Dynamic Navigation Enabler

Approved Version 1.0 – 17 Dec 2013

Open Mobile Alliance

OMA-ER-DynNav-V1_0-20131217-A

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1. Scope

This document is a combined document that includes requirements and architecture of the Dynamic Navigation (DynNav) Enabler. The interfaces and functionalities of DynNav Enabler are specified in a separate document according to RESTful network API approach [OMA DN TS].

The DynNav Enabler provides an overall framework (mechanisms, functionalities, APIs, and etc.) to enable dynamic routing of vehicle based on traffic information.

The following areas will be covered as part of the scope of the enabler:

- Delivering traffic information and/or route information to the Navigation Application;
- Delivering value added information to the Navigation Application, such as Point Of Interest (POI);
- Security and privacy aspects.

DynNav Enabler will reuse as much as possible existing technologies. In particular, with respect to interface specification, it is in the scope of this Enabler:

- To reuse traffic information data formats defined by TPEG in [ISO TTI].

2. References

2.1 Normative References

[3GPP LPP] LTE Positioning Protocol, 3GPP TS 36.355, URL:http://www.3gpp.org/ftp/Specs/html-info/36355.htm

[ISO BIN] "Traffic and Travel Information (TTI)" ISO/TS 18234, URL:http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=54706

[ISO TTI] "Traffic and Travel Information (TTI)" ISO/TS 24530, URL:http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=54706

[OMA DN TS] OMA Dynamic Navigation Enabler", Open Mobile Alliance™, OMA-TS- REST_NetAPI_DynNav-V1_0, URL:http://www.openmobilealliance.org/

[OMA LPPe] "LPP Extension", Version 1.0, Open Mobile Alliance™, OMA-ERP-LPPe-V1_0, URL:http://www.openmobilealliance.org/

[OMA MLS] "Mobile Location Service", Version 1.2, Open Mobile Alliance™, OMA-ERP-MLS-V1_2 URL:http://www.openmobilealliance.org/

[OMA-SUPL] "Secure User Plane Location", Version 2.0, Open Mobile Alliance™, OMA-ERP-SUPL-V2_0, URL:http://www.openmobilealliance.org/

[OMNA] URL:http://www.openmobilealliance.org/Tech/OMNA/

[OSE] "OMA Service Environment", Open Mobile Alliance™, URL:http://www.openmobilealliance.org/

[RFC2119] "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt

[RFC4234] "Augmented BNF for Syntax Specifications: ABNF". D. Crocker, Ed., P. Overell. October 2005, URL:http://www.ietf.org/rfc/rfc4234.txt

[SCRRULES] "SCR Rules and Procedures", Open Mobile Alliance™, OMA-ORG-SCR_Rules_and_Procedures, URL:http://www.openmobilealliance.org/

[W3C POI] W3C Points of Interest Core, URL:http://www.w3.org/TR/2011/WD-poi-core-20110512/

2.2 Informative References

[OMADICT] "Dictionary for OMA Specifications", Version 2.9, Open Mobile Alliance™, OMA-ORG-Dictionary-V2_9, URL:http://www.openmobilealliance.org/

3. Terminology and Conventions

3.1 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 [RFC2119].

All sections and appendixes, except “Scope” and “Introduction”, are normative, unless they are explicitly indicated to be informative.

3.2 Definitions

DynNav Application/ Client	An entity that is in charge of interacting with a DynNav Server to get route information and/or real-time and forecast traffic information and complimentary data. Throughout this document client and application can be used interchangeably.
DynNav Server	An entity that is in charge of providing the DynNav Application with route information or real-time and forecast traffic information and complimentary data.
Location URI	A URI that enables the current location of a device to be obtained from a particular location server using a particular dereferencing protocol.
Navigation Device (ND)	An entity that, using the GNSS service, assists the driver showing correct route to reach the final destination. This entity may process real-time and forecast traffic information and dynamically estimates the optimal route, according to user preferences.
Network Performance Parameter	Information regarding the performances (i.e. speed, delay and travel time) of road segments related to an area or a route.
Point Of Interest	POI describes information about locations such as name, category, unique identifier, or civic address.
Route Information	Sequence of road segments, each of them defined with end points coordinates and road name, from an origin to a destination.
Traffic Event	Information regarding events related to an area or a route that are either imposed or planned by the road network operator (i.e. roadworks leading to lane closures) or events that occur outside the control of the network operator (i.e. accidents).
Traffic Information	Information which consists of traffic events and network performance parameters related to an area or a route.

3.3 Abbreviations

A-GNSS	Assited GNSS
API	Application Programming Interface
GNSS	Global Navigation Satellite System
ISO	International Organization for Standardization
LPP	LTE Positioning Protocol
LPPe	LPP extension
MLS	Mobile Location Service
MSISDN	Mobile Subscriber Integrated Services Digital Network-Number
ND	Navigation Device
OMA	Open Mobile Alliance
POI	Point Of Interest
REST	REpresentational State Transfer
SET	SUPL Enabled Terminal

SLP	SUPL Location Platform
SUPL	Secure User Plane Location
TLS	Transport Layer Security
TPEG	Transport Protocol Expert Group
TTI	Traffic and Travel Information
URI	Uniform Resource Identifier
XSD	XML Schema Definition

4. Introduction

Navigation Devices (NDs) represent a common tool in driving assistance. Dynamic navigation functionalities, based on real-time traffic information, have been indicated as the most valuable features in navigation device industry, being the reason for the popularity: reduction of the driving time, reduction of the fuel consumption, safety improvement.

The standardization forum ISO TPEG (Transport Protocol Expert Group) has defined a service for delivering real-time traffic information to NDs, publishing a complete set of technical specifications [ISO BIN]. In the service defined by TPEG, the traffic data is conveyed over a broadcasting communication channel; this choice, even if suitable in some cases, limits the service deployment for the following reasons:

- Unavailability in many country of broadcasting bearers matching bandwidth requirements of the TPEG application;
- Broadcasting technology imposes constraints on the flexibility in data transmission, in particular in the resolution of road segments, in its geographic coverage and time span.

As part of the TPEG framework, the [ISO BIN] series defines the application and data structures to convey traffic information, in details:

- Travelling time for road segments between roads junctions;
- Traffic blockage on road segments, due to accidents and/or works;
- Parking lots and public transportation information.

[ISO TTI] series issued by TPEG provides an XML encoding schema for info-mobility information entities defined in the [ISO BIN], which enables these XML structures to be used to access TPEG information over the (wireless) Internet. However, this results in an approach that mimics the simple download of a file containing traffic information, which implies a rather inefficient access because of the unavailability of filtering mechanisms that enable the selective access to the provided information.

In this technological scenario, delivering traffic information over mobile data network, with efficient bandwidth occupation, gains importance for mobile operators. Using a two-ways communication channel, customized traffic information and route information may be delivered to the ND according to journey parameters and selected time; route information may be updated along the drive, taking into account real-time and forecast traffic information. Mobile operators have the edge over other actors in delivering traffic and routing information, due to the fact that they can obtain traffic information by exploiting their own assets: two different strategies may be implemented by mobile operators to calculate driving times and delays for road segments:

- Anonymous tracking of mobile voice and data connection
- Tracking of GNSS enabled ND

Moreover, the DynNav Enabler represents an additional step toward the full support of navigation applications by OMA standardization framework: OMA enablers define functionalities exploited by navigation applications. A complete set of procedure for tracking and triggering is implemented in [OMA-SUPL], [OMA MLS], Assisted GNSS feature and high accuracy assistance (lane detection) have been defined respectively in [3GPP LPP] and [OMA LPPe]and supported by [OMA-SUPL].

4.1 Version 1.0

The version 1.0 of the DynNav Enabler defines an overall framework that enables dynamic vehicles navigation service based on traffic information over a mobile network.

The core functionalities exposed by the DynNav Enabler include the following operations:

- Request and Provide a set of routes based on the journey parameters defined by the user

- Provide traffic information related to the route and an area defined by the ND
- Provide complementary information (i.e. POI) related to defined routes and/or areas
- Manage subscriptions to notification services for updates on traffic information and alternative route proposal
- Provide security and privacy protection

5. Requirements (Normative)

The following subsections group the requirements in functional areas for the sake of document's readability. There is no architecture implication derived from the requirements grouping.

5.1 High-Level Functional Requirements

This section identifies the high-level functional requirements for the Dynamic Navigation enabler.

Label	Description	Release
DynNav-HLF-001	The DynNav enabler SHALL be able to provide the user with a set of proposed routes and related traffic information to reach a final destination, based on following journey parameters: • Origin • Destination • Waypoints • Time • Road preferences (e.g. highways) • Vehicle type description (e.g. car, coach).	1.0
DynNav-HLF-002	The DynNav enabler SHALL allow a user to request traffic information related to a set of routes estimated by the ND, in the following scenarios: • Real-time (for dynamic routing) • Forecast (for journey planning).	1.0
DynNav-HLF-003	The DynNav enabler SHALL allow a user to request traffic information related and limited to a specific area (e.g. a neighbourhood, a metropolitan area, a region, etc.) in the following scenarios: • Real-time (for dynamic routing) • Forecast (for journey planning).	1.0
DynNav-HLF-004	Traffic information delivered to the ND SHALL include at least traffic events (i.e. accidents, constructions, etc.) and network performance parameters (i.e. delay, speed for road segments) as defined in [ISO TTI].	1.0
DynNav-HLF-005	The DynNav enabler SHALL allow a user to select a set of routes for which being notified of related traffic information updates**.** **Informational Note**: The route is selected among the ones proposed by the server or the ND.	1.0
DynNav-HLF-006	The DynNav enabler SHALL allow a user to be notified of an alternative route when specific conditions are met along previously selected routes. **Informational note:** Example of conditions that trigger notification of alternative route is traffic blockage.	1.0
DynNav-HLF-007	The DynNav enabler SHALL allow a user to disable location tracking procedure for the defined journey. **Informational Note:** The way of executing the location tracking procedure is out of scope of DynNav enabler.	1.0
DynNav-HLF-008	The DynNav enabler SHALL allow a user to provide the server with a location URI in order to allow the server to access, if authorized, to user's position information.	1.0
DynNav-HLF-009	The DynNav enabler SHALL allow a user to receive information related to parking lots, public transportation according to the format defined in ISO [ISO TTI].	Future
DynNav-HLF-010	The DynNav enabler SHOULD allow a user to receive information related to POI according to the format defined in W3C [W3C POI].	1.0
DynNav-HLF-011	The DynNav enabler SHALL allow the user to request re-routing information as the user is deviating from the predetermined route.	1.0

DynNav-HLF-012	The DynNav enabler SHALL be able to encode the proposed routes in two different approaches: • Full • Summarized. **Informational Note**: Route information in summarized format is used in a preliminary stage to allow a user to select one preferred route out of a set of proposed routes. Thereafter the DynNav Server will provide the selected route information in full format to the DynNav client.	1.0
DynNav-HLF-013	The DynNav enabler SHALL provide different services based on the specific capabilities of the ND. **Informational Note**: For example the ND may make different requests to the DynNav Server on the basis if it is able to calculate routes or not.	1.0
DynNav-HLF-014	The DynNav enabler SHALL allow a user to request the route to the 3rd party.	1.0

5.2 Security & Privacy Requirements

Label	Description	Release
DynNav-PRI-001	The DynNav Enabler SHALL support mechanisms to ensure confidentiality in data transferred between the Principals.	1.0
DynNav-PRI-002	The DynNav Enabler SHALL support mechanisms to ensure data integrity in data transferred between the Principals.	1.0
DynNav-PRI-003	The DynNav Enabler SHALL support mechanisms to authenticate the Principals.	1.0

6. Architectural Model

This section defines the functional components and the interfaces of the DynNav enabler, thus providing its architecture, in alignment with the requirements that have been captured in the Requirements Section of this document. The architecture is described in the following sections.

6.1 Dependencies

Not Applicable

6.2 Architectural Diagram

The following figure represents the DynNav architecture, showing the DynNav interface and the DynNav components.

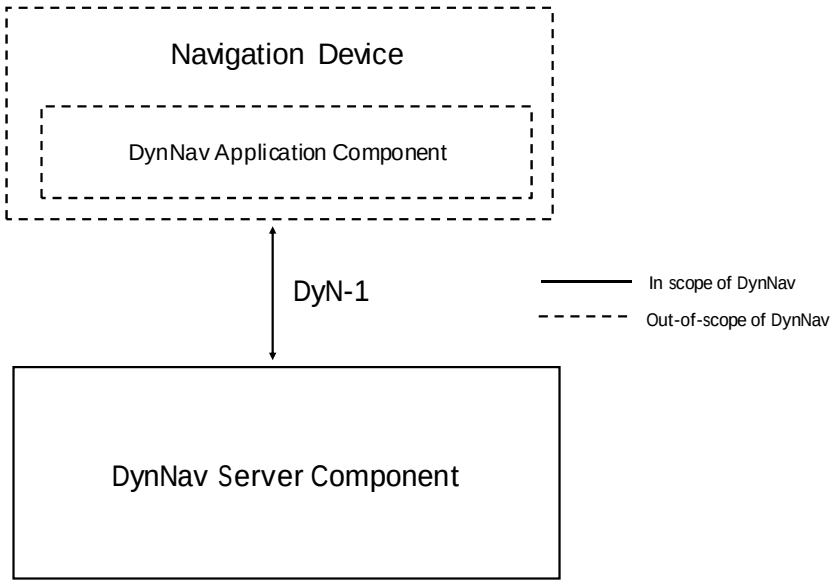

Figure 1: DynNav Enabler Architectural Diagram

6.3 Functional Components and Interfaces Definition

6.3.1 DynNav Server Component Description

The role of this component is to provide route and traffic information to the DynNav Application component. In addition, the DynNav Server component allows the DynNav Application component to be notified about updated traffic information, and the DynNav Application component will be notified about alternative routes in case the performances of proposed routes become degraded

The DynNav Server component performs the following functions:

- Analysis of journey parameters defined by the DynNav Application component and proposal of a set of routes, based on real-time and forecast traffic information; the destination may be defined by a target 3rd party's identifier (whose position has to be estimated by an external location server). For bandwidth optimization, in a preliminary stage routes may be encoded according to a summarized format; full route information is delivered only for the route selected by the ND, out of proposed set. The route information at server level may be updated using user's current position information.
- Provision of real-time and forecast traffic information related to a set of routes proposed by the DynNav Application component or by the DynNav Server itself;
- Provision of real-time and forecast traffic information related to one or more areas defined by the DynNav Application component;
- New route proposition, in the following conditions:
    - Performances of current route become degraded;
    - User diverts and deviates from the on-going route;
    - In case of route to the 3rd party (the 3rd party's position may not be static, the DynNav Server monitors the 3rd party's position and updates the proposed route when the 3rd party's position is changed);.
- Provisioning of complementary information (i.e. POIs) related to a route or an area;
- Notification service of traffic information updates related to the set of routes defined in function #2;
- Notification service of traffic information updates, for areas defined in function #3;
- Notification service of new routes estimated in function #4;
- Using the IP address or a location URI, provided by the DynNav Application component, to access the position information of the DynNav Application component, the DynNav Server component shall not access location procedures if disabled by the user.

Note that user and 3rd party tracking procedures are implemented through an enabler external to DynNav Server component.

Note that the user may access DynNav application data such as route information through 3rd party application server, for instance for planning a journey [Appendix C]. In this scenario the user just requests routing information based on forecast traffic information (procedures 1, 2, 3): it is not interested in real-time notification services.

6.3.2 DyN-1 Interface

This interface is the entry point to DynNav enabler for traffic and route information.

It operates in a request/response model; notification procedures for real-time information updates are also available

This interface supports the following type of procedures:

- Proposal of a set of routes based on journey parameters (origin, destination or 3rd party's ID) defined by the user; routes may be encoded according to summarized format or full format
- Delivery of traffic information related to a set of routes defined by the DynNav Server components
- Delivery of traffic information related to a set of routes defined by the the DynNav Application component
- Delivery of traffic information related to an area defined by the DynNav Application component.
- Delivery of complementary information (i.e. POI) related to defined routes and/or areas
- Notification service for the following kind of events:
    - updates on traffic information related to an area
    - updates on traffic information related to a route

  - alternative routes proposal for the defined journey
  - route and trip update in case of route to the 3rd party
- Disabling the access at server level to user's location information through an external location application

Note that definition of the data is specified at the TS stage.

6.4 Security Considerations

DyN-1 interface is expected to be provided over secure connections, e.g. as secured by TLS (e.g. HTTPS), to ensure that the interface operations are only visible to the appropriate DynNav Application component.

DynNav SHOULD allow Service Provider's deployment to perform the specific security features below:

- mutual authentication of the DynNav Client and DynNav Server Component
- confidentiality and integrity protection in communication between DynNav Application component and DynNav Server Component

Note that how to achieve access control is implementation specific.

7. Release Information

7.1 Supporting File Document Listing

Doc Ref	Permanent Document Reference	Description
Supporting Files		
[DynNav XSD]	OMA-SUP-XSD_rest_DynNav-V1_0-20131217-A	XSD for the messages and included specified schema of RESTful Network API for DynNav v1.0. Working file in OMA Profile Data directory: file: rest_dynnav-v1_0.xsd. path: http://www.openmobilealliance.org/techical

Table 1: Listing of Supporting Documents in DynNav 1.0 Release

7.2 OMNA Considerations

The OMNA portal [OMNA] needs to maintain the following schema namespace into Schema Namespace Registry

Description	Registered URN	Schema Links
XSD Schema for DynNav 1.0	urn:oma:xml:rest:netapi:dynnav:1	http://www.openmobilealliance.org/tech/profiles/rest_netapi_DynNav-v1_0.xsd

Table 2: OMNA Namespaces

Appendix A. Change History (Informative)

A.1 Approved Version History

Reference	Date	Description
OMA-ER-DynNav-V1_0-20131217-A	17 Dec 2013	Status changed to Approved by TP TP Ref # OMA-TP-2013-0388-INP_DynNav_V1_0_ERP_for_final_Approval

Appendix B. Use Cases (Informative)

B.1 Dynamic vehicle routing: traffic information delivery

This scenario aims at enabling users to interconnect a DynNav Application with a DynNav Server infrastructure that provides real-time and forecast traffic information. The users request traffic information (real-time and/or forecast) related to a specific area (e.g., in a city neighbourhood, or metropolitan area, a region, etc.) from the server. In this scenario the route estimation procedure is executed by the ND.

B.1.1 Short Description

The DynNav Application communicates to the DynNav Server the area of interest (e.g., a city neighbourhood, or metropolitan area, a region, etc.) for which it wishes to obtain information correlated with time information; the DynNav Application may optionally specify a set of preferences (e.g., no toll roads, vehicle type etc.). The DynNav Server selects the information related to the specified area and sends it to the DynNav Application. Traffic information includes performance parameters for road segments and traffic events. With this information the ND can estimate the optimal route(s) for the user. The user can subscribe to notification service: at a later stage the server will send updated traffic information to keep the DynNav Application aligned with real-time traffic flows and traffic events in the specified area.

The user may request information about Parking lots, public transportation, POI; this query is based on specified area of interest.

B.1.2 Market benefits

The user may benefit from this use case in terms of travelling time, cost saving and safety; the user may also be informed in real-time about parking lot, public transportation and POI (e.g. restaurants, petrol stations).

B.2 Dynamic vehicle routing: routing information delivery

This scenario aims at enabling users to interconnect a DynNav Application with a DynNav Server infrastructure that provides routing information and associated traffic information. The DynNav Application provides journey parameters and the DynNav Server replies with optimal route information for that journey.

B.2.1 Short Description

The DynNav Application requests routing information from the DynNav Server, sending information about the journey, in terms of origin/its current position, final destination, road preferences and vehicle type. The DynNav Server, based on available real-time and forecast traffic data, estimates the optimal route(s) with related network performance parameters and traffic events; the data are sent to the DynNav Application. From the proposed set of routes, the user deletes the ones it is not interested in and subscribes to notification service to receive updated information about:

- Network performance parameters and traffic events for the set of route(s)
- Alternative routes in case of traffic anomalies (e.g. delay or bloackage) on current selection, if available.

In a different implementation, a preliminary set of routes is proposed by the DynNav Application without access to real-time traffic information. For those routes, the DynNav Server is requested to provide estimated performance parameters and traffic events. As in the pervious scenario, the user may then remove the routes he is not interested and he may subscribe to notification service to receive updated traffic information and/or alternative routes proposals.

If the DynNav Server tracks the DynNav Application position or the DynNav Application periodically updates its current position, the DynNav Server can update in real-time the route information related to the a specific navigation session, deleting routes not consistent with the DynNav Application current position and deleting road segments already travelled from the routes description.

The user may request information about parking lots, public transportation, and POI (restaurants, petrol stations) releted to selected routes.

B.2.2 Market benefits

The user may benefit from this application in terms of travelling time optimization, cost saving and safety; the user may also be informed in real-time about POI and parking lot, restaurants, etc.

B.3 Traffic monitoring

With the consensus of the users, the service provider may track the DynNav Applications and create real-time maps of traffic flows.

B.3.1 Short Description

The user communicates its availability to be tracked by the server for real-time traffic information estimation at server level; the server subscribes to the DynNav Application for tracking procedure, defined in [OMA-SUPL][OMA MLS], to collects position and velocity data. With this information the server estimates information on traffic flows on the road network (road segments delays and traffic blockage).

B.3.2 Market benefits

The service provider is able to collect valuable data, create a real-time traffic map, and exploit these data to provide a value added information.

B.4 Re-route Request

This scenario aims at enabling the DynNav Application to re-route when the vehicle which has the ND is diverting and deviating from the on-going route.

B.4.1 Short Description

When a user is guided by the predetermined route provisioned by the DynNav Server, the user may change the route by turning the wrong direction or on purpose while driving. Under the circumstances, the DynNav Application is able to recognize the situation that the vehicle is deviating from the route (e.g. the algorithm for detecting deviations is the out of scope of this enabler), and then, the DynNav Application may request re-route information to the DynNav Server simply based on the current position of the vehicle and the preset destination.

B.4.2 Market benefits

Using the re-route request, the service provider is able to optimize the use of network bandwidth and the overload of the DynNav Server can be also reduced since the DynNav enabler does not need to create a new trip and other subsequent procedures (e.g. subscription).

B.5 Summarized route delivery

This scenario aims at enabling the DynNav Server to provide the summarized routing information for saving the network bandwidth.

B.5.1 Short Description

Since only a selected or preferred route, out of a set of routes proposed by the DynNav Server to the user, is used as routing information for a journey, full format encoding of the all set of routes represents redundant information from the network standpoint. In a preliminary stage, the DynNav Server should provide to the user a set of summarized routes and only the selected route will be provided to the user encoded in the full format.

The summarized route allows reducing the size of the route data provided because the summarized route may consist of the small number of high significant segments out of full road segments.

Normal Flow:

1. The user defines the journey parameters and the DynNav Application submits a request from the DynNav Server to acquire a set of proposed routes.
2. The DynNav server estimates a set of routes and summarizes the estimated routes and sends the set of summarized routes to the DynNav Application (which are much lighter than full format routes).
3. The user can see the summarized routes on the screen and selects a route out of the proposed routes it is interested in and the DynNav Application reports the route selection to the DynNav server.
4. The DynNav server sends only the selected route in full format providing detailed information for the route..

B.5.2 Market benefits

The method allows the service provider to save its bandwidth and reduce the time to transmit the potentially unused set of fully described routes.

Appendix C. Deployment Diagram (informative)

The following figure presents a possible deployment scenario. The DynNav Application may reside in a Navigation Device or in a 3rd party application server as part of the Navigation AppServer, the network element providing the navigation service to the final user.

The main application related to the case where the DynNav Application resides in the Navigation Device is turn-by-turn vehicle navigation. In this application, firstly, the user requests route and traffic information and then subscribes to notification service to receive real-time traffic information and alternative route proposal. Furthermore, the DynNav Application may provide real-time position information to the Navigation AppServer, updating journey information or through an external application (e.g. SUPL), and the DynNav Server uses location information in order to

1. Update the set of proposed routes created for a specific user,
2. Estimate network performance parameters on the roads on the basis of the NDs tracking information.

On the other side, the main application related to the case where the DynNav Application resides in an 3rd party application server is represented by journey planning tools offered through the web: the end user will access real-time traffic information and routing information through an web interface exposed by the 3rd party application server, the 3rd party application server will access the requested route and traffic information through the DynNav interface(DyN-1), acting as a DynNav Application. In this scenario, the user is not interested in notification services.

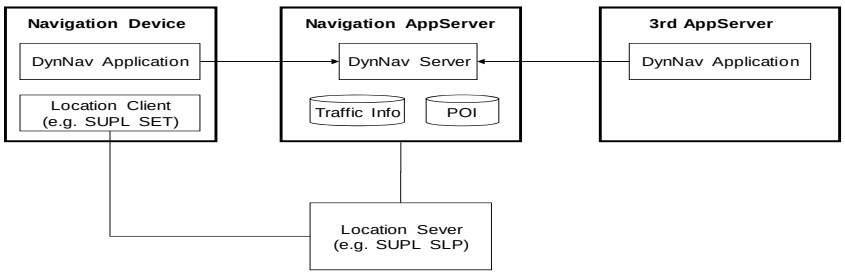

Figure 2: Deployement Diagram

Appendix D. Flow (informative)

D.1 Routing information delivery Call Flow

The figure below describes the message flow for a possible implementation of use case B.2 (Routing information delivery) and B.4 (Re-route Request).

In the example, the DynNav Application asks for navigation data (e.g. route information) to the DynNav Server. The user sets journey parameters, (starting point, destination and other preferences); those parameters are sent to the DynNav Server. The DynNav Server will reply with a set of routes matching up with journey parameters and related traffic information (network performance parameters and traffic events). The user then selects one or more proposed routes, and subscribes to notification service for receiving updated traffic information and alternative routes proposals.

The DynNav Server will then provide the client with real-time and forecast traffic information updates for the proposed routes, over the notification procedure.

Due to a traffic jam on the selected route, the DynNav Server proposes an alternative route to the DynNav application. The DynNav Server will automatically update its subscription settings related to the DynNav Application adding the alternative route in the subcribed resources set. This implicit subscription procedure is recommended for safety reason in automotive applications.

Afterwards, the user diverted from the selected route by turning the wrong direction or on purpose. The DynNav Application will request new routing information and related traffic information to the DynNav Server.

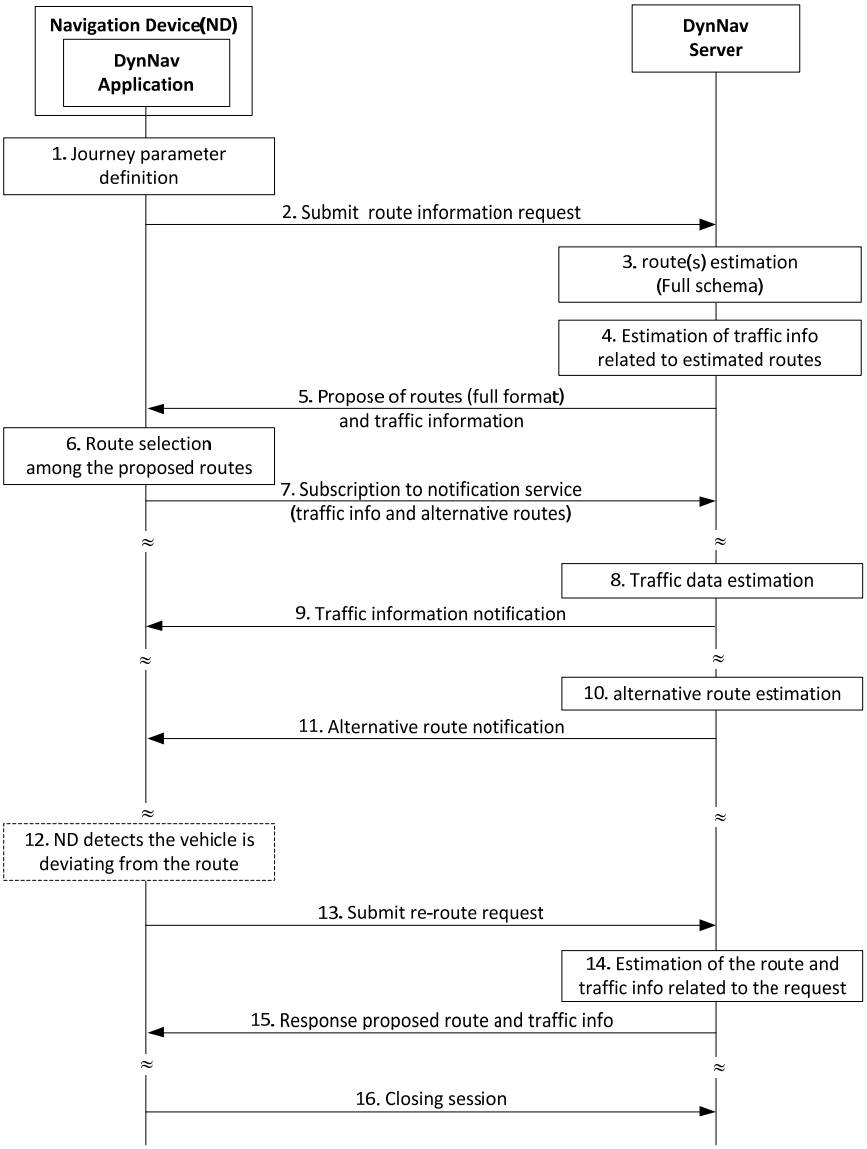

Figure 3: Data Operation Call Flow (B.2 and B.4)

This call flow is triggered by a request to access real-time routing information and related traffic data as described in [B.2 and B.4].

1. The user defines the journey parameters.
2. The DynNav Application submits a query to the DynNav Server to access route information and related traffic information, providing the server with journey parameters.
3. The DynNav Server estimates a set of routes for the defined journey.
4. The DynNav Server generates performance parameters and traffic events related to the estimated routes previously.
5. The DynNav Server proposes a set of routes with related traffic information encoded in the full format to the client.
6. The user selects the routes it is interested in.
7. The DynNav Application subscribes to notification service to receive real-time information about;

a) Traffic information for the route the user has selected

b) Alternative route proposal, whenever performance of proposed routes becomes degraded.

In this procedure, the DynNav Application may provide the DynNav Server with a locationURI that is used by an external location application for tracking procedures based on the consensus of the user.

8. For the selected route, the DynNav Server estimates real-time and forecast traffic information (traffic events and network performance parameters).
9. The DynNav Server updates on traffic information related to selected route are notified to the DynNav Application.
10. When performances of a proposed route become degraded, the DynNav Server estimates alternative route proposal, if available.
11. The alternative route is provided to the DynNav Application by the DynNav Server. The subscription settings are implicitly updated in the server in order to provide real-time traffic information for the alternative route.
12. The ND detects that the vehicle is diverting and deviating from the predetermined route.
13. The DynNav Application automatically submits the re-route request to update the route accordingly to current position.
14. The DynNav Server re-estimates the route and traffic information related to the re-route request, based on the current position of the user.
15. The DynNav Server proposes a route with related traffic information to the DynNav Application. The subscription settings are also implicitly updated in the DynNav Server.
16. The session is closed by the DynNav Application.

D.2 Traffic information delivery Call Flow

The figure below describes the message flow for a possible implementation of use case B.1 (traffic information delivery) and use case B.4 (Re-route Request) in case the routes are proposed by the DynNav Application.

In this scenario, the DynNav Application calculates a route that matches journey parameters defined by the user and it requests related traffic information from the DynNav Server. Based on traffic information provided by the server, the DynNav Application assumes the route as the reference one. Then the DynNav Application subscribes to notification service for receiving traffic information updates related to the route, confirming that it allows to be tracked by the DynNav Server.

At a given point, an accident on the reference route will trigger a notification message from the DynNav Server toward the DynNav Application. Upon updated traffic information, the DynNav Application estimates an alternative route and asks for traffic information to the DynNav Server. Since the new route appears to be rather congested, the DynNav Application estimates a second alternative route and asks again traffic information to the DynNav Server. At the moment, the answer satisfies the user and the DynNav Application removes the old route not to receive related notifications.

Furthermore, the user diverts from the route and the DynNav Application will automatically estimates a new route and submit it to the DynNav Server and the DynNav Server provides the real-time traffic information regarding the re-estimated route and the subscription parameters are updated by the DynNav Application.

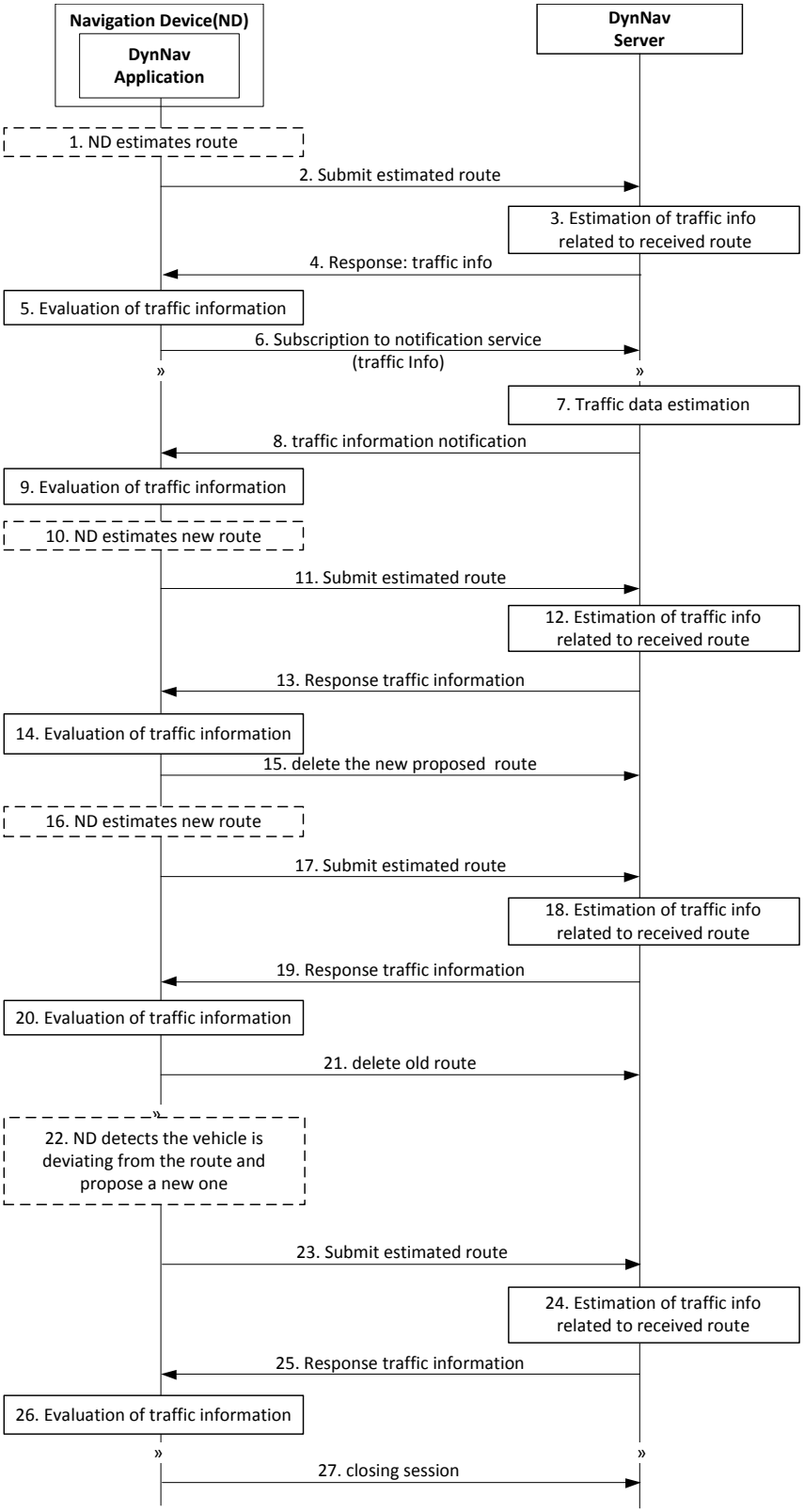

Figure 4: Data Operation Call Flow (B.1 and B.4)

This call flow is triggered by a request to access real-time traffic data related to a set of routes proposed by the ND as described in [B.1 and B.4].

1. The ND estimates a route.
2. The DynNav Application submits a query to the DynNav Server to access traffic information related to the estimated route.
3. The DynNav Server generates network performance parameters and traffic events related to the received route.
4. The DynNav Server sends the DynNav Application the traffic information related to the proposed route.
5. The DynNav Application evaluates the received traffic information and assumes the route as reference one.
6. The DynNav Application subscribes to notification service to receive real-time information about traffic information for the reference route. In this procedure, the DynNav Application also provides the DynNav server with a locationURI that is used by an external location application for tracking procedures.
7. An accident occurs along the reference route, the DynNav Server estimates updated traffic information for the route (e.g. delays for each road segments).
8. The DynNav Server notifies to the DynNav Application updated traffic information along the reference route.
9. The ND evaluates the received information.
10. If the DynNav Application reckons that performances are heavily degraded, it estimates alternative route.
11. The DynNav Application submits a query to the DynNav Server to access traffic information related to the alternative route.
12. The DynNav Server generates performance parameters and traffic events related to the received route.
13. The DynNav Server sends the DynNav Application the estimated traffic information.
14. The ND evaluates the received information and reckons that performances of the new routes do not have any advantage over to previous one.
15. The DynNav Application deletes the last proposed route since there is no interested in.
16. The ND estimates a second alternative route.
17. The DynNav Application submits a query to the DynNav Server to access traffic information related to the second alternative route. .
18. The DynNav Server generates performance parameters and traffic events related to the received route.
19. The DynNav Server sends the ND the estimated traffic information.
20. The DynNav Application evaluates the received traffic information and reckons that the last proposed route has advantage over the previous ones and the DynNav Application assumes this alternative route as the reference one. The DynNav Application will automatically receive traffic information updates related to the new route.
21. The previously proposed route is deleted since it is no more the reference one.
22. The ND detects the vehicle is deviating from the reference route. The ND automatically estimates a new route based on the current position of the ND.
23. The DynNav Application submits a query to the DynNav Server to access traffic information, providing the DynNav Server with the estimated route.
24. The DynNav Server generates performance parameters and traffic events related to the received route.
25. The DynNav Server sends the DynNav Application the estimated traffic information.

26. The DynNav Application evaluates the received traffic information and it assumes the new route as the reference one. The ND will automatically receive traffic information updates related to the new route

27. The session is closed by the ND.

D.3 Summarized Route Delivery Call Flow

This section describes the message flow for delivering a set of summarized routes to the DynNav Application (use case B.5).

In this flow, the DynNav Server uses the summarized encoding format for the first delivery of route information to the ND, this choice allows optimization of bandwidth and response time with respect of full encoding approach. The DynNav Server may choose the encoding format based on journey parameters (i.e. journey length) and implementation dependant conditions.

When the DynNav Application has received the set of summarized routes, it selects the ones it is interested in; and then it will request from the server the full description of the selected routes.

The remaining part of DynNav application call flow remains the same as the flow D.1.

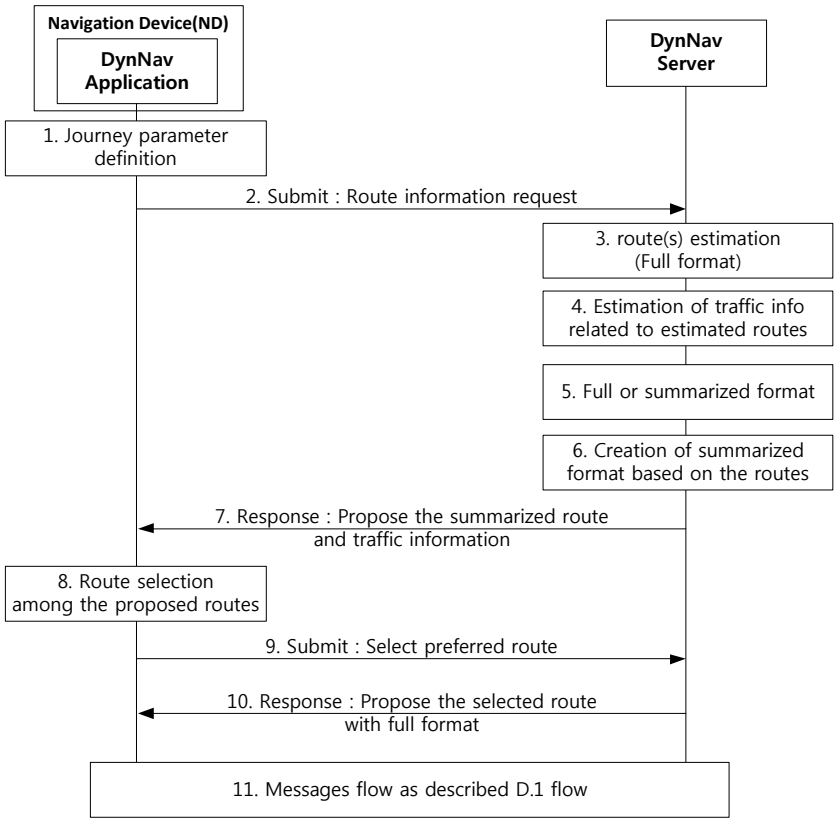

Figure 5: Data Operation Call Flow (B.5)

This call flow is triggered by a request to access real-time routing information and related traffic data, in the first stage of the information is encoded accoriding to summarized format described in [B.5].

1. The user defines journey parameters.

2. The DynNav Application submits a query to the DynNav Server to access route information and related traffic information, providing the DynNav Server with the journey parameters.

3. The DynNav Server estimates a set of routes according to full format based on the defined journey parameters.

4. The DynNav Server generates performance parameters and traffic information related to the set of proposed routes.
5. The DynNav Server determines that the summarized route format is sent to the DynNav Application.
6. The DynNav Server encodes the set of proposed routes according to the summarized format.
7. The DynNav Server sends the summarized routes and related traffic information to the DynNav Application.
8. The user seletcs a preferred route among the proposed set.
9. The DynNav Application requests the full description of the selected route from the DynNav Server.
10. The DynNav Server sends the full desription of the route to the DynNav Application.

The message flow of a typical application should continue as described in flow D.1, (in the steps from 7 to 17).