Mission-Critical Data Interoperability

SureLine Field Application Examples

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Unrestricted

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1 Introduction

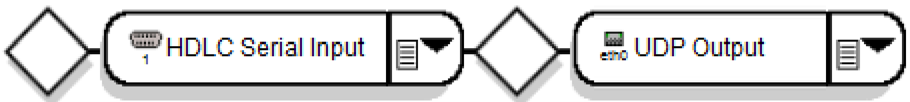
This is a listing of common field applications supported in SureLine. The examples are divided into groupings based on their field application category. Screenshots from SureLine's Dataflow Editor are used to depict the configuration of the system for each field application at a high level. Each node shown in the dataflows have additional specific configuration parameters that are not covered here as that level of detail is not the intent of this document.

2 Serial to IP Applications

2.1 HDLC ASTERIX Radar to UDP ASTERIX

ASTERIX data over serial lines typically uses HDLC with our products to bring the data in and translate it to IP and normally to the UDP protocol. Below are some examples of SureLine working with ASTERIX HDLC serial input and IP UDP output with and without conversion.

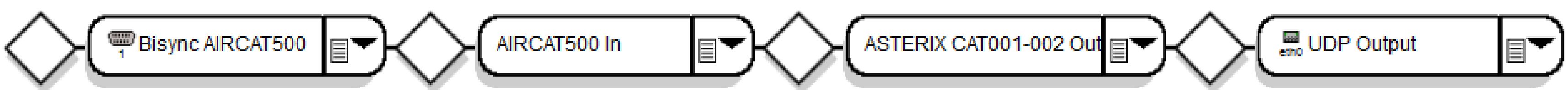
2.1.1 Without Conversion



2.1.2 With Conversion

2.2 Custom Radar Input to UDP ASTERIX w/ conversion

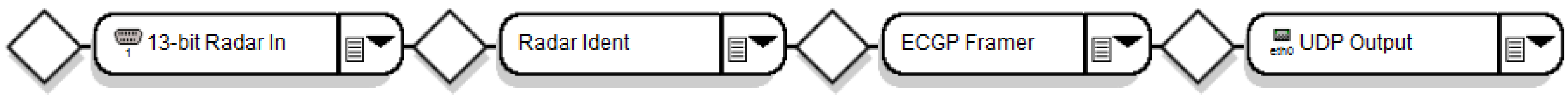
AIRCAT500 uses the Bisync AIRCAT500 serial port protocol to bring in the serial feed. Then the AIRCAT500 Input node is used to convert the input to generics. Finally the data is converted to Eurocontrol ASTERIX Category 1 and 2 and then output via IP UDP.



2.3 13-bit radar to ECGP

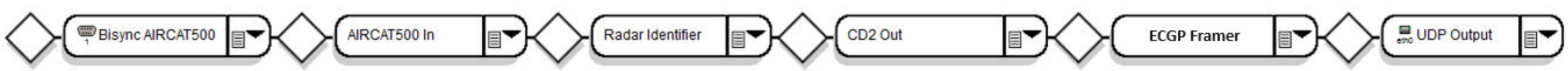
13-bit radar is a serial protocol used for many radar formats within SureLine. It is one of the main protocols developed since the birth of the software application that is now SureLine. Below are examples to translate and convert serial to IP with an ECGP Framer added to the data. ECGP framing is common with 13-bit radar going to IP UDP output.

2.3.1 Without Conversion



2.3.2 With conversion

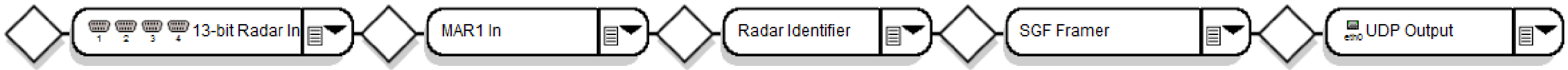
2.4 Custom Radar Input to ECGP w/ conversion



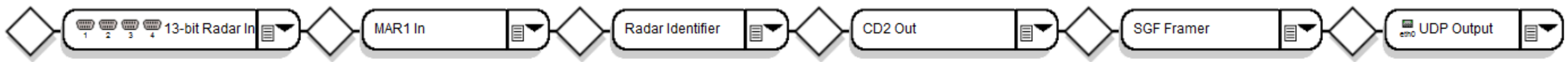
2.5 13 Bit radar to SGF

13-bit radar is a serial protocol used for many radar formats within SureLine. It is one of the main protocols developed since the birth of the software application that is now SureLine. Below are examples to translate and convert serial to IP with an SGF Framer added to the data. SGF framing is common with 13-bit radar going to IP UDP output.

2.5.1 Without Conversion



2.5.2 With Conversion



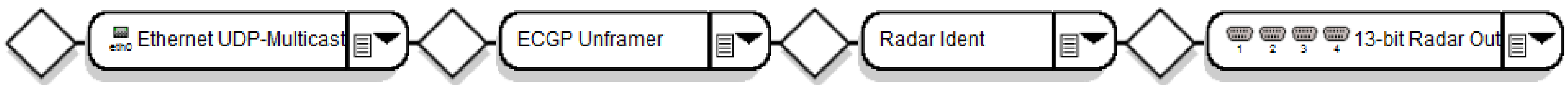
2.6 Custom Radar Input to SGF w/ conversion

3 IP to Serial Applications

3.1 ECGP to 13-bit radar serial out

IP UDP ECGP Input is commonly translated or converted to a 13-bit radar serial output using SureLine. Below are some examples of unframing IP UDP ECGP input with and without conversion to 13-bit radar serial output.

3.1.1 Without Conversion



3.1.2 With Conversion

3.2 SGF to 13-bit radar serial out

IP UDP SGF Input is commonly translated or converted to a 13-bit radar serial output using SureLine. Below are some examples of unframing IP UDP SGF input with and without conversion to 13-bit radar serial output.

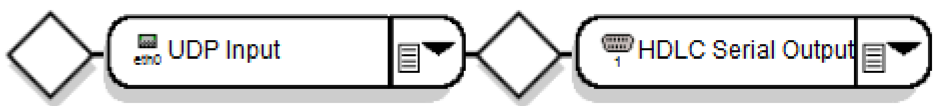
3.2.1 Without conversion

3.2.2 With conversion

3.3 ASTERIX UDP to HDLC serial out

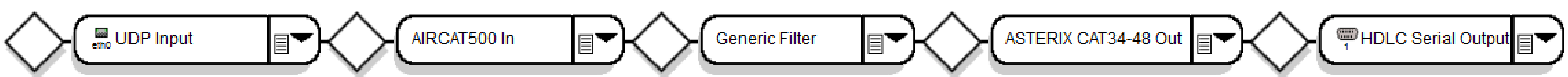
IP UDP ASTERIX Input is commonly translated or converted to a HDLC serial output using SureLine. Below are some examples of unframing IP UDP input with and without conversion to HDLC serial output.

3.3.1 Without conversion



3.3.2 With conversion and generic filtering

3.4 Custom Radar Input to serial out w/ conversion and generic filtering

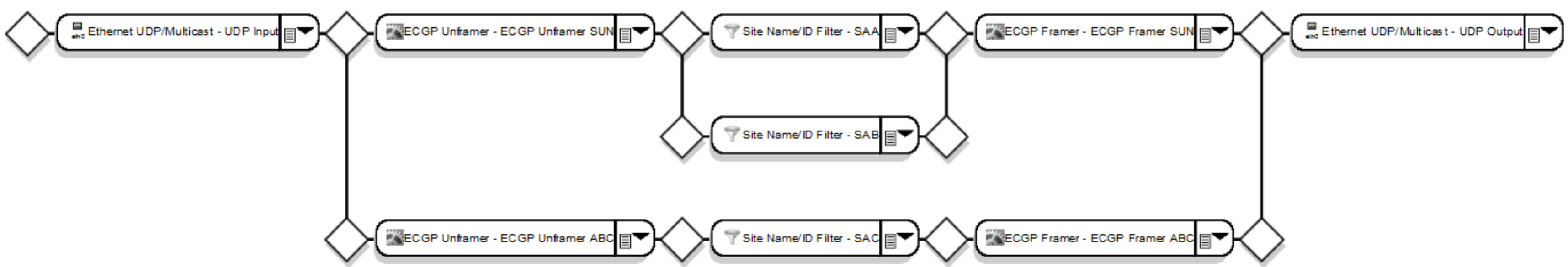


4 IP to IP Applications

SureLine offers many variations of purpose-built dataflows using the flexible dataflow configuration software with the SureLine application. Below are some common examples that are focused on IP-to-IP applications of SureLine.

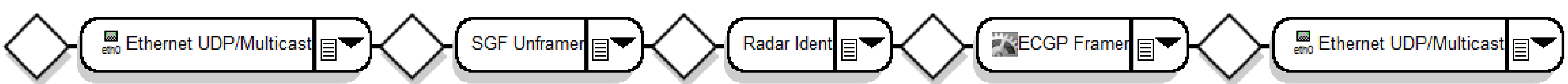
4.1 ECGP to ECGP w/ center/site filtering

A common field application is to receive a large group of ECGP radar feeds, process a subset of that large group of feeds, and retransmit only the subset of feeds to the end user. Below is an example that receives 2 radars from 1 center on row 1 and 2 as 1 radar from 1 center on row 3. Then finally the new ECGP output is merged and sent out the UDP output node on the far right on row 1.



4.2 SGF to ECGP

A common field application is to receive SGF framed IP UDP data and retransmit as ECGP IP UDP output. Below is an example for doing so. The Radar Identifier is used for adding the center/site info into the ECGP packet since SGF does not include this information natively.

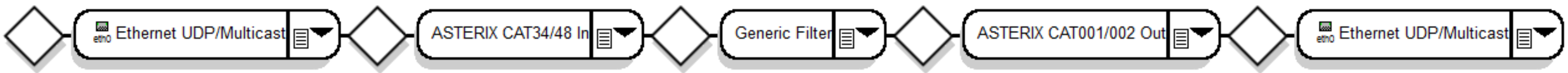


4.3 ECGP to SGF

A common field application is to receive ECGP framed IP UDP data and retransmit as SGF IP UDP output. Below is an example for doing so. The Radar Identifier is used for adding the radar characteristics that may not be present as needed in the ECGP input.

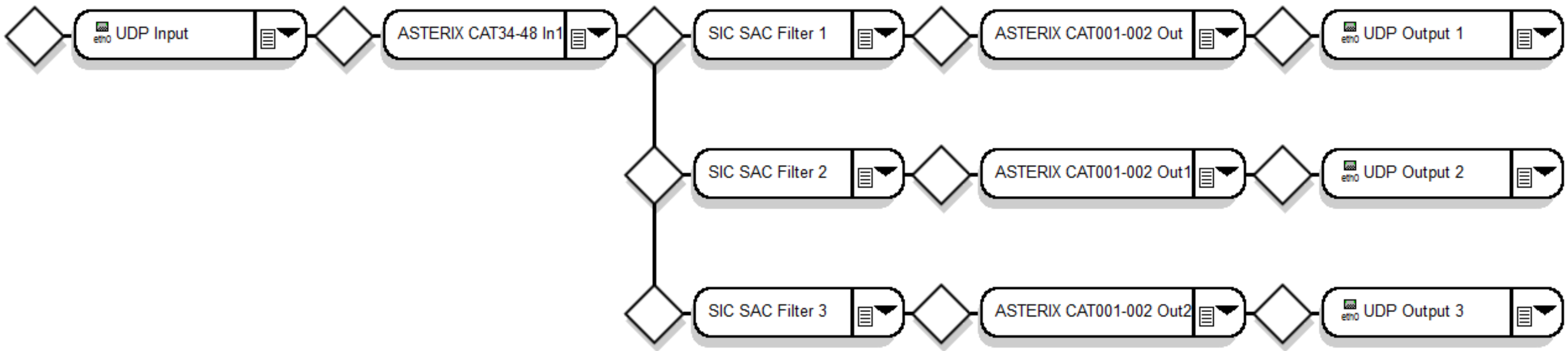
4.4 ASTERIX to ASTERIX w/ Filtering and Conversion

A common field application is to receive ASTERIX, filter the data in some way, and convert the data to a different format for a receiving subsystem. This example brings in the newer ASTERIX 34/48 input, filters out specific fields as needed with the generic filter, and converts the data to the legacy ASTERIX 1/2 output via UDP IP.



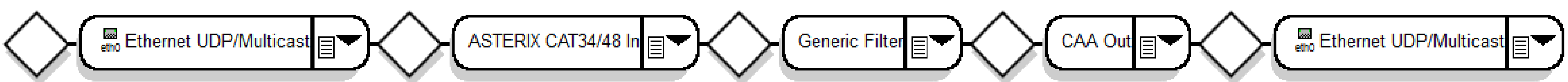
4.5 ASTERIX to ASTERIX w/ SIC/SAC Filtering (using the Generic Filter) and Conversion

A common field application is to receive ASTERIX, filter the ASTERIX data of interest based on its SIC/SAC code, which is a unique identifier, and convert the data to a different format for a receiving subsystem. This example brings in the newer ASTERIX 34/48 input, filters based on incoming SIC/SAC codes via the generic filter and converts the data to the legacy ASTERIX 1/2 output via UDP IP.



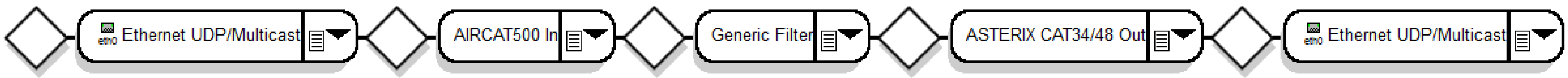
4.6 ASTERIX to Custom Radar Output w/ Filtering

A common field application is to receive ASTERIX, filter the data in some way, and convert the data to a different format for a receiving subsystem. This example brings in the newer ASTERIX 34/48 input, filters out specific fields as needed with the generic filter, and converts the data to the legacy CAA output via UDP IP.



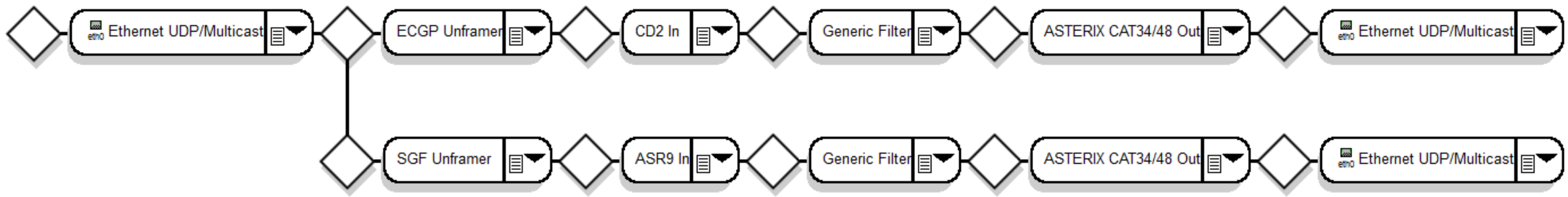
4.7 Custom Radar Input to ASTERIX w/ filtering

A common field application is to receive a non-ASTERIX radar data format, filter the data in some way, and convert the data to a ASTERIX format for a receiving subsystem. This example brings in the AIRCAT500 input, filters out specific fields as needed with the generic filter, and converts the data to the ASTERIX 34/48 output via UDP IP.



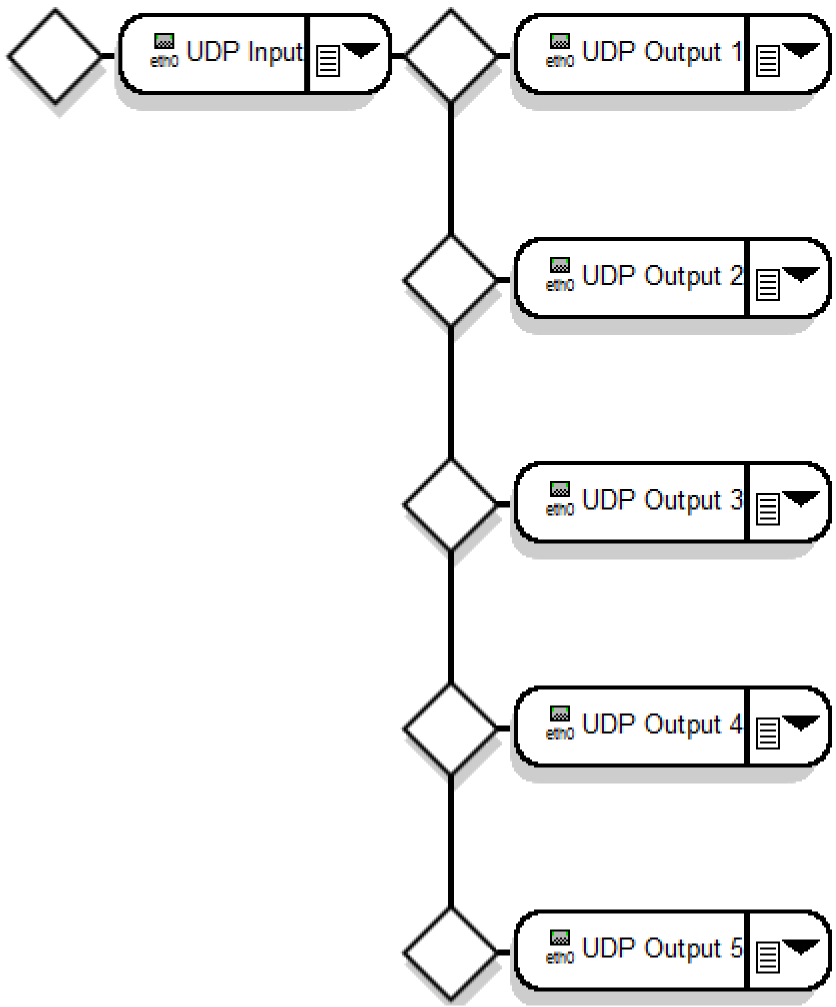
4.8 ECGP/SGF Input to ASTERIX w/ conversion and filtering

A common field application is to receive a non-ASTERIX ECGP and SGF radar data format, filter the data in some way, and convert the data to a ASTERIX format for a receiving subsystem. This example brings in the ECGP and SGF input, filters out specific fields as needed with the generic filter, and converts the data to the ASTERIX 34/48 output via UDP IP.



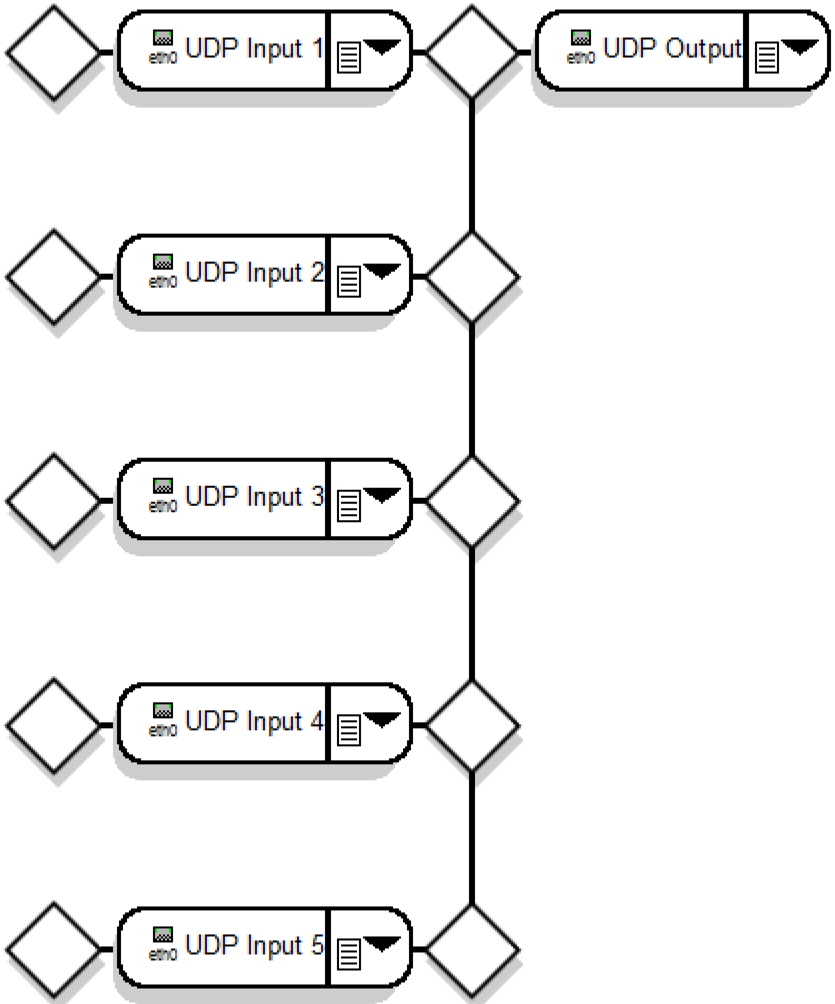
4.9 Single IP Input to Multiple IP Outputs (One to Many or fanout)

A common field application is to receive 1 IP UDP input and send it out to, say, 5 different places. Below is an example of such a dataflow configuration within SureLine.



4.10 Many IP inputs to 1 IP Output (Many to One or fan-in)

A common field application is to receive multiple IP UDP inputs and send it out all the data to 1 UDP destination. Below is an example of such a dataflow configuration within SureLine where 5 UDP inputs are condensed to 1 UDP output.



5 Advanced Applications

There are advanced applications that can be constructed using SureLine dataflow configurations. Some of these require use of additional licensed software like Virtual Radar or different hardware like a Sunhillo Longport or Margate 2 ADS-B Receiver. Below are some examples of some common advanced applications and how they are to be configured within the SureLine dataflow configuration GUI.

5.1 Virtual Radar Examples

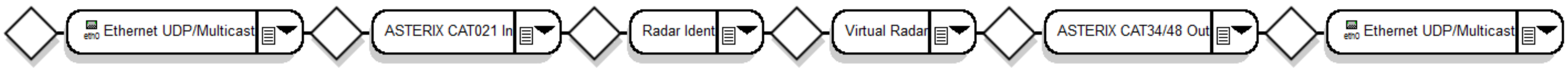
Virtual Radar is a licensed node within SureLine Tier 1+ that enables input tracks with lat/long and northmark to be converted to radar plots. This was originally used in the Gulf of Mexico on oil rigs with ADS-B FAA Category 23/33 input which was converted to CD2 to feed legacy FAA automation systems. Since then, it has been fully integrated into SureLine and can support a plethora of input and output data formats for various field applications. Below are some example configurations utilizing Virtual Radar.

5.1.1 Sunhillo's ADS-B Receiver to ASTERIX Cat 34-48

A common field application is to receive ADS-B input from a Sunhillo ADS-B Receiver and output ASTERIX 34/48 radar plots via IP UDP output. Virtual Radar is required to convert the track input to plot output in this example and shown below.

5.1.2 ASTERIX Cat 21 to ASTERIX Cat 34-48

A common field application is to receive ADS-B Category 21 input and output ASTERIX 34/48 radar plots via IP UDP output. Virtual Radar is required to convert the track input to plot output in this example and shown below.



5.1.3 ASTERIX Cat 62 to ASTERIX 34-48

A common field application is to receive ASTERIX Category 62 track input and output ASTERIX 34/48 radar plots via IP UDP output. Virtual Radar is required to convert the track input to plot output in this example and shown below.

5.1.4 ASTERIX Cat33 to ASTERIX Cat 34-48

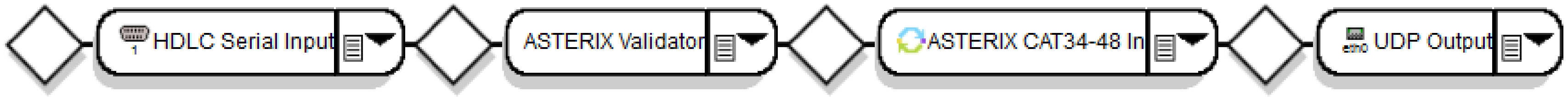
A common field application is to receive ASTERIX Category 33 track input and output ASTERIX 34/48 radar plots via IP UDP output. Virtual Radar is required to convert the track input to plot output in this example and shown below.

5.1.5 Sunhillo's XML SDO In to ASTERIX 34/48

A common field application is to receive Sunhillo's XML SDO input and output ASTERIX 34/48 radar plots via IP UDP output. Virtual Radar is required to convert the XML SDO input to plot output in this example and shown below.

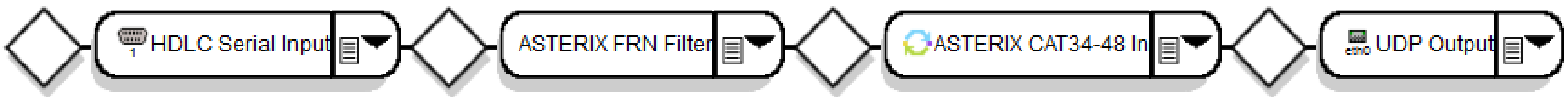
5.2 ASTERIX Validation

A common field application is to validate incoming ASTERIX input before translating or converting it and send it out to an end user. In this example, a serial HDLC input in received of ASTERIX 34/48 input, and then is ran through Sunhillo's ASTERIX Validator which validates each field is as expected based on a set of AML files resident on the system. The ASTERIX Validator will drop any malformed input and only pass along expected ASTERIX 34/48 input to ensure the end user receives what they are expecting. Below is the dataflow configuration of SureLine for this example.



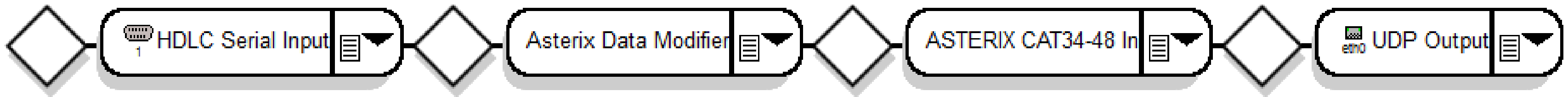
5.3 ASTERIX FRN Filtering

A common field application is to drop specific fields or data items within an ASTERIX input stream before translating or converting it and send it out to the end user. In this example, a serial HDLC input is received of ASTERIX 34/48 input, and then is ran through Sunhillo's FRN Filter where specific data items can be entered to be removed from the message before passing it along to the end user. This ensures the end user remain interoperable by use of SureLine and Sunhillo's product's preprocessing capabilities to their input data stream essentially cleaning the data as needed before it goes into their system. Below is the dataflow configuration of SureLine for this example.



5.4 ASTERIX Data Modification

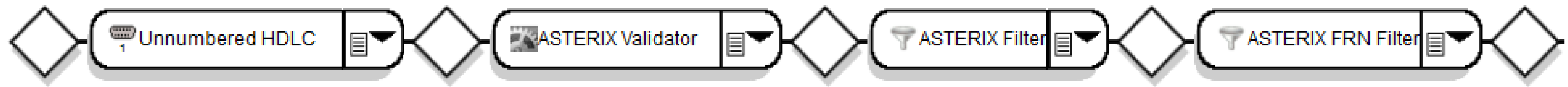
A common field application is to make decisions based on ASTERIX input data characteristics before translating or converting it and sending it out to the end user. In this example, a serial HDLC input is received of ASTERIX 34/48 input, and then is ran through Sunhillo's ASTERIX Data Modifier where specific criteria or comparators can be entered to alter message before passing it along to the end user. This ensures the end user remain interoperable by use of SureLine and Sunhillo's product's preprocessing capabilities to their input data stream essentially cleaning the data as needed before it goes into their system. Below is the dataflow configuration of SureLine for this example.



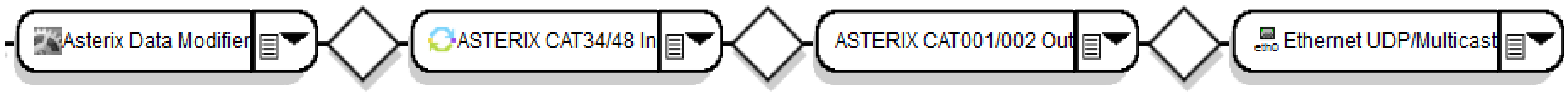
5.5 ASTERIX Validation/FRN Filtering/Data Modification/Conversion

Combining the last few examples into a single dataflow below, we can validate, filter, modify and convert the ASTERIX input data before sending it outbound to the end user. This depicts some of the advanced flexibility and power of SureLine for data processing, conversion, and distribution.

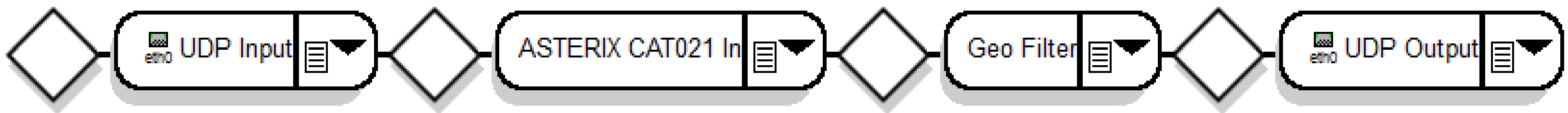
5.5.1 First half of the single row dataflow



5.5.2 Second half of the single row dataflow:



5.6 Geographic Filtering



The left screenshot shows Geographic Filtering all targets outside of the configured area, only displayed those targets inside the region configured.

The right screenshot shows Geographic Filtering of all targets inside the configured area, only displaying those targets outside of the region configured.

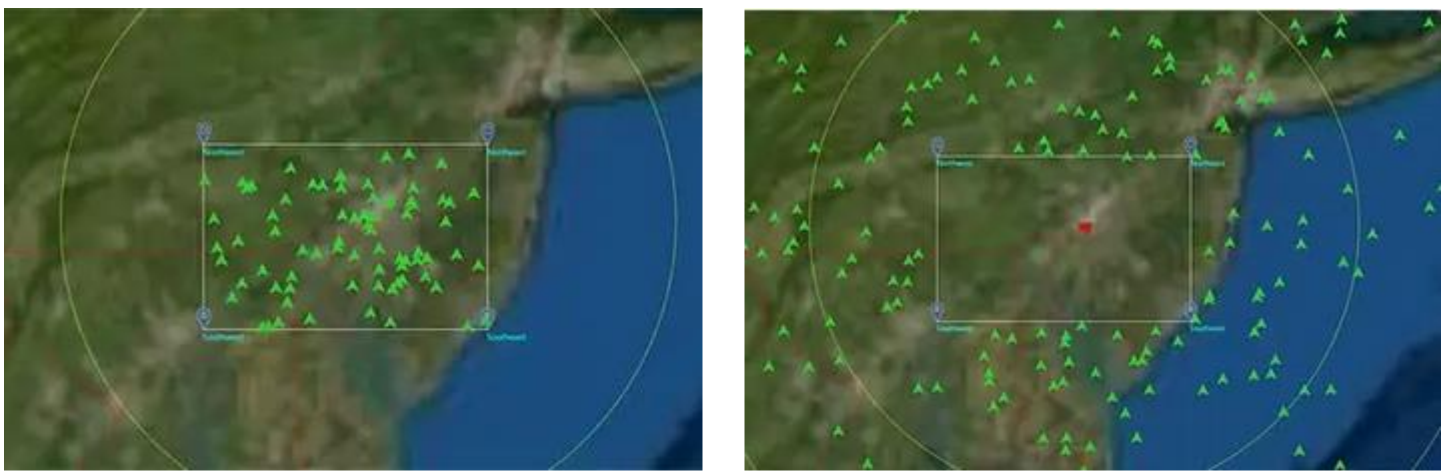
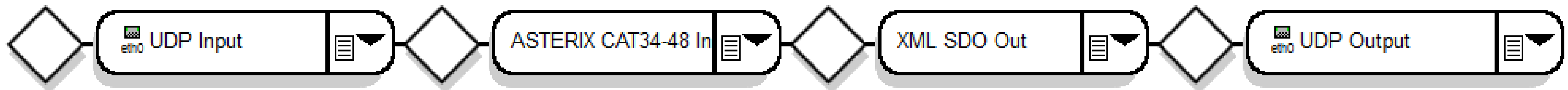


Figure 5-1: Geographical Filtering

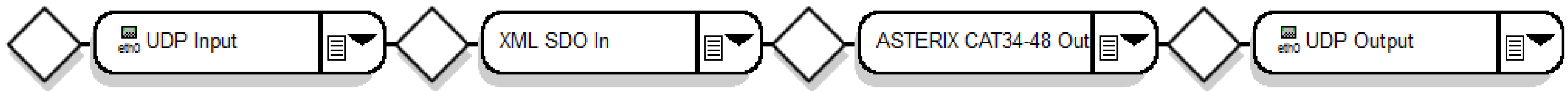
5.7 Cross Domain Solution using ASTERIX 34-48 and XML SDO

Using two different boxes, like 2 Brigantines for example, an end user can configure each to receive and transmit ASTERIX radar input and convert to and from XML SDO in between. XML SDO is an XML-based flexible message format with a provided ICD from Sunhillo for incorporation into an end user's receiving subsystem for display or analysis of radar data of interest for advanced situational awareness. The below examples show the simple dataflow to convert ASTERIX 34/48 to XML SDO and vice versa XML SDO to ASTERIX 34/48 all using UDP input/output endpoints in this example.

5.7.1 ASTERIX 34-48 to XML SDO (input side)

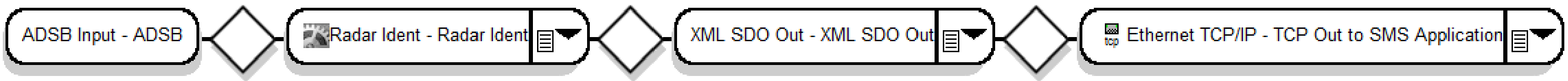


5.7.2 XML SDO to ASTERIX 34-48 (output side)



5.8 ADS-B to Surveillance Monitor System (SMS)

Sunhillo has an ADS-B Receiver product line that is capable of receiving ADS-B from an RF antenna and bringing this data into SureLine for conversion to a Sunhillo-developed display application called the Surveillance Monitoring System (SMS). This system is deployed and primarily used for situational awareness for end users. Below is an example of receiving ADS-B input, converting to XML SDO and transmitting via TCP/IP to the SMS where the targets can be seen on a map display.



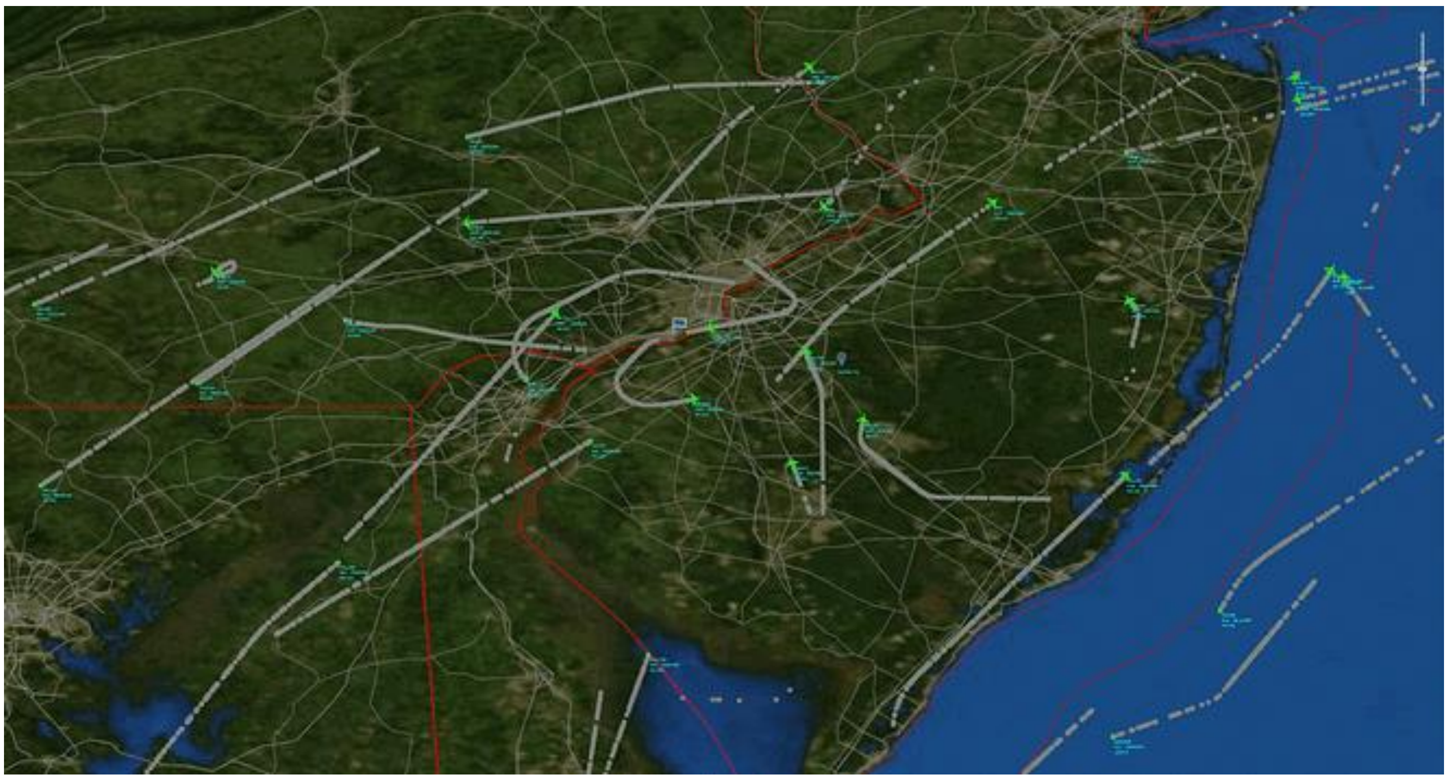
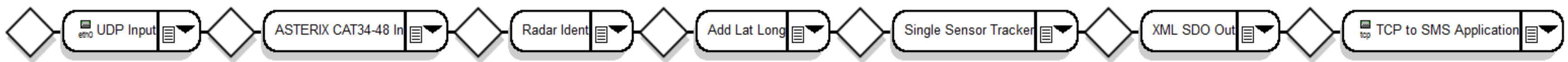


Figure 5-2: SMS Display

5.9 Single Radar to SMS w/ Single Sensor Tracker

Sunhillo products are capable of receiving radar plot input over serial or IP and bringing this data into SureLine for conversion to SMS for display. Sunhillo products are also capable of converting plots to tracks by way of our Single Sensor Tracker. Below is an example of receiving ASTERIX 34/48 input, adding a latitude and longitude to the data based on the radar's known location, transitioning plots to tracks using Sunhillo's Single Sensor Tracker, and finally converting to XML SDO for transmission via TCP/IP to the SMS display where the original radar plot targets can be seen on a map display as clear tracks.



ASTERIX 34/48 Input are plots as shown left in the Radar Display within SureLine

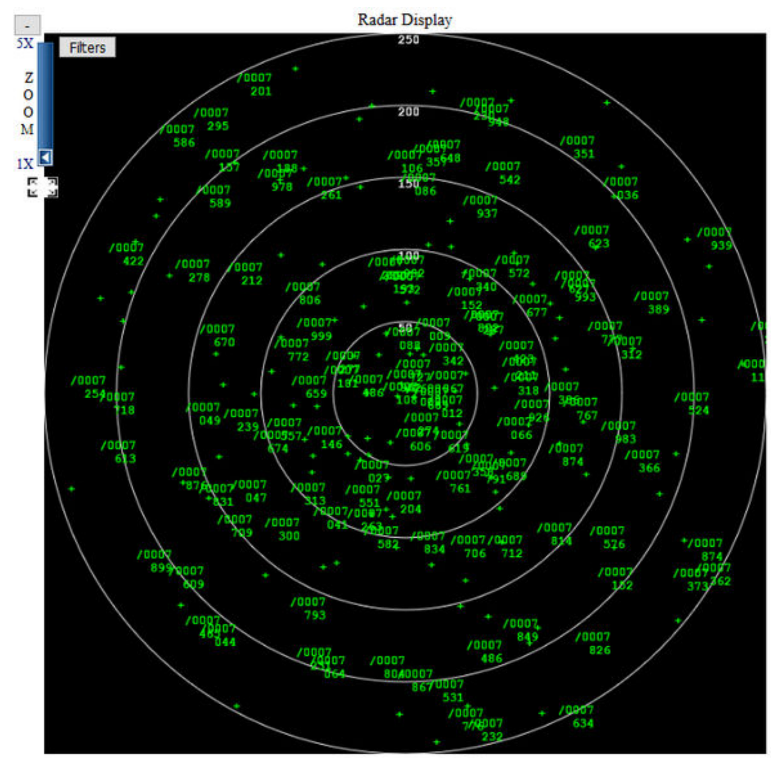


Figure 5-3: Radar Display Example

5.9.1 XML SDO Output

Plots coming into the Single Sensor Tracker are converted to tracks with added latitude and longitude information. This makes them displayable on the SMS application as shown below. Other track output types such as ASTERIX Cat 62 are available as well within SureLine as needed.

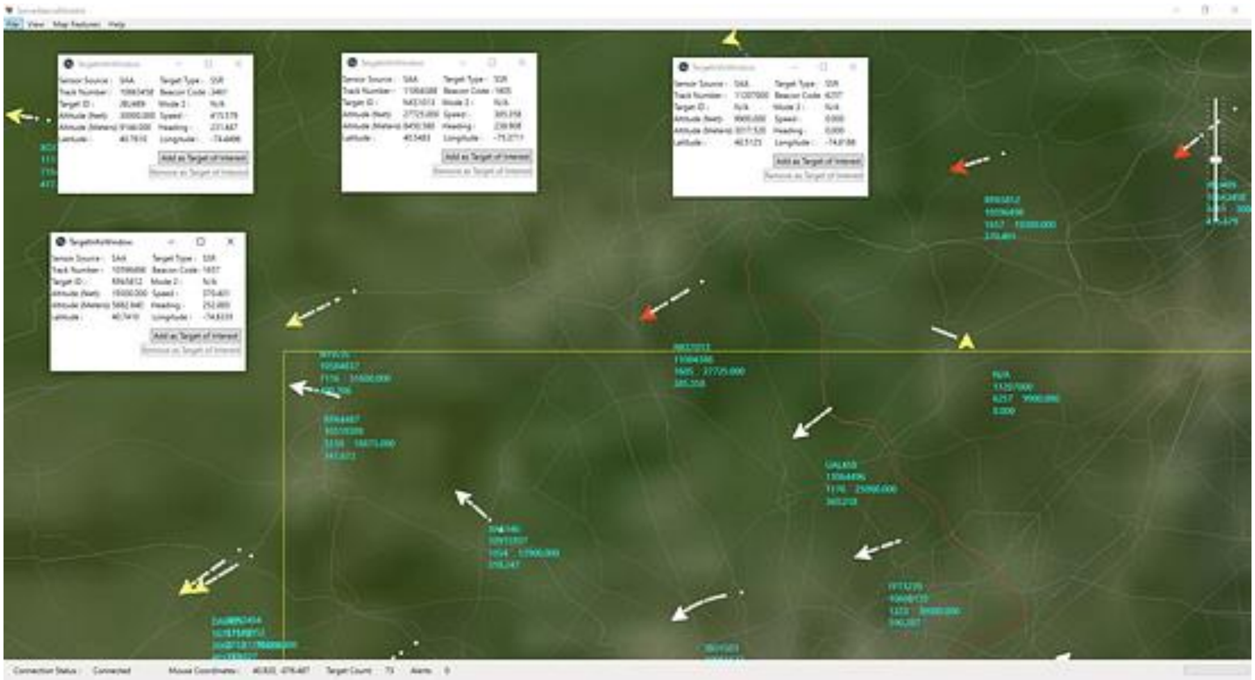


Figure 5-4: SMS Display of Plots From the Single Sensor Tracker

5.10 Multiple Radars to SMS w/ Single Sensor Tracker/Multi-Track Fuser

Sunhillo often pairs the Single Sensor Tracker when multiple radar inputs with overlapping coverage are in play with our Multi-Track Fuser. This allows the deduplication of targets and offers a clean output picture to the SMS displays or other displays. With SureLine's flexibility, many different types of radars and track input data can be brought into the system and tracked and fused for a single clear air picture. Below is an overview of the multi-track fuser and some configuration examples.

5.10.1 Multi-Track Fuser Overview

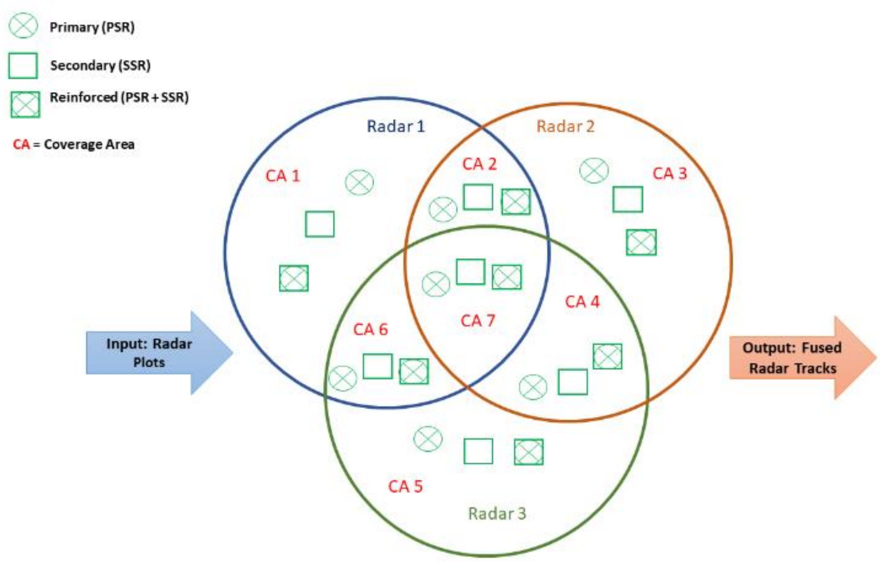


Figure 5-5: Overlapping Radar Example

Coverage Areas 1, 3 and 5 on Radars 1, 2 and 3 see only these three targets. SST converts three plots to three tracks: PSR track, SSR track and SSR+PSR (reinforced) track. MTF does not fuse these three because only one radar sees these targets and there are no duplicate radar reports.

Coverage Area 2 = Radar 1 and Radar 2; both see these three targets. SST converts all three plots to three tracks for Radar 1 and Radar 2 for a total of six targets. MTF receives these six targets, checks which Radar location (preconfigured latitude/longitude location of radar) is closest to these six targets and outputs only three tracks rather than six tracks. Thus, multi-track fusing its input to the clear output feed for situational awareness displays or systems.

Area 7 = Radars 1, 2 and 3; all three radars see these three targets. SST converts all three plots to three tracks for all three radars for a total of nine targets. MTF receives these nine targets, checks which Radar location (preconfigured latitude/longitude location of radar) is closest to these nine targets and outputs only three tracks rather than nine tracks. Thus, multi-track fusing its input to the clear output feed for situational awareness displays or systems.

5.10.2 Visual Example of Radar Data with and Without Sunhillo's Tracker

Without a tracker in place there are duplicates in overlapping coverage areas as shown below

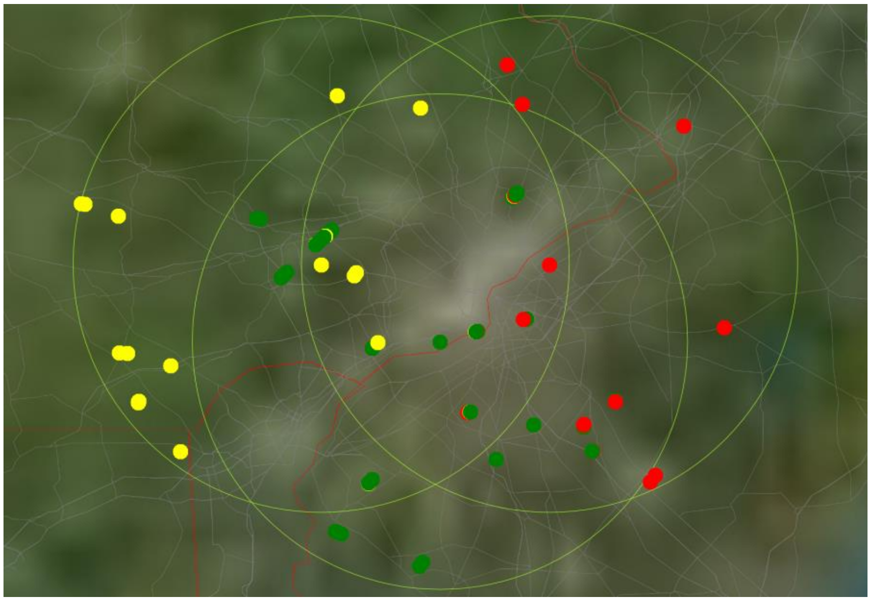


Figure 5-6: Unfused Data

With a tracker in place there are no longer any duplicates in overlapping coverage areas as shown below

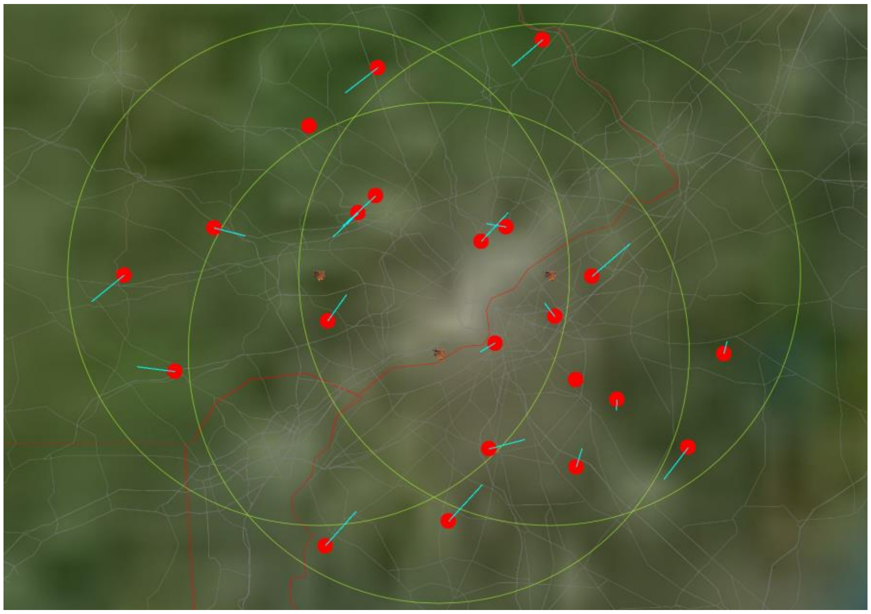
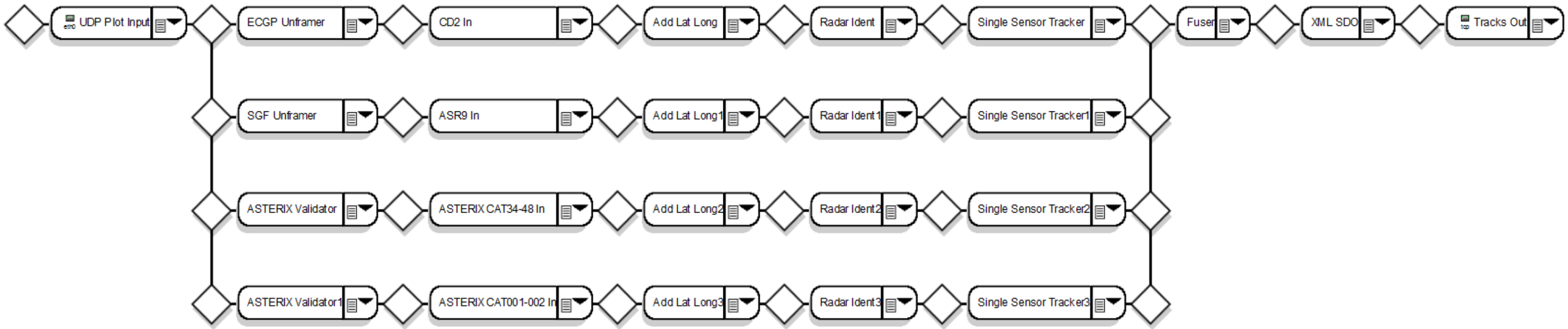


Figure 5-7: Fused Data

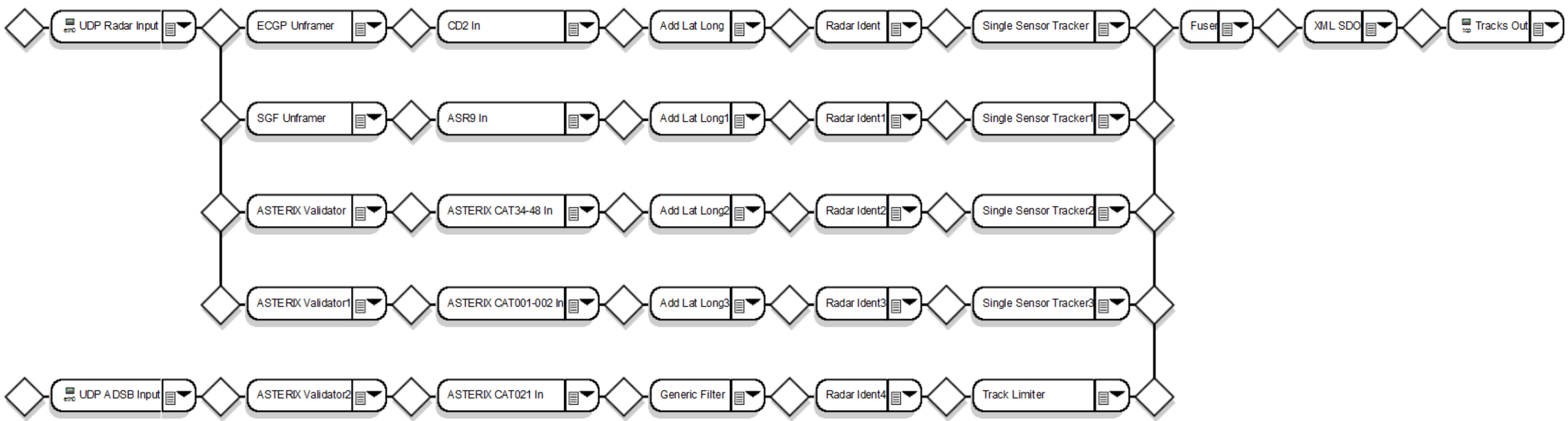
5.10.3 Dataflow Example

In this example below, we have UDP IP input of 4 radar inputs of disparate formats which are ECGP wrapped CD2 input, an SGF wrapped ASR9 input, an ASTERIX 34/48 input, and an ASTERIX Cat 1/2 input. They all feed into their own individual Single Sensor Tracker and then all 4 SSTs feed to one Multi-Track Fuser. Then finally the output is converted to XML SDO and transmitted over TCP/IP to the SMS display.



5.11 ADS-B and Radar fusion to SMS w/ Single Sensor Tracker/Multi Track Fuser

This example is similar to the prior but adds ADS-B input on the bottom row to go along with the 4 disparate radar input formats. The ADS-B flow is also featuring the Track Limiter inline before feeding the Multi-Track Fuser to limit the number of ADS-B targets going to the MTF as to not overload the end user due to scan/refresh rates of radar versus ADS-B. The ADS-B is merged into the MTF and then also converted to XML SDO for output to the SMS via TCP/IP.



Appendix A Acronyms

Table A-1: Acronyms

Acronym	Expansion
3DES	Triple Data Encryption Standard
ABM	Asynchronous Balanced Mode
ABS-HQ	Aireon Business System Headquarters
ACL	Access Control List
ADS-B	Automatic Dependent Surveillance – Broadcast
AF	Air Force
AIMS	ATCRBS Identification Friend-or-Foe Mark XII System
AML	Automation Markup Language
AMQP	Advanced Message Queueing Protocol
ANSI	American National Standards Institute
API	Application Programming Interface
ARP	Address Resolution Protocol
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ASCII	American Standard Code for Information Interchange
ASR	Airport Surveillance Radar
ASTERIX	All Purpose Structured Eurocontrol Surveillance Information Exchange
ATCBI	Air Traffic Control Beacon Indicator
ATCRBS	Air Traffic Control Radar Beacon System
bps	bits per second
BRTQC	Beacon Real Time Quality Control
CD	Common Digitizer
CE	Checksum Error
CMHP	Common Message Handling Protocol
CRC	Cyclic Redundancy Check
CSV	Comma-Separated Values
CTS	Clear to Send
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DO	Data Overrun
DTR	Data Terminal Ready
DU	Data Overrun
EBCDIC	Extended Binary Coded Decimal Interchange Code
ECGP	Enroute Communications Gateway Protocol
ESD	Electrostatic Discharge
ESM	Ethernet Switch Module
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration
FIFO	First in, First out
FTP	File Transfer Protocol
GCS	Ground Control Station
GUI	Graphical User Interface
HDLC	High-level Data Link Communications

HQ ABS	Aireon Headquarters–Aireon Business Systems
HTTPS	Hypertext Transfer Protocol Secure
ICMP	Internet Control Message Protocol
IEC	International Electrotechnical Commission
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
keepalived	keepalive daemon
KML	Keyhole Markup Language
LAN	Local Area Network
LED	Light Emitting Diode
LOC	Loss of Clock
LVC	Live Virtual Constructive
MAR	Minimally Attended Radar
MIB	Management Information Base
MPS	Multi-Protocol Server
MRDIF	Military Radar Data Interchange Format
MTBF	Mean Time Between Failure
MTL	Mean Threshold Level
NADIN	National Airspace Data Interchange Network
NASA	National Aeronautics and Space Administration
NATS	National Air Traffic Agency
NDPP	Network Device Protection Profile
NIC	Network Interface Card
NTP	Network Time Protocol
OID	Object Identifier
OOS	Out of Sync
OTG	Over-the-Horizon Targeting Gold
PCAP	Packet Capture
PCM	Processor Card Module
PE	Parity Error
POST	Power On System Test
PSAR	Peripheral System Analysis and Recording
PSM	Power Supply Module
RAG	Range Azimuth Gate
RAPPI	Random Access Plan Position Indicator
RD	Receive Data
RDFPS	Radar Data Filtering and Processing System
RICI	Real-Time Interface and Conversion Item
RSA	Rivest-Shamir-Adleman
RSAF	Royal Saudi Air Force
RTS	Request to Send
SAC	System Area Code
SDP	Service Delivery Point
SFP	Small Form-factor Pluggable
SFTP	Secure File Transfer Protocol
SGC	Sunhillo Generic Configuration
SGF	Sensis Generic Format
SIC	System Identification Code

SIU	System interface Unit
SNMP	Simple Network Management Protocol
SRTQC	Search Real Time Quality Control
SSD	Solid State Drive
SSH	Secure Shell
STUI	Sunhillo Terminal User Interface
TCP	Transmission Control Protocol
TIS	Time in Storage
TTL	Time to Live
UDP	User Datagram Protocol
USAF	United States Air Force
USB	Universal Serial Bus
VLAN	Virtual Local Area Network
VRRP	Virtual Router Redundancy Protocol