Augmented Reality (AR)

(F003774)

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Important Note

You need to use the RE specification macros provided by the “RE_SpecificationMacroTemplate.dotm” (refer to “Utilities” on page “Specification Templates” in the RE Wiki) to allow seamless VSEM import of the specification content. **Use only these RE specification macros to create requirements** in this specification. Refer to “How to use the Specification Templates” on how to enable and use the macros and the requirements templates in this specification.

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1 INTRODUCTION

1.1 Document Purpose

The Feature Implementation Specification (FIS) specifies the deployment of the logical functions of a feature to an electrical architecture. The FIS specifies all interactions between the ECUs of the electrical architecture required for the feature including the technical signals and the interfaces. It also gives interface and integration requirements, which are specific to the feature for the electrical architecture.

To get more information about the concept of feature, function and component level abstraction refer to the Ford RE Wiki.

1.2 Document Scope

This FIS describes the deployment of the feature <Feature> to the following electrical architecture(s):

Electrical Architecture Name	Owner	Reference

Table 1-1: Electrical Architecture(s) referenced in this document

1.3 Document Audience

The FIS is authored by <Author's Name / Role>. All Stakeholders, i.e., all people who have a valid interest in the feature implementation should read and, if possible, review the FIS. It needs to be guaranteed, that all stakeholders have access to the currently valid version of the FIS.

1.3.1 Stakeholder List

For the latest list of stakeholder of the feature and their influence refer to <Put VSEM Link here>.

List of Stakeholders

Name	CDSID /phone	Stake	Contact date	Elicitation response	Review worksheet	Review meeting
Bentley, Sonya (S.D.)	sbentle5	Systems Engineering Manager	11/23/2019	Accepted	Yes	Yes
Yousif, Meisam (M.L.)	myousif	Feature Owner Supervisor	11/23/2019	Accepted	Yes	Yes
Abdelhamid, Mahmoud (M.)	mabdelh1	Feature Owner Lead	11/23/2019	Accepted	Yes	Yes
Alsamarai, Ahmed (A.)	aalsamar	Feature Owner (co-lead)	8/17/2020	Accepted	Yes	Yes
Flores, Luis (L.A.)	lflore70	Feature Owner (co-lead)	8/17/2020	Accepted	Yes	Yes
Ahmed, Fahd	fahmed2	AR Feature Champion / AR Planning Lead	2/10/2021	Accepted	Yes	Yes
Kessler, Chris	ckessle8	Global AR Marketing Lead for Ford and Lincoln	01/25/2021	Accepted	Yes	Yes
King, Anthony (A.G.)	aking6	AR module Product owner Supervisor	8/17/2020	Accepted	Yes	Yes
Langkamp, Ulf (U.K.)	ulangkam	AR module Product owner Engineer	7/31/2020	Accepted	Yes	Yes
Nachtegall, Debbie (D.E.)	dnachte1	AR ECU D&R - Hardware	8/07/2020	Accepted	Yes	Yes
Keerthivasan, Venkataraman	vkeerth5	AR ECU D&R – Hardware	6/24/2021	Accepted	Yes	Yes

List of Stakeholders

Name	CDSID /phone	Stake	Contact date	Elicitation response	Review worksheet	Review meeting
Vootkuri, ChandraSekhar (C.R.)	cvootkur	AR ECU D&R - Software	8/04/2020	Accepted	Yes	Yes
Lazalde, Eric (E.)	elazald1	HMI lead for the core interaction on the panoramic displays- HHDD	2/4/2021	Accepted	Yes	Yes
To, Curtis (C.S.)	cto3	HMI Supervisor, Customer Experience	8/26/2020	Accepted	Yes	Yes
Khanafer, Dima (D.)	dkhanafe	HMI Engineer, Customer Experience	8/26/2020	Accepted	Yes	Yes
Von hausen, Christian (C.)	cvonhaus	HMI Engineer, Customer Experience	8/26/2020	Accepted	Yes	Yes
Van Moen, Lidia	lvanmoen	Core Hardware Engineer / ADAS FWC Camera	9/01/2020	Accepted	Yes	Yes
Zaragoza, Claudia	czarago1	Core Hardware Engineer / FIR Camera	10/29/2020	Accepted	Yes	Yes
Saini, Akriti (A.)	asaini10	Core Hardware Engineer / AR Camera	01/19, 2021	Accepted	Yes	Yes
Rahtz, Timothy (T.A.)	trahtz	AR Nav product owner	12/03/2020	Accepted	Yes	Yes
Check, Laura	lburek	IVI/Phoenix Product Owner	8/18/2020	Accepted	Yes	Yes
White, Melissa	mwhite35	Manufacturing point of contact	9/16/2020	Accepted	Yes	Yes
Civiero, Christian	ccivier1	ASO SME for AR	8/17/2020	Accepted	Yes	Yes
Gehrke, Mark	mgehrke2	GTDS #22423 Lead for FIR Camera Project	10/26/2020	Accepted	Yes	Yes
Hiskens, David	dhiskens	GTDS #22423 Co-Lead for FIR Camera Packaging	9/01/2020	Accepted	Yes	Yes
Diedrich, Jonathan (J.)	jdiedris	GTDS #22423 Co-Lead for FIR Camera Calibration	11/16/2020	Accepted	Yes	Yes
Cauvet, Colleen	ccauvet	GTDS #30199 Lead for (Thermally Enhanced Night vision Features)	8/28/2020	Accepted	Yes	Yes
Dutta, Arun	adutta2	GTDS #30199 Engineer for (Thermally Enhanced Night vision Features)	9/10/2020	Accepted	Yes	Yes
Hurley, Collin	churle15	GTDS #30199 Engineer for (Thermally Enhanced Night vision Features)	9/11/2020	Accepted	Yes	Yes
Farrell, David (D.E.)	dfarre13	Functional Safety SE Lead	9/28/2020	Accepted	Yes	Yes
Dean, Shawn (S.)	sdean44	Functional Safety SE Engineer	9/28/2020	Accepted	Yes	Yes
Balachandran, Vignesh	vbalach4	Functional safety EESE Lead	1/14/2021	Accepted	Yes	Yes
Foresto, Marco (M.P.)	mforesto	Functional architecture	1/14/2021	Accepted	Yes	Yes
Perkins, Steve (S.)	sperki50	Functional architecture	10/21/2020	Accepted	Yes	Yes
Becerra, Alejandro (JABS.)	jbecer16	Feature MBSE Modeler	8/20/2020	Accepted	Yes	Yes
Ortiz Anguiano, Alejandro	aortizan	Feature MBSE Supervisor	8/17/2020	Accepted	Yes	Yes

List of Stakeholders

Name	CDSID /phone	Stake	Contact date	Elicitation response	Review worksheet	Review meeting
Mahmood, Hamid	hmahmoo3	Pre-PS IVI – CoOps Supervisor	10/12/2020	Accepted	Yes	Yes
Rahman, Moshiur	mrahma29	Pre-PS IVI – CoOps Engineer	8/20/2020	Accepted	Yes	Yes
Caballero, Fernando (F.)	fcabal11	FMA Coach Engineer	10/09/2020	Accepted	Yes	Yes
Buchanan, Alan (A.D.)	abuchan1	FMA Coach Lead	1/14/2021	Accepted	Yes	Yes
Fayad, Omar (O.)	ofayad	AR Cybersecurity Requirements	9/11/2020	Accepted	Yes	Yes
Raparthi, Satya (S)	srapart1	AR Cybersecurity Requirements	1/22/2021	Accepted	Yes	Yes
Childers, Chad (C.B)	cchilde1	AR Cybersecurity TARA modeling	9/21/2020	Accepted	Yes	Yes
Kalash, Mohammad (M.)	mkalash	ADAS customer experience	10/28/2020	Accepted	Yes	Yes
Aaron Mills	amills2	AR/DAT point of contact	11/04/2020	Accepted	Yes	Yes
Nath, Nitendra (N.)	nnath	AR/DAT point of contact	8/21/2020	Accepted	Yes	Yes
Sripinyo, Peter (P.P.)	psripiny	Power Mode - Software	2/26/2021	Accepted	Yes	Yes
Affeldt, Matthew (M.D.)	maffeldt	VSEM DAT point of contact	11/05/2020	Accepted	Yes	Yes
Cheng, Gail (L.G.)	gcheng	VSEM IVI point of contact	11/18/2020	Accepted	Yes	Yes
Sun, Jayla	Jsun55	IVI FVSS development engineer	1/17/2021	Accepted	Yes	Yes
Obeidat, Omar (O.A.)	oobeida2	AR GPS (GNSS) Location	10/20/2020	Accepted	Yes	Yes
Schein, Jamey (J.)	jschein2	AR Navigation point of contact	11/17/2020	Accepted	Yes	Yes
Medl, Chris (C.)	cmedl	AR Navigation point of contact	1/19/2021	Accepted	Yes	Yes
Olzewski, Chet	colzewsk	SIM Engineer	6/24/2021	Accepted	Yes	Yes
Yu, Diven (D.W.)	dyu12	DuerOS module owner supervisor	6/08/2021			
Li, Qiyang (Q.)	QLI111	DuerOS module owner	6/08/2021			
Yang, Frank (F.)	FYANG36	PMT China	6/08/2021			
Ding, Sunny (X.)	XDING13	China local solution AR Nav Owner	6/08/2021			

1.4 Document Organization

1.4.1 Document Context

Refer to the Specification Structure page in the Ford RE Wiki to understand how the FIS relates to other Ford Requirements Documents and Specifications.

1.4.2 Document Structure

The structure of this document is explained below:

Section 1 – Introduction – Giving an explanation how to use this document including responsibilities and the scope of the document. Additionally it contains the revision history and a list of unsettled but known issues that have to be consolidated in future versions. It explains the terminology and gives a clarification of the definitions, concepts and abbreviations used in the document.

Section 2 – Feature Implementation Description – Giving an overview of the platform and listing assumptions, constraints or dependencies

Section 3 – Feature Implementation Architecture – Describing 3 Architecture Views:

- Functional Architecture – Showing the logical architecture of functions
- Physical Architecture – Showing the physical architecture (first of all the E/E Architecture), which the Logical Functions get allocated to.
- Software Architecture – Showing the software architecture relevant for the feature (for features with in-house development only)
- Function Deployment – Presenting the allocation of logical functions and signals to the electrical and other components

Section 4 – Deployment Specific Modeling –Modeling techniques providing additional detail on e.g. interface behavior

Section 5 – Deployment Specific Requirements – Deployment specific requirements for ECUs, Network Communication, and Process

Section 6 – List of Open Concerns

Section 7 – Revision History

Section 8 – Appendix - Presenting additional data mainly in a tabular form, e.g., a data dictionary

1.5 Document Conventions

1.5.1 Requirements Templates

Refer to “How to use the Specification Templates” on how to use the specification templates and the VBA macros to create/edit the requirements in the specifications.

The VBA macro enable the import of the specification to VSEM (refer to "How to import specifications into VSEM as separate requirements").

1.5.1.1 Identification of requirements

The unique requirement ID given in the headline of any requirement follows the requirement throughout the development process. The requirement ID format follows a well-defined syntax.

All identifiers in an FIS shall be composed of 4 parts:

- A leading prefix, which indicates the type of requirement (R=Requirement, UC=Use Case, SC=Scenario, …)
- A prefix, which indicates the abstraction level (F=Feature, FNC=Function, CMP = component).
- Followed by a name, indicating the scope, which the requirement belongs to (e.g. feature or function name)
- Ending with the actual requirement number

Example:

R_CMP_LockArbitrator_00004	This is the fourth requirement on component level for the function Lock Arbitrator.

1.5.1.2 Requirements Attributes

Additionally attributes can be added to each requirement. This helps to classify requirements. A list of available attributes is given in the RE Wiki.

1.6 References

1.6.1 Ford Documents

The list of all Ford internal documents, which are directly related.

Reference	Title	Doc. ID	Revision	Document Location
NA				

Table 1-2: Ford internal Documents

1.6.2 External Documents and Publications

The list of external documents could include books, reports and online sources.

Reference	Document / Publication
N/A	

Table 1-3: External documents and publications

1.7 Glossary

1.7.1 Definitions

Definition	Description

Table 1-4: Definitions used in this document

1.7.2 Abbreviations

Abbr.	Stands for	Description
ADAS (IPMA)	Advanced Driver Assistant System	
APIM_CDC	Accessory Protocol Interface Module (Phoenix Domain Controller)	
APIM_CISM	DuerOS; CISM (Cockpit Infotainment System Module)	China IVI
AR feature	Augmented Reality feature – Scope of this document	
AR-CAM	Augmented Reality Camera (visible)	
ARM (AR-ECU)	Augmented Reality Electronic Control Unit (New Hardware)	
BCM	Body Control Module	
CAM	Camera	

Abbr.	Stands for	Description
ECG	Enhanced Central Gateway	
FIR-CAM	Far Infrared Camera	
FNV3	Fully Networked Vehicle-3	
FOV	Field of view	
GNSS	Global Navigation Satellite System	
GPS	Global Positioning System (the US GNSS system)	
HHDD	High Head Down Display (Panoramic Display), External display for AR content	
HMI	Human-Machine Interface	
MVP	Minimum viable product	
OEM	Original Equipment Manufacturer	
OTA	Over the Air Updates	
PDB	Power Distribution Box	
POI	Point of Interest	
TCU	Telematics Control Unit	
EH	Electronic Horizon	
FPD Link	Flat Panel Display Link	

Table 1-5: Abbreviations used in this document.

2 FEATURE IMPLEMENTATION OVERVIEW

2.1 Description

2.2 Input Requirements/Documents

Reference (Reference as listed in ch. "References")	**Section/Requirement**	**Description**	**Derived Requirement** (optional – reference to requirement in ch. "Feature Implementation Requirements")
Feature/Function Requirements			
Feature document V2.2			
Function document V2.2			
Ford Engineering Standards			
Legal Regulations			
Industry Standards			
Other Sources			
Camera Gain for Augmented Reality Background Transition Point V1.1	Process video Mode		
FIR MVP Requirement V5.0	Process video Mode		
FIR_Pedestrian_Detection_and_Classification_Func_Spec	Object (Pedestrian and large animal) detection		
AR FIR camera hardware interface requirements_3Aug2021	AR and FIR Camera Interface requirement to AR ECU	[AUGREAL-59] AR FIR camera interface requirements - FORD JIRA	

Table 1-6: Input Requirements/Documents

2.3 Lessons Learned

N/A.

3 FEATURE IMPLEMENTATION ARCHITECTURE

3.1 Functional Architecture

3.1.1 Description

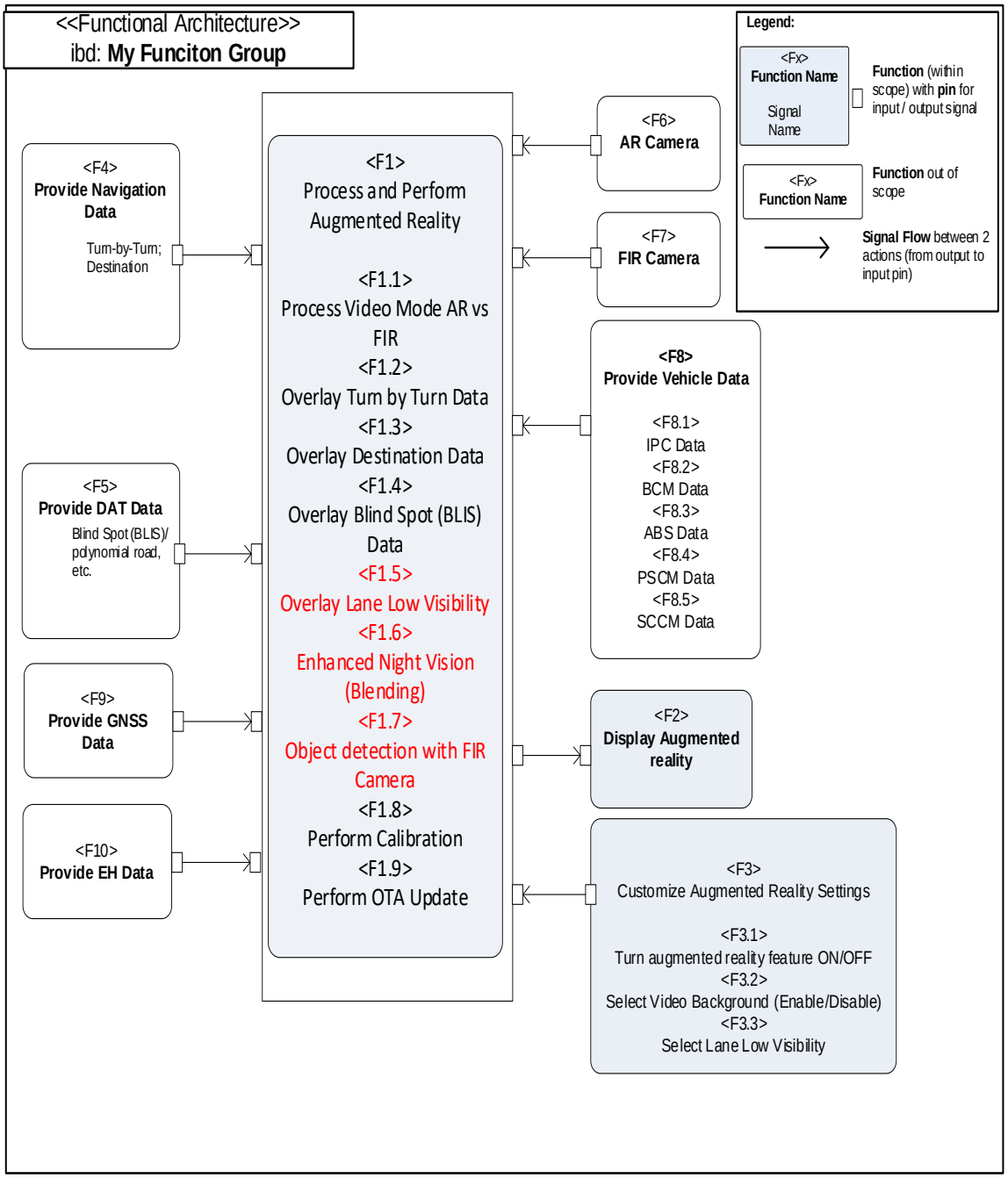


Figure 3-1: Functional Architecture

3.1.2 Function List

The augmented reality AR feature has the following function groups:

Fu-Group 1- Process and Perform Augmented Reality – AR ECU

1- Process Video Mode AR Camera vs FIR Camera. (MVP variant).
2- Overlay Turn by Turn Data. (MVP variant).
3- ~~Overlay Street Name Data (MVP Variant)~~ Note: Deleted not Supported by Google
4- ~~Overlay House Number Data (MVP Variant)~~ Note: Deleted not Supported by Google
5- ~~Overlay Point of Interest (POI) Data (MVP Variant)~~ Note: Deleted not Supported by Google
6- Overlay Destination Data. (MVP variant).
7- Overlay Blind Spot (BLIS) Data. (MVP variant).
8- Overlay Lane Low Visibility Data. Post<J1>OTA
9- Enhanced Night Vision (Blending). Post <J1> OTA
10- Object Detection with FIR Camera. Post <J1>OTA.
11- ~~Overlay Lane Level Navigation (MVP+ Variant)~~ Note: Deleted not Supported by Google
12- ~~Overlay Lane Biasing Data (MVP+ Variant)~~ Note: Deleted, CIED not recommend this for CIED application
13- ~~Overlay Highway Assist Data (Far Variant)~~ Note: Deleted, CIED not recommend this for CIED application
14- ~~Overlay Assist Lane Change Data (Far Variant)~~ Note: Deleted, CIED not recommend this for CIED app.
15- Perform Calibration. (MVP variant).
16- Perform OTA Update. (MVP variant).

Fu-Group 2- Control the Display of Augmented Reality – HMI- IVI/SYNC (MVP variant).

Fu-Group 3- Customize Augmented Reality Settings- HMI- IVI/SYNC (MVP variant).

1- Select AR Feature. (MVP Variant)
2- Select Video Background. (MVP Variant)
3- Select Lane Low Visibility. (post <J1>OTA).

Fu-Group 4- Provide Navigation data – IVI/SYNC. (MVP variant).
Fu-Group 5- Provide DAT related data – DAT. (MVP variant).
Fu-Group 6- Provide AR Camera Data – AR Camera. (MVP variant).
Fu-Group 7- Provide FIR Camera Data – FIR Camera. (MVP variant).
Fu-Group 8- Provide Vehicle Data. (MVP variant).
Fu-Group 9- Provide GNSS Data. (MVP variant).
Fu-Group 10- Provide Electronic Horizon (EH) Data. (MVP variant)

The following functions from the Global Feature & Function List are referenced in this Feature Implementation Specification:

Function ID	Function Name	Function Description	ASIL
F1	Process and Perform Augmented Reality	Process the received data and Perform the AR overlay functions required by the feature.	QM
F1.1	Process Video Mode	Process video mode AR camera vs FIR camera	QM
F1.2	Overlay Turn by Turn Data	Turn by turn Data received from NAV will be overlaid on the video feed from the cameras.	QM
F1.3	Overlay Destination Data	Destination icons Data received from NAV will be overlaid on the video feed from the cameras.	QM
F1.4	Overlay Blind Spot Data	BLIS warning will be rendered spatially correct to the neighboring lane.	QM
F1.5	Overlay Lane Low Visibility	Lane Low Visibility Data received will be overlaid on the video feed from the cameras.	TBD
F1.6	Enhanced Night Vision (Blending).	Enhanced Night Vision (Blending) data will be overlaid on the video feed from both AR and FIR cameras.	TBD
F1.7	Object Detection with FIR Camera	Object detection with FIR Camera data will be overlaid on the FIR camera video feed.	TBD
F1.8	Perform Calibration	Perform calibration for AR/FIR cameras.	QM
F1.9	Perform OTA Update	Receive and perform OTA updates.	QM
F2	Display Augmented Reality	Display the AR video to the HHDD display (TBT, Destination, Blind Spot, etc.)	QM
F3	Customize AR Settings	Provide the user the ability to customize the feature.	QM
F3.1	Select AR Feature	Turn AR feature (ON/OFF)	QM
F3.2	Select Video background	Select video background (Enable/Disable)	QM
F3.3	Select Lane Low Visibility	Turn Lane Low Visibility feature (ON/OFF)	TBD
F4	Provide Navigation Data	Provide the required data from NAV to support the overlay functions.	QM
F5	Provide DAT Data	Provide the required data from DAT to support the overlay functions.	QM
F6	Provide AR Camera Data	Provide the video feed from AR camera.	QM
F7	Provide FIR Camera Data	Provide the video feed from FIR camera.	QM
F8	Provide Vehicle Data	Provide the required vehicle data from different ECUs.	QM
F8.1	Provide IPC Data	Provide fuel level status	QM
F8.2	Provide BCM Data	Provide ignition status	QM
F8.3	Provide ABS Data	Provide vehicle speed status	QM
F8.4	Provide PSCM Data	Provide steering angle status	QM
F8.5	Provide SCCM Data	Provide turn light signal status	QM
F9	Provide GNSS Data	Provide GNSS data	QM
F10	Provide EH Data	Provide Electronic Horizon data	QM

Table 3-1: List of Functions

3.1.3 Signal List

3.2 Physical Architecture

3.2.1 E/E Architecture

3.2.1.1 E/E Architecture Variants

E/E Architecture Variant Name	Variant Description	Variant Condition (optional)
FNV3	Fully Networked Vehicle-3	

3.2.1.1.1 E/E Architecture “FNV3”

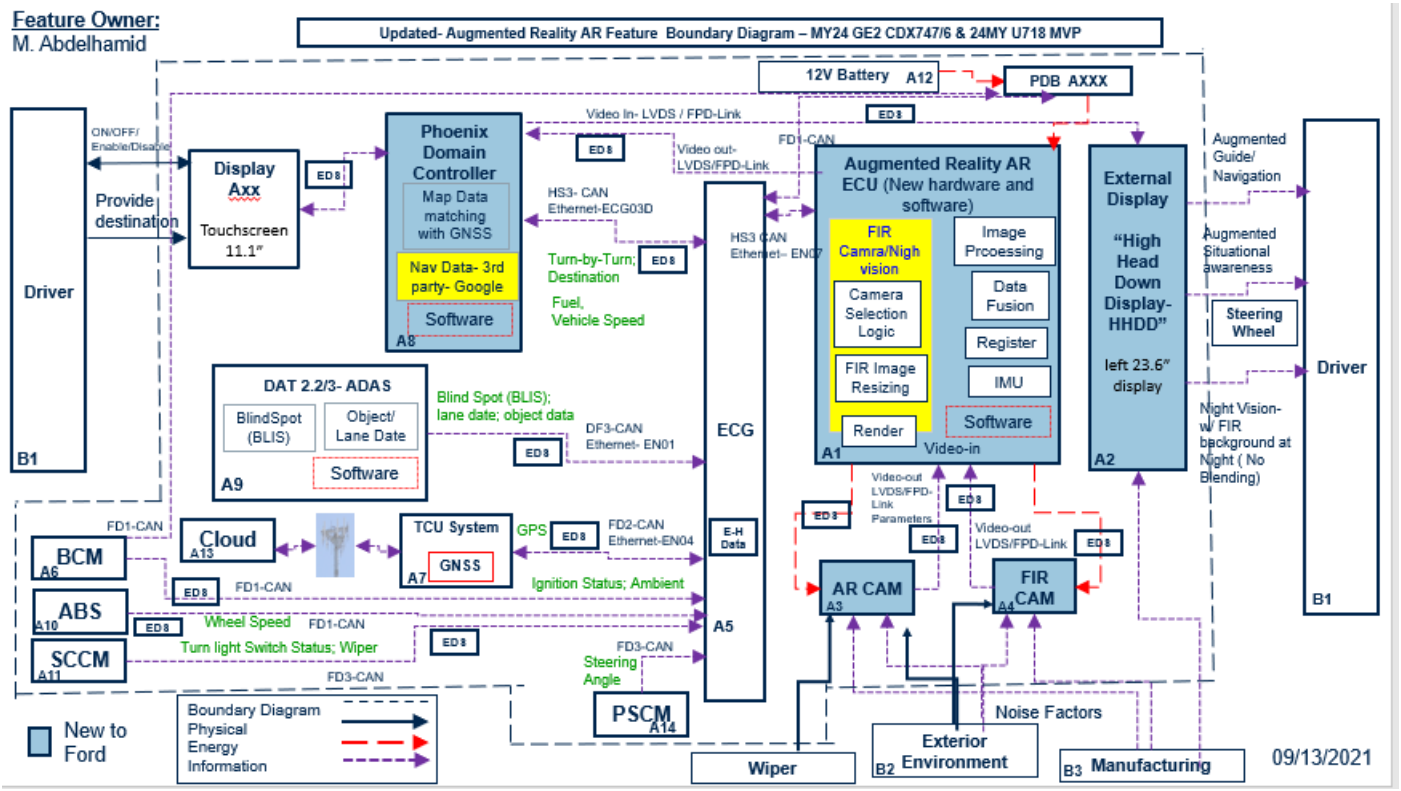


Figure 3-2 E/E Architecture

3.2.1.2 E/E Components

Component Name	**Description**
APIM_CDC	Phoenix Domain Controller includes Instrument Panel cluster (IPC)
ADAS	Driver Assistance Technologies
TCU	Telematics Control Unit
ECG	Gateway module to transfer messages between communication buses
ARM (AR ECU)	Augmented Reality Module
HHDD	High Head Down Display
AR Camera	Augmented Reality Camera
FIR Camera	Far Infra-Red Camera
BCM	Body Control Module
ABS	Anti-lock Braking System
SCCM	Steering Control Column Control Module.
PSCM	Primary/Secondary Power Steering Control Module
DuerOS	IVI system for China (equivalent to Phoenix)

Table 3-2: Electrical Components

3.2.1.3 E/E Connections

Connection Name	**Connection Type**	**Protocol** Only if 'Connection Type' is "Network"/"RF-Digital"	**Description**	**Allocated Messages** Only if 'Connection Type' is "Network"/"RF-Digital"	**Connected Nodes**
HS3-CAN	Network	CAN (High Speed)	High Speed CAN bus	…	ARM-APIM_CDC APIM_CDC-ARM
HS3-CAN	Network	CAN (High Speed)	High Speed CAN bus		ECG-ARM
FD3-CAN	Network	CAN FD	FD CAN Bus		ADAS-ECG-ARM SCCM-ECG-ARM PSCM-ECG-ARM
FD2-CAN	Network	CAN FD	FD CAN Bus		TCU-ECG-ARM
FD1-CAN	Network	CAN FD	FD CAN Bus		BCM-ECG-ARM
EN01	Network	Ethernet (MQTT)	Ethernet network Bus		ADAS-ECG-ARM
EN04	Network	Ethernet (MQTT)	Ethernet network Bus		TCU-ECG-ARM
EN07	Network	Ethernet (MQTT)	Ethernet network Bus		APIM_CDC-ECG-ARM
LVDS	Digital	I2C			ARM-AR Camera
LVDS	Digital	I2C			ARM-FIR Camera
LVDS	Analog	n/a			AR Camera-ARM
LVDS	Analog	n/a			FIR Camera-ARM
LVDS	Analog	n/a			ARM-APIM_CDC
LVDS	Analog	n/a			APIM_CDC-HHDD

Table 3-3: E/E Connections

3.3 Function Deployment

3.3.1 Deployment Variants

Deployment Variant Name	Variant Description	Variant Condition (optional)
FNV3		

3.3.1.1 Deployment “Augmented Reality Feature”

This deployment variant shows the feature functions allocation.

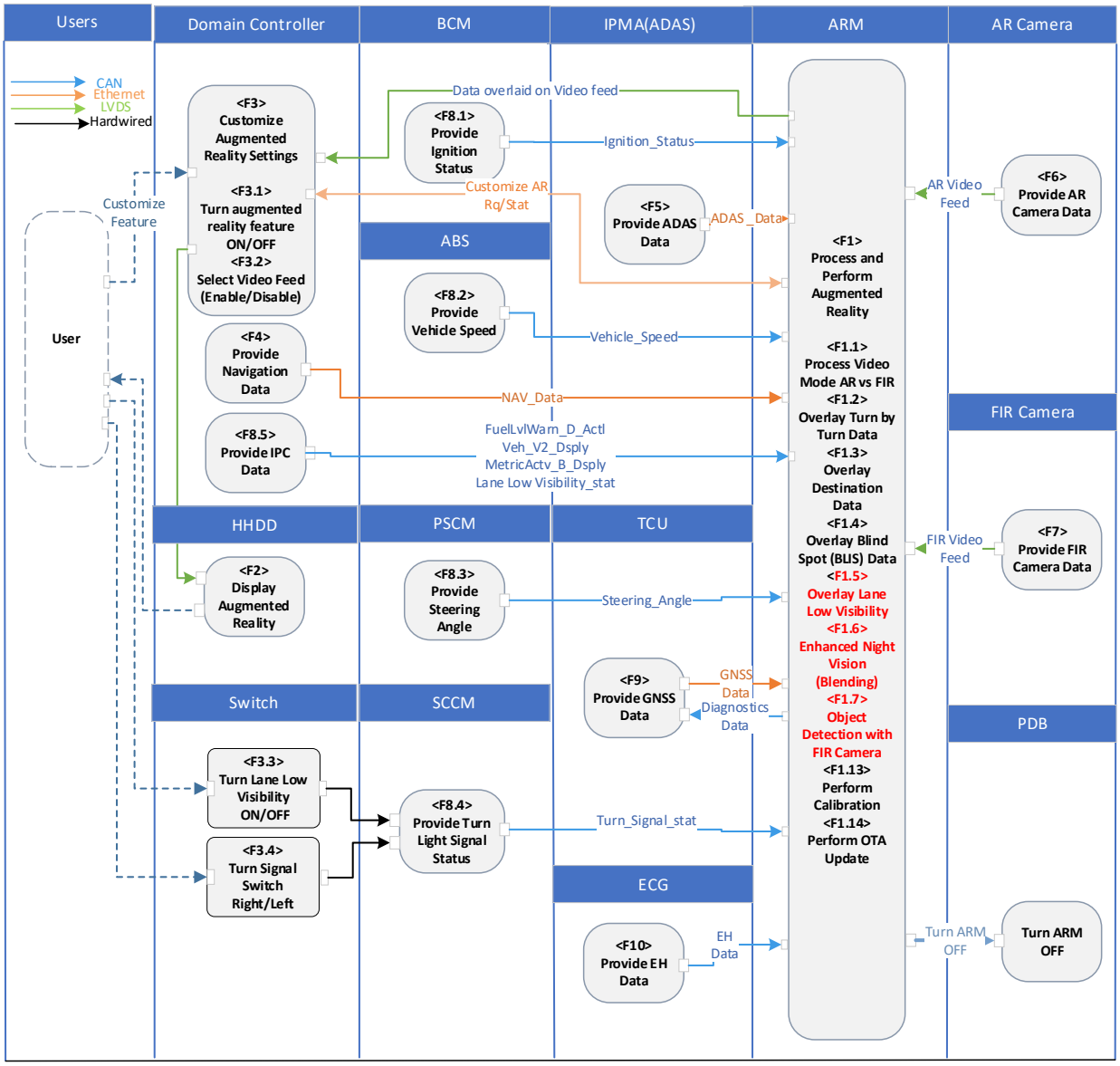


Table 3-3: Deployment Diagram

3.3.2 Function Allocation

Component	Technology Function Name	Logical Function Name
Phoenix Domain Controller (APIM_CDC) or DuerOS (APIM_CISM)	Select AR Feature	Select AR Feature
	Select Video background	Select Video background
	Select Lane Low Visibility ~~(Voice Command)~~	Select Lane Low Visibility
	Provide Navigation Data	Provide Navigation Data
	Control Augmented Reality Display	Control Augmented Reality Display
AR ECU (ARM)	Process Video Mode AR Camera vs FIR Camera	Process Video Mode AR Camera vs FIR Camera
	Overlay Turn by Turn Data	Overlay Turn by Turn Data
	Overlay Destination Data	Overlay Destination Data
	Overlay Blind Spot (BLIS) Data	Overlay Blind Spot (BLIS) Data
	Overlay Lane Low Visibility	Overlay Lane Low Visibility
	Enhanced Night Vision (Blending).	Enhanced Night Vision (Blending).
	Object Detection with FIR Camera	Object Detection with FIR Camera
	Perform Calibration	Perform Calibration
	Perform OTA Update	Perform OTA Update
AR Camera	Provide AR Camera Video Feed	Provide AR Camera Video Feed
FIR Camera	Provide FIR Camera Video Feed	Provide FIR Camera Video Feed
ADAS (IPMA)	Provide DAT Data	Provide DAT Data
TCU	Provide GNSS Data	Provide GNSS Data
BCM	Provide Vehicle Data	Provide Vehicle Data
SCCM	Provide Vehicle Data	Provide Vehicle Data
ABS	Provide Vehicle Data	Provide Vehicle Data
PSCM	Provide Vehicle Data	Provide Vehicle Data
ECG	Provide EH Data	Provide electronic horizon data

Table 3-4: Function Allocation Table (Basic)

Component		Technology Function Name	TSR	
Name	**ASIL**		**ID**	**ASIL**
Phoenix Domain Controller or DuerOS	QM	Select AR Feature		QM
		Select Video background		QM
		Select Lane Low Visibility		QM
		Provide Navigation Data		QM
		Control Augmented Reality Display		QM
ARM	QM	Process Video Mode AR vs FIR Camera		QM
		Overlay Turn by Turn Data		QM
		Overlay Destination Data		QM
		Overlay Blind Spot (BLIS) Data		QM
		Overlay Lane Low Visibility		TBD
		Enhanced Night Vision (Blending).		TBD
		Object Detection with FIR Camera		TBD
		Perform Calibration		QM
		Perform OTA Update		QM
AR Camera	QM	Provide AR Camera Video Feed		QM
FIR Camera	QM	Provide FIR Camera Video Feed		QM
BCM	QM	Provide Vehicle Data		QM
SCCM	QM	Provide Vehicle Data		QM
ABS	QM	Provide Vehicle Data		QM
PSCM	QM	Provide Vehicle Data		QM
ECG	QM	Provide EH Data		QM

Table 3-5: Function Allocation Table (Functional Safety Extension)

4 FEATURE IMPLEMENTATION MODELING

4.1 Component Interaction Diagrams

4.1.1 Scenario: “System Startup / Shutdown”

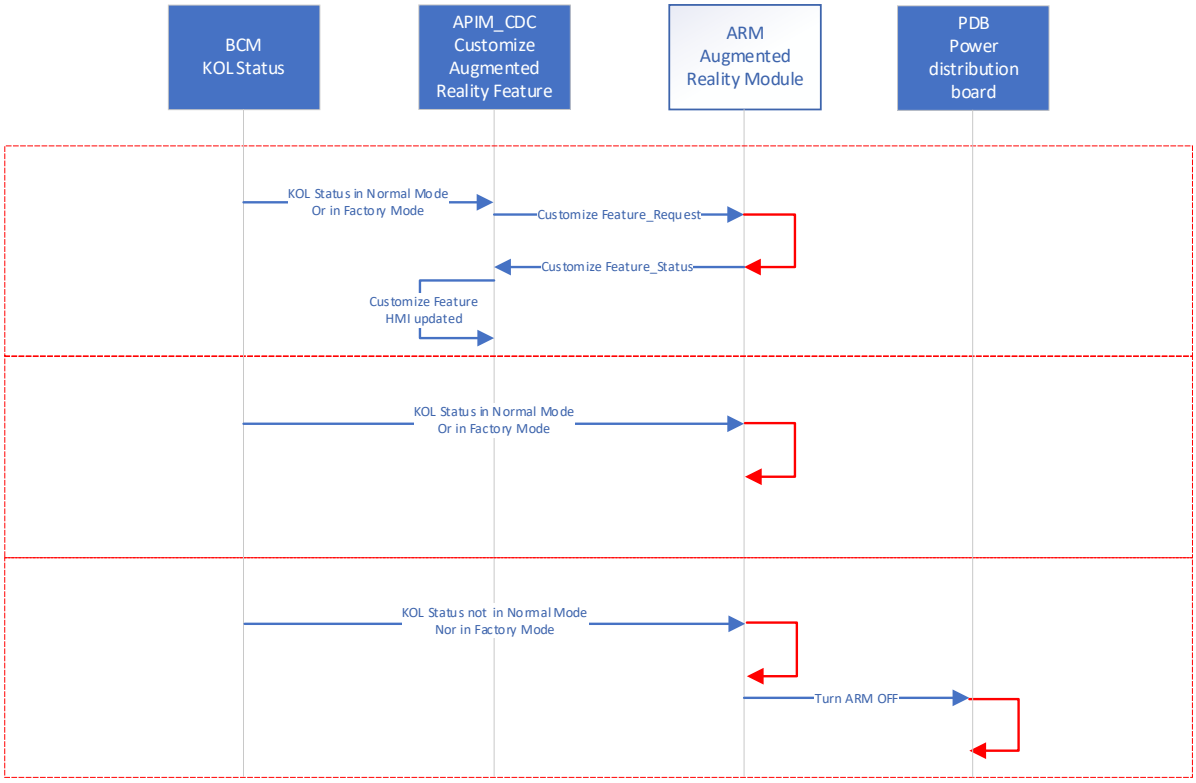


Figure 4-1: Scenario “System Startup / Shutdown”

4.1.2 Scenario: “Customize Augmented Reality Feature”

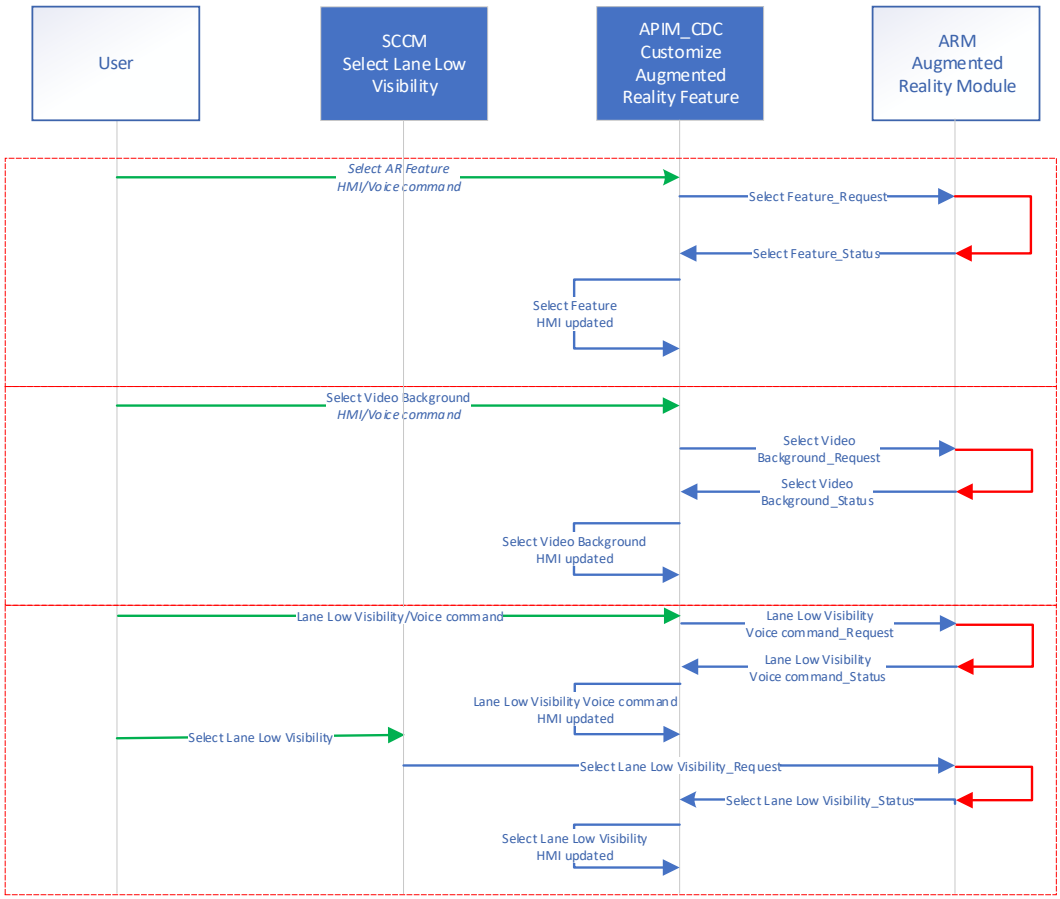


Figure 4-2: Scenario “Customize Augmented Reality Feature”

4.1.3 Scenario: “Process and Perform Augmented Reality”

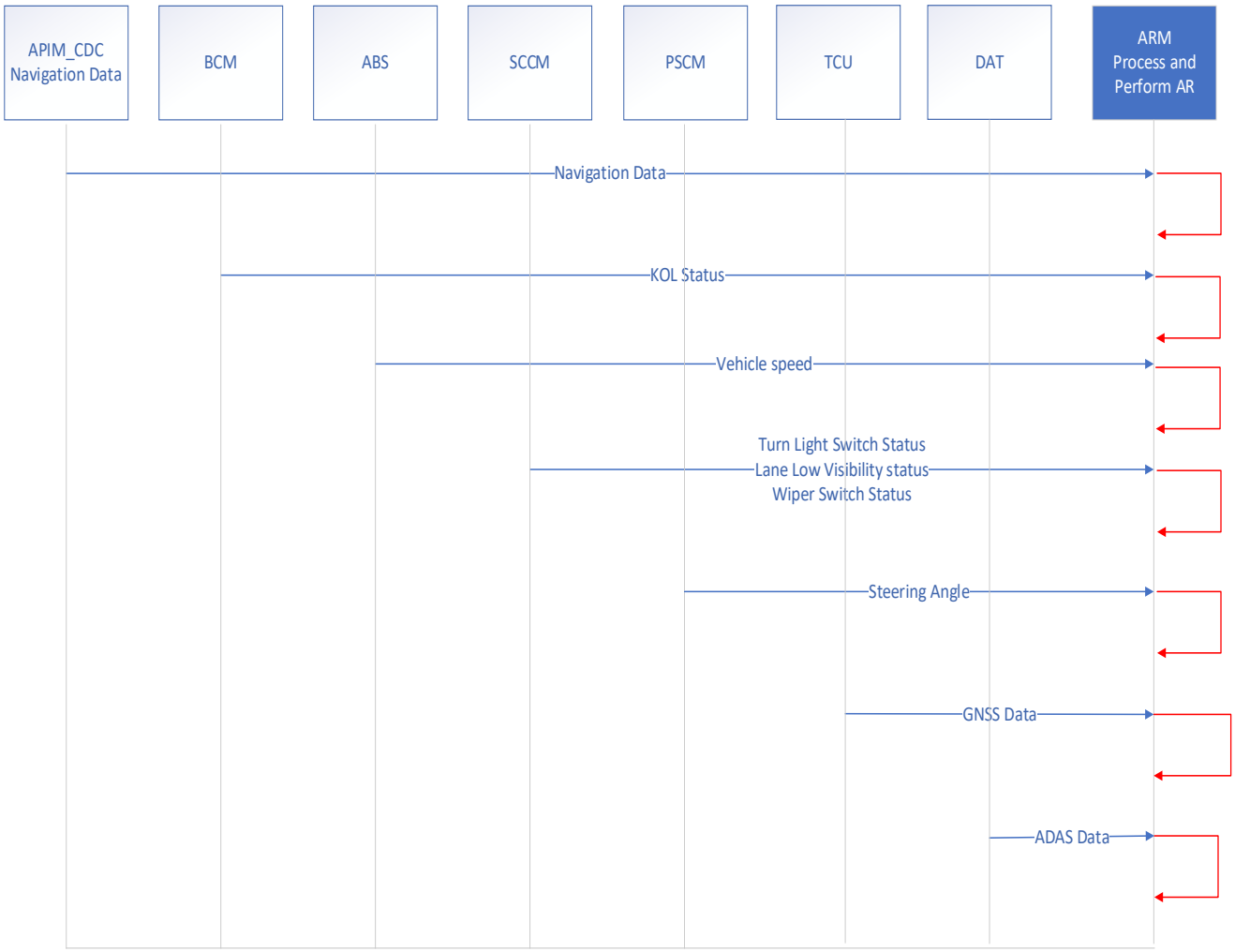


Figure 4-3: Scenario “Process and Perform Augmented Reality”

4.1.4 Scenario: “Process Video mode”

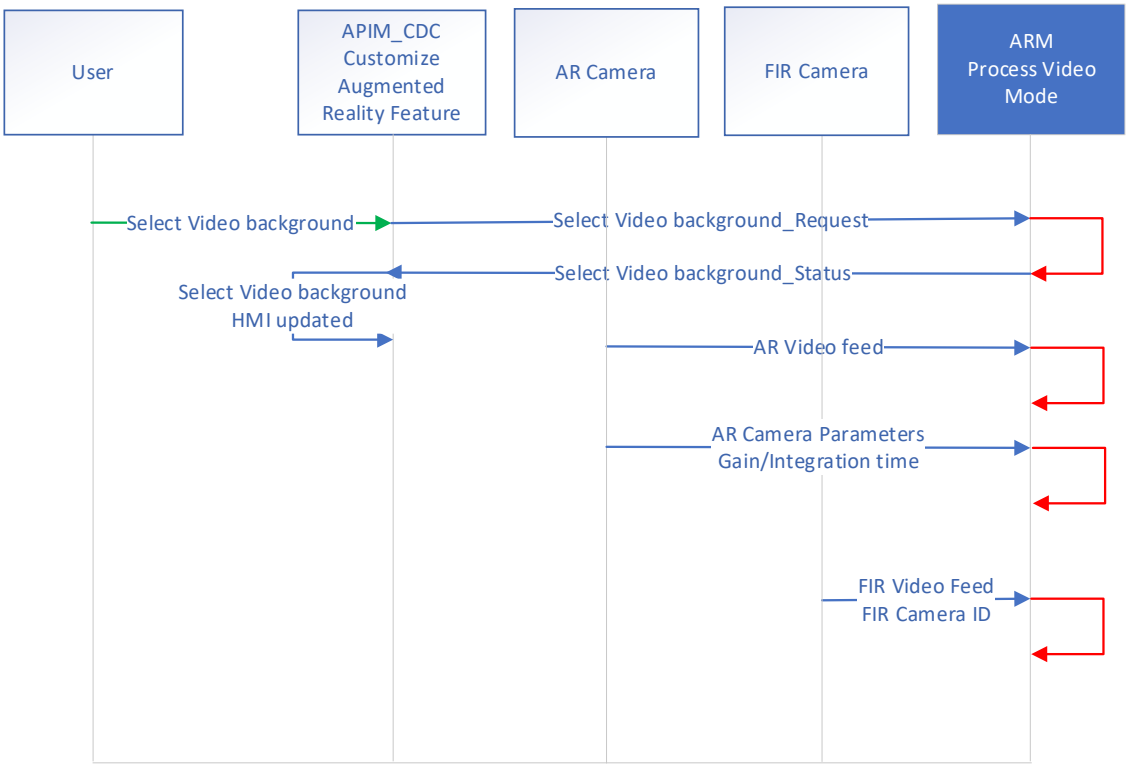


Figure 4-4: Scenario “Process Video mode”

The process shall follow the following steps (refer to FIR MVP Requirement v5.0 and Camera Gain for Augmented Reality Background Transition Point for more details):

Step1: Initial Checks
When the ARM recognizes a signal for the need to show an AR event on screen, the ARM shall first check if the following are true:
1- The ARM shall verify that the vehicle is equipped and configured to use the FIR camera
2- The ARM shall verify that the FIR camera is functioning
3- The ARM shall verify that the user has set the AR camera selection setting to Enable
If any of these requirements are not met, then the standard visible AR camera shall be used instead.

Step2: Decision to Use FIR Camera
The ARM shall determine which camera to use based on the following values.
1- AR camera’s gain
2- AR camera’s integration time
3- Time of Day (this information is already provided to the ARM for navigation use cases)
4- Vehicle Heading Information (this information is already provided to the ARM for navigation use cases)

Step3: History of Camera Frame Parameters

A rolling history of the AR camera parameters shall be stored over the course of the drive. This history is used to mitigate noise.

a- Short Term Frame Parameter History
The ARM shall hold a rolling memory of camera parameters from the last **60 frames** over the past **60**

seconds from before the AR event trigger has been received. These values are recorded at a periodic rate of **1 Hz / frame per second.**

1. The periodic sampling rate shall be configurable between **1 Hz and 60 Hz**
2. The number of sets of frame parameters to save in the short-term parameter history shall be configurable between **1 and 500.**
3. The time window for the short-term frame parameter history shall be configurable between **1 second and 120 seconds.**
   The maximum time window shall be limited by the rate of sampling for the camera parameters and the number of stored sets of frame parameters

b- Long Term Frame Parameter History
The ARM shall hold a rolling memory of camera parameters from the last **60 frames** over the past **5 minutes** before the short-term parameter history. These values are recorded at a periodic rate of **0.2 Hz / frame per second (or 12 frames per minute)**.

1. The periodic sampling rate shall be configurable between **0.01667 Hz (1 frame per minute) and 60 Hz**
2. The number of sets of frame parameters to save in the short-term parameter history shall be configurable between **1 and 500**
3. The time window for the long-term frame parameter history shall be configurable between **5 minutes and 10 minutes.**
   The maximum time window shall be limited by the rate of sampling for the camera parameters and the number of stored sets of frame parameters

c- Camera Parameter History Retention
After keying off, the ARM shall clear the short term history.
The ARM shall clear the long-term history after **6 minutes**. The time to clear the long-term history shall be configurable between **1 and 15 minutes**.

Step 4: Decision Logic
If the values for the gain and integration time are equal to or below the set thresholds that correlate to the SNR value reduction from optimal of **15% from optimal** dB with a tolerance of **+/- 5% from optimal** dB, then the FIR camera shall be selected as the background for the AR event. The optimal value shall be selected based on the procedure outlined in (**Camera Gain for Augmented Reality Background Transition Point for more details v1.1).**
If these values are above the set thresholds, then the standard visible AR camera shall be used instead. The values used for this decision are based on one of the following situations below.

1- Situation 1: Full Parameter History Log
The values for gain and integration time shall be chosen based on the average values over the short term history. If these values are greater or smaller compared to the average value over the long term history by [tolerance range(s)], then the average between the long term and short term averages shall be used as the final decision values.

2- Situation 2: Partially Filled Parameter History Log
The ARM shall choose the camera for AR as in Situation 1 but with a limited decision set.

1. If the camera parameters indicate that the AR camera would be chosen.

3- Situation 3: Empty Long-Term History Log with Partial/Full Short-Term History
The values for gain and integration time shall be chosen based on the average values over the short-term history.

1. If the AR camera is chosen, the ARM shall check to make sure that the vehicle is not driving into the sun using the time of day and GPS bearing
2. If the vehicle is driving East, North East, or South East between 6:00AM and 9:00AM in the morning, then the FIR camera shall be chosen for AR events
   a. The beginning and end times for this time window shall be configurable between 5:00AM and 10:00AM
3. If the vehicle is driving West, North West, or South West between 6:00PM and 9:00PM in the evening, then the FIR camera shall be chosen for AR events
   a. The beginning and end times for this time window shall be configurable between 5:00PM and 10:00PM

Step 5: Decision Timing
The camera background choice shall be made within **50 ms,** of the trigger for an AR event (timing should match AR camera).

4.1.5 Scenario: “Display Augmented Reality”

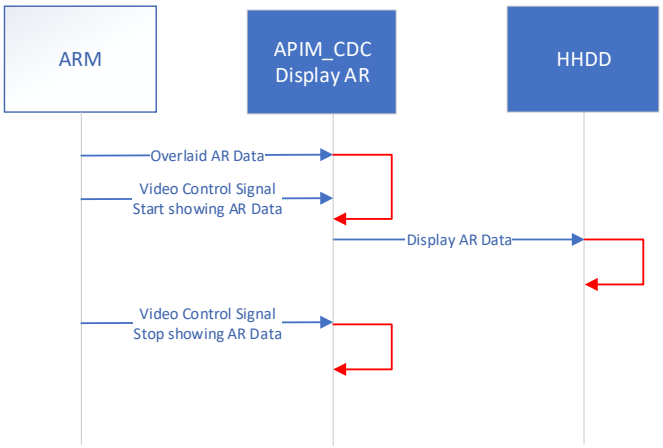


Figure 4-5: Scenario “Display Augmented Reality”

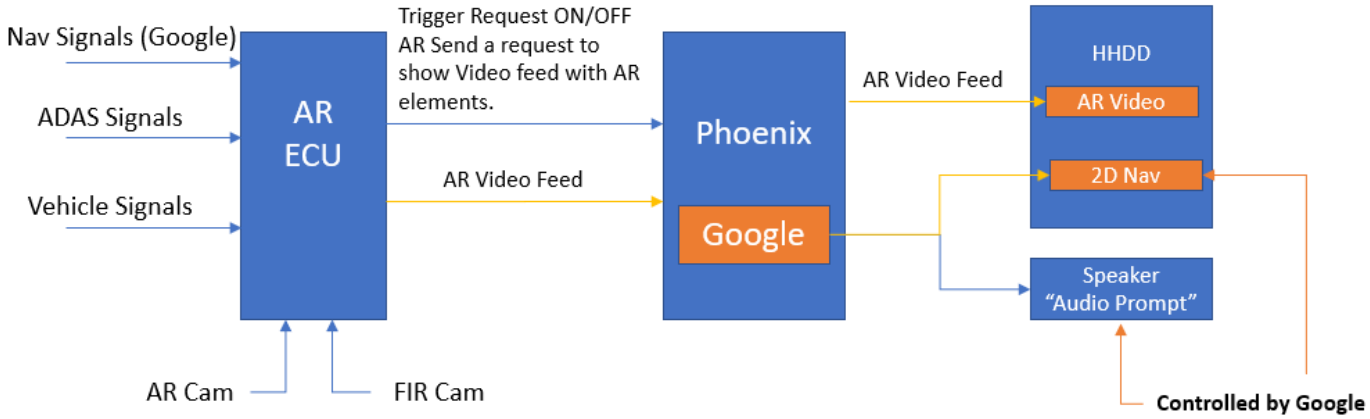


Figure 4-6: “Display Augmented Reality Control Process”

4.2 Component Interface Behavior Diagrams

#Hint: For complex (application level) interface protocols a protocol state machine would be more appropriate than a bunch of sequence diagrams to illustrate the interactions between components. So, this section would typically show a (protocol) state machine.

5 FEATURE IMPLEMENTATION REQUIREMENTS

5.1 Functional Safety

5.1.1 ASIL Decomposition of Technical Safety Requirements

The Augmented Reality Feature is QM. See Functional Safety (section 6) in the feature document.

5.2 Requirements on Components

5.2.1 ARM (AR ECU)

5.2.1.1 Technology Function “Process and Perform Augmented Reality”

5.2.1.1.1 Function Interfaces

5.2.1.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Comment**
Activate AR Feature	API name: setARFeature		Ethernet	
Activate Lane Low Visibility	TBD		Ethernet	Post<J1>OTA
Select video Mode	API name: setARVideoMode		Ethernet	
Navigation Status	TBD		Ethernet	
lane count info	TBD		Ethernet	
Speed limit value	TBD		Ethernet	
Route geometry	TBD		Ethernet	
Elevation data / 3D Road Geometry	TBD		Ethernet	
Distance to next maneuver	TBD		Ethernet	
Maneuver intersection geo location	TBD		Ethernet	
~~Maneuver street name~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
Maneuver phases from navigation system	TBD		Ethernet	
Road network geometry and topology (roundabout geometry)	TBD		Ethernet	
Following maneuver info	TBD		Ethernet	
~~Road links street names~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~Buildings position and address~~	~~TBD~~		~~Ethernet~~	Removed-currently not

				available due to Google signal availability
~~House number via navigation predicted route for Inactive route~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~House number via voice command for Inactive route~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~House number via voice command for active route~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~Name of building /business~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~Define common houses~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
Destination position and address	TBD		Ethernet	
Distance to destination	TBD		Ethernet	
~~Road restrictions (e.g. school, no entry, etc.)~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~Points of interest info: location, type, description~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~Conditional signals (for conditional POIs)~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
~~Footprint, number of levels, for façade highlighting~~	~~TBD~~		~~Ethernet~~	Removed-currently not available due to Google signal availability
Current lane position/direction	ServiceLaneData ServicePredPathDataService CBZData ServiceInPathData		Ethernet	
Ego vehicle in-lane offset				
HD lanes block				
Lane markings type				

Height Map/Elevation	ServiceLightsData ServiceSignData			
Target lane position/direction				
Object collision warning signal	ServicePedestrianData ServiceRoadTargetsData		Ethernet	
Distance to object				
Object position				
Object size				
BLIS_Right_Status	SodAlrtRight_D_Stat		HS3-CAN	
BLIS_Left_Status	SodAlrtLeft_D_Stat		HS3-CAN	
AR Video Feed			FPD-Link III	
FIR Video Feed			FPD-Link III	
AR Camera Gain			I2C	
AR Camera Integration Time			I2C	
Vehicle Data	FuelLvlWarn_D_Actl		HS3-CAN	
	Veh_V2_Dsply		HS3-CAN	
	MetricActv_B_Dsply		HS3-CAN	
	Ignition_Status		HS3-CAN	
	Remote_Start_Status		HS3-CAN	
	Parklamp_Status		HS3-CAN	
	Day_Night_Status		HS3-CAN	
	Litval		HS3-CAN	
	Dimming_Lvl		HS3-CAN	
	CrashEvnt_D_Stat		HS3-CAN	
	FogLghtFrontOn_B_Stat		HS3-CAN	
	KeyOffMde_D_Actl		HS3-CAN	
	VehOverGnd_V_Est		HS3-CAN	
	VehYawComp_W_Actl		HS3-CAN	
	VehRolComp_W_Actl		HS3-CAN	
	VehLatComp_A_Actl		HS3-CAN	
	VehLongComp_A_Actl		HS3-CAN	
	WhlFl_W_Meas		HS3-CAN	
	WhlFr_W_Meas		HS3-CAN	
	WhlRl_W_Meas		HS3-CAN	
	WhlRr_W_Meas		HS3-CAN	
	StePinComp_An_Est		HS3-CAN	
	StePinCompAnEst_D_Qf		HS3-CAN	
	TurnLghtSwtch_D_Stat		HS3-CAN	
	WiprFrontSwtch_D_Stat WiprFront_D_Stat		HS3-CAN	
Latitude	LocationServices		Ethernet	
Longitude				
Height				
Moving direction				
Calculated speed				
VDOP				
HDOP				
PDO				
Position	EH Data		HS3-CAN	
Segment				
Stub				
Profile Short				
Profile Long				
Meta-Data				

Table 5-1: Input Signal mappings of Function "Process and Perform Augmented Reality"

5.2.1.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Overlaid Data			FPD-Link	
Video Control Signal	API name: VideoFeedControl		Ethernet	
AR feature status	API name: setARFeature		Ethernet	
Lane Low Visibility Status	TBD		Ethernet	
Video Mode Status	API name: setARVideoMode		Ethernet	
Turn ARM OFF	AugRealtyMdule_B_Rq		HS3-CAN	
Fault Msg Requ	TBD		HS3-CAN	

Table 5-2: Output Signal mappings of Function "Process and Perform Augmented Reality"

5.2.1.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**
AR image cropping amount				Configrable paratmers Deafult = 15%
FIR image cropping amount				Configrable paratmers Deafult = 0% The amount of cropping from the bottom of the image shall be configurable between 0 and 200 pixels The amount of cropping from the top of the image shall be configurable between 0 and 200 pixels

Table 5-3: Parameter mappings of Function "Process and Perform Augmented Reality"

5.2.1.1.1.4 Interface Requirements

###R_CMP_AR_00056### ARM Video Interface to APIM_CDC (DuerOS)

The ARM shall have the video interface to Phoenix (APIM_CDC) / DuerOS (APIM_CISM) through LVDS connection / FPD-Link with 60Hz frame rate and YUV422 data format.
The ARM shall use a Ford approved FPD Link serializer

	The ARM shall have video interface LVDS connection /FPD-Link with Phoenix (APIM_CDC) / DuerOS (APIM_CISM

End of Requirement

###R_CMP_AR_00057### ARM Interface to AR Camera

The ARM (AR ECU) shall have the interface to AR camera as below:

1. The AR ECU shall be designed with a Ford approved coax connector for the FPD Link applications.
2. The AR ECU shall use a Ford approved FPD Link de-serializer.
3. The AR ECU shall meet the electrical FPD Link requirements in RQT-000601-023124.
4. The AR ECU shall be capable of delivering 2.1W to the AR Camera component as measured at the AR camera component.
5. The AR ECU shall be able to power AR camera for input voltage from 6V to 13V as measured at the AR Camera I/O connector.
6. The AR ECU shall deliver a DC regulated voltage as measured at the AR ECU connector I/O (to meet #5). The AR ECU shall assume 14m of RTK-031 for worst case DC wiring voltage drop (the 14m coax length is a recommendation).
7. The AR ECU shall meet the output protection requirements in RQT-191001-009853.
8. The AR ECU shall meet the output short circuit protection requirements in RQT-191001-009855.
9. The AR ECU shall meet the output diagnostic detection capability requirements in RQT-191001-009856.
10. The AR ECU shall configure 24 bit Dynamic range for AR camera.
11. The AR ECU shall configure 25MHz of clock input to AR camera.
12. The AR ECU shall utilize 12 bit RAW data from AR camera to feed to ISP on ECU for image quality tuning for AR camera.
13. The AR ECU shall configure MIPI CSI-2 data rate per recommendation from image sensor supplier for AR camera. The current recommendation is 222.75MHz.

For more details, refer to the latest AR and FIR Camera Interface requirement to AR ECU (this link)
[AUGREAL-59] AR FIR camera interface requirements - FORD JIRA

	The ARM shall have video interface LVDS connection /FPD-Link with AR Camera

End of Requirement

###R_CMP_AR_00058### ARM Interface to FIR Camera – If vehicle is equipped with FIR camera

The ARM (AR ECU) shall have the interface to FIR camera as below:

1. The AR ECU shall be designed with a Ford approved coax connector for the FPD Link applications.
2. The AR ECU shall use a Ford approved FPD Link de-serializer.
3. The AR ECU shall meet the electrical FPD Link requirements in RQT-000601-023124.
4. The AR ECU shall be capable of delivering 5W to the FIR Camera component as measured at the FIR camera component.
5. The AR ECU shall be able to power the FIR Camera component for input voltage from 6V to 19V as measured at the FIR Camera I/O connector.

6. The AR ECU shall deliver a DC regulated voltage as measured at the AR ECU connector I/O (to meet #5). The AR ECU shall assume 14m of RTK-031 for worst case DC wiring voltage drop (the 14m coax length is a recommendation).
7. The AR ECU shall meet the output protection requirements in RQT-191001-009853.
8. The AR ECU shall meet the output short circuit protection requirements in RQT-191001-009855.
9. The AR ECU shall meet the output diagnostic detection capability requirements in RQT-191001-009856.
10. The AR ECU shall utilize Challenge Handshake Authentication Protocol (CHAP) to form secure connection with FIR Camera.
11. The AR ECU shall complete initial CHAP at power up within 750(+/-30%) msec.

For more details, refer to the latest AR and FIR Camera Interface requirement to AR ECU (this link)
[AUGREAL-59] AR FIR camera interface requirements - FORD JIRA

	The ARM shall have video interface LVDS connection /FPD-Link with FIR Camera

End of Requirement

###R_CMP_AR_00059### ARM Ethernet Interface

The ARM shall have Ethernet (SOA) interface with the following ECU's through ECG (Gateway).

1- APIM_CDC(Phoenix) or APIM_CISM(DuerOS).
2- TCU
3- IPMA(ADAS)
4- ECG

	The ARM shall communicate on Ethernet interface with APIM, TCU, IPMA, and ECG

End of Requirement

###R_CMP_AR_00060### ARM CAN Interface

The ARM shall communicate on CAN Bus with the following ECU's through ECG (Gateway).

1- BCM.
2- ABS.
3- APIM_CDC(Phoenix) or APIM_CISM (DuerOS).
4- IPMA(ADAS)
5- PSCM.
6- SCCM.
7- PDB
8- ECG.

	The ARM shall communicate on CAN Bus with BCM, ABS, APIM, IPMA, PSCM, SCCM, PDB, ECG

End of Requirement

5.2.1.1.2 Function Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00001		Unchanged		
R_CMP_AR_00002		Unchanged		
R_CMP_AR_00003		Unchanged		

R_CMP_AR_00004		Modified		
R_CMP_AR_00005		Modified		
R_CMP_AR_00006		Unchanged		
R_CMP_AR_00007		Modified		
R_CMP_AR_00008		Modified		
R_CMP_AR_00009		Modified		
R_CMP_AR_00010		Modified		
R_CMP_AR_00011		Unchanged		
R_CMP_AR_00012		Replaced		R_CMP_AR_00057 R_CMP_AR_00058
R_CMP_AR_00013		Modified		
R_CMP_AR_00014		Modified		
R_CMP_AR_00055		Modified		
R_CMP_AR_00056		Modified		
R_CMP_AR_00057		Modified		
R_CMP_AR_00058		Modified		
R_CMP_AR_00059		Modified		
R_CMP_AR_00060		Unchanged		
R_CMP_AR_00061		Modified		
R_CMP_AR_00062		Modified		
R_CMP_AR_00081		Modified		
R_CMP_AR_00082		Modified		
R_CMP_AR_00083		Added		
R_CMP_AR_00084		Added		
R_CMP_AR_00085		Added		
R_CMP_AR_00104		Added		

Table 5-4: Component Specific Requirements

All Function Requirements related to Process and Perform Augmented Reality from Function Specification (Version 2.2) (ID_F003774) in sections (4.1 to 4.16) are valid and required for implementation specified below in the table.

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00001		
R_FNC_AR_00002		
R_FNC_AR_00004		
R_FNC_AR_00005		
R_FNC_AR_00006		
R_FNC_AR_00007		
R_FNC_AR_00008		
R_FNC_AR_00009		
R_FNC_AR_00010		
R_FNC_AR_00011		
R_FNC_AR_00012		
R_FNC_AR_00014		
R_FNC_AR_00015		
R_FNC_AR_00016		
R_FNC_AR_00120		
R_FNC_AR_00017		
R_FNC_AR_00018		
R_FNC_AR_00121		
R_FNC_AR_00122		
R_FNC_AR_00123		

R_FNC_AR_00124		
R_FNC_AR_00125		
R_FNC_AR_00046		
R_FNC_AR_00047		
R_FNC_AR_00048		
R_FNC_AR_00052		
R_FNC_AR_00054		
R_FNC_AR_00055		
R_FNC_AR_00056		
R_FNC_AR_00148		
R_FNC_AR_00057		
R_FNC_AR_00058		
R_FNC_AR_00059		
R_FNC_AR_00060		
R_FNC_AR_00061		
R_FNC_AR_00062		
R_FNC_AR_00126		
R_FNC_AR_00127		
R_FNC_AR_00063		
R_FNC_AR_00065		
R_FNC_AR_00066		
R_FNC_AR_00128		
R_FNC_AR_00129		
R_FNC_AR_00130		
R_FNC_AR_00067		
R_FNC_AR_00131		
R_FNC_AR_00068		
R_FNC_AR_00132		
R_FNC_AR_00133		
R_FNC_AR_00134		
R_FNC_AR_00135		
R_FNC_AR_00136		
R_FNC_AR_00137		
R_FNC_AR_00138		
R_FNC_AR_00139		
R_FNC_AR_00140		
R_FNC_AR_00141		
R_FNC_AR_00142		
R_FNC_AR_00092		
R_FNC_AR_00093		
R_FNC_AR_00094		
R_FNC_AR_00095		
R_FNC_AR_00096		

Table 5-5: Inherited Requirements

5.2.1.1.2.1 Component Specific Requirements

###R_CMP_AR_00001### ARM Diagnostics DTC

The ARM shall set a DTC for the following events

1- AR camera fault

2- FIR camera fault
3- Loss of communication and invalid data
4- Calibration failure
5- Stuck image from AR Camera or FIR camera
6- FIR Camera swap
7- AR or FIR Image Quality below threshold (e.g., >2 missing consecutive frame rate out of 30 fps)
8- AR or FIR camera blocked or dead pixels

	The ARM shall set a DTC for fault events

End of Requirement

###R_CMP_AR_00083### ARM Fault Message to APIM

The ARM shall send a CAN signal (TBD) to APIM to notify it when a fault diagnostic DTC is set

	ARM shall send a CAN signal (TBD) to APIM to notify it when a fault diagnostic DTC is set

End of Requirement

###R_CMP_AR_00002### Reading FIR Camera ID

The ARM shall read and verify the FIR camera IDs.

	The ARM shall read and verify the FIR camera IDs

End of Requirement

###R_CMP_AR_00003### AR Configuration DID

The ARM shall have a DID to allow to be configurable to support different AR feature configurations.
0 x 0 == OFF
0 x1 == ON with No FIR Camera (if vehicle is not equipped with FIR camera)
0 x 2 = ON with FIR Camera (if vehicle is equipped with FIR camera)

	The ARM shall have a Configuration DID

End of Requirement

###R_CMP_AR_00103### ARM Rendering Color Format

The ARM shall use color format (YUV422)

	The ARM shall use color format (YUV422)

End of Requirement

###R_CMP_AR_00004### AR Store Data Analytic DID or DTC

The ARM shall have a DID or DTC to allow to store a data analytic required for the augmented reality feature (refer to section 5.4.3.1 Data analytics requirements in feature document for details).

Turn by Turn AR data analytics for output to HHDD

When the AR turn by turn is triggered, the ARM shall provide the data analytics of the AR turn by turn and record the turn by turn event(failure modes) through the connected vehicle services to have data analysis throughout the following:

- How often does the AR turn by turn is requested when maneuver trigger > 0.1 for city and >0.2 for highway received from navigation system
- How often does the AR turn by turn is requested without a user set a destination in navigation system
- How many times per drive cycle, hours in operation, per week, month, year, etc. AR turn by turn are shown with blue turn by turn arrow when speed of the vehicle is higher than speed limit?
- How many times per drive cycle, hours in operation, per week, month, year, etc. AR turn by turn are shown with Amber turn by turn arrow when speed of the vehicle is below speed limit?
- When AR turn by turn trigger is completed, how long it takes ARM to send a request to stop show AR window (in scenario no other AR trigger is active).
- How often does the AR turn by turn display on AR window show overlap with an object in front of the host vehicle (car, pedestrian, bike, motorcycle, etc.)
- How often does the AR turn by turn display on AR window show a wiper motion? What was the wiper motion speed when AR view is triggered?

Destination AR data analytics for output to HHDD

When the AR destination is triggered, the ARM shall provide the data analytics of the AR destination (failure modes) and record the destination event through the connected vehicle services to have data analysis throughout the following:

- How often does the AR destination is requested when user does not set a destination in navigation system (No active route)
- How many times per drive cycle, hours in operation, per week, month, year, etc. AR destination symbol are shown without show checkboard after reaching destination.
- How many times per drive cycle, hours in operation, per week, month, year, etc. AR destination symbol are not shown but the checkboard is shown after reaching destination.
- How many times per drive cycle, hours in operation, per week, month, year, etc. AR destination symbol and checkerboard are not shown after reaching destination.
- How often does the AR destination checkerboard display on AR window show overlap with an object in front of the host vehicle (car, pedestrian, bike, motorcycle, etc.)
- How often does the AR destination display on AR window show a wiper motion? What was the wiper motion speed when AR view is triggered?
- How long does it take for ARM to send stop show destination window, after driver arrive destination (assume no other AR triggers?

Blindspot AR data analytics for output to HHDD

When the AR blind spot is triggered, the ARM shall provide the data analytics of the AR blind spot (failure modes) and record the blind spot event through the connected vehicle services to have data analysis throughout the following:

- When AR blind spot is requested, how long it takes to ARM to send start show AR window
- How long it takes ARM to send stop show AR window, when BLIS trigger ends and no other AR trigger is active

- How often does the AR blind spot is requested when ADAS blind spot is not active?
- How often does the AR blind spot is requested when ADAS left blind spot is active and customer does not activate left turn signal
- How often does the AR blind spot is requested when ADAS right blind spot is active and customer does not activate right turn signal
- How often does the AR blind spot display on AR window show overlap with an object in front of the host vehicle (car, pedestrian, bike, motorcycle, etc.)
- How often does the AR blind spot display on AR window show a wiper motion? What was the wiper motion speed when AR view is triggered?

Failure mode Night Vision AR data analytics for output to HHDD

The ARM shall record the data analytics for the failure mode of AR night vision based on below events through the connected vehicle services to have data analysis throughout the following:

- How often does the AR window is shown with FIR image background, when user select AR select mode (AR night vision) setting Disable.
- How often does the AR window is shown with FIR image background, when user select AR select mode (AR night vision) setting Enable but light threshold (AR camera gain threshold) is < threshold (TBD)
- How often does the AR window is shown with AR image background, when user select AR select mode (AR night vision) setting Enable but light threshold (AR camera gain threshold) is >= threshold (TBD)
- How often does the AR window is transition between AR image background to FIR image background (or opposite), while current AR event is active

AR Failure Messages

The ARM shall record the data analytics of the faults messages appear on the HMI and the reason of the faults based on below events through the connected vehicle services to have data analysis throughout the following:

- How many times the fault messages are due to fault in AR camera
- How many times the fault messages are due to fault in FIR camera
- How many times the fault messages are due to miss communication between components or invalid data

	ARM shall have a DID or DTC to store data required for the augmented reality feature

End of Requirement

###R_CMP_AR_00006### ARM OTA Capability

The ARM shall be capable to receive fast OTA.

End of Requirement

###R_CMP_AR_00005### AR Video Trigger

The ARM shall send trigger request signal to start or stop display AR video content (on ethernet) to APIM with information about the AR content.

Video control API name: VideoFeedControl

Method Type	Fire&Forget
QoS Level	Default
Retained	No

R/O	Name	Type	Literals	Value	Description
Request					
R	DisplayARView	Enum	-	-	The request to start/stop showing the AR view on HHDD
			Start	0x0	
			Stop	0x1	
Response					
-	-	-	-	-	-

	ARM shall send trigger request signal to start or stop display AR window

End of Requirement

###R_CMP_AR_00007### ARM Activate/Deactivate AR Feature

ARM shall reply with status signal when receiving a request signal to turn AR feature ON/OFF from APIM.

AR Settings – Turn ON/OFF AR
API name: setARFeature

This API is used to send the request to ARM to activate/deactivate AR feature. The ARM also uses this API for its response.

Method Type	One-Shot (Synch)
QoS Level	Default
Retained	No

R/O	Name	Type	Literals	Value	Description
Request					
R	SetAR	Enum	-	-	N/A
			OFF	0x0	Used to turn OFF the AR feature
			ON	0x1	Used to turn ON the AR feature
Response					
R	ARStatus	Enum	-	-	Used to indicate status of AR feature
			OFF	0x0	
			ON	0x1	

	ARM shall reply with status signal when receiving a request to turn the feature OnOff

End of Requirement

###R_CMP_AR_00008### ARM Enable/Disable Video Mode

ARM shall receive video mode activation signal request from APIM and shall send back a status signal. The ARM shall follow the selection process of the camera based on the steps described in section 4.1.4.

AR Settings – Select AR Video Mode
API name: setARVideoMode

This API is used to send the request to ARM to select AR video mode. The ARM also uses this API for its response.

Method Type	One-Shot (Synch)
QoS Level	Default
Retained	No

R/O	Name	Type	Literals	Value	Description
Request					
R	SetVideoMode	Enum	-	-	N/A
			Disable	0x0	The AR feature uses AR visible camera only

			Enable	0x1	The AR feature switches automatically between the AR vs FIR camera based on the AR Outside Light Level Adaptation
Response					
R	VideoModeStatus	Enum	-	-	Used to indicate current status of video mode
			Disabled	0x0	
			Enabled	0x1	

	ARM shall reply with status signal when receiving a request to Enable or disable the video mode.

End of Requirement

###R_CMP_AR_00009### ARM Activate/Deactivate Lane Low Visibility (Post <J1> OTA)

ARM shall receive lane low visibility activation signal request (TBD) from APIM and shall send back a status signal

	Lane low visibility activation signal request (TBD) received from APIM to activate the feature and shall send status signal to APIM

End of Requirement

###R_CMP_AR_00010### Video Feed- Resolution (Cropping)

The ARM shall crop the AR camera FoV to 85% of the native view such that the proximity of environmental objects would appear more realistic to the driver. The cropping value amount shall be configrable parameter.

	The ARM shall crop the AR camera FoV to 85% of the native view and amount of copiing is configurable parameter

End of Requirement

~~###R_CMP_AR_00012### ARM Powering Capability for AR and FIR Cameras~~

~~Note: Replaced with R_CMP_AR_00057 and R_CMP_AR_00058~~

~~The ARM shall be able to provide power to the AR camera and FIR camera as below:~~
~~1- The AR Camera component shall meet performance requirements for input voltage from 6V to 13V as measured at the AR Camera I/O connector.~~
~~2- The AR Camera component shall draw less than or equal to 2.1W.~~
~~3- The FIR Camera component shall meet performance requirements for input voltage from 6V to 19V as measured at the FIR Camera I/O connector.~~
~~4- The FIR Camera component shall draw less than or equal to 5W.~~

	~~The ARM shall be able to provide power to the AR camera and FIR camera as below:~~ ~~1- The AR Camera component shall meet performance requirements for input voltage from 6V to 13V as measured at the AR Camera I/O connector.~~ ~~2- The AR Camera component shall draw less than or equal to 2.1W.~~ ~~3- The FIR Camera component shall meet performance requirements for input voltage from 6V to 19V as measured at the FIR Camera I/O connector.~~ ~~4- The FIR Camera component shall draw less than or equal to 5W.~~

~~End of Requirement~~

###R_CMP_AR_00055### FIR Cameras Image Manipulation

The ARM shall be able to provide FIR Image Manipulation. The ARM shall be able to crop the FIR image and then up-sample it as described below.

1- The amount of cropping from the bottom of the image shall be configurable between 0 and 200 pixels
2- The amount of cropping from the top of the image shall be configurable between 0 and 200 pixels.
3- The cropped FIR image shall be up sampled so that the new increased height matches the AR window.
4- The ARM shall accommodate the differences in camera perspective, resolution, field of view, and aspect ratio when rendering AR overlays onto the FIR camera background view.

The amount of cropping shall be determined, in conjunction with, and approved by a Ford D&R based on target vehicle mounting

	ARM shall be able to crop and then up- sample the FIR image

End of Requirement

###R_CMP_AR_00084### ARM Selection Between AR Camera and FIR Camera

ARM shall use the AR camera feed or FIR camera feed for the AR video background based on the values for the gain and integration time of the AR camera.
If the values for the gain and integration time are **equal to or below** the set thresholds that correlate to the SNR value, then the FIR camera shall be selected as the background for the AR event.
If these values are **above** the set thresholds, then the AR camera shall be used instead.
The optimal value shall be selected based on the procedure outlined in (Camera Gain for Augmented Reality Background Transition Point for more details v1.1).

	ARM shall be able to select between the AR camera feed or FIR camera feed based on the values for the gain and integration time of the AR camera

End of Requirement

###R_CMP_AR_00013### ARM Video Rendering Concurrent Display

ARM shall allow the concurrent display of AR features (i.e., show turn-by-turn maneuver with blind spot). The AR view shall remain if at least one feature metaphor is active. Once one of the trigger events expire, the feature metaphor animation shall fade out with a 250 ms.

	The metaphors for each AR feature are designed to complement each other when concurrently displayed for any given environmental situation.
	Concurrent display of AR features (i.e., show turn-by-turn maneuver with blind spot) shall be allowed. Once one of the trigger events expire, the feature metaphor animation shall fade out with a 250 ms..

End of Requirement

###R_CMP_AR_00014### Rendering Font/Text Size (In case required in future)

The ARM shall render the text that supported for all languages, and language 's font shall be consistent with Ford's regulated "Ford Antenna" - Ford Latin Characters, non-Latin other fonts. For Lincoln vehicle Latin characters- "Madera" font shall be used. The minimum text size will follow RQT-002003-021808 (Legibility Text).

	The minimum text size will follow RQT-002003-021808

End of Requirement

###R_CMP_AR_00061### Wiper Motion Removal from Video Feed

In case the wiper motion is active/moving and within the AR camera FOV, the ARM shall digitally remove the wiper motion from the AR view with minimal noticeable lag for the driver.

	The ARM shall digitally remove the wiper motion from the AR view with minimal noticeable lag for the driver, In case the wiper motion is active/moving and within the AR camera FOV

End of Requirement

###R_CMP_AR_00062### ARM Operation Modes

The ARM shall operate with full functionality to support the AR feature if the latest known status of Key OFF Load (KOL) Modes (KeyOffMde_D_Actl) is in Normal or Factory mode.

	ARM shall operate with full functionality if the latest known status of Key OFF Load (KOL) Modes is in Normal or Factory mode

End of Requirement

###R_CMP_AR_00011### ARM processing Latency

The ARM processing latency shall be ≤ (50ms).

	The ARM processing latency shall be ≤ (50ms).

End of Requirement

###R_CMP_AR_00081### ARM Perform Calibration - EOL

The ARM shall be able to perform EOL calibration for AR and FIR cameras.

	The ARM shall be able to perform EOL calibration for AR and FIR cameras.

End of Requirement

###R_CMP_AR_00082### ARM Perform Calibration - Service

The ARM shall be able to perform service calibration for AR and FIR cameras.

	The ARM shall be able to perform service calibration for AR and FIR cameras.

End of Requirement

###R_CMP_AR_00085### ARM Memory Allocation

The ARM shall allocate computation resource (size TBD) to integrate FIR Camera supplier software in case of image quality optimization support required from ARM.
The ARM shall configure FIR Camera as detailed in FIR Camera supplier communication protocol specification (to be obtained via sourced supplier). This includes, but not limit to,

1- Serializer Configuration Registers,
2- Serializer Status Registers,
3- Video Stream Configuration.

	The ARM shall allocate computation resource (size TBD) to integrate FIR Camera supplier software

End of Requirement

###R_CMP_AR_00104### ARM request to Power OFF by PDB

The ARM shall send power OFF (AugRealtyMdule_B_Rq=0x00) request to PDB after (TBD)sec from ignition status OFF.

	The ARM shall send power OFF (AugRealtyMdule_B_Rq=0x00) request to PDB after (TBD)sec from ignition status OFF.

End of Requirement

5.2.2 APIM_CDC (Phoenix) or APIM_CISM (DuerOS)

5.2.2.1 Technology Function “Display Augmented Reality”

5.2.2.1.1 Function Interfaces

5.2.2.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*
Overlaid Data	TBD		FPD-Link	

Video Control Signal	API name: VideoFeedControl		Ethernet	
KOL Status	KeyOffMde_D_Actl		HS3-CAN	
Fault Msg Requ	TBD		HS3-CAN	

Table 5-33: Input Signal mappings of Function "Display Augmented Reality"

5.2.2.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
HHDD Data	TBD		FPD-Link	

Table 5-64: Output Signal mappings of Function "Display Augmented Reality"

5.2.2.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-35: Parameter mappings of Function "Display Augmented Reality"

5.2.2.1.1.4 Interface Requirements

###R_CMP_AR_00025### APIM Video Interface to ARM

The APIM_CDC or (APIM_CISM) shall receive the video feed from ARM through LVDS connection / FPD-Link with 60Hz frame rate and YUV422 data format
The APIM shall use a Ford approved FPD Link de-serializer

	shall receive the video feed from ARM through LVDS connection / FPD-Link with 60Hz frame rate and YUV422 data format

End of Requirement

###R_CMP_AR_00063### APIM Video Interface to HHDD

The APIM_CDC or (APIM_CISM) shall send the video feed to HHDD through LVDS connection / FPD-Link with 60Hz frame rate and YUV422 data format

	shall send the video feed to HHDD through LVDS connection / FPD-Link with 60Hz frame rate and YUV422 data format

End of Requirement

5.2.2.1.2 Function Requirements

All Function Requirement related to Display Augmented Reality from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	Requirement Title	Modification	Requirement ID (of Technology Function)	Comment
R_CMP_AR_00022		Removed		
R_CMP_AR_00023		Modified		
R_CMP_AR_00024		Modified		
R_CMP_AR_00025		Modified		
R_CMP_AR_00026		Unchanged		
R_CMP_AR_00053		Modified		
R_CMP_AR_00063		Modified		
R_CMP_AR_00078		Modified		
R_CMP_AR_00079		Modified		
R_CMP_AR_00086		Added		
R_CMP_AR_00087		Added		
R_CMP_AR_00088		Added		

Table 5-36: Component Specific Requirements

Requirement ID (of Logical Function)	Requirement Title	Comment
R_FNC_AR_00097		
R_FNC_AR_00143		
R_FNC_AR_00098		
R_FNC_AR_00099		
R_FNC_AR_00144		
R_FNC_AR_00145		
R_FNC_AR_00146		
R_FNC_AR_00147		
R_FNC_AR_00109		
R_FNC_AR_00113		
R_FNC_AR_00097		

Table 5-37: Inherited Requirements

5.2.2.1.2.1 Component Specific Requirements

~~###R_CMP_AR_00022### Display Augmented Reality On ignition RUN~~

Note: Deleted/Replaced
~~The APIM-CDC shall send the video to the HHDD while ignition status = run.~~

End of Requirement

###R_CMP_AR_00086### APIM AR Window Trigger

APIM_CDC or (APIM_CISM) module shall start showing the AR window when receiving **Start** AR display request from ARM (if no higher priority event e.g. global alerts or warnings is active), and shall stop showing the AR window when receiving **Stop** AR display request from ARM.

API name: VideoFeedControl

This API is used to receive the request from ARServer to start/stop the AR view display.

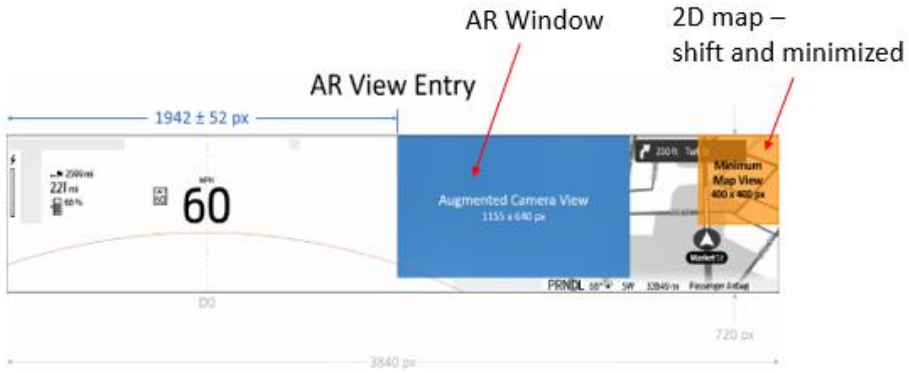
Method Type	Fire&Forget				
QoS Level	Default				
Retained	No				
R/O	Name	Type	Literals	Value	Description
Request					
R	DisplayARView	Enum	-	-	The request to start/stop showing the AR view on HHDD
			Start	0x0	
			Stop	0x1	
Response					
-	-	-	-	-	-

	VideoFeedContro API shall be received from ARM to start/Stop showing the AR window

End of Requirement

###R_CMP_AR_00023### APIM Augmented Reality Window Location on HHDD

APIM_CDC or (APIM_CISM) module shall display the AR window on the HHDD with location 1942 (± 52) px from the left corner of the HHDD screen.

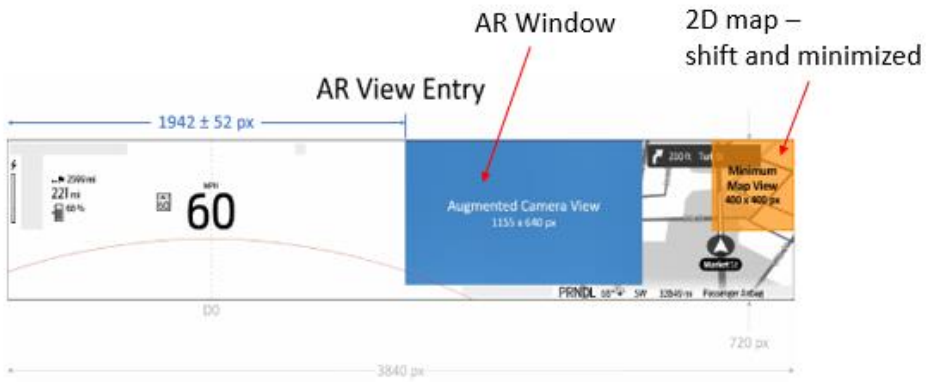


	1942 (± 52) px from the left corner of the HHDD screen

End of Requirement

###R_CMP_AR_00024### APIM AR Window

APIM_CDC or (APIM_CISM) module shall resize the AR video stream received from ARM to (1155 x640) px to fit the HHDD AR window.
The color format for the video stream received from ARM shall be (YUV422)

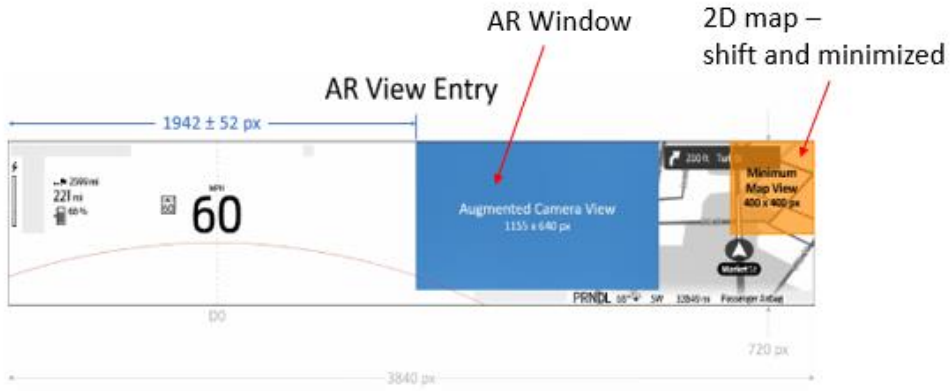


	(YUV422)

End of Requirement

###R_CMP_AR_00087### APIM Resize and Shift the 2D Map

Once the AR window is shown on HHDD, the APIM_CDC or (APIM_CISM) module shall minimize the 2D map to at least 400 x 400 dpi and shift the 2D map to the right of the AR window.



	The minimum size for the 2D map view is 400 x 400 dp. 1 dp is about 1px for a 160 dpi display. The HHDD panoramic display is about 165 dpi. When the AR view is up, we still give 743 x 640px (WxH) for the map.

End of Requirement

###R_CMP_AR_00026### APIM_CDC Display Latency

The APIM_CDC or (APIM_CISM) shall show the video on HHDD with latency ≤ (5 ms) from receiving the request to show/remove the video from ARM.

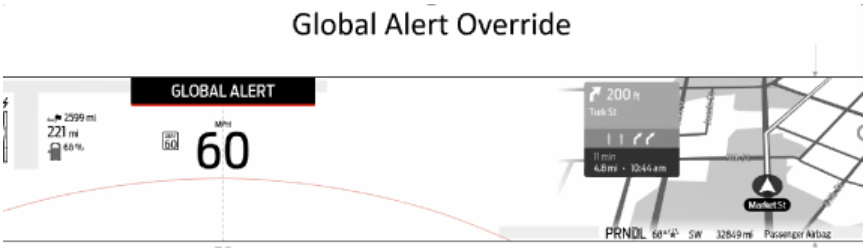
	shall show the video on HHDD with latency ≤ (5 ms) from receiving the request to show/remove the video from ARM.

End of Requirement

###R_CMP_AR_00053### APIM Hid or Delay AR Window If Higher Priority Event is Active

APIM_CDC or (APIM_CISM) module shall

1) Hide the AR window, if the AR window is active and other higher priories events are triggered (e.g., Global Alert popup message), Warning popup messages, or a User actions that result in information being presented in the area of the AR camera view (e.g., accommodations menu).
2) Delay the AR window when receiving a start request from ARM If a higher priority event is active until the event expires and stop request from ARM is not received.



	APIM shall Hide the AR window, if the AR window is active and other higher priories events are triggered or delay the AR window when receiving a start request from ARM If a higher priority event is active until the event expires and stop request from ARM is not received.

End of Requirement

###R_CMP_AR_00088### APIM AR Window With Active Steering Wheel Control Mirror Entry

For actions that only add the control mirror on the screen (e.g., touching the steering wheel controls, volume control), APIM_CDC or (APIM_CISM) module shall show the AR window with the control mirror overlaps the AR camera view.

	The AR window shall show the steering wheel control mirror entry overlaps with the AR camera view

End of Requirement

###R_CMP_AR_00078### APIM_CDC Display Control

The APIM_CDC or (APIM_CISM) module shall receive the requested start or stop display AR video from ARM and respond as below:

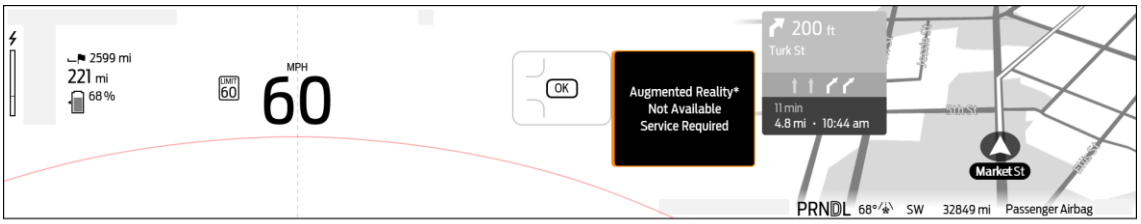
1) Coordinate the fade in and fade-out transition between AR video and 2D map.
2) Coordinate the AR video with 2D MAP voice prompt.

	oordinate the fade in and fade-out transition between AR video and 2D map, and the AR video with 2D MAP voice prompt.

End of Requirement

###R_CMP_AR_00079### APIM_CDC Display Fault Messages

The APIM_CDC or (APIM_CISM) shall display fault messages on HHDD if
1- Fault detected by APIM
2- Fault detected by ARM and communicated to APIM through CAN signal (TBD).



Warning Type: single cycle – SC*
Time Out: N/A
Icon: N/A
Color: Amber
Chime: No
Due Care: No

	shall display fault messages on HHDD if a fault detected by APIM or detected by ARM and communicated to APIM through CAN signal (TBD).

End of Requirement

5.2.2.2 Technology Function “Customize Augmented Reality Settings”

5.2.2.2.1 Function Interfaces

5.2.2.2.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** *(Optional)*
AR feature status	API name: setARFeature		Ethernet	
Lane Low Visibility Status	TBD		Ethernet	
Video Mode Status	API name: setARVideoMode		Ethernet	
KOL Status	KeyOffMde_D_Actl		HS3-CAN	

Table 5-73: Input Signal mappings of Function “Customize Augmented Reality Settings”

5.2.2.2.1.2 Outputs

Logical Signal Name	Technical Signal Name	Mapping Details *(Conditional)*	Publisher Interface	Connection *(Optional)*
Activate AR Feature	API name: setARFeature		Ethernet	
Activate Lane Low Visibility	TBD		Ethernet	
Select video Mode	API name: setARVideoMode		Ethernet	

Table 5-24: Output Signal mappings of Function "Customize Augmented Reality Settings"

5.2.2.2.1.3 Parameters

Logical Parameter Name	Technical Parameter Name	Mapping Details *(Conditional)*	Method	Method Details

Table 5-25: Parameter mappings of Function "Customize Augmented Reality Settings

5.2.2.2.1.4 Interface Requirements

###R_CMP_AR_00064### APIM Ethernet Interface to ARM

The APIM_CDC or (APIM_CISM) shall communicate with ARM on Ethernet (SOA) interface through ECG.

	shall communicate with ARM on Ethernet (SOA) interface through ECG

End of Requirement

###R_CMP_AR_00065### APIM CAN Interface to ARM

The APIM_CDC or (APIM_CISM) shall communicate with ARM through HS3-CAN interface.

	shall communicate with ARM on HS3-CAN bus

End of Requirement

5.2.2.2.2 Function Requirements

All Function Requirements related to Process and Perform Augmented Reality from Function Specification (ID_F003774) in sections (4.17 to 4.19) are Valid and required for implementation.

Requirement ID (of Logical Function)	Requirement Title	Modification	Requirement ID (of Technology Function)	Comment
R_CMP_AR_00064		Unchanged		
R_CMP_AR_00065		Unchanged		
R_CMP_AR_00066		Modified		
R_CMP_AR_00054		Unchanged		
R_CMP_AR_00015		Unchanged		
R_CMP_AR_00016		Unchanged		
R_CMP_AR_00017		Unchanged		

R_CMP_AR_00018		Unchanged		
R_CMP_AR_00019		Unchanged		
R_CMP_AR_00089		Added		
R_CMP_AR_00090		Added		
R_CMP_AR_00091		Added		
R_CMP_AR_00092		Added		

Table 5-26: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00097		
R_FNC_AR_00143		
R_FNC_AR_00098		
R_FNC_AR_00099		
R_FNC_AR_00144		
R_FNC_AR_00145		
R_FNC_AR_00146		
R_FNC_AR_00147		
R_FNC_AR_00109		
R_FNC_AR_00113		

Table 5-27: Inherited Requirements

5.2.2.2.2.1 Component Specific Requirements

###R_CMP_AR_00066### APIM Operation Modes

The APIM_CDC or (APIM_CISM) shall operate with full functionality to support the AR feature if the latest known status of Key OFF Load (KOL) Modes (KeyOffMde_D_Actl) is in Normal or Factory mode.

	Key OFF Load (KOL) status is in Normal or Factory mode

End of Requirement

###R_CMP_AR_00015### APIM Diagnostics DTC

APIM_CDC or (APIM_CISM) module shall do the following events:

1- Set A DTC for loss of communication and invalid data
2- Set a DTC for Stuck image
3- Monitor Published ARM DTC's

End of Requirement

###R_CMP_AR_00054### APIM Configuration DID

The APIM_CDC or (APIM_CISM) shall have a DID to allow it to be configurable for different AR feature configurations
0 x 0 == OFF
0 x1 == ON with No FIR Camera (if vehicle is not equipped with FIR camera)

0 x 2 = ON with FIR Camera (if vehicle is equipped with FIR camera)

	Configuration DID

End of Requirement

###R_CMP_AR_00016### APIM DID or DTC – Store Data Analytic

APIM_CDC or (APIM_CISM) Module shall have a DID or DTC to allow to store a data analytic required for the augmented reality feature (refer to section 5.4.3.1 Data analytics requirements in feature document V2.2 for more details)

Feature Status On/Off AR data analytics for output to HHDD

When the driver turns the AR feature On/Off on the physical HMI, the APIM_CDC (or DuerOS) shall provide the data analytics of this action through the connected vehicle services to have data analysis throughout the following timelines:

- How many users are still in the default state (AR feature status ON)?
- How many users that changed the default feature setting status from ON to Off
- How many users that changed the feature setting status from OFF to ON
- How many users push the info icon of AR feature setting to learn about the feature status settings

Failure Mode Feature Status On/Off AR data analytics for output to HHDD

The failure mode of AR feature HMI setting shall record through APIM_CDC (or DueOS) the data analytics based on below events:

- When customer turn AR feature status OFF, how often per vehicle, days, etc. the feature still ON and display AR event?
- When customer turn AR feature status ON, how often per vehicle, days, etc. the feature still OFF and display no AR event?
- When customer press to display AR feature status info icon, how often per vehicle, days, etc. the info icon not shown?
- When customer press to close AR feature status info icon, how often per vehicle, days, etc. the info icon still shown?

AR Video Mode Status Enable/Disable AR data analytics for output to HHDD

When the driver turns the AR video mode (AR night vision) Enable/Disable on the physical HMI, the APIM_CDC (or DuerOS) shall provide the data analytics of this action through the connected vehicle services to have data analysis throughout the following timelines:

- How many users are still in the default state (AR video mode status Enable)?
- How many users that changed the default AR video mode setting status from Enable to Disable
- How many users that changed the AR video mode setting status from Disable to Enable
- How many users push the info icon of AR video mode setting to learn about the AR video setting

Failure Mode: AR Video Mode Status Enable/Disable AR data analytics for output to HHDD

The failure mode of AR video mode HMI setting shall record the data analytics based on below events:

- When customer turn AR video mode status Disable, how often per vehicle, days, etc. the video mode setting still Enable and display AR event using FIR camera background?
- When customer turn AR video mode status Enable, how often per vehicle, days, etc. the video mode setting still disable and not shown the AR display event using FIR camera background when low light threshold is detected?

- When customer turn AR video mode status Enable, how often per vehicle, days, etc. the video mode setting still disable and not shown the AR display event using AR camera background when high light threshold is detected?
- When customer press to display AR video mode setting info icon, how often per vehicle, days, etc. the info icon not shown?
- When customer press to close AR video mode setting info icon, how often per vehicle, days, etc. the info icon still shown

AR Events data analytics for output to HHDD

The APIM_CDC (or DuerOS) shall provide and record the data analytics of the AR events through the connected vehicle services to have data analysis throughout the following:

- When APIM_CDC (or DuerOS) receive a request to show AR video by ARM, how long it takes to appear in AR window
- When APIM_CDC (or DuerOS) receive a request to stop show AR video by ARM, how long it takes to stop show the AR window
- How often does the 2D map is Not shifted to the right and/or Not minimized, when AR window is displayed on HHDD
- How often does the 2D map audio chime for turn by turn is Not synchronized when AR turn by turn window is displayed on HHDD (e.g., time differences when AR turn by turn appear on the HHDD vs time when turn by turn 2D map chime is generated by nav system)
- How often does the 2D map audio chime for destination is Not synchronized when AR destination window is displayed on HHDD (e.g., time differences when AR destination appear on the HHDD vs time when turn by turn 2D map chime is generated by nav system)

AR Failure Messages

The APIM_CDC (or DuerOS) data analytics shall record the faults messages appear on the HMI and the reason of the faults based on below events through the connected vehicle services to have data analysis throughout the following:

- How many times the fault messages are due to fault in AR camera
- How many times the fault messages are due to fault in FIR camera
- How many times the fault messages are due to miss communication between components or invalid data

End of Requirement

###R_CMP_AR_00017### APIM Select HMI Settings

APIM-CDC Module shall allow the user to select the AR settings if the Key OFF Load (KOL) (KeyOffMde_D_Actl) status is in Normal or Factory mode.

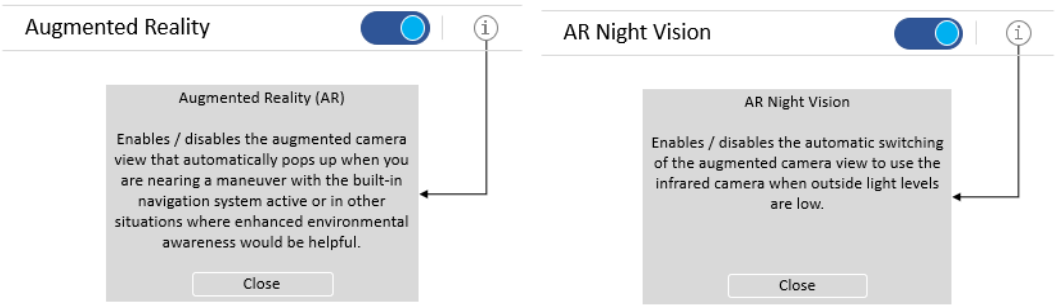
	Key OFF Load (KOL) status is in Normal or Factory mode

End of Requirement

###R_CMP_AR_00089### APIM HMI Settings for AR Feature

APIM_CDC or (APIM_CISM) Module shall provide the following AR setting with info icons:

1- Turn AR feature ON (default)/OFF
2- Select video background (AR Night Vision) Enable (default)/Disable (for vehicles equipped with FIR camera).
3- Select lane low visibility ON/OFF (default).



The APIM_CDC or (APIM_CISM) shall keep the user preference setting for the coming ignition cycles unless the user overwrite it.

	shall provide info icons for AR setting.

End of Requirement

###R_CMP_AR_00090### APIM Activate/Deactivate AR Feature

APIM_CDC or (APIM_CISM) shall send a request signal to ARM to turn AR feature ON/OFF.

AR Settings – Turn ON/OFF AR
API name: setARFeature

This API is used to send the request to ARM to activate/deactivate AR feature. The ARM also uses this API for its response.

Method Type	One-Shot (Synch)
QoS Level	Default
Retained	No

R/O	Name	Type	Literals	Value	Description
Request					
R	SetAR	Enum	-	-	N/A
			OFF	0x0	Used to turn OFF the AR feature
			ON	0x1	Used to turn ON the AR feature
Response					
R	ARStatus	Enum	-	-	Used to indicate status of AR feature
			OFF	0x0	
			ON	0x1	

	shall send a request signal (Ethernet API) to ARM to turn AR feature ON/OFF

End of Requirement

###R_CMP_AR_00091### APIM Enable/Disable Video Mode

APIM_CDC or (APIM_CISM) shall send a request signal to ARM to select AR video mode.

AR Settings – Select AR Video Mode
API name: setARVideoMode

This API is used to send the request to ARM to select AR video mode. The ARM also uses this API for its response.

Method Type	One-Shot (Synch)
QoS Level	Default
Retained	No

R/O	Name	Type	Literals	Value	Description
Request					
R	SetVideoMode	Enum	-	-	N/A
			Disable	0x0	The AR feature uses AR visible camera only
			Enable	0x1	The AR feature switches automatically between the AR vs FIR camera based on the AR Outside Light Level Adaptation (if vehicle is equipped with FIR camera)
Response					
R	VideoModeStatus	Enum	-	-	Used to indicate current status of video mode
			Disabled	0x0	
			Enabled	0x1	

	shall send a request signal (Ethernet API) to ARM to select AR video mode Enable/Disable
	End of Requirement

###R_CMP_AR_00092### APIM Broadcast AR Feature Current Settings

APIM_CDC or (APIM_CISM) Module shall broadcast the AR settings on each ignition cycle according to the personal profile settings.

API name: CurrentARSetting

This API is used to broadcast the current AR setting (ON/OFF).

Method Type	On Change
QoS Level	Default
Retained	Yes

R/O	Name	Type	Literals	Value	Description
Request					
-	-	-	-	-	N/A
Response					
R	ARSetting	Enum	-	-	Used to indicate current setting of AR feature
			OFF	0x0	
			ON	0x1	

API name: CurrentARVideoSetting

This API is used to broadcast the current AR video setting (Enable/Disable).

Method Type	On Change
QoS Level	Default
Retained	Yes

R/O	Name	Type	Literals	Value	Description
Request					
-	-	-	-	-	N/A
Response					
R	ARVideoSetting	Enum	-	-	Used to indicate current setting of AR feature
			Disable	0x0	
			Enable	0x1	

	APIM shall Broadcast AR Feature Current Settings on each ignition cycle according to the personal profile settings.

End of Requirement

###R_CMP_AR_00018### APIM_CDC HMI Latency

The APIM_CDC or (APIM_CISM) HMI latency shall be ≤ (5 ms).

	The APIM_CDC or (APIM_CISM) HMI latency shall be ≤ (5 ms).

End of Requirement

~~###R_CMP_AR_00019### APIM_CDC Voice Command- TBD for MVP- voice commands NOT supported by Google- pending discussion~~

Note: Removed, not supported by Google

~~The APIM_CDC shall be able to activate the following functions (Table below) through the voice command.~~

~~Voice Command~~	~~Suggested Voice Command~~	~~Rationale~~	~~Route Active~~	~~No Route Active~~
~~Turn Augmented Reality Feature On or OFF~~	~~"Turn AR On" Turn AR OFF~~	~~On (default) - augmented camera view will be presented to the driver contextually during vehicle operation. OFF - No augmented camera view will be presented to the driver at anytime during vehicle operation.~~	~~Yes~~	~~Yes~~
~~Select AR Video Mode Enable/Disable (Only If vehicle is equipped with FIR Camera)~~	~~Enable AR Video Mode Disable AR Video Mode~~	~~Enable (default) – The AR feature shall switch automatically between the AR and FIR camera based on the level of environmental lights. Disable – the AR feature shall use AR visible camera only~~	~~Yes~~	~~Yes~~
~~Activate House Numbers~~	~~"Show me House Numbers"~~	~~1- With navigation routing enabled, house can be treated like a destination location POI. House number to be triggered by navigation as with any destination. 2- With navigation routing disabled, a series of 4 house numbers on the drive when approaching target house. Require the vehicle speed to be below 25 MPH or below current residential speed limit.~~	~~Yes~~	~~Yes~~
~~Activate Point of Interset (POI)~~	~~"Show me *POIs specified by Navigation*~~	~~POIs are shown as received from the navigation system. Any POIs active in the navigation system are shown in the AR view according to near navigation / destination~~	~~Yes~~	~~Yes~~

	~~System (e.g., Gas Stations; Restaurants, Pharmacies; Coeffe Shops, Repair Shops, etc.)~~	~~specifications. All POI related driver voice commands are received and actioned upon by the navigation system.~~ ~~1. Voice commands "Show me all the pharmacies around" "Show me restaurants": work with Route and No Route active.~~ ~~2. Near NAV: only show preferred or history POIs when AR screen is triggered because NAV route is active "Google".~~		
~~Activate Low Lane Visibility~~	~~"Help me see"~~	~~Visual imagery to show the most likely path for the driver (i.e., navigation without a route set).~~	~~Yes~~	~~Yes~~

~~Pending CIED definition of experience~~

~~Street Names~~	~~"Show me Street Names"~~	-	~~TBD~~	~~TBD~~

~~End of Requirement~~

5.2.2.3 Technology Function "Provide Navigation data"

5.2.2.3.1 Function Interfaces

5.2.2.3.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-88: Input Signal mappings of Function "Provide Navigation data"

5.2.2.3.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Navigation Status	TBD		Ethernet	
Vehicle Data	TBD		Ethernet	
lane count info	TBD		Ethernet	
Speed limit value	TBD		Ethernet	
Route geometry	TBD		Ethernet	
Elevation data / 3D Road Geometry	TBD		Ethernet	
Distance to next maneuver	TBD		Ethernet	
Maneuver intersection geo location	TBD		Ethernet	
~~Maneuver street name~~	TBD		Ethernet	(Not available due to google signal availability)

Maneuver phases from navigation system	TBD		Ethernet	
Road network geometry and topology (roundabout geometry)	TBD		Ethernet	
Following maneuver info	TBD		Ethernet	
~~Road links street names~~	TBD		Ethernet	(Not available due to google signal availability)
~~Buildings position and address~~	TBD		Ethernet	(Not available due to google signal availability)
~~House number via navigation predicted route for Inactive route~~	TBD		Ethernet	(Not available due to google signal availability)
~~House number via voice command for Inactive route~~	TBD		Ethernet	(Not available due to google signal availability)
~~House number via voice command for active route~~	TBD		Ethernet	(Not available due to google signal availability)
~~Name of building/business~~	TBD		Ethernet	(Not available due to google signal availability)
~~Define common houses~~	TBD		Ethernet	(Not available due to google signal availability)
Destination position and address	TBD		Ethernet	
Distance to destination	TBD		Ethernet	
~~Road restrictions (e.g. school, no entry, etc.)~~	TBD		Ethernet	(Not available due to google signal availability)
~~Points of interest info: location, type, description~~	TBD		Ethernet	(Not available due to google signal availability)
~~Conditional signals (for conditional POIs)~~	TBD		Ethernet	(Not available due to google signal availability)
~~Footprint, number of levels, for façade highlighting~~	TBD		Ethernet	(Not available due to google signal availability)
~~POI_ Voice Command (Active Route)~~	TBD		Ethernet	(Not available due to google signal availability)
~~POI_ Voice Command (Inactive Route)~~	TBD		Ethernet	(Not available due to google signal availability)

Table 5-29: Output Signal mappings of Function "Provide Navigation data"

5.2.2.3.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-30: Parameter mappings of Function "Provide Navigation data"

5.2.2.3.1.4 Interface Requirements

5.2.2.3.2 Function Requirements

All Function Requirement related to Provide Navigation Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00020		Unchanged		
R_CMP_AR_00021		Unchanged		

Table 5-31: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00109		
…		

Table 5-32: Inherited Requirements

5.2.2.3.2.1 Component Specific Requirements

###R_CMP_AR_00020### APIM_CDC Navigation Data Latency

The APIM_CDC or (APIM_CISM) Navigation Data latency shall be ≤ (10 ms).

	The APIM_CDC or (APIM_CISM) Navigation Data latency shall be ≤ (10 ms)

End of Requirement

###R_FNC_AR_00021### APIM_CDC Navigation Data Accuracy

The APIM_CDC or (APIM_CISM) Navigation Data accuracy shall be ≤ 1 m

	The APIM_CDC or (APIM_CISM) Navigation Data accuracy shall be ≤ 1 m

End of Requirement

5.2.3 IPMA(ADAS)

5.2.3.1 Technology Function “Provide ADAS Data (IPMA)”

5.2.3.1.1 Function Interfaces

5.2.3.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-38: Input Signal mappings of Function "Provide ADAS Data"

5.2.3.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Current lane position/direction	ServiceLaneData ServicePredPathDataService CBZData ServiceInPathData ServiceLightsData ServiceSignData		Ethernet	
Ego vehicle in-lane offset				
HD lanes block				
Lane markings type				
Height Map/Elevation				
Target lane position/direction				
Object collision warning signal	ServicePedestrianData ServiceRoadTargetsData		Ethernet	
Distance to object				
Object position				
Object size				
BLIS_Right_Status	SodAlrtRight_D_Stat		FD3-CAN	
BLIS_Left_Status	SodAlrtLeft_D_Stat		FD3-CAN	

Table 5-99: Output Signal mappings of Function "Provide ADAS Data"

5.2.3.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-100: Parameter mappings of Function "Provide ADAS Data"

5.2.3.1.1.4 Interface Requirements

###R_CMP_AR_00067### IPMA(ADAS) Ethernet Interface to ARM

The IPMA (ADAS) shall communicate with ARM on Ethernet (SOA) interface through ECG.

	The IPMA (ADAS) shall communicate with ARM on Ethernet (SOA) interface through ECG.

End of Requirement

###R_CMP_AR_00068### IPMA(ADAS) CAN Interface to ARM

The IPMA (ADAS) shall communicate with ARM on CAN bus through ECG.

	The IPMA (ADAS) shall communicate with ARM on CAN bus through ECG.

End of Requirement

5.2.3.1.2 Function Requirements

All Function Requirement related to Provide ADAS (IPMA) Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00027		Unchanged		
R_CMP_AR_00028		Unchanged		
R_CMP_AR_00029		Modified		
R_CMP_AR_00067		Unchanged		
R_CMP_AR_00068		Unchanged		

Table 5-41: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00114		
…		

Table 5-42: Inherited Requirements

5.2.3.1.2.1 Component Specific Requirements

###R_CMP_AR_00027### Required ADAS (IPMA) Signals Latency

The ADAS (IPMA) shall send related signals with latency ≤ (25) ms.

	The ADAS (IPMA) shall send related signals with latency ≤ (25) ms.

End of Requirement

###R_CMP_AR_00028### ADAS (IPMA) Signal Accuracy

The ADAS (IPMA) shall provide the polynomial signals (up to 100m) with the accuracy limits shown below
Δ guide#1 lat vs road < 100mm
Δ guide#1 long vs ego < 250mm
Δ guide#2 lat vs road < 150mm
Δ lead long vs marker < 250mm
Δ marker lat vs lead < 150mm

	The ADAS (IPMA) shall provide the polynomial signals (up to 100m) with the accuracy limits Δ guide#1 lat vs road < 100mm, Δ guide#1 long vs ego < 250mm, Δ guide#2 lat vs road < 150mm, Δ lead long vs marker < 250mm, and Δ marker lat vs lead < 150mm.

End of Requirement

###R_CMP_AR_00029### ADAS (IPMA) Data Frequency

The ADAS (IPMA) shall send related signals with frequency ≤ 25 ms (40 Hz).

	The ADAS (IPMA) shall send related signals with frequency ≤ 25 ms (40 Hz).

End of Requirement

5.2.4 ECG

5.2.4.1 Technology Function “Provide Electronic Horizon (EH) Data”

5.2.4.1.1 Function Interfaces

5.2.4.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-58: Input Signal mappings of Function “Provide Vehicle Data”

5.2.4.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Position	TBD		HS3-CAN	
Stub	TBD		HS3-CAN	
Profile Short	TBD		HS3-CAN	
Profile Long	TBD		HS3-CAN	
Meta-Data	TBD		HS3-CAN	
Segment	TBD		HS3-CAN	

Table 5-59: Output Signal mappings of Function “Provide EH Data”

5.2.4.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-60: Parameter mappings of Function "Provide Vehicle Data"

5.2.4.1.1.4 Interface Requirements

###R_CMP_AR_00093### ECG (Transmitter) CAN Interface to ARM

The ECG shall transmit Electronic Horizon (EH) data to ARM through HS3-CAN bus.

	The ECG shall transmit Electronic Horizon (EH) data to ARM through HS3-CAN bus.

End of Requirement

###R_CMP_AR_000X94## ECG (Gateway) Ethernet Interface

The ECG shall route below ECUs signals to ARM using Ethernet (SOA)

1. Phoenix (APIM_CDC) or DuerOS (APIM_CISM).
2. TCU
3. IPMA(ADAS)

	The ECG shall route (Phoenix (APIM_CDC) or DuerOS (APIM_CISM), TCU, and IPMA(ADAS)) signals to ARM using Ethernet (SOA).

End of Requirement

###R_CMP_AR_00095### ARM CAN Interface

The ECG shall reroute below ECUs signals to ARM on HS3-CAN bus.

1. ABS.
2. Phoenix (APIM_CDC) or DuerOS (APIM_CISM).
3. IPMA(ADAS)
4. PSCM.
5. SCCM.
6. PDB

	The ECG shall reroute (ABS, Phoenix (APIM_CDC) or DuerOS (APIM_CISM), IPMA(ADAS), PSCM, SCCM, and PDB) signals to ARM on HS3-CAN bus.

End of Requirement

5.2.4.1.2 Function Requirements

All Function Requirement related to Provide EH Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00093		Added		
R_CMP_AR_00094		Added		
R_CMP_AR_00095		Added		
R_CMP_AR_00096		Added		
R_CMP_AR_00097		Added		
R_CMP_AR_00098		Added		

Table 5-61: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00149		
…		

Table 5-112: Inherited Requirements

5.2.4.1.2.1 Component Specific Requirements

###R_CMP_AR_00096### ECG EH Data Latency

The ECG shall send Electronic Horizon (EH) signals with latency ≤ 25 ms

	The ECG shall send Electronic Horizon (EH) signals with latency ≤ 25 ms

End of Requirement

###R_CMP_AR_00097### ECG EH Data Frequency

The ECG shall send Electronic Horizon (EH) signals with frequency ≤ 25 ms (40 Hz).

	The ECG shall send Electronic Horizon (EH) signals with frequency ≤ 25 ms (40 Hz).

End of Requirement

###R_CMP_AR_00098### ECG EH Data Accuracy

The ECG shall send Electronic Horizon (EH) signals with Accuracy ≤ TBD

	The ECG shall send Electronic Horizon (EH) signals with Accuracy ≤ TBD

End of Requirement

5.2.5 TCU

5.2.5.1 Technology Function “Provide GNSS Data”

5.2.5.1.1 Function Interfaces

5.2.5.1.1.1 Inputs

Logical Signal Name	Technical Signal Name	Mapping Details *(Conditional)*	Subscriber Interface	Connection (*Optional)*

Table 5-38: Input Signal mappings of Function "Provide GNSS Data"

5.2.5.1.1.2 Outputs

Logical Signal Name	Technical Signal Name	Mapping Details *(Conditional)*	Publisher Interface	Connection *(Optional)*
Latitude	Location Services		Ethernet	
Longitude				
Height				
Moving direction				
Calculated speed				
VDOP				
HDOP				
PDO				

Table 5-129: Output Signal mappings of Function "Provide GNSS Data"

5.2.5.1.1.3 Parameters

Logical Parameter Name	Technical Parameter Name	Mapping Details *(Conditional)*	Method	Method Details

Table 5-130: Parameter mappings of Function "Provide GNSS Data"

5.2.5.1.1.4 Interface Requirements

###R_CMP_AR_00069### TCU Ethernet Interface to ARM

The TCU shall communicate with ARM on Ethernet (SOA) interface through ECG.

	The TCU shall communicate with ARM on Ethernet (SOA) interface through ECG.

End of Requirement

5.2.5.1.2 Function Requirements

All Function Requirement related to Provide GNSS Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	Requirement Title	Modification	Requirement ID (of Technology Function)	Comment
R_CMP_AR_00030		Unchanged		
R_CMP_AR_00031		Unchanged		
R_CMP_AR_00032		Unchanged		

Table 5-41: Component Specific Requirements

Requirement ID (of Logical Function)	Requirement Title	Comment
R_FNC_AR_00119		
…		

Table 5-42: Inherited Requirements

5.2.5.1.2.1 Component Specific Requirements

###R_CMP_AR_00030### TCU GNSS Data Latency

The TCU shall send GNSS Data with latency ≤ 100ms

	The TCU shall send GNSS Data with latency ≤ 100ms

End of Requirement

###R_CMP_AR_00031### TCU GNSS Data Accuracy

The TCU shall send GNSS Data with accuracy ≤ 1 m

	The TCU shall send GNSS Data with accuracy ≤ 1 m

End of Requirement

###R_CMP_AR_00032### TCU GNSS Data Frequency

The TCU shall send GNSS Data with frequency ≤ 1000 msec (1Hz).

	The TCU shall send GNSS Data with frequency ≤ 1000 msec (1Hz).

End of Requirement

5.2.6 AR Camera

5.2.6.1 Technology Function “Provide AR Camera Data”

5.2.6.1.1 Function Interfaces

5.2.6.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-43: Input Signal mappings of Function “Provide AR Camera Data”

5.2.6.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
AR Video Feed			FPD-Link	
AR Camera Gain			I2C	
AR Camera Integration Time			I2C	

Table 5-44: Output Signal mappings of Function “Provide AR Camera Data”

5.2.6.1.1.3 Parameters

Logical Parameter Name	Technical Parameter Name	Mapping Details *(Conditional)*	Method	Method Details
Gain	AR camera gain			
Integration Time	AR camera integration time			

Table 5-145: Parameter mappings of Function "Provide AR Camera Data"

5.2.6.1.1.4 Interface Requirements

###R_CMP_AR_00034### AR Camera Interface

The AR Camera shall have the interface to ARM as below

1. The AR Camera component shall be designed with a Ford approved coax connector for FPD Link applications.
2. The AR Camera component shall use a Ford approved FPD Link serializer.
3. The AR Camera component shall meet the FPD Link electrical requirements as detailed in RQT 000601-023124.
4. The AR Camera component shall draw less than or equal to 2.1W.
5. The AR Camera component shall meet performance requirements for input voltage from 6V to 13V as measured at the AR Camera I/O connector.
6. The AR Camera component shall use an image sensor with a minimum 2Mpixels (resolution of 1920x1080).
7. The AR Camera component shall be capable of 30 frames/s video.
8. The AR Camera component shall configure the FPD Link serializer for synchronous mode.
9. The AR Camera component shall configure the FPD Link serializer for 0x30 (8bit) I2C address.
10. The AR Camera component shall configure the video imager for 0x1A (7bit) I2C address.
11. The AR Camera component shall configure PWL12 (Piece wise Linear compressed 12 bit Output).
12. The AR Camera component shall utilize 25MHz of clock input.

For more details, refer to the latest AR and FIR Camera Interface requirement to AR ECU (this link)
[AUGREAL-59] AR FIR camera interface requirements - FORD JIRA

	The AR Camera shall have the interface to ARM as below 1. The AR Camera component shall be designed with a Ford approved coax connector for FPD Link applications. 2. The AR Camera component shall use a Ford approved FPD Link serializer. 3. The AR Camera component shall meet the FPD Link electrical requirements as detailed in RQT 000601-023124. 4. The AR Camera component shall draw less than or equal to 2.1W.

	5. The AR Camera component shall meet performance requirements for input voltage from 6V to 13V as measured at the AR Camera I/O connector. 6. The AR Camera component shall use an image sensor with a minimum 2Mpixels (resolution of 1920x1080). 7. The AR Camera component shall be capable of 30 frames/s video. 8. The AR Camera component shall configure the FPD Link serializer for synchronous mode. 9. The AR Camera component shall configure the FPD Link serializer for 0x30 (8bit) I2C address. 10. The AR Camera component shall configure the video imager for 0x1A (7bit) I2C address. 11. The AR Camera component shall configure PWL12 (Piece wise Linear compressed 12 bit Output). 12. The AR Camera component shall utilize 25MHz of clock input.

End of Requirement

5.2.6.1.2 Function Requirements

All Function Requirement related to Provide AR Camera Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00033		Removed		
R_CMP_AR_00034		Modified		
R_CMP_AR_00035		Unchanged		
R_CMP_AR_00036		Unchanged		
R_CMP_AR_00037		Unchanged		
R_CMP_AR_00079		Modified		
R_CMP_AR_00099		Added		
R_CMP_AR_00100		Added		

Table 5-46: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00116		
…		

Table 5-47: Inherited Requirements

5.2.6.1.2.1 Component Specific Requirements

~~###**R_CMP_AR_00033**### **AR Camera ID**~~

Note: Deleted

~~The AR Camera shall provide a unique ID to ARM~~

End of Requirement

###R_CMP_AR_00035### AR Camera Data Parameters

The AR camera shall provide the Input video feed to the ARM according to the following parameters:

- Resolution: 1920px x 1080px
- FoV: ~99.6 degrees H x 54.6 degrees V (+- 3 degree angular tolerance)
- Frame Rate = 30 Hz
- RGB visible image data
- Gain
- Integration time

	The AR camera shall provide the Input video feed to the ARM according to the following parameters: Resolution: 1920px x 1080px, FoV: ~99.6 degrees H x 54.6 degrees V (+- 3 degree angular tolerance), Frame Rate = 30 Hz, RGB visible image data, Gain, and Integration time

End of Requirement

###R_CMP_AR_00036### AR Camera Data Fault Conditions

The AR camera shall provide fault conditions (No Signal, Short Circuit, Open Circuit, Missing Video Signal, and Frozen Image) to the ARM.

	The AR camera shall provide fault conditions (No Signal, Short Circuit, Open Circuit, Missing Video Signal, and Frozen Image) to the ARM.

End of Requirement

###R_CMP_AR_00037### AR Camera Data Latency

The AR Camera Data latency shall be ≤ (10ms).

	The AR Camera Data latency shall be ≤ (10ms).

End of Requirement

###R_CMP_AR_00079### AR Camera Packaging

The AR Camera shall be packaged as below:

1) Within a 6-inch distance to the DAT (FWC) camera
2) Within a 5% FOV to the DAT (FWC) camera.
3) AR camera misalignment in the vehicle due to mechanical tolerances shall be:
    a. Roll < ± 1.0 degrees
    b. Pitch < ± 0.5 degrees
    c. Yaw < ± 1.0 degrees
4) AR camera backet misalignment in the vehicle due to mechanical tolerances shall be:
    a. Roll < ± 1.0 degrees
    b. Pitch < ± 0.5 degrees
    c. Yaw < ± 1.0 degrees

	The AR Camera shall be packaged as below: 1) Within a 6-inch distance to the DAT (FWC) camera 2) Within a 5% FOV to the DAT (FWC) camera. 3) AR camera misalignment in the vehicle due to mechanical tolerances shall be: Roll < ± 1.0 degrees, Pitch < ± 0.5 degrees, and Yaw < ± 1.0 degrees

	4) AR camera backet misalignment in the vehicle due to mechanical tolerances shall be: Roll < ± 1.0 degrees, Pitch < ± 0.5 degrees, and Yaw < ± 1.0 degrees

End of Requirement

###R_CMP_AR_00099### AR Camera Intrinsic Calibration Parameters

The AR camera shall provide to ARM the AR camera intrinsic calibration parameters:
distortion coefs – TBD
focal length – TBD
optical center - TBD

	The AR camera shall provide to ARM the AR camera intrinsic calibration parameters, distortion coefs (TBD), focal length (TBD), optical center (TBD).

End of Requirement

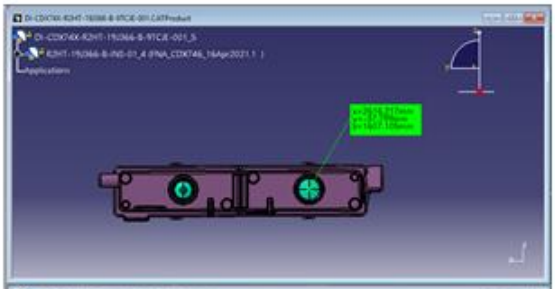
###R_CMP_AR_00100### AR Camera Extrinsic Calibration Parameters

The AR camera shall provide extrinsic parameters as below
default camera position (x,y,z) - TBD
rotation (yaw, pitch, roll)) – TBD

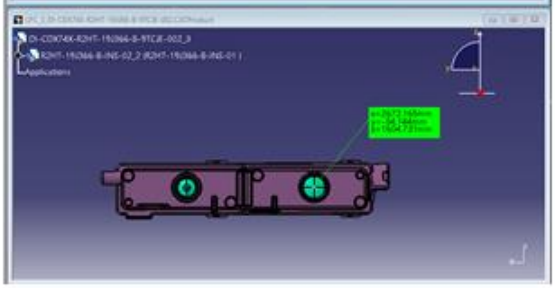
Note: per latest CAD, the Default camera position as below (these values are subject to change per AR camera D&R until be fixed by MP1).
CDX746 x=2616.217mm y=-37.799mm z=1607.105mm
CDX747 x=2672.165mm y=-34.144mm z=1604.731mm

AR camera XYZ for CDX74x

CDX746:



CDX747:



	The AR camera shall provide extrinsic parameters as below, default camera position (x,y,z) (TBD), and rotation (yaw, pitch, roll)) (TBD).

End of Requirement

5.2.7 FIR Camera

5.2.7.1 Technology Function “Provide FIR Camera Data”

5.2.7.1.1 Function Interfaces

5.2.7.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-48: Input Signal mappings of Function “Provide FIR Camera Data”

5.2.7.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
FIR Video Feed			FPD-Link	

Table 5-49: Output Signal mappings of Function “Provide FIR Camera Data”

5.2.7.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**
FIR Camera ID				

Table 5-50: Parameter mappings of Function “Provide FIR Camera Data”

5.2.7.1.1.4 Interface Requirements

###R_CMP_AR_00039### FIR Camera Interface – if Vehicle is equipped with FIR Camera

The FIR Camera shall have the interface to ARM as below

1. The FIR Camera component shall be designed with a Ford approved coax connector for FPD Link applications.
2. The FIR Camera component shall use a Ford approved FPD Link serializer.
3. The FIR Camera component shall meet the FPD Link electrical requirements as detailed in RQT 000601-023124.
4. The FIR Camera component shall draw less than or equal to 5W.
5. The FIR Camera component shall meet performance requirements for input voltage from 6V to 19V as measured at the FIR Camera I/O connector.
6. The FIR camera component shall isolate attachment points to the vehicle and eliminate ground loops to the vehicle in case of case ground design.
7. The FIR Camera component shall use an image sensor with a minimum 230.4kpixels (resolution of 640x368).
8. The FIR Camera component shall be capable of 30 frames/s video.
9. The FIR Camera component shall configure the FPD Link serializer for synchronous mode.
10. The FIR Camera component shall configure the FPD Link serializer for 0x30/0x18 (8bit/7bit) I2C address.
11. The FIR Camera component shall configure the embedded CPU controlled ISP chip for 0xE0/0x70 (8bit/7bit) I2C address.
12. The FIR Camera component shall output two video streams in CSI-2 RAW8 and RAW14 format.
13. The FIR Camera component shall utilize Challenge Handshake Authentication Protocol (CHAP) to form secure connection with AR ECU.
14. The FIR Camera component shall complete initial CHAP at power up within 750(+/-30%) msec.

For more details, refer to the latest AR and FIR Camera Interface requirement to AR ECU (this link)
[AUGREAL-59] AR FIR camera interface requirements - FORD JIRA

	The FIR Camera shall have the interface to ARM as below 1. The FIR Camera component shall be designed with a Ford approved coax connector for FPD Link applications. 2. The FIR Camera component shall use a Ford approved FPD Link serializer. 3. The FIR Camera component shall meet the FPD Link electrical requirements as detailed in RQT 000601-023124. 4. The FIR Camera component shall draw less than or equal to 5W. 5. The FIR Camera component shall meet performance requirements for input voltage from 6V to 19V as measured at the FIR Camera I/O connector. 6. The FIR camera component shall isolate attachment points to the vehicle and eliminate ground loops to the vehicle in case of case ground design. 7. The FIR Camera component shall use an image sensor with a minimum 230.4kpixels (resolution of 640x368). 8. The FIR Camera component shall be capable of 30 frames/s video. 9. The FIR Camera component shall configure the FPD Link serializer for synchronous mode. 10. The FIR Camera component shall configure the FPD Link serializer for 0x30/0x18 (8bit/7bit) I2C address. 11. The FIR Camera component shall configure the embedded CPU controlled ISP chip for 0xE0/0x70 (8bit/7bit) I2C address. 12. The FIR Camera component shall output two video streams in CSI-2 RAW8 and RAW14 format. 13. The FIR Camera component shall utilize Challenge Handshake Authentication Protocol (CHAP) to form secure connection with AR ECU. 14. The FIR Camera component shall complete initial CHAP at power up within 750(+/-30%) msec.

End of Requirement

5.2.7.1.2 Function Requirements

All Function Requirement related to Provide FIR Camera Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00038		Unchanged		
R_CMP_AR_00039		Modified		
R_CMP_AR_00040		Unchanged		
R_CMP_AR_00041		Unchanged		
R_CMP_AR_00042		Unchanged		
R_CMP_AR_00080		Modified		
R_CMP_AR_00101		Added		
R_CMP_AR_00102		Added		

Table 5-151: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00117		
…		

Table 5-52: Inherited Requirements

5.2.7.1.2.1 Component Specific Requirements

###R_CMP_AR_00038### FIR Camera ID

The FIR Camera shall provide a unique ID to ARM

	The FIR Camera shall provide a unique ID to ARM

End of Requirement

###R_CMP_AR_00040### AR FIR Camera Parameters if Vehicle is equipped with FIR Camera

The FIR Camera shall provide the Input video feed to the ARM according to the following parameters:

1) Resolution: 640 x 368 px
2) Frame Rate = 30 Hz

3) FoV: ~65±5°H x 47.5±5°V
4) Black and white thermal image data
5) FIR thermal data from camera. Images appear in grayscale based on thermal signature.

	The FIR Camera shall provide the Input video feed to the ARM according to the following parameters: Resolution: 640 x 368 px, Frame Rate = 30 Hz, FoV: ~65±5°H x 47.5±5°V, Black and white thermal image data, and FIR thermal data from camera. Images appear in grayscale based on thermal signature.

End of Requirement

###R_CMP_AR_00041### AR FIR Camera Fault Conditions if Vehicle is equipped with FIR Camera

The FIR camera shall provide fault conditions (No Signal, Short Circuit, Open Circuit, Missing Video Signal, and Frozen Image) to the ARM.

	The FIR camera shall provide fault conditions (No Signal, Short Circuit, Open Circuit, Missing Video Signal, and Frozen Image) to the ARM.

End of Requirement

###R_CMP_AR_00042### FIR Camera Data Latency

The FIR Camera Data latency shall be ≤ (10ms).

	The FIR Camera Data latency shall be ≤ (10ms).

End of Requirement

###R_CMP_AR_00080### FIR Camera Packaging

The FIR Camera shall be packaged as below:

1) Within 6" in X and Y, and 2" in depth maximum separation to the AR camera for full blending AR vs FIR images, if the packaging of FIR allows that (Note- this is Not the current case for FIR camera in CDX747)
2) If AR and FIR Camera packaging not within full blending, the FIR camera shall be packaged TBD distance to allow for partial/selective blending.
3) FIR camera misalignment in the vehicle due to mechanical tolerances shall be:
    a. Roll < ± 1.0 degrees
    b. Pitch < ± 0.5 degrees
    c. Yaw < ± 1.0 degrees
4) FIR camera bracket misalignment in the vehicle due to mechanical tolerances shall be:
    a. Roll < ± 1.0 degrees
    b. Pitch < ± 0.5 degrees
    c. Yaw < ± 1.0 degrees

	The FIR Camera shall be packaged as below:

	1) Within 6" in X and Y, and 2" in depth maximum separation to the AR camera for full blending AR vs FIR images, if the packaging of FIR allows that (Note- this is Not the current case for FIR camera in CDX747) 2) If AR and FIR Camera packaging not within full blending, the FIR camera shall be packaged TBD distance to allow for partial/selective blending. 3) FIR camera misalignment in the vehicle due to mechanical tolerances shall be: Roll < ± 1.0 degrees, Pitch < ± 0.5 degrees, and Yaw < ± 1.0 degrees 4) FIR camera bracket misalignment in the vehicle due to mechanical tolerances shall be: Roll < ± 1.0 degrees, Pitch < ± 0.5 degrees, and Yaw < ± 1.0 degrees

End of Requirement

###R_CMP_AR_00101### FIR Camera Intrinsic Calibration Parameters

The FIR camera shall provide to ARM the FIR camera intrinsic calibration parameters:
distortion coefs – TBD
focal length – TBD
optical center - TBD

	The FIR camera shall provide to ARM the FIR camera intrinsic calibration parameters, distortion coefs (TBD), focal length (TBD), and optical center (TBD).

End of Requirement

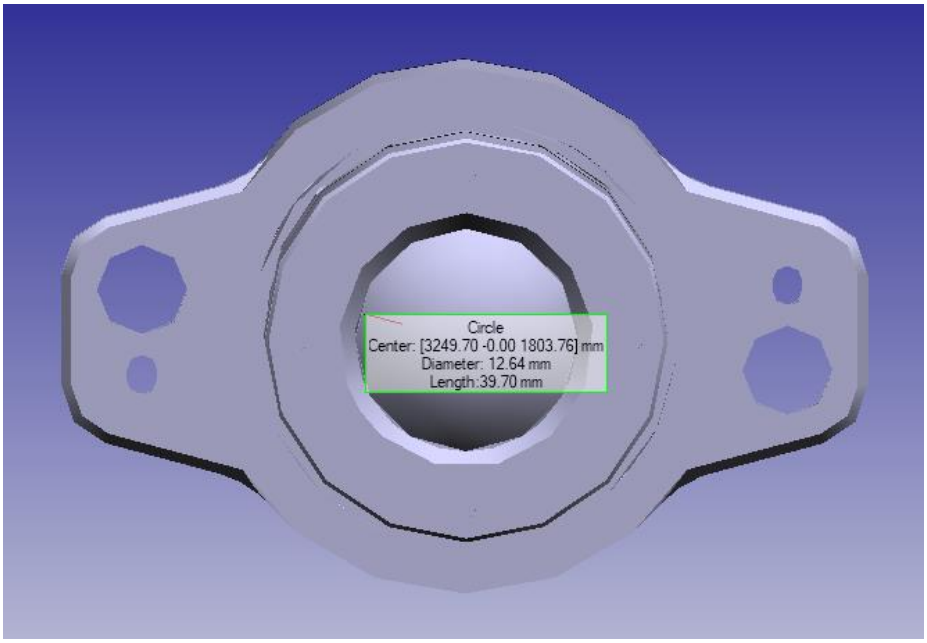
###R_CMP_AR_00102### FIR Camera Extrinsic Calibration Parameters

The FIR camera with the beauty cover shall provide extrinsic parameters as below
default camera position (x,y,z) - TBD
rotation (yaw, pitch, roll) – TBD

Note: The FIR camera tolerance itself is below, which does not include the beauty cover which can contribute more to the overall camera aiming, still not TBD.

FIR Camera Rotation (yaw, pitch, roll)
Roll < ±0.7°
PITCH < ±0.5°
YAW< ±0.7°

Current camera location(x,y,z) on CDX747, based on the latest CAD as below, the number are subject to change per FIR camera D&R.



	The FIR camera shall provide extrinsic parameters as below, default camera position (x,y,z) (TBD), and rotation (yaw, pitch, roll) (TBD).

End of Requirement

5.2.8 Phoenix Domain Controller-IPC

5.2.8.1 Technology Function “Provide Vehicle Data”

5.2.8.1.1 Function Interfaces

5.2.8.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-58: Input Signal mappings of Function “Provide Vehicle Data”

5.2.8.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*

Vehicle Data	FuelLvlWarn_D_Actl		HS3-CAN	
	Veh_V2_Dsply		HS3-CAN	
	MetricActv_B_Dsply		HS3-CAN	

Table 5-59: Output Signal mappings of Function "Provide Vehicle Data"

5.2.8.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-60: Parameter mappings of Function "Provide Vehicle Data"

5.2.8.1.1.4 Interface Requirements

###R_CMP_AR_00070### IPC CAN Interface to ARM

The Phoenix Domain Controller-IPC shall communicate with ARM on CAN bus.

	The Phoenix Domain Controller-IPC shall communicate with ARM on CAN bus.

End of Requirement

5.2.8.1.2 Function Requirements

All Function Requirement related to Provide Vehicle Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00043		Unchanged		
R_CMP_AR_00044		Unchanged		
R_CMP_AR_00070		Unchanged		

Table 5-61: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00118		
…		

Table 5-162: Inherited Requirements

5.2.8.1.2.1 Component Specific Requirements

###R_CMP_AR_00043### IPC Data Latency

The IPC (APIM_CDC) shall send required signals with latency ≤ (1000ms).

	The IPC (APIM_CDC) shall send required signals with latency ≤ (1000ms).

End of Requirement

###R_CMP_AR_00044### IPC Data Frequency

The IPC (APIM_CDC) shall send required signals with frequency ≤ (1000ms (1Hz))

	The IPC (APIM_CDC) shall send required signals with frequency ≤ (1000ms (1Hz))

End of Requirement

5.2.9 BCM

5.2.9.1 Technology Function “Provide Vehicle Data”

5.2.9.1.1 Function Interfaces

5.2.9.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-63: Input Signal mappings of Function “Provide Vehicle Data”

5.2.9.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Vehicle Data	Ignition_Status		FD1-CAN	
	Remote_Start_Status		FD1-CAN	
	Parklamp_Status		FD1-CAN	
	Day_Night_Status		FD1-CAN	
	Litval		FD1-CAN	
	Dimming_Lvl		FD1-CAN	
	CrashEvnt_D_Stat		FD1-CAN	
	FogLghtFrontOn_B_Stat		FD1-CAN	

Table 5-64: Output Signal mappings of Function “Provide Vehicle Data”

5.2.9.1.1.3 Parameters

Logical Parameter Name	Technical Parameter Name	Mapping Details *(Conditional)*	Method	Method Details

Table 5-65: Parameter mappings of Function "Provide Vehicle Data"

5.2.9.1.1.4 Interface Requirements

###R_CMP_AR_00071### BCM CAN Interface to ARM

The BCM shall communicate with ARM on CAN bus through ECG.

	The BCM shall communicate with ARM on CAN bus through ECG

End of Requirement

5.2.9.1.2 Function Requirements

All Function Requirement related to Provide Vehicle Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	Requirement Title	Modification	Requirement ID (of Technology Function)	Comment
R_CMP_AR_00045		Unchanged		
R_CMP_AR_00046		Unchanged		
R_CMP_AR_00071		Unchanged		

Table 5-66: Component Specific Requirements

Requirement ID (of Logical Function)	Requirement Title	Comment
R_FNC_AR_00118		
…		

Table 5-177: Inherited Requirements

5.2.9.1.2.1 Component Specific Requirements

###R_CMP_AR_00045### BCM Data Latency

The BCM shall send required signals with latency ≤ (1000ms).

	The BCM shall send required signals with latency ≤ (1000ms).

End of Requirement

###R_CMP_AR_00046### BCM Data Frequency

The BCM shall send required signals with frequency shall be ≤ 1000ms (1 Hz).

	The BCM shall send required signals with frequency shall be ≤ 1000ms (1 Hz).

End of Requirement

5.2.10 ABS

5.2.10.1 Technology Function “Provide Vehicle Data”

5.2.10.1.1 Function Interfaces

5.2.10.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-68: Input Signal mappings of Function “Provide Vehicle Data”

5.2.10.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Vehicle Data	VehOverGnd_V_Est		FD1-CAN	
	VehYawComp_W_Actl		FD1-CAN	
	VehRolComp_W_Actl		FD1-CAN	
	VehLatComp_A_Actl		FD1-CAN	
	VehLongComp_A_Actl		FD1-CAN	
	WhlFl_W_Meas		FD1-CAN	
	WhlFr_W_Meas		FD1-CAN	
	WhlRl_W_Meas		FD1-CAN	
	WhlRr_W_Meas		FD1-CAN	

Table 5-69: Output Signal mappings of Function “Provide Vehicle Data”

5.2.10.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-70: Parameter mappings of Function “Provide Vehicle Data”

5.2.10.1.1.4 Interface Requirements

###R_CMP_AR_00072### ABS CAN Interface to ARM

The ABS shall communicate with ARM on CAN bus through ECG.

	The ABS shall communicate with ARM on CAN bus through ECG.

End of Requirement

5.2.10.1.2 Function Requirements

All Function Requirement related to Provide Vehicle Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00047		Unchanged		
R_CMP_AR_00048		Unchanged		
R_CMP_AR_00072		Unchanged		

Table 5-71: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00118		
…		

Table 5-72: Inherited Requirements

5.2.10.1.2.1 Component Specific Requirements

###R_CMP_AR_00047### ABS Data Latency

The ABS shall send related signals with latency shall be ≤ (10ms).

	The ABS shall send related signals with latency shall be ≤ (10ms).

End of Requirement

###R_CMP_AR_00048### ABS Data Frequency

The ABS shall send related signals with frequency ≤ 20ms (50 Hz).

	The ABS shall send related signals with frequency ≤ 20ms (50 Hz).

End of Requirement

5.2.11 PSCM

5.2.11.1 Technology Function “Provide Vehicle Data”

5.2.11.1.1 Function Interfaces

5.2.11.1.1.1 Inputs

Logical Signal Name	Technical Signal Name	Mapping Details *(Conditional)*	Subscriber Interface	Connection (*Optional)*

Table 5-73: Input Signal mappings of Function "Provide Vehicle Data"

5.2.11.1.1.2 Outputs

Logical Signal Name	Technical Signal Name	Mapping Details *(Conditional)*	Publisher Interface	Connection *(Optional)*
Vehicle Data	StePinComp_An_Est		FD3-CAN	
	StePinCompAnEst_D_Qf		FD3-CAN	

Table 5-74: Output Signal mappings of Function "Provide Vehicle Data"

5.2.11.1.1.3 Parameters

Logical Parameter Name	Technical Parameter Name	Mapping Details *(Conditional)*	Method	Method Details

Table 5-75: Parameter mappings of Function "Provide Vehicle Data"

5.2.11.1.1.4 Interface Requirements

###R_CMP_AR_00073### PSCM CAN Interface to ARM

The PSCM shall communicate with ARM on CAN bus through ECG.

	The PSCM shall communicate with ARM on CAN bus through ECG.

End of Requirement

5.2.11.1.2 Function Requirements

All Function Requirement related to Provide Vehicle Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	Requirement Title	Modification	Requirement ID (of Technology Function)	Comment
R_CMP_AR_00049		Unchanged		
R_CMP_AR_00050		Unchanged		
R_CMP_AR_00073		Unchanged		

Table 5-76: Component Specific Requirements

Requirement ID	Requirement Title	Comment

(of Logical Function)		
R_FNC_AR_00118		
…		

Table 5-77: Inherited Requirements

5.2.11.1.2.1 Component Specific Requirements

###R_CMP_AR_00049### PSCM Data Latency

The PSCM shall send required signals with latency ≤ (20ms).

	The PSCM shall send required signals with latency ≤ (20ms).

End of Requirement

##R_CMP_AR_00050### PSCM Data Frequency

The PSCM shall send required signals with frequency ≤ 20ms (50 Hz).

	The PSCM shall send required signals with frequency ≤ 20ms (50 Hz).

End of Requirement

5.2.12 SCCM

5.2.12.1 Technology Function “Provide Vehicle Data”

5.2.12.1.1 Function Interfaces

5.2.12.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*

Table 5-78: Input Signal mappings of Function "Provide Vehicle Data"

5.2.12.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*
Vehicle Data	TurnLghtSwtch_D_Stat		FD3-CAN	
	WiprFrontSwtch_D_Stat		FD3-CAN	
	WiprFront_D_Stat		FD3-CAN	

Table 5-79: Output Signal mappings of Function "Provide Vehicle Data"

5.2.12.1.1.3 Parameters

Logical Parameter Name	**Technical Parameter Name**	**Mapping Details** *(Conditional)*	**Method**	**Method Details**

Table 5-80: Parameter mappings of Function "Provide Vehicle Data"

5.2.12.1.1.4 Interface Requirements

###R_CMP_AR_00074### SCCM CAN Interface to ARM

The SCCM shall communicate with ARM on CAN bus through ECG.

	The SCCM shall communicate with ARM on CAN bus through ECG.

End of Requirement

5.2.12.1.2 Function Requirements

All Function Requirement related to Provide Vehicle Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	**Requirement Title**	**Modification**	**Requirement ID** (of Technology Function)	**Comment**
R_CMP_AR_00051		Unchanged		
R_CMP_AR_00052		Unchanged		
R_CMP_AR_00074		Unchanged		

Table 5-81: Component Specific Requirements

Requirement ID (of Logical Function)	**Requirement Title**	**Comment**
R_FNC_AR_00118		

Table 5-82: Inherited Requirements

5.2.12.1.2.1 Component Specific Requirements

###R_CMP_AR_00051### SCCM Data Latency

The SCCM shall send required signals with latency ≤ (1000 ms).

	The SCCM shall send required signals with latency ≤ (1000 ms).

End of Requirement

##R_CMP_AR_00052### SCCM Data Frequency

The SCCM shall send required signals with frequency ≤ 1000ms (1Hz).

	The SCCM shall send required signals with frequency ≤ 1000ms (1Hz).

End of Requirement

5.2.13 PDB

5.2.13.1 Technology Function “Turn ARM OFF”

5.2.13.1.1 Function Interfaces

5.2.13.1.1.1 Inputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Subscriber Interface**	**Connection** (*Optional)*
Turn AR ECU OFF	AugRealtyMdule_B_Rq		HS3-CAN	

Table 5-78: Input Signal mappings of Function “Turn ARM OFF”

5.2.13.1.1.2 Outputs

Logical Signal Name	**Technical Signal Name**	**Mapping Details** *(Conditional)*	**Publisher Interface**	**Connection** *(Optional)*

Table 5-79: Output Signal mappings of Function "Turn ARM OFF"

5.2.13.1.1.3 Parameters

Logical Parameter Name	Technical Parameter Name	Mapping Details *(Conditional)*	Method	Method Details

Table 5-80: Parameter mappings of Function "Turn ARM OFF"

5.2.13.1.1.4 Interface Requirements

###R_CMP_AR_00075### PDB CAN Interface to ARM

The PDB shall communicate with ARM on CAN bus through ECG.

	The PDB shall communicate with ARM on CAN bus through ECG.

End of Requirement

5.2.13.1.2 Function Requirements

All Function Requirement related to Provide Vehicle Data from Function Specification (ID_F003774) are Required.

Requirement ID (of Logical Function)	Requirement Title	Modification	Requirement ID (of Technology Function)	Comment
R_CMP_AR_00075		Unchanged		
R_CMP_AR_00076		Modified		
R_CMP_AR_00077		Unchanged		

Table 5-81: Component Specific Requirements

Requirement ID (of Logical Function)	Requirement Title	Comment
R_FNC_AR_00118		
…		

Table 5-82: Inherited Requirements

5.2.13.1.2.1 Component Specific Requirements

###R_CMP_AR_00076### PDB to Power ON ARM

The PDB shall provide power to ARM if the latest known status of Key OFF Load (KOL) Modes (KeyOffMde_D_Actl) is in Normal or Factory mode.

	The PDB shall provide power to ARM if the latest known status of Key OFF Load (KOL) Modes (KeyOffMde D Actl) is in Normal or Factory mode.

End of Requirement

###R_CMP_AR_00077### PDB to Power OFF ARM

The PDB shall power OFF ARM if AugRealtyMdule_B_Rq=0x00 is received from ARM or after (TBD)sec from ignition status OFF.

	The PDB shall power OFF ARM if the request is received from ARM or after (TBD)sec from ignition status OFF.

End of Requirement

5.3 Requirements on Connections

5.3.1 Networks

5.3.1.1 “CAN Bus xxx”

5.3.1.1.1 Protocol Requirements

5.3.1.1.2 Electrical Requirements

5.3.1.2 “LIN Bus xxx”

5.3.1.2.1 Protocol Requirements

5.3.1.2.1.1 Schedule Table

5.3.1.2.2 Electrical Requirements

5.3.1.3 “Ethernet xxx”

5.3.2 HW I/Os

5.3.2.1 “HW I/O xxx”

5.4 Requirements on Development Process

6 OPEN CONCERNS

ID	Concern Description	e-Tracker Reference	Status	Solution
1	AR Camera SNR value of **TBD** dB with a tolerance of **TBD** dB for AR vs FIR camera switching		Open	
2	All Navigation signals – physical names		Open	
3	Timer duration to shut off ARM by PDB		Open	
4	All Voice Commands		Closed	Removed, not supported by Google
5	ARM Fault Message to APIM		Open	
6	ARM Memory Allocation for object detection		Open	
7	EH – physical names		Open	
8	AR Camera Intrinsic Calibration Parameters		Open	
9	AR Camera extrinsic Calibration Parameters		Open	
10	FIR Camera Final location		Open	
11	AR Camera Final location		Open	
12	FIR Camera Intrinsic Calibration Parameters		Open	
13	FIR Camera extrinsic Calibration Parameters		Open	
14	Overlay Lane Low Visibility (Post<J1>OTA)		Open	Pending R&A GTDS completion
15	Enhanced Night Vision (Blending) (Post<J1>OTA).		Open	Pending R&A GTDS completion
16	Object Detection with FIR Camera (Post<J1>OTA)		Open	Pending R&A GTDS completion

Table 6-1: Open Concerns

7 REVISION HISTORY

Revision	Date	Description	Approved by	Responsible
1.0	4/21/2021	Initial Release		mabdelh1

1.1	7-12-2021	The following section were updated on the document:
		• 3.1 Functional Architecture.
		• 3.2 Physical Architecture.
		• 3.3 Function Deployment
		• 4.1 Component Interaction Diagrams
		• 5.2 Requirements on Components:
		  ○ Deleted/replaced CMP requirements- #4, #22.
		  ○ Modified requirements: #1, #7, #8, #9, #10, #13, #16, #17, #23, #24, #25, #29, #30, #35, #40.
		  ○ New Requirements: #53, , #54, #55, #56, #57, #58, #59, #60, #61, #62, #63, #64, #65, #66, #67, #68, #69, #70, #71, #72, #73, #74, #75, #76, #77, #78, #79, #80, #81, #82.
		• 6 Open Concerns
		• 7 Revision History
				aalsamar

1.2	9/17/2021	The following section were updated on the document:
		• 3.1 Functional Architecture.
		• 3.2 Physical Architecture.
		• 3.3 Function Deployment
		• 4.1 Component Interaction Diagrams
		• 5.2 Requirements on Components:
		  ○ Deleted/replaced CMP requirement- #12, #19, #33.
		  ○ Deleted/replaced TSG requirements- #1, #2, #3, #4, #5, #6.
		  ○ Modified/Updated requirements- #4, #5, #7, #8, #9, #10, #13, #14, #23, #24, #25, #29, #53, #55, #56, #57, #58, #59, #61, #62, #63, #66, #76, #78, #79
		  ○ New Requirements: #83, #84, #85, #86, #87, #88, #89, #90, #91, #92, #93, #94, #95, #96, #97, #98, #99, #100, #101, #102, #103, #104
		• 6 Open Concerns
		• 7 Revision History		

8 APPENDIX

8.1 Data Dictionary

8.1.1 Logical Signals

8.1.2 Logical Parameters

8.1.3 Technical Signals

###TSG_Augmented Reality_00001### AugRealtyFeat_B_Rq

Signal request to turn the feature ON or OFF. The user will select to turn the feature ON or OFF by a selection menu option through APIM screen or a voice command.

ASIL		QM
Init Default Value		<Default value after reset / initialization on sender side>
Encoding Type Name		<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>
Note: An encoding is either discrete or continuous. Delete fields below which are not needed.		
Value (Continuous Encoding)	Min Value	
	Max Value	
	Resolution	
	Offset	
Value (Discrete Encoding)	0x0	AR Feature OFF
	0x1	AR Feature ON
	...	...
Unit		

###TSG_Augmented Reality_00002### VideoFeed_B_Rq

Signal request to select video feed source. The user will select the video feed from AR camera or keep it automatic based on certain camera parameters.

ASIL	QM
Init Default Value	<Default value after reset / initialization on sender side>
Encoding Type Name	<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>

Note: An encoding is either discrete or continuous. Delete fields below which are not needed.		
Value (Continuous Encoding)	Min Value	
	Max Value	
	Resolution	
	Offset	
Value (Discrete Encoding)	0x0	Video Mode Disabled
	0x1	Video Mode Enabled
	...	
Unit		

###TSG_Augmented Reality_00003### LaneVisblLo_B_Rq

Signal request to turn the Lane Low Visibility feature ON or OFF. The user will select to turn the feature ON or OFF by a selection switch on steering wheel or a voice command.

ASIL		QM
Init Default Value		<Default value after reset / initialization on sender side>
Encoding Type Name		<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>
Note: An encoding is either discrete or continuous. Delete fields below which are not needed.		
Value (Continuous Encoding)	Min Value	
	Max Value	
	Resolution	
	Offset	
Value (Discrete Encoding)	0x0	Lane Low Visibility OFF
	0x1	Lane Low Visibility ON
	...	...
Unit		

###TSG_Augmented Reality_00004### AugRealtyFeat_B_Stat

Augmented Reality ECU repot the feature status to the user through APIM to HHDD screen.

ASIL	QM
Init Default Value	<Default value after reset / initialization on sender side>
Encoding Type Name	<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>

Note: An encoding is either discrete or continuous. Delete fields below which are not needed.		
Value (Continuous Encoding)	Min Value	
	Max Value	
	Resolution	
	Offset	
Value (Discrete Encoding)	0x0	AR Feature OFF
	0x1	AR Feature ON
Unit		unitless

###TSG_Augmented Reality_00005### ARVidMod_B_Stat

Augmented Reality ECU repot the video feed selection status to the user through APIM to HHDD screen.

ASIL		QM
Init Default Value		<Default value after reset / initialization on sender side>
Encoding Type Name		<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>
Note: An encoding is either discrete or continuous. Delete fields below which are not needed.		
Value (Continuous Encoding)	Min Value	
	Max Value	
	Resolution	
	Offset	
Value (Discrete Encoding)	0x0	Video Mode Disabled
	0x1	Video Mode Enabled
	...	
Unit		

###TSG_Augmented Reality_00006### LaneVisblLo_B_Stat

Augmented Reality ECU repot the Lane Low Visibility select status to the user through APIM to HHDD screen.

ASIL		QM
Init Default Value		<Default value after reset / initialization on sender side>
Encoding Type Name		<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>
Note: An encoding is either discrete or continuous. Delete fields below which are not needed.		
Value	Min Value	

~~(Continuous Encoding)~~	~~Max Value~~	
	~~Resolution~~	
	~~Offset~~	
~~**Value** (Discrete Encoding)~~	~~0x0~~	~~Lane Low Visibility OFF~~
	~~0x1~~	~~Lane Low Visibility ON~~
	~~…~~	~~…~~
~~**Unit**~~		

###TSG_Augmented Reality_00007### AugRealtyMdule_B_Rq

Augmented Reality ECU request the PDB to turn the ARM ECU OFF.

ASIL		QM
Init Default Value		<Default value after reset / initialization on sender side>
Encoding Type Name		<If you reuse an existing encoding type, fill in the Encoding Type Name here and delete fields below. Otherwise leave the Encoding Type Name field blank and fill in relevant fields below>
Note: An encoding is either discrete or continuous. Delete fields below which are not needed,		
Value (Continuous Encoding)	Min Value	
	Max Value	
	Resolution	
	Offset	
Value (Discrete Encoding)	0x0	ARM OFF
	0x1	ARM ON
	…	…
Unit		

8.1.3.1 GSDB Signals

8.1.3.2 HW I/Os

8.1.3.3 Diagnostic Interfaces

8.1.3.3.1 DTCs

###<DTC_<ID>>### <DTC Name>

<Some Description of the DTC.
Refer to VSEM document "Diagnostic Fault Coverage and DTC Numbers Design Consideration", what to fill into the attributes below>

Test Period Time	
Test Run Criteria,	
Enable Criteria (EC)	
Applicable	
FailureTypeBytes	
Test Period Time	
Test Run Criteria,	

8.1.3.3.2 DIDs

8.1.4 Technical Parameters

8.1.5 Mappings

8.1.6 Technical Interfaces

8.1.6.1 AIS Interfaces

8.1.6.1.1 Publisher Interfaces

8.1.6.1.2 Subscriber Interfaces

8.1.6.2 AUTOSAR Ports

8.1.7 Messages/APIs

8.1.7.1 CAN Bus “<Bus Name>”

###<MSG_MessageID### MessageName

CAN ID	Transmission Mode	Period	Signal Names	Transmitter(s)	Receiver(s)

8.1.7.2 LIN Bus “<Bus Name>”

8.1.7.3 AUTOSAR Interfaces

8.1.7.4 SOA Service Contracts

###<ServiceContractID>### Service Contract Name

<Service contract purpose/behavior>

Messaging Pattern	Frequency (For Data Broadcast Only)	Message Data Element(s) (Must Match GPB) or applicable CAN signal	Description of Data Element(s)	Topic Name
Choose an item.		GBP Data element / CAN Signal name 1	Detailed encoding of data element 1	
		…		
		GBP Data element / CAN Signal name 1	Detailed encoding of data element 3	

8.1.8 Encoding Types

Document ends here.