This step is optional and only performed if the LS or MD requires ALN Almanac data. The ALN DB may require Map Data in order to provide the LS with the Almanac Data. In this case the ALN DB requests (and obtains) the required Map Data from the Map DB.

# E2E Message Flows – Use Case Specific: Visitor Analytics – Mobile Device Centric, Network Initiated

- J. The LS reports the position result to the LBS AS in a Location Report. The Location Report includes the MD ID and position.
- K. The LBS AS invokes an LS Reconfiguration requesting that the LS periodically obtain the MD's position.
- L. - Y are a repeat of steps G and I (it is assumed that no additional ALN Almanac data is required). While performing these steps, the MD's position is periodically determined. The LBS AS processes the obtained position data for visitor analytics.
- Z. The MD leaves the venue.