# Using Third Parties to Deliver I2V

SOUTHWEST RESEARCH INSTITUTE®

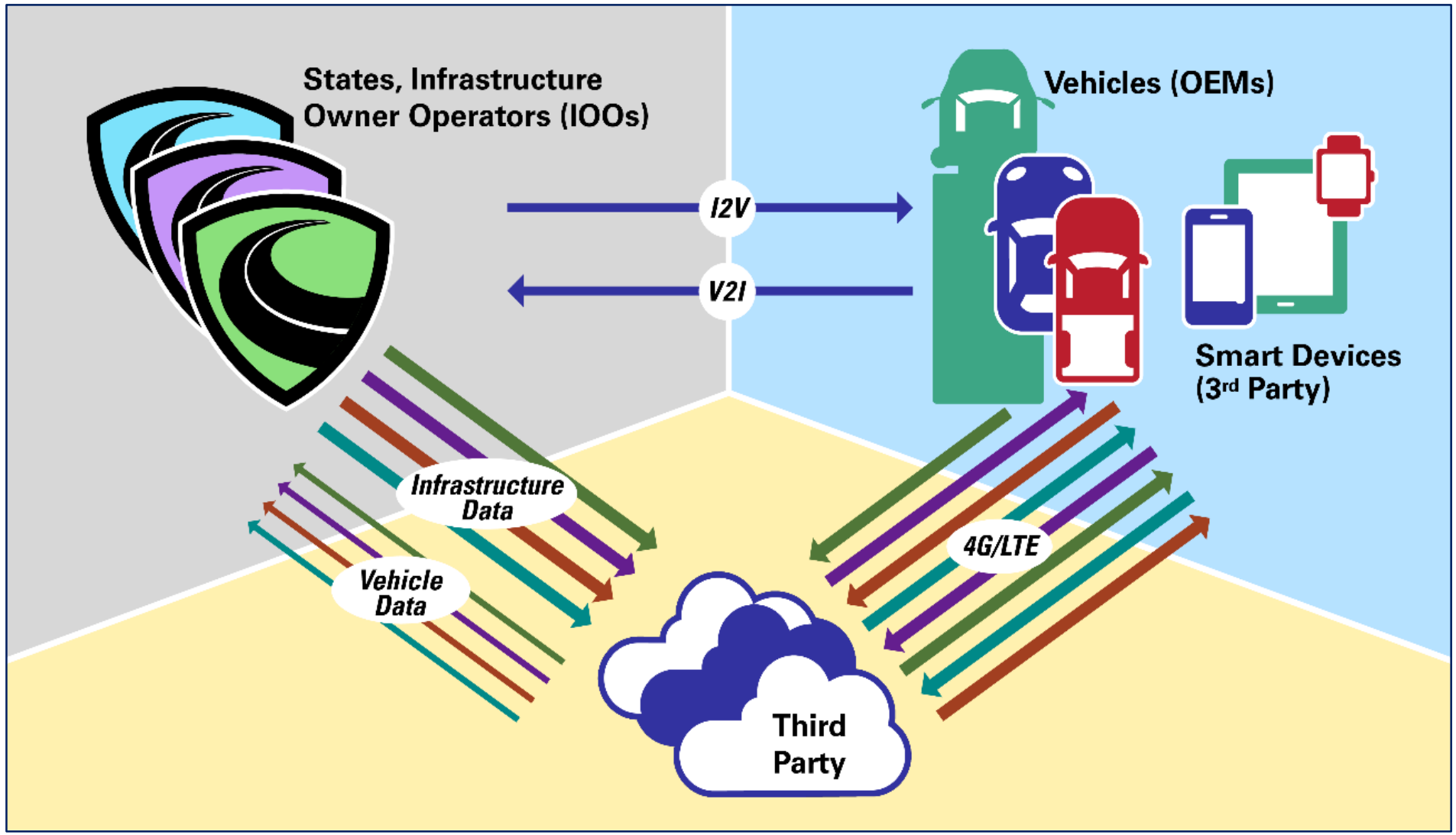
12/10/2019

System Requirements Document Walkthrough

# Agenda

- Introduction/Context
- Status
- Supported Applications
- System Diagram
- System Functions
- External Interface Requirements
- Data Elements
- Internal Subsystems
- Nonfunctional Requirements
- Open Discussion
- Closing Remarks

# Introduction



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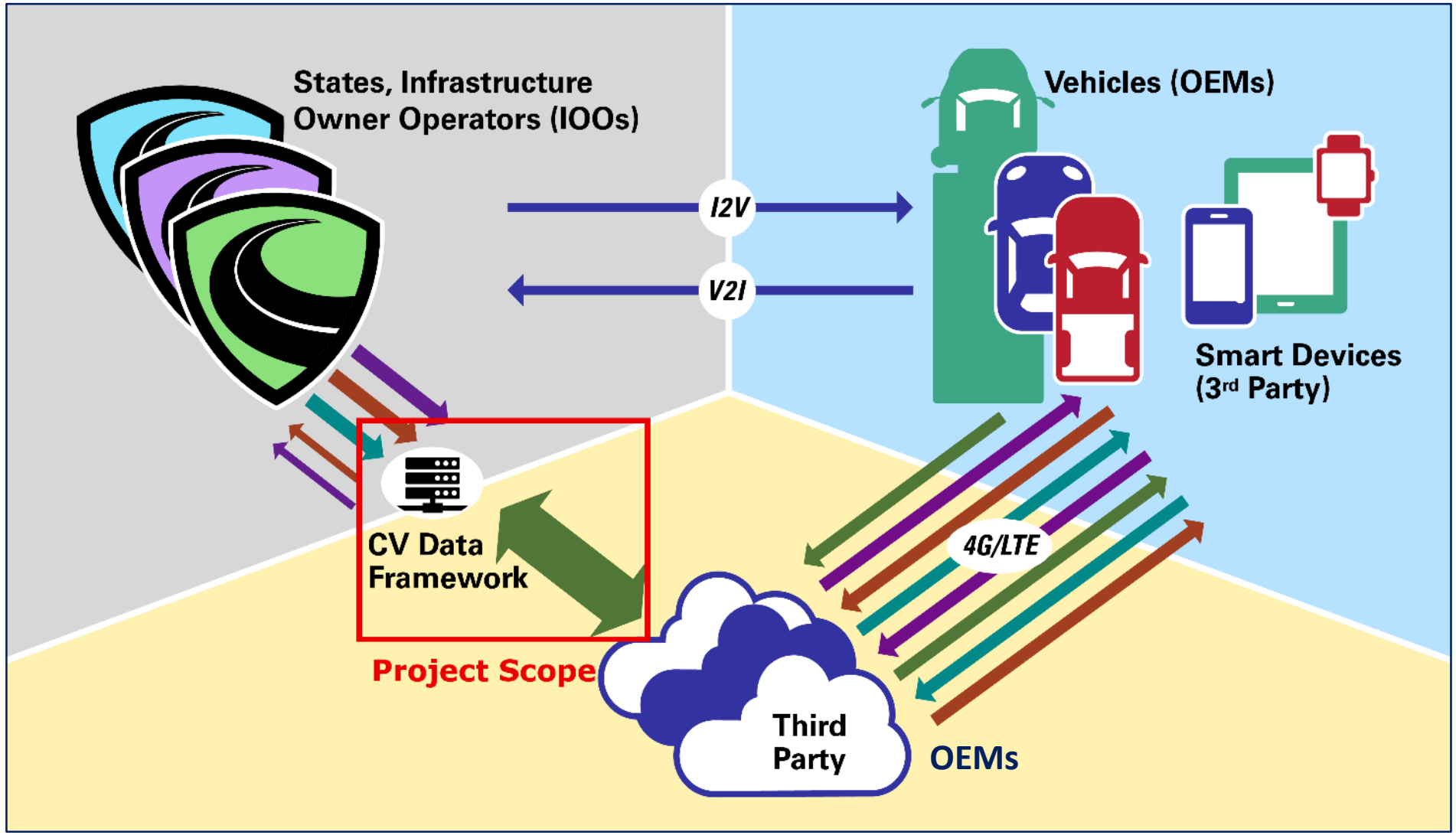
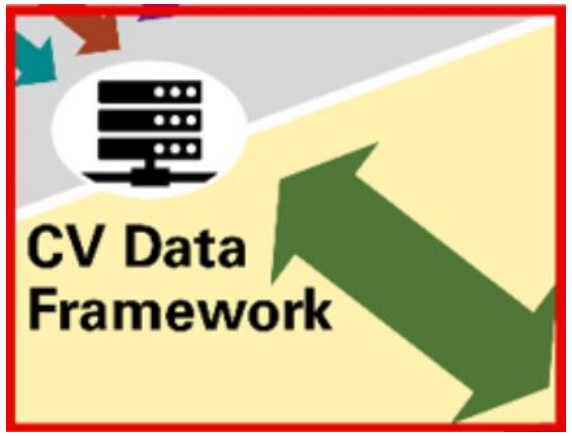


# Introduction

- Scope
  - Connected Vehicle Data Framework provides the standardization of the functions and communication for transmitting data from IOOs to Third Parties.
  - Systems already exist and are being developed that provide this.
    - Implementations (CV Data Portals) created by stakeholders will need to adhere to the requirements and ICD in order to be compliant with the CV Data Framework



# Status

- Provided Draft System Requirements to CV PFS and Stakeholders
- Some feedback provided
  - Slides will reflect improvements based on feedback
  - Invite additional submissions for comment – use PDF markup
- SwRI to incorporate feedback from today's discussion and PDF provided to SwRI by 12/13
- Final to be provided Jan 10th

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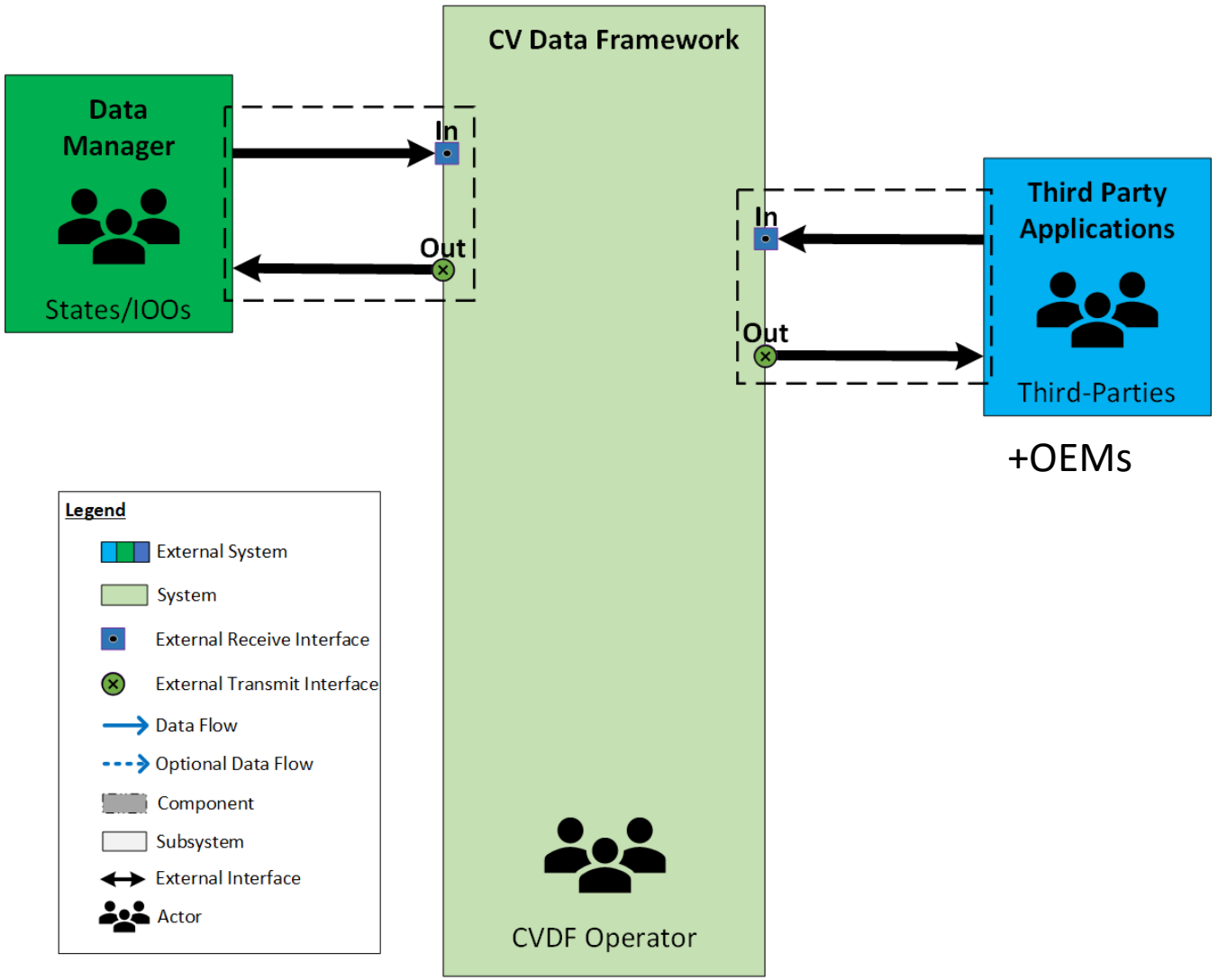
- Final to be provided Jan 10th
- Definition of high-level Data Elements have been pulled forward into this document
  - Originally expected in ICD

# Supported Applications

| Application Reference Name | Application Name | Description |
|---|---|---|
| ECOS | Eco Approach and Departure at Signalized Intersections | An application that allows connected vehicles to optimize the timing spent and fuel consumption used to traverse an intersection. |
| EECOS | Extended Eco-Approach at Signalized Intersection | Similar to the ECOS, but extends the scope of the applicable intersections to include intersections that are more than one light cycle away. |
| RLVW | Red Light Violation | An application that will provide awareness to a connected vehicle and its driver that based on their current trajectory they will pass the stop bar of the intersection during a stop and remain phase. |
| PEDX | Pedestrian in Crosswalk | An application that will provide awareness to a connected vehicle and its driver that the vehicle is approaching an area where there are active pedestrian calls. |
| SPP | Signal Preemption and Priority | An application that allows authorized vehicles to request a change in phase status to receive a favorable signal to clear an intersection in a timelier manner. |
| LTA | Left Turn Assist | An application that will alert a connected vehicle and its driver that an oncoming vehicle has a permissive green turning signal and may legally be occupying their through movement lane. |

* Not an exclusive list

# System Diagram



# System Functions

The CVDF supports the following major system functions:

- Verify the authenticity of input data
- Store data directly from authenticated providers
- Enhance input data where possible
- Provide the ability to archive data
- Manage an authorized recipients list
- Provide event-based data to authorized recipients
- Provide archived data to authorized recipients
- Secure outbound and inbound connections to the system

# External Interface Requirements

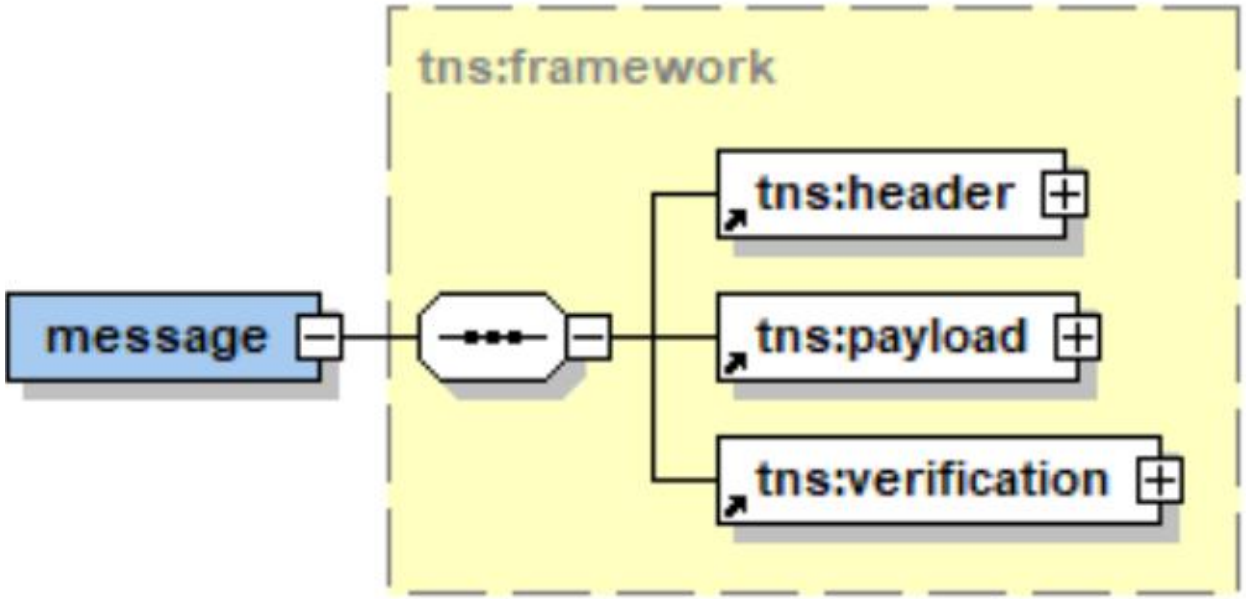
| ReqID | Requirement |
|---|---|
| REQ-EXT-1.0 | The CVDF shall collect data from **zero** or more external systems. |
| REQ-EXT-1.1 | The CVDF shall only collect information from external interfaces in **properly identified** data storage types. |
| REQ-EXT-1.2 | The CVDF shall acquire time synchronization information about the data from the external systems. |
| REQ-EXT-1.4 | The CVDF shall collect data at variable rates from publishers. |
| REQ-EXT-1.5 | The CVDF shall collect data only from authorized publishers. |
| REQ-EXT-1.6 (input) | **The CVDF shall provide schemas that describe the format of the data available from the external interfaces.** |
| REQ-EXT-1.6.1 | **The CVDF schemas shall contain information identifying the sender.** |
| REQ-EXT-1.6.2 | **The CVDF schemas shall contain information that identifies the time at which the message was created.** |
| REQ-EXT-1.6.3 | **The CVDF schemas shall contain information pertaining to a geographical region in which it is applicable.** |
| REQ-EXT-1.6.4 | **The CVDF schemas shall contain information identifying whether the provider wants the information to be restricted to specific subscriptions permissions.** |
| REQ-EXT-1.6.5 | **The CVDF schemas shall contain information regarding the source of time that was used for stamping the message creation time.** |
| ~~REQ-EXT-1.6.1~~ | ~~External systems shall adhere to schemas that define how data is structured.~~ |
| REQ-EXT-2.0 | The CVDF shall transmit data to **zero** or more external systems. |
| REQ-EXT-2.1 | The CVDF shall only publish data to authenticated external systems. |
| REQ-EXT-2.2 (output) | **The CVDF shall provide schemas that describe the format of the data provided to subscribers of the external interfaces.** |
| REQ-EXT-2.3 | The CVDF shall only publish data to subscribers with appropriate subscription permissions. |

* **bold** items have been changed from the draft

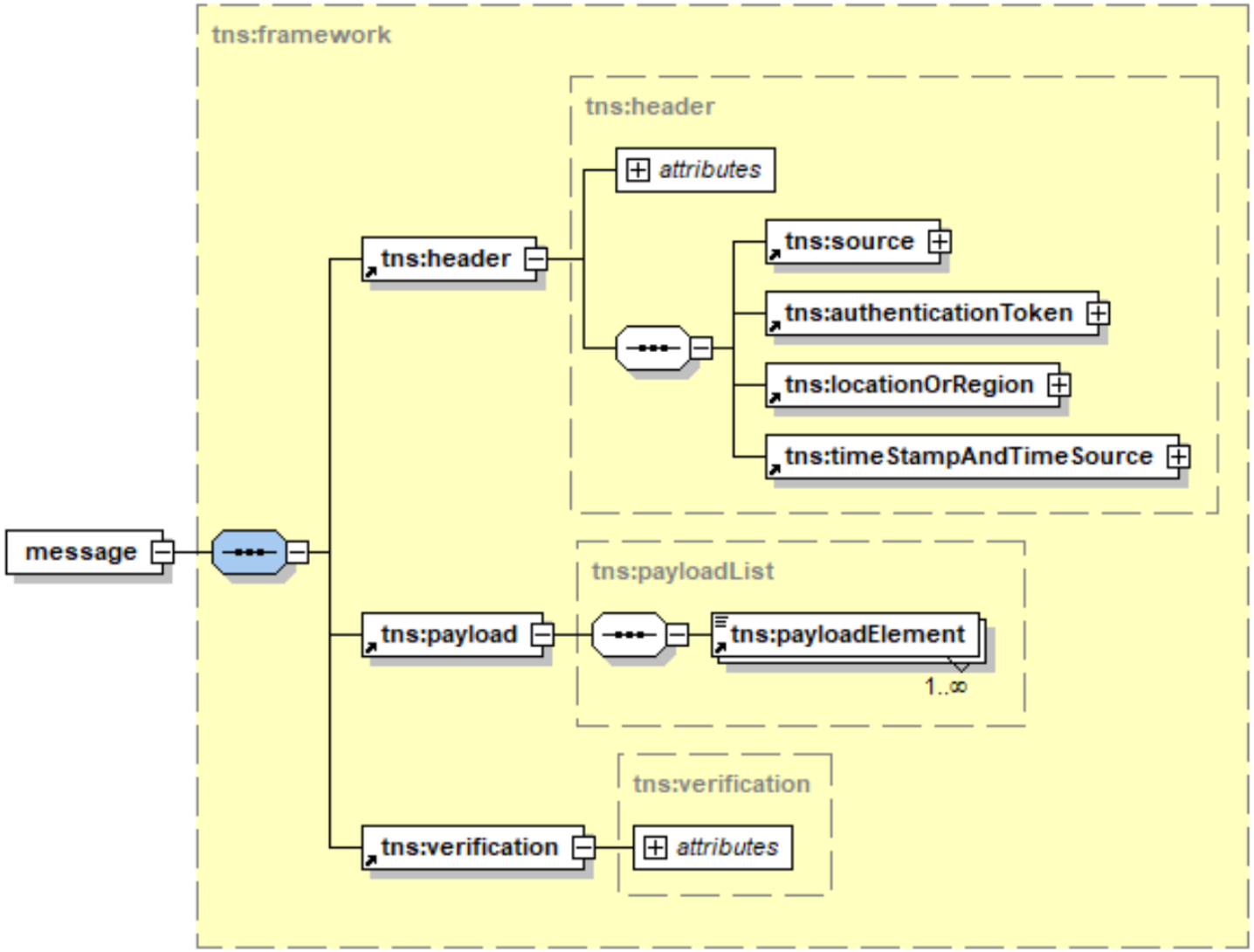
# Example Data Elements

| Message Portion | Contents |
|---|---|
| Header | Source |
| | Authentication token |
| | Location |
| | **Distribution restrictions** |
| | Timestamp and time source |
| Payload | Standardized or Custom Message |
| Verification | CRC/Checksum/Hash |

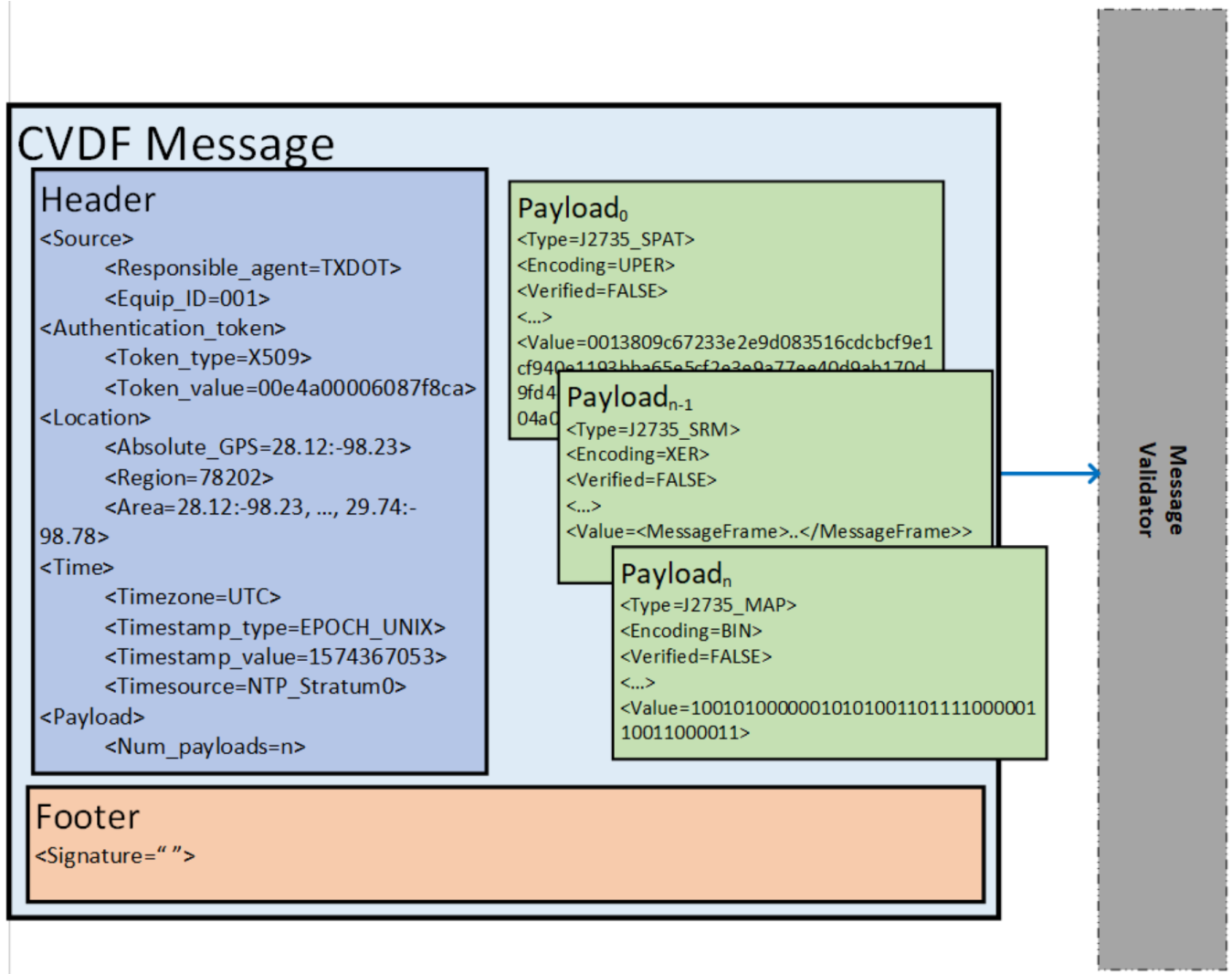
# Data Elements – high-level



# Data Elements – additional details



# Data Elements Strawman – into CVDF



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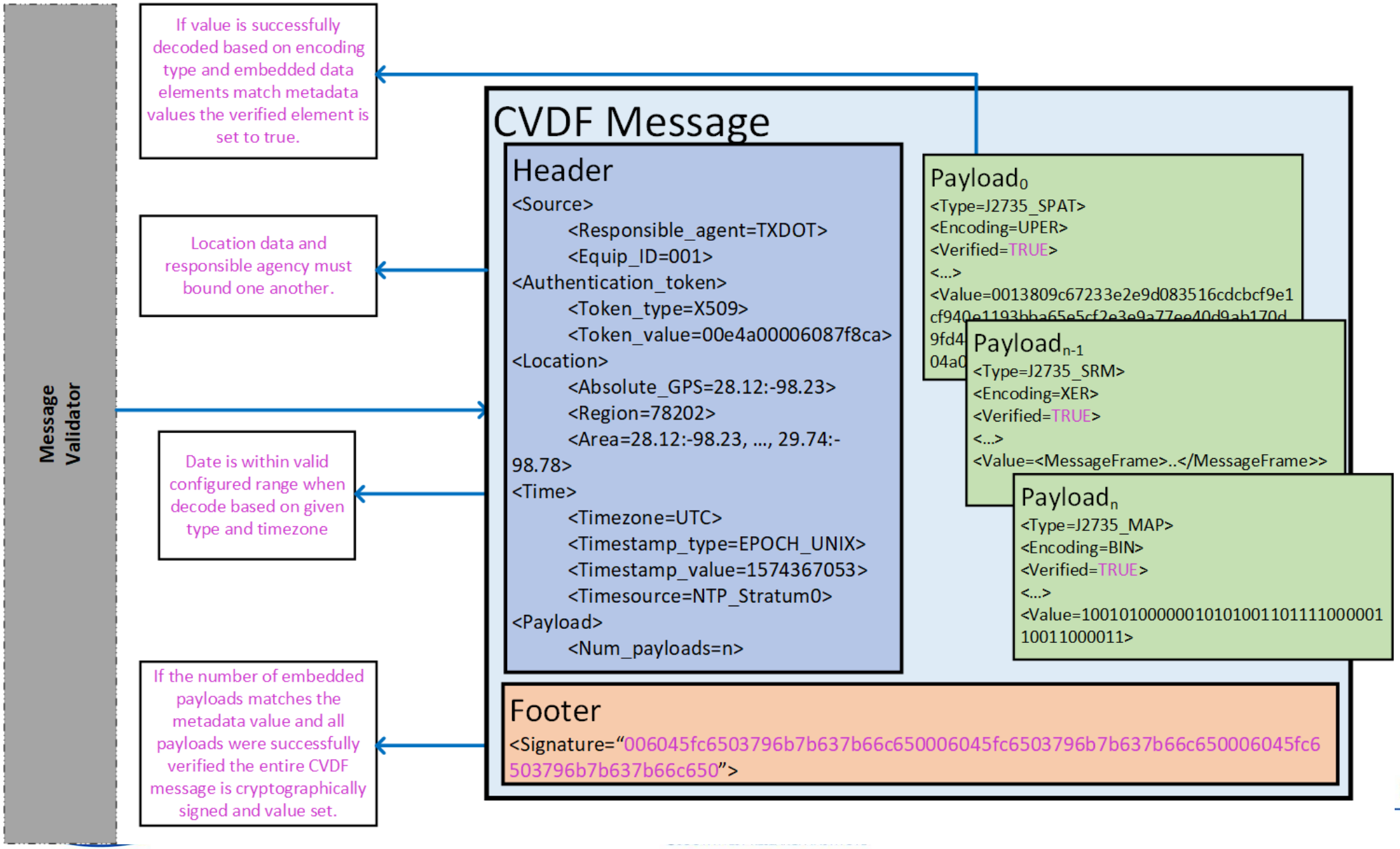
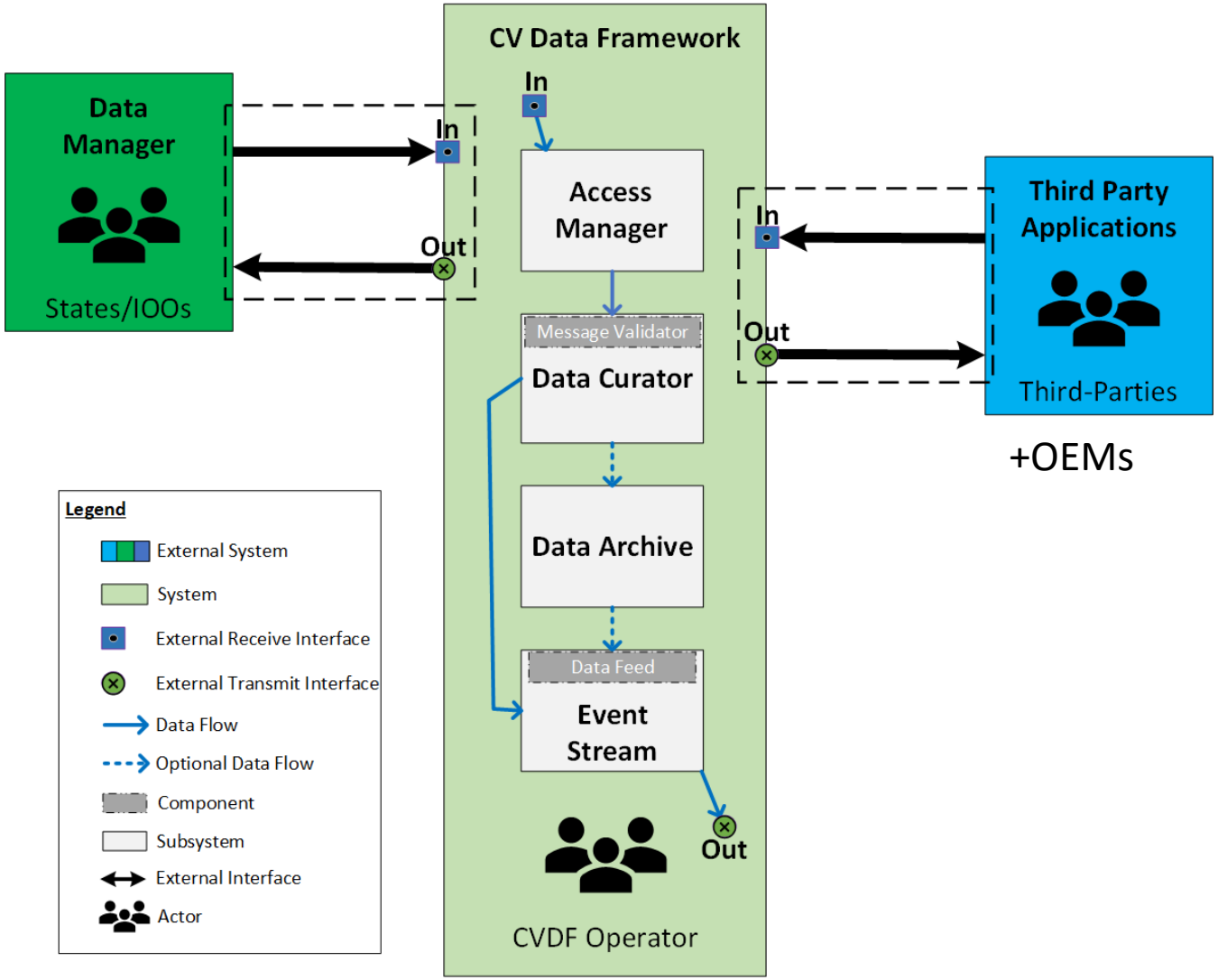


# Internal subsystems

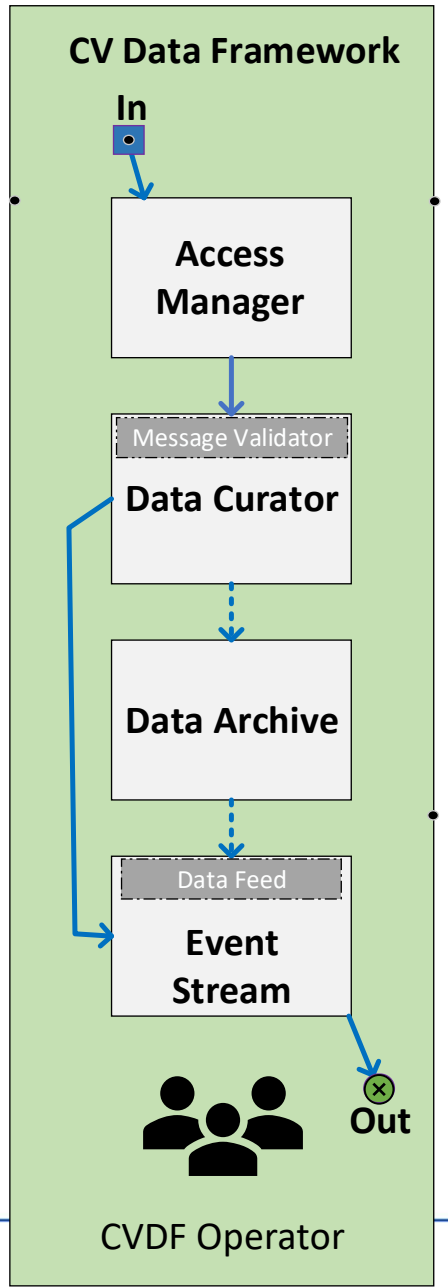
- Design and implementations are not restricted by this document
  - Provides context for discussion purposes
  - Allow us to convey the intent of the management of the external interfaces
  - Focus on what needs to be done in order to prepare/handle the messages

# Internal Subsystem Diagram



# Subsystems

- Access Manager
- Data Curator
- Data Archive
- Event Stream



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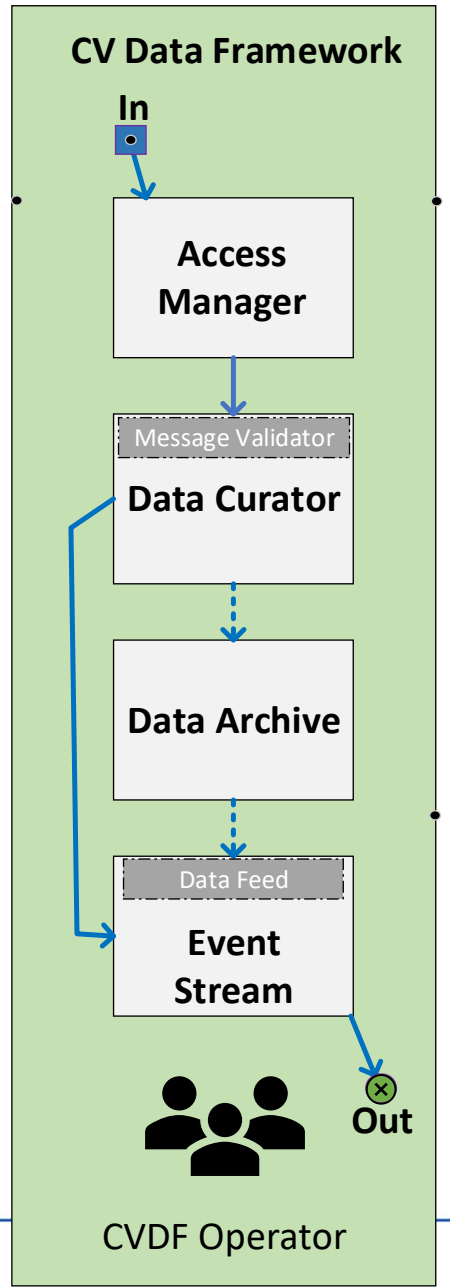



Subsections for each will include:

- Description and Priority
- Stimulus/Response Sequences
- **Functional Requirements**

# Access Manager – Description

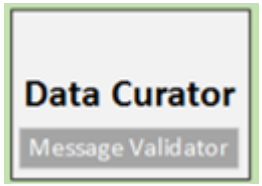

- The access manager's function is to authenticate every user and that user's ability or lack of ability to submit queries into the system.
- An access manager feature is of high priority to the CVDF as a barrier between the users of the system and the internal sub systems.

# Access Manager – Functional Requirements

| Requirement ID | Description |
|---|---|
| REQ-IAM-1.1 | The access manager shall utilize an access control system. |
| REQ-IAM-1.2 | The access manager shall authenticate users in a secure way, so that other internal subsystems can verify the authentication for the duration of a session. |
| REQ-IAM-1.3 | The access manager shall allow CVDF operator administrators to modify the access control system. |
| REQ-IAM-1.4 | The access manager shall verify a user's identity using trusted cryptography standards and current best practices. |
| REQ-IAM-1.5 | The access manager shall not leak information about users regardless of their status within the system. |
| REQ-IAM-1.6 | The access manager shall ~~have sufficient computing resources available to~~ verify and create cryptographic signatures for messages of a sufficient quality to withstand attacks. |
| REQ-IAM-1.7 | The access manager shall store **pertinent information regarding** subscription agreements between users of the system. |
| REQ-IAM-1.8 | The access manager shall update the access control system based on subscription agreements between users of the system. |
| REQ-IAM-1.9 | The access manager shall securely communicate with 3rd party networks. |
| REQ-IAM-1.10 | The access manager shall allow users to access specific event stream socket connections in accordance with the active access control system **permissions**. |

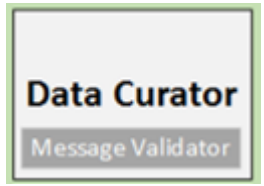
# Data Curator – Description

- Handles all incoming data
- Optional Message Validator
- Prepares messages for the Event Stream
- Manages data storage archival
- Central communication



# Data Curator – Functional Requirements

| Requirement ID | Description |
|---|---|
| REQ-IDC-1.1 | The data curator shall ensure all required metadata elements are valid and populated before messages can be routed anywhere. ~~Such required metadata elements include time of message creation, time source, applicable region, message frame schema and encoding formats, payload message type encoding, and schema, etc. Metadata elements will become present through data aggregation or directly from the provider in the top level message frame.~~ |
| REC-IDC-1.2 | The data curator may modify metadata values based on subscription/publication agreements or flags within the message. For example: changing EST time to UTC time. |
| REQ-IDC-1.3 | The data curator shall validate high level message construction and formatting such as conformity to standardized schemas. |
| REC-IDC-1.4 | The data curator may implement a message frame validator. |
| ~~REQ-IDC-1.5~~ | ~~The data curator shall sanitize input data to remove Personally Identifiable Information (PII).~~ |
| ~~REQ-IDC-1.6~~ | ~~The data curator shall normalize units and scales for data in the header or appropriate customized payloads to an agreed-upon common reference. For example: all geolocation points shall be stored in absolute decimal degree units.~~ |



# Data Archive – Description and Priority


- Allocates memory for messages
  - Messages to be archived
  - Messages from local archive
- May distribute messages to external data archive
- Store and retrieve messages
  - Does not validate

# Data Archive – Functional Requirements

| Requirement ID | Description |
|---|---|
| ~~REQ-IDA-1.1~~ | ~~The data archive shall have sufficient resources to be able to withstand physical and virtual failure without the loss of data.~~ |
| REQ-IDA-1.2 | **The data archive shall handle valid external data provider archive requests and subscriber archive data requests.** |
| ~~REQ-IDA-1.3~~ | ~~The data archive shall handle database subscription request queries that originate from the event stream.~~ |

**Data Archive**

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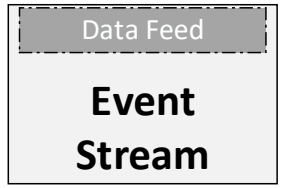
**Data Archive**

Open question:

Should the Data Archive be an optional component?

- What provides transient storage capabilities?
- Archive may be external.

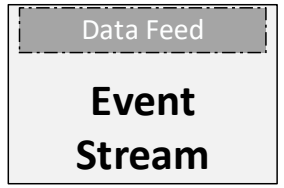
# Event Stream – Description and Priority




- Forward relevant data to subscribers
- Provides timing metadata
- Manages connections

# Event Stream – Functional Requirements

| Requirement ID | Description |
|---|---|
| ~~REQ-IES-1.1~~ | ~~An event stream shall provide consistent access and up time.~~ |
| REQ-IES-1.2 | **An event stream shall operate a timing mechanism dependent on at least a straum-1 device.** |
| REQ-IES-1.3 | An event stream shall only operate in an outbound direction. |
| REC-IES-1.4 | An event stream may implement an **Aggregate** Feed component to **combine disparate individual payloads into an outbound message**. |
| ~~REQ-IES-1.5~~ | ~~An event stream shall possess the ability to create data archive requests in response to subscription requests.~~ |
| REQ-IES-1.6 | An event stream shall be able to open **and sustain a connection to the subscriber** when directed to by the access manager. |
| REQ-IES-1.7 | An event stream shall be able to publish data **to multiple subscribers concurrently.** |



# System Requirements – Other Nonfunctional Requirements

- **Performance Requirements**
- **Security Requirements**
- **Software Quality Attributes**

# Performance Requirements

| Requirement ID | Description |
|---|---|
| REQ-PERF-1.1 | Data marked by external users as “low-latency data” shall be sent to other external users with minimal delay from the time it was received by the system. |
| REC-PERF-1.2 | The system may archive BSMs for some pre-determined duration. |
| REQ-PERF-1.3 | The system shall archive SPaT data for some pre-determined duration. |
| REQ-PERF-1.4 | The system shall archive MAP data for some pre-determined duration. |

# Security Requirements

| Requirement ID | Description |
| --- | --- |
| REQ-SEC-1.1 | External systems shall be authenticated by the CVDF |
| REC-SEC-1.2 | External systems may encrypt communication with the CVDF |

# Software Quality Requirements

| Requirement ID | Description |
|---|---|
| REQ-SWQA-1.1 | The system shall receive and provide BSMs. |
| REQ-SWQA-1.2 | The system shall receive and provide MAP messages. |
| REQ-SWQA-1.3 | The system shall receive and provide SPaT Messages. |
| ~~REQ-SWQA-1.4~~ | ~~The system shall receive and provide route planning data.~~ |
| REQ-SWQA-1.5 | The system shall receive and provide vehicle speed data. |
| REQ-SWQA-1.6 | The system shall receive and provide predictive analytic insights. |
| ~~REQ-SWQA-1.7~~ | ~~Data provided by the system shall not be modified to such a degree that the receiver cannot deduce the value in which it was originally sent to the system.~~ |

# Open Discussion

# Follow Up

- Feedback requested on System Requirements
  - Provide via PDF markup by Dec 13th
- Specific question:
  - How will these requirements affect your implementation of a CVDF?
- Are there known gaps or inconsistencies with the requirements as identified?

# Questions?