



ADS-B Data Model

Automatic Dependent Surveillance – Broadcast

TES-SAVi Training Package
Modeled using the TES-SAVi FAME tool suite
Version Alpha, dated February 2016



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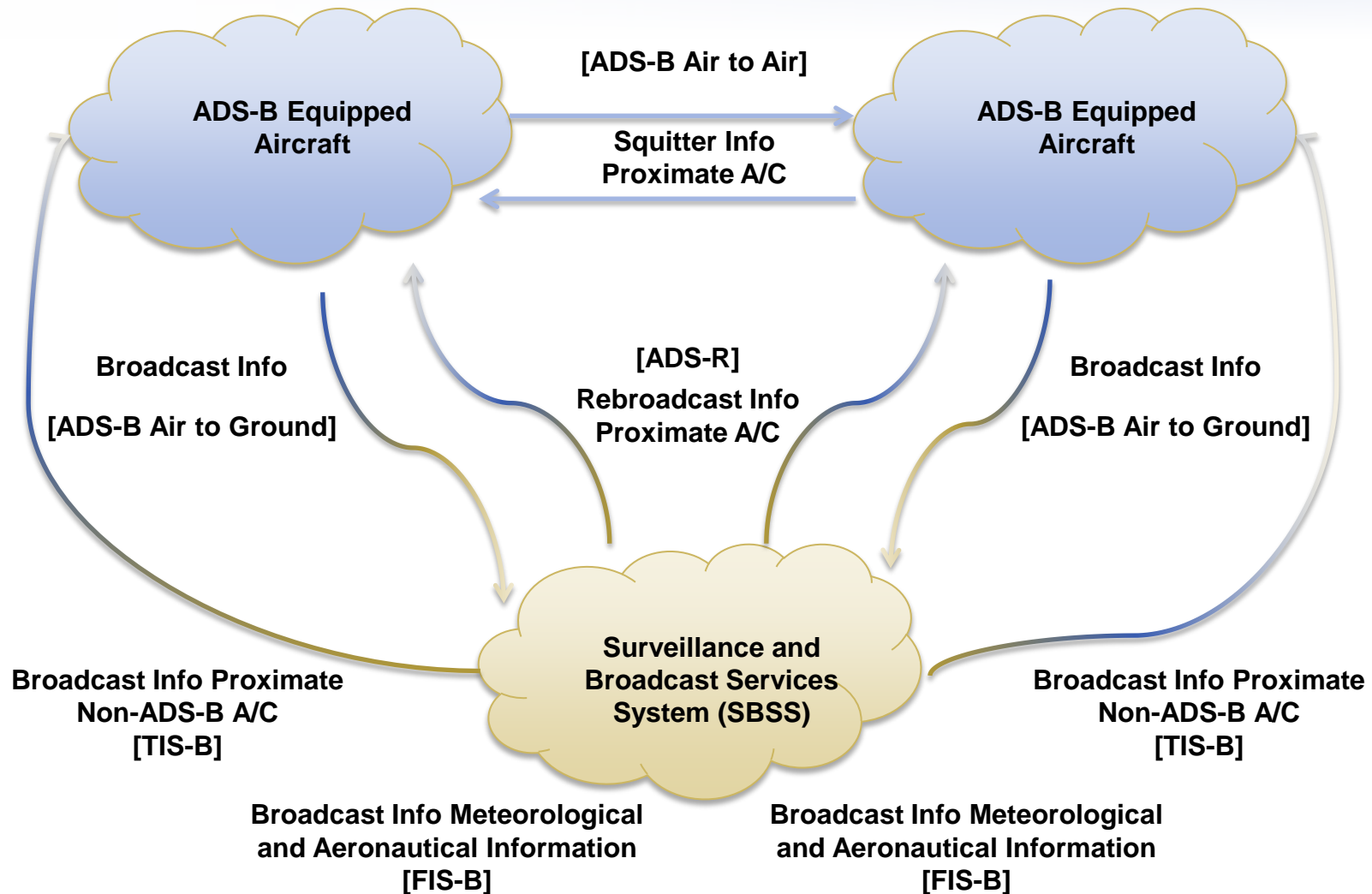


- ADS-B Overview Diagram
- Scope of ADS-B Modeling
- FACE Modeling Notes
- ADS-B Modeling Notes
- Model Naming Conventions
- Model Structure
- FAME Model
- Known Issues

NOTE: This presentation *assumes* the reader is familiar with the FACE Data Model Language

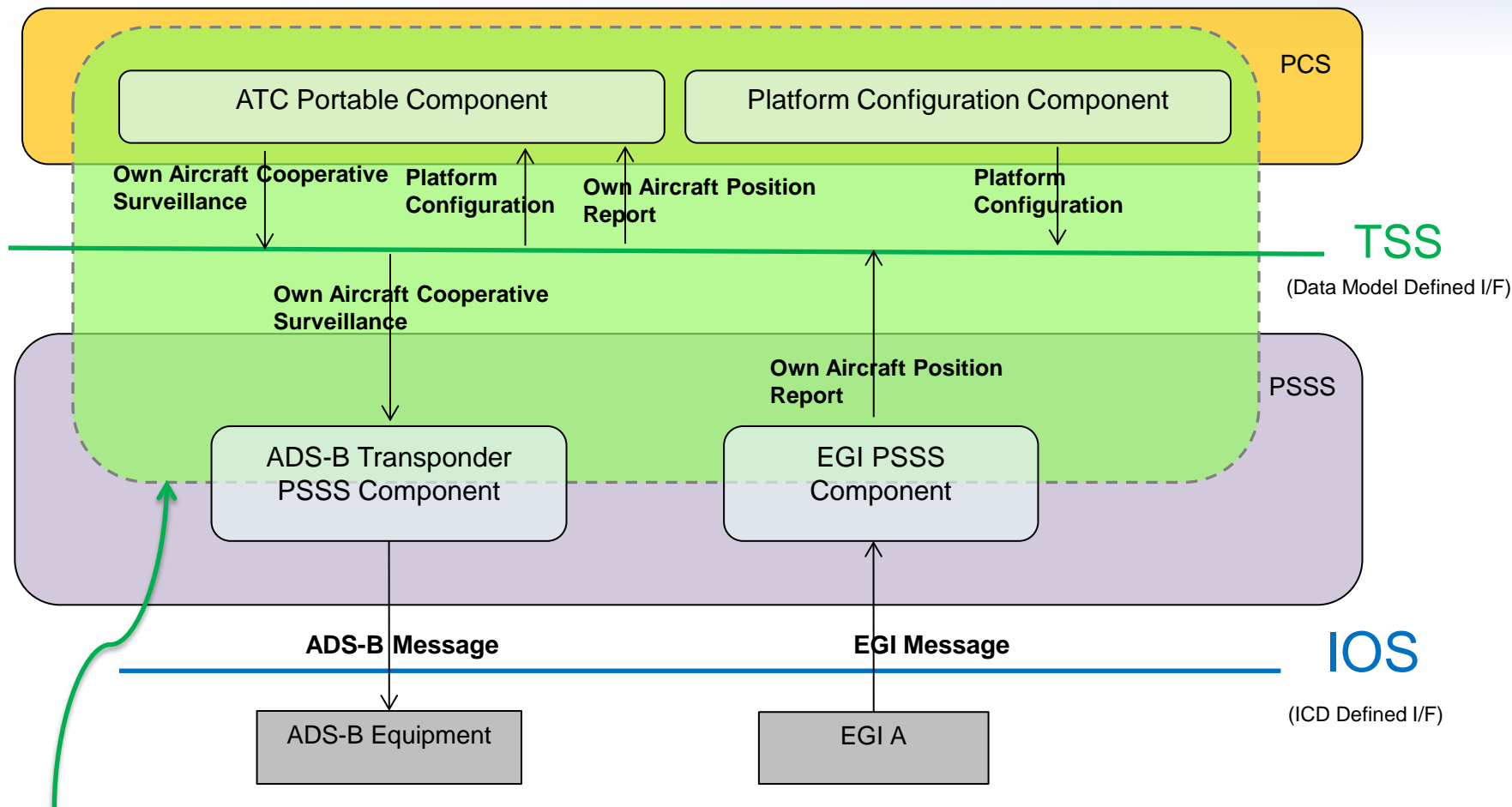


ADS-B Overview Diagram





Scope of ADS-B Modeling



The scope of the *initial* modeling effort is highlighted in light green. We define and model the conceptual, logical, platform, and UoP models for the ATC, Platform Configuration, ADS-B Transponder, and EGI Components



- This ADS-B was modeled using TES-SAVi's FAME™
 - FAME™ (FACE Architecture Modeling Environment) is an Eclipse-based modeling tool
 - Visit www.TES-SAVi.com for more information on this tool
- FACE Conformance was verified using FACE Conformance Test Suite v.2.1.3
- Compromises, due to immaturity of FACE Shared Data Model (SDM), were required, specifically
 - Name is used as the unique identifier at the conceptual, logical, and platform levels. An identifier (whose type is Observable UniqueID) is used only at the conceptual level for each Entity
 - No enumerations currently used, e.g., for navigation data source



- Scope of ADS-B Modeling (*.face)
 - The FACE Integration Workshop (FACE IWS) is using the following requirements documents for the scope of Balsa and ADS-B modeling
 - ADSB_SDD.xlsx
 - ADSB_SRS.xlsx
 - ADSB_SRS_SDD_RTM.xlsx
 - EGI_SDD.xlsx
 - SRS.xlsx
 - Derived component, “PlatformConfiguration_PCS_Component” provides Aircraft ID
 - Scope *does not include control code* generated from this ADS-B model
 - TES-SAVi’s FAME allows developers to edit, navigate, and view the data model; import and export *.face files; and save the QuickView, as an HTML file documenting the FACE model data dictionary. The *.face and documentation is available for FACE IWS efforts

- Naming Conventions
 - Entities are named by capitalizing the first letter of each word, no spaces
 - Characteristic compositions are named by capitalizing the first letter of each word save the first, even when an acronym is used as the first word
 - Descriptions for Entities are only provided at the Conceptual Level to minimize duplication
 - No descriptions are provided for characteristic compositions as they are not available for entry in the Eclipse plug-ins



- All additional elements were placed in folders under the root FACE_IWS_ADSB “Data Model” Element:
 - Conceptual_Model/Entities: contains ADS-B conceptual entities
 - Logical_Model/Entities: contains ADS-B logical entities
 - Platform_Model/Entities: contains ADS-B platform entities
 - Platform_Model/IDLTypes: contains IDL Types (primitives and structs) that realize logical measurements and measurement axes
 - Platform_Model/Views: contains views used as Message Type elements for Message Ports of the Units of Portability (UoPs)
 - UoP_Model: contains:
 - the ATC_PCS_Component UoP and its associated Message Port elements
 - the PlatformConfiguration_PCS_Component and its associated Message Port elements
 - the ADSBTransponder_PSSS_Component UoP and its associated Message Port elements
 - the EGI_PSSS_Component UoP and its associated Message Port elements



Model Walkthrough

FAME

File Window Help

AWESUM Project Explorer Project Explorer

Column: Any Search:

Data Element Name	Description
FACE_IWS_ADSB	
Conceptual_Model	
Observables	
Entities	Contains concep
OwnAircraft	The ownship, or
oaID	Distinguishes an
oaAircraftID	Human meaning
oaPosition	Location of an ite
oaTimeAtPosition	Position in time,
Logical_Model	
Platform_Model	
UoP_Model	

Properties

Selection from AWESUM Project Explorer

BASIC

Display

Traces

Advanced

CONCEPTUAL ENTITY

Name: OwnAircraft

Description: The ownship, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Characteristics:

Name
oaID
oaAircraftID
oaPosition
oaTimeAtPosition

***IWS_ADS-B.cda**

Quick Access

OwnAircraft

oaAircraftID : Logical_IWS_ADS-B.NameMeasurement
 oaPosition : Logical_IWS_ADS-B.WGS84PositionMeasurement
 oaTimeAtPosition : Logical_IWS_ADS-B.UTCTimeMeasurement
 +new :

realizes

OwnAircraft

has a has a has a has a

UniquelIdentifier
Distinguishes an item from all other items.

Name
Human meaningful

Position
Location of an item relative to a

CalendarTime
Position in time, a realization of which could

Dashboard Diagrams Auto-Diagram

Preview

Conceptual_IWS_ADS-B.OwnAircraft

The ownship, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Compositions

Name	Type
oaID	Conceptual_IWS_ADS-B.UniquelIdentifier
oaAircraftID	Conceptual_IWS_ADS-B.Name
oaPosition	Conceptual_IWS_ADS-B.Position
oaTimeAtPosition	Conceptual_IWS_ADS-B.CalendarTime



Conceptual Observable (Position)

The screenshot displays the FAME software interface, which is used for modeling and simulation. The interface is divided into several panes:

- Project Explorer:** Located on the left, it shows a tree view of data elements. The 'Position' element is selected, showing its description: 'Location of an item relative to a fixed reference frame.'
- Properties:** Below the Project Explorer, it shows the 'Basic' properties of the selected 'Position' element. The 'Name' is 'Position' and the 'Description' is 'Location of an item relative to a fixed reference frame.'
- Diagram:** The main central pane shows a conceptual model. It includes a green box labeled 'WGS84PositionMeasurement' with the following properties:
 - WGS84PositionHeightMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionHeightMeasurementAxis
 - WGS84PositionLatitudeMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionLatitudeMeasurementAxis
 - WGS84PositionLongitudeMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionLongitudeMeasurementAxis
 - +new :Below this box is a 'Position' element (represented by an eye icon) with the description 'Location of an item relative to a'. Arrows indicate relationships: 'aggregate' from 'WGS84PositionMeasurement' to 'Position' and 'realizes' from 'WGS84PositionMeasurement' to 'Position'.
- Auto-Diagram:** At the bottom, it shows a preview of the conceptual model, titled 'Conceptual_IWS_ADS-B.Position', with the description 'Location of an item relative to a fixed reference frame.'



Logical Measurement (WGS-84)

FAME

File Window Help

AWESUM Project Explorer Project Explorer

Column: Any Search:

ta Element Name

- OrientationMeasures
 - PositionMeasures
 - ECEFPosition
 - WGS84Position
 - WGS84PositionMeasurement
 - WGS84PositionMeasurementSystem
 - WGS84PositionMeasurementSystemHeightAxis
 - WGS84PositionMeasurementSystemLatitudeAxis
 - WGS84PositionMeasurementSystemLongitudeAxis
- PowerMeasures
- PressureMeasures
- RateMeasures

Properties

Selection from AWESUM Project Explorer

Basic

Display

Traces

Advanced

MEASUREMENT

Name: WGS84PositionMeasurement

Description: Describes a location relative to the WGS-84 frame of reference.

Axes:

- WGS84PositionHeightMeasurementAxis
- WGS84PositionLatitudeMeasurementAxis
- WGS84PositionLongitudeMeasurementAxis

Measure

***IWS_ADS-B.cda**

Quick Access

WGS84PositionMeasurement

WGS84PositionHeightMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionHeightMeasureme
WGS84PositionLatitudeMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionLatitudeMeasure
WGS84PositionLongitudeMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionLongitudeMea
+new :

implements

WGS84PositionMeasurementSystem

WGS84PositionMeasurementSystemHeightAxis : Logical_IWS_ADS-B.RealMeters
WGS84PositionMeasurementSystemLatitudeAxis : Logical_IWS_ADS-B.RealDegrees
WGS84PositionMeasurementSystemLongitudeAxis : Logical_IWS_ADS-B.RealDegree
+new :

realizes depends on depends on

Polar3D

Polar3DAngularAxis : Logical_IWS_ADS-B.Polar3DAngularAxis
Polar3DAzimuthalAxis : Logical_IWS_ADS-B.Polar3DAzimuthalAxis
Polar3DRadialAxis : Logical_IWS_ADS-B.Polar3DRadialAxis
+new :

EarthCenter **PrimeMeridianEquat**

Dashboard Diagrams Auto-Diagram

Preview

Logical_IWS_ADS-B.WGS84PositionMeasurement

Describes a location relative to the WGS-84 frame of reference.

Realized Type: **Conceptual_IWS_ADS-B.Position**

Measurement

Name	Type	Unit
WGS84PositionMeasurement	Logical_IWS_ADS-B.Real	Logical_IWS_ADS-B.Meters



Platform Physical Type (IDL Struct)

FAME

File Window Help

AWESUM Project Explorer

Column: Any Search:

ta Element Name

- IDLFloat_WGS84PositionLongitudeMeasurementAxis
- IDLString_NameMeasurement
- IDLShort_UTC_GregorianYear_VTU
- IDLShort_UTC_MonthOfGregorianYear_VTU
- IDLShort_UTC_DayOfGregorianMonth_VTU
- IDLShort_UTC_HourOfGregorianDay_VTU
- IDLShort_UTC_MinuteOfHour_VTU
- IDLShort_UTC_SecondOfMinute_VTU
- IDLStruct_UTCTimeMeasurement
- IDLStruct_WGS84PositionMeasurement
- Views
- UoP_Model
- Diagrams

Properties

Selection from AWESUM Project Explorer

BASIC

TYPE

Name: IDLStruct_WGS84PositionMeasurement

Description: IDL Struct that realizes the WGS-84 Position Measurement.

Attributes:

Name	Type
heightAboveEllipsoid	Platform
latitude	Platform
longitude	Platform

Note

***IWS_ADS-B.cda**

Quick Access

Diagram illustrating the IDL Struct hierarchy:

```

graph TD
    oaPosition[oaPosition] -- aggregate --> IDLStruct_WGS84PositionMeasurement[IDLStruct_WGS84PositionMeasurement]
    reportedPosition[reportedPosition] -- aggregate --> IDLStruct_WGS84PositionMeasurement
    IDLStruct_WGS84PositionMeasurement -- realizes --> WGS84PositionMeasurement[WGS84PositionMeasurement]
    IDLStruct_WGS84PositionMeasurement -- is-a --> IDLStruct[IDLStruct]
  
```

WGS84PositionMeasurement

WGS84PositionHeightMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionHeightMeasurementAxis
 WGS84PositionLatitudeMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionLatitudeMeasurementAxis
 WGS84PositionLongitudeMeasurementAxis : Logical_IWS_ADS-B.WGS84PositionLongitudeMeasurementAxis
 + new :

IDLStruct

An IDLStruct "realizes" a logical AbstractMeasurement in terms of

Dashboard Diagrams Auto-Diagram

Preview

Platform_IWS_ADS-B.IDLStruct_WGS84PositionMeasurement

IDL Struct that realizes the WGS-84 Position Measurement.

Realized Type: **Logical_IWS_ADS-B.WGS84PositionMeasurement**



Conceptual Data Model

FAME

File Window Help

AWESUM Project Explorer Project Explorer

Column: Any Search:

ta Element Name

- FACE_IMPORT
 - FACE_IWS_ADSB
 - Conceptual_Model
 - Observables
 - Entities
 - OwnAircraft
 - Logical_Model
 - Platform_Model
 - UoP_Model
 - Diagrams
 - DataModel

Properties

CONCEPTUAL ENTITY

Name: OwnAircraft

Description: The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Characteristics:

Name	Type
oaID	Conceptual
oaAircraftID	Conceptual
oaPosition	Conceptual
oaTimeAtPosition	Conceptual

***IWS_ADS-B.cda**

Quick Access

OwnAircraft

oaAircraftID : Logical_IWS_ADS-B.NameMeasurement
 oaPosition : Logical_IWS_ADS-B.WGS84PositionMeasurement
 oaTimeAtPosition : Logical_IWS_ADS-B.UTCTimeMeasurement
 +new :

realizes

OwnAircraft

has a has a has a has a

UniqueIdentifier
Distinguishes an item from all other items.

Name
Human meaningful

Position
Location of an item relative to a

CalendarTime
Position in time, a realization of which could

Dashboard Diagrams Auto-Diagram

Preview

Conceptual_IWS_ADS-B.OwnAircraft

The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Compositions

Name	Type
oaID	Conceptual_IWS_ADS-B.UniqueIdentifier
oaAircraftID	Conceptual_IWS_ADS-B.Name
oaPosition	Conceptual_IWS_ADS-B.Position
oaTimeAtPosition	Conceptual_IWS_ADS-B.CalendarTime



Logical Data Model

FAME

File Window Help

AWESUM Project Explorer

Column: Any Search:

Data Element Name

- Entities
 - OwnAircraft
- Logical_Model
 - CoordinateSystems
 - LogicalValueTypes
 - Measures
 - Units
 - Enumerations
 - Entities
 - OwnAircraft
 - Platform_Model
 - UoP_Model

Properties

Selection from AWESUM Project Explorer

Basic

Display

Traces

Advanced

LOGICAL ENTITY

Name: OwnAircraft

Description: The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Characteristics:

Name	Type
oaAircraftID	Logi
oaPosition	Logi
oaTimeAtPosition	Logi

***IWS_ADS-B.cda**

OwnAircraft

oaAircraftID : Platform_IWS_ADS-B.IDLString_NameMeasurement
 oaPosition : Platform_IWS_ADS-B.IDLStruct_WGS84PositionMeasurement
 oaTimeAtPosition : Platform_IWS_ADS-B.IDLStruct_UTCTimeMeasurement
 + new :

realizes

OwnAircraft

oaAircraftID : Logical_IWS_ADS-B.NameMeasurement
 oaPosition : Logical_IWS_ADS-B.WGS84PositionMeasurement
 oaTimeAtPosition : Logical_IWS_ADS-B.UTCTimeMeasurement
 + new :

realizes

OwnAircraft

Dashboard Diagrams Auto-Diagram

Preview

The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Realized Type: **Conceptual_IWS_ADS-B.OwnAircraft**

Compositions

RoleName	Type	Realizes
oaAircraftID	Logical_IWS_ADS-B.NameMeasurement	Conceptual_IWS_ADS-B.OwnAircraft
oaPosition	Logical_IWS_ADS-B.WGS84PositionMeasurement	Conceptual_IWS_ADS-B.OwnAircraft
oaTimeAtPosition	Logical_IWS_ADS-B.UTCTimeMeasurement	Conceptual_IWS_ADS-B.OwnAircraft



Platform Data Model

FAME

File Window Help

AWESUM Project Explorer

Column: Any Search:

Data Element Name

- Measures
- Units
- Enumerations
- Entities
 - OwnAircraft
 - Platform_Model
 - Entities
 - OwnAircraft
 - oaAircraftID
 - oaPosition
 - oaTimeAtPosition
 - IDLTypes

Properties

Selection from AWESUM Project Explorer

Basic

Display

Traces

Advanced

PLATFORM ENTITY

Name: OwnAircraft

Description: The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Characteristics:

Type
Platform_IWS_ADS-B.IDLString_Name...
Platform_IWS_ADS-B.IDLStruct_WGS84...
Platform_IWS_ADS-B.IDLStruct_UTCTi...

***IWS_ADS-B.cda**

surveillanceData

The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

aggregate

OwnAircraft

oaAircraftID : Platform_IWS_ADS-B.IDLString_NameMeasurement
 oaPosition : Platform_IWS_ADS-B.IDLStruct_WGS84PositionMeasurement
 oaTimeAtPosition : Platform_IWS_ADS-B.IDLStruct_UTCTimeMeasurement
 > new <

realizes

OwnAircraft

oaAircraftID : Logical_IWS_ADS-B.NameMeasurement
 oaPosition : Logical_IWS_ADS-B.WGS84PositionMeasurement
 oaTimeAtPosition : Logical_IWS_ADS-B.UTCTimeMeasurement

Dashboard Diagrams Auto-Diagram

Preview

The ownership, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

Realized Type: **Logical_IWS_ADS-B.OwnAircraft**

Compositions

RoleName	Type	
oaAircraftID	Platform_IWS_ADS-B.IDLString_NameMeasurement	Logical_IWS_A
oaPosition	Platform_IWS_ADS-B.IDLStruct_WGS84PositionMeasurement	Logical_IWS_A
oaTimeAtPosition	Platform_IWS_ADS-B.IDLStruct_UTCTimeMeasurement	Logical_IWS_A



Platform Views

FAME

File Window Help

*IWS_ADS-B.cda

Views
Contains Views

has a

OwnAircraftCooperativeSurveillance_View
Projects to the Own Aircraft data needed for cooperative surveillance with other Aircraft.

has a

PlatformConfiguration_View
Projects to configuration data for the platform.

has a

OwnAircraftPositionReport_View
Projects to data that describes the reporting of the Own Aircraft position.

Dashboard Diagrams Auto-Diagram

AWESUM Project Explorer

Column: Any Search:

Name

- IDLTypes
- Views
 - OwnAircraftCooperativeSurveillance_View
 - PlatformConfiguration_View
 - OwnAircraftPositionReport_View
- UoP_Model
- ms
- odel

Preview

The ownship, or own aircraft and its characteristics. For simplicity, the navigation data for the own aircraft are modeled entirely within this entity.

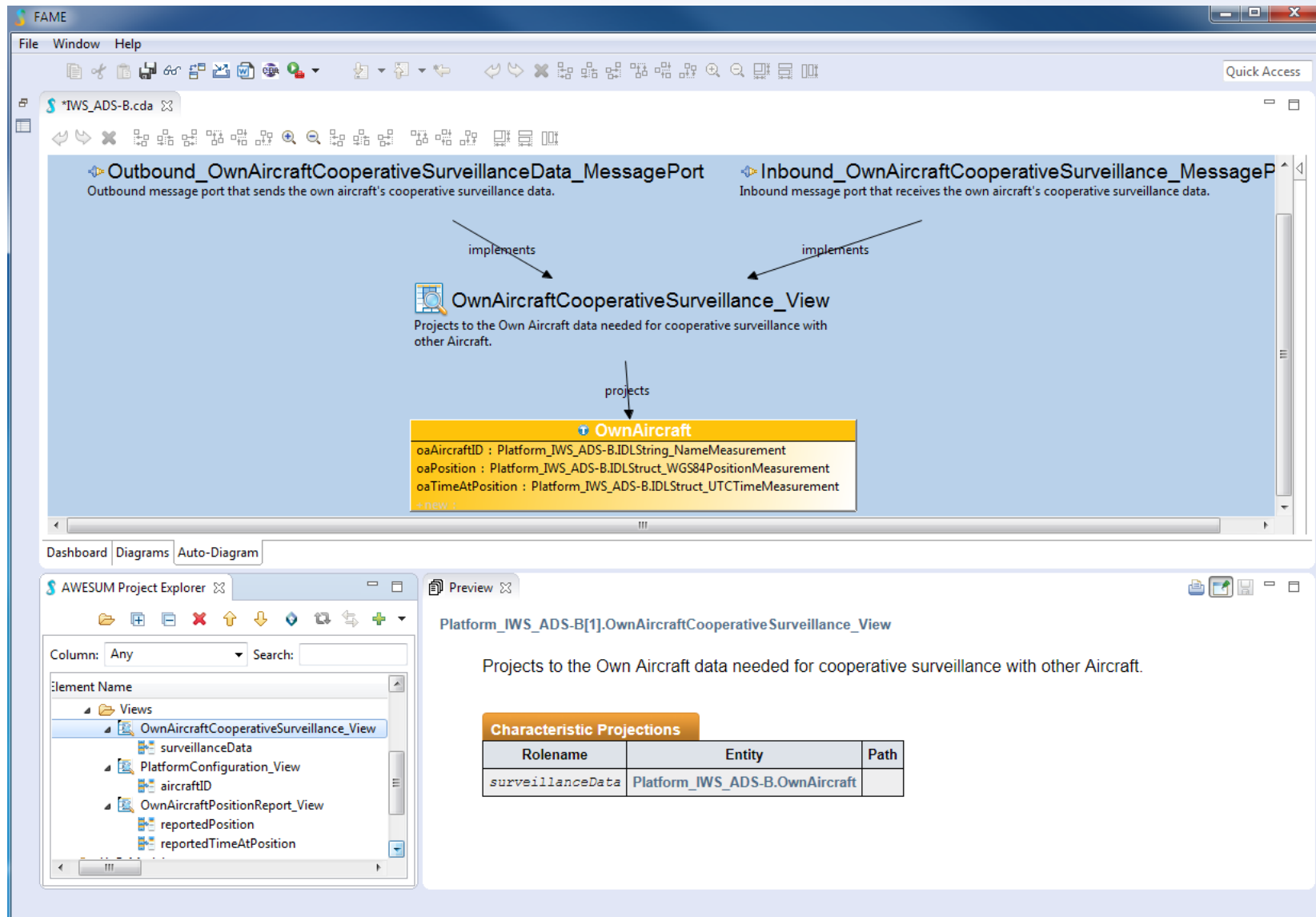
Realized Type: **Logical_IWS_ADS-B.OwnAircraft**

Compositions

RoleName	Type	Realizes
oaAircraftID	Platform_IWS_ADS-B.IDLString_NameMeasurement	Logical_IWS_ADS-B.OwnAircraft.oaAircraftID
oaPosition	Platform_IWS_ADS-B.IDLStruct_WGS84PositionMeasurement	Logical_IWS_ADS-B.OwnAircraft.oaPosition
oaTimeAtPosition	Platform_IWS_ADS-B.IDLStruct_UTCTimeMeasurement	Logical_IWS_ADS-B.OwnAircraft.oaTimeAtPosition

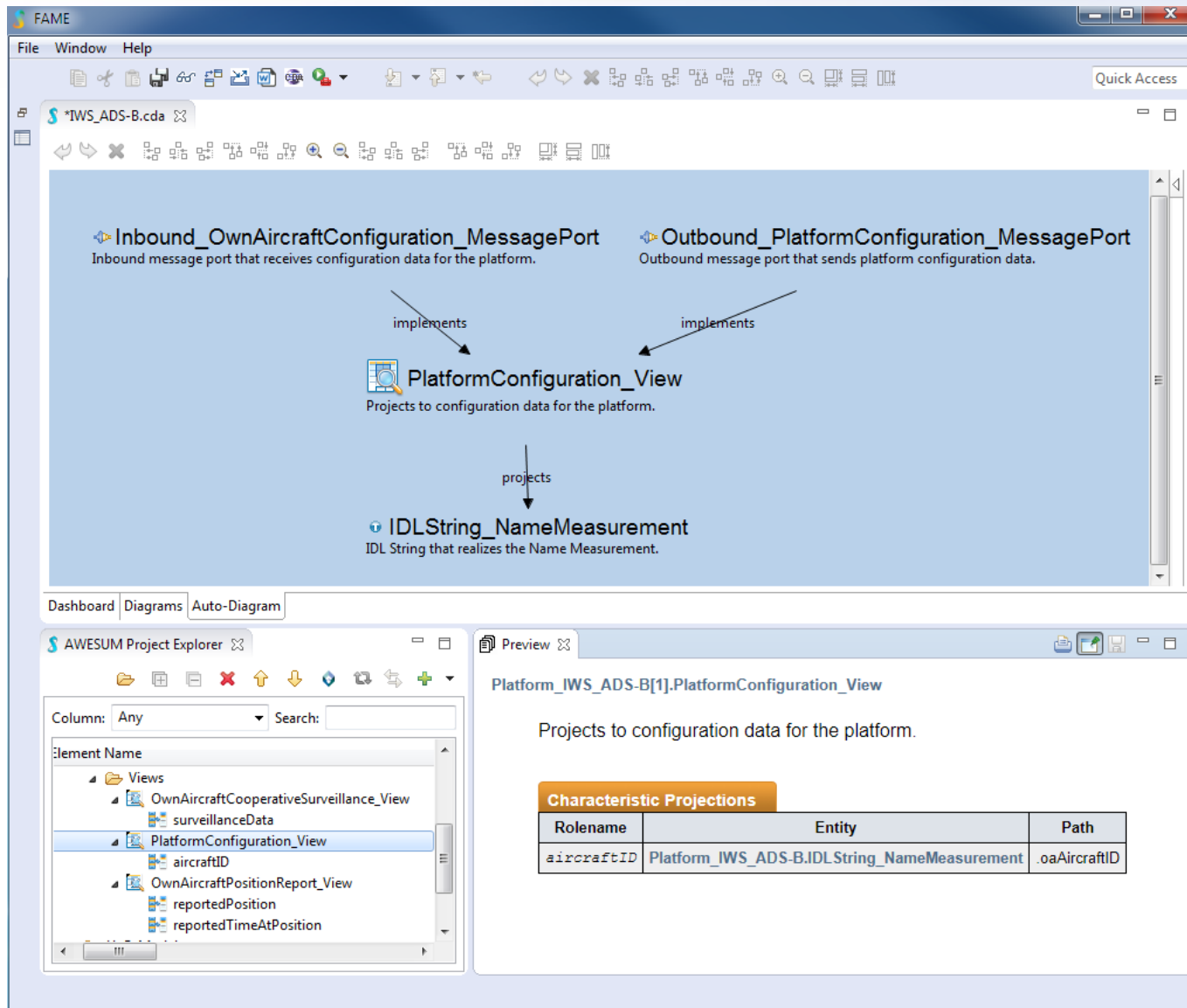


Platform Views



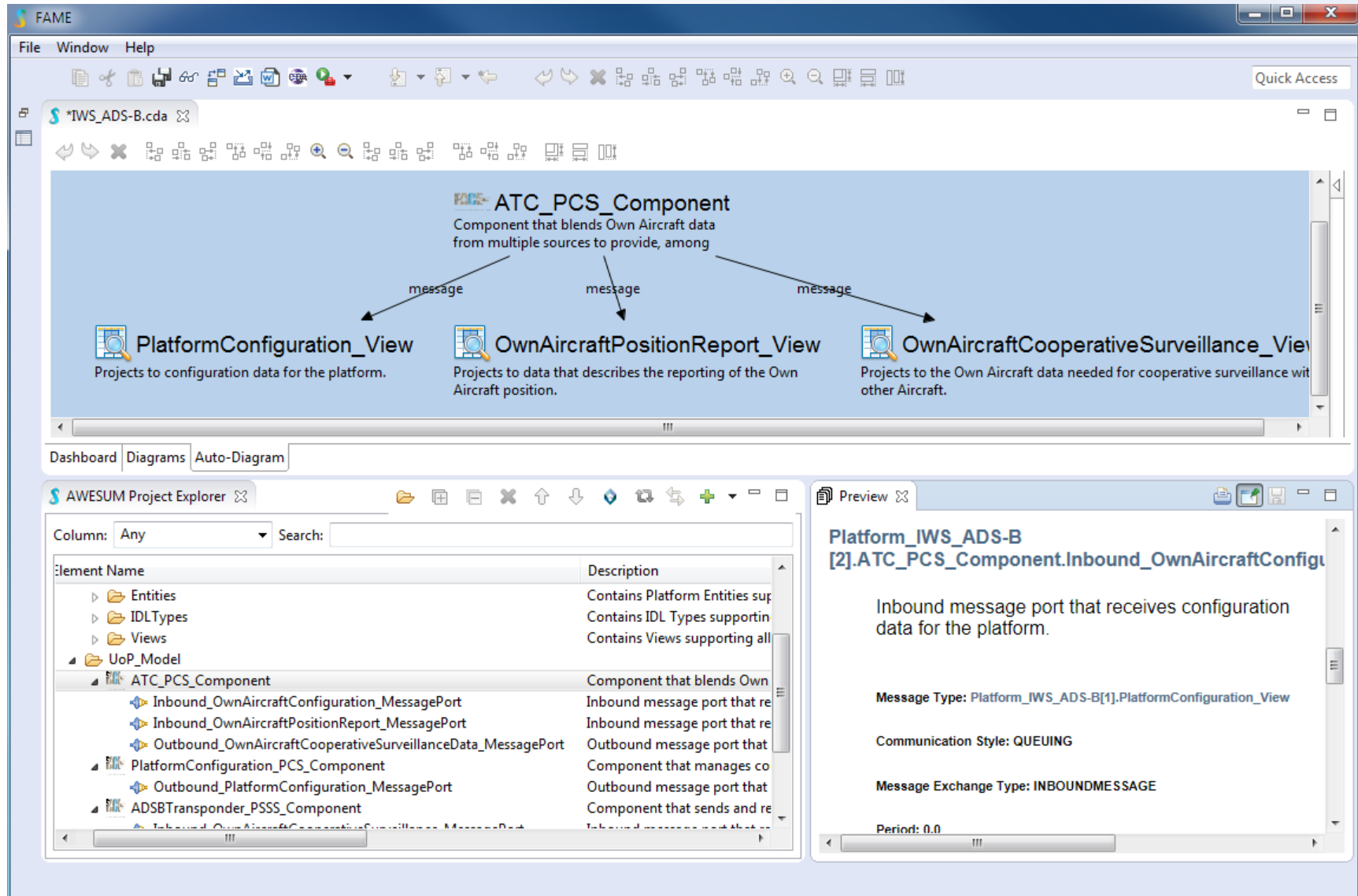


Platform Views





ATC UoP Model





- Conformance Fails in one area due to elements being added to the UoP Model
 - “[Warning]: SDM Conformance Error: Unallowable update of " (). The addition of '[Component Name]' ([Component Type]) modifies the existing Shared Data Model”
 - NOTE: We opened FACE Problem Report (ID #118) for this issue
- This data model shall evolve as the FACE IWS BALSAs fleshes-out



Questions



ADS-B Data Model Automatic Dependent Surveillance – Broadcast

TES-SAVi Training Package

Modeled using the TES-SAVi FAME tool suite
Version Alpha, dated February 2016



For additional Information

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