Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – NAV Repeater

APIM Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.1

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FORD CONFIDENTIAL

Revision History

Date	Version	Notes	
May 30, 2013	1.0	Initial Release	
July 18, 2014	1.1	STR-070081/B-Functional Definition (TcSE ROIN-294186-1)	Added new function for Detailed Intersection Widgits
		NAVREPEAT-FUN-REQ-092269/A-Detailed Intersection Widgit	New function
		NAVREPEAT-UC-REQ-092268/A-Detailed Intersection Widgit	New use case
		EH-FUR-REQ-092267/A-Detailed Intersection Widgit	<wstephe1> Requirement added by rpaquet2for EH related to NavRepeater (See requirement text)

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1 Architectural Design

1.1 NAVREPEAT-CLD-REQ-022852/A-Navigation Repeater Server (TcSE ROIN-150516-3)

Responsibility: The Navigation Repeater Server is the interface to the Navigation Client for the Navigation function. It responds to requests from the Navigation Client during List Browse requests. It also provides route information, next maneuver indicators, and status messages to the Navigation Client.

1.1.1 Requirements

1.1.1.1 NAVREPEAT-SR-REQ-022853/A-Format for DistanceToNextManeuver parameter (TcSE ROIN-221180-1)

The Navigation Repeater Server shall use the Nav Repeater Format configuration bit to determine what format (Motorola vs. INTEL) to code the DistanceToNextManeuver paramter in the NavigationSymbollInfo.St TP signal.

Example of formating

DistanceToNextManeuver = 1.2 miles with PropertyOfDistance = length

INTEL Format : Byte 2 = $0C, Byte 3 = $00

Motorola Format : Byte 2 = $00, Byte 3 = $0C

1.1.1.2 NAVREPEAT-SR-REQ-022848/A-Event Periodic TP signals (TcSE ROIN-197787-1)

The following TP signals shall be sent every four (4) seconds, even if there is no change in the data that is being sent: NavigationSymbolInfo.St, CurrentStreetName.St, and StreetName.St. If any data changes within these signals in between the four (4) second period, the signal shall be updated and sent out immediately with these changes.

1.2 Interface Requirements

1.2.1 NAVREPEAT-IIR-REQ-022789/B-Navigation Repeater Server Signals (TcSE ROIN-149260-8)

Method	Notes	Parameters
CancelCurrentWaypoint.Rsp()	Message Type : Response Response message from Navigation Repeater Server to Navgation Repeater Client, stating that current waypoint was cancelled.	int *CancelWaypoint* 0x0 Inactive 0x1 Cancelled
CurrentStreetName.St()	Message Type : Status Description: This attribute shows the name of the current street that the	int *DataUpdate* 0x0 Inactive 0x1 Set Operation

	vehicle is driving on. It is sent over the ISO 15765-2 protocol. It also provides the numerical value of the speed limit if there is one for the current street. This value can be from 1 to 255. Units are not provided.	0x2 Data refresh string *CurentStreetName* 20 characters max int *SpeedLimit* 0x00 Invalid 0x01 1 ... 0xFF 255
Destination_Info.St()	Message Type : Status TP signal which contains information about the destination or waypoint. The signal is provided from the Navigation Repeater Server to the Navigation client. The signal is sent upon Destination / waypoint arrival. If any strings are longer than 19 Characters + EOS the data is truncated. It is sent over the ISO 15765-2 protocol.	int *TotalDistTraveled* 0x0 ... 0xFFFF Note: TotalDistTraveled units are in steps of 0.1 miles/kilometers Ex. 0x0005 = 0.5 miles/kilometers int *DistUnits* 0x0 Miles 0x1 Kilometres int *TotalTime* 0x0 ... 0xFFFF

		{ units is minutes } string *Destination* 19 Characters Max
DistanceToDestination.St()	Mesage Type: Status This attribute shows the remaining distance to destination to the infotainment displays. $0: Kilometers [km] $1: Meters [m] $2: Miles [mi] $3: Yards [yd] For North America market, this parameter shall be sent out in feet by the Server, and the encoding shall be $3 – yards. The Client shall know to display the distance in feet based on the configuration (NA America). For FoE markets, this parameter shall be sent out in yards by the Server, and the encoding shall be in $3 – yards.	int *Distance* Size: 2 byte Values: 0x0000 .. 0xFFFD: Distance (0 .. 65533) 0xFFFE: Distance not available 0xFFFF: Invalid Note: Distance units are in steps of 0.1 miles/kilometers Ex. 0x0005 = 0.5 miles/kilometers int *Unit :* Size: 2 bit Values: $0: Kilometers [km] $1: Meters [m] $2: Miles [mi] $3: Yards [yd]
GPS_Compass_direction.St()	Message Type : Status Message from GPS	int *Direction* 0x0 North

	Server. Current compass position is returned to Navigation Client.	0x1 Northeast 0x2 East 0x3 Southeast 0x4 South 0x5 Southwest 0x6 West 0x7 Northwest
NavError.St	Message Type : Status Message from Navigation Server to Navigation Client reporting status of Navigation System Errors.	Int *ErrorStatus* 0x0 Invalid 0x1 No Error 0x2 Navigation_Fault
NavigationSymbolInfo.St()	Message Type: Status This method is used to display the navigation recommendations in the repeater display. The TP signal NavigationSymbolInfo_St has to be set with all information and values in all cases. The supported symbols are shown in the requirements. For North America market, the HeaderInfo Unit of Length parameter shall be sent out in feet by the Server, and the encoding shall be $3 – yards. The Client shall know to display the distance in feet based on the configuration (NA America). For FoE markets, this parameter shall be sent out in yards by the Server,	int *HeaderInfo* Bitfield: Bit 7: Property of distance ($0: bargraph, $1: length) Bits 5-6: Unit of Length ($0: kilometres, $1: miles, $2: metres, $3: yards) Bits 0-4 Reserved The values 0x2 and 0x3 of the UnitOfLength shall only be used for Gen3 and Gen 3.1 systems. int *DistanceToNextManeuver* Values: $0000 .. $FFFF: If the "PropertyOfDistance" is set to "length", the

	and the encoding shall be in $3 – yards. The message is transferred using the ISO 15765-2 transport protocol.	"DistanceToNextManeuver" shall be in steps of 0.1 kilometres / miles. Ex. 0x0005 = 0.5 miles/kilometers If the "PropertyOfDistance" is set to "bargraph", the "DistanceToNextmaneuver" shall be in steps of 0.01 kilometres / miles. Ex. 0x0005 = 0.05 miles/kilometers If the "UnitOfLength" is set to "metres" or "yards", the "DistanceToNextManeuver" shall be in steps of 5 metres / yards. The value "DistanceToNextManeuver" is coded in Intel Format. For example, if DistanceToNextManuever is 1.2 Miles and PropertyOfDistance = length, Byte 2 = 0C and byte 3 = 00 int *BargraphSteps* Values: $00 .. $FF: The relative size of the bargraph is defined in the range from 0x00 = 0% up to 0xFF = 100%. The BargraphSteps value decreases from 0xFF at start down to 0x00 when the decision point is reached.

		int *NumberOfStreetSegments* Value: $01 .. $14 int *DirectionAndNumbers* 0x00 North 0x01 1 0x02 2 0x03 3 0x04 4 0x05 5 0x06 6 0x07 7 0x08 8 0x09 9 0x10 North - North - West 0x20 North - West 0x30 West - North - West 0x40 West 0x50 West - South - West 0x60 South - West 0x70 South - South - West 0x80 South 0x90 South - South - East 0xA0 South - East 0xB0 East - South - East

		0xC0 East 0xD0 East - North - East 0xE0 North - East 0xF0 North - North - East 0xFF No direction int ManeuverElement 0x00 NoSymbol (NO_SYMBOL) 0x01 SideStreet (SIDESTREET) 0x02 Silent (SILENT) 0x03 Turn (TURN) 0x04 UTurnTrafficRightSide (U_TURN_TRS_RIGHT) 0x05 UTurnTrafficLeftSide (U_TURN_TRS_LEFT) 0x06 ChangeLane (FILTER) 0x07 ServiceRoad (PARALLEL_CWY) 0x08 ServiceRoad (SERVICE ROAD) 0x09 Fork (ORIENTATE) 0x0A Exit (EXIT) 0x0B TurnOnMainroad (MAINROAD) 0x0C RoundaboutTrafficRightSide (ROUNDABOUT_TRS_RIGHT) 0x0D RoundaboutTrafficLeftSide (ROUNDABOUT_TRS_LEFT)

		0x0E SquareTrafficRightSide (SQUARE_TRS_RIGHT) 0x0F SquareTrafficLeftSide (SQUARE_TRS_LEFT) 0x10 NoInfo (NO_INFO) 0x11 FollowStreet (FOLLOW_STREET) 0x12 ChangeLane (PREPARE_TURN) 0x13 ArrivedAtDestination (DEST_REACHED) 0x14 ArrivedAtWaypoint 0x15 ApproachingDestination 0x16 ApproachingWaypoint 0x17 EnterHighway 0x18 FerryAhead 0x19 Merge 0x20 OffRoad (OFF_ROAD) 0x21 OffMap (OFF_MAP) 0x22 NoRoute (NO_ROUTE) 0x23 CalcRoute (CALC_ROUTE) 0x24 ArrivedDestinationOffMap (DEST_AREA) 0x25 RecalcRoute (RECALC_ROUTE)

		0x30 Number (NUMBER) ArrayType *Array* Array(1.. NumberOfStreetSegments) of record (DirectionAndNumbers, ManeuverElement)
RemainTimeToDestination.St()	Mesage Type: Status This attribute shows the remaining time to destination to the infotainment displays.	Int *Days:* Size: 4 bit Values: 0x0…0xD days (0..13) 0xE Greater than 13 days int *Hours :* Size: 5 bit Values: 0x00 .. 0x18: Hours (0 .. 24) 0x1E: Not available 0x1F: Invalid int *Minutes :* Size: 6 bit Values: 0x00 .. 0x3C: minutes (0 .. 60) 0x3D .. 0x3D: reserved 0x3E : not available

		0x3F : invalid
RouteActive.St()	Message Type : Status Method from Navigation Repeater Server to Navigation Repeater Client. Reports Status of Route.	int *RouteActive* 0x0 Not Active 0x1 Active
StreetName.St()	Message Type: Status This method is used to display street name in the text area of the Navigation repeater display. The current street name shall be displayed if the recommendations "Follow Street" is sent (GEN 3.0 only). In all other cases the following street name shall be displayed. The full street name shall be sent, truncation is up to the display. The message is transferred using the ISO 15765-2 transport protocol.	int *Attribute* Text alignment 0x0 centered 0x1 left aligned 0x2 right aligned The text alignment bit shall only be used for Gen2 systems and ignored on all Gen3 and Gen3.1 systems. int *StreetName* Values: Bytes 0 .. 20: StreetName
WaypointsActive.St()	Message Type : Status Message from Navigation Repeater Server to Navigation Repeater Client reporting status of waypoints. If Max_Waypoints_Active is set, the Navigation Repeater Client shall disallow setting another Waypoint.	int *WaypointStatus* 0x0 Invalid 0x1 Waypoints_Inactive 0x2 Waypoints_Active 0x3 Max_Waypoints_Active
UpcomingStreetName.St()	Message Type : Status	int *Path Index*

	Description: This attribute shows the name and/or Road Shield data of the defined intersecting stub that is expanded via the Electronic Horizon Server. It is sent over the ISO 15765-2 protocol.	0x0 – 0x7 = Reserved 0x8 – 0x63 = IndexOfPath int *Stub Path Index* 0x0 StubStartsFirstPathInHorizon 0x1 – 0x7 Reserved 0x8 – 0x63 SubIndexOfPath int *Road Shield Icon* 1 Byte See Coding table string *RoadshieldText* 9 characters max string *UpcomingStreetNameText* 20 characters max

1.2.2 NAVREPEAT-IIR-REQ-022790/A-Navigation Repeater Client Signals (TcSE ROIN-149266-1)

Method	Notes	Parameters
CancelCurrentWaypoint.Rq()	Message Type : Request Method from Navigation Repeater Client to Navigation Repeater Server to request that current active waypoint be cancelled. Route remains active.	int *CancelWaypoint* 0x0 Inactive 0x1 Cancel
CancelRoute.Rq()	Message Type : Request Method from Navigation Repeater Client to Navigation Repeater Server to request that current active route be cancelled. This would also cancel any waypoints that are	int *CancelRoute* 0x0 Inactive 0x1 Cancel

	also active.	
Guidance_Repeat.Rq()	Message Type: Request Method from Navigation Repeater Client to Navigation Repeater Server. Signal that tells Navigation Repeater Server to repeat the last voice guidance prompt.	int *RepeatGuidance* 0x0 Inactive 0x1 Active

2 Functional Definition

2.1 NAVREPEAT-FUN-REQ-022791/A-Browse Navigation (TcSE ROIN-294096-1)

2.1.1 Use Cases

2.1.1.1 NAVREPEAT-UC-REQ-022792/A-Quick Navigation Browse (TcSE ROIN-292751-1)

Actors	User
Pre-conditions	User currently on the Route not Active home screen in the Cluster OR Active Route Options Menu within the Navigation Cluster HMI screens.
Scenario Description	The user enters quick browse to view a list.
Post-conditions	List of available items shown
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.1.1.2 NAVREPEAT-UC-REQ-022793/A-Destination Selection (TcSE ROIN-292752-1)

Actors	User
Pre-conditions	List browse is active List of valid destinations active
Scenario Description	User selects destination
Post-conditions	Exit browse and show navigation home screen
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.1.1.3 NAVREPEAT-UC-REQ-022794/A-Waypoint Selection (TcSE ROIN-292753-1)

Actors	User
Pre-conditions	Route is active Browse is active List of valid waypoints active
Scenario Description	User selects waypoint
Post-conditions	Navigation home screen
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.1.2 Requirements

2.1.2.1 NAVREPEAT-SR-REQ-022795/A-List Browse- Set Operation (TcSE ROIN-159114-1)

While in the Quick Navigation list Browser, if there is no child list available for current list, the browser shall issue a SetLBPItem.Rq command to the Navigation Repeater Server.

The Navigation Repeater Server shall then respond to this SetLBPItem.Rq by issuing a CurrentStreetName.St TP message, with Set Operation encoding for the DataUpdate parameter.

This shall trigger the Navigation Repeater Client to update the HMI of the display to the Route Active home screen.

2.1.3 Sequence Diagrams

2.1.3.1 NAVREPEAT-SD-REQ-022796/A-Quick Navigation Browse (TcSE ROIN-118701-1)

Scenarios

Normal Usage

The user enters < Quick Navigation List Browser > to select a new destination / waypoint from the cluster HMI.

Constraints

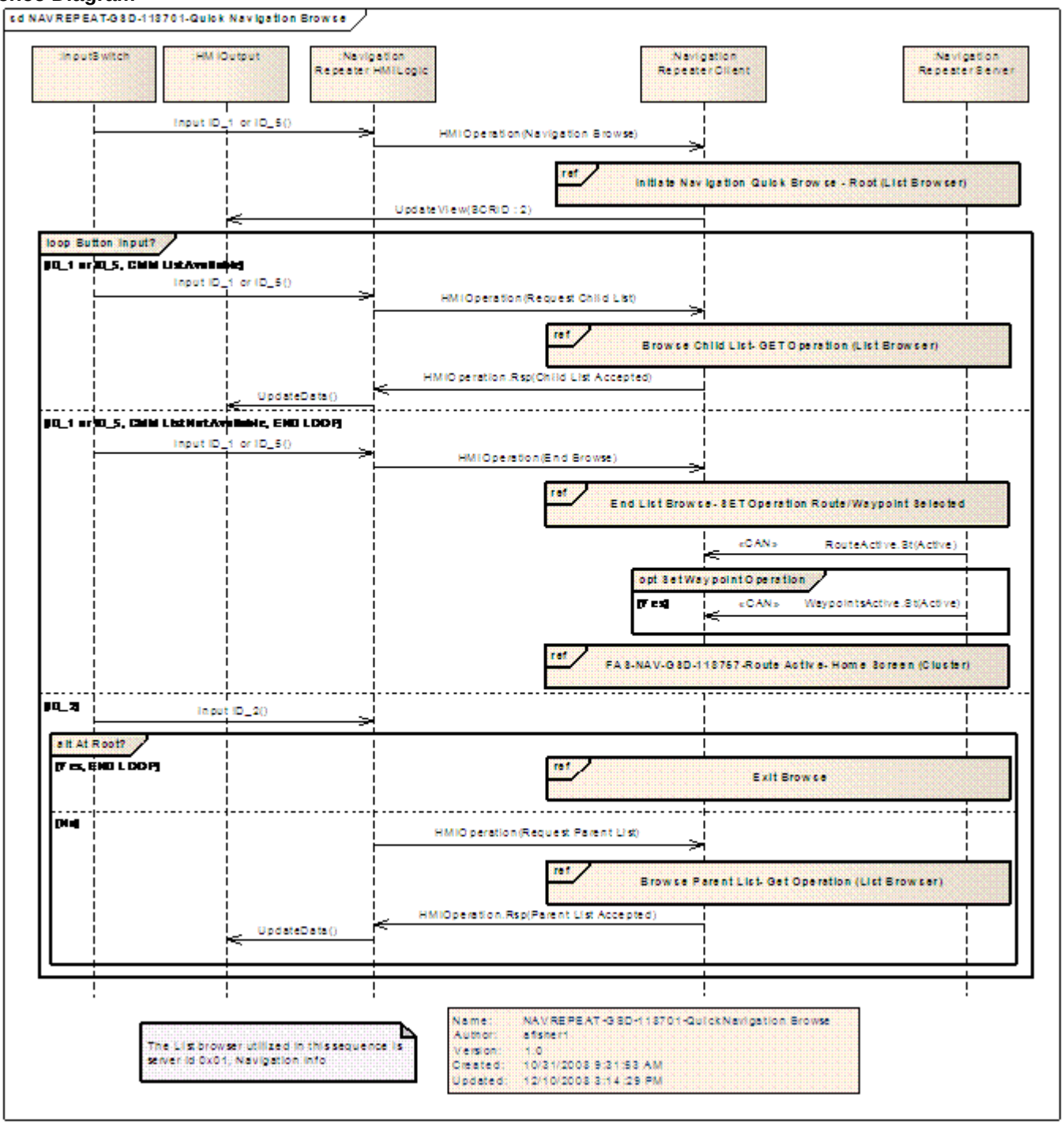
Pre-condition

User currently on the Route not Active home screen in the Cluster OR Active Route Options Menu within the Navigation Cluster HMI screens.

Post-condition

User has exited browse, and returns to Navigation home screen.

Sequence Diagram



2.2 NAVREPEAT-FUN-REQ-022797/A-Display Route not Active Home Screen (TcSE ROIN-294099-1)

2.2.1 Sequence Diagrams

2.2.1.1 NAVREPEAT-SD-REQ-022798/A-Route Not Active - Home Screen (TcSE ROIN-118771-2)

Linked Elements
NAVREPEAT-FUN-REQ-022797/A-Display Route not Active Home Screen (TcSE ROIN-294099-1)

Scenarios

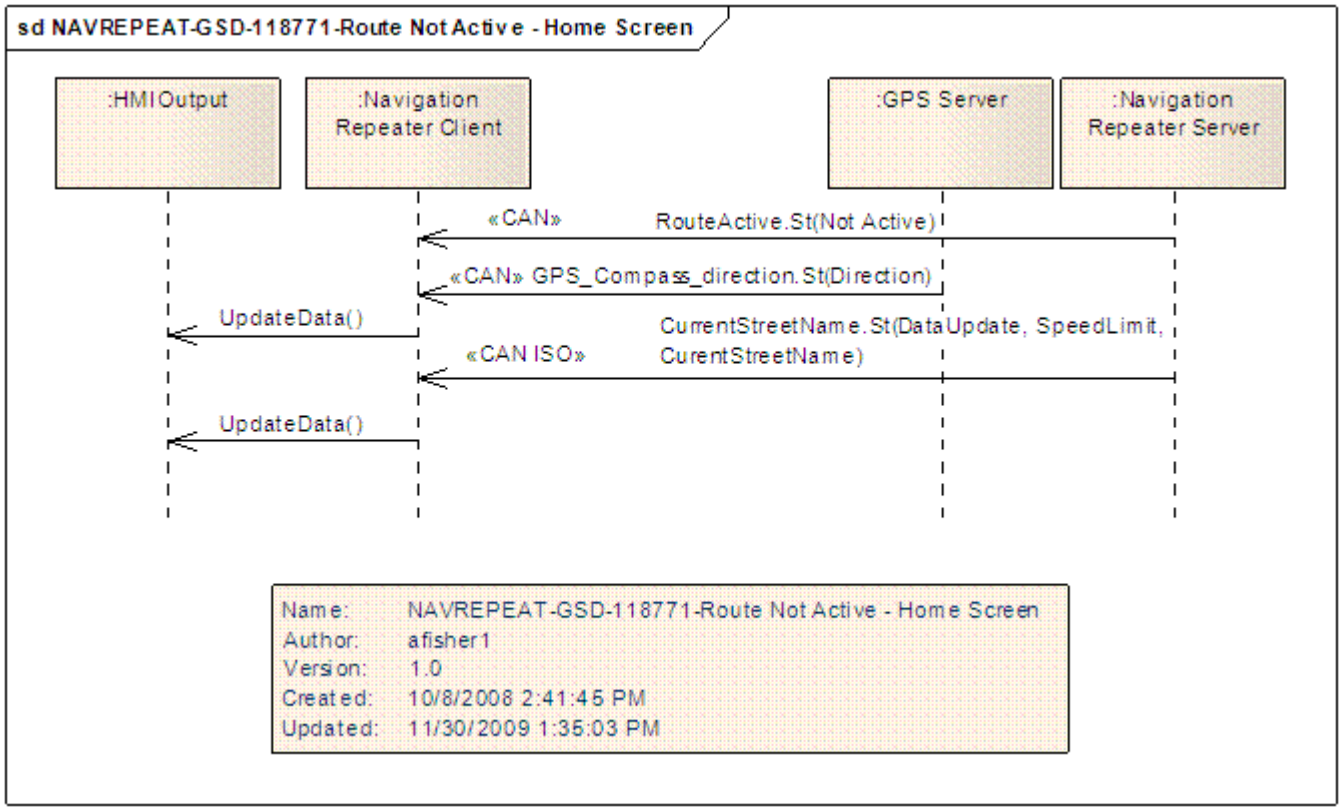
Normal Usage
User is viewing route not active home screen on the right hand side cluster display.

Constraints

Pre-condition
{The Navigation route not active home screen} is displayed via cluster HMI.

Post-condition
{The Navigation route not active home screen} is displayed via cluster HMI.

Sequence Diagram



2.3 NAVREPEAT-FUN-REQ-022799/A-Display Route Active Home Screen (TcSE ROIN-294101-1)

2.3.1 Use Cases

2.3.1.1 NAVREPEAT-UC-REQ-022800/A-Show Destination Reached Symbol (TcSE ROIN-292743-1)

Actors	System
Pre-conditions	The navigation system is active. A route is computed and guidance is active. The map database is available. The navigation system is able to provide a valid position. The user reaches his destination.
Scenario Description	The user sees the "ArrivedAtDestination" symbol in the navigation repeater display when he reaches his destination. The appearance of the symbol is aligned to the related voice guidance command.
Post-conditions	The destination reached symbol is shown in the navigation repeater display.
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.3.1.2 NAVREPEAT-UC-REQ-022801/A-Show Route Guidance Information (TcSE ROIN-292744-1)

Actors	System
Pre-conditions	The navigation system is active. A route is computed and guidance is active. The map database is available. The navigation system is able to provide a valid position.
Scenario Description	The user receives guidance information in the navigation repeater display during active route guidance. The appearance of the symbols is aligned to the related voice guidance command. Related to the capability of the navigation repeater display, the user can see the following information: - Guidance command symbols - Distance to next maneuver as total length and bar graph - Current Street name - Next Maneuver Street name - Estimated time of arrival - Estimated time to destination - Distance to destination
Post-conditions	The guidance information is shown in the navigation repeater display.
List of Exception Use Cases	E1-Start up
Interfaces	Vehicle System Interface G-HMI

2.3.1.3 NAVREPEAT-UC-REQ-022802/A-Start Up (TcSE ROIN-292745-1)

Linked Elements
NAVREPEAT-UC-REQ-022801/A-Show Route Guidance Information (TcSE ROIN-292744-1)

Actors	System
Pre-conditions	Same as normal use case
Scenario	User initiated route guidance

Description	
Post-conditions	After starting a route guidance and receiving the first guidance information by the navigation system, the navigation repeater display shows up the first information just after receiving a valid route guidance symbol to prevent showing fragmented symbols or incomplete information.
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.3.1.4 NAVREPEAT-UC-REQ-022803/A-Show Symbol for Route Calculation (TcSE ROIN-292746-1)

Actors	System
Pre-conditions	The navigation system is active. The map database is available. The navigation system is able to provide a valid position. A valid destination is entered by the user and route calculation has started.
Scenario Description	The user sees the symbol for active route calculation in the navigation repeater display during ongoing route calculation.
Post-conditions	The symbol for route calculation is shown in the navigation repeater display.
List of Exception Use Cases	E1- Route recalculation
Interfaces	Vehicle System Interface G-HMI

2.3.1.5 NAVREPEAT-UC-REQ-022804/A-Route Recalculation (TcSE ROIN-292747-1)

Linked Elements
NAVREPEAT-UC-REQ-022803/A-Show Symbol for Route Calculation (TcSE ROIN-292746-1)

Actors	System
Pre-conditions	Same as normal case
Scenario Description	User deviates from current route
Post-conditions	The user sees the symbol for route recalculation in the navigation repeater display, if the route is recalculated during active route guidance.
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.3.2 Requirements

2.3.2.1 NAVREPEAT-FUR-REQ-022805/A-Recommendation is not supported (TcSE ROIN-149633-1)

If the recommendations can't be identified the display shall show nothing until a new recommendations is received.

2.3.2.2 NAVREPEAT-FUR-REQ-022806/A-Maneuver Elements within NavigationSymbolInfo.St message (TcSE ROIN-152682-1)

The complete driving recommendations are composed of one or several street segments of different action types, (ex. TURN, SILENT, etc.)

The list of street segments shall contain exactly one main element except for the action EXIT which can contain one additional action EXIT.

The last entry of the list of street segments shall always be the main element.

2.3.2.3 NAVREPEAT-FUR-REQ-022807/A-Maneuver element "NoSymbol" (TcSE ROIN-159100-1)

ManeuverElement **Main Element** Additional Elements	DirectionsAndNumbers	NumberOfStreetSegments
No Symbol	**No direction**	1

No symbol. Delete all recommendations. If the Navigation application was stopped or was canceled the Navigation Repeater Display symbol/data shall be deleted immediately.

The "NoSymbol" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element. The direction is not relevant.

2.3.2.4 NAVREPEAT-FUR-REQ-022808/A-Additional element definition "SideStreet" (TcSE ROIN-152685-1)

"SideStreet" is a road segment which begins or terminates at an intersection.

The "SideStreet" element is not a main element. The "SideStreet" element has to be combined with a main element (ex. TURN, FORK) and helps to further clarify or describe the intersection. There can be several side streets in the same intersection.

2.3.2.5 NAVREPEAT-FUR-REQ-022809/A-Additional element definition "Silent" (TcSE ROIN-152686-1)

This refers to an intersection which is not accompanied by any audio driving recommendations (voice). This definition closes the description of the current intersection, but it is never the end of the complete list of route direction words. If the resolution of the display is not sufficient, the complete intersection does not have to be displayed. This intersection can be used to visualize an audio instruction like "Take the second right."

The "Silent" element is not a main element. The silent element has to be combined with a main element. If there are several consecutive "Silent" elements within the ManeuverElement, the display shall delete the unnecessary "Silent" automatically.

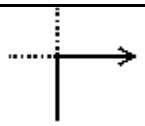
2.3.2.6 NAVREPEAT-FUR-REQ-022810/A-Maneuver element "Turn" (TcSE ROIN-152600-2)

This refers to an intersection which is accompanied by audio driving recommendations (voice).

The "Turn" element always closes the description of the current intersection.

The "SideStreet" and "Silent" elements are used to help further describe the intersection geometry for the "Turn" element.

The following table shows examples of turn elements using the NavigationSymbol.St interface. The main element of the turn element is always the last element of the array in NavigationSymbol.St, and is shown in bold in the table.

ManeuverElement **Main Element** Additional Elements	**DirectionsAndNumbers**	**NumberOfStreetSegments**	**Expected Symbol**
Turn SideStreet SideStreet	**East** North West	3	
Turn	**North - East**	1	
Turn SideStreet SideStreet Silent SideStreet SideStreet SideStreet	**South - West** East West North East West North - East	7	
Turn	**North – North - West**	1	

2.3.2.7 NAVREPEAT-FUR-REQ-022811/A-Maneuver element "Uturn" (TcSE ROIN-152683-1)

Make a U turn where traffic is right-hand drive or where traffic is left-hand drive.

The following table shows examples of Uturn elements using the NavigationSymbol.St interface. The main element of the turn element is always the last element of the array in NavigationSymbol.St, and is shown in bold in the table. For the U turn element, there are no other subelements needed to describe the U turn. Direction is also not needed.

ManeuverElement **Main Element** Additional Elements	**DirectionsAndNumbers**	**NumberOfStreetSegments**	**Expected Symbol**
UTurnTrafficRightSide	**No Direction Needed**	1	
UTurnTrafficLeftSide	**No Direction Needed**	1	

2.3.2.8 NAVREPEAT-FUR-REQ-022812/A-Maneuver element "ChangeLane" (TcSE ROIN-159104-1)

ManeuverElement **Main Element** Additional Elements	**DirectionsAndNumbers**	**NumberOfStreetSegments**	**Expected Symbol**
ChangeLane	**North East**	1	

	North West	1	

Drive into another lane.

The "ChangeLane" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element. The direction of the main element can be "North – East" or "North - West".

2.3.2.9 NAVREPEAT-FUR-REQ-022813/A-Maneuver element "Fork" (TcSE ROIN-152687-1)

Bear left/right or drive straight on at the upcoming fork in the road. There are five possible fork symbols.

The following table shows the five possible "fork" symbols and their list of instructions using the NavigationSymbol.St interface. The main element "Fork" is always the last element of the array in NavigationSymbol.St, and is shown in bold in the table.

Two or three branches can be shown with the fork.

ManeuverElement **Main Element** Additional Elements	**DirectionsAndNumbers**	**NumberOfStreetSegments**	**Expected Symbol**
Fork Silent	**West** North	2	
Fork Silent	**East** North	2	
Fork Silent	**North** North	2	
Fork SideStreet	**West** North	3	

Silent	North		
Fork SideStreet Silent	**East** North North	3	

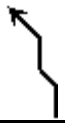
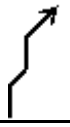
2.3.2.10 NAVREPEAT-FUR-REQ-022814/A-Maneuver element "Exit" (TcSE ROIN-152688-2)

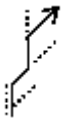
Leave the road/motorway at the turn-off on the left/right.

This main element can be combined with a second main element "EXIT" to indicate a double exit. Both EXIT directions shall have the same direction (i.e. North - East or North - West)

The following table shows examples of turn elements using the NavigationSymbol.St interface. The main element of the EXIT element is always the last element of the array in NavigationSymbol.St, and is shown in bold in the table.

It is also possible to use the "SideStreet" element with EXIT to further describe the exit(s).

ManeuverElement **Main Element** Additional Elements	**DirectionsAndNumbers**	**NumberOfStreetSegments**	**Expected Symbol**
Exit	**North - West**	1	
Exit	**North - East**	1	
Exit **Exit**	**North - West** **North - West**	2	
Exit **Exit**	**North - East** **North - East**	2	
Exit **Sidestreet** **Sidestreet**	**North – West** **North** **North - West**	3	

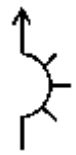
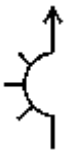
Exit **Sidestreet** **Sidestreet**	**North – East** **North** **North - East**	3	
Exit **Sidestreet** **Sidestreet** **Exit** **Sidestreet** **Sidestreet**	**North – West** **North** **West** **North – West** **North** **West**	6	
Exit **Sidestreet** **Sidestreet** **Exit** **Sidestreet** **Sidestreet**	**North – East** **North** **East** **North – East** **North** **East**	6	

2.3.2.11 NAVREPEAT-FUR-REQ-022815/A-Maneuver element "Roundabout" (TcSE ROIN-152689-2)

This element refers to the road by which a roundabout should be exited. All SideStreet elements which precede this item in the intersection description belong to this roundabout. The Number element can also be used to describe which exit should be taken on the roundabout.

The following table shows examples of Roundabout elements using the NavigationSymbol.St interface. The main element of the Roundabout element is always the last element of the array in NavigationSymbol.St, and is shown in bold in the table.

ManeuverElement **Main Element** Additional Elements	DirectionsAndNumbers	NumberOfStreetSegments	Expected Symbol
RoundaboutTrafficRightSide	**North**	4	

SideStreet	South - East		
SideStreet	East		
SideStreet	North - East		
RoundaboutTrafficLeftSide	**North**	4	
SideStreet	South - West		
SideStreet	West		
SideStreet	North - West		
RoundaboutTrafficRightSide	**North**	5	4 
SideStreet	**South - East**		
SideStreet	**East**		
SideStreet	**North – East**		
Number	**4**		
RoundaboutTrafficLeftSide	**North**	5	4 
SideStreet	**South - West**		
SideStreet	**West**		
SideStreet	**North – West**		
Number	**4**		

2.3.2.12 NAVREPEAT-FUR-REQ-022816/A-Maneuver element "FollowStreet" (TcSE ROIN-159108-1)

ManeuverElement	DirectionsAndNumbers	NumberOfStreetSegments	Expected Symbol
Main Element			
Additional Elements			
FollowStreet	**North**	1	

Continue to follow the street until further instructions.

The "FollowStreet" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element. The direction to follow the street is "North".

2.3.2.13 NAVREPEAT-FUR-REQ-022817/A-Maneuver element "NoRoute" (TcSE ROIN-159111-1)

ManeuverElement **Main Element** Additional Elements	**DirectionsAndNumbers**	**NumberOfStreetSegments**	**Expected Symbol**
NoRoute	**North** **North – North – East** **North – East** **East – North – East** **East** **East – South – East** **South – East** **South – South – East** **South** **South – South – West** **South – West** **West – South – West** **West** **West – North – West** **North – West** **North – North – West**	1	Arrow Pointing in the direction called out in DirectionsAndNumbers

The "NoRoute" maneuver element is utilized when the destination is known, but a route cannot be calculated by the navigation system. The Navigation system shall provide a general direction from current location to the destination.

The "NoRoute" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element.

2.3.2.14 NAVREPEAT-FUR-REQ-022818/A-Maneuver element "CalcRoute" (TcSE ROIN-159107-1)

ManeuverElement **Main Element** Additional Elements	DirectionsAndNumbers	NumberOfStreetSegments
CalcRoute	**No direction**	1

If the route is being calculated initially this information is given to the presentation device.

The "CalcRoute" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element. The direction is not relevant.

The HMI shall determine what to show on the display for this element.

2.3.2.15 NAVREPEAT-FUR-REQ-022819/A-Additional element definition "Number" (TcSE ROIN-149632-1)

The "Number" element is not a main element. The Number element has to be combined with a main element.

2.3.2.16 NAVREPEAT-FUR-REQ-022820/A-Maneuver element "ArrivedAtDestination" (TcSE ROIN-175720-1)

Main Element Additional Elements	**Direction**	**Number of Maneuver Element**
ArrivedAtDestination	**North** **West** **East**	1

(DEST_REACHED)

The destination is arrived.

The "ArrivedAtDestination" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element. The direction specifies what side of the street the destination is on. If North is used, the side of the street is not known.

2.3.2.17 NAVREPEAT-FUR-REQ-022821/A-Maneuver element "ArrivedAtWaypoint" (TcSE ROIN-175721-1)

Main Element Additional Elements	**Direction**	**Number of Maneuver Element**
	North **West**	
ArrivedAtWaypoint	**East**	2

The Waypoint has arrived.

The "ArrivedAtWaypoint" element cannot be combined with "SideStreet", or other maneuver element. The direction specifies what side of the street the waypoint is on. If North is used, the side of the street is not known. "ArrivedAtWaypoint" is always combined with "Number" to indicate the number of the waypoint that has been reached.

2.3.2.18 NAVREPEAT-FUR-REQ-022822/A-Maneuver element "ApproachingDestination" (TcSE ROIN-175722-1)

Main Element Additional Elements	**Direction**	**Number of Maneuver Element**
	North **West**	
ApproachingDestination	**East**	1

Approaching the destination.

The "ApproachingDestination" element cannot be combined with "SideStreet", "Number", "Silent" or other maneuver element. The direction specifies what side of the street the destination is on. If North is used, the side of the street is not known.

2.3.2.19 NAVREPEAT-FUR-REQ-022823/A-Maneuver element "ApproachingWaypoint" (TcSE ROIN-175723-1)

Main Element Additional Elements	**Direction**	**Number of Maneuver Elements**
	North **West**	
ApproachingWaypoint	**East**	2

Approaching the next waypoint.

The "ApproachingWaypoint" element cannot be combined with "SideStreet", or other maneuver element. The direction specifies what side of the street the waypoint is on. If North is used, the side of the street is not known. "ApproachingWaypoint" is always combined with "Number" to indicate the number of the waypoint that being approached.

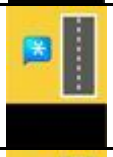
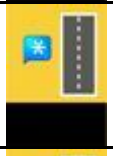
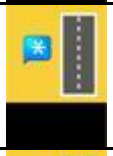
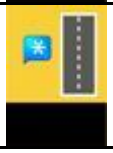
2.3.2.20 NAVREPEAT-SR-REQ-022824/A-NavigationSymbolInfo.St - list of available icons for Repeater display (TcSE ROIN-169348-3)

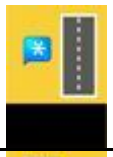
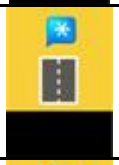
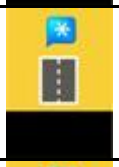
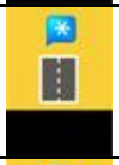
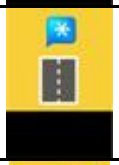
When the NavigationSymbolInfo.St message is sent by the Navigation Repeater Server, the value for byte 5 - 9 of the TP message shall correspond to the icon displayed in the Repeater display based upon the following table:

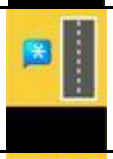
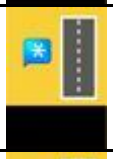
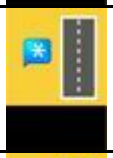
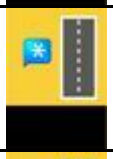
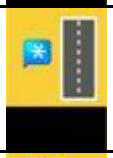
Description	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Icon
Continue	$01	$00	$11	Not used	Not used	
Left	$01	$40	$03	Not used	Not used	
Right	$01	$C0	$03	Not used	Not used	

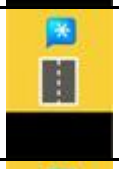
Sharp Left	$01	$60	$03	Not used	Not used	
Sharp Right	$01	$A0	$03	Not used	Not used	
Slight Left	$01	$20	$03	Not used	Not used	
Slight Right	$01	$F0	$03	Not used	Not used	
Keep Right(Fork)	$02	$00	$02	$C0	$09	
Keep Left(Fork)	$02	$00	$02	$40	$09	
Left Exit	$02	$00	$01	$20	$0A	
Right Exit	$02	$00	$01	$E0	$0A	
U-Turn Right Traffic	$01	$FF	$04	Not used	Not used	
U-Turn Left Traffic	$01	$FF	$05	Not used	Not used	
Round-about RH-1	$01	$A0	$0C	Not used	Not used	
Round-about RH-2	$01	$C0	$0C	Not used	Not used	
Round-about RH-3	$01	$E0	$0C	Not used	Not used	
Round-about RH-4	$01	$00	$0C	Not used	Not used	

Round-about RH-5	$01	$20	$0C	Not used	Not used	
Round-about RH-6	$01	$40	$0C	Not used	Not used	
Round-about RH-7	$01	$60	$0C	Not used	Not used	
Round-about LH-1	$01	$A0	$0D	Not used	Not used	
Round-about LH-2	$01	$C0	$0D	Not used	Not used	
Round-about LH-3	$01	$E0	$0D	Not used	Not used	
Round-about LH-4	$01	$00	$0D	Not used	Not used	
Round-about LH-5	$01	$20	$0D	Not used	Not used	
Round-about LH-6	$01	$40	$0D	Not used	Not used	
Round-about LH-7	$01	$60	$0D	Not used	Not used	
Change Lane West	$01	$20	$12	Not used	Not used	
Change Lane East	$01	$E0	$12	Not used	Not used	
Off Route	$01	$FF	$10	Not used	Not used	
Off Route	$01	$00	$10	Not used	Not used	
Off Route	$01	$E0	$10	Not used	Not used	

Off Route	$01	$C0	$10	Not used	Not used	
Off Route	$01	$A0	$10	Not used	Not used	
Off Route	$01	$80	$10	Not used	Not used	
Off Route	$01	$60	$10	Not used	Not used	
Off Route	$01	$40	$10	Not used	Not used	
Off Route	$01	$20	$10	Not used	Not used	
Calculate Route	$01	$FF	$23	Not used	Not used	TBD by HMI. Commonize with primary display
No Route	$01	$00	$22	Not used	Not used	TBD by HMI. Commonize with primary display
Arrived at Destination on Left	$01	$40	$13	Not used	Not used	
Arrived at Destination on Right	$01	$C0	$13	Not used	Not used	
Arrived at Destination Ahead	$01	$00	$13	Not used	Not used	
Arrived at Waypoint 1 on left	$02	$01	$30	$40	$14	
Arrived at Waypoint 2 on left	$02	$02	$30	$40	$14	
Arrived at Waypoint 3 on left	$02	$03	$30	$40	$14	
Arrived at Waypoint 4 on left	$02	$04	$30	$40	$14	

Arrived at Waypoint 5 on left	$02	$05	$30	$40	$14	
Arrived at Waypoint 1 on right	$02	$01	$30	$C0	$14	
Arrived at Waypoint 2 on right	$02	$02	$30	$C0	$14	
Arrived at Waypoint 3 on right	$02	$03	$30	$C0	$14	
Arrived at Waypoint 4 on right	$02	$04	$30	$C0	$14	
Arrived at Waypoint 5 on right	$02	$05	$30	$C0	$14	
Arrived at Waypoint 1 ahead	$02	$01	$30	$00	$14	
Arrived at Waypoint 2 ahead	$02	$02	$30	$00	$14	
Arrived at Waypoint 3 ahead	$02	$03	$30	$00	$14	
Arrived at Waypoint 4 ahead	$02	$04	$30	$00	$14	
Arrived at Waypoint 5 ahead	$02	$05	$30	$00	$14	
Approaching Destination on Left	$01	$40	$15	Not used	Not used	

Approaching Destination on Right	$01	$C0	$15	Not used	Not used	
Aproaching Destination Ahead	$01	$00	$15	Not used	Not used	
Approaching Waypoint 1 on left	$02	$01	$30	$40	$16	
Approaching Waypoint 2 on left	$02	$02	$30	$40	$16	
Approaching Waypoint 3 on left	$02	$03	$30	$40	$16	
Approaching Waypoint 4 on left	$02	$04	$30	$40	$16	
Approaching Waypoint 5 on left	$02	$05	$30	$40	$16	
Approaching Waypoint 1 on right	$02	$01	$30	$C0	$16	
Approaching Waypoint 2 on right	$02	$02	$30	$C0	$16	
Approaching Waypoint 3 on right	$02	$03	$30	$C0	$16	
Approaching Waypoint 4 on right	$02	$04	$30	$C0	$16	
Approaching Waypoint 5 on right	$02	$05	$30	$C0	$16	

Approaching Waypoint 1 ahead	$02	$01	$30	$00	$16	
Approaching Waypoint 2 ahead	$02	$02	$30	$00	$16	
Approaching Waypoint 3 ahead	$02	$03	$30	$00	$16	
Approaching Waypoint 4 ahead	$02	$04	$30	$00	$16	
Approaching Waypoint 5 ahead	$02	$05	$30	$00	$16	

Notes:

Icon graphics are a representation of the actual icons that will be shown on the repeater display. They are not necessarily the actual graphics.

Asterisk (*) shall correspond to actual number of the waypoint. There shall be 15 actual Waypoint icons.

2.3.2.21 NAVREPEAT-SR-REQ-022825/A-Destination_Info.St - list of available icons for Repeater display (TcSE ROIN-169349-2)

Requirement is deleted. Moved information contained in this requirement to NAVREPEAT-GREQ-169348-2-NavigationSymbolInfo.St - list of available icons for Repeater display Requirement.

2.3.2.22 NAVREPEAT-SR-REQ-022826/A-NavigationSymbolInfo.St - Scale for bargraph (TcSE ROIN-169350-2)

When 'PropertyOfDistance' parameter within 'NavigationSymbolInfo.St' changes from length ($1) to bargraph ($0) (i.e. anytime the cluster changes from length to bargraph it shall use the following ranges to determine the scale of the progress bar)

OR

When a new 'NavigationSymbolInfo.St' is received with 'PropertyOfDistance' = bargraph ($0) && BargraphSteps within this newly received 'NavigationSymbolInfo.St' > BargraphSteps within previous 'NavigationSymbolInfo.St'

x = distance to next maneuver [when'PropertyOfDistance' parameter within 'NavigationSymbolInfo.St' changes from length($1) to bargraph($0)] ***OR*** [(when (a new 'NavigationSymbolInfo.St' is received with 'PropertyOfDistance' = bargraph($0)) *&&* (BargraphSteps within this newly received 'NavigationSymbolInfo.St' > BargraphSteps within previous 'NavigationSymbolInfo.St')]

(x > 0.7 miles) / (x > 1126 meters) – scale of (0~1mile) / (0~2 km)

(0.35miles < x < = 0.7 miles) / (563 meters < x < = 1126 meters) – scale of (0~0.5 mile) / (0~1 km)

(0.15miles < x < = 0.35 miles) / (241 meters < x < = 563 meters) – scale of (0~0.2 mile) / (0~0.4 km)

(x < = 0.15miles) / (x < = 241 meters) – scale of (0~0.1 miles) / (0 ~ 0.2 km)

2.3.2.23 NAVREPEAT-SR-REQ-022827/A-NavigationSymbolInfo.St - DistanceToNextManeuver rounding for display purposes (TcSE ROIN-285754-2)

The Navigation Repeater Client and Server shall use the following table as instruction on how to round the distance shown on their respective displays based on the value received in DistanceToNextManeuver.

Property of distance	Unit of Length	DistanceToNextManeuver (Decimal Value)	Displayed on Centerstack
$1:length	$1:miles	116	12 miles
		115	12 miles
		114	11 miles
		113	11 miles
		112	11 miles
		111	11 miles
		110	11 miles
		109	11 miles
		108	11 miles
		107	11 miles
		106	11 miles

		105	11 miles
		104	10 miles
		103	10 miles
		102	10 miles
		101	10 miles
		100	10 miles
		99	9.9 miles
		98	9.8 miles
		97	9.7 miles
		96	9.6 miles

Property of distance	Unit of Length	DistanceToNextManeuver (Decimal Value)	Displayed on Centerstack
$0:bargraph	$1:miles	116	1.2 miles
		115	1.2 miles
		114	1.1 miles
		113	1.1 miles
		112	1.1 miles
		111	1.1 miles
		110	1.1 miles
		109	1.1 miles
		108	1.1 miles
		107	1.1 miles
		106	1.1 miles
		105	1.1 miles
		104	1.0 miles
		103	1.0 miles
		102	1.0 miles
		101	1.0 miles
		100	1.0 miles
		99	1.0 miles
		98	1.0 miles
		97	1.0 miles
		96	1.0 miles

2.3.3 Sequence Diagrams

2.3.3.1 NAVREPEAT-SD-REQ-022828/A-Route Active- Home Screen (TcSE ROIN-118757-3)

Scenarios

Normal Usage

The user is viewing active route turn by turn instructions on the cluster display.

HMI indicates {next street, current street, next maneuver, distance to next maneuver, ETA, time to destination}

Constraints

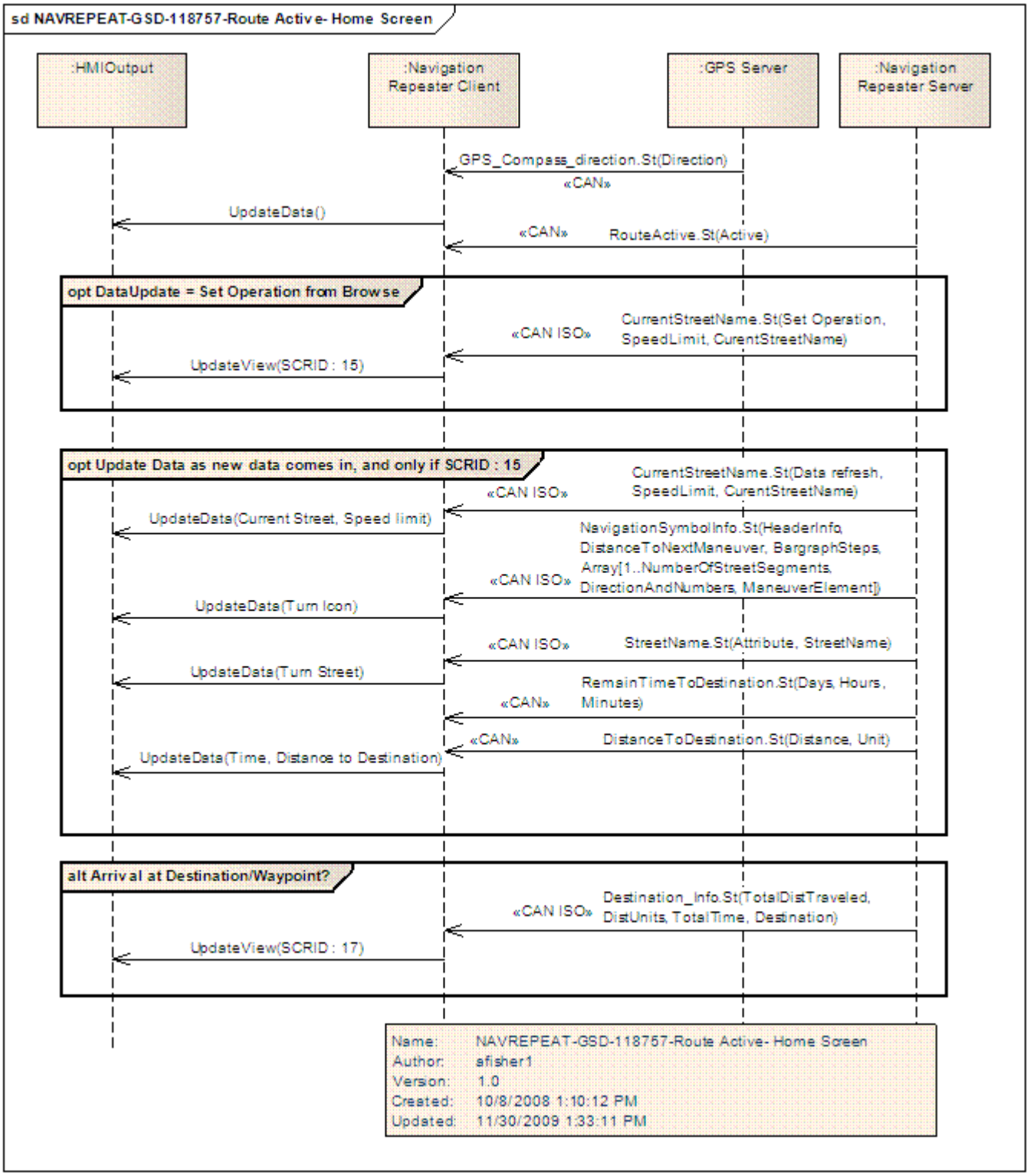
Pre-condition

A route is active on the navigation system, and the user is on the Route Active home screen in the cluster display.

Post-condition

A route is active on the navigation system, and the user is on the Route Active home screen in the cluster display.

Sequence Diagram



2.4 NAVREPEAT-FUN-REQ-022829/A-Repeat Guidance, Route Active (TcSE ROIN-294105-1)

2.4.1 Use Cases

2.4.1.1 NAVREPEAT-UC-REQ-022830/A-Repeat Guidance (TcSE ROIN-292750-1)

Actors	User
Pre-conditions	Route is currently active. RH cluster is currently on the main Navigation home screen.
Scenario Description	The user selects repeat route guidance to hear the last guidance prompt again.
Post-conditions	Route is currently active. RH cluster is currently on the main Navigation home screen.
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.4.2 Sequence Diagrams

2.4.2.1 NAVREPEAT-SD-REQ-022831/A-Repeat Guidance, Route Active (TcSE ROIN-118708-1)

Scenarios

Normal Usage

The user <selects repeat route guidance> via the cluster HMI to hear the last guidance prompt again.

Constraints

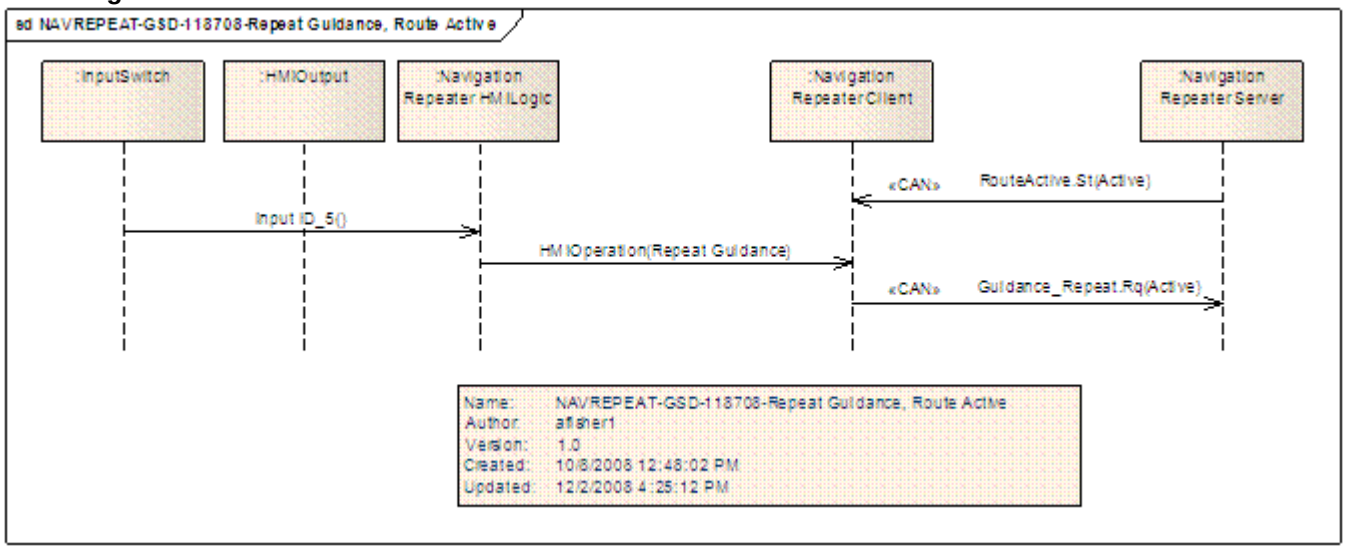
Pre-condition

Route is currently active. RH cluster is currently on the main Navigation home screen.

Post-condition

Route is currently active. RH cluster is currently on the main Navigation home screen.

Sequence Diagram



2.5 NAVREPEAT-FUN-REQ-022832/A-Cancel Active Route (TcSE ROIN-294107-1)

2.5.1 Use Cases

2.5.1.1 NAVREPEAT-UC-REQ-022833/A-Cancel Active Route (TcSE ROIN-292749-1)

Actors	User
Pre-conditions	Navigation has an active route running.
Scenario Description	User cancels active route
Post-conditions	The current active route is cancelled. Cluster display returns to the Navigation-Route not active home screen.
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.5.2 Sequence Diagrams

2.5.2.1 NAVREPEAT-SD-REQ-022834/A-Cancel Active Route (TcSE ROIN-150103-2)

Scenarios

Normal Usage

The user selects <Cancel Route> via the ~~cluster~~ HMI.

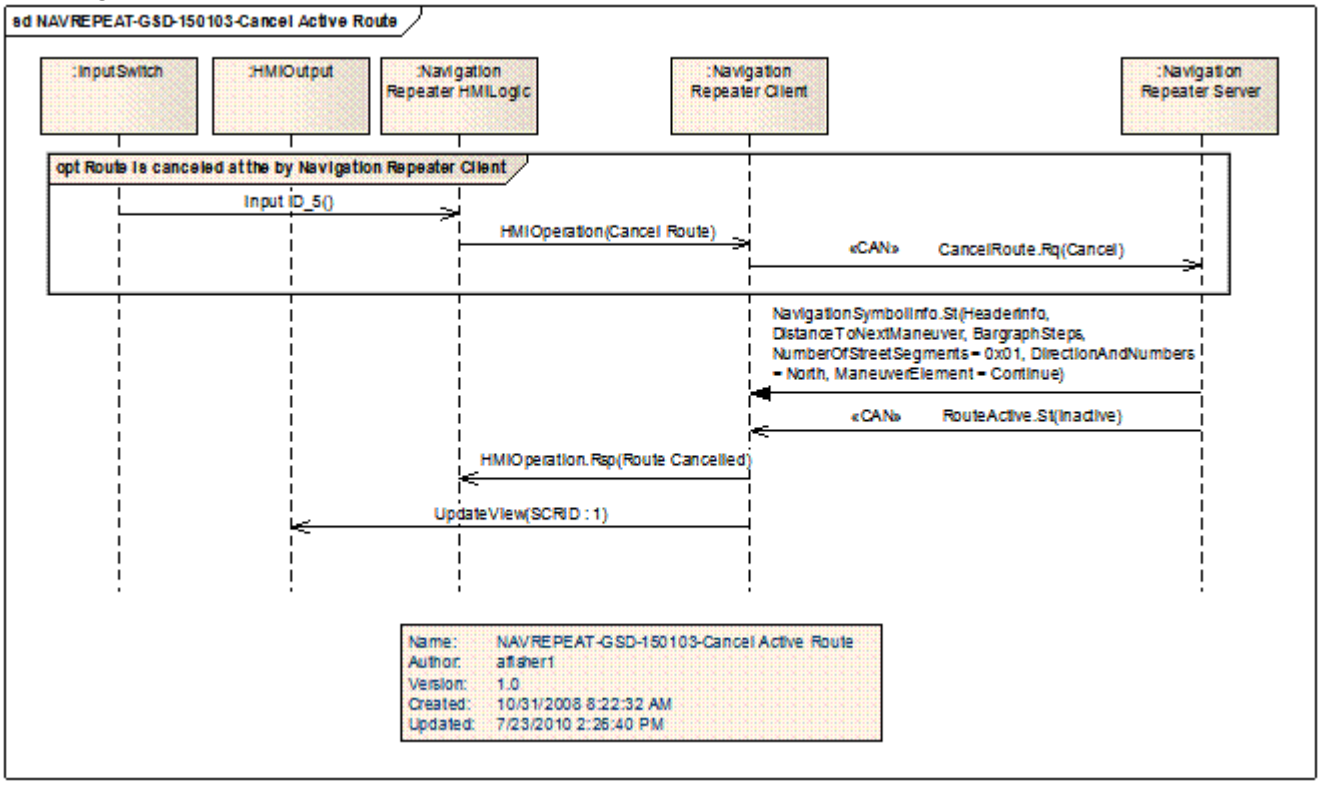
Constraints

Pre-condition

Navigation has an active route running.

Post-condition
The current active route is cancelled. Cluster display returns to the Navigation- Route not active home screen.

Sequence Diagram



2.6 NAVREPEAT-FUN-REQ-022835/A-Cancel Current Active Waypoint (TcSE ROIN-294109-1)

2.6.1 Use Cases

2.6.1.1 NAVREPEAT-UC-REQ-022836/A-Cancel Waypoint (TcSE ROIN-292748-1)

Actors	User
Pre-conditions	Navigation has an active route running, with at least one waypoint entered.
Scenario Description	User cancels waypoint
Post-conditions	The current active waypoint is cancelled. Cluster display returns to the Navigation-Route active home screen and continues the active route.
List of Exception Use Cases	N/A
Interfaces	Vehicle System Interface G-HMI

2.6.2 Sequence Diagrams

2.6.2.1 NAVREPEAT-SD-REQ-022837/A-Cancel Current Active Waypoint (TcSE ROIN-150110-1)

Scenarios

Normal Usage

The user selects <Cancel current waypoint> via the cluster HMI.

Constraints

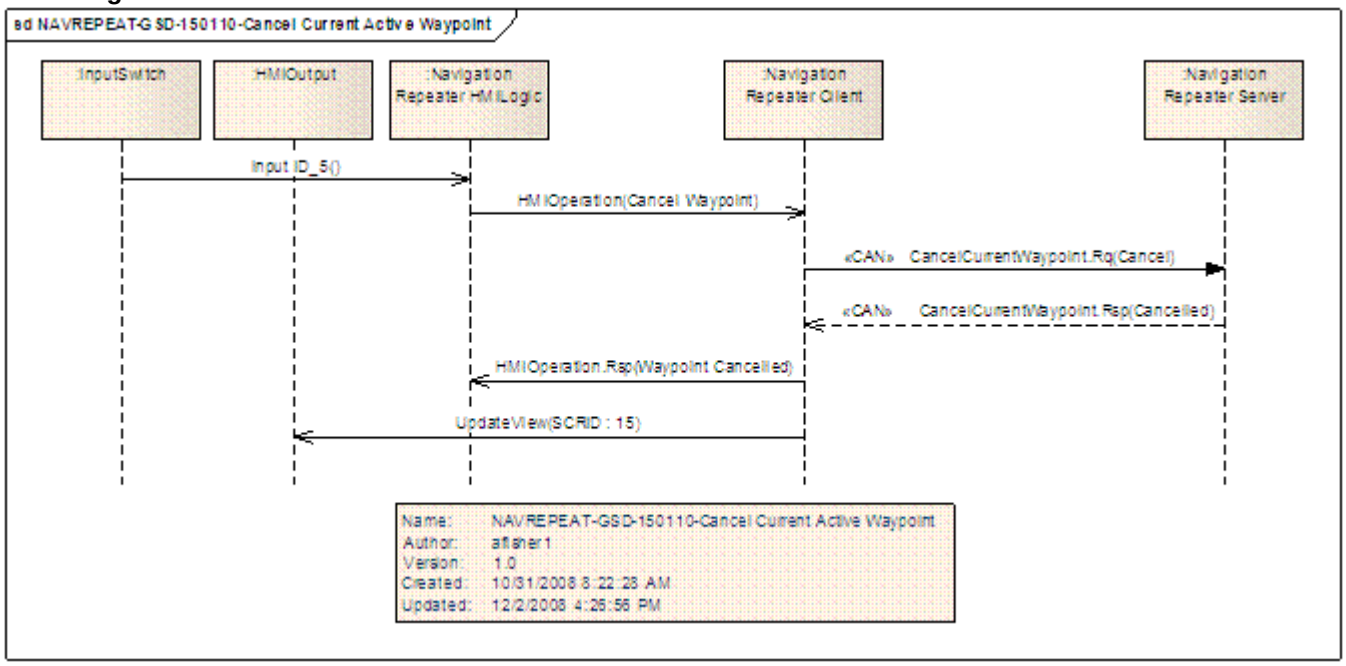
Pre-condition

Navigation has an active route running, with at least one waypoint entered.

Post-condition

The current active waypoint is cancelled. Cluster display returns to the Navigation- Route active home screen and continues the active route.

Sequence Diagram



2.7 NAVREPEAT-FUN-REQ-092269/A-Detailed Intersection Widgit

Detailed Intersection Widgit

2.7.1 Use Cases

Use Cases

2.7.1.1 NAVREPEAT-UC-REQ-092268/A-Detailed Intersection Widgit

Actors	System
Pre-conditions	Embedded navigation route active.

	Vehicle equipped with an Electronic Horizon rich map.
Scenario Description	The vehicle approaches a manuver.
Post-conditions	The HUD or equivalent technology shall render a representation of that manuver.
List of Exception Use Cases	
Interfaces	CAN, GHMI

2.7.2 Requirements

Requirements

2.7.2.1 EH-FUR-REQ-092267/A-Detailed Intersection Widgit

Given NAV Repeater conformance level of 2 or greater, the expansion of the most probable path must trigger UpcomingStreetName.St signal for each new stub identified. See NAV Repeater feature for UpcomingStreetName.St definition.

3 Appendix: Reference Documents

Reference #	Document Title
1	
2	
3	
4	
5	