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# Document Overview

## Purpose & Scope

Platform Vehicle Control Services are software modules designed according Service Oriented Architecture (SOA) design principles. They provide consumer focused features with highly re-usable interfaces which allow the feature to interact with common vehicle resources such as doors, windows, lights, or cameras.

These interfaces abstract the feature from underlying technological implementations and changes over time, allowing the feature to work across vehicle programs and model years.

The purpose of this document is to define a specific Platform Vehicle Control Service, including its intent, context, high level architecture, and requirements, such that the document can be provided to a software development team who will then design and code the software service.

## Requirement Types

Several types of requirements are defined within this document, as described below.

|  |  |
| --- | --- |
| Requirement Type | Description |
| Functional Requirements | Requirements that directly impact consumer expectations of successful delivery. They provide the functionality that is expected by various consumers. |
| Non-Functional Requirements | Requirements that indirectly impact consumer expectations of successful delivery. They are items like performance, availability, and security that are not directly requested by the consumer yet will contribute to their perceived satisfaction with the product. |
| Interface Requirements | Requirements that help define interfaces between software modules and ECUs, including definitions for the constructs below. |
| Data Enumerations | Lists of values for interface parameters that are limited to a predetermined set of values, or enumerated list. |
| Data Structures | Definitions of data structures that are used within interfaces. |
| Provided Contracts | Interfaces that the Service will provide to consuming feature software. |
| Required Contracts | Interfaces that the Service will need, or use, in order to deliver desired functionality. |

## Document Conventions

This document is generated out of the Vehicle Software and Electrical Management System (VSEM).

The document sub-sections which define requirements will have a heading that contains the following information;

* + VSEM Object Type
  + Unique Object ID
  + Revision Level of the object

This heading will look something like;

FUR-REQ-403606/A

Which breaks down in the following Manner:

* ***FUR-REQ:*** Is the VSEM Object Type and identifies it as a Requirement (REQ) and may further describe the requirement sub-type where FUR is a Functional Requirement Object, and NFN is a non-functional requirement.
* ***404053:***is the Unique Object ID
* ***/A:***is the Revision Level of the object*.*

## Related Documents

Below is a list of documents that should be consulted in addition to this functional specification.

**Sources**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Number** | **Document Location** | **Owner** |
| Enhanced Dash Camera (EDC) | F003751 | VSEM | Eteer, Malik (meteer) |
| Sentinel | F003417 | VSEM | Gupta, Ishan (igupta1) |
| Mobile Device Viewer for Vehicle Cameras (MDVVC) | F002812 | VSEM | Moreno Bautista, Ariana (amorenob) |
| Police Data Track Recorder (PTDR) | F004510 | VSEM | Ayala gonzalez, Hugo (hayalago) |

**Other References**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Number** | **Document Location** | **Owner** |
| CameraService | 754814 | VSEM | Morris, Melissa (mmorr183) |

# Revision History

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| **Object** | **Rev** | **Rev Description** | **Release Status** | **Date Modified** | **Modified By** |
| ENG-754753/A-CameraManagerService+ | A |  | Frozen | 27-Apr-2020 09:49 | Karkare, Medha (mkarkare) |
| ENG-754753/B-CameraManagerService+ | B | Camera Manager Rev B - Allign with SOA CDD Compatible ADAS Camera SErvice, and initial Feature Requirements only. | Released | 07-Dec-2020 17:15 | Morris, Melissa (mmorr183) |
| ENG-754753/C-CameraManagerService+ | C | - Add Power-up and low power  - Rename update interface, clarify is for active stream  - Remove Pause  - Add severity param, enums for streaming & not available  - Add Configs & some Non-Funct Requirements  - Diagrams updated | Released | 29-Mar-2021 11:28 | Morris, Melissa (mmorr183) |
| ENG-754753/D-CameraManagerService+ | D | - Updates per ECG Dev Review  - Multicasting & Raw  - Transit & AR Views  - ADAS errors, retries, wait times  - Remove List view  - Powering ECUs (client ID, Lazy off)  - Reserve Stream & Status  - Multiplexing as FUTURE  - Software Versioning | Released | 20-May-2021 14:18 | Morris, Melissa (mmorr183) |
| ENG-754753/E-CameraManagerService | E | - Add Stream Status & Cancel Reserved Stream APIs  - Update views for latest ADAS list  - Correct topic & message names  - Update diagrams for VPSM, MDV  - Add full configuration values  - Change View is NOT MVP  - Clarify power voting | Released | 22-Jun-2021 13:12 | Morris, Melissa (mmorr183) |

# Service Overview

The Camera Manager is a portion of an in-vehicle camera solution that enables many Features to access vehicle cameras and stream video over Ethernet for a variety of purposes.

The Camera Manager acts as a single point of contact for any feature wishing to interact with a vehicle’s cameras. It provides a catalog of views available in the specific vehicle. It also acts as a mediator between the consumer and the various controllers of the cameras allowing the Features to be abstracted from the underlying camera architecture and its changes from vehicle to vehicle.

The Camera Manager will accomplish this by interacting with many instances of a Camera Service, that must be deployed on any ECU that acts as a camera controller.

Camera Manager can reside on any "Fast" ECU (or compute center) which is connected to ethernet. It should be up and running at startup of the ECU

## Stakeholders

Below is a list of individuals who are either impacted by or have influence over the content within this specification.

|  |  |  |
| --- | --- | --- |
| **Name** | **CDS ID** | **Role / Responsibility** |
| Dogiparthi, Sivaram sudhak (S.) | [sdogipar](mailto:sdogipar@ford.com) | Product Manager – Mobile Device Viewer (MDVVC) |
| Gupta, Ishan (I.) | igupta1 | Feature Owner – Integrated Security Cam (Sentinel) |
| Zuraw, Timothy (T.) | tzuraw | Feature Team – Integrated Security Cam (Sentinel) |
| Luken, Richard (R.) | rluken2 | Feature Team – Integrated Security Cam (Sentinel) |
| Ayala gonzalez, Hugo (H.) | [hayalago](mailto:hayalago@ford.com) | Feature Owner – Police Track Data Recorder |
| Eteer, Malik (M.) | Meteer | Feature Owner – Enhanced Dash Cam |
| Choi, Kai (K. H.) | Kchoi12 | Feature Owner – In Vehicle Video Calling (IVVC) |
| Benhamouche, Fatima (F.) | [fbenhamo](mailto:fbenhamo@ford.com) | Core Function Owner - VRP |
| Dhawan, Pradeep (P.K.) | pdhawan | ADAS D&R Engineer (SOA interfaces) |
| Indrakanti, Ram (R.) | rindraka | ADAS – Sentinel Feature |
| Midde, Vijaya Kumar (V.) | [vmidde](mailto:vmidde@ford.com) | ADAS - Mobile Device Viewer Feature  ADAS - Modeling and Signal Mapping |
| Karramreddy, Venkat Sai R (V.) | [vkarramr](mailto:vkarramr@ford.com) | ADAS - Mobile Device Viewer Feature  ADAS Modeling and Signal Mapping |
| Khan, Kamal (A.) | [kkhan30](mailto:kkhan30@ford.com) | ECG Development Team – Camera Manager |
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| Do, Leon (L.) | ldo2 | ECG – Development Team |
| Purvine, Greg (G.) | gpurvine | ECG – Development Team |
| Cole, Michael (M.J.) | mcole67 | ECG – Development Team |
| Vootkuri, ChandraSekhar (C.R.) | cvootkur | AR Module – Core Software Lead |
| Shokry Soliman, Ahmed (A.) | ashokrys | ConOps – Connectivity Engineer |
| Mueller, Holger (H.) | hmuell62 | IVI-C Software – Video Recorder & Playback |
| Emani, Savitha (S.) | semani4 | IVI-C – SPSS Writer VRP & Sentinel |
| Chapekis, Steven (S.A.) | schapeki | IVI-C – Connected Streaming Services |
| Pohl, Sascha (S.) | spohl6 | PO for Sentinel on SYNC |
| Coloney, Shane (S.) | lcoloney | Ford Pass - Ford Performance App (PTDR) |
| Nunzio DeCia | ndecia | ECG - SPSS Owner Mobile Device Viewer |

## Potential Use Cases

Below is a list of ways in which the Camera Manager can be used.

|  |  |
| --- | --- |
| **Use Case ID** | **Use Case Description** |
| UC\_FN\_CameraMgrServ\_C00001 | Vehicle owner would like to get list of the available Camera Views on the vehicle for selection. |
| UC\_FN\_ CameraMgrServ \_00002 | Vehicle owners would like to view a video stream on their phone via Ford Pass or Lincoln Way. |
| UC\_FN\_ CameraMgrServ \_00003 | Vehicle owner would like to stop the video stream they are viewing. |
| UC\_FN\_ CameraMgrServ \_00004 | Analytics or upcoming feature would like to select the available camera for streaming. |
| UC\_FN\_ CameraMgrServ \_00005 | A security feature would like to record video from around and/or inside the vehicle when an alarm is triggered. |

## Abbreviations and Definitions

Below is a list of definitions for the abbreviations and terms used within this document.

|  |  |
| --- | --- |
| **Abbreviation** | **Description** |
| ADAS | Advanced Driver Assistance System |
| AR | Augmented Reality Module |
| BCM | Body Control Module |
| Camera Controller | The ECU connected to one or more camera devices which hosts an instance of the Camera Service. |
| CDD | Complex Device Driver  A Software Component used to model a function outside of the normal **AUTOSAR** Basic Software stack |
| ECU | Electronic Control Unit |
| ECG | Enhanced Central Gateway  A Compute center within the vehicle that manages in vehicle networking. It also hosts several platform software components. |
| H.264 | A well-known video compression standard for high-definition digital video |
| Host | For the purposes of this document, it is one of the ECUs where a Camera Service is installed. |
| ISC | Integrated Security Camera  Formerly known as “Sentinel”.  Feature that automatically records video from around and in the vehicle whenever a perimeter alarm is activated. |
| MDVVC  Or MDV | Mobile Device Viewer of Vehicle Cameras  Feature that allows the vehicle owner to request video feeds from vehicle cameras to their phone using Ford Pass. |
| MQTT | A lightweight messaging protocol for small sensors and mobile devices |
| RTP | Real-time Transport Protocol  A network protocol for delivering audio and video over IP networks. |
| RTCP | Real-time Transport Control Protocol  Works with RTP to monitor delivery statistics like number of bytes sent, packets sent, lost packets and round-trip delay between endpoints, so that compensating measures can be taken |
| SOA | Service Oriented Architecture |

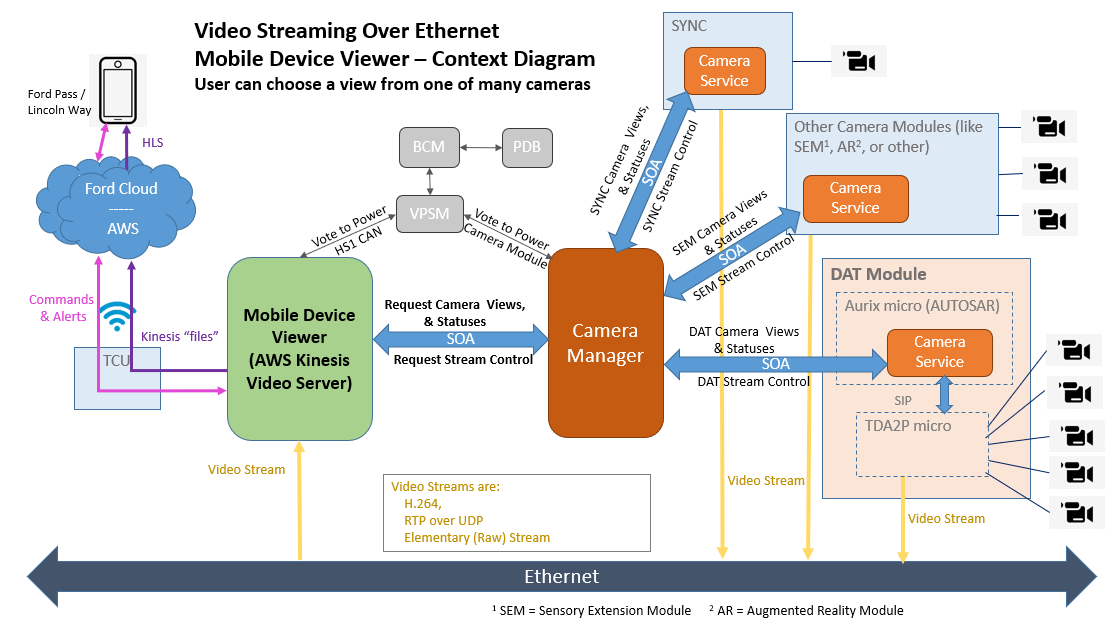
# Architecture/Context Diagrams

The sections below provide high level diagrams showing the Camera Manager architecture and it’s interactions with other software.

## Context - Mobile Device Viewer Feature

Below is a context diagram showing how Camera Manager will make views from multiple in-vehicle camera devices available to the Mobile Device Viewer feature, streaming the video over in vehicle Ethernet. Camera Manager abstracts the feature away from underlying vehicle technology like which ECU provides which view.

The Mobile Device Viewer feature will allow the vehicle owner to select a view and stream video from it to their phone.

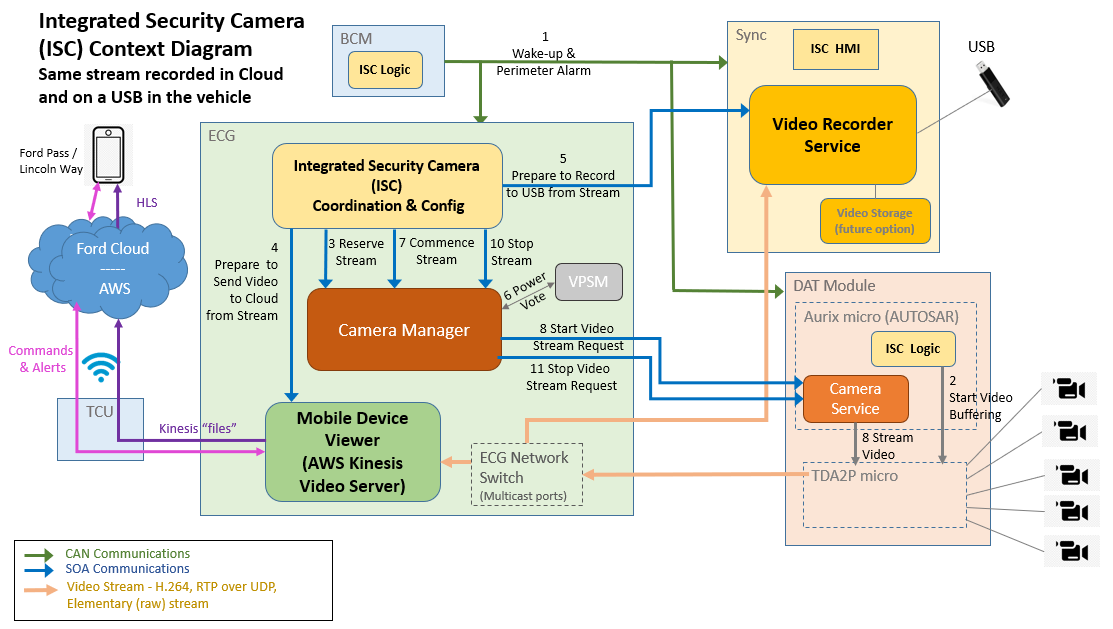


## Context - Integrated Security Camera (Sentinel) Feature

Below is a context diagram showing how Camera Manager, residing on ECG, will interact with the Video Recorder Service, Mobile Device Viewer / AWS Kinesis Video to Cloud server, and a number of Camera Services on a variety of camera controllers, in order to facilitate the Integrated Security Camera (ISC) feature use case.

The ISC Feature will record video both to a USB device within the vehicle and the cloud whenever a perimeter alarm is triggered on the vehicle. In this use case the ignition is off, and ECUs must be powered up in order to stream and record the video. Since the power up time for SYNC and ECG (in FNV2 or FNV3) is on the order of 10 to 12 seconds. The ADAS module will power up first and will begin buffering the ISC required views to memory prior to the request to stream them for recording.

Since the video must be sent to 2 recipients within the vehicle, this feature requires a multicasting solution. Please see the architecture sections on multicasting for more information.



## Multicasting Architecture

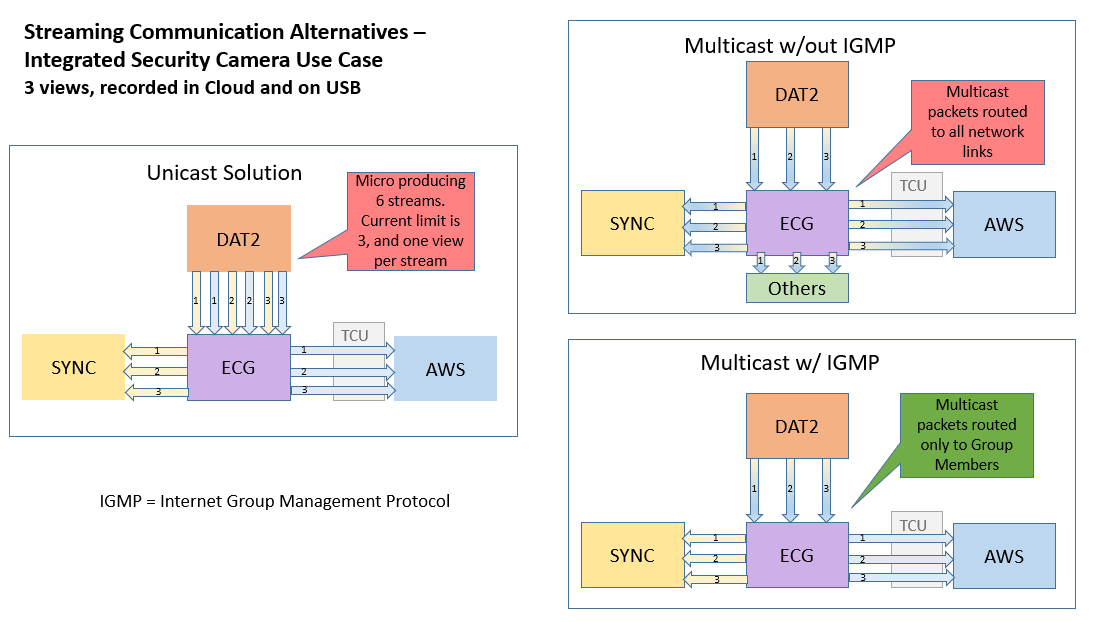
The original architecture plan for the camera solution, in support of the Mobile Device Viewer Feature communicated in a unicast manner. In this strategy the video recipient provided the IP Address and Port where it wanted to receive the video. This meant that only one recipient could receive the video stream for that view at any given time.

When considering the Integrated Security Camera feature (formerly known as Sentinel) requirements, it became clear that a unicast communication strategy would not be feasible. Therefore, a multicasting approach was pursued and approved by the ECG Network switch team and cyber security.

### Alternatives Considered

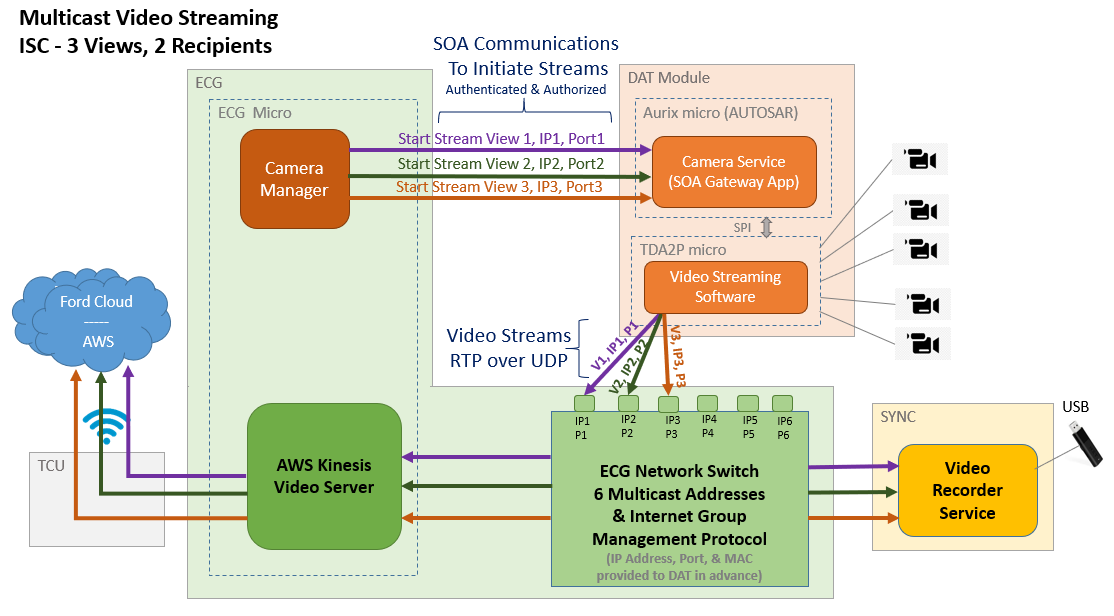
The diagrams below are included to help explain why multicasting with Internet Group Management Protocol (IGMP) has been chosen for our video over Ethernet solution.

As you can see a unicast solution places too large a burden on the Camera Controller microprocessors, while multicast without IGMP would create excessive and unnecessary network traffic.



### Multicasting Diagram - Integrated Security Camera

Below is a high-level architecture diagram depicting how multicasting, configured on the ECG Network Switch, along with Internet Group Management Protocol (IGMP), will allow 3 different views to be sent to 2 recipients each, in support of the Integrated Security Camera (formerly Sentinel) Use Case.



In this scenario when Camera Manager receives the first request for a particular view, it selects an available Multicast IP address and port from a preconfigured list. That address and port is sent to the Camera Controller for use as the destination of the video stream.

Camera Manager will provide that same IP address and port back to the requestor, so it can bind an address and join the multicast group.

When Camera Manager receives a second request for the same view, it will reply to the requestor with that same IP address and port, allowing the second requestor to join the multicast group and receive the in-progress video stream.

# Requirements

This section provides the list of requirements for the Camera Manager.

## Functional Requirements

The functional requirements below are those that directly impact consumer expectations of successful delivery. They provide the functionality expected by various consumers.

### F-REQ-404064/D-Publish Camera Views and Status (On Demand, On Change)

Camera Manager shall allow various features and systems to discover what camera views are available in a specific target vehicle by providing an On-Demand, On Change broadcast of camera views and statuses.

The view status will indicate if the view is available or not available in the vehicle, or if the camera responsible is in a fault condition.

These view statuses will represent a consolidated list of all views from across all the Camera Services in the vehicle

During initialization, in an **ignition on** state, Camera Manager shall gather this data from all possible Camera Services within the vehicle (see the configuration and required interface sections of this document for more information on gathering that data). If a configured camera service host is not responsive, or not available within the specific vehicle, Camera Manager must set the status for all the views provided by that host controller to Not Available.

During initialization, in an **ignition off** state, Camera Manager shall provide the last known values, which it should persist from the last ignition on cycle, or streaming activity (see configuration section of this specification).

Note: Due to limitations with SOA interfaces on AUTOSAR Classic Controllers, it was not possible to have the camera services for each controller register its views and statuses with Camera Manager. Therefore, Camera Manager is currently keeping a superset of all possible views and hosts across all vehicle lines and must verify presence in the vehicle upon initialization. In the future it may be possible to add a registration interface that camera services on future controllers could use to update Camera Managers list of camera host controllers and views.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Reworded to reflect separation into view status and new stream status broadcast |

### F-REQ-404065/B-Unsubscribe to Broadcast of Camera Views and Stats

Camera Manager shall allow consumers to unsubscribe to the broadcast of camera views and their current status, when the consumer no longer requires the information.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | B |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Removed reference to configuration info (res, frame rate, bit rate). This info cannot be provided by ADAS in status broadcast. |

### REQ-404066/A-Multiple Subscribers to Camera Views Broadcast

Camera Manager shall facilitate multiple subscribers receiving the same broadcast of Camera Views and stats, only terminating the on-change broadcast when the last subscriber indicates they no longer require the information (unsubscribes), or otherwise abort listening.

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| **Requirement Information** | |
| **Requirement Type** |  |
| **Requirement Revision** | A |
| **Revision Date** | 07-Dec-2020 17:15 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** |  |

### REQ-404068/B-Start Video Stream

Camera Manager shall facilitate a consumer establishing an Ethernet connection and streaming video over it, from any camera / view in the vehicle. This will include passing the necessary IP address and port information to both the recipient of the video stream and the camera service providing it.

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| **Requirement Information** | |
| **Requirement Type** |  |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | REplaced term Camera Controller with Camera Service |

### F-REQ-404069/C-Stop Video Stream

Camera Manager shall facilitate stopping an active video stream. If there is more than one recipient of the same view stream, Camera Manager will only send the stop request to the Camera Service providing the video when the last recipient sends a stop request.

**Please Note:**

It is the consumers responsibility to make sure stop requests are successful. This may mean retrying until a success response is received, in the event of any communication disruption or system crash. The consumer should persist knowledge about active video streams, and upon restart, ensure that it sends stop requests for any streams that were in process prior to the failure.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added Note that consumer is responsible to ensure successful stop. |

### FUR-REQ-409915/C-Change Config While Streaming

The Camera Manager may allow a consumer that is the sole recipient of a streaming view, to change the stream configuration (resolution, framerate, and bitrate) while the stream is active.

If there are multiple recipients of the view stream, then requests to change the configuration will be rejected with an invalid request error.

Note: This is not required for the Minimum Viable Product (MVP)

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Changing from Shall to May. This is a nice to have not MVP |

### F-REQ-404080/C-Manage Multiple Camera Services

Camera Manager shall manage multiple Camera Service instances across different controllers. This includes;

1. Retaining the master list of all possible camera controllers and views
2. Gathering current statuses from all camera services during ignition on cycle.
3. Persisting last known status for use in ignition off state.
4. Providing control interfaces for video streaming of all camera views, across multiple Camera Services.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified wording based on review questions. |

### F-REQ-404092/B-Multiple Cameras per Camera Service Instance

Camera Manager shall support Camera Service instances connected to a single camera as well as those connected to multiple cameras. A given Camera Service can manage one or more cameras, and each camera can provide one or more views.

There will be only one Camera Service managing a given camera and its views.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarify wording based on review questions. |

### F-REQ-404397/C-Multiple Views Streaming Simultaneously

Camera Manager shall support streaming video from multiple cameras / views at the same time.

This is required for features like Integrated Security Camera or Enhanced Dash Cam where views from multiple cameras will be recorded after a triggering event. Note: Enhanced Dash Cam is expecting to record up to 5 views at a time

This is also necessary to allow multiple features to access camera video streams at the same time.

If the number of streams requested exceeds CPU or Bandwidth thresholds, the Camera   
Service will provide Camera Manager with one of the following errors:

* ERROR\_BANDWIDTH\_LOAD
* ERROR\_CPU\_LOAD

Camera Manager will need to pass this error on to the consumer requesting the video stream.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Updated to indicate source of any bandwidth or CPU load errors. |

### F-REQ-415896/A-Support Multicasting and Manage Addresses

The video over ethernet platform within Ford vehicles will require multicasting and Internet Group Management Protocol (IGMP) in order to fulfill feature requirements for multiple recipients of the same camera view.

The Camera Manager shall support multicasting, by managing the list of multicast addresses and ports available within the vehicle. The list of multicast addresses is expected to be a static set across all vehicles (see list below).

Camera Manager shall select an available address for use with a given start stream request.

It will then supply the IP Address and port both to the video source and the video recipient.

Camera Manager shall also track which addresses are actively in use and what views are currently available on those addresses (see configuration section within this document). If subsequent requests for the same view are received, Camera Manager will reply to the consumer with the existing IP Address and Port without making another start video stream request to the camera service.

The list of possible multicast ports are as follows:

|  |  |  |
| --- | --- | --- |
| **IP Address** | **Port** | **MAC Address** |
| 235.10.1.1 | 5000 | 01-00-5e-0a-01-01 |
| 235.10.1.2 | 5000 | 01-00-5e-0a-01-02 |
| 235.10.1.3 | 5000 | 01-00-5e-0a-01-03 |
| 235.10.1.4 | 5000 | 01-00-5e-0a-01-04 |
| 235.10.1.5 | 5000 | 01-00-5e-0a-01-05 |
| 235.10.1.6 | 5000 | 01-00-5e-0a-01-06 |
| 235.10.1.7 | 5000 | 01-00-5e-0a-01-07 |
| 235.10.1.8 | 5000 | 01-00-5e-0a-01-08 |
| 235.10.1.9 | 5000 | 01-00-5e-0a-01-09 |
| 235.10.1.10 | 5000 | 01-00-5e-0a-01-0a |

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added requirement |

### F-REQ-416298/A-Unicast Not Supported

Camera Manager and the In-Vehicle Video Over Ethernet solution will not support a unicast communication strategy. Unicast limits the views to one recipient at a time. This would increase the chances of a consumer receiving an error indicating that a camera is in use, and not available to them for streaming.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** |  |

### F-REQ-410555/C-Track Stream/View Consumers

The Camera Manager shall be responsible for keeping track of what camera views are currently streaming, the recipients for each view (client Ids), as well as the resolution, framerate, and bitrate requested for the stream.

The stream ID and associated information shall be stored / persisted prior to sending the start stream request to the camera controller. This will facilitate potential crash recovery later, see non-functional requirements and configuration sections of this document for more information.

If the start request sent to the Camera Controller fails, Camera Manager must remove the stored stream and associated information.

If a subsequent request is received for a camera view that is already streaming, then Camera Manager must respond by directing the consumer to the existing stream address. Do not request a new stream from the camera controller.

For any stop stream requests Camera Manager must first remove the client from the list of recipients for that stream, and only pass the stop stream request on to the Camera Service when the LAST consumer has requested to stop.

After successful termination of the stream, camera manager must remove the persisted information for that stream.

Note:

A camera can provide more than one view, but not at the same time. If a different view is requested from that same camera, the Camera Service will respond with an Invalid\_Request error.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add removing stored info if request to start stream fails with camera controller. |

### FUR-REQ-409523/B-Stream Buffered Video

The Camera Manager Service shall NOT provide any video stream buffering.

If buffering is required that will be done either by the video source, or the video recipient.

The ADAS Camera Service will provide buffering to cover the Integrated Security Camera (formerly known as Sentinel) feature use case. That feature must record video within less than 2 seconds of a perimeter alarm event in an ignition off state.

Therefore, rapid boot ECUs controlling the cameras (like ADAS) will establish a video buffer for the camera views, so they can capture video while longer boot ECUs (like SYNC and ECG) are booting.

The stream control interfaces provided by Camera Manager should not be impacted by this buffering functionality.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added. |

### FUR-REQ-409524/C-Power-Up Camera Controller

The Camera Manager shall be responsible for ensuring that the required camera controller is powered, using the Vehicle Power State Manager (VPSM).

For each start stream request, Camera Manager will receive a power severity and client Id from the consumer. This will be used by Camera Manager to submit a keep powered request to VPSM for the Camera Controller) responsible for the requested view (see the section on view to controller configuration in this document).

Camera Manager could send power votes to VPSM by individual client id, or it could calculate the highest vote for that camera controller from among all existing stream requests and place a single Camera Manager vote with VPSM.

The stop stream request will also include a client id so that Camera Manager can remove the vote for that specific client id from VPSM, or from its internal vote calculations and alter the severity of its single vote accordingly.

When a given consumer is requesting or stopping more than one video stream, Camera Manager will be responsible for tracking all streams needed by that consumer (client id) and remove the vote only when that consumer no longer needs any stream from a given camera controller.

Notes:

* + Information on VPSM can be found at the links below:
    - [VPSM High Level Design](https://www.eesewiki.ford.com/display/ecg/VPSM+HLD)
    - [VPSM Programmers Guide](https://www.eesewiki.ford.com/display/ecg/ECG+Programmer+Guide+%2810%29%3A+fnv%3A%3Avpsm+API+library)
  + The Vehicle Power State Manager (VPSM) must be updated for FNV3 and use of the BCM Variable Power Moding strategy.
  + For more information on Variable Power Moding see the following VSEM artifacts:
  + RPKG-792782/A-FAS Variable Power Mode
  + VDOC085107-Variable Power Mode ECG SPSS

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Udpate CM could vote by client, or with one CM vote. |

### F-REQ-410564/C-Verify Camera Service SOA Status

Prior to sending a request, Camera Manager shall verify that the camera service for the target camera controller has registered with the SOA broker. This is particularly important in an ignition off state, after voting for the camera controller to be powered, in order to ensure that the Camera Service is ready to receive SOA requests.

If the camera service for that controller is not registered within a configurable time out period, Camera Manager shall respond with a timed-out error to the consumer(s) requesting the view(s).

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Minor wording updates for clarity |

### FUR-REQ-409678/C-Low Power Camera Mode

Prior to any a start stream request, the Camera Manager shall send a request to enable a low power mode to the camera controller, if it offers such a mode (see the camera host configuration section in this document).

The low power mode request for cameras is similar to using VPSM to vote for an ECU to stay powered. It is a vote to keep the cameras powered and available to stream, allowing the camera controller to remove power from other microprocessors and functions when appropriate.

When stopping the last active stream for that controller, Camera Manager must send a request to disable low power mode for cameras, allowing cameras to be powered off, if needed in order to conserve battery state of charge.

Notes:

* These requests should be made regardless of ignition state, since the ignition state could change while the video is streaming. The camera controller will take ignition state into account in its logic.
* See the configuration section of this document for information on how to determine which camera controllers support a low power camera mode.
* See the required interfaces section of this document for more information on the low power mode request.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified use configuattion information to idenitfy what hosts support. |

### F-REQ-412365/B-Persist Last Known Camera View Statuses

The Camera Manager shall persist the last known status for all camera views for use in an ignition off state. This will allow Camera Manager to publish the list of views available within the target vehicle in an ignition off state, without having to power up all the camera controllers.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Revised to persisting last known state from Camera Controllers, since they will now provide a Streaming Status. Camera Manager does not have to attempt to track a streaming status based on successful requests. |

### F-REQ-415404/A-Lazy Power Off of Camera Controller

The Camera Manager shall support a “Lazy Power Off” functionality that will allow the consumer to request Camera Manager to delay powering off the camera controller after a stop stream request, for a configurable amount of time (see configuration section in this document).

This functionality will facilitate use cases where an end consumer may be switching to a new view from the same camera controller. It will prevent unnecessarily powering off the camera controller, then quickly cycling it back on. It will also prevent unnecessary delays in providing the video stream to the consumer.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added Requirement |

### F-REQ-415419/B-Reserved Stream

The Camera Manager shall allow consumers to “reserve” a stream in order to achieve a coordinated start allowing all planned recipients to join the multicast group and prepare for the video stream in advance of the stream starting.

The consumer that is coordinating the stream recipients uses the start stream request with a reserved parameter set to true, in order to receive the multicast address and port from Camera Manager, prior to the video stream starting.

The coordinating consumer will then provide the address information to all recipients allowing them to set up for the stream and join the multicast group. Once all desired recipients are ready, the coordinating consumer will issue a commence stream request to Camera Manager. Camera Manager will then communicate to appropriate Camera Controllers in order to start the actual video stream.

When Camera Manager receives a request to reserve a stream it must:

1. Establish a stream Id
2. Determine a multicast address to be used
3. Store appropriate stream information (client Id, config)
4. Add the stream to the stream status broadcast with a status of “Reserved”.
5. Respond to the consumer with a success message and provide the appropriate IP Address and port.
6. Establish a timer for receipt of the commence request.

If a different consumer requests the same view as one that is currently reserved, the consumer will be informed that they are joining an existing reserved stream in the response message (see StreamType data enumeration and the Start Stream response message in the interface section of this document). That consumer must wait for the original coordinating consumer to commence the stream.

When the timer for the commence stream expires, and the Coordinating consumer has NOT commenced nor canceled the stream, then Camera Manager must determine if another consumer has requested the same view and then;

1. If any other consumer is waiting for the stream, then automatically commence the stream.
2. If no other consumer is waiting for the stream, then;
   1. Do not start the video stream
   2. Clear the stored information for the stream
   3. Remove it from the stream status broadcast.

If the coordinating consumer cancels a reserved stream then Camera Manager must determine if there are other consumers waiting for the stream, then;

* 1. If any other consumer is waiting for the stream, automatically commence the stream on their behalf.
  2. If no other consumer for the stream, then:
     1. Clear the information stored for that stream
     2. Remove the stream from the stream status broadcast.

Use Case:

The primary use case for this functionality is the Integrated Security Camera (ICS) Feature in which it is important for 2 different recipients to be ready in advance of the video stream starting. This ensures both will receive **all** of the buffered video, and capture events as close to the perimeter alarm activating as possible.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add cancel API, If another client and no commence, autostart. |

### F-REQ-415886/A-Battery Depletion Threshold Warning

Upon receiving an indication from the VPSM system that a vote to keep a controller powered is about to be removed due to battery depletion, the Camera Manager shall change the status of any streaming views for the camera controller to a Battery Warning status.

The assumption is that the consumer, upon receiving this status will either:

1. Stop the stream
2. Ask the End User to start the vehicle.
3. The consumer may send a request to Camera Manager to change their power severity level, in order to gain time for the end user to start the vehicle. Camera Manager, upon receiving this request, will alter the power vote on behalf of the client, and change the status of appropriate views back to streaming.

If no action is taken by the consumer within a configurable amount of time, see configuration section of this document, then the **Camera Manager shall**:

1. Send stop stream requests to the host camera services in order to execute a graceful shutdown. Once the active streams are stopped, the stream and view statuses from the host camera services should be updated. At that time Camera Manager shall persist the new value as part of last known status for the next power up cycle.
2. Remove the active stream IDs and clients associated to them from persisted data.
3. Remove votes with VPSM to power the camera controllers.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added |

### F-REQ-415890/B-Change Power Severity Interface

The Camera Manager shall provide an interface that will enable consumers to temporarily change the power severity used to vote to keep camera controllers powered. This interface is used when the consumer software receives a battery warning and needs to gain time for the end user to start the vehicle.

Note: VPSM may only provide the warning when the highest existing severity vote is reached. If the consumer is at a lower severity threshold, they may not receive the warning until a higher severity threshold is reached. Therefore, raising the power severity vote may not be possible in all scenarios.

Upon receiving a request to raise the power severity, Camera Manager may take one of two courses of action, depending on how it implements voting with VPSM.

1. If Camera Manager is submitting individual consumer votes to VPSM, then it should determine the highest existing vote it is placing with VPSM for that controller, and temporarily raise the vote for the requesting consumer to the next severity level above that. If it is not possible to raise the vote any higher, it should send a failure response to the requesting consumer.
2. If Camera Manager is placing a consolidated vote on behalf of all its consumers to VPSM, then it should raise that vote to the next highest severity. If it is not possible to raise the vote any higher, it should send a failure response to the requesting consumer.

After raising either the consumer-based vote or the accumulated vote, Camera Manager must:

1. Set a timer to determine when to return the vote back to its prior level (the raised severity is only temporary, to allow for possible end user action.
2. When the timer expires, Camera Manager should return the power vote to its original severity level.

If the vehicle is started, the battery warning will no longer apply, the stream status will return to streaming, and the camera controllers will remain powered.

If the vehicle is not started, then a new warning should be received from VPSM either at the new power severity level, or when the severity level is returned to its old value. Camera Manager shall process that warning according to the battery depletion threshold warning requirement.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add - VPSM may only warn at highest existing vote.  CM could vote by client or with a single CM vote based on all clients. |

### F-REQ-423315/A-Publish Stream Statuses (On Demand, On Change)

The Camera Manager shall provide an On-Demand, On-Change interface to communicate the status of any active video streams. Those statuses shall include but are not limited to the following:

* Streaming: A start stream request was successfully processed and video is actively streaming
* Reserved: A stream has been “reserved” for a coordinated start. The video will begin streaming when a commence request is received from the consumer that reserved it.
* Battery\_Warning: This warning is provided when streaming in an ignition off state, letting the consumer know that the stream may terminate soon to protect battery state of charge. The consumer should send a stop request or ask the end user to start the vehicle.
* Failed: The active stream failed and has been terminated by the video source. The stream status will report as Failed, until the consumer sends a Stop Request. It is the consumers responsibility to always send stop requests, and ensure they are successful.

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| **Requirement Information** | |
| **Requirement Type** | F - Functional |
| **Requirement Revision** | A |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added |

## Non-Functional Requirements

The non-functional requirements below are those that indirectly impact consumer expectations of successful delivery. They are items like performance and security that are not directly requested by the consumer but will contribute to their perceived satisfaction with the product.

### NFN-REQ-410183/B-Transport Protocol

The video shall be streamed over Ethernet using the Real-time Transport Protocol (RTP) at the application layer, over the User Datagram Protocol (UDP) transport layer.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added UDP statement |

### NFN-REQ-410184/C-Codec - Video Compression Technology

The video streams provided by the Camera Services shall adhere to the H.264 video compression standard.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified Cam Mgr is not providing video |

### NFN-REQ-412227/C-Video Container / Format

The video streams provided by the Camera Services shall be raw or elementary streams.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified Cam Mgr is not providing video |

### NFN-REQ-415819/B-Video Stream Frames & Embedded Parameter Sets

The video streams provided by the Camera Services shall consist of the following:

1. An I-frame or Instantaneous Decoder Refresh (IDR) frame shall be provided at a configurable interval within the video stream. As these contribute to bandwidth utilization, the recommended default is every 1 second, but it should be possible to tune this value during testing.
2. Every I-frame must be preceded with an embedded;
   1. Sequence Parameter Set (SPS)
   2. Picture Parameter set (PPS)

The above is critical in order to ensure that recipients can properly interpret and use the video stream even if they join after the stream has started.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified Cam Mgr is not providing video |

### NFN-REQ-410185/A-Non-Volatile Storage

Camera Manager will need some form of non-volatile, read-write memory storage (configuration parameters, DIDs or other) in order to store the following information:

* Camera Controllers installed in the vehicle
* Views offered by those controllers
* Last status of the views
* Parameters used to power them up in ignition off state, if needed.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added. |

### NFP-REQ-410186/A-Response Times

It is expected that the Camera Manager shall be built to perform as efficiently as possible, with response times (from receipt of a request to the action being completed) on the order of hundreds of milliseconds.

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| **Requirement Information** | |
| **Requirement Type** | NFP - Non-Functional-Performance |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** |  |

### NFN-REQ-410276/A-Availability - Life Cycle

The Camera Manager Service shall be available in the normal vehicle life cycle mode, it may be available, but is not required, in other modes like factory or transport.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Wording updated. changed from Paragraph to Requirement object in VSEM. |

### NFN-REQ-410277/A-Availability - Ignition State

The Camera Manager Service shall be available in all ignition states, including off, provided available battery charge is not low.

This is required so that any cameras permanently attached to the vehicle (either by Ford, or as an aftermarket option, like the rear auxiliary camera) will be available to stream video over Ethernet.

When ignition is off, it must be possible for the Camera Manager Service to request the ECUs controlling the cameras to wake-up and make cameras available for video streaming.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Wording updated. changed from Paragraph to Requirement object in VSEM. |

### NFN-REQ-410278/B-Availability - Wake-up

The Camera Manager Service shall be part of the ECU wakeup and initialization strategy. Camera Manager shall be available for off board requests via wake-up requests from the cloud.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Wording updated to clarify meaning of "remote start" |

### NFM-REQ-410279/A-Software Updates

Camera Manager shall support updates via Over The Air (OTA) software updates. It shall also be possible for dealers and technicians to update the software as part of an ECU update.

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| **Requirement Information** | |
| **Requirement Type** | NFM - Non-Functional-Maintain |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** |  |

### NFS-REQ-410281/A-Security

Camera Manager will utilize the authentication and authorization functionality provided via the SOA Middleware, the Access Control List (ACL), and Ethernet using TLS.

Additional Security requirements are;

1. Only Camera Manager will have access to request topics of the various Camera Service Instances.
2. Consumers can request access to Camera Manager.
3. Authorization to control cameras will be provided through the Access Control List (ACL) supported by the SOA Manager infrastructure.

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| **Requirement Information** | |
| **Requirement Type** | NFS - Non-Functional-Security |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Changed from paragraph to requirement object in VSEM. |

### NFM-REQ-410282/B-Audit Logs

Camara Manager shall adhere to ECG / vehicle platform error logging standards, in order to facilitate root cause analysis and problem resolution.

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| **Requirement Information** | |
| **Requirement Type** | NFM - Non-Functional-Maintain |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified wording, log per ECG error logging standards |

### NFN-REQ-410284/A-Authorization

Camera Manager shall utilize existing SOA Middleware tools to Authorize the service subscriber before allowing any operation to be performed on cameras.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Changed from paragraph to requirement object in VSEM. |

### NFN-REQ-410285/A-Retry and Timeout

The Camera Manager Service shall wait a configurable amount of time (see configuration section) for the Camera Controller to respond to a request.

If the Camera Controller fails to respond in that time, the Camera Manager Service shall retry the request a configurable number of times (see configuration section). If there still is no acknowledgement after the last retry, then it shall send a failure response to the consumer with a reason of TIMED\_OUT.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added requirement, based on ECG dev team request |

### NFN-REQ-410287/A-Multiple Requests - Queuing

The Camera Manager Service must queue incoming requests and process them in the order received.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added requirement, based on ECG dev team request |

### NFN-REQ-410286/B-Multiple Requests - Max Concurrent Requests

The Camera Manager Service shall implement a configurable max queue size (default = 10) for incoming requests, after which incoming requests will be denied. When the Queue is full, the Camera Manager Service will respond to the consumer with a failure status and an error description of "QUEUE\_FULL". See configuration section in this document for the max queue size parameter.

Rationale: Unlimited requests cannot be supported. There are upcoming features like Enhanced Dash Cam, that wish to request 5 Camera Views to stream at the same time. Allowing 10 to ensure that concurrent stop requests are not lost.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Increased max concurrent expected, do not want to lose any stop requests. |

### NFM-REQ-415814/A-Software Interface Version Compatibility

Given the advent of Over The Air (OTA) Software updates, it is possible for software interface versions on different ECUs to become incompatible. It is desirable to capture this error state and prevent any critical failure in the overall camera video streaming solution, such as starting a video stream, and then not being able to send a version compatible stop request.

Therefore, Camera Manager shall facilitate software interface version management with Camera Services in a manner that is compatible with SOA limitations on AUTOSAR Classic nodes (see note below) by doing the following;

1. Store the Camera Service Software Version it expects for each Camera Controller (Host ECU) see configuration section of this document.
2. When receiving a View Status broadcast from each Camera Service, compare the software version reported in the broadcast to the one that is stored by Camera Manager for that controller and perform the actions below. NOTE: ADAS has an exemption from providing its camera service software version for the DAT 221 release train.
   1. If the versions represent a match, or a backward compatible change, meaning:
      1. Major portion of the version numbers are equivalent,
      2. AND the minor portion stored by Camera Manager is equal to or less than the one reported in the broadcast)

Then proceed as normal, assuming all Camera Manager functionality will be possible.

* 1. If the versions represent a non-backward compatible change, meaning:
     1. Major portion of the software versions are not equal,
     2. OR the minor portion stored by Camera Manager is greater than the one reported in the broadcast.

Then log the version incompatibility error per standard ECG error logging and set all views from that camera controller to “Software Version Incompatible”.

**Note:** For AUTOSAR Classic Modules utilizing the Ford SOA CDD, it is not possible to utilize the SOA Broker version library functions and the versions contained in the .info proto file. Therefore, the versions are exchanged as part of the payload of the view status broadcast.

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| **Requirement Information** | |
| **Requirement Type** | NFM - Non-Functional-Maintain |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** |  |

### NFN-REQ-415843/B-Detect Mid-Stream Error and Clean Up

Camera Manager shall monitor the Stream Status broadcast of all Camera Services in order to determine if a failure has occurred with an active stream.

If a Stream status transitions from Streaming to Failed, then Camera Manager must:

1. Update the stream status Camera Manager broadcast to Failed.
2. Execute a Lazy Off Stop Stream Request for that view consisting of:
   1. Sending a Stop Stream request to the Camera Service
   2. Clearing the list of recipients (client ids) for that stream and view
   3. After receiving the Stop Stream status broadcast from the camera service for that request ID, then
      1. Remove the stream status from the stream status broadcast.
      2. If there are no other views streaming from that Camera Service host controller then:
         1. Implement the lazy off timer
         2. When the timer has expired, remove the VPSM vote to keep that camera controller powered.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | CM updates stream status not view status. |

### NFN-REQ-415848/B-Crash Recovery

Upon start up (initialization) Camera Manager must determine if there was an ungraceful crash and resynchronize stream status information by:

1. Determine if any Camera Service is broadcasting Stream Statuses. If so, subscribe to those statuses and compare the broadcast values to the Camera Manager persisted values.
2. If the stream statuses broadcast by the camera service matches the Camera Manager last known status, no further action is required.
3. If the stream statuses broadcast by the Camera Service do not match Camera Manager values, then it must;
   1. Broadcast an updated Stream Status, utilizing the statuses from the active Camera Service (the Camera Service on the camera controller is the master of stream status).
   2. For any stream where Camera Manager’s persisted value is streaming, but the Camera Service has no stream status for that view then, clear the list of recipients (client ids) for that stream, and if no other views from that camera controller are streaming, remove any vote with VPSM to keep that camera controller (host) powered.
   3. For any view where the Camera Service is broadcasting a stream status of Failed, execute the logic for mid-stream Failure, as described in the detect mid-stream failure requirement in this document.
4. Determine if Camera Manager has any remaining stored stream IDs and recipients for views that are not broadcast as streaming by a camera service and remove them from the persisted values and stream status broadcast. This could have occurred if Camera Manager crashed just after sending a start request to the Camera Service, so it would have stored a stream ID and intended recipient, but may not have received a failed start response from the Camera Service in order to update the stream’s status.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Update to use stream status, not view status. |

### NFN-REQ-416643/B-Communication Loss while Streaming

Whenever a Video stream is in progress, the Camera Manager shall monitor the Stream Status Broadcast from that host camera service in order to determine if SOA Communication is lost to that camera controller.

If no periodic update is received for a configurable period of time, see Comm\_ Loss\_Time\_Out in the configuration section of this document, then Camera Manager shall assume that either the Camera Controller or the SOA infrastructure has had a catastrophic failure, and take the following measures:

1. Try to reenable the stream status broadcast by sending an appropriate <host>VideoStreamStatus request for a configurable number of times, see Comm\_Loss\_Retries in the configuration section of this document.
2. If the periodic broadcast is not reestablished after the above retries, then;
   1. Update the StreamStatus broadcast for that Stream to Failed.
   2. Set the status for all views from that host to “Faulty” and publish a broadcast update. Retain the Faulty status as the last know value.
   3. Remove votes with VPSM to keep that host powered.
   4. Remove existing stream and client data for that host.

Notes:

* It is expected that the stream status of Failed, will cause the consumer to send a stop request.
* The faulty status for those views will not get updated until the next ignition on cycle, provided the host camera service is operational again and able to communicate via SOA messaging.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Changed to monitor only the Stream Status from each Camera Service. The View Status broadcast is now On Change. |

### NFN-REQ-417023/A-Spamming Protection

The Camera Manager is NOT required to provide spamming protection for incoming requests, as is done with other platform vehicle control services.

**Rationale:**

The spam protection implemented in the other Platform Vehicle Control Services was implemented for the following reasons:

1. To protect hardware devices, like door locks and the horn, from wear and overheating
2. To eliminate or protect against potential spamming as a nuisance factor, like repeatedly honking a horn for extended periods of time.

At this time, it is not believed that Video streaming is subject to such issues since:

1. Video streaming is an action that occurs over an extended period. Subsequent requests for the same view will simply receive a reply with the existing multicast address, without incurring additional load on the vehicle resource.
2. There are bandwidth and CPU load limits in place.

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| **Requirement Information** | |
| **Requirement Type** | NFN - Non-Functional-N/A |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added |

## Future Requirements

Below is a list of anticipated future requirements or enhancements. These are provided as information only, but they should be taken into consideration while making near term design and implementation decisions.

### Registration interface

A future addition of a registration interface that would allow camera services to register new views, or new camera controllers (hosts) could eliminate the need for manual configuration and software updates to Camera Manager in order to make those additional views and hosts available.

This would be dependent on having camera controllers (including those on AUTOSAR Classic and the SOA CDD) able to act as a consumer of interfaces from services outside the module, and to implement support for the string data type, and nested messages or arrays.

### Support Multiplexing and MPEG2-TS

As we add more features and have multiple features utilizing video streams at the same time, the in-vehicle camera solution will need to provide more video streams simultaneously. One feature in progress desires 5 simultaneous exterior views from the ADAS camera views.

In the future, Camera Manager may need to facilitate the multiplexing of several views into one complex communication stream, whenever both the requester and the Camera Controller providing the video both support multiplexing. This will also require the video stream to use MPEG2-TS container formatting.

Note: It is likely that within a given vehicle we will have a mix of sources and recipients at different capability levels, not all will move to support multiplexing at the same time.

Multiplexing support may be achieved by adding a new interface named StartMuxedStream. Which would allow the consumer to request multiple views within a single request message (thus indicating a desire and capacity to process a multiplexed stream).

Upon receiving such a request, Camera Manager would need to determine what, if any, of the views are from the same camera controller, and if that controller supports multiplexing.

The response to such a request will likely be an array of the requested views along with a stream Id, IP Address, Port, and Multiplexed Flag for each view.

A mechanism would be needed to inform Camera Manager as to what camera controllers support multiplexing and MPEG2-TS containers, perhaps this could be achieved by adding a parameter to the View Status broadcast.

### Secured Transport protocol (SRTP)

The cyber security team has granted a temporary exception for the use of the Real Time Transport Protocol (RTP) and has requested that we prepare a roadmap to move to Secure Real-Time Transport Protocol (SRTP) in the future.

When SRTP is implemented it is envisioned that Camera Manager would provide session-based keys to the video source and all authorized recipients, allowing the video stream within the vehicle to be encrypted for transport.

### Store Camera Controller Capability Info

Camera Manager may need to store configuration information about each installed camera service and what it can support like:

* SRTP versus RTP
* Multiplexed or not.

Ideally the camera controllers will be the master source for this information and provide it as part of their status broadcast.

This will also allow Camera Manager to adjust its behavior based on what each different controller is capable of, as well as adapting to possible over the air software updates of the controller that enhance its functionality.

### Unicast Support on FNV2/ECG1

If it is determined that features like Mobile Device Viewer or Integrated Security Camera (Sentinel) will be implemented on FNV2/ECG1 vehicle programs AND if ECG1 cannot be configured for Multicasting on those programs, then Camera Manager may have to support both multicasting and a different Unicast behavioral model based on how the vehicle is configured.

# Interface Contracts

## Data Enumerations

The sections below provide values and definitions for the data enumerations required for Camera Manager interfaces.

### IR-REQ-404118/D-CameraLocation

This enumeration provides a list of all possible camera locations (or areas of view) across all vehicles. Note some locations may not be present in all vehicles.

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| --- | --- |
| **Value** | **Description** |
| EXT\_FRONT | Views showing the area to the exterior front of the vehicle. |
| EXT\_REAR | Views showing the area to the exterior rear of the vehicle. |
| EXT\_RIGHT | Views to the exterior right-side of the vehicle. |
| EXT\_LEFT | Views to the exterior left-side of the vehicle. |
| TRAILER\_VIEWS | Views typically from aftermarket cameras installed to provide views related to trailers. These cameras may be mounted to the rear of the trailer or inside the trailer. |
| EXT\_HITCH | Views of the hitch, typically used for Trailer reverse guidance. |
| EXT\_360 | 360-degree views of the vehicle exterior, provided by multiple cameras. |
| INTERIOR | Views of the interior of the vehicle |
| EXT\_OTHER | Views that show mixed or undefine areas of the exterior of the vehicle. |

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| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add exterior other |

### IR-REQ-404121/D-CameraViews

**Description:** This enumeration provides the camera views supported by various cameras in the vehicle. They are grouped below by area viewed, for convenience.

As more are added to vehicles, this list will grow.

For sample views please see; <https://wiki.ford.com/display/CS/Cameras%2C+Views%2C+and+Configurations+Available>

|  |  |  |
| --- | --- | --- |
| Location /  Area Viewed | View Name | Description |
| Exterior Rear | REARNORMAL | View of the area behind the vehicle, from the rear camera under the license plate in center of back bumper. |
| REARZOOM | Same as above, but zoomed in. |
| REAR360 | This view includes both a video feed showing the area to the rear of the vehicle, plus a representation of the vehicle (360 degrees around it) with gray zones depicting possible camera views. |
| REARSPLIT |  |
| REAR\_ROCK\_CRAWL | Close up view of rear tires, split to show both sides |
| REAR\_CAM | Raw fisheye data from the rear camera |
| CHMSL | View from near the Center High Mounted Stop Lamp (CHMSL) using RearCamera2.  For a pick-up truck it looks on to the bed of the truck.  For Transit vehicles, this will be replaced by the Interior Cargo View. |
| CHMSLZOOM | Same as CHMSL above but zoomed in. |
| CHMSL\_CAM | Raw fisheye data from the CHMSL camera |
| TBA2\_REARSPLIT |  |
| TBA2\_REAR360 |  |
| TBA2\_CHMSL |  |
| TBA2\_AUX |  |
| TBA2\_REARNORMAL |  |
| REAR\_FWD\_OFFSET |  |
| REAR\_RWD\_OFFSET |  |
| REAR\_FL\_CORNER |  |
| REAR\_FR\_CORNER |  |
| REAR\_RL\_CORNER |  |
| REAR\_RR\_CORNER |  |
| AH\_REARNORMAL |  |
| AH\_REARZOOM |  |
| Exterior Front | FRONTNORMAL | View of the area in front of the vehicle, from a camera located on the front bumper. |
| FRONT360 | This view includes both a video feed showing the area to the front of the vehicle, plus a representation of the vehicle (360 degrees around it) with gray zones depicting possible camera views. |
| FRONTSPLIT |  |
| FRONT\_FWD\_OFFSET |  |
| FRONT\_RWD\_OFFSET |  |
| FRONT\_FL\_CORNER |  |
| FRONT\_FR\_CORNER |  |
| FRONT\_RL\_CORNER |  |
| FRONT\_RR\_CORNER |  |
| FRONT\_ROCK\_CRAWL | Close up view of front tires, split to show both sides |
| FRONT\_CAM | Raw fisheye data from the front camera |
| EXT\_FRONT\_AR\_RGB | Augmented Reality, Red, Green, Blue (RGB) Camera View. Shows the area to the front of the vehicle from a front windshield perspective.  Available only at following resolutions:  1080p (1920x1080)  720p (1280x720)  Contacts for more information = ulangkam; cvootkur; dnachte1 |
| EXT\_FRONT\_AR\_FIR | Augmented Reality, Far InfraRed (FIR) Camera View.  Shows the area to the front of the vehicle from a front windshield perspective.  Available only at:  640 x 480  Contacts for more information = ulangkam; cvootkur; dnachte1 |
| Exterior Left | LEFT | Exterior area to the left of the vehicle |
| SIDE\_L\_CAM | Raw fisheye data from the left side camera |
| Exterior Right | RIGHT | Exterior area to the left of the vehicle |
| SIDE\_R\_CAM | Raw fisheye data from the right-side camera |
| Hitch | HITCH | View of hitch mechanism for a trailer. |
| Trailer | AUX | After Market Camera installed to the rear of vehicle for use with trailers.  For the Transit vehicle this may be replaced by the Interior Cabin View (below). |
| AUX\_CAM | Raw fisheye data from the above Aux camera |
| TRAILER360 |  |
| TRAILERREARNORMAL |  |
| TRAILERINTERIOR\_VIEW1 |  |
| TRAILERINTERIOR\_VIEW2 |  |
| TRAILERLEFT |  |
| TRAILERRIGHT |  |
| TBA2\_TRAILER360 |  |
| TBA2\_TRAILERREARNORMAL |  |
| TBA2\_TRAILERINTERIOR\_VIEW1 |  |
| TBA2\_TRAILERINTERIOR\_VIEW2 |  |
| TBA2\_TRAILERLEFT |  |
| TBA2\_TRAILERRIGHT |  |
| Exterior 360 | NORMAL\_360 | A 360-degree view of the exterior of the vehicle. This is created by stitching together views from the Front, Rear, Left, and Right cameras. Resulting image has 4 separate panels, one for each camera embedded into one video image.  Can only stream at Res of 1280x800 (with each of the 4 camera frames at 640x400)  This is one of the default views recorded for the Integrated Security Camera (ICS) Feature.  For ICS it will stream at;  Framerate: 30 fps  Bitrate: 10,000 kps |
| Interior | INTCAM1 | Interior view. In the Transit vehicle program this replaces the CHMSL view and displays the interior cargo area of the vehicle.  This is one of the default views recorded for the Integrated Security Camera (ISC) Feature.  For ICS it will stream at;  Res: 720x480  Framerate: 30 fps  Bitrate: 10,000 kps |
| INTCAM2 | Interior view. In the Transit vehicle program this replaces the AUX view and displays the interior cabin area of the vehicle.  This is one of the default views recorded for the Integrated Security Cameras (ICS) Feature.  For ICS it will stream at;  Res: 720x480  Framerate: 30 fps  Bitrate: 10,000 kps |
| Exterior Other | TBA2\_STRAIGHT\_BACK | tbd |
| TADZOOM | tbd |
| V5050 | Tbd |
| IVV |  |

|  |  |
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| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Major updates to views provided by ADAS, AR view names updated. |

### IR-REQ-404124/C-Resolution

**Description:** This enumeration provides the list of available resolutions that are used to change a cameras configuration when starting or changing a stream.

**Note:** For the ADAS module all video streams will have the same orientation (landscape or portrait) as used by SYNC for the in-vehicle monitor.

|  |  |
| --- | --- |
| **Value** | **Description** |
| RES\_1280\_BY\_800 | This is a high-resolution setting |
| RES\_640\_BY\_480 | This is a medium resolution setting |
| RES\_480\_BY\_360 | This is a low-resolution setting |
| RES\_1920\_BY\_1080 | 1080p Only supported by the AR Module RGB View |
| RES\_1280\_BY\_720 | 720p – Only supported by the AR Module Views |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Updated description: used for start and change. Remove Not Available (not needed since not including in publish view status). Added AR Resolutions. |

### IR-REQ-404127/C-FrameRate

**Description:** This enumeration provides the list of supported Frame rates for camera configurations when starting or changing a stream.

|  |  |
| --- | --- |
| **Value** | **Description** |
| FPS\_30 | 30 Frames per second |
| FPS\_15 | 15 frames per second |
| FPS\_10 | 10 frames per second |
| FPS\_60 | 60 Frames Per Second, only supported by AR Views |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Corrected description: used for start and change. Remove Not Available (not needed since not including in publish view status). Added AR 60 FPS |

### IR-REQ-404128/C-BitRate

**Description:** This enumeration provides the list of supported Bit Rates for camera configurations when starting or changing a stream.

|  |  |
| --- | --- |
| **Value** | **Description** |
| KBPS\_10000 | 10,000 Kilobits per second |
| KBPS\_5000 | 5,000 Kilobits per second |
| KBPS\_1000 | 1,000 Kilobits per second |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Corrected description: used for start and change. Remove Not Available (not needed since not including in publish view status). |

### IR-REQ-404130/D-CameraViewStatus

**Description:** This enumeration describes the possible camera view statuses.

|  |  |
| --- | --- |
| **Value** | **Description** |
| NOT\_AVAILABLE | The camera view is configured as not available in this vehicle. |
| AVAILABLE | The camera view is configured as available in this vehicle. |
| FAULTY | The Camera View is present, but not operational due to a serious hardware or configuration fault. |
| SOFTWARE\_INCOMPATIBLE | The Camera Service software version on the video source ECU is not compatible with the Camera Manager Software version of the vehicle platform. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Separating View Statuses from Stream Statuses that will be communicated in a new stream status interface. |

### REQ-416594/B-StreamType

**Description:** This enumeration is used in the start stream response to identify the type of stream the consumer will be joining. This allows the consumer to know if the stream is already in progress or will be starting soon.

|  |  |
| --- | --- |
| Value | Description |
| NEW\_STREAM | The stream was created for the consumers request and should begin streaming soon. |
| IN\_PROGRESS\_STREAM | The consumer is joining an already in progress stream for the requested Camera View. |
| NEW\_RESERVED\_STREAM | A Stream reservation has been made for the consumer. The stream will not start until the consumer sends a Commence Reserved Stream request. |
| EXISTING\_RESERVED\_STREAM | The consumer is joining a stream that was reserved by a different consumer. The video will begin streaming when one of the following occurs:  The originating consumer sends a commence request  The reservation times out, and another consumer is waiting for the view to stream  The originating consumer cancels the reservation, and another consumer is waiting for it |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** |  |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarified start for existing reserved stream |

### IR-REQ-404167/B-PublishRequestType

**Description:** This enumeration describes the type of publish request being made, either to subscribe to the broadcast or unsubscribe from the broadcast.

|  |  |
| --- | --- |
| **Value** | **Description** |
| SUBSCRIBE | Consumer is interested in the publication of Camera View Stats. Camera Manager will either start or continue the broadcast. |
| UNSUBSCRIBE | Consumer is no longer interested in the publication of Camera View Stats. If all subscribers have unsubscribed the broadcast will terminate. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 29-Mar-2021 11:27 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Updates to Interface Requirement object type. |

### IR-REQ-404168/D-RespStatus

**Description:** This enumeration provides response statuses to indicate the status of the request or any errors that may have occurred.

|  |  |
| --- | --- |
| Value | Description |
| SUCCESS | Request was completed successfully |
| SUCCESS\_DEFAULT\_SETTINGS\_USED | This occurs under 2 circumstances;  Subsequent requests for the same view as an existing multicast stream.  When the requested settings (resolution, framerate, bitrate) where not valid for the requested camera view. The video is streaming using the default values. |
| UNKNOWN\_ERROR | Failed due to an unexpected error |
| VERSION\_NOT\_COMPATIBLE | Request API Version is not compatible with installed Camera Solution version |
| INVALID\_REQUEST | Requested camera view is not valid, or an invalid action was requested, like stopping a stream when there is no active stream, or changing a stream configuration when there is more than one recipient of the stream. |
| ACCESS\_DENIED | Requester is not authorization for requested action, or Camera Is occupied streaming a different view. |
| COMMAND\_NOT\_SUPPORTED | Unknown command in SOA request |
| INVALID\_PARAMETER | Command known but parameter value is wrong. |
| STREAMING\_ERROR | An error occurred when encoding the stream at the start or during streaming. This corresponds to a “failed” error from the Camera Controller on a start stream request. |
| ERROR\_CPU\_LOAD | If the stream request results in exceeding acceptable CPU load the stream request will be denied. |
| ERROR\_BANDWIDTH\_LOAD | If the stream request results in exceeding desirable ethernet Bandwidth, the stream request will be denied. |
| CAMERA\_VIEW\_NOT\_AVAILABLE | Camera View is not available in this vehicle, cannot stream. |
| TIMED\_OUT | Camera controller did not respond in a reasonable time. |
| QUEUE\_FULL | Request queue is full, try request again later. |
| CAMERA\_NOT\_POWERED | This occurs either when the Camera controller has failed to power up and register for SOA requests, or the Low Power Mode request failed. |
| VIDEO\_BUFFERING\_ERROR | This occurs only for the Integrated Security Camera feature when the buffers for the required views failed to be created. No Video is available to stream for this use case. |
| CONFIG\_ERROR | The camera controller encountered an error while configuring the camera for the requested view and settings. |
| BATTERY\_TOO\_LOW | The battery state is too low, and the Camera Module cannot be powered at this time. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Adding Battery Low error if VPSM denies initial vote and can't start. |

### IR-REQ-423316/A-StreamStatus

**Description:** This enumeration describes the possible video stream statuses.

|  |  |
| --- | --- |
| **Value** | **Description** |
| STREAMING | A camera view is actively streaming. |
| RESERVED | A camera view has been reserved for a coordinated start. |
| FAILED | The active stream failed and has been terminated by the video source, or communication has been lost with the video source ECU. |
| BATTERY\_WARNING | Used to indicate that battery depletion is approaching the severity threshold. The stream will be terminated if no action is taken (like, turning ignition on, or remote starting the vehicle, and/or raising the power severity). |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | A |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added for new interface providing stream statuses |

## Data Structures

Below are the data structures required for Camera Manager.

### IR-REQ-404254/D-CameraViewStatuses

**Description**: This is a data structure (nested message) is used to provide status information for all possible camera views.

|  |  |  |
| --- | --- | --- |
| **Data Name** | **Data Type** | **Description** |
| camera\_location | Enumeration  CameraLocation | Describes the location or area that the view covers. |
| camera\_view | Enumeration  CameraView | Name of the View. |
| camera\_view\_status | Enumeration  CameraViewStatus | Current status of the Camera / View, used to determine if the view is configured as available in the target vehicle. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Clarifying no config info, no stream info |

### IR-REQ-423382/A-StreamStatuses

**Description**: This is a data structure (nested message) is used to provide status information for active video streams.

|  |  |  |
| --- | --- | --- |
| **Data Name** | **Data Type** | **Description** |
| stream\_id | Uint32 | The unique ID of the stream assigned by Camera Manager when the video stream was started. |
| stream\_status | Enumeration  StreamStatus | Current status of the stream, used to identify possible problems, including when the battery threshold is reached indicating stream will be terminated. |
| camera\_view | Enumeration  CameraView | Name of the View being streamed. |
| resolution | Enumeration  Resolution | Resolution for the active stream |
| framerate | Enumeration  FrameRate | Framerate for the active stream |
| bitrate | Enumeration  BitRate | Bitrate for the active stream |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | A |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | added to support new interface |

## Provided Interface Contracts (Camera Manager to Consumer)

Camera Manager will provide the following interface contracts to all its consumers.

### IR-REQ-404259/C-PublishViewStatus

***Purpose:*** This API will allow the consumer to enable or disable an on demand, on change broadcast of all Camera Views and their status within the vehicle. It is used to determine which views are configured as available in the target vehicle, and if any are faulty. It may be used by HMIs to provide end users with a list of views specific to their vehicle.

***Message Pattern:*** On Demand, on Change Broadcast

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/INFO\_REQUEST

***Response Topic:*** < Consumer Provided >

***Data Topic:*** SERVICE/DATA/CAMERA\_MANAGER/VIEW\_STATUSES

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| PublishViewStatusReq | enum | \_api\_version | see \_ApiVersion Enumeration in the info.proto file. |
|  | enum | publish\_request\_type | Used to identify if the request is to enable or disable the broadcast, see PublishRequestType enum. |
| PublishViewStatusRsp | enum | resp\_status | Status of the request, see RespStatus enum. |
| PublishViewStatus | enum | \_api\_version | Version of API |
|  | array | camera\_view\_status | Nested message of repeated camera view statuses. See Data Structure CameraViewStatuses |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Remove config from message names. Clarify purpose. ADd data topic |

### IR-REQ-404260/D-StartStream

***Purpose:*** This API will allow the consumer to start a video stream of a single camera view. The consumer can coordinate the start to ensure that all recipients are ready in advance of the stream starting by setting the “reserve\_for\_coordinated\_start” parameter to True. The consumer will receive the intended multicast address, allowing all recipients to connect to the address, and join the multicast group prior to the stream starting.

If a stream is reserved, then the consumer that reserved it must send a Commence Reserved Stream request in order to start the video streaming. If a commence or cancelation request is not received in a reasonable amount of time, the reservation will be automatically canceled or started depending on presence of other consumers for that stream. The stream status will be updated.

***Message Pattern:*** Request / Response

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/STREAM\_CONTROL

***Response Topic:*** < Consumer Provided >

Notes:

* If the requested resolution, framerate, and bitrate are not supported by the requested View, it will still stream but at the default settings for that view.
* Subsequent requests for an already streaming view will be directed to the in-progress stream, with the existing configuration (resolution, framerate, and bitrate).

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| StartStreamReq | Enum  CameraView | camera\_view | The view requested. |
|  | String | view\_name | As an alternative to the enum above, the consumer can provide a string containing the view name, as listed in the view status broadcast. This is done so that other platform services like Video Recorder, do not have to keep a camera view enum in synch with that of Camera Manager. Instead it can receive a view name from its consumer, and pass that on in this parameter. |
|  | Enum  Resolution | resolution | Desired resolution for the stream |
|  | Enum  FrameRate | frame\_rate | Desired frame rate for the stream |
|  | Enum  BitRate | bit\_rate | Desired bitrate for the stream |
|  | uint32 | power\_severity\_level | Power severity of the feature or function for use when voting to power the camera controllers with VPSM.  NOTE: all key off activities need to be evaluated by power supply team, Hussein Berry or Z Deljevic, in order to get severity assigned. |
|  | string | client\_id | Client Id of the consumer, for use in power requests to VPSM in order to power the camera controller. |
|  | bool | reserve\_for\_coordinated\_start | When set to true Camera Manager will reserve a multicast port for the stream request, but not initiate the stream until it receives a commence reserved stream request.  Default will be False |
| StartStreamRsp | Enum  RespStatus | response\_status | Status of request. |
|  | uint32 | stream\_id | Stream\_id is an auto generated uid by Camera Manager for each video stream. This is used later to change or stop the stream. |
|  | string | ip\_address | Multicast IP Address where the stream can be received (recipient must bind and join the multicast group). |
|  | uint32 | port | Multicast port where the stream can be received. |
|  | Enum  StreamType | stream\_type | Type of stream the consumer will be joining.  This can help the consumer determine if the stream is already in progress or a reserved stream that will not start until the reserving client sends a commence request. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Remove "Repeating" from view parameter. Each view must be requested separately. |

### IR-REQ-404261/D-StopStream

***Purpose:*** This API will allow the consumer to stop a particular video stream. If there is more than one recipient of the stream, then Camera Manager will only send the stop request to the video source when the last recipient sends a stop request.

***Message Pattern:*** Request / Response

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/STREAM\_CONTROL

***Response Topic:*** < Consumer Provided >

Note: It is the consumers responsibility to make sure stop requests are successful. This may mean retrying until a successful response is received, particularly in the event of a communication disruption or system crash. The consumer should persist knowledge about active video streams, and upon restart, ensure that it sends stop requests for any streams that were in process prior to the failure.

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| StopStreamReq | uint32 | stream\_id | Stream Id that is to be stopped. |
|  | string | client\_id | Client Id of the consumer, for use in power requests to VPSM in order to appropriately remove vote to power the camera controller. |
|  | bool | lazy\_power\_off | When set to true Camera Manager will delay powering off the Camera Controller in case the feature is simply switching between views from the same camera controller. This prevents the camera controller from powering down and back up, and unnecessary delays in providing video streams for the consumer. |
| StopStreamRsp | enum | response\_status | Status of request, see RespStatus enum. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Correct name of response message |

### IR-REQ-410119/C-ChangeStreamConfig

***Purpose:*** This interface will allow the sole consumer of a streaming view to change the configuration (resolution, framerate, and bitrate). If there are multiple consumers for the same streaming view, then the request will be rejected with an invalid request error.

Please note there will be a delay on the order of one second for the camera to alter the configuration of the active video stream

***Message Pattern:*** Request / Response

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/ STREAM\_CONTROL

***Response Topic:*** < ConsumerProvided>

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| ChangeStreamConfigReq | uint32 | stream\_id | Unique identifier of the stream, that was established by Camera Manager when the stream was started. |
|  | Enum  Resolution | resolution | New desired resolution for the active video stream |
|  | Enum  FrameRate | framerate | New desired frame rate for the active video stream |
|  | Enum  BitRate | bitrate | New desired frame rate for the active video stream |
| ChangeStreamConfigRsp | Enum  RespStatus | response\_status |  |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Correct message names to match interface name, ChangeStreamConfig |

### IR-REQ-415420/B-CommenceReservedStream

***Purpose:*** This interface will allow the consumer to start a stream that was previously reserved by using the “reserve for coordinated start” parameter of the start stream request.

***Message Pattern:*** Request / Response

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/ STREAM\_CONTROL

***Response Topic:*** < ConsumerProvided>

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CommenceStreamReq | uint32 | stream\_id | Unique identifier of the stream, that was established by Camera Manager when the stream was reserved. |
|  | string | client\_id | Client Id of the consumer. |
| CommenceStreamRsp | Enum  RespStatus | response\_status |  |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add Clent ID |

### IR-REQ-415894/B-ChangePowerSeverity

***Purpose:*** This interface will allow the consumer of a streaming view whose status has changed to a battery warning, to change their power severity level for voting to keep the camera controller powered. This should ONLY be used if more time is needed to allow the end user to start the vehicle in order to keep their video stream active. Otherwise the consumer should stop the stream and allow the ECUs to power down, conserving battery.

Notes:

* Upon successful completion of this request the view status should change from the battery warning back to streaming. However, if the vehicle is not started, then a later battery warning at the new level shall occur, changing the view status back to battery warning.
* The raised severity is subject to a time out and will be returned to the original severity level of the feature for starting the video stream.
* If no action is taken the stream will be terminated***.***

***Message Pattern:*** Request / Response

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/ STREAM\_CONTROL

***Response Topic:*** < ConsumerProvided>

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| ChangePowerSeverityReq | uint32 | stream\_id | Unique identifier of the stream, that was established by Camera Manager when the stream was started. |
|  | uint32 | power\_severity\_level | New power severity to be used when voting to power the camera controllers with VPSM. |
|  | string | client\_id | Client Id of the consumer, for use in power requests to VPSM in order to power the camera controller. |
| ChangePowerSeverityRsp | Enum  RespStatus | response\_status |  |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add note that is subject to a time out. |

### IR-REQ-423317/A-PublishStreamStatus

***Purpose:*** This API will allow the consumer to enable or disable an on demand, on change broadcast of video stream statuses.

***Message Pattern:*** On Demand, on Change Broadcast

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/INFO\_REQUEST

***Response Topic:*** < Consumer Provided >

***Data Topic:*** SERVICE/DATA/CAMERA\_MANAGER/STREAM\_STATUSES

Note:

When a stream status changes to failed, it is expected that the consumer will still send a stop stream request. This will indicate that the consumer has processed the failure and allow Camera Manager to clean up data and return to a normal state.

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| PublishStreamStatusReq | enum | \_api\_version | see \_ApiVersion Enumeration in the info.proto file. |
|  | enum | publish\_request\_type | Used to identify if the request is to enable or disable the broadcast, see PublishRequestType enum. |
| PublishStreamStatusRsp | enum | resp\_status | Status of the request, see RespStatus enum. |
| PublishStreamStatus | enum | \_api\_version | Version of API |
|  | array | stream\_statuses | Nested message of repeated stream statuses and configs. See Data Structure StreamStatuses |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | A |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | added |

### REQ-424678/A-CancelReservedStream

***Purpose:*** This API will allow the consumer to cancel a stream reservation they created, in the event there is no longer a need for the video.

***Message Pattern:*** Request / Response

***Request Topic:*** SERVICE/REQUEST/CAMERA\_MANAGER/STREAM\_CONTROL

***Response Topic:*** < Consumer Provided >

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CancelReservedStreamReq | uint32 | stream\_id | ID of the reserved stream to cancel. |
|  | string | client\_id | Client Id of the consumer. |
| CancelReservedStreamRsp | enum | response\_status | Status of request, see RespStatus enum. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** |  |
| **Requirement Revision** | A |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** |  |

## Required Interface Contracts (used by Camera Manager)

Below is a list of the interfaces Camera Manager will require from downstream resources in order to interact with the actual cameras. These interfaces will be implemented as Camera Services on various ECUs.

In order to allow Camera Manager to easily interact with the various Camera Services a common SOA topic naming schema has been created. Camera Manager will direct requests to the correct Camera Service by using the generic SOA Topic, and replacing <host> with the appropriate ECU acronym of the camera controller, like ADAS or AR.

The generic request topic below:

SERVICES/REQUEST/<host>/CAMERA\_SERVICE/STREAM

would become the following for a camera view controlled by the ADAS module in the specific vehicle:

SERVICES/REQUEST/ADAS/CAMERA\_SERVICE/STREAM

More information about these interfaces, enumerations, and the Camera Service behavior, can be found in the Camera Service Specification, VSEM ID: ENG-754814.

Draft GPB Files for the camera services to be implemented on the camera controllers can be found at: <https://github.ford.com/sw-architecture/idl/tree/master/Services/CameraService>

### Camera View Status and config

Below are the interfaces Camera Manager will need from the downstream Camera Services, in order to gather the current status of all camera views within a specific vehicle.

These also follow a pattern for the topic names so that Camera Manager can substitute the common ECU acronym for the <host> variable in the topic name.

#### IR-REQ-411859/C-CamSrv<host>CameraViewStatus

Each Camera Service shall implement an on-demand, on-change broadcast interface that will provide Camera Manager with the status of all camera views it hosts, as well as the installed version number of the Camera Service Software.

Note: ADAS module is exempt from versioning for their DAT 221 release.

For efficient implementation across camera controllers a common pattern of message and topic naming has been created, containing a “host” identifier. During implementation the ECU module team must replace all occurrences of the phrase “host” with the common ECU acronym of the camera controller (like ADAS or AR).

Message names shall follow the pattern of:

CamSrv<host>CameraViewStatus.<msg\_type>

Where CamSrv is a prefix required to ensure uniqueness in the AUTOSAR environment.

Where <host> is replaced by the common acronym of the ECU that acts as a camera controller. controller.

And <msg\_type> is replaced by the appropriate suffix for that type of message:

* Request
* Response
* Data

Topic names will follow the pattern below, where <host> is replaced by the common acronym of the controller.

* ***Request Topic:*** SERVICES/REQUEST/<host>/CAMERA\_SERVICE/STATUS
* ***Response Topic:*** <Consumer Provided>
* ***Data Topic:*** SERVICES/DATA/<host>/CAMERA\_STATUS

The Camera View Status interfaces in the sections below provide the detailed messaging for each Camera Controller.

**Please note:**

1. The interfaces below were structured taking into account the limitations of the SOA CDD implementation for FNV3, which cannot support strings, nested messages, nor repeated fields.
2. Current view configuration information (resolution, framerate, and bitrate) were removed since these cannot be provided by the ADAS camera processor.

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Changed to On Change Broadcast (per Feature/ADAS request to conserve bandwidth).  - Update Response Topic to <Consumer Provided> Per ECG request and SOA Standards.  - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

##### IR-REQ-410732/D-CamSrvAdasCameraViewStatus

***Purpose:*** This API will allow the Camera Manager to receive a list of views provided by the ADAS module along with the view statuses

This data broadcast shall be enabled by request. The values will be broadcast after receiving the request, and then re-broadcast anytime a view status is changed. The broadcast will end when a request to disable the broadcast is received, or the Camera Service is shutdown to conserve battery.

***Message Pattern:*** On Demand Broadcast, rebroadcast when data changes

***Request Topic:*** SERVICES/REQUEST/ADAS/CAMERA\_SERVICE/STATUS

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/ADAS/CAMERA\_STATUS

Notes:

Since the SOA CDD cannot support nested messages in order to create arrays, and AUTOSAR modules cannot support dynamic arrays, the values for each view are specifically created and named.

ADAS (DAT221 Release) is exempt from providing Version information in the broadcast.

ADAS DAT221 Release will NOT stream video when Ignition is on. It will continue to report the views as available, but any request to stream when ignition is on, will be denied.

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrvAdasCameraViewStatus.Request | enum | broadcast\_request | Type of broadcast request (enable or disable) see Data Type above named CamSrv\_BroadcastRequest |
| CamSrvAdasCameraViewStatus.Response | enum | command\_status | Acknowledgement that request was received, and broadcast should begin, see data type enum named CamSrv\_RequestStatus |
| CamSrvAdasCameraViewStatus.Data | enum | CamStatData\_FRONTNORMAL | Status of the camera view, see enum data type named CamSrv\_CameraViewStatus |
|  | enum | CamStatData\_REARNORMAL | Status of the camera view. |
|  | enum | CamStatData\_FRONT360 | Status of the camera view. |
|  | enum | CamStatData\_REAR360 | Status of the camera view. |
|  | enum | CamStatData\_FRONTSPLIT | Status of the camera view. |
|  | enum | CamStatData\_REARSPLIT | Status of the camera view. |
|  | enum | CamStatData\_REARZOOM | Status of the camera view. |
|  | enum | CamStatData\_CHMSL | Status of the camera view. |
|  | enum | CamStatData\_CHMSLZOOM | Status of the camera view. |
|  | enum | CamStatData\_AUX | Status of the camera view. |
|  | enum | CamStatData\_TBA2\_STRAIGHT\_BACK | Status of the camera view. |
|  | enum | CamStatData\_TADZOOM | Status of the camera view. |
|  | enum | CamStatData\_V5050 | Status of the camera view. |
|  | enum | CamStatData\_LEFT | Status of the camera view. |
|  | enum | CamStatData\_RIGHT | Status of the camera view. |
|  | enum | CamStatData\_TBA2\_REARSPLIT | Status of the camera view. |
|  | enum | CamStatData\_TBA2\_REAR360 | Status of the camera view. |
|  | enum | CamStatData\_TBA2\_CHMSL | Status of the camera view. |
|  | enum | CamStatData\_TBA2\_AUX | Status of the camera view. |
|  | enum | CamStatData\_TBA2\_REARNORMAL | Status of the camera view. |
|  | enum | CamStatData\_REAR\_FWD\_OFFSET | Status of the camera view. |
|  | enum | CamStatData\_REAR\_RWD\_OFFSET | Status of the camera view. |
|  | enum | CamStatData\_FRONT\_FWD\_OFFSET | Status of the camera view. |
|  | enum | CamStatData\_FRONT\_RWD\_OFFSET | Status of the camera view. |
|  | enum | CamStatData\_REAR\_FL\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_REAR\_FR\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_REAR\_RL\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_REAR\_RR\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_FRONT\_FL\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_FRONT\_FR\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_FRONT\_RL\_CORNER | Status of the camera view. |
|  | enum | CamStatData\_FRONT\_RR\_CORNER |  |
|  | enum | CamStatData\_FRONT\_ROCK\_CRAWL |  |
|  |  | CamStatData\_REAR\_ROCK\_CRAWL |  |
|  |  | CamStatData\_HITCH |  |
|  |  | CamStatData\_AH\_REARNORMAL |  |
|  |  | CamStatData\_TRAILER360 |  |
|  |  | CamStatData\_TRAILERREARNORMAL |  |
|  |  | CamStatData\_TRAILERINTERIOR\_VIEW1 |  |
|  |  | CamStatData\_TRAILERINTERIOR\_VIEW2 |  |
|  |  | CamStatData\_TRAILERLEFT |  |
|  |  | CamStatData\_TRAILERRIGHT |  |
|  |  | CamStatData\_TBA2\_TRAILER360 |  |
|  |  | CamStatData\_TBA2\_TRAILERREARNORMAL |  |
|  |  | CamStatData\_TBA2\_TRAILERINTERIOR\_VIEW1 |  |
|  |  | CamStatData\_TBA2\_TRAILERINTERIOR\_VIEW2 |  |
|  |  | CamStatData\_TBA2\_TRAILERLEFT |  |
|  |  | CamStatData\_TBA2\_TRAILERRIGHT |  |
|  |  | CamStatData\_IVV |  |
|  |  | CamStatData\_AH\_REARZOOM |  |
|  |  | CamStatData\_INTCAM1 |  |
|  |  | CamStatData\_INTCAM2 |  |
|  |  | CamStatData\_NORMAL\_360 |  |
|  |  | CamStatData\_AUX\_CAM |  |
|  |  | CamStatData\_CHMSL\_CAM |  |
|  |  | CamStatData\_FRONT\_CAM |  |
|  |  | CamStatData\_REAR\_CAM |  |
|  |  | CamStatData\_SIDE\_L\_CAM |  |
|  |  | CamStatData\_SIDE\_R\_CAM |  |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Add Note DAT221 won't stream in ignition on |

##### IR-REQ-417486/B-CamSrvArCameraViewStatus

***Purpose:*** This API will allow the Camera Manager to receive a list of views provided by the Augmented Reality (AR) module along with the view statuses

This data broadcast shall be enabled by request. The values will be broadcast after receiving the request, and then re-broadcast anytime a view status is changed. The broadcast will end when a request to disable the broadcast is received, or the Camera Service is shutdown to conserve battery.

***Message Pattern:*** On Demand Broadcast, rebroadcast when data changes

***Request Topic:*** SERVICES/REQUEST/AR/CAMERA\_SERVICE/STATUS

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/AR/CAMERA\_STATUS

Notes:

Since the SOA CDD cannot support nested messages in order to create arrays, and AUTOSAR modules cannot support dynamic arrays, the values for each view are specifically created and named.

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrvArCameraViewStatus.Request | Enum | broadcast\_request | Type of broadcast request (enable or disable) see Data Type above named CamSrv\_BroadcastRequest |
| CamSrvArCameraViewStatus.Response | enum | command\_status | Acknowledgement that request was received, and broadcast should begin, or that versions or incompatible, see data type enum named CamSrv\_RequestStatus |
| CamSrvArCameraViewStatus.Data | uint32 | API\_major\_version | 3-digit number incremented to indicate a major software change that is NOT backward compatible |
|  | uint32 | API\_minor\_version | 3-digit number incremented to indicate a minor software change that IS backward compatible (additions) |
|  | uint32 | API\_file\_updt\_version | 3-digit number incremented to indicate either a pre-production update, or software change that does not impact interfaces or functionality, like bug fixes, comments or tags |
|  | enum | CamStatData\_EXT\_FRONT\_AR\_RGB | Status of the camera view, see enum data type named CamSrv\_CameraViewStatus |
|  | enum | CamStatData\_EXT\_FRONT\_AR\_FIR | Status of the camera view. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Changed to On Change Broadcast (per Feature/ADAS request to conserve bandwidth).  - Update Response Topic to <Consumer Provided> Per ECG request and SOA Standards.  - Add CamSrv prefix for uniqueness in AUTOSAR |

#### Required Data Enumerations

The data enumerations defined below will be used by Camera Manager when interacting with the View Status interface.

##### IR-REQ-403743/D-CamSrv\_CameraViewStatus

**Description:** This enumeration describes the possible camera view statuses.

|  |  |
| --- | --- |
| Value | Description |
| NOT\_AVAILABLE | The camera view is not configured as present within the specific vehicle. |
| AVAILABLE | The camera view is configured as present within the specific vehicle. |
| FAULTY | A serious hardware or configuration fault has occurred that prevents the camera responsible for this view from operating. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

### Video Stream Control

Camera Manager will require all Camera Services on all ECUs to implement the video control interfaces described below. Camera Manager will use these interfaces to start, change, or stop a video stream for a specific view.

Since different camera views will be provided by different ECUs, the topics used to exchange messages will follow the common pattern that will allow Camera Manager to substitute the appropriate ECU acronym (like ADAS or AR) for the <host> variable within the topic name.

Camera Manager will need to store an association between view name and host ECU (see configuration section).

#### IR-REQ-409234/C-CamSrvHostStartVideoStream

***Purpose:*** This interface will allow Camera Manager to start a video stream for the specified camera view.

***Message Pattern:*** Request / Response followed by a one-time status broadcast

**Note:** The response is a quick acknowledgement of receipt and initial validation. It is followed later by a one-time broadcast of the final processing status. This was done because the actual processing takes some time and may be done in a separate microprocessor. This prevents blocking other SOA messaging while the request is processed.

***Request Topic:*** SERVICES/REQUEST/<host>/CAMERA\_SERVICE/STREAM

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/<host>/START\_STREAM\_STATUS

Notes:

1. The IP Address of the stream destination has been broken into 4 parts since the FNV2/FNV3 implementation of the SOA Complex Device Driver for AUTOSAR Classic Modules does not support strings.
2. When sending a start stream request to the ADAS module, Camera Manager must wait for ADAS to respond before sending the next start stream request. This will prevent the second start stream request from inadvertently superseding or overwriting the prior request while it is in progress.

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrv<host>StartVideoStream.Request | Enum | camera\_view | Camera View to be streamed.  See enum named CamSrv\_<host>CameraView |
|  | Enum | resolution | Desired resolution for the video. See enum named CamSrv\_Resolution |
|  | Enum | frame\_rate | Desired frame rate for the video. See enum named CamSrv\_FrameRate |
|  | Enum | bit\_rate | Desired bit rate for the video. See enum named Cam\_srv\_Bitrate |
|  | uint32 | stream\_id | Unique identifier of the stream. This is established by Camera Manager and used for subsequent control and communications between Camera Manager and the Camera Service. |
|  | uint32 | request\_id | Unique number of the request assigned by Camera Manager, used to link the final processing result to the originating request. The number will go from 1 to 255, and then start over. |
|  | uint32 | port | Port to be used for the stream. |
|  | uint32 | ip\_address\_part1 | First portion of the IP address for the stream. NOTE: Strings are not supported by the SOA CDD, so breaking into parts. |
|  | uint32 | ip\_address\_part2 | Second portion of the IP address for the stream |
|  | uint32 | ip\_address\_part3 | Third portion of the IP address for the stream |
|  | uint32 | ip\_address\_part4 | Fourth portion of the IP address for the stream |
| CamSrv<host>StartVideoStream.Response | Enum | command\_status | Request receipt acknowledgement, indicating request is in progress. See enum named CamSrv\_RequestStatus |
| CamSrv<host>StartStream.Data | uint32 | Request\_id | Unique ID of the start stream request. |
|  | Enum | strt\_strm\_command\_status | Status of the Start Stream Request. See enum named CamSrv\_ProcessingStatus |

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| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Change Response topic to <Consumer Provided> per ECG request and Ford SOA Broker Standard.  - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment  - Add "host" to name & need cam view by host. |

#### IR-REQ-409235/C-CamSrvHostStopVideoStream

***Purpose:*** This interface will allow Camera Manager to stop a video stream for a specific Camera View.

***Message Pattern:*** Request / Response followed by a one-time status broadcast

***Request Topic:*** SERVICES/REQUEST/<host>/CAMERA\_SERVICE/STOP\_STREAM

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/<host>/STOP\_STREAM\_STATUS

**Note:** When sending a stop stream request to the ADAS module, Camera Manager must wait for ADAS to respond before sending the next stop stream request. This will prevent the second stop stream request from inadvertently superseding or overwriting the prior request while it is in progress.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** | |
| CamSrv<host>StopVideoStream.Request | Enum | camera\_view | Camera View to be stopped.  See enum named CamSrv\_<host>CameraView | |
|  | uint32 | stream\_id | Unique identifier of the stream. This is established by Camera Manager and used for subsequent control and communications between Camera Manager and the Camera Service. | |
|  | uint32 | request\_id | Unique number of the request assigned by Camera Manager, used to link the final processing result to the originating request. | |
| CamSrv<host>StopVideoStream.Response | Enum | command\_status | Request receipt acknowledgement, indicating request is in progress. See enum named CamSrv\_RequestStatus. | |
| CamSrv<host>StopVideoStream.Data | uint32 | Request\_id | Unique ID of the stop stream request. |
|  | Enum | stp\_strm\_command\_status | Status of the stop stream request. See enum named CamSrv\_ProcessingStatus. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Change Response topic to <Consumer Provided> per ECG request and Ford SOA Broker Standard.  - Add CamSrv prefix for uniqueness in AUTOSAR  - Add "host" to name & need cam view by host. |

#### IR-REQ-409916/C-CamSrvHostChangeViewConfig

***Purpose:*** This interface will allow Camera Manager to change the configuration of an active camera video stream. Please note there will be a delay on the order of one second for the camera to alter the configuration of the active video stream

***Message Pattern:*** Request / Response followed by a one-time status broadcast

***Request Topic:*** SERVICES/REQUEST/<host>/CAMERA\_SERVICE/CHANGE\_STREAM

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/<host>/CHANGE\_STREAM\_STATUS

**Note:** When sending a change stream request to the ADAS module, Camera Manager must wait for ADAS to respond before sending the next change stream request. This will prevent the second change stream request from inadvertently superseding or overwriting the prior request while it is in progress.

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrv<host>ChangeViewConfig.Request | Enum | camera\_view | Camera View to be changed. See enum named CamSrv\_<host>CameraView |
|  | uint32 | stream\_id | Unique identifier of the stream. This is established by Camera Manager and used for subsequent control and communications between Camera Manager and the Camera Service. |
|  | uint32 | request\_id | Unique number of the request assigned by Camera Manager, used to link the final processing result to the originating request. |
|  | Enum | resolution | New desired resolution for the active video stream. See enum named CamSrv\_Resolution |
|  | Enum | framerate | New desired frame rate for the active video stream. See enum named CamSrv\_FrameRate |
|  | Enum | bitrate | New desired frame rate for the active video stream. See enum named CamSrv\_BitRate |
| CamSrv<host>ChangeViewConfig.Response | Enum | command\_status | Request receipt acknowledgement, indicating request is in progress. See enum named CamSrv\_RequestStatus. |
| CamSrv<host>ChangeViewConfig.Data | uint32 | Request\_id | Unique ID of the change stream request. |
|  | Enum | chg\_view\_command\_status | Status of the change stream request. See enum named CamSrv\_ProcessingStatus |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Change Response topic to <Consumer Provided> per ECG request and Ford SOA Broker Standard.  - Add CamSrv prefix for uniqueness in AUTOSAR  - Add "host" to name & need cam view by host. |

#### Required Data Enumerations

The data enumerations defined below will be used by Camera Manager when interacting with the video control interfaces.

##### IR-REQ-403738/E-CamSrv\_AdasCameraViews

**Description:** The enumeration below provides the list of camera views supported by the ADAS Module.

As more Cameras and views are added, this list must be updated.

For sample views please see; <https://wiki.ford.com/display/CS/Cameras%2C+Views%2C+and+Configurations+Available>

|  |  |  |
| --- | --- | --- |
| **Value** | **ADAS Signal Value** | **Description** |
| OFF | 0 | This will not be used in messaging. It exists to ensure alignment with ADAS values, as it must have an initial / default value to indicate no request. |
| FRONTNORMAL | 1 | Shows the area to the exterior FRONT of the vehicle. |
| REARNORMAL | 2 | Shows the area to the exterior REAR of the vehicle, from a camera at the license plate. |
| FRONT360 | 3 | This view includes both a video feed showing the area to the front of the vehicle, plus a representation of the vehicle (360 degrees around it) with gray zones depicting possible camera views. |
| REAR360 | 4 | This view includes both a video feed showing the area to the rear of the vehicle, plus a representation of the vehicle (360 degrees around it) with gray zones depicting possible camera views. |
| FRONTSPLIT | 12 |  |
| REARSPLIT | 13 |  |
| REARZOOM | 14 |  |
| CHMSL | 15 | View from near the Center High Mounted Stop Lamp (CHMSL), for a pick-up truck it looks back on to the bed of the truck. |
| CHMSLZOOM | 16 | Same as CHMSL above but zoomed in. |
| AUX | 17 | After Market Camera installed to the rear of vehicle for use with trailers. |
| TBA2\_STRAIGHT\_BACK | 20 |  |
| TADZOOM | 21 |  |
| V5050 | 22 |  |
| LEFT | 24 | Shows the area to the exterior LEFT side of the vehicle. Left is from the reference of a driver looking out the windshield. |
| RIGHT | 26 | Shows the area to the exterior RIGHT side of the vehicle. Right is from the reference of a driver looking out the windshield. |
| TBA2\_REARSPLIT | 27 |  |
| TBA2\_REAR360 | 28 |  |
| TBA2\_CHMSL | 29 |  |
| TBA2\_AUX | 30 |  |
| TBA2\_REARNORMAL | 31 |  |
| REAR\_FWD\_OFFSET | 33 |  |
| REAR\_RWD\_OFFSET | 34 |  |
| FRONT\_FWD\_OFFSET | 35 |  |
| FRONT\_RWD\_OFFSET | 36 |  |
| REAR\_FL\_CORNER | 37 |  |
| REAR\_FR\_CORNER | 38 |  |
| REAR\_RL\_CORNER | 39 |  |
| REAR\_RR\_CORNER | 40 |  |
| FRONT\_FL\_CORNER | 41 |  |
| FRONT\_FR\_CORNER | 42 |  |
| FRONT\_RL\_CORNER | 43 |  |
| FRONT\_RR\_CORNER | 44 |  |
| FRONT\_ROCK\_CRAWL | 45 | Close up view of front tires, split to show both the left and right tires in one view. |
| REAR\_ROCK\_CRAWL | 46 | Close up view of rear tires, split to show both the left and right tires in one view. |
| HITCH | 47 |  |
| AH\_REARNORMAL | 48 |  |
| TRAILER360 | 59 |  |
| TRAILERREARNORMAL | 60 |  |
| TRAILERINTERIOR\_VIEW1 | 61 |  |
| TRAILERINTERIOR\_VIEW2 | 62 |  |
| TRAILERLEFT | 63 |  |
| TRAILERRIGHT | 64 |  |
| TBA2\_TRAILER360 | 65 |  |
| TBA2\_TRAILERREARNORMAL | 66 |  |
| TBA2\_TRAILERINTERIOR\_VIEW1 | 67 |  |
| TBA2\_TRAILERINTERIOR\_VIEW2 | 68 |  |
| TBA2\_TRAILERLEFT | 69 |  |
| TBA2\_TRAILERRIGHT | 70 |  |
| IVV | 74 |  |
| AH\_REARZOOM | 81 |  |
| INTCAM1 | 82 | Interior view. In the Transit vehicle program this replaces the CHMSL view and displays the interior cargo area of the vehicle. |
| INTCAM2 | 83 | Interior view. In the Transit vehicle program this replaces the AUX view and displays the interior cabin area of the vehicle. |
| NORMAL\_360 | 84 | This view is 4 camera feeds stitched together to show exterior front, rear, left, and right areas around the vehicle within one video stream. |
| AUX\_CAM | 85 | Raw fisheye view from the AUX\_1 camera. |
| CHMSL\_CAM | 86 | Raw fisheye view from the CHMSL camera. |
| FRONT\_CAM | 87 | Raw fisheye view from the Front camera. |
| REAR\_CAM | 88 | Raw fisheye view from the Rear camera. |
| SIDE\_L\_CAM | 89 | Raw fisheye view from the left side camera. |
| SIDE\_R\_CAM | 90 | Raw fisheye view from the righty side camera. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | E |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Updated to separate enum per Module.  - Updated with ADAS latest list of views.  - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

##### IR-REQ-422105/A-CamSrv\_ArCameraView

**Description:** The enumeration below provides the camera views supported by the Augmented Reality (AR) Module.

As more Cameras and views are added, this list must be updated.

For sample views please see; <https://wiki.ford.com/display/CS/Cameras%2C+Views%2C+and+Configurations+Available>

|  |  |
| --- | --- |
| Value | Description |
| EXT\_FRONT\_AR\_RGB | Augmented Reality, Red, Green, Blue (RGB) Camera View. Shows the area to the front of the vehicle from a front windshield perspective.  Available only at the following resolutions:  1080p (1920x1080)  720p (1280x720)  Contacts for more information = ulangkam; cvootkur; dnachte1 |
| EXT\_FRONT\_AR\_FIR | Augmented Reality, Far InfraRed (FIR) Camera View.  Shows the area to the front of the vehicle from a front windshield perspective.  Available only at a resolution of:  640 x 480  Contacts for more information = ulangkam; cvootkur; dnachte1 |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | A |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - added for separate enum for the Augmented Raelity (AR) Module camera view values.  - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

##### IR-REQ-403744/D-CamSrv\_RequestStatus

**Description:** This enumeration describes the immediate responses that will be given by the Camera Service. This includes only quick validation and acknowledgement of receipt. Actual status of processing the request will be provided in a broadcast update later.

|  |  |
| --- | --- |
| Value | Description |
| ACKNOWLEDGED | The request was received and has been passed on to other layers for processing. |
| ~~INVALID\_COMMAND~~ | ~~Incoming Request ID (start, change, or stop) matches~~ *~~the~~* ~~previous request ID.~~ |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | D |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Moving Invalid Command to Processing Status. Per ADAS team IPMB Ford Model will do Validation, so won't be part of immediate validation/ack.  - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

##### IR-REQ-411344/C-CamSrv\_ProcessingStatus

**Description:** This enumeration describes the final result of processing a request (success or failure type) which will be given by the Camera Service once processing has completed.

|  |  |
| --- | --- |
| Value | Description |
| SUCCESS | The request was processed successfully. |
| FAILED | Depending on the request made, this means that an error occurred, while encoding the video, altering the video stream, preparing a broadcast, or an unknown error occurred. |
| INVALID\_REQUEST | Requested camera view is not valid, or an invalid action was requested, like stopping a stream when there is no active stream. |
| VALIDATION\_FAILED | Requested settings (resolution, framerate, bitrate) are not valid. But the video will stream using the cameras default settings. |
| ACCESS\_DENIED | Requested camera or view is part of an ongoing stream |
| ERROR\_CPU\_LOAD | Request is rejected because the CPU load is more than the threshold (90%) |
| ERROR\_BANDWIDTH\_LOAD | Request is rejected because bandwidth limit will be exceeded. Bandwidth threshold is 80% (48Mbps) |
| VIDEO\_BUFFERING\_ERROR | An error occurred when establishing a buffer for this view. Note: This occurs for the Integrated Security Camera feature prior to the stream request being sent, but the buffering error will be communicated upon requesting the view to be streamed. Video will NOT be streamed. |
| CONFIG\_ERROR | An error was detected in the client configuration. |
| INVALID\_COMMAND | Incoming Request ID (start, change, or stop) matches *the* previous request ID. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Move Invalid Command from Request Status to here. Per ADAS team IPMB Ford Model will do Validation, so won't be part of immediate validation/ack.  - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

### Stream Statuses

Below are the interfaces Camera Manager will need from the downstream Camera Services, in order to gather the current status of all video streams.

These also follow a pattern for the topic names so that Camera Manager can substitute the common ECU acronym for the <host> variable in the topic name.

#### IR-REQ-418782/B-CamSrvHostVideoStreamStatuses

***Purpose:*** This API will allow the Camera Manager to receive the statuses of any video streams along with the view being streamed if active.

This data broadcast shall be enabled by request, and then broadcast periodically, on the order of every 500 milliseconds, from that point forward. The broadcast will end when a request to disable the broadcast is received, or the Camera Service is shutdown to conserve battery.

***Message Pattern:*** On Demand Broadcast, updated periodically

***Request Topic:*** SERVICES/REQUEST/<host>/CAMERA\_SERVICE/STREAM\_STATUS

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/<host>/STREAM\_STATUS

Notes:

* <host> in the above topic names should be replaced with the common name of the ECU hosting the Camera Service (like ADAS or AR).
* Since the SOA CDD cannot support nested messages in order to create arrays, and AUTOSAR modules cannot support dynamic arrays, the values for each of the possible streams are specifically created and named (stream1, stream2, and stream3).

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrv<Host>VideoStreamStatus.Request | Enum | broadcast\_request | Type of broadcast request (enable or disable). See enum named CamSrv\_BroadcastRequest |
| CamSrv<Host>VideoStreamStatus.Response | enum | command\_status | Acknowledgement that request was received, and broadcast should begin, or that versions or incompatible. See enum named CamSrv\_RequestStatus |
| CamSrv<Host>VideoStreamStatus.Data | enum | stream1\_view\_name | Name of the Camera View being streamed, or None.  See enum named CamSrv\_<host>CameraViews |
|  | enum | stream1\_status | Status of the video stream  See enum named CamSrv\_StreamStatus. |
|  | enum | stream2\_view\_name | Name of the Camera View being streamed, or None.  See enum named CamSrv\_<host>CameraViews |
|  | enum | stream2\_status | Status of the video stream.  See enum named CamSrv\_StreamStatus. |
|  | enum | stream3\_view\_name | Name of the Camera View being streamed, or None.  See enum named CamSrv\_<host>CameraViews |
|  | enum | stream3\_status | Status of the video stream.  See enum named CamSrv\_StreamStatus. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Update Response Topic to <Consumer Provided> per ECG requestand Ford SOA Broker Standard.  - Correct Data Topic Stream\_Status not Camera\_Status  - Add CamSrv prefix for uniqueness in AUTOSAR  - Add "host" to name & need cam view by host. |

#### Required Data Enumerations

The data enumerations defined below will be used by Camera Manager when interacting with the Stream Status interface, in addition to those already defined above.

##### IR-REQ-418781/B-CamSrv\_StreamStatus

**Description:** This enumeration describes the possible video stream statuses.

|  |  |
| --- | --- |
| Value | Description |
| NO\_REQUEST | There is no request to occupy this stream. |
| STREAMING | Actively streaming a camera view. |
| STREAMING \_FAILED | A failure has occurred while streaming the view.  Note: It is expected that the Camera Manager will send a Stop Video Stream command following the failure, in order to return the stream status to No\_Request. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

### Low Power Mode

Below are interfaces that Camera Manager will utilize in order to request camera controllers to go into a Low Power Mode if ignition is off.

Please note, these interfaces are similar using VPSM to vote for a specific ECU to be powered, in that Camera Manager will be voting for the Camera Controller to keep the cameras powered.

#### IR-REQ-409331/C-CamSrvHostLowPowerMode

***Purpose:*** This interface will be implemented by any camera controller that supports a low power mode. It will allow Camera Manager to request the module power up cameras and additional microprocessors necessary for video streaming, while leaving other functionality un-powered in order to conserve battery life in an ignition off state.

The Camera Service for each Camera Controller that has a low power mode, will replace <host> in the message name and topic with the applicable acronym for the ECU controlling the cameras (like ADAS, AR, SYNC, etc.)

***Message Pattern:*** Request / Response followed by a one-time status broadcast

***Note:*** It can take @ 1 second for the cameras to power up and initialize.

***Request Topic:*** SERVICES/REQUEST/<host>/CAMERA\_SERVICE/POWER\_MODE

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/<host>/POWER\_MODE\_STATUS

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrv<host>LowPowerMode.Request | Enum | powermode | Power Mode to be initiated, based on desired views to stream.  See enum named CamSrv\_PowerMode. |
| CamSrv<host>LowPowerMode.Response | Enum | command\_status | Receipt acknowledged or Incompatible version. See enum named CamSrv\_RequestStatus |
| CamSrv<host>CameraLowPower.Data | Enum | lwr\_pwr\_command\_status | Status of lower power mode (enabled or disabled). When enabled cameras are powered and ready for stream requests. See enum named CamSrv\_CameraLowPowerStatus |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Update Response Topic to <Consumer Provided> per ECG request and Ford SOA Broker Standard.  - Add CamSrv prefix for uniqueness in AUTOSAR |

##### IR-REQ-419702/B-CamSrvAdasLowPowerMode

***Purpose:*** The ADAS module supports a low power mode, for cameras. This interface will allow Camera Manager to request the ADAS module to power up cameras and additional microprocessors necessary for video streaming, while leaving other functionality un-powered in order to conserve battery life in an ignition off state.

***Message Pattern:*** Request / Response followed by a one-time status broadcast

***Note:*** It can take @ 1 second for the ADAS cameras to power up and initialize.

***Request Topic:*** SERVICES/REQUEST/ADAS/CAMERA\_SERVICE/POWER\_MODE

***Response Topic:*** <Consumer Provided>

***Data Topic:*** SERVICES/DATA/ADAS/POWER\_MODE\_STATUS

|  |  |  |  |
| --- | --- | --- | --- |
| **Message Name** | **Data Type** | **Message Element Name** | **Description** |
| CamSrvAdasLowPowerMode.Request | Enum | powermode | Power Mode to be initiated, based on desired views to stream.  See enum named CamSrv\_PowerMode |
| CamSrvAdasLowPowerMode.Response | Enum | command\_status | Receipt acknowledged or Incompatible version. See enum named CamSrv\_RequestStatus |
| CamSrvAdasLowPowerMode.Data | Enum | lwr\_pwr\_command\_status | Status of lower power mode (enabled or disabled). When enabled cameras are powered and ready for stream requests. See enum named CamSrv\_PowerStatus |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Update Response Topic to <Consumer Provided> per ECG request and Ford SOA Broker Standard.  - Add CamSrv prefix for uniqueness in AUTOSAR |

#### Required Data Enumerations

The data enumerations defined below will be used by Camera Manager when interacting with the Low Power Interface.

##### IR-REQ-409332/B-CamSrv\_PowerMode

**Description:** This enumeration describes the power mode options available based on desired camera views for the ADAS Module.

|  |  |
| --- | --- |
| **Value** | **Description** |
| OFF | No Low Power Mode is being requests |
| VIEWABLE\_CAMERAS | Request to Power on Cameras and any additional processor required to support video streaming. |
| FRONT\_WINDSHIELD\_CAMERA | Placeholder only for ADAS. May be used to power only a separate windshield camera/microprocessor, which is not currently available to stream. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment |

##### IR-REQ-411345/B-CamSrv\_PowerStatus

**Description:** This enumeration provides the status of the Camera Low Power Mode.

|  |  |
| --- | --- |
| **Value** | **Description** |
| ENABLED | Low Power Mode is enabled, and cameras are powered and ready for stream request. |
| DISABLED | Low Power Mode is not enabled. If ignition state is off, Cameras may not have power nor be ready to stream.  This is the default value. |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 15-Jun-2021 14:59 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | - Add CamSrv Prefix required to ensure uniqueness in AUTOSAR environment  - Aligned to name in GPB and ADAS |

### IR-REQ-412194/B-Camera Controller Power-Up using VPSM

Camera Manager shall utilize the FNV3 Vehicle Power State Manager (VPSM) in order to request power to the necessary Camera Controllers when initiating a video stream in an ignition off state.

Note: The FNV3 VPSM solution must be updated to use the new Variable Power Moding (VPM) CAN signal strategy.

More information on VPSM can be found at:

* [VPSM High Level Design](https://www.eesewiki.ford.com/display/ecg/VPSM+HLD)
* [VPSM Programmers Guide](https://www.eesewiki.ford.com/display/ecg/ECG+Programmer+Guide+%2810%29%3A+fnv%3A%3Avpsm+API+library)

For more information on Variable Power Moding see the following VSEM artifacts:

* + RPKG-792782/A-FAS Variable Power Mode
  + VDOC085107-Variable Power Mode ECG SPSS

Additional Contacts:

VPSM = Peter Wang (pwang53@ford.com)

VPM = Hussein Berry (hberry11@ford.com)

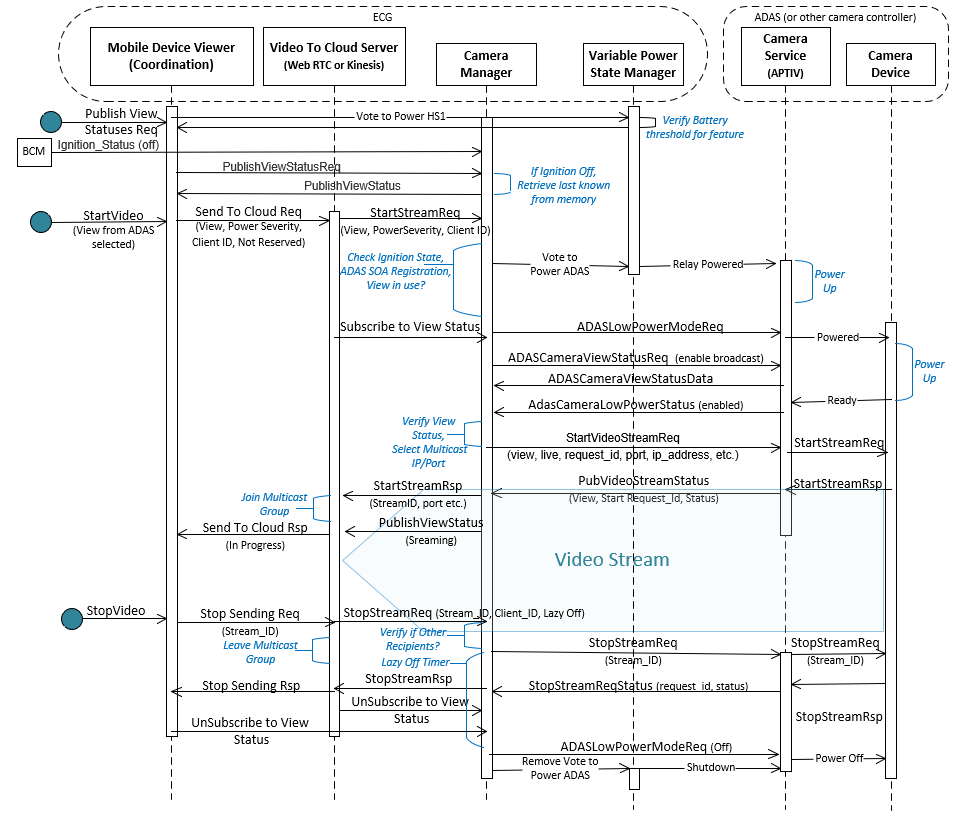
|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | IR - Interface Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | adding link to VPSM Programmers Guide |

# Service Behavioral Diagram

Below are some sample sequence diagrams for the Mobile Device Viewer and Integrated Security Camera use cases.

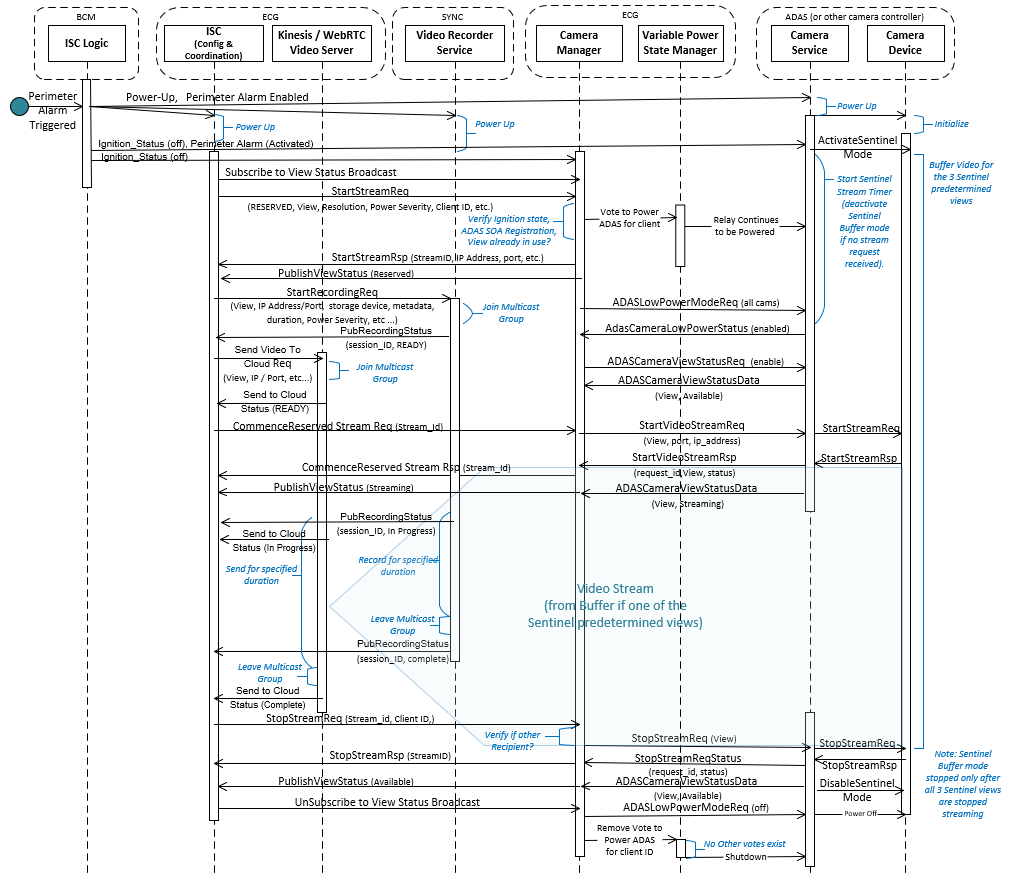
## Mobile Device Viewer - Start Video Stream

Below is a sequence diagram showing Mobile Device Viewer using Camera Manager to start a video stream and using the Lazy Off option when stopping the stream.



## Integrated Security Camera (ISC) Coordinated Start

Below is a sequence diagram depicting the interactions for the Integrated Security Camera Feature (formerly called Sentinel) using Camera Manager with a reserved stream, to allow both the On Board Video Recorder and the Kinesis Video to the Cloud Functions to prepare for the streams in advance, so that none of the buffered video is lost.



# Configuration Requirements

The Camera Manager Service will require the configuration information listed below to be stored in non-volatile, read-write memory, in configuration DIDs, or other mechanism.

## DCR-REQ-415402/A-Camera Host Information

The Camera Manager shall require data on the capabilities and software version of the various camera controllers that act as hosts for a Camera Service instance.

This information will be used to:

1. Determine correct parameter to use when voting to power on the camera controller (ECU)
2. Determine if the camera controller supports a low power mode, which Camera Manager must use to ensure cameras stay powered up.
3. Determine the Camera Service Software Interface version on a given camera controller in order to verify API version compatibility.

This information will include the following data and will be expanded as more Camera Controllers and Camera Services are added within vehicles.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Camera Controller (ECU)** | **Power Up Parameter (for VPSM)** | **Low Power Mode Supported** | **Camera Service Version** | | |
| **Major** | **Minor** | **File Update** |
| ADAS | tbd | Yes | 001 | 000 | 000 |
| AR | tbd | No | 001 | 000 | 000 |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | DCR - Diagnostic Configuration Requirement |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added Requirement |

## DCR-REQ-410359/C-View to Controller & Last Known Status Config

The Camera Manager shall require a persistent set of data (configuration) about what camera views are associated with which controller (host) in a specific vehicle. It must also track the last known status of that view. This information is necessary to;

1. Determine what ECU is host to the camera view, in order to utilize the correct topics for communications
2. Determine / store the last known status of the view, for use in an ignition off state.
3. Identify camera location (area viewed), for use when publishing view information to consumers.

The status data should be updated based on the broadcasts from the various Camera Services, as they are the master for view status information.

Note: This list of views and controllers is currently established manually, and part of Camera Manager software updates. This is due to limitations with a registration approach for AUTOSAR Classic modules. It is hoped that in the future a registration interface could be added to Camera Manager that would allow camera services to register themselves and their available views at runtime.

The data for host camera controllers to views, and the view status information will consist of an array with the data shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Location** | **View Name** | **Camera Controller** | **Last Status** |
| EXT\_REAR | REARNORMAL | ADAS | (per Camera Service View Status) |
| EXT\_REAR | REARZOOM | ADAS |  |
| EXT\_REAR | REAR360 | ADAS |  |
| EXT\_REAR | REARSPLIT | ADAS |  |
| EXT\_REAR | REAR\_ROCK\_CRAWL | ADAS |  |
| EXT\_REAR | REAR\_CAM | ADAS |  |
| EXT\_REAR | CHMSL | ADAS |  |
| EXT\_REAR | CHMSLZOOM | ADAS |  |
| EXT\_REAR | CHMSL\_CAM | ADAS |  |
| EXT\_REAR | TBA2\_REARSPLIT | ADAS |  |
| EXT\_REAR | TBA2\_REAR360 | ADAS |  |
| EXT\_REAR | TBA2\_CHMSL | ADAS |  |
| EXT\_REAR | TBA2\_AUX | ADAS |  |
| EXT\_REAR | TBA2\_REARNORMAL | ADAS |  |
| EXT\_REAR | REAR\_FWD\_OFFSET | ADAS |  |
| EXT\_REAR | REAR\_RWD\_OFFSET | ADAS |  |
| EXT\_REAR | REAR\_FL\_CORNER | ADAS |  |
| EXT\_REAR | REAR\_FR\_CORNER | ADAS |  |
| EXT\_REAR | REAR\_RL\_CORNER | ADAS |  |
| EXT\_REAR | REAR\_RR\_CORNER | ADAS |  |
| EXT\_REAR | AH\_REARNORMAL | ADAS |  |
| EXT\_REAR | AH\_REARZOOM | ADAS |  |
| EXT\_FRONT | FRONTNORMAL | ADAS |  |
| EXT\_FRONT | FRONT360 | ADAS |  |
| EXT\_FRONT | FRONTSPLIT | ADAS |  |
| EXT\_FRONT | FRONT\_FWD\_OFFSET | ADAS |  |
| EXT\_FRONT | FRONT\_RWD\_OFFSET | ADAS |  |
| EXT\_FRONT | FRONT\_FL\_CORNER | ADAS |  |
| EXT\_FRONT | FRONT\_FR\_CORNER | ADAS |  |
| EXT\_FRONT | FRONT\_RL\_CORNER | ADAS |  |
| EXT\_FRONT | FRONT\_RR\_CORNER | ADAS |  |
| EXT\_FRONT | FRONT\_ROCK\_CRAWL | ADAS |  |
| EXT\_FRONT | FRONT\_CAM | ADAS |  |
| EXT\_FRONT | EXT\_FRONT\_AR\_RGB | AR |  |
| EXT\_FRONT | EXT\_FRONT\_AR\_FIR | AR |  |
| EXT\_LEFT | LEFT | ADAS |  |
| EXT\_LEFT | SIDE\_L\_CAM | ADAS |  |
| EXT\_RIGHT | RIGHT | ADAS |  |
| EXT\_RIGHT | SIDE\_R\_CAM | ADAS |  |
| HITCH | HITCH | ADAS |  |
| TRAILER | AUX | ADAS |  |
| TRAILER | AUX\_CAM | ADAS |  |
| TRAILER | TRAILER360 | ADAS |  |
| TRAILER | TRAILERREARNORMAL | ADAS |  |
| TRAILER | TRAILERINTERIOR\_VIEW1 | ADAS |  |
| TRAILER | TRAILERINTERIOR\_VIEW2 | ADAS |  |
| TRAILER | TRAILERLEFT | ADAS |  |
| TRAILER | TRAILERRIGHT | ADAS |  |
| TRAILER | TBA2\_TRAILER360 | ADAS |  |
| TRAILER | TBA2\_TRAILERREARNORMAL | ADAS |  |
| TRAILER | TBA2\_TRAILERINTERIOR\_VIEW1 | ADAS |  |
| TRAILER | TBA2\_TRAILERINTERIOR\_VIEW2 | ADAS |  |
| TRAILER | TBA2\_TRAILERLEFT | ADAS |  |
| TRAILER | TBA2\_TRAILERRIGHT | ADAS |  |
| EXT\_360 | NORMAL\_360 | ADAS |  |
| INTERIOR | INTCAM1 | ADAS |  |
| INTERIOR | INTCAM2 | ADAS |  |
| EXT\_OTHER | TBA2\_STRAIGHT\_BACK | ADAS |  |
| EXT\_OTHER | TADZOOM | ADAS |  |
| EXT\_OTHER | V5050 | ADAS |  |
| EXT\_OTHER | IVV | ADAS |  |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | DCR - Diagnostic Configuration Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Adding ALL views, per latest list from ADAS |

## DCR-REQ-415824/B-In Progress Streams

The Camera Manager must keep track of streams that are in progress and persist that data in order to recover after a crash. This information is also used to supply the correct IP address and port for subsequent requests for the same view, and to publish stream statuses.

The persisted stream data will look something like the table below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Stream ID** | **View** | **IP Address** | **Port** | **Resolution** | **Frame**  **rate** | **Bit**  **rate** |
| 1 | NORMAL\_360 | 235.10.1.1 | 5000 | RES\_1280\_BY\_800 | FPS\_30 | KBPS\_10000 |
| 2 | INTERIOR\_CARGO | 235.10.1.2 | 5000 | RES\_1280\_BY\_800 | FPS\_30 | KBPS\_10000 |
| 3 | INTERIOR\_CABIN | 235.10.1.3 | 5000 | RES\_1280\_BY\_800 | FPS\_30 | KBPS\_10000 |
| 4 | AR\_RGB\_CAMERA | 235.10.1.4 | 5000 | RES\_1920\_BY\_1080 | FPS\_60 | KBPS\_10000 |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | DCR - Diagnostic Configuration Requirement |
| **Requirement Revision** | B |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Also persist resolution, framerate, and bitrate |

## DCR-REQ-415825/A-Stream Clients

The Camera Manager must keep track of each client that is receiving an active stream. It must also know which view the client is using, and the power severity the client has provided in order to keep the camera controller powered. This data must be persisted in order to recover after a crash.

The stream client data will look something like the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Stream\_Id** | **View Name** | **Client\_Id** | **Power Severity** |
| 1 | NORMAL\_360 | Client\_1 | 3 |
| 1 | NORMAL\_360 | Client\_2 | 2 |
| 2 | INTERIOR\_CABIN | Client\_1 | 3 |
| 3 | INTERIOR\_CARGO | Client\_1 | 3 |
| 4 | AR\_RGB\_CAMERA | Client\_3 | 4 |

Note: The data above represents the following:

* Client 1 receiving 3 views on streams 1, 2, and 3
* Client 2 receiving only 1 view, on stream 1.
* Client 3 receiving a view from a different camera controller.

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | DCR - Diagnostic Configuration Requirement |
| **Requirement Revision** | A |
| **Revision Date** | 20-May-2021 14:18 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Added Requirement |

## DCR-REQ-410436/C-General Configurations

Below is a list of other data configurations that must be maintained in order for Camera Manager to fulfil the functional and non-functional requirements.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name / Purpose** | **Data Type** | **Size** | **Recommended** | | **Initial / Default Value** | **Units** |
| **Min** | **Max** |
| Camera\_Time\_Out  The amount of time Camera Manager should wait for a response to a control or broadcast request from a Camera Service before timing out. | uint | 4 digits | 0200 | 3000 | 0500 | milliseconds |
| Camera\_Retry  The number of times Camera Manager should retry sending a control or broadcast request to a Camera Service when no response is received back. | uint | 1 digit | 0 | 9 | 1 | N/A |
| Low\_Power\_Time\_Out  The amount of time to wait for the Low Power Mode of a camera controller to become enabled, and Cameras to be ready to stream, before timing out. | uint | 4 digits | 1000 | 3000 | 1500 | milliseconds |
| Low\_Power\_Retry  The number of times to retry a Low Power Mode Request to a Camera Service. | uint | 1 digit | 0 | 9 | 1 | N/A |
| Lazy\_Power\_Off\_Delay  The amount of time Camera Manager will wait prior to powering off the camera controller after a stop stream command, with Lazy Power Off set to true.  Note: Should be less than the MDVC inactivity timeout which is 2 minutes. | uint | 2 digits | 03 | 99 | 30 | Seconds |
| Reserved\_Stream\_Time\_Out  This is the amount of time Camera Manager will wait to receive a Commence or Cancel Reserved Stream Request, before taking an automatic action. | uint | 2 digits | 1 | 99 | 3 | Seconds |
| Battery\_Warning\_Timeout  Used to track the amount of time between when a battery warning is published for a view, and when Camera Manager automatically terminates the view, if consumer takes no action.  Note: **Must be less than VPSM timeout, value can be set based on that** | uint | 4 digits | 0300 | tbd | tbd | milliseconds |
| Raised\_Severity\_Time\_Out  Used to determine how long a consumer’s request to raise their power severity will be honored before returning to the original value. | uint | 2 digits | 1 | 99 | 2 | minutes |
| Comm\_ Loss\_Time\_Out  Used to track maximum amount of time between periodic stream status broadcast before initiating communication loss processing. | uint | 1 digit | 1 | 9 | 3 | seconds |
| Comm\_Loss\_Retries  The number of times Camera Manager should attempt to re-establish stream status communications before treating as a communication loss failure. | uint | 1 digit | 0 | 9 | 3 | N/A |
| max\_queued\_cmd\_cnt  The maximum number of incoming commands or requests that Camera Manager will allow to queue up before giving a Queue Full error. | uint | 2 digits | 00 | 99 | 10 | N/A |

|  |  |
| --- | --- |
| **Requirement Information** | |
| **Requirement Type** | DCR - Diagnostic Configuration Requirement |
| **Requirement Revision** | C |
| **Revision Date** | 22-Jun-2021 13:12 |
| **Revised By** | Morris, Melissa (mmorr183) |
| **Revision Status** | Released |
| **Revision Comments** | Update Reservation Time Out |

# GPB Files (GitHub Links)

**Drafts** of the Google ProtoBuf (GPB) files for the Camera Manager can be found at:

<https://github.ford.com/sw-architecture/idl/tree/master/camera-mgr-srvc>

Please note that once an ECG in house development team is engaged to work on the Camera Manager, the GPB files will be moved to the common Ford Repository.

**Master Ford GBP Repository**:

<https://github.ford.com/FNV/idl>