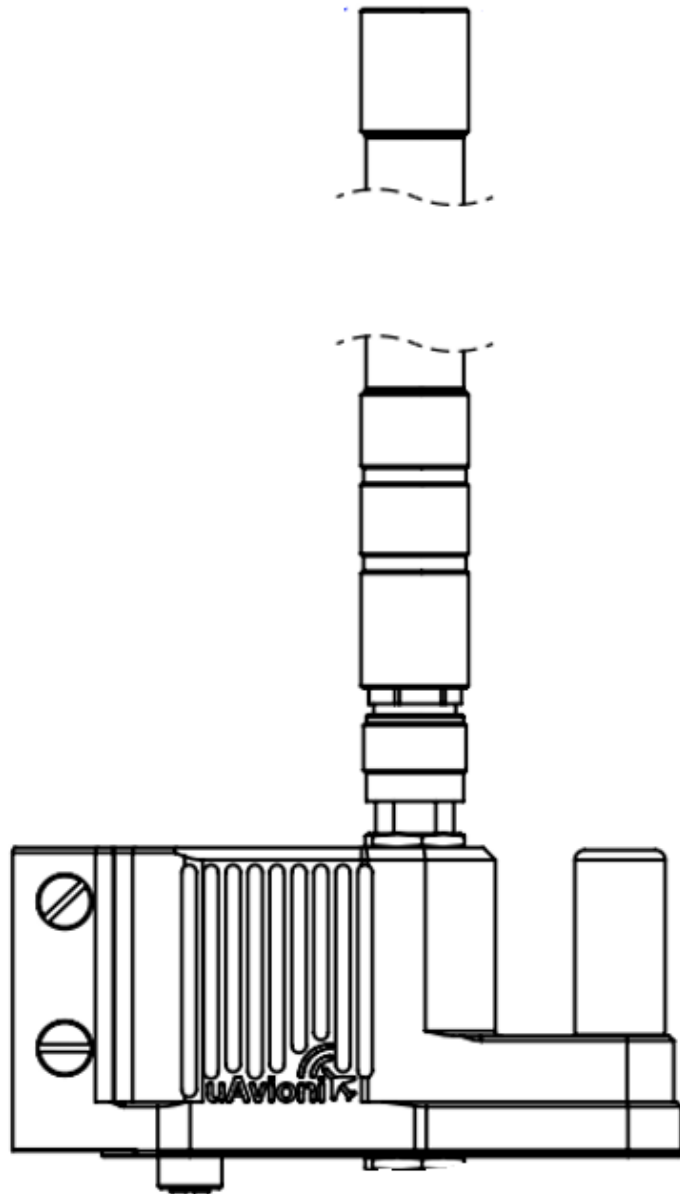




**pingStation 3
ICD
Rev E**



1 Overview

pingStation is an environmentally protected, networked dual-link ADS-B receiver. It can be configured for use in both internet connected and disconnected environments, and provides an extensible platform for collecting and processing surveillance data.

A single Ethernet port provides data connectivity and power to the device using Power-over-Ethernet (PoE). The device contains a DHCP client, and accepts DHCP leases based on existing network policy. To determine the assigned device address please consult your network administrator.

Surveillance data may be consumed using the methods detailed here.

2 Data Class

Data is received by pingStation and undergoes processing. The received aircraft data is parsed and assembled, it may contain information derived from a number of packets. This information may be JSON, CompressedVRS or ASTERIX CAT021 formatted and is stateless and fully self-describing.

2.1 JSON Traffic object

The pingStation delivers fields in the traffic table that are valid where field validity can be determined. This includes coordinates, altitude, heading, velocity, callsign, squawk, vertical velocity, and barometer difference. The JSON array of fields are dynamic.

The JSON document consists of an array of aircraft containing the following fields:

Field Name	Data Type	Description
icaoAddress	%02X%02X%02X	ICAO of the aircraft
trafficSource	%d	0 = 1090ES 1 = UAT
latDD	%f	Latitude expressed as decimal degrees
lonDD	%f	Longitude expressed as decimal degrees
altitudeMM	%ld	Geometric altitude or barometric pressure altitude in millimeters
headingDE2	%d	Course over ground in centi-degrees
horVelocityCMS	%lu	Horizontal velocity in centimeters/sec
verVelocityCMS	%ld	Vertical velocity in centimeters/sec with positive being up
squawk	%d	Squawk code
altitudeType	%d	Altitude Source 0 = Pressure

		1 = Geometric
Callsign	%c%c%c%c %c%c%c%c	Callsign
emitterType	%d	Category type of the emitter 0 = No aircraft type information 1 = Light (ICAO) < 15,500 lbs 2 = Small - 15,500 to 75,000 lbs 3 = Large - 75,000 to 300,000 lbs 4 = High Vortex Large (e.g., B757) 5 = Heavy (ICAO) - > 300,000 lbs 6 = Highly Maneuverable > 5G acceleration and high speed 7 = Rotorcraft 8 = (Unassigned) 9 = Glider/sailplane 10 = Lighter than air 11 = Parachutist/sky diver 12 = Ultralight/hang glider/paraglider 13 = (Unassigned) 14 = Unmanned aerial vehicle 15 = Space/trans-atmospheric vehicle 16 = (Unassigned) 17 = Surface vehicle-emergency vehicle 18 = Surface vehicle-service vehicle 19 = Point Obstacle (includes tethered balloons) 20 = Cluster Obstacle 21 = Line Obstacle 22-39 = (Reserved)
sequenceNumber	%d	Auto incrementing packet sequence number
pingStationGuid	%02x%02x%02x%02x %02x%02x%02x%02x	Unique pingStation identifier
utcSync	%d	UTC time flag
timeStamp	%s	Time packet was processed on the pingStation ISO 8601 format: YYYY-MM-DDTHH:mm:ss:ffffffZ
timeOfReceptionS	%lu	Raw GPS second counter that the pingStation was in when the ADSB packet was delivered.
timeOfReceptionNS	%lu	The number of nanoseconds into the current GPS PPS pulse that the packet was received.

A field called “detail” may be present containing the following data:

Field Name	Data Type	Description
Common Fields to 1090ES and UAT		
navIntegrity	%d	Navigation integrity category (NIC) 0 = RC >=37.04 km (20 NM) Unknown Integrity 1 = RC < 37.04 km (20 NM) RNP-10 containment radius 2 = RC < 14.816 km (8 NM) RNP-4 containment radius 3 = RC < 7.408 km (4 NM) RNP-2 containment radius 4 = RC < 3.704 km (2 NM) RNP-1 containment radius 5 = RC < 1852 m (1 NM) RNP-0.5 containment radius 6 = RC < 1111.2 m (0.6 NM) RNP-0.3 containment radius 7 = RC < 370.4 m (0.2 NM) RNP-0.1 containment radius 8 = RC < 185.2 m (0.1 NM) RNP-0.05 containment radius 9 = RC < 75 m and VPL < 112 m e.g., SBAS, HPL, VPL 10 = RC < 25 m and VPL < 37.5 m e.g., SBAS, HPL, VPL 11 = RC < 7.5 m and VPL < 11 m e.g., GBAS, HPL, VPL 12 = (Reserved) (Reserved) 13 = (Reserved) (Reserved) 14 = (Reserved) (Reserved) 15 = (Reserved) (Reserved)
navAccuracy	%d	Navigation accuracy category (NACv) 0 = Unknown or >= 10 m/s Unknown >= 50 feet (15.24 m) per second 1 = < 10 m/s < 50 feet (15.24 m) per second 2 = < 3 m/s < 15 feet (4.57 m) per second 3 = < 1 m/s < 5 feet (1.52 m) per second 4 = < 0.3 m/s < 1.5 feet (0.46 m) per second 5 = (Reserved) (Reserved) 6 = (Reserved) (Reserved) 7 = (Reserved) (Reserved)
verVelocitySrc	%d	Vertical velocity source 0 = Pressure 1 = Geometric
emergencyStatus	%d	Emergency status 0 = No-Emergency 1 = General Emergency 2 = Lifeguard/Medical 3 = Min Fuel 4 = No Comm 5 = Unlawful Interference 6 = Downed Aircraft
sysIntegrityLevel	%d	Source Integrity Level (SIL) - indicates the probability of the reported horizontal position exceeding the containment radius defined by the NIC
sysDesignAssurance	%d	System Design Assurance (SDA) – indicated the probability of an ADS-B system malfunction causing false or misleading position
airGroundState	%d	Airborne or ground 0 = Airborne subsonic condition

		1 = Airborne supersonic condition 2 = On ground condition
svHeadingType	%d	Track angle from heading 0 = True Track Angle 1 = Heading
verticalVelType	%d	Vertical rate information 0 = Pressure 1 = Geometric
navPositionAccuracy	%d	The reported State Vector has sufficient position accuracy for the intended use (NACp) 0 = EPU >= 18.52 km (10 NM) 1 = EPU < 18.52 km (10 NM) 2 = EPU < 7.408 km (4 NM) 3 = EPU < 3.704 km (2 NM) 4 = EPU < 1852 m (1NM) 5 = EPU < 926 m (0.5 NM) 6 = EPU < 555.6 m (0.3 NM) 7 = EPU < 185.2 m (0.1 NM) 8 = EPU < 92.6 m (0.05 NM) 9 = EPU < 30 m and VEPU < 45 10 = EPU < 10 m and VEPU < 15 11 = EPU < 3 m and VEPU < 4 m 12 = (Reserved) 13 = (Reserved) 14 = (Reserved) 15 = (Reserved)
navVelocityAccuracy	%d	The least accurate velocity component being transmitted (NACv) 0 = Unknown or >= 10 m/s Unknown or >= 50 feet (15.24 m) per second 1 = < 10 m/s < 50 feet (15.24 m) per second 2 = < 3 m/s < 15 feet (4.57 m) per second 3 = < 1 m/s < 5 feet (1.52 m) per second 4 = < 0.3 m/s < 1.5 feet (0.46 m) per second 5 = (Reserved) (Reserved) 6 = (Reserved) (Reserved) 7 = (Reserved) (Reserved)
navIntegrityBaro	%d	Barometer checked (NICbaro) 0 = Barometric Pressure Altitude has NOT been cross checked 1 = Barometric Pressure Altitude has been cross checked
geoVerticalAccuracy	%d	Geometric Vertical Accuracy (GVA) 0 Unknown or > 150 meters 1 ≤ 150 meters 2 ≤ 45 meter
tcasAcasOperating	%d	Aircraft is fitted with a TCAS (ACAS) computer and that computer is turned on and operating in a mode that can generate Resolution Advisory (RA) alerts
tcasAcasAdvisory	%d	TCAS II or ACAS computer is currently issuing a Resolution Advisory
identSwActive	%d	Ident switch is activated
atcServicesRecvd	%d	ATC pilot message mode setting 0 = Not receiving ATC messages

		1 = Receiving ATC messages
magHeading	%d	True north or magnetic north 0 = True north 1 = Magnetic north
utcCoupledCondition	%d	Represents if the Ground Station is UTC-Coupled 0 = Ground Station is not UTC coupled 1 = Ground Station is UTC coupled
1090ES Specific Fields		
surveilStatus	%d	Surveillance status 0 = No Condition 1 = permanent alert 2 = temp alert 3 = SPI
baroaltDiffMM	%ld	Difference between the pressure altitude and the gnss altitude in mm
addressQualifier	%d	Defines the type of target that delivered the data 0 = ADS-B target with ICAO 24-bit 1 = Reserved for National use 2 = TIS-B target with ICAO 24-bit address 3 = TIS-B target with track file identifier 4 = Surface Vehicle 5 = Fixed ADS-B Beacon 6 = (Reserved) 7 = (Reserved)
1090esMopsVersion	%d	1 = DO-260A 2 = DO-260B
rawData	%x	Defines the 112 bit/14 byte raw 1090 long ADSB packet MSB
UAT Specific Fields		
secondaryAltType	%d	Altitude source 0 = Pressure 1 = Geometric
secondaryAltitudeMM	%ld	Geometric altitude or barometric pressure altitude in millimeters
tisBSiteld	%d	The tisBSiteld is unit-less and is from the a transmitted TISb UAT message signifies which uplink tower transmitted the TISb frame
transmitMSO	&d	the transmitMSO is the 6bit field from the transmitted UAT message which should signify which MSO the message was transmitted in. MSO's can range from 0 to 3951 but only transmit the 6 LSB's of the actual MSO if transmitted. Received range is from 0 - 63.
addressQualifier	%d	Defines the type of target that delivered the data 0 = ADS-B target with ICAO 24-bit 1 = Reserved for National use 2 = TIS-B target with ICAO 24-bit address 3 = TIS-B target with track file identifier 4 = Surface Vehicle 5 = Fixed ADS-B Beacon 6 = (Reserved) 7 = (Reserved)
uatMopsVersion	%d	1 = DO-282A

Reference Number (FRN) in the associated User Application Profile (UAP) and transmitted in the following layout within the Data Block:

CAT = 021	LEN	FSPEC	Items of the first record		FSPEC	Items of the last record
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where:

- “CAT = 021,” or the Data Category, is a one-octet field indicating that the Data Block contains ADS-B reports;
- “LEN,” or the Length Indicator, is a two-octet field indicating the total length in octets of the Data Block, including the CAT and LEN fields;
- and “FSPEC” is the Field Specification, which is a field of up to seven octets which indicates which Data Items are to be transmitted in a record, with the presence of a Data Item indicated by having its corresponding FSPEC bit set to ‘1’.

Of the fields specified by CAT021, pingStation3 uses the subset defined below. The transmission of each field depends on the availability of valid data to populate that field as received by the pingStation3.

FRN	Data Item	Information
1	I021/010	Data Source Identification
2	I021/040	Target Report Descriptor
6	I021/130	Position in WGS-84 co-ordinates
7	I021/131	Position in WGS-84 co-ordinates, high res.
9	I021/150	Air Speed
10	I021/151	True Air Speed
11	I021/080	Target Address
12	I021/073	Time of Message Reception of Position
14	I021/075	Time of Message Reception of Velocity
16	I021/140	Geometric Height
17	I021/090	Quality Indicators
18	I021/210	MOPS Version
19	I021/070	Mode 3/A Code
21	I021/145	Flight Level
22	I021/152	Magnetic Heading

23	I021/200	Target Status
24	I021/155	Barometric Vertical Rate
25	I021/157	Geometric Vertical Rate
26	I021/160	Airborne Ground Vector
28	I021/077	Time of Report Transmission
29	I021/170	Target Identification
30	I021/020	Emitter Category
36	I021/008	Aircraft Operational Status

3 Protocols

3.1 UDP

The pingStation JSON and ASTERIX CAT021 data can be delivered as UDP to a specified host IP address and port number. The UDP destination and port number can be entered using the webpage interface at <http://nnn.nnn.nnn.nnn/>. As aircraft data is received into the pingStation, it is timestamped and formatted before being pushed to the UDP listener. Each UDP datagram contains a single aircraft update. The aircraft JSON data will contain the optional “detail” object. Data will be continually streamed out to the UDP listener as aircraft updates arrive. Every 30 seconds a JSON status object will be delivered if the pingStation is configured to send JSON over UDP. The data is dynamic in that only valid fields will be formatted and sent on to the UDP host.

To disable UDP send functionality, enter an IP address of 0.0.0.0 on the configuration webpage at <http://nnn.nnn.nnn.nnn/>.

3.2 TCP

The pingStation CompressedVRS and ASTERIX CAT021 data can be delivered as TCP to a specified host IP address and port number. The TCP destination and port number can be entered using the webpage interface at <http://nnn.nnn.nnn.nnn/>. As aircraft data is received into the pingStation, it is timestamped and formatted before being pushed to the TCP listener. Each TCP payload contains a single aircraft update.

To disable TCP send functionality, enter an IP address of 0.0.0.0 on the configuration webpage at <http://nnn.nnn.nnn.nnn/>.

3.3 REST

The pingStation data can be accessed in a basic pull model using the REST protocol which will return the JSON formatted data. Data can be accessed by using the GET method to the pingStation URL (nnn.nnn.nnn.nnn).

The pingStation base URL is:

<http://nnn.nnn.nnn.nnn/api/v1/>

Example resource path are:

<http://nnn.nnn.nnn.nnn/api/v1/traffic>

<http://nnn.nnn.nnn.nnn/api/v1/status>

No GET query strings are currently supported to limit returned data sets.

4 JSON Example Sentences

4.1 Traffic Object

```
{
  "aircraft": [
    {
      "icaoAddress": "C00586",
      "trafficSource": 0,
      "latDD": 42.132614,
      "lonDD": -93.007891,
      "altitudeMM": 10370820,
      "headingDE2": 26330,
      "horVelocityCMS": 21143,
      "verVelocityCMS": 0,
      "squawk": 1305,
      "altitudeType": 0,
      "callsign": "CJT340",
      "emitterType": 5,
      "sequenceNumber": 81223,
      "pingStationGuid": "754104714b10e9a6",
      "utcSync": 1,
      "timeStamp": "2022-12-13T21:11:32Z",
      "timeOfReceptionS": 1355001092,
      "timeOfReceptionNS": "317283895",
      "detail": {
        "navIntegrity": 8,
        "navAccuracy": 1,
        "verVelocitySrc": 1,
        "emergencyStatus": 0,
        "surveilStatus": 0,
        "baroaltDiffMM": -30480,
        "1090esMopsVersion": 2,
        "sysIntegrityLevel": 3,
        "sysDesignAssurance": 2,
        "airGroundState": 0,
        "svHeadingType": 0,
        "verticalVelType": 1,
        "navPositionAccuracy": 9,
        "navVelocityAccuracy": 1,
        "navIntegrityBaro": 1,
        "geoVerticalAccuracy": 2,
        "tcasAcasOperating": 1,
        "tcasAcasAdvisory": 0,
        "identSwActive": 0,
        "magHeading": 0,
        "utcCoupledCondition": 0,
        "rawData": "8dc0058658af979ecbc80d0c3c70"
      }
    }
  ]
}
```

4.2 Status Object

```
{
  "status": {
    "pingStationGuid": "754104714b10828b",
    "pingStationVersionMajor": 1,
    "pingStationVersionMinor": 0,
    "pingStationVersionBuild": 0,
    "timeStamp": "2020-11-23T23:02:22.3725496Z",
    "pingStationLatDD": 48.088375,
    "pingStationLonDD": -114.091881,
    "pingStationAltType": 1,
    "pingStationAltMM": 946700,
    "gpsStatus": 4,
    "receiverStatus": 0
  }
}
```

5 ASTERIX CAT021 Example Packet

```

▼ ASTERIX packet, Category 021
  Category: 21
  Length: 53
  ▼ Asterix message, #01, length: 50
    FSPEC
    > 010, Data Source Identification
    > 040, Target Report Descriptor
    > 130, Position in WGS-84 Co-ordinates
    ▼ 131, High-Resolution Position in WGS-84 Co-ordinates
      Latitude [deg]: 39.933280851692
      Longitude [deg]: -88.3812030404806
    ▼ 080, Target Address
      Aircraft Address: 0xa6452d
    ▼ 090, Quality Indicators
      010. .... = NUCr or NACv: 2
      ...1 000. = NUCp or NIC: 8
      .... ...1 = FX: Extension into next extent (1)
      1... .... = NIC BARO: 1
      .11. .... = SIL: 3
      ...1 010. = NACP: 10
      .... ...1 = FX: Extension into next extent (1)
      ..0. .... = SILS: Measured per flight-hour (0)
      ...1 1... = SDA: 3
      .... .10. = GVA: 2
      .... ...0 = FX: End of data item (0)
    > 210, MOPS Version
    ▼ 070, Mode 3/A Code in Octal Representation
      .... 0100 0000 0001 = SQUAWK: 02001
    ▼ 145, Flight Level
      FL: 390.25
    > 200, Target Status
    > 155, Barometric Vertical Rate
    > 160, Airborne Ground Vector
    ▼ 170, Target Identification
      Aircraft Identification: ATN3597
    > 020, Emitter Category
    > 008, Aircraft Operational Status

```