

Advanced Ionospheric Model (AIM) ICD

Version 3.0

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Revisions

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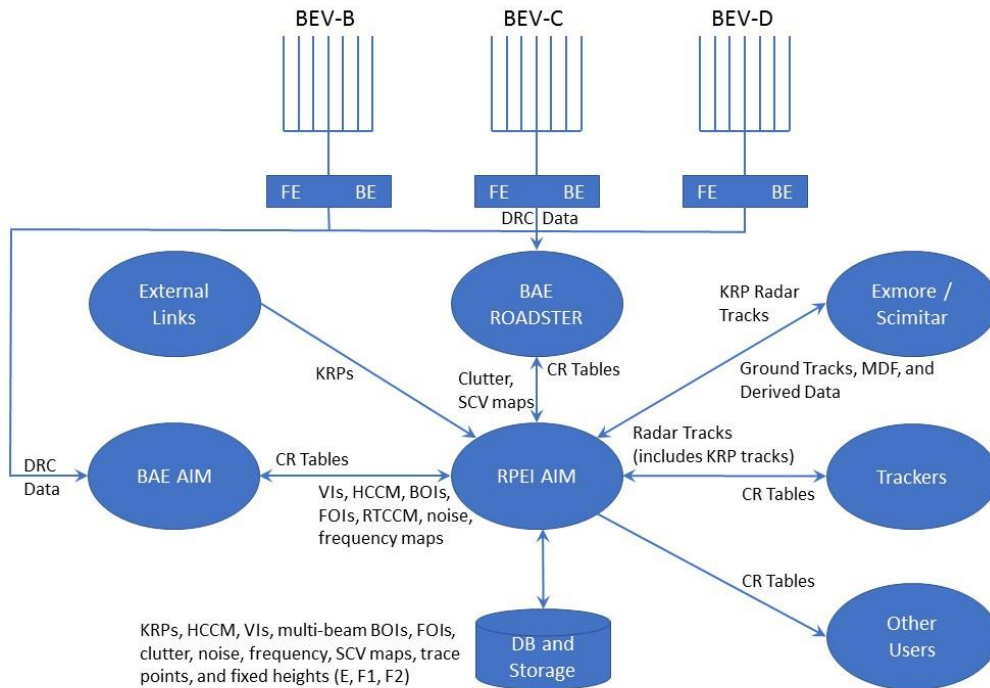
References

1. Real-time RPEI Prototype ICD, MIT/LL, 2017 Sep 11

Open Issues

Introduction

This document describes the interfaces to the RPEI Advanced Ionospheric Model (AIM). Figure 1 presents a high-level view of these interfaces.



(U) Figure 1 - RPEI AIM Interfaces

This document describes two versions of the interface: a streaming interface used for real-time processing and a file-based interface used for offline processing.

Types of information transferred

As shown in Figure 1, RPEI AIM interfaces with the BAE AIM, External Links, BAE ROADSTER, Exmore, Scimitar, Trackers, and other users. The formats for each data type are described within this document.

Interface Protocol

The interfaces to RPEI AIM will incorporate the RTI Data Distribution Service (DDS) to publish and subscribe to topics and data types. For new development such as BAE AIM and ROADSTER, DDS will be incorporated into the application. For legacy systems such as Exmore, and Scimitar the team will develop a DDS process within these systems that converts legacy messages to/from DDS.

BAE AIM

The BAE AIM system will publish the following DDS topics to RPEI AIM:

- Online Sounder Data - The VI, beam formed backscatter, or forward scatter oblique sounder data consisting of time delay as a function of frequency and as a function of angle.
- Online RTCCM Data – The RTCCM data.

- Online HCCM Data – The Historical CCM data.
- Online Beam Formed Noise Map – The beam formed RTCCM data consisting of noise levels as a function of angle for a specified time in KMZ format.
- Online Beam Formed Frequency Map – The beam formed RTCCM data consisting of power vs frequency as a function of angle for a specified time in KMZ format.
- Offline Sounder Data - The VI, beam formed backscatter, or forward scatter oblique sounder data consisting of time delay as a function of frequency and as a function of angle for import into a Scimitar ADS.

Sounder Data Requests

Sounder data is taken on a regular schedule. At any given time, each antenna array is collecting a BOI sounding, collecting a FOI sounding, or waiting for the next collection to start. A schedule file on the system indicates exactly when each sounder collection starts and which receivers it uses. The VI soundings are received by the legacy delta antenna and are not beam-formed. The BOI/FOI soundings are received by several elements and are beam-formed into a small number of beams referred to as “sectors”. The number of beams to be produced by the beamforming operation and their values will be defined in a configuration file on the system. In addition to the beam values specified in the configuration file, the RPEI system will produce an additional beam whose azimuth is specified by the operator.

The BOI soundings are collected from one of two transmitting antennas while the FOI soundings are collected from a down range transponder that supports the FOI capability. The RPEI software will determine which sounder transmitting antenna to use for the BOIs by looking at the requested azimuth value (i.e. OI north for azimuths ≤ 72 degrees, OI south for azimuths > 72 degrees).

The number of frequencies, frequency increment, number of delays and delay increment are set in a configuration file. For the first release the values are set to be compatible with Scimitar:

- Frequencies go from 8 MHz and ending with 35 MHz in 20 kHz steps, for a total of 1350 frequencies for OIs.
- Time delays should correspond to ranges of 0 to 12000 km for a total of 1600 delays for OIs. (range = delay/speed of light)
- These will be different for the VIs (i.e. frequency range will be 1 MHz to 16 MHz in 20 kHz steps).

There are two methods of transferring sounder data – Online transfer and offline transfer. For online transfer the client will subscribe for a data stream containing data from the sounder being collected currently. For offline processing, the user can convert raw DRC sounder data into a form which can be read in by Scimitar.

Sounder Scheduling

Sounder transmissions happen on a fixed schedule, with the time between successive sounders being 5 minutes. The current implementation uses a schedule file to indicate when soundings are scheduled to start. When the client subscribes for the next online sounding, the BAE AIM software will wait until the next sounding is scheduled and publish this to the client.

Online Sounder Processing

In online processing the following workflow will occur:

- 1) The client will subscribe to online soundings.
- 2) The client will receive the next online sounding based on the sounder schedule.

Online Sounder Data

This command will subscribe to RPEI BOI, FOI, and VI soundings.

DDS Participant: RPEI AIM subscribe to Online Sounding Data from BAE AIM

DDS Topic: OnlineSoundingOpRequest

DDS Data Type: OnlineSoundingOpRequest

The OnlineSoundingOpRequest subscription response will contain the following information:

| Parameter | Type | Notes |
|-------------------------|-------------------------|---|
| OnlineSoundingOpRequest | uint64 | OnlineSounding Op Request reference |
| Start Frequency | float | MHz |
| Stop Frequency | float | MHz |
| Ion Type | enum | 0=VI, 1=BOI, 2=FOI |
| Sounder transmitter | enum | North, South, VI, Transponder |
| Transponder id | String[25] | Name of transponder (FOI only) |
| Bev | enum | B,C,D (OI, FOI only) |
| Elements | long array[64] octet | Absolute elements used to capture the sounding (OI, FOI only) |
| Start Time | uint64 | msecs start time since Jan 1 1970 |
| Stop Time | uint64 | msecs start time since Jan 1 1970 |
| Min dBm value | float | Smallest dB value in spectral data |
| Max dBm value | float | Largest dB value in spectral data |
| Beamwidth | float | Sounding beamwidth (8 degrees) (OI only) |

| Parameter | Type | Notes |
|--------------------|------------------------------------|--|
| Azimuth | float | Azimuth (center beam) of the sounding, (OI only) |
| Freq Resolution x | float | Frequency step size (i.e. 20kHz) |
| Range Resolution y | float | Range step size (i.e. 7.5km) |
| Number of Values | long | The number of sounder values being returned |
| Sounder data | float array[freq, range] vector | The sounder data power values in dB. These will be organized into sweeps for a specific frequency for all ranges in that sweep |

Online RTCCM Data

This command will subscribe to online RTCCM data.

DDS Participant: RPEI AIM subscribe to online RTCCM data from BAE AIM

DDS Topic: RTCCMOpRequest

DDS Data Type: RTCCMOpRequest

The following input parameters must be specified with the RTCCMOpRequest:

| Paramater | Type | Notes |
|------------------|--------|----------------------------|
| RTCCMOpRequest | uint64 | RTCCM Op Request reference |
| Centre frequency | float | 8-25 MHz |
| Bandwidth | float | 1-2.5MHz, 100kHz |
| Azimuth | float | 0-359 degrees |
| Beamwidth | float | 1-359 degrees |

The RTCCMOpRequest subscription response will contain the following information and will be received every 2.5 seconds:

| Parameter | Type | Notes |
|----------------------|---------------------------------------|---|
| RTCCMOpRequest | uint64 | RTCCM Op Request reference |
| Centre frequency | float | 8-35 MHz |
| Azimuth Beamwidth | float | 1 - 359 degrees |
| Bandwidth | float | 1-2.5MHz, 100kHz |
| Num samples | uint64 | |
| Frequency bin size | float | Frequency per Bin |
| Power_dBm | float array[num_samples] vector | This is the RTCCM data |
| Min dBm value | float | Smallest power |
| Max dBm value | float | Largest power |
| Bev | enum | B,C,D |
| Time Generated | uint64 | msecs since Jan 1, 1970 when the RTCCM data was collected |
| Elements | long | Number of elements used to collect the RTCCM data |

Online HCCM Data

This command will subscribe to the online HCCM data.

DDS Participant: RPEI AIM subscribes to Online HCCM Data from BAE AIM

DDS Topic: HCCMOpRequest

DDS Data Type: HCCMOpRequest

The HCCMOpRequest subscription response will contain the following information and will be received every 2.5 seconds:

| Parameter | Type | Notes |
|-----------------|--------------------------------------|--|
| HCCMOpRequest | uint64 | HCCM Op Request reference |
| Start Frequency | ulong (Hz) | The starting frequency in Hz. |
| End Frequency | ulong (Hz) | The ending frequency in Hz. |
| Num samples | long | Number of HCCM samples |
| Power_dBm | long array[num_samples] vector | This is the HCCM data. A scaled value in dBm * 100 (e.g. 123 represents 1.23dBm). The data stream will contain Data Bytes/2 samples per block |
| Time Generated | uint64 | msecs since Jan 1, 1970 when the HCCM data was collected |

Online Beam Formed Noise Map

This command will subscribe to the online beam formed noise map.

DDS Participant: RPEI AIM subscribes to Online Noise Map from BAE AIM

DDS Topic: RTCCMOpRequest

DDS Data Type: RTCCMOpRequest

The noise map is comprised of the beam formed RTCCM data consisting of noise levels as a function of angle for a specified time in KMZ format. The noise map will appear as a geospatial overlay of power versus angle regardless of ground range i.e. entire “finger beam” will be displayed in one color representing the average power from a specific azimuth. These maps are published at the same time the RTCCM data is published and uses the same parameters from the associated RTCCM request.

The RTCCMOpRequest subscription response will contain the following information and will be received every minute:

| Parameter | Type | Notes |
|----------------------|--|---|
| RTCCMOpRequest | uint64 | RTCCM Op Request reference |
| Bev | enum | B,C,D |
| Number of KMZ values | long | The number of bytes being returned for the KMZ |
| Noise map | byte data[Number of KMZ values] octet | The KMZ data corresponding to the noise map |
| Time Generated | uint64 | msecs since Jan 1, 1970 when the map was generated |
| Elements | long | Number of elements used to collect the noise map data |
| Frequency | float | Center frequency |
| Beamwidth | float | Beamwidth used for beam forming |

Online Beam Formed Frequency Map

This command subscribes to the online beam formed frequency map.

DDS Participant: RPEI AIM subscribes to Online Frequency Map from BAE AIM

DDS Topic: FreqMapOpRequest

DDS Data Type: FreqMapOpRequest

The frequency map is comprised of the beam formed OI sounding data consisting of power vs frequency as a function of angle for a specified time in KMZ format. The frequency map is a KMZ file consisting of color coded frequency (with color intensity for return power) with the highest power (after removing spurious emitters) for a specific range and azimuth. The frequency map will be provided for each active transmitter every 5 minutes.

The Online Frequency Map subscription response will contain the following information and will be received every 5 minutes:

| Parameter | Type | Notes |
|----------------------|--|--|
| FreqMapOpRequest | uint64 | FreqMap Op Request reference |
| Bev | enum | B,C,D |
| Number of KMZ values | long | The number of bytes being returned for the KMZ |
| frequency map | byte data[Number of KMZ values] octet | The KMZ data corresponding to the frequency map |
| Time Generated | uint64 | msecs since Jan 1, 1970 when the map was generated |
| Elements | long array[64] octet | Absolute elements used to capture the soundings used to generate the frequency map |

Offline Sounder Data

This command will request RPEI beam formed BOI, FOI, and non-beam formed VI soundings.

DDS Participant: RPEI AIM request Offline Sounding Data from BAE AIM

DDS Topic: OfflineSoundingOpRequest

DDS Data Type: OfflineSoundingOpRequest

The following input parameters must be specified with this request:

| Parameter | Type | Notes |
|---------------------------|--------|--------------------------------------|
| OfflineSoundingOp Request | uint64 | OfflineSounding Op Request reference |
| Start Time | uint64 | msecs since Jan 1 1970 |
| Stop Time | uint64 | msecs since Jan 1 1970 |

| Parameter | Type | Notes |
|-----------|-------|-------------------------------|
| Ion Type | enum | 0=VI, 1=BOI, 2=FOI |
| Azimuth | float | 0 – 359 degrees BOI, FOI only |
| Beamwidth | float | 1 - 359 degrees BOI, FOI only |

The following represents the offline sounding data format:

| Parameter | Type | Notes |
|--------------------------|-------------------------|---|
| OfflineSoundingOpRequest | uint64 | OfflineSounding Op Request reference |
| Start Frequency | float | MHz |
| Stop Frequency | float | MHz |
| Ion Type | enum | 0=VI, 1=BOI, 2=FOI |
| Sounder transmitter | enum | North, South, VI, Transponder |
| Transponder id | String[25] | Name of transponder (FOI only) |
| Bev | enum | B,C,D (OI, FOI only) |
| Elements | long array[64] octet | Absolute elements used to capture the sounding (OI, FOI only) |
| Start Time | uint64 | msecs start time since Jan 1 1970 |
| Stop Time | uint64 | msecs start time since Jan 1 1970 |
| Min dBm value | float | Smallest dB value in spectral data |
| Max dBm value | float | Largest dB value in spectral data |
| Beamwidth | float | Sounding beamwidth (8 degrees) (OI only) |
| Azimuth | float | Azimuth (center beam) of the sounding, (OI only) |
| Freq Resolution x | float | Frequency step size (i.e. 20kHz) |

| Parameter | Type | Notes |
|--------------------|---|--|
| Range Resolution y | float | Range step size (i.e. 7.5km) |
| Number of Values | long | The number of sounder values being returned |
| Sounder data | float array[freq, range] vector | The sounder data power values in dB. These will be organized into sweeps for a specific frequency for all ranges in that sweep |

BAE ROADSTER

The BAE Roadster system will publish the following DDS topics to RPEI AIM:

- Online Beam Formed Clutter Map – The beam formed radar data consisting of ground return as a function of angle and range for a specified time in KMZ format.
- On line Beam Formed Sub-Clutter Visibility (SCV) Map – The beam formed radar data consisting of the ratio of clutter to noise as a function of angle for a specified time in KMZ format.

Online Beam Formed Clutter Map

This command requests an online clutter map.

DDS Participant: RPEI AIM subscribes to Clutter Map from BAE ROADSTER

DDS Topic: ClutterMapOpRequest

DDS Data Type: ClutterMapOpRequest

The clutter map is a KMZ file containing a clutter map consisting of the transmit power (backscatter return) averaged over azimuths as a function of ground range. The clutter map will be provided for each active transmitter every 5 minutes.

The inputs to the clutter map request are

- A CR table for converting radar range to ground range. The clutter map function will use this table as an interpolation table. If the user does not specify a table the function will return a clutter map in which the range is equal to radar range rather than ground range. The CR table will be published by RPEI AIM and subscribed to by BAE AIM.
- The beam widths for all clutter maps will be 40 degrees centered on their respective slewed transmitter antenna azimuths.

The return data will contain the following:

| Parameter | Type | Notes |
|------------------------|--|---|
| ClutterMapOpRequest | uint64 | Clutter Map Op Request reference |
| Transmitter Antenna id | enum | Identifier of the transmit antenna. This will match the legacy system resource enumerated types |
| Tx antenna slew | float | +/- 30deg |
| Tx Power | float | 10-500 kW |
| Bev | enum | B,C,D |
| Number of KMZ values | long | The number of bytes being returned for the KMZ |
| clutter map | byte data[Number of KMZ values] octet | The KMZ data corresponding to the clutter map |
| Time Generated | uint64 | msecs since Jan 1, 1970 when the map was generated |
| Elements | long octet | Number of elements used to collect the clutter map data. |

Online Beam Formed Sub Clutter Visibility (SCV) Map

This command requests an online SCV map.

DDS Participant: RPEI AIM subscribes to SCV map from BAE ROADSTER

DDS Topic: SCVMapOpRequest

DDS Data Type: SCVMapOpRequest

The SCV map is a KMZ file containing a SCV map consisting of the transmit power sub-clutter visibility, or clutter to noise ratio, averaged over azimuths as a function of ground range. The SCV map will be provided for each active transmitter every 5 minutes.

The inputs to the SCV map request are

- A CR table for converting radar range to ground range. The SCV map function will use this table as an interpolation table. If the user does not specify a table the function will return a SCV map in which the range is equal to radar range rather than ground range. The CR table will be published by RPEI AIM and subscribed to by BAE AIM.
- The beam widths for all SCV maps will be 40 degrees centered on their respective slewed transmitter antenna azimuths.

The return data will contain the following:

| Parameter | Type | Notes |
|------------------------|--|---|
| SCVMapOpRequest | uint64 | SCV Map Op Request reference |
| Transmitter Antenna id | enum | Identifier of the transmit antenna. This will match the legacy system resource enumerated types |
| Tx antenna slew | float | +/- 30 degrees |
| Tx Power | float | 10-500 kW |
| Bev | enum | B,C,D |
| Number of KMZ values | long | The number of bytes being returned for the KMZ |
| SCV map | byte data[Number of KMZ values] octet | The KMZ data corresponding to the SCV map |
| Time Generated | uint64 | msecs since Jan 1, 1970 when the map was generated |
| Elements | Long octet | Number of elements used to collect the SCV map data. |

Trackers, Exmore, and Scimitar

The Trackers, Exmore, and Scimitar will publish the following DDS topics to RPEI AIM:

- Radar Tracks – Extracted tracks in radar coordinates. These can include KRP tracks that contain extracted points with a known ground location which will be used by RPEI AIM and the CR model to update the CR tables based on the KRP track truth data (i.e. adjust height and tilt).

Radar Track Data

This command subscribes to radar track data.

DDS Participant: RPEI AIM subscribes to radar track data from Trackers, Exmore, or Scimitar

DDS Topic: RadarTrackOpRequest

DDS Data Type: RadarTrackOpRequest

The radar tracks are tracks that contain the radar coordinates, specifically radar range and cone angle.

The return data will contain the following:

| CLASS | FIELD | TYPE | NOTES |
|-------------------------------|-------------------------------------|--------|----------------------------------|
| | RadarTrackOpRequest | uint64 | Radar Track Op Request reference |
| XTR_TRACK_CLASS | Track id # | long | |
| For each mode (1+, Mixed, 1-) | | | Only mixed mode |
| XTR_TRACK_MODE_CLASS | # segments | long | |
| ROP_PARAMS_CLASS | Elevation angle | float | |
| ROP_PARAMS_CLASS | PRF | float | |
| ROP_PARAMS_CLASS | Center recorded range | float | |
| ROP_PARAMS_CLASS | Max recorded range | float | |
| ROP_PARAMS_CLASS | Min recorded range | float | |
| ROP_PARAMS_CLASS | Max unambiguous range | long | |
| ROP_PARAMS_CLASS | Number range bins | short | |
| ROP_PARAMS_CLASS | Mechanical boresight | float | |
| ROP_PARAMS_CLASS | Boresight azimuth (receive azimuth) | float | |
| ROP_PARAMS_CLASS | Tilt angle | float | |
| ROP_PARAMS_CLASS | Beam element | long | |
| ROP_PARAMS_CLASS | RX Beamwidth | float | |

| CLASS | FIELD | TYPE | NOTES |
|---------------------------------|---------------------------|-------|-------|
| ROP_PARAMS_CLASS | Collection type | float | |
| XTR_TRACK_SEGMENT_CLASS | Number track points | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Amplitude | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Noise | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Doppler | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Integrated velocity | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Total phase/slant azimuth | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | SNR | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | True radar range | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Start time seconds | uint | |
| XTR_TRACK_SEGMENT_CLASS | Initial range | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Azimuth | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Rx ground range | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Tx ground range | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Rx path length | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Tx path length | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Latitude | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Longitude | float | |

RPEI AIM

RPEI AIM will publish the following DDS topics to Trackers, Exmore, Scimitar, BAE AIM and ROADSTER:

- Ground Tracks – Extracted tracks in ground coordinates.
- Derived Data – Data created by the AIM CR model from extracted track data. This includes Doppler, azimuth, radar range, integrated velocity, SNR, etc. and is expected to be included in the same track file that provided the radar coordinates

- MDF File – Metric data file, used in Oilstock to present track plots on the map.
- CR Tables – Coordinate registration tables for both direct and sky wave modes.

Ground Track and Derived Data

This command subscribes to ground track and derived data.

DDS Participant: Exmore and Scimitar subscribe to ground track and derived data from RPEI AIM

DDS Topic: GroundTrackOpRequest

DDS Data Type: GroundTrackOpRequest

The ground tracks and derived data contain the ground coordinates, specifically latitude and longitude.

The return data will contain the following:

| CLASS | FIELD | TYPE | NOTES |
|-------------------------------|-------------------------------------|--------|--|
| | GroundTrackOpRequest | uint64 | Ground Track and Derived Data Op Request reference |
| XTR_TRACK_CLASS | Track id # | long | |
| For each mode (1+, Mixed, 1-) | | | Only mixed mode |
| XTR_TRACK_MODE_CLASS | # segments | long | |
| ROP_PARAMS_CLASS | Elevation angle | float | |
| ROP_PARAMS_CLASS | PRF | float | |
| ROP_PARAMS_CLASS | Center recorded range | float | |
| ROP_PARAMS_CLASS | Max recorded range | float | |
| ROP_PARAMS_CLASS | Min recorded range | float | |
| ROP_PARAMS_CLASS | Max unambiguous range | long | |
| ROP_PARAMS_CLASS | Number range bins | short | |
| ROP_PARAMS_CLASS | Mechanical boresight | float | |
| ROP_PARAMS_CLASS | Boresight azimuth (receive azimuth) | float | |
| ROP_PARAMS_CLASS | Tilt angle | float | |

| CLASS | FIELD | TYPE | NOTES |
|---------------------------------|---------------------------|-------|-------|
| ROP_PARAMS_CLASS | Beam element | long | |
| ROP_PARAMS_CLASS | RX Beamwidth | float | |
| ROP_PARAMS_CLASS | Collection type | float | |
| XTR_TRACK_SEGMENT_CLASS | Number track points | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Amplitude | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Noise | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Doppler | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Integrated velocity | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Total phase/slant azimuth | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | SNR | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | True radar range | float | |
| XTR_EXTRACTED_TRACK_POINT_CLASS | Start time seconds | uint | |
| XTR_TRACK_SEGMENT_CLASS | Initial range | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Azimuth | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Rx ground range | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Tx ground range | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Rx path length | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Tx path length | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Latitude | float | |
| XDD_DERIVED_DATA_POINT_CLASS | Longitude | float | |

Metric Data File (MDF) Data

This command subscribes to MDF data.

DDS Participant: Exmore and Scimitar subscribe to MDF data from RPEI AIM

DDS Topic: MDFDataOpRequest

DDS Data Type: MDFDataOpRequest

The MDF data can be loaded into Oilstock to present a plot of a track on the map.

The return data will contain the following:

| CLASS | FIELD | TYPE | NOTES |
|--|----------------------------------|----------|---------------------------------|
| | MDFDataOpRequest | uint64 | MDF Data Op Request reference |
| The following data is repeated for each track point: | | | |
| PAM_MAP_CLASS | Plot Type | char(2) | Sa plot type |
| PAM_MAP_CLASS | Track Color | char(1) | Track Color |
| PAM_MAP_CLASS | Track Symbol | char(4) | Track Symbol |
| PAM_MAP_CLASS | SACC | char(3) | U00 for UNCLASS, S00 for SECRET |
| PAM_MAP_CLASS | CRCM | char(6) | Control and Release Marking |
| PAM_MAP_CLASS | Latitude | char(7) | DDMMSS[N/S] |
| PAM_MAP_CLASS | Longitude | char(8) | DDDMMSS[E/W] |
| PAM_MAP_CLASS | Altitude (meters) | char(8) | <blank> |
| PAM_MAP_CLASS | Event Time (Time of track point) | char(11) | YYDDHMMSS |
| PAM_MAP_CLASS | Track ID | char(24) | Track ID |
| PAM_MAP_CLASS | Track Name | char(16) | Track Name (same as Track ID) |
| PAM_MAP_CLASS | Target Type | char(16) | Target Type |
| PAM_MAP_CLASS | Event Time – Hundreds of Sec | char(2) | 0-99 |
| PAM_MAP_CLASS | Alternate Location | char(20) | DD:MM:SSA/DDD:MM:SSA |
| PAM_MAP_CLASS | Integrated Velocity | char(7) | NNNN.NN km |

| CLASS | FIELD | TYPE | NOTES |
|---------------|------------------------------------|---------|-----------------------|
| PAM_MAP_CLASS | Radar Range | char(7) | NNNN.NN km |
| PAM_MAP_CLASS | Azimuth | char(6) | NNN.NN degrees |
| PAM_MAP_CLASS | Smoothed Azimuth | char(7) | NNN.NNN degrees |
| PAM_MAP_CLASS | Velocity | char(8) | +/-NNNNN.N meters/sec |
| PAM_MAP_CLASS | Virtual Height | char(6) | NNN.NN km |
| PAM_MAP_CLASS | Vertical Velocity | char(8) | +/-NNNN.NN meters/sec |
| PAM_MAP_CLASS | Total Phase | char(8) | +/-NNNN.NN radians |
| PAM_MAP_CLASS | True Velocity | char(7) | +/-NNNN.N meters/sec |
| PAM_MAP_CLASS | Altitude Change | char(7) | +/-NNNN.N meters |
| PAM_MAP_CLASS | Heading | char(5) | NNN.N degrees |
| PAM_MAP_CLASS | Event Time (Seconds past midnight) | char(8) | NNNNN.NN seconds |
| PAM_MAP_CLASS | Mode Source | char(3) | +M- |
| PAM_MAP_CLASS | Mode 1 Radar Range | char(7) | NNNN.NN km |
| PAM_MAP_CLASS | Mode 1 Integrated Velocity | char(7) | NNNN.NN km |
| PAM_MAP_CLASS | Mode 1 Doppler | char(7) | +/-NNNN.N Hz |
| PAM_MAP_CLASS | Mode 1 Radial Velocity | char(8) | +/-NNNNN.N meters/sec |
| PAM_MAP_CLASS | Mode 1 SNR | char(5) | NNN.N dB |
| PAM_MAP_CLASS | Mode 2 Radar Range | char(7) | NNNN.NN km |
| PAM_MAP_CLASS | Mode 2 Integrated Velocity | char(7) | NNNN.NN km |
| PAM_MAP_CLASS | Mode 2 Doppler | char(7) | +/-NNNN.N Hz |
| PAM_MAP_CLASS | Mode 2 Radial Velocity | char(8) | +/-NNNNN.N meters/sec |
| PAM_MAP_CLASS | Mode 2 SNR | char(5) | NNN.N dB |
| PAM_MAP_CLASS | Mode 3 Radar Range | char(7) | NNNN.NN km |

| CLASS | FIELD | TYPE | NOTES |
|---------------|----------------------------|---------|-----------------------|
| PAM_MAP_CLASS | Mode 3 Integrated Velocity | char(7) | NNNN.NN km |
| PAM_MAP_CLASS | Mode 3 Doppler | char(7) | +/-NNNN.N Hz |
| PAM_MAP_CLASS | Mode 3 Radial Velocity | char(8) | +/-NNNNN.N meters/sec |
| PAM_MAP_CLASS | Mode 3 SNR | char(5) | NNN.N dB |
| PAM_MAP_CLASS | Ionospheric Layer | char(5) | FIXED, E F1, F2 |
| PAM_MAP_CLASS | Tx Ray Elevation Angle | char(5) | NN.NN degrees |
| PAM_MAP_CLASS | Rx Ray Elevation Angle | char(5) | NN.NN degrees |
| PAM_MAP_CLASS | Target Ray Receive Angle | char(5) | NN.NN degrees |
| PAM_MAP_CLASS | Target Ray Reflect Angle | char(5) | NN.NN degrees |
| PAM_MAP_CLASS | Tx Ground Range | char(8) | NNNNN.NN km |
| PAM_MAP_CLASS | Rx Ground Range | char(8) | NNNNN.NN km |
| PAM_MAP_CLASS | Tx Path Length | char(8) | NNNNN.NN km |
| PAM_MAP_CLASS | Rx Path Length | char(8) | NNNNN.NN km |

CR Table Data

This command subscribes to the CR table data.

DDS Participant: Trackers, BAE AIM, BAE ROADSTER, and other users subscribe to CR tables from RPEI AIM

DDS Topic: CRTableOpRequest

DDS Data Type: CRTableOpRequest

The CR tables convert radar coordinates into ground coordinates.

The return data will contain the following:

| Parameter | Type | Notes |
|------------------|--------|------------------------------|
| CRTableOpRequest | uint64 | CRTable Op Request reference |

| Parameter | Type | Notes |
|-------------------------|--------------------------------|--|
| Registration table size | long | size of the registration table, greater than 2 |
| Radar Range Table | float[registration table Size] | Positive, monotonically increasing, radar range values in km |
| Ground Range Table | float[registration table Size] | Positive, ground range values in km |

External Links

The external links will provide known reference points (KRPs) to AIM. These systems will publish the following DDS topic to RPEI AIM:

- KRPs – Known reference points (i.e. ADS-B). This will be developed as part of the RPEI AIM KRP effort.

Network protocol for online operation

The BAE AIM system will use DDS publish and subscribe for transferring data streams to the RPEI AIM.