Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Local Hazard Information Navigation v2

APIM Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.0

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Version Date: June 19, 2018

FORD CONFIDENTIAL

Revision History

Date	Version	Notes	
June 19, 2018	1.0		Initial Release

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1.1 Abbreviations

CCS	Customer Connectivity Settings Stems values for bAllowOnOff and bSAllowOnOff for this feature
DENM	Decentralized Environment Notification Message describes events for vehicles without navigation system
ETSI	European Telecommunications Standards Institute
FCD	Floating Car Data
FTCP	Ford Telematics Communication Protocol
HMI	Human Machine Interface
HUD	Heads-Up Display
IPC	Instrument Panel Cluster
LHI	Local Hazard Information
LHN	Local Hazard Notification
LHR	Local Hazard Reporting
LHRA	Local Hazard Reporting (Automatic)
LHRM	Local Hazard Reporting (Manual)
OLT	Online Traffic / Live Traffic
SDN	Service Delivery Network
NGSDN	Next Generation Service Delivery Network
TCU	Telematics Control Unit

2 Introduction

The Local Hazard Information (LHI) feature shall provide the capability to inform the driver about relevant events on the road ahead.
The vehicle is connected to the V-SDN backend via the cellular network and shall authorize usage of the Local Hazard Information service through issuing an access token.

The vehicles then directly connect to the traffic service provider and receive data about events, e.g. animals on the road in its vicinity, e.g. within a 25 km circle around the vehicle. LHI shall store received events and periodically check the relevance for the driver. If an event gets relevant, because the vehicle is heading to the event, the driver will be informed via the in-vehicle HMI.
The event message is generated by a 3rd party service provider. The provider could use different sources to generate events, e.g. incident database from public authorities. The service provider is reliable for the information quality. LHI should work as a cooperative system and thus includes the possibility to provide vehicle data (e.g. vehicle position, speed or wiper status) as well as events to the service provider. All reported events are sent from the vehicle directly to the 3rd party service. The 3rd party service shall analyze the received events. The analysis shall include the aggregation of reported incidents to one event to avoid data communication to the vehicle and inconsistent event storage.

3 General Requirements

3.1 LHI-REQ-275357/A-Diagnostics Parameter to Configure Availability of Feature

The part implementing this specification shall support one diagnostics configuration parameter for availibility of the feature as-built.

4 General Notification Requirements

4.1 LHI-REQ-273412/A-Hazard Information as part of Live Traffic Query

The information for hazards shall be retrieved from the backend using the existing traffic session and periodic traffic data queries.

4.2 LHI-REQ-273462/B-Hazard Information Push from Traffic Service Provider

There shall be the possibility to push hazards from the backend to the vehicle using commands correlated to the existing traffic session queries.

4.2.1 LHI-REQ-264852/B-Hazard Information as part of Correlated Command

There shall be the possibility to push hazards from the backend to the vehicle using commands correlated to the existing FTCP traffic session queries. Receiption of an FTCP command shall trigger a request for traffic data with the service provider in the session at hand.

4.3 LHI-REQ-251094/A-In-Vehicle Hazard Storage

The hazard matching algorithm in the vehicle shall run over a database of cached hazards, which were previously sent to the vehicle.

4.4 LHI-REQ-251087/A-Periodic Matching for Notification

The notification matching function shall periodically match hazards for relevance to the current driving direction and, if applicable, active route guidance.

4.5 LHI-REQ-251089/A-Configurable Thresholds for Notification

Thresholds for displaying notifications shall apply to distance to event, current speed of vehicle, active distance profile.

4.6 LHI-FUR-REQ-251093/A-Compression and Decompression of Hazard Data over Communication Links

The traffic and hazard data used for notification matching shall be GZIP compressed (deflate). It shall be decompressed in the hazard matching logic prior to updating the hazard event storage in the vehicle.

4.7 LHI-REQ-257565/A-Notifications with Distance Indication

Notifications in the HMI shall be given using a distance indication, if a distance can be attributed to the event in question, i.e. the event is located at a given point.

4.8 LHI-REQ-257567/A-Notifications without Distance Indication

For events which are highly dynamic or can only be attributed to a road segment, notifications shall be given without distance indication.

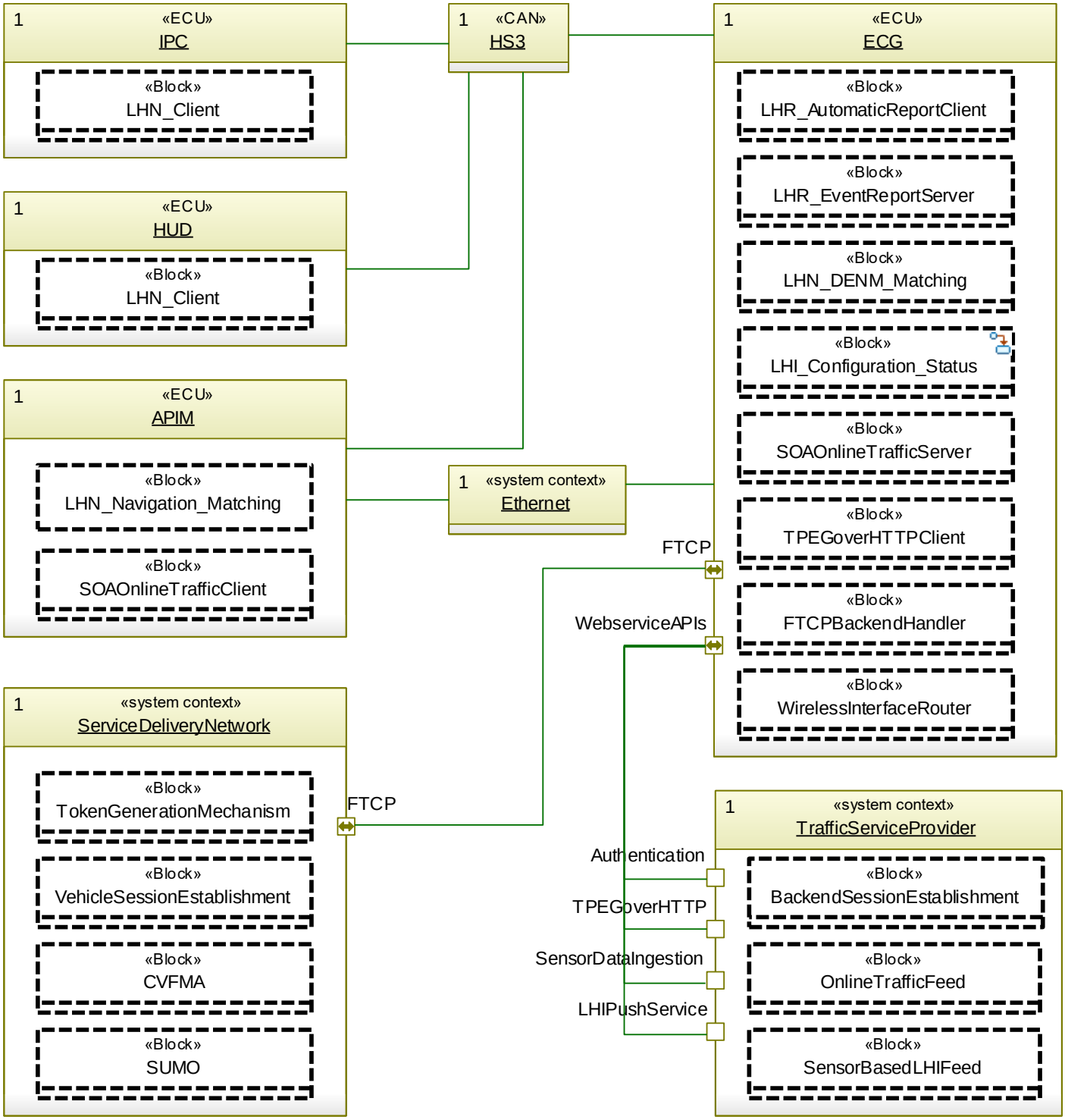
4.9 LHI-REQ-264822/A-Notifications without Distance Indication if Location is Close or Behind

If the computed distance upon applying the decrease step logic evaluates to zero, or if the event is already behind the current location, the event notification shall be given without distance indication in LHN_EventInfo.

5 Architectural Design

5.1 Interface Requirements and Method Descriptions

5.1.1 LHI-CD-REQ-293415/A-FNV2 In-Vehicle Architecture Deployment



5.1.2 LHI-IIR-REQ-293438/B-LHI_Navigation_Matching_Rx

5.1.2.1 LHI-MD-REQ-251111/B-LHI_Feature_St

Message Type: Status

This signal is used to distribute the status of available LHI service via the BackendHandler

Name	Literals	Value	Description
LHIService_St	-	-	Current state of LHI service
	Invalid	0x00	LHI online service not running, or not available as built
	bSAllowOff	0x01	LHI online service not enrolled, i.e. subscribed to
	bAllowOff	0x02	LHI online service not allowed due to CCS
	NoSession	0x03	No LHI online session is established
	NoService	0x04	No LHI online service for current area
	Available	0x05	LHI online service is available
	Suspended	0x06	LHI operation with distance indication suspended – only limited operation without distance indication possible

5.1.2.2 LHI-MD-REQ-251112/A-LHI_MatcherType_St

Message Type: Status

This signal is used to distribute the active LHN matching model.

Name	Literals	Value	Description
LHI_MatcherType_St	-	-	Active flavor of LHN matching model
	Invalid	0x0	No matching model available
	DENM_EM	0x1	LHI DENM matching on embedded modem active
	TPEG/TEC	0x2	LHI navigation based matching active
	Reserved1	0x3	Reserved, not used
	…	…	
	Reserved13	0xF	Reserved, not used

5.1.3 LHI-IIR-REQ-293439/B-LHI_Navigation_Matching_Tx

5.1.3.1 LHI-MD-REQ-251108/B-LHN_EventInfo

ISO-CAN
Message Type: Data

This method is used to transmit information for local hazards as they were matched to the driving direction at hand.

Name	Literals	Value	Description
EventTypeIcon	-	-	
	None	0x0	Event type none is used for indicating that no event was matched to the driving direction at hand
	General	0x1	Show General Hazard Icon
	Road Works	0x2	Show Road Works Hazard Icon
	Obstacle	0x3	Show Obstacle Hazard Icon
	End of Traffic Jam	0x4	Show End of Traffic Jam Icon
	Broken Down Vehicle	0x5	Show Broken Down Vehicle Icon

	Fire	0x6	Show Fire Icon
	Hazardous Driving Condition	0x7	Show Hazardous Driving Condition Icon
	Objects on the road	0x8	Show Objects on Road Icon
	Animals on the road	0x9	Show Animals on Road Icon
	People on roadway	0xA	Show People on Road Icon
	Vehicle on wrong Carriageway	0xB	Show Vehicle on wrong carriageway icon
	ReservedIcon1	0xC	Reserved, not used.
	ReservedIcon2	0xD	Reserved, not used.
	ReservedIcon3	0xE	Reserved, not used.
	ReservedIcon4	0xF	Reserved, not used.
DistanceUnitUsed	-	-	Indicates the unit used to transfer the distance
	Meter	0x0	
	Kilometer	0x1	
	Feet	0x2	
	Yards	0x3	
	Miles	0x4	
Distance	-	-	Indicates the remaining distance until reaching the triggered warning event. Distance units are in steps of 0.01 for miles&kilometers Ex. 0x01A9 = 4.25 km/mil Distance units are single digit steps for meters/feet/yards Ex. 0x01A9 = 425 m/ft/yd
	min	0x0000	
	max	0xFFFE	
	NoDistance	0xFFFF	Used for warnings without Distance indication
NotificationLevel	-	-	
	Background	0x0	
	Popup	0x1	Event shall trigger a popup, unless popups are deactivated by configuration
EventDescription	-	-	Event description maximum containing a description of the event in natural language
	String	Max. 80 characters + 1 EOS character	

5.1.4 SOA Interface Requirements

5.1.4.1 IIR-REQ-289182/A-Online Traffic API

5.1.4.1.1 MD-REQ-288960/B-RequestOnlineTrafficData

Method Type	On-Change
QoS Level	Default
Retained	No

R/O	Name	Type	Literals	Value	Description
Request					
O	SessionType	Enum	-	-	Determines which session should be requested
			TPEG TEC-TFP	0x0	Used to request a standard Online Traffic Session with LHI data included for systems with on board Navigation
			TPEG-DENM	0x1	Used a request a standalone LHI session for systems without on board Navigation
O	CountryCode	String	-	3 chars.	Country Code according to ISO 3166-1 ALPHA 3. Example CountryCode for Germany: "DEU"
Rep	MapVersion	message			Transports the LTN map information to the Backend
O	RouteActive	Boolean	-	True False	Defines if a route is currently active.
Rep	Route	message			Repeated "Route" field with different routes provided by the Navigation unit to request traffic data
O	Resynchronize OnlineTraffic	Boolean	-	True False	Flag to indicate that a new OnlineTraffic session shall be established to cure a "out-of-sync" situation
O	Decompression Failed	Boolean	-	True False	Decompression of traffic data failed
O	DecodingFailed	Boolean	-	True False	Decoding of traffic data failed
O	SPTHash	bytes	-	-	SHA-256 hash value (32 Bytes), of unencrypted, uncompressed SPT data. If Hash does not match latest SPT will be provided in the Response message.
Response					
O	SessionID	Uint32			Unique Identifier from the Backend application to identify the session created.
O	t_BroadcastFallback	ENUM	-		Used to adjust OnBoard timer via the Backend Application
			invalid	0x00	Not used
			T1	0x01	Value Range 60 – 1800 seconds.
			…	…	

			T30	0x1E	Resolution 60 seconds. T1=60 seconds T2=120 seconds … T30=1800 seconds See Timer requirements for applicable values.
O	t_TrafficQueryInterval	ENUM	-	-	Used to adjust OnBoard timers via the Backend Application
			invalid	0x00	Not used
			T1	0x01	Value Range 30 – 300 seconds. Resolution 30 seconds. T1=30 seconds T2=60 seconds … T10=300 seconds See Timer requirements for applicable values.
			…		
			T10	0x0A	
O	SPTUpdate	message	-	-	Only send when SPT Hash provided in the request does not match the latest SPT available
O	response_code	ENUM	NoService	0xXYZ	
			Success	0x1	
			NotAllowedByCCSSettings	0x2	
			NotConnectedToBackend	0x3	
			Timeout	0x4	
			newData	0x5	
			Failed	0x6	
O	PayloadData	message	-	-	Carries the actual payload data requested.

5.1.4.1.1.1 Nested message fields

5.1.4.1.1.1.1 REQ-289177/A-MapVersion

R/O	Name	Type	Literals	Value	Description
O	CC	Uint32	-	0x0-0xF	Represents the CountryCode of following LTN
O	LTN	Uint32	-	0x00-0x3F	LocationTableNumber
O	LTNMajorVersion	Uint32	-	0x00-0x63	Represents the Major Version part of the LTN Version
O	LTNMinorVersion	Uint32	-	0x00-0x63	Represents the Minor Version part of the LTN Version

5.1.4.1.1.1.2 REQ-289181/A-Route

R/O	Name	Type	Literals	Value	Description
Rep	Waypoints	message			Carries different waypoints of a route

5.1.4.1.1.1.2.1 REQ-289178/B-Waypoints

R/O	Name	Type	Literals	Value	Description
O	Latitude	Double			Carries the Latitude of a waypoint (WGS84) decimal prasentation
O	Longitude	Double			Carries the Longitude of a waypoint(WGS84) decimal prasentation

5.1.4.1.1.1.3 REQ-299957/A-SpeedProfileTableUpdate

R/O	Name	Type	Literals	Value	Description
O	SPTHash	bytes	-	-	SHA-256 hash value (32 Bytes), of unencrypted, uncompressed SPTdata
Rep	SPTTable	SPTTable Entry	-	-	Message structure to contain the SpeedProfileTable entries

5.1.4.1.1.1.3.1 REQ-299958/B-SPTTableEntry

R/O	Name	Type	Literals	Value	Description
O	CauseCode	Uint32	-	-	TPEG/TEC/DENM Cause Code
			Min/Default	0x00	
			Max	0xFF	
O	SubCauseCode	Uint32	-	-	TPEG/TEC/DENM Sub Cause Code
			Min/Default	0x00	
			Max	0xFF	
O	eventCode	Uint32	-	-	TMC Event Code
			Min/Default	0x000	
			Max	0xFFF	
O	LHNIconIndex	Uint32	-	-	
			Min	0x0	
			Max	0xF	
			Default	0x0	
O	NotificationLevel	Uint32	-	-	
			Background/Default	0x0	
			Popup	0x1	
O	Priority	Uint32	-	-	
			Min	0x000	
			Max	0x17F	
O	speedThreshold	Uint32	-	-	Speed Threshold in meter/second

			Min	0x00	
			Max	0xFF	
O	ETAThreshold	Uint32	-	-	ETA Threshold in seconds
			Min	0x0000	
			Max	0xFFFF	
O	distanceThreshold	Uint32	-	-	Distance Threshold in meter
			Min	0x0000	
			Max	0xFFFF	
O	includesDistance	Boolean	-	-	
			False	0x0	
			True	0x1	
O	ReRoute	ENUM	-	-	
			NotUsed (default)	0x0	
			False	0x1	
			True	0x2	

5.1.4.1.1.1.4 MD-REQ-289176/A-PayloadData

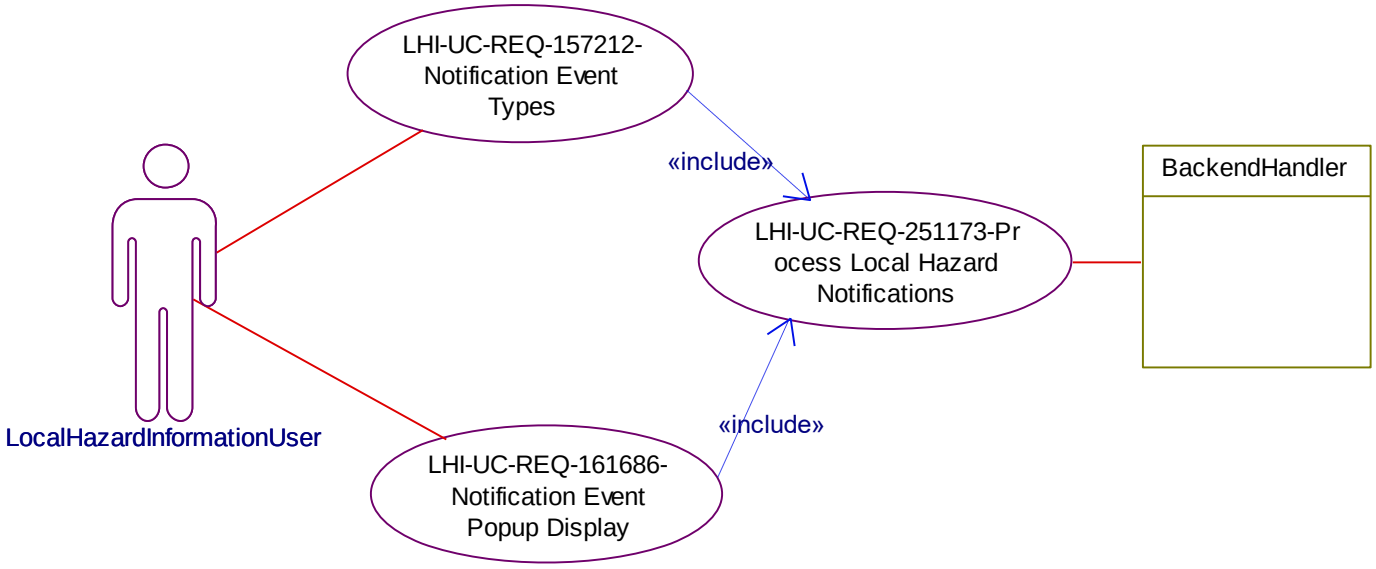
R/O	Name	Type	Literals	Value	Description
O	TransactionID	UInt32	-	-	TransactionID delivered from the TSP to identify the packet sequence order
O	Data	bytes		<=2MB	GZIP-compressed TPEG transport frame. Can contain multiple transport frames.

6 Functional Definition

6.1 LHI-FUN-REQ-293435/A-LHN Navigation Matching

6.1.1 Use Cases

6.1.1.1 LHI-UCD-REQ-257974/A-Local Hazard Information Matching



6.1.1.2 LHI-UC-REQ-251173/A-Process Local Hazard Notifications

Linked Elements
LHI-ACT-REQ-251176/A-Receive Local Hazard Notifications
LHI-ACT-REQ-251177/A-Check relevancy of Local Hazard Notifications APIM

Actors	Local Hazard Notification Backend Handler
Pre-conditions	IGN on, LHI System connected to SDN, LHI System is activated.
Scenario Description	LHI Data is received by the Backend Handler and processed by the Location Hazard Notification Model.
Post-conditions	Local Hazard Notification event information shall be sent to the controller
List of Exception Use Cases	E1: LHI Data is not relevant: If the LHI data is not relevant for the current vehicle ego position then the local hazard notification event information shall indicate no hazard
Interfaces	Mobile-Network, In-Vehicle Network

6.1.1.3 LHI-UC-REQ-157212/B-Show Notification with Event Type

Linked Elements
LHI-ACT-REQ-257552/B-Show Notification Event Types
LHI-REQ-161690/B-Type of hazards
LHI-REQ-270596/A-Push of Hazard Information to Vehicles
LHI-REQ-251089/A-Configurable Thresholds for Notification
LHI-REQ-251088/A-Prioritization of Events for Notification
LHI-REQ-264822/A-Notifications without Distance Indication if Location is Close or Behind
LHI-REQ-251090/A-Subsume X-Urgent Traffic and other Hazard Notifications
LHI-REQ-257567/A-Notifications without Distance Indication
LHI-REQ-265753/A-Prioritization Criterion
LHI-REQ-251094/A-In-Vehicle Hazard Storage
LHI-REQ-251087/A-Periodic Matching for Notification
LHI-REQ-251147/A-Display for TPEG/TEC and X-Urgent Traffic Warnings
LHI-REQ-257565/A-Notifications with Distance Indication

Actors	Driver
Pre-conditions	IGN on, LHI System connected to SDN, LHI System is activated.
Scenario Description	The vehicle is approaching a hazard. LHN is displaying an Icon in the HMI
Post-conditions	The icon shall be indicating the related type of event. The distance to the hazard is indicated to the user via <<HMI output>>.
List of Exception Use Cases	
Interfaces	GUI

6.1.1.4 LHI-UC-REQ-161686/B-Show Notification Event Popup

Linked Elements
LHI-ACT-REQ-257553/B-Show Notification Event Popup

Actors	Driver
Pre-conditions	IGN on, LHI System connected to SDN, LHI System is activated.
Scenario Description	The vehicle is approaching a hazard, which is relevant for the current driving direction. The speed profile table indicates a notification level POPUP
Post-conditions	Driver shall be notified by means of a popup to the user via <<HMI output>>
List of Exception Use Cases	E1: No popup indication: If notification popups are deactivated according to <<HMI specification>>, no LHN popup shall be triggered indicated to the user via <<HMI output>>
Interfaces	GUI

6.1.2 Requirements

6.1.2.1 LHI-REQ-252063/A-Periodic Evaluation of all NMs in the Database

The LHI database shall be checked for relevant events every elapse of the TMR-REQ-265754.

6.1.2.2 LHI-REQ-252066/A-Select Notification Level from Speed Profile Table

The notification level shall be populated in LHN_EventInfo based on the value found in the prioritized rule line item.

6.1.2.3 LHI-REQ-252068/A-LHI Event active

For each LHI Event an "active" Flag shall be tracked in volatile memory.

6.1.2.4 LHI-REQ-252070/B-Relevant LHI Event data for HMI

The following LHI Event data shall be updated and periodically transmitted as part of LHN_EventInfo:

- Event Type according to Speed Profile Table
- Notification Level according to Speed Profile Table
- Distance unit according to CAN signal for distance units and part configuration
- Distance to target along the approach path, if there is an approach path and if notification includes distance according to Speed Profile Table
- Event description string according to currently selected language (*see REQ-252071, REQ-252073, Disp_LangSel2_St*)

6.1.2.4.1 LHI-REQ-275058/A-Update LHI Event data On Change for HMI

All LHN_EventInfo data shall be updated and sent to the client on change, if the language setting, the distance unit or the active matcher result changes.

6.1.2.5 LHI-REQ-252108/A-LHI Notification Consistency

Once an event notification display has been activated, it shall not be suppressed due to vehicle speed reduction.

6.1.2.6 LHI-REQ-252111/A-Prioritization of Multiple Active Events by Type

If the vehicle is approaching a scene of events of different types, which would cause overlapping notifications, the LHN Matcher shall prioritize the event notifications against each other, according to Event Notification Speed Profile Table. As a result, the LHN Matcher shall always trigger the notification for the highest prioritized event without interruption.

6.1.2.7 LHI-REQ-251088/A-Prioritization of Events for Notification

If more than one hazard event is relevant for the driver, a prioritization mechanism shall be part of the hazard notification model.

6.1.2.7.1 LHI-REQ-265753/A-Prioritization Criterion

The priority column in the speed profile table shall be used for prioritization of applicable rules. A lower number in the priority column equals a higher priority.

6.1.2.8 LHI-REQ-257969/A-Receive LHI Data

Since the LHI Navigation matching engine relies on the existing Online Traffic Data please refer to the Online Traffic receive mechanisms.

6.1.2.9 Configurable Parameter Requirements

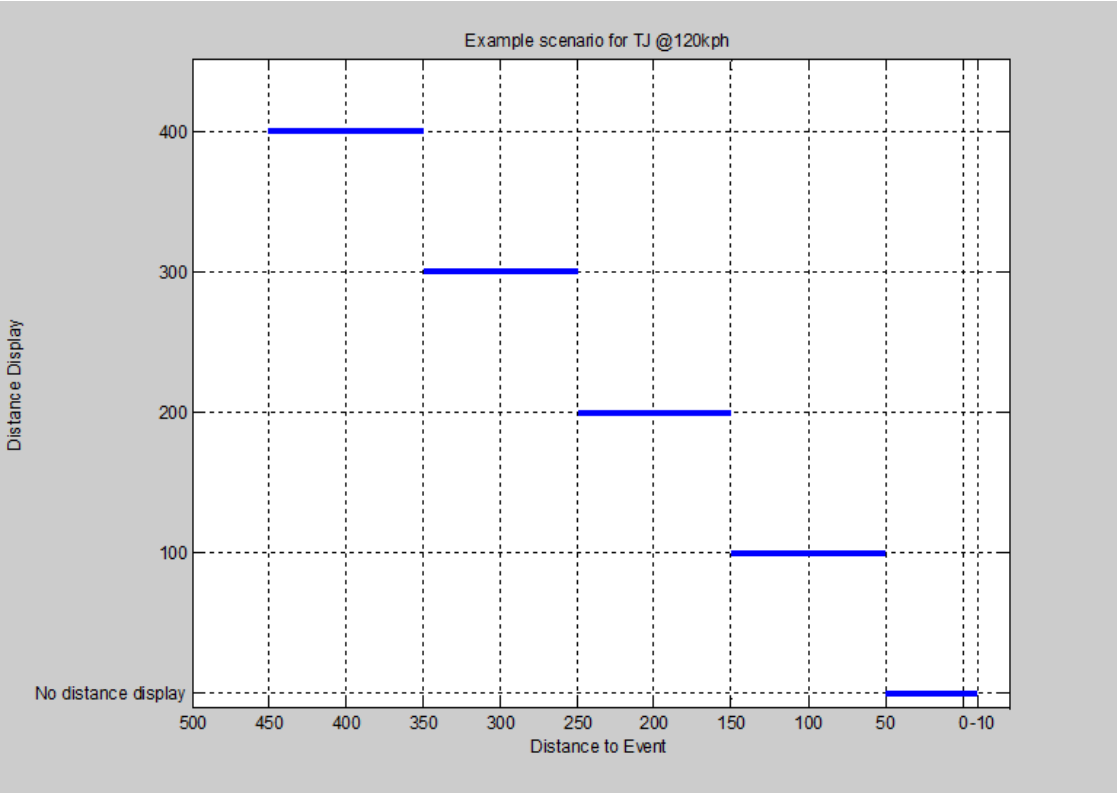
6.1.2.9.1 LHI-REQ-252104/A-Configurable Notification Distance Step

If the vehicle is approaching an event and notification display is active, the driver shall also be informed about the remaining distance to the event in steps of [LHI_DECREASE_STEP].

6.1.2.9.2 LHI-REQ-252105/A-Configurable Notification Distance Offset

Distance updates shall be given for the location which is [LHI_DECREASE_OFFSET] closer than the actual position of the event, if the distance is decreasing.
If the distance to the event is closer than [LHI_DECREASE_OFFSET], no distance information shall be given.

6.1.2.9.2.1 PD-REQ-268062/A-Offset and Step Visualization for Decreasing Distance



Example for LHI_DECREASE_STEP_M = 100m, LHI_DECREASE_OFFSET_M = 50m

6.1.2.9.2.2 LHI-REQ-268059/A-Counting Up Notification Distance Offset

The distance indication in LHN_EventInfo shall only be increased, if the increment of distance to the event is greater than [LHI_DECREASE_OFFSET] compared to the observed minimum. During increase of distance, the distance indication shall be given using an offset value which is twice the configurable [LHI_DECREASE_OFFSET].

6.1.2.9.3 LHI-REQ-267191/A-Configurable Unit Switch Threshold

Within the imperial and metric systems, the distance unit shall switch from miles to feet or yard and kilometers to meters respectively if the distance gets equal or less than the configurable thresholds [SWITCH_KM_TO_M], [SWITCH_MI_TO_YD], [SWITCH_MI_TO_FT].

6.1.2.9.3.1 LHI-REQ-267950/A-Configurable Switch between Feet and Yard

When the imperial system is active, the distance unit used to express distances other than miles shall be selected based on a configurable switch between feet and yards based on the legal destination market. [ImperialDistanceUnit]

6.1.2.9.4 LHI-REQ-252071/A-LHI Event Short Text Description

Each LHI Event short text description shall consist of a configurable text string with maximum 80 characters.

6.1.2.9.5 LHI-REQ-252073/A-LHI Event Short Text Translation Table

The LHI Event description table shall store translations for event descriptions for the different markets by cause or event code.

6.1.2.9.6 LHI-REQ-252106/A-LHI Event Notification Speed Profile

The LHI Event speed profile shall store a distance threshold dependent on event type and vehicle speed. This means that a notification would not be triggered if the distance to the event is larger than the threshold.

6.1.2.9.6.1 LHI-REQ-256347/A-Include LHI Event Notification Distance

The LHI Event Notification Speed Profile shall support a flag to indicate, whether distance values shall be included in the event info structure for display in the HMI. Events which are rather static, such as road works would likely be with distance indication, while highly mobile events like wrong way driver would likely be sent without distance indication included.

6.1.2.9.6.2 LHI-REQ-252075/A-LHI Event Icons for Notification Speed Profile

Every LHI Event shall be mapped to one of 16 icons. The mapping is defined in the LHI Event Speed Profile Table.

6.1.2.9.6.3 LHI-REQ-256328/A-LHI Event Notification Speed Profile Table Schema

The LHI Event Notification Speed Profile Table schema shall comprise the following columns:

CauseCode (TPEG/TEC)	SubCauseCode (TPEG/TEC)	EventCode (TMC)	LHNIconIndex	NLEVEL (0/1)	Priority (integer, >0)	SpeedThresh (m/s)	ETA Threshold (seconds)	DistanceWarningThreshold	Include Distance in LHN_EventInfo
Exemplary tables contents below									
1	1	0	1	0	2	200	60	2000	YES
1	1	0	1	0	1	120	120	1000	YES
2	1	0	2	1	3	20	80	10000	NO
0	0	1	3	0	4	50	90	8000	NO
…									

Table 1 – LHI Event Notification Speed Profile Table Schema

6.1.2.9.6.4 LHI-REQ-258093/A-LHI Speed Profile TPEG Cause Code or TMC Event Code

Every speed profile entry shall be applied to Cause Code or Event Code as attribute.

6.1.2.9.6.5 LHI-REQ-252066/A-Select Notification Level from Speed Profile Table

The notification level shall be populated in LHN_EventInfo based on the value found in the prioritized rule line item.

6.1.2.9.6.6 LHI-REQ-256329/A-LHI Speed Profile Line Item Count

A maximum line item count of 300 speed profile rules shall be supported.

6.1.2.9.7 LHI-REQ-252109/A-Consider Event not Active after Passing

The vehicle shall stop informing the driver about an event, [NOTIFICATION_REVOKE_DISTANCE], after the event location has been passed.

6.1.2.9.8 LHI-REQ-252115/A-Event aggregation for events of the same type

If the vehicle is approaching several events of the same type, which are [AGGREGATION_DISTANCE] apart from each other, the driver shall only be informed about the closest event.

6.1.2.9.9 REQ-258151/A-Update of the Speed Profile Table

The Speed Profile Table shall be updateable via in-vehicle network.

6.1.2.9.10 REQ-258152/A-Trigger for Speed Profile Table update

The LHI_Navigation_Matcher shall request for a Speed Profile Table update every time when the LHI_Feature_St is "active" for the first time on the curent IGN cycle.

6.1.2.9.11 REQ-258153/A-Receiving a update of the Speed Profile Table

If a new Speed Profile Table is received successfully it shall replace the existing table and be stored in non-volatile memory.

6.1.2.9.12 LHI-TMR-REQ-265754/A-t_LHN_EventInfoInterval

Name	Description	Units	Range	Resolution	Default
t_LHN_EventInfoInterval	t_LHNEventInfoInterval for evaluating and matching events in the database with subsequent transmission of LHN_EventInfo	msec	100-2000	100	1000

6.1.2.9.13 LHI-REQ-265755/A-Summary of Configurable Parameters

The configurable parameters for the navigation matching function are summarized in the table below. These shall be read/writeable via diagnostics.

Name	Unit	Range	Resolution	Default
LHN_DECREASE_STEP_M	m	10-1000	10	100
LHN_DECREASE_STEP_KM	km	0.1-10	0.05	0.5
LHN_DECREASE_STEP_FT	ft	100-10000	100	100
LHN_DECREASE_STEP_MI	mi	0.1-10	0.05	0.25
LHN_DECREASE_OFFSET_M	m	5-500	5	25
LHN_DECREASE_OFFSET_KM	km	0.05-5	0.005	0.25
LHN_DECREASE_OFFSET_FT	ft	50-5000	50	50
LHN_DECREASE_OFFSET_MI	mi	0.05-5	0.005	0.125
SWITCH_KM_TO_M	m	0-2550	10	950
SWITCH_MI_TO_FT	ft	0-5280	32	1024
SWITCH_MI_TO_YD	yd	0-2550	10	840
NOTIFICATION_REVOKE_DIST	m	10-1000	10	10
AGGREGATION_DIST	m	1-1000	1	50
t_LHN_EventInfoInterval	*See REQ-265754*			
t_LHN_StopAfterLeavingPath	*See REQ-265757*			
t_LHN_StartAfterGettingOnPath	*See REQ-265758*			

Table 2 – Summary of Configurable Parameters

6.1.2.9.14 LHI-REQ-264851/A-Stop of Hazard Notification Event Info within Time after Leaving Path

An active hazard match shall become inactive if the vehicle did not follow the most probable path or actively guided route, which has lead to the active match within 2 seconds of leaving the path.

6.1.2.9.14.1 LHI-TMR-REQ-265757/A-t_LHN_StopAfterLeavingPath

Name	Description	Units	Range	Resolution	Default
t_LHN_StopAfterLeavingPath	See requirements referencing t_LHN_StopAfterLeavingPath	msec	0-5000	100	2000

6.1.2.9.15 LHI-REQ-265263/A-Start of Hazard Notification Event Info within Time after Getting on Path

An active hazard match shall become active if the vehicle enters a most probable path or actively guided route, which leads to an active match within 2 seconds of entering the path.

6.1.2.9.15.1 LHI-TMR-REQ-265758/A-t_LHN_StartAfterGettingOnPath

Name	Description	Units	Range	Resolution	Default
t_LHN_StartAfterGettingOnPath	See requirements referencing t_LHN_StartAfterGettingOnPath	msec	0-5000	100	2000

6.1.2.10 LHI-REQ-251090/A-Subsume X-Urgent Traffic and other Hazard Notifications

The notification view mechanism shall encompass handling current TPEG/TEC and X-Urgent traffic messages, as well as additional hazard notifications added with this feature.

6.1.2.10.1 LHI-REQ-251147/A-Display for TPEG/TEC and X-Urgent Traffic Warnings

If the vehicle has Local Hazard Notification (LHN) capability, the TPEG/TEC and X-Urgent messages shall be shown using LHN. Conversely, if the vehicle does not have LHN capability, the TPEG/TEC and X-Urgent messages shall be shown as before on the center stack HMI.

6.1.2.10.2 LHI-REQ-267177/A-Fallback to Center Stack X-Urgent Display Logic

If LHI_Feature_St is not set to <available>, or the matcher is not working (e.g. due to unability to process the speed profile table), the navigation system shall fall back to the center stack X-Urgent traffic message display as defined by Online Traffic.

6.1.2.10.2.1 LHI-REQ-267182/A-Missing Signal Leads to Fallback to Center Stack X-Urgent Display Logic

If the LHI_Feature_St is missing for more than 10 seconds, the value shall be assumed to be Invalid and hence the navigation system shall fall back to the center stack X-Urgent traffic message display as defined by Online Traffic.

6.1.2.11 LHI-REQ-264849/A-Matching on Most Probable Path or Actively Guided Route

The navigation system shall provide notifications for events on the most probable path in case of non-active route guidance.

6.1.2.12 LHI-REQ-264850/A-Matching on Actively Guided Route

The navigation system shall provide notifications for events on the path of any actively guided route.

6.1.2.13 LHI-REQ-267176/A-Compute Hash Value of Speed Profile Table

The hash value used in requests for speed profile table update shall come from a computation of the SHA256 function on the entirety of the speed profile table loaded in memory. The raw data format shall be as defined in the transport protocol SPSS.

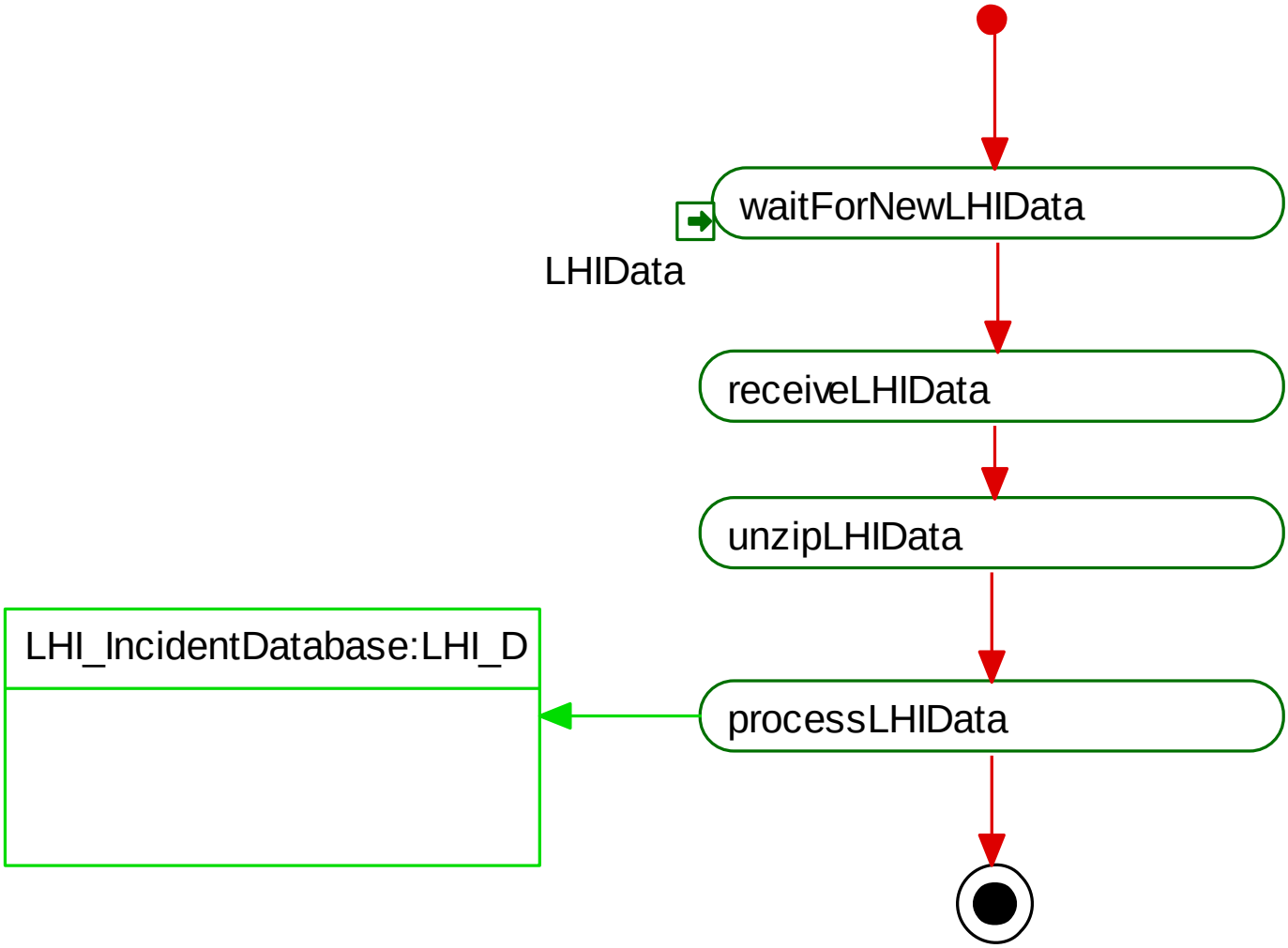
6.1.2.14 LHI-REQ-268162/A-Matching Algorithm with Single Precision Floating Point (IEEE 754)

All matching algorithm computations, including spanning and transforming into a metric coordinate system, shall be performed with at least single precision floating point arithmetic according to IEEE754. All available latitude and longitude fractional digits shall be accounted for. Computed single precision distance to event values shall be rounded according to the distance indication requirements only prior to populating LHN_EventInfo for display in <<HMI output>>.

6.1.3 Activity Diagrams

6.1.3.1 LHI-ACT-REQ-251176/A-Receive Local Hazard Notifications

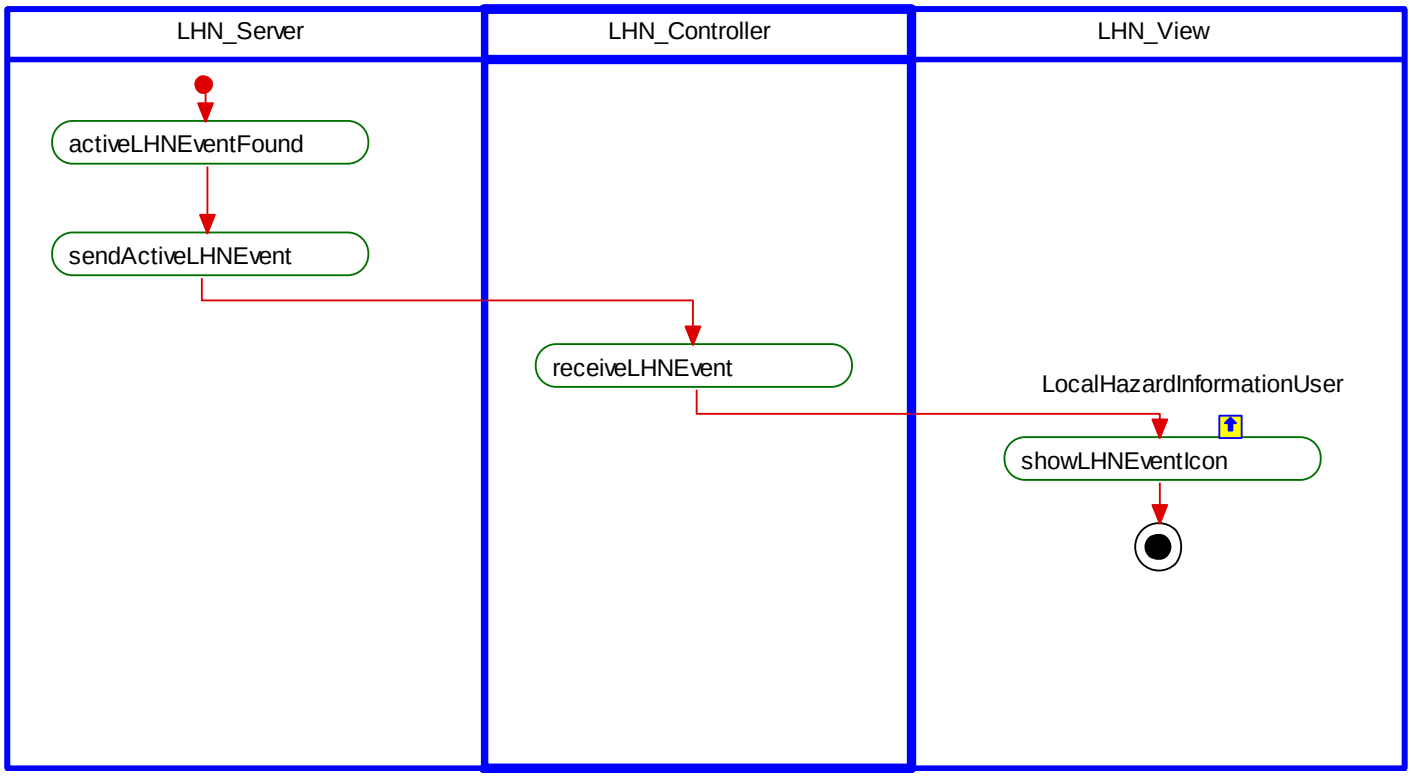
Linked Elements
LHI-UC-REQ-251173/A-Process Local Hazard Notifications



6.1.3.2 LHI-ACT-REQ-257552/B-Show Notification Event Types

Linked Elements
LHI-UC-REQ-157212/B-Show Notification with Event Type

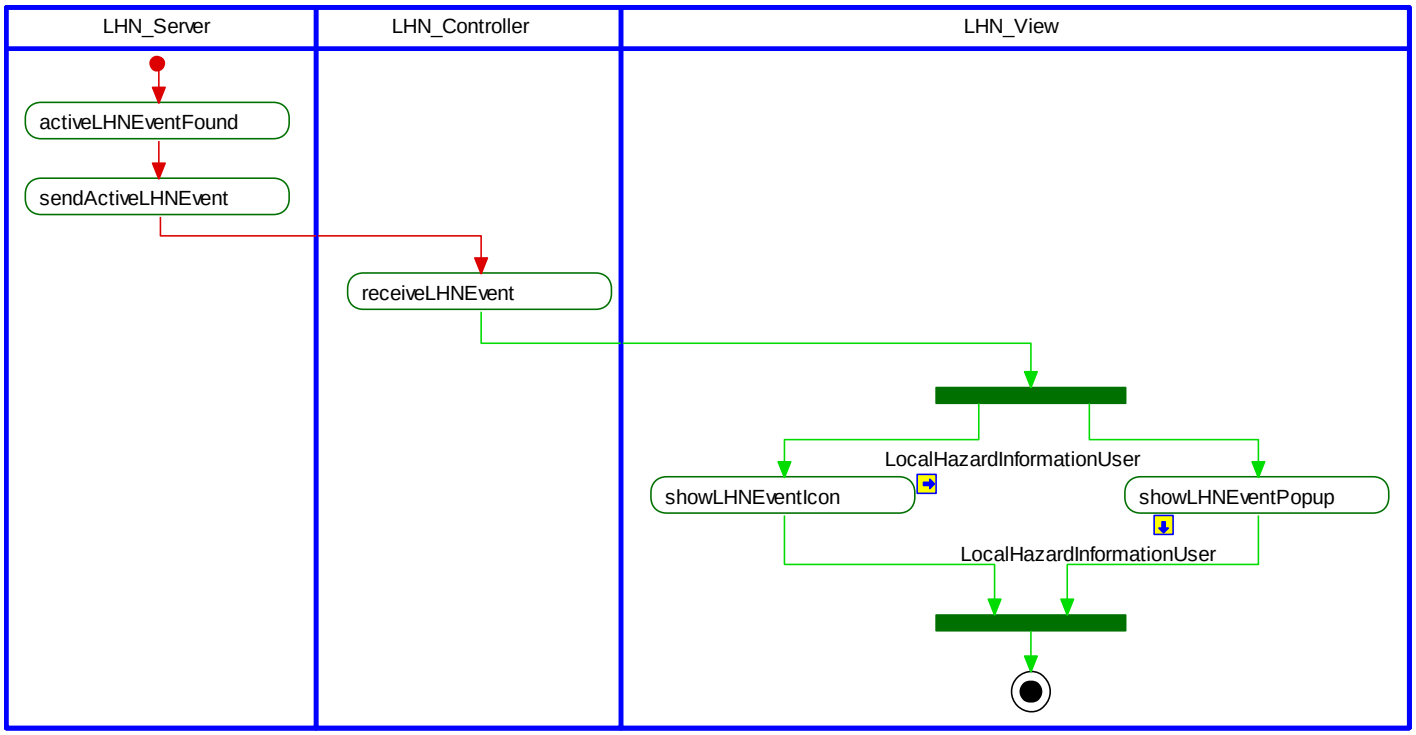
White Box View



6.1.3.3 LHI-ACT-REQ-257553/B-Show Notification Event Popup

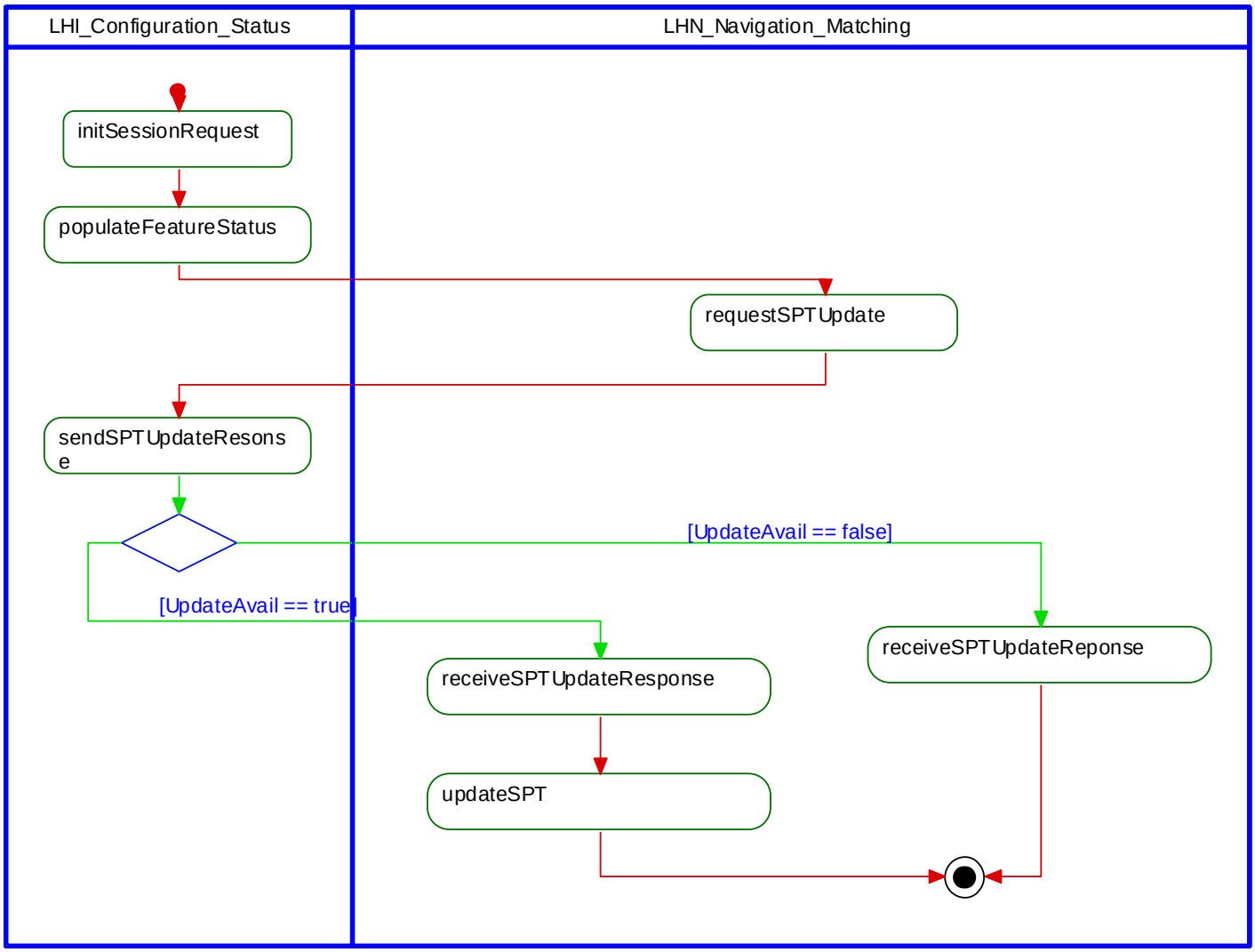
Linked Elements
LHI-UC-REQ-161686/B-Show Notification Event Popup

WhiteBoxView



6.1.3.4 LHI-ACT-REQ-258028/A-Updating Speed Profile Table for Navigation Matcher

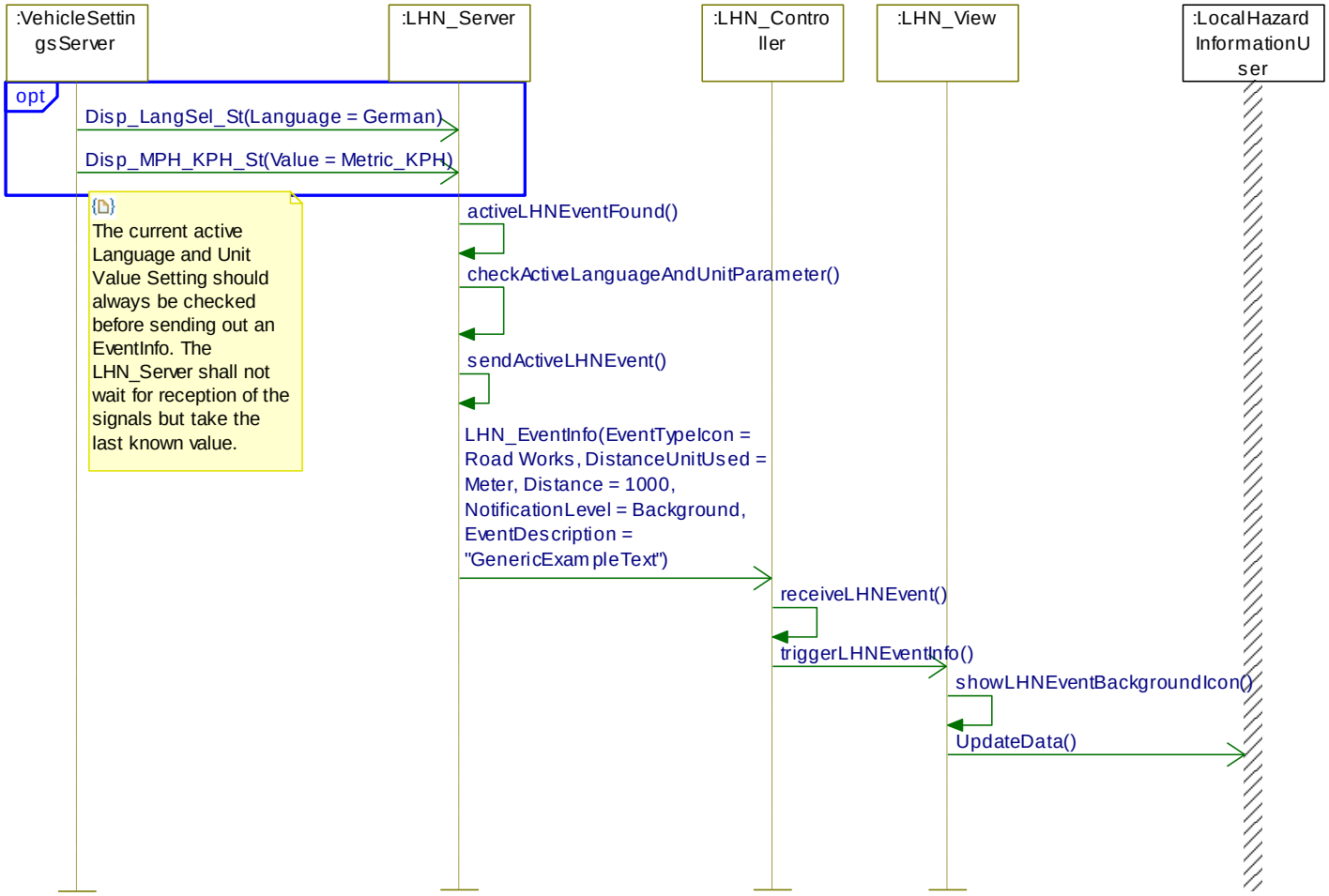
WhiteBoxView



6.1.4 Sequence Diagrams

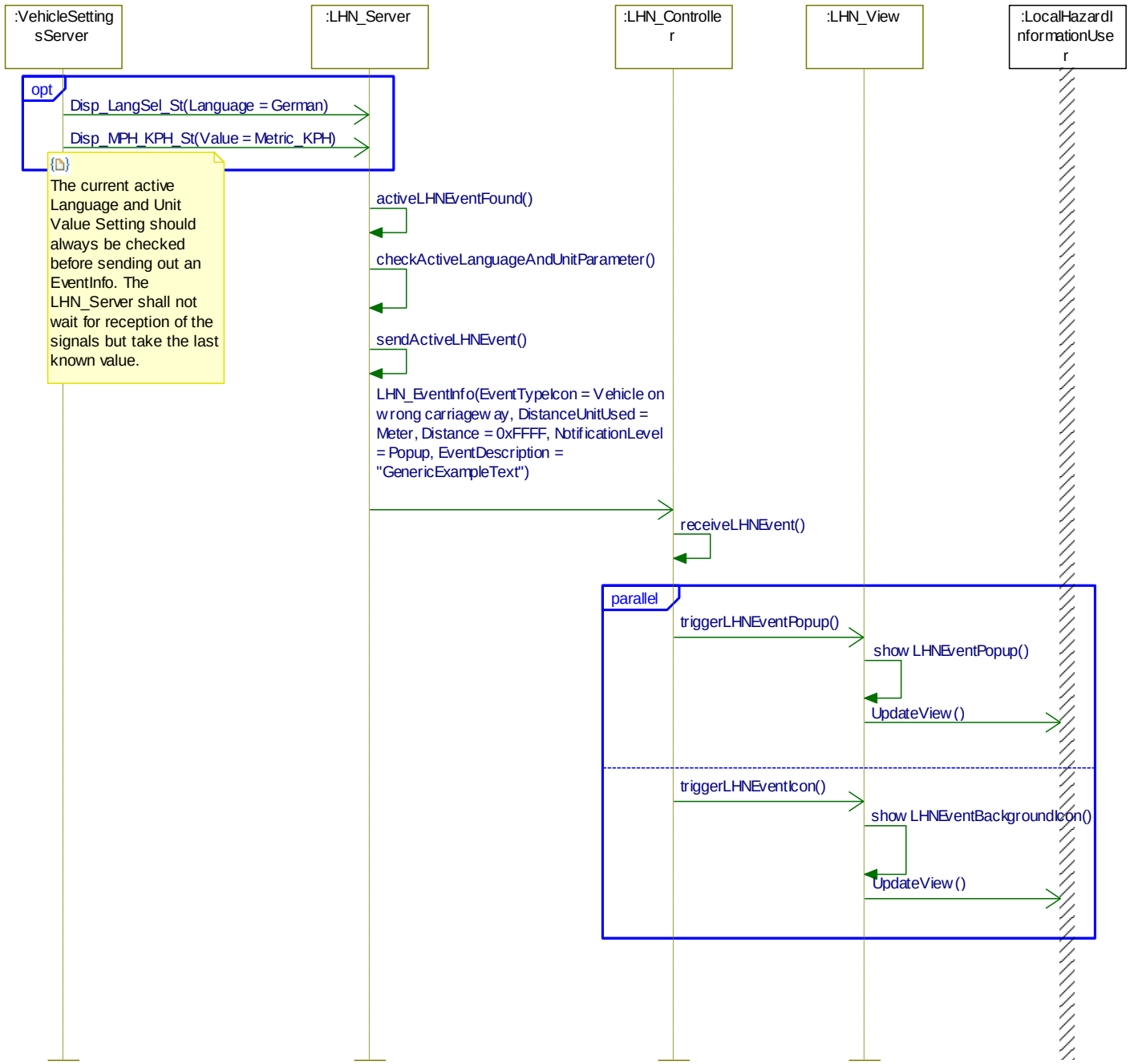
6.1.4.1 LHI-SD-REQ-257559/B-Show LHN Information

Linked Elements
LHI-ACT-REQ-257552/B-Show Notification Event Types



6.1.4.2 LHI-SD-REQ-257560/B-Show LHI Notification Popup

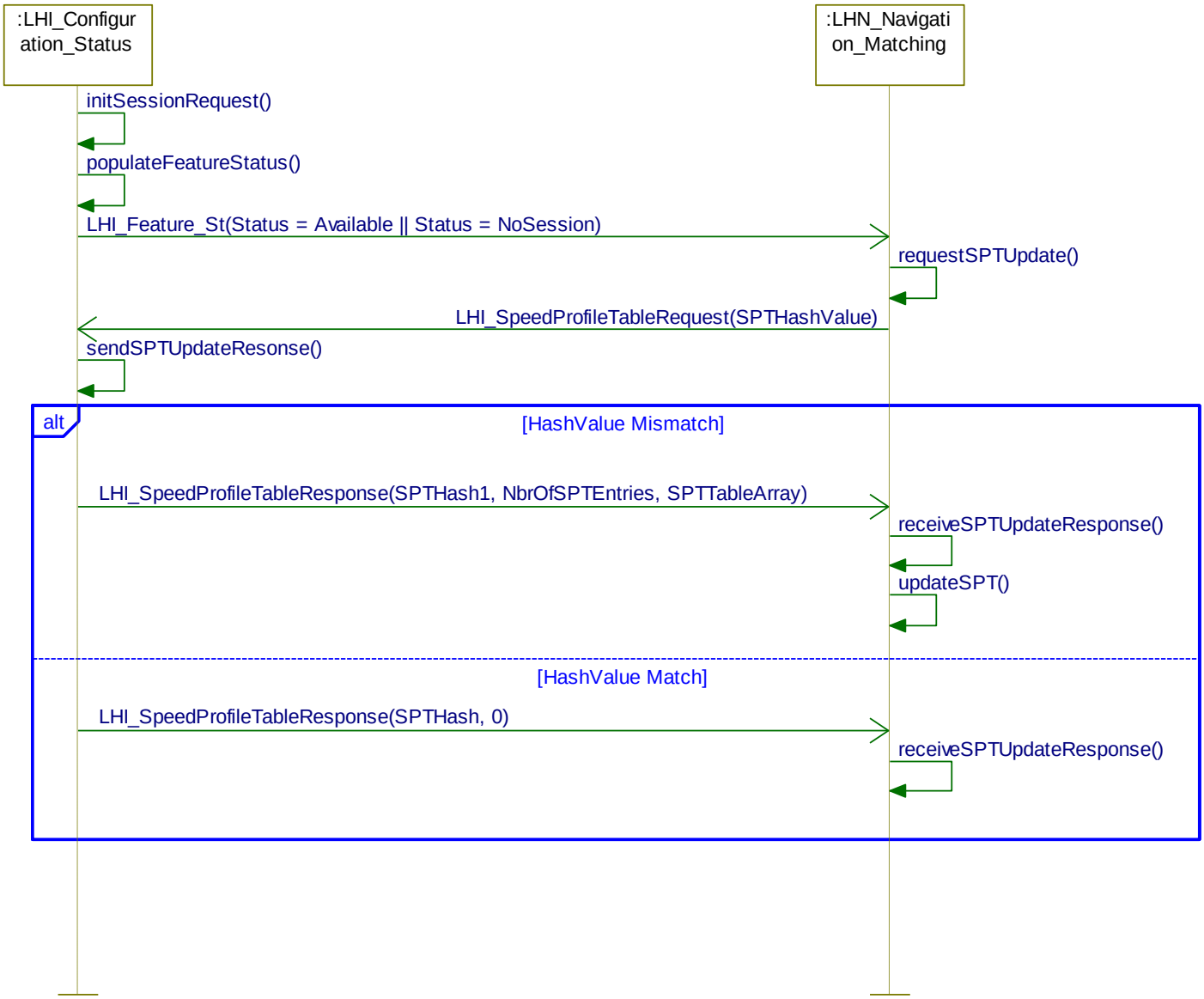
Linked Elements
LHI-ACT-REQ-257553/B-Show Notification Event Popup



6.1.4.3 LHI-SD-REQ-258027/A-Updating Speed Profile Table for Navigation Matcher

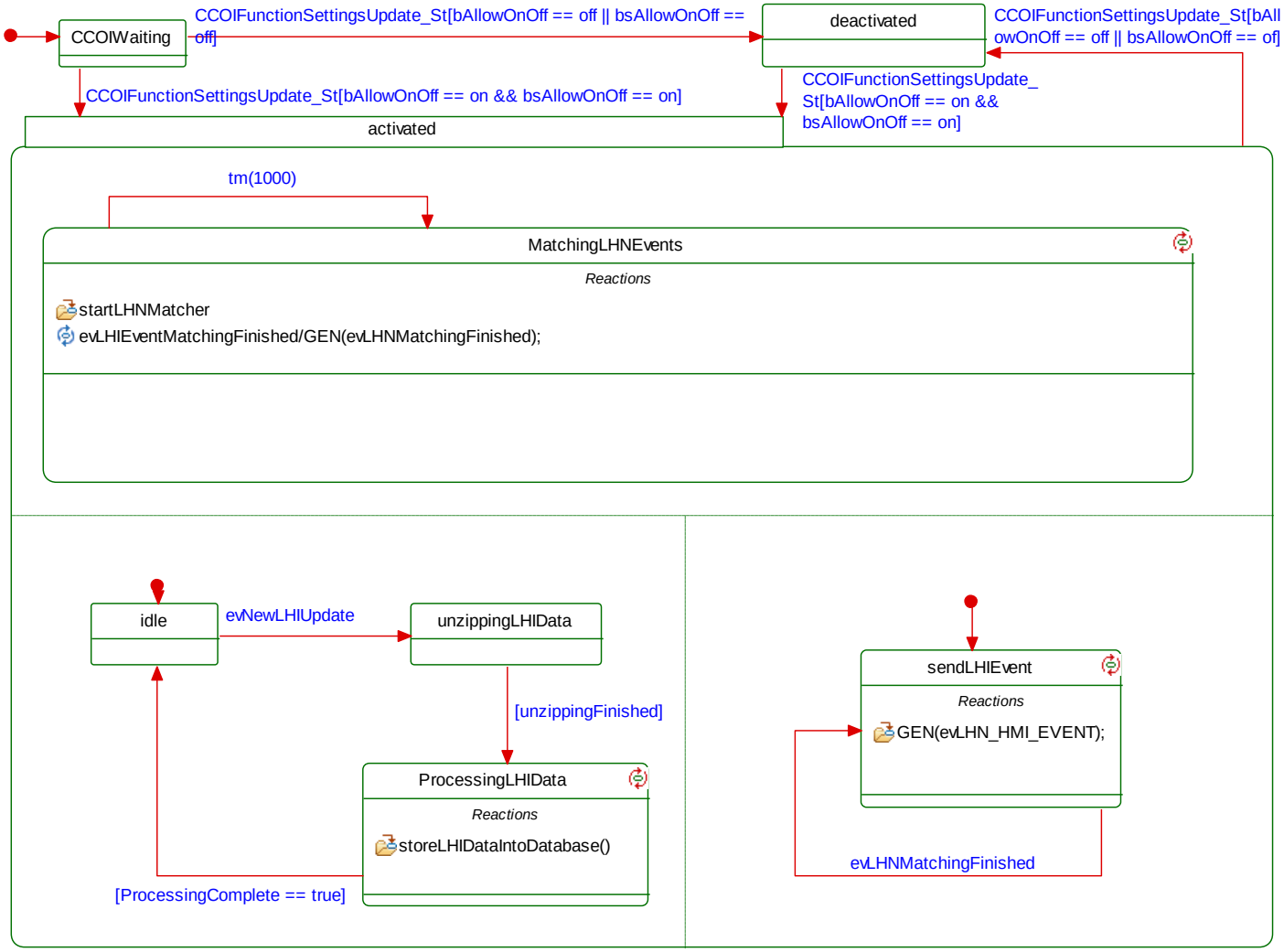
Linked Elements

LHI-ACT-REQ-258028/A-Updating Speed Profile Table for Navigation Matcher


:LHI_Configur ation_Status
:LHN_Navigati on_Matching
initSessionRequest()
populateFeatureStatus()
LHI_Feature_St(Status = Available || Status = NoSession)
requestSPTUpdate()
LHI_SpeedProfileTableRequest(SPTHashValue)
sendSPTUpdateResonse()
alt
[HashValue Mismatch]
LHI_SpeedProfileTableResponse(SPTHash1, NbrOfSPTEntries, SPTTableArray)
receiveSPTUpdateResponse()
updateSPT()
[HashValue Match]
LHI_SpeedProfileTableResponse(SPTHash, 0)
receiveSPTUpdateResponse()

6.1.5 State Machine

6.1.5.1 LHI-STM-REQ-251171/A-LocalHazardNotificationServer



6.2 LHI-FUN-REQ-252059/A-Customer Connectivity Settings

6.2.1 Use Cases

6.2.1.1 LHI-UC-REQ-250166/A-Use Cases through Customer Connectivity Settings

Actors	User
Pre-conditions	Connectivity Customer Opt-In System is Available HMI System is ON
Scenario Description	User navigates to Customer Connectivity Settings Menu
Post-conditions	The settings menu shall cover the following detailed use cases for gathering consent, displaying subscription (aka enrollment) information and notifications prior to subscription expiration
List of Exception Use Cases	
Interfaces	V-HMI

6.2.1.1.1 LHI-UC-REQ-157200/A-Display Subscription Information in Vehicle

Actors	User
Pre-conditions	Customer Connectivity Opt-In is available HMI System is ON
Scenario Description	User navigates to the Customer Connectivity Settings menu in the HMI
Post-conditions	The LHI subscription (aka feature package enrollment) information shall be displayed in the HMI. This includes the start and expiration dates as well as the type of subscription, or package.
List of Exception Use Cases	
Interfaces	

6.2.1.1.2 LHI-UC-REQ-160934/A-License Expiration Popup

Actors	Driver
Pre-conditions	LHI system is ON
Scenario Description	LHI feature license is about to expire
Post-conditions	The feature license expiration shall be announced using a popup in the HMI.
List of Exception Use Cases	If there has not been a connection to the Ford SDN, and no license information is cached within the vehicle, no information shall be displayed.
Interfaces	

6.2.1.1.3 LHI-UC-REQ-157208/A-Privacy Statement in Vehicle

Actors	Driver
Pre-conditions	LHI system is OFF
Scenario Description	Driver is changes configuration to LHI system ON. Privacy statement is displayed and asks for acceptance.
Post-conditions	If privacy statement is accepted, LHI system status shall transfer to ON, otherwise LHI system status remains OFF.
List of Exception Use Cases	
Interfaces	

6.2.2 Requirements

6.2.2.1 LHI-REQ-267963/A-Local Hazard Information Feature Entities

Customer Connectivity Settings shall maintain two feature entities for Local Hazard Information. One each for with and without navigation, named:

- LHINav
- LHINonNav

6.2.2.2 LHI-REQ-267966/A-Local Hazard Information Function Entity

Customer Connectivity Settings shall maintain one function entity for Local Hazard Information (LHIMainFunction). The allow parameters received through the respective interface shall be used for REQ-267962, REQ-257673, and REQ-251171.

6.2.2.3 LHI-REQ-251085/A-Local Hazard Information Requires Floating Car Data Upload

Local Hazard Information requires upload of floating car data, configured through the traffic session establishment mechanism.

6.2.2.4 LHI-REQ-267964/A-Local Hazard Information Requires OLT Main Function

The Local Hazard Information main function requires operation of the online traffic main function.

6.2.2.5 LHI-REQ-267965/A-Local Hazard Information with Navigation Requires OLT

Turning off online traffic shall turn off Local Hazard Information for vehicles equipped with navigation.

6.3 CCOI-FUN-REQ-205048/A-PolicyGovernedFunction

6.3.1 Static View

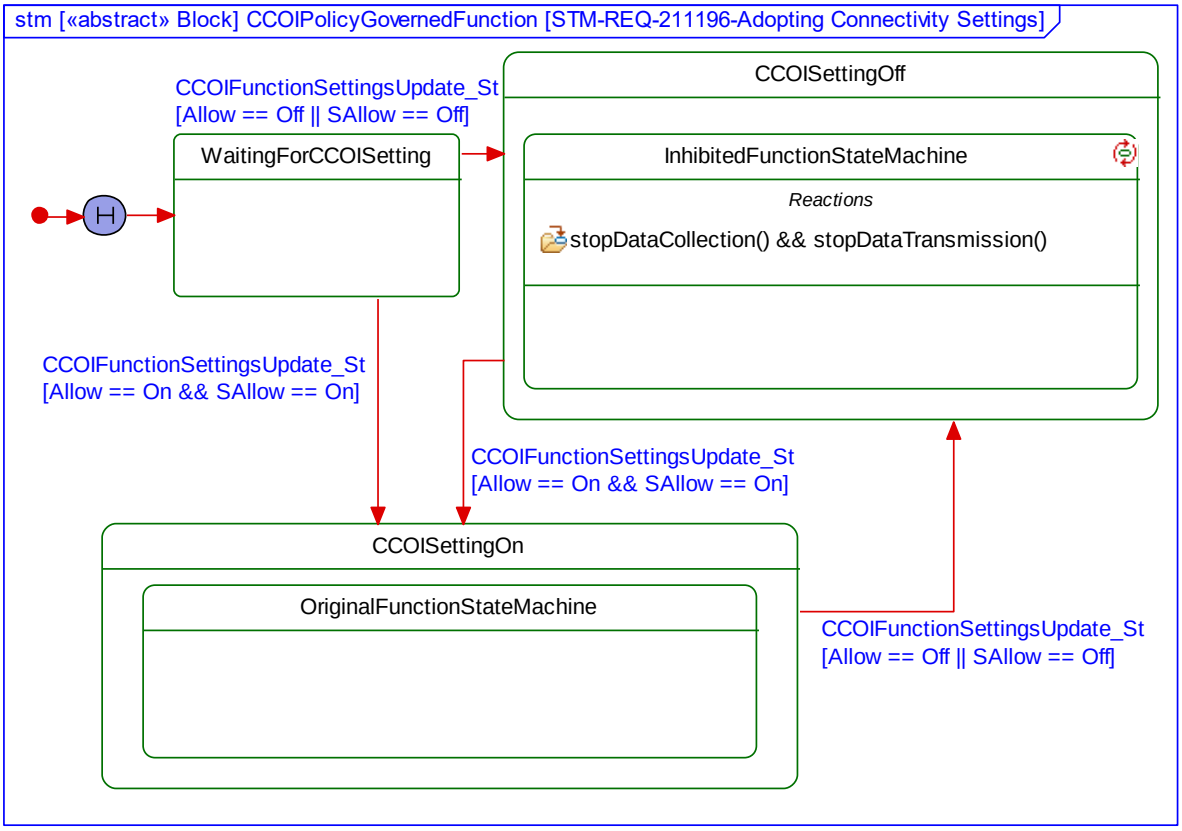
6.3.1.1 CCOI-CLD-REQ-205735/A-PolicyGovernedFunction

PolicyGovernedFunction is an abstract object providing an interface for receiving customer opt-in status.

6.3.2 Requirements

6.3.2.1 CCOI-STM-REQ-211196/A-Adopting Connectivity Settings

State Diagram



6.3.2.2 CCOI-TMR-REQ-211199/A-Deadline to Adopt Connectivity Settings

Name	Description	Units	Range	Resolution	Default
Deadline to Adopt Connectivity Settings	Once notified of connectivity settings status change, the state machine transition for adopting connectivity settings to <deactivated> shall occur in any case within 1 second.				

6.3.2.3 CCOI-REQ-231538/A-Suspend PolicyGovernedFunction Operation in WaitingForCCOISetting

The underlying function shall be suspended, while the state machine is in the WaitingForCCOISetting state.

7 Non-Functional Requirements

7.1 LHI-REQ-257584/B-Change in Distance Unit Takes Effect Immediately

The overall responsiveness for a change in distance unit for event info shall take immediate effect and be reflected in all LHI related distance indications within 250 ms with 99.9% probability. The responsiveness of the LHN_Server shall be to send out an updated LHN_EventInfo within less than 100 ms with 99.9% probability.

7.2 LHI-REQ-265264/A-Hazard Notification Event Info Match Quality

Matching a hazard location onto a path shall achieve at least 98 % True Positive match rate, at most 2 % False Positive, and at most 2 % False Negative.

7.3 LHI-REQ-265265/A-Vehicle Location Map Matching Quality

Matching the vehicle location into the map shall achieve at least 98 % True Positive match rate, at most 2 % False Positive, and at most 2 % False Negative, if the vehicle is currently on a road which exists in the navigation data.

7.4 LHI-REQ-267190/A-Location Quality Classification Criterion

The event and vehicle location map matching shall be considered True Positive, if the matched position on the correct road and within 20 m from the respective real position.
The event and vehicle location map matching shall be considered False Positive, if the matched position is on the wrong road and more than 20 m from the respective real position.
The event and vehicle location map matching shall be considered False Negative, if the event or vehicle could not be matched to a road although the correct road exists in the map.

8 Appendix

#	Reference Document	Version	Description
1	Online Traffic APIM SPSS	?	Online Traffic (OLT) is delivering the traffic TPEG/TEC data structures into the traffic logic
2	Transport Protocol APIM SPSS	?	First order transport protocol for method description requirements containing data sizes larger than eight Bytes

Table 3 – Reference Documents