Airborne ARIA Event Data Schema

VERSION 3

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Contents

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1 Introduction

Airborne ARIA emits events in JSON format (see an example in Appendix A). Output Airborne ARIA events can be to sent to one (or more) of these targets:

- to disk
- to standard out
- to Kafka

1.1 Kafka Partitions

If JSON events are sent to Kafka, they are sent to a single Kafka topic (e.g. `ARIA_AIRBORNE_EVENTS`), but to **different partitions** of that topic. Airborne ARIA assigns each NOP Facility its own partition (within the event destination topic). E.g., all events for A80 will be sent to partition 1, all events for D10 will be sent to partition 45.

2 Data Schema

This section breaks down the fields in the JSON schema, beginning with top-level fields and moving down into nested fields.

2.1 Top-Level Airborne ARIA Event JSON Fields

These fields are at the top of the JSON schema. Some of these fields have nested sub-fields, the nested fields are described later.

Table 1: The top-level Airborne ARIA Event JSON Fields

Field	Nullable?	Example
uniqueId	NO	"3e13ce400cd5cd05ecf01fb7d2e4dcbe"
facility	NO	"SCT"
eventScore	NO	48.831343719532775
eventDate	NO	"2021-09-19"
eventEpochMsTime	NO	1632009648317
title	NO	"SCT–DAL335–N502SX"
latitude	NO	33.9370183364953
longitude	NO	-118.27507592566856
isInsideAirspace	NO	true
isNearTower	NO	true
closestTower	YES	See Section 3.1
timeToCpaInMilliSec	NO	-60002
atEventTime	NO	See Section 3.3
atEstimatedCpaTime	YES	See Section 3.2
atClosestLateral	NO	See Section 3.2
atClosestLateralWith1kVert	YES	See Section 3.2
atClosestVerticalWith3Nm	YES	See Section 3.2
atClosestVerticalWith5Nm	YES	See Section 3.2
isLevelOffEvent	NO	true
courseDelta	NO	1
conflictAngle	NO	"SAME"
aircraft_0	NO	See Section 3.4
aircraft_1	NO	See Section 3.4
schemaVersion	NO	"3"
airborneDynamics	NO	See Section 3.5

3 Top-Level Airborne ARIA Event JSON Field Definitions

The table below provides definitions for the fields within the Airborne ARIA event JSON data.

Top-Level Field	Definition
airborneDynamics	Contains the raw data to plot 6 different time series graphs
aircraft_0	A collection of data describing the 1st aircraft. See Section 3.4
aircraft_1	A collection of data describing the 2nd aircraft. See Section 3.4
atClosestLateral	This is an Airborne Dynamics Snapshot. See Section 3.2
atClosestLateralWith1kVert	This is an Airborne Dynamics Snapshot. See Section 3.2
atClosestVerticalWith3Nm	This is an Airborne Dynamics Snapshot. See Section 3.2
atClosestVerticalWith5Nm	This is an Airborne Dynamics Snapshot. See Section 3.2
atEstimatedCpaTime	This is an Airborne Dynamics Snapshot. See Section 3.2
atEventTime	This is an Airborne Dynamics Snapshot with Separation Predictions. See Section 3.3
conflictAngle	Derived from `courseDelta`. Will be `SAME`, `CROSSING`, `OPPOSITE`
courseDelta	The number of degrees between the heading of the two aircraft
closestTower	The field only appears when `isNearTower` is true. It provides the tower's three digit code and its type. Possible types are: `TRACON`, `CTT`, `TOWER`, and `CENTER`
eventDate	A UTC date for the event in the format "YYYY-MM-DD"
eventEpochMsTime	An unix epoch time for the event Unix Time
eventScore	The Airborne ARIA score for this event. Lower scores are riskier than higher scores.
facility	The NOP Data Feed from which this event was found. Note: this does **not** indicate which airspace the event occured in
isInsideAirspace	True or False: Is the event's (latitude, longitude, altitude) location inside the source facilitie's airspace. This field is currently used to deduplicate events that are detected within multiple NOP Facility data feeds (e.g. D10 and ZFW)
isLevelOffEvent	True or False: Are **all** of these contraints met: (1) One of the aircraft was flying level, (2) the other aircraft was climbing or descending towards the aircraft flying level, (3) the climbing/descending aircraft stopped short of the other aircraft and *leveled off*
isNearTower	True if an event occurs within a Tower's *Hockey Puck*. A tower's *Hockey Puck* is a cylinder with a 5 NM radius and a height of 3,000ft. **NOTE** These towers {DWH, FFZ, GPM, HEF, PWA} have had the height of their hockey puck's reduces to 2,000ft
latitude	The average latitude of the two aircraft involved in the encounter. This value is computed at the `eventEpochMsTime`
longitude	The average latitude of the two aircraft involved in the encounter. This value is computed at the `eventEpochMsTime`
timeToCpaInMilliSec	The estimated number of milliseconds until the two aircraft will arrive at their closest point of approach (CPA). This is computed by assuming both aircraft's current speed and direction will not change
title	A human readable title for an event that includes Facility, callsign 1, and callsign 2. If a callsign is not available the aircraft's beacon code will be used in its place. Example "SCT–DAL335–N502SX"
schemaVersion	A version number of the data
uniqueId	A universally unique identifier for an event (or track) computed by ARIA and assigned at creation time.

3.1 Closest Tower Field

The `closestTower` field may be missing. It only exists when `isNearTower` is `true`

Example:

```
"closestTower": {
  "airport": "HHR",
  "type": "TOWER"
}
```

3.2 Snapshots of Airborne Dynamics Taken at Arbitrary Time

A "Snapshot" is an extraction from `airborneDynamics` taken at a specific moment in time. Snapshots are only listed when the underlying data permits.

The snapshot fields are labeled:

- atEventTime
- atEstimatedCpaTime
- atClosestLateral
- atClosestLateralWith1kVert
- atClosestVerticalWith3Nm
- atClosestVerticalWith5Nm

Snapshots are extracted when:

- The minimum (i.e. riskiest) Airborne ARIA score is recorded (**always exists**)
- The estimated Closest Point of Approach occurs (**may not exist**)
- The Aircraft are at their closest lateral proximity (**always exists**)
- The Aircraft are at their closest lateral proximity AND vertical separation is 1,000 ft or less (**may not exist**)
- The Aircraft are at their closest vertical proximity AND lateral separation is 3 NM or less (**may not exist**)
- The Aircraft are at their closest vertical proximity AND lateral separation is 5 NM or less (**may not exist**)

Example


```
"atClosestLateral": {
  "timestamp": "2021-09-19T00:01:31.829Z",
  "epochMsTime": 1632009691829,
  "score": 53.483467355409665,
  "trueVerticalFt": 802.1219135802469,
  "trueLateralNm": 1.2715920589807321,
  "angleDelta": 4,
  "vertClosureRateFtPerMin": 1157.4074074074067,
  "lateralClosureRateKt": 12.691665845160934
}
```

3.3 Snapshot of Airborne Dynamics Taken at ARIA Event Time

This is the Snapshot that corresponds to the moment the Airborne ARIA event was recorded. It is a normal Snapshot with three extra fields: `estTimeToCpaMs`, `estVerticalAtCpaFt`, and `estLateralAtCpaNm`.

Example


```
"atEventTime": {
  "timestamp": "2021-09-19T00:00:48.317Z",
  "epochMsTime": 1632009648317,
  "score": 48.831343719532775,
  "trueVerticalFt": 898.0120812740251,
  "trueLateralNm": 1.4581844233095556,
  "angleDelta": 1,
  "vertClosureRateFtPerMin": 658.9785831960417,
  "lateralClosureRateKt": 19.799152987005236,
  "estTimeToCpaMs": 60002,
  "estVerticalAtCpaFt": 239.01153212521035,
  "estLateralAtCpaNm": 1.2826165850825844
}
```

3.4 Single Aircraft Description (`aircraft_N`)

An `aircraft_N` field extracts various pieces of information about one of the aircraft involved in an Airborne ARIA event.

Example


```
"aircraft_0": {
  "callsign": "DAL335",
  "uniqueId": "d25684e87a4897f39d3a5937f2cc42f6",
  "altitudeInFeet": 1898,
  "climbStatus": "DESCENDING",
  "speedInKnots": 170,
  "direction": "WEST",
  "course": 264,
  "beaconcode": "2015",
  "trackId": "1972",
  "aircraftType": "A321",
  "latitude": 33.94866717856433,
  "longitude": -118.27091266022427,
  "ifrVfrStatus": "IFR",
  "climbRateInFeetPerMin": -976,
  "aircraftClass": "FIXED_WING",
  "engineType": "JET",
  "pilotSystem": "MANNED",
  "isMilitary": "FALSE"
}
```

3.5 The `airborneDynamics` Field

The `airborneDynamics` field provides the raw data to plot 6 different time series graphs:

- ARIA Score vs time
- Vertical Separation vs time
- Lateral Separation vs time
- Estimated Time to Closest Point of Approach vs time
- Estimated Vertical Separation at predicted Closest Point of Approach vs time
- Estimated Lateral Separation at predicted Closest Point of Approach vs time

These time series graphs are valid when there is NOP data for both aircraft involved in the event. The "shared time values" (i.e. the x-coordinate of time-series graph) is provided by `epochMsTime`. The y-values in the graphs are provided by the other arrays

Example

```
"airborneDynamics": {
  "epochMsTime": [ array of numbers ],
  "trueVerticalFt": [ array of numbers ],
  "trueLateralNm": [ array of numbers ],
  "estTimeToCpaMs": [ array of numbers ],
  "estVerticalAtCpaFt": [array of numbers ],
  "estLateralAtCpaNm": [ array of numbers ],
  "score": [ array of numbers ]
}
```

Appendix A: Sample JSON Event

Below is an example of the JSON representation of an Airborne ARIA event.

Notice the `atEstimatedCpaTime` Snapshot is missing from this sample event because data for one of the aircraft was not available at the predicted CPA

```
{
  "uniqueId": "3e13ce400cd5cd05ecf01fb7d2e4dcbe",
  "facility": "SCT",
  "eventScore": 48.831343719532775,
  "eventDate": "2021-09-19",
  "eventTime": "00:00:48.317",
  "eventEpochMsTime": 1632009648317,
  "title": "SCT--DAL335--N502SX",
  "latitude": 33.9370183364953,
  "longitude": -118.27507592566856,
  "isInsideAirspace": true,
  "isNearTower": true,
  "closestTower": {
    "airport": "HHR",
    "type": "TOWER"
  },
  "timeToCpaInMilliSec": 60002,
  "atEventTime": {
    "timestamp": "2021-09-19T00:00:48.317Z",
    "epochMsTime": 1632009648317,
    "score": 48.831343719532775,
    "trueVerticalFt": 898.0120812740251,
    "trueLateralNm": 1.4581844233095556,
    "angleDelta": 1,
    "vertClosureRateFtPerMin": 658.9785831960417,
    "lateralClosureRateKt": 19.799152987005236,
    "estTimeToCpaMs": 60002,
    "estVerticalAtCpaFt": 239.01153212521035,
    "estLateralAtCpaNm": 1.2826165850825844
  },
  "atClosestLateral": {
    "timestamp": "2021-09-19T00:01:31.829Z",
    "epochMsTime": 1632009691829,
    "score": 53.483467355409665,
    "trueVerticalFt": 802.1219135802469,
    "trueLateralNm": 1.2715920589807321,
    "angleDelta": 4,
    "vertClosureRateFtPerMin": 1157.4074074074067,
    "lateralClosureRateKt": 12.691665845160934
  },
  "atClosestLateralWith1kVert": {
    "timestamp": "2021-09-19T00:01:31.829Z",
    "epochMsTime": 1632009691829,
    "score": 53.483467355409665,
    "trueVerticalFt": 802.1219135802469,
    "trueLateralNm": 1.2715920589807321,
    "angleDelta": 4,
```

```
    "vertClosureRateFtPerMin": 1157.4074074074067,
    "lateralClosureRateKt": 12.691665845160934
  },
  "atClosestVerticalWith3Nm": {
    "timestamp": "2021-09-19T00:01:31.829Z",
    "epochMsTime": 1632009691829,
    "score": 53.483467355409665,
    "trueVerticalFt": 802.1219135802469,
    "trueLateralNm": 1.2715920589807321,
    "angleDelta": 4,
    "vertClosureRateFtPerMin": 1157.4074074074067,
    "lateralClosureRateKt": 12.691665845160934
  },
  "atClosestVerticalWith5Nm": {
    "timestamp": "2021-09-19T00:01:31.829Z",
    "epochMsTime": 1632009691829,
    "score": 53.483467355409665,
    "trueVerticalFt": 802.1219135802469,
    "trueLateralNm": 1.2715920589807321,
    "angleDelta": 4,
    "vertClosureRateFtPerMin": 1157.4074074074067,
    "lateralClosureRateKt": 12.691665845160934
  },
  "isLevelOffEvent": false,
  "courseDelta": 1,
  "conflictAngle": "SAME",
  "aircraft_0": {
    "callsign": "DAL335",
    "uniqueId": "d25684e87a4897f39d3a5937f2cc42f6",
    "altitudeInFeet": 1898,
    "climbStatus": "DESCENDING",
    "speedInKnots": 170,
    "direction": "WEST",
    "course": 264,
    "beaconcode": "2015",
    "trackId": "1972",
    "aircraftType": "A321",
    "latitude": 33.94866717856433,
    "longitude": -118.27091266022427,
    "ifrVfrStatus": "IFR",
    "climbRateInFeetPerMin": -976,
    "aircraftClass": "FIXED_WING",
    "engineType": "JET",
    "pilotSystem": "MANNED",
    "isMilitary": "FALSE"
  },
  "aircraft_1": {
    "callsign": "N502SX",
    "uniqueId": "6f6906ab0fb792da80a68d772bd05659",
    "altitudeInFeet": 1000,
    "climbStatus": "DESCENDING",
    "speedInKnots": 129,
    "direction": "WEST",
    "course": 266,
```

```
    "beaconcode": "1066",
    "trackId": "1238",
    "aircraftType": "GLF5",
    "latitude": 33.92536949442626,
    "longitude": -118.27923919111285,
    "ifrVfrStatus": "IFR",
    "climbRateInFeetPerMin": -402,
    "aircraftClass": "FIXED_WING",
    "engineType": "JET",
    "pilotSystem": "MANNED",
    "isMilitary": "FALSE"
  },
  "schemaVersion": "3",
  "airborneDynamics": {
    "epochMsTime": [ array of numbers ],
    "trueVerticalFt": [ array of numbers ],
    "trueLateralNm": [ array of numbers ],
    "estTimeToCpaMs": [ array of numbers ],
    "estVerticalAtCpaFt": [array of numbers ],
    "estLateralAtCpaNm": [ array of numbers ],
    "score": [ array of numbers ]
  }
}
```
