Sunhillo SDDS-IP

Sunhillo's SDDS solution, utilizing our SureLine® software, provides value with the lowest risk and the flexibility and features to support future SDDS growth.

SureLine Software Suite

Sunhillo's SureLine Software (SureLine) has evolved over 20+ years from its early predecessor, the Data Communications Gateway (DCG), which was developed to function within the Federal Aviation Administration's (FAA) Enroute Communications Gateway infrastructure and accepted a limited set of radar formats.

The DCG baseline application software has progressed dramatically over two decades to become the SureLine software, used by 15 Air Navigation Service Providers (ANSP) including the FAA. SureLine is highly configurable and provides surveillance interface/conversion capabilities supporting a variety of serial and IP-based national and international surveillance protocols, including the common versions of All-purpose Structured EUROCONTROL Surveillance Information Exchange (ASTERIX).

Table 1: SureLine Features and Benefits

Features	Benefits
Mature design deployed in 52 countries and 1000s of systems deployed in all FAA locations	Trusted and verified for ATC use. Mature system continually updated with customer feedback
Flexible Graphical Configuration	Allows infinite number of data flows by graphically drawing inputs to outputs
Web interface built in for maintenance, monitoring, and control	Accessible from any workstation with browser
Mature product. Large runtime (over 15,000 instances of SureLine currently executing)	Proven reliability and robustness
Over 60 useful function nodes with advanced features	Enhanced features available for future needs
Realtime data viewer radar scope at any locations in data flow	Easily Monitor messages decoded through the data flow
Built in recorder	Record data at any location in data flow in PCAP or raw format for replay and analysis
XML output	Data formatted for interchange or SOA applications
Google Earth output (KML)	View targets live on Google Earth

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Features	Benefits
Virtual Radar	Turn tracks (e.g. ADS-B) into plots for conversion to legacy formats
Single Sensor Tracker	Turn plots into tracks for conversion from legacy formats
Multi-Track Fuser	Eliminate duplicate targets from overlapping sensors

Figure 1 Presents a High-level Concept Diagram of the SureLine Subsystems as they are utilized in our SureLine SDDS Solution.

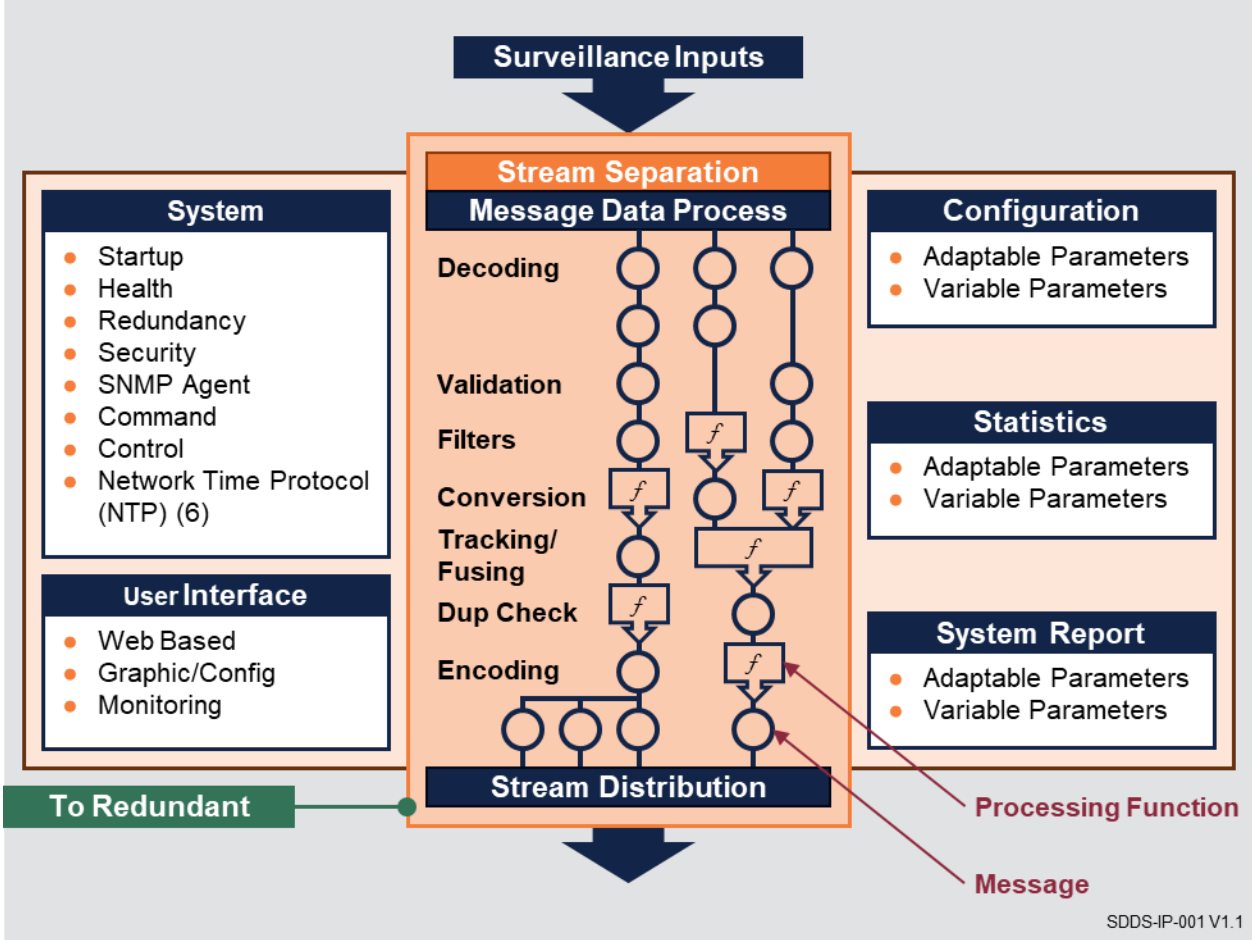


Figure 1: SureLine Components Provide Many Features and Allow Customization

SureLine Processing Overview

SureLine's operational software executes its data processing functions by passing messages through a series of message handling nodes in a processing tree called a "data flow". A data flow consists, at minimum, of an input connected to an output as a simple flow. SureLine supports more than 400 conversion combinations or channels. The data flow and, hence, the processing of messages within SureLine, is determined by the last active (XML-formatted) adaptation file it reads in during system startup.

SureLine's GUI presents the system configuration by mapping the nodes defined in the adaptation XML file to a graphical representation of the data flow in SureLine's configuration editor. Conceptually, a "node" is a software object – either part of the application code or a separate plug-in – that represents a physical connection (e.g., IP interface) or a function (e.g., ASTERIX FRN filter) and utilizes its methods, and that of its parent object, to operate on its input message object prior to passing it to either the next node in the tree or to its output destination. Each node has its own set of configuration parameters, which are easily accessed through the GUI by left clicking on the node in the data flow.

SureLine's processing allows nodes to be "chained" from input to output, with potential conversion, data insertion or modification, framing/unframing, filtering, and detailed message parsing provided along the flow path. The inputs and outputs can be one-to-one, one-to-many, or many-to-one, meaning that an input can be mapped to a single output, or it can be split onto multiple paths destined for multiple outputs. Conversely, multiple inputs can be sent to multiple outputs, or can be merged to a single destination node. When new paths are created to "branch" data to multiple paths, manipulation function nodes become available along the new path as well. The failure of one data path unless it is merged, doesn't affect the output of the other data paths. An example data flow concept is depicted in **Figure 2**.

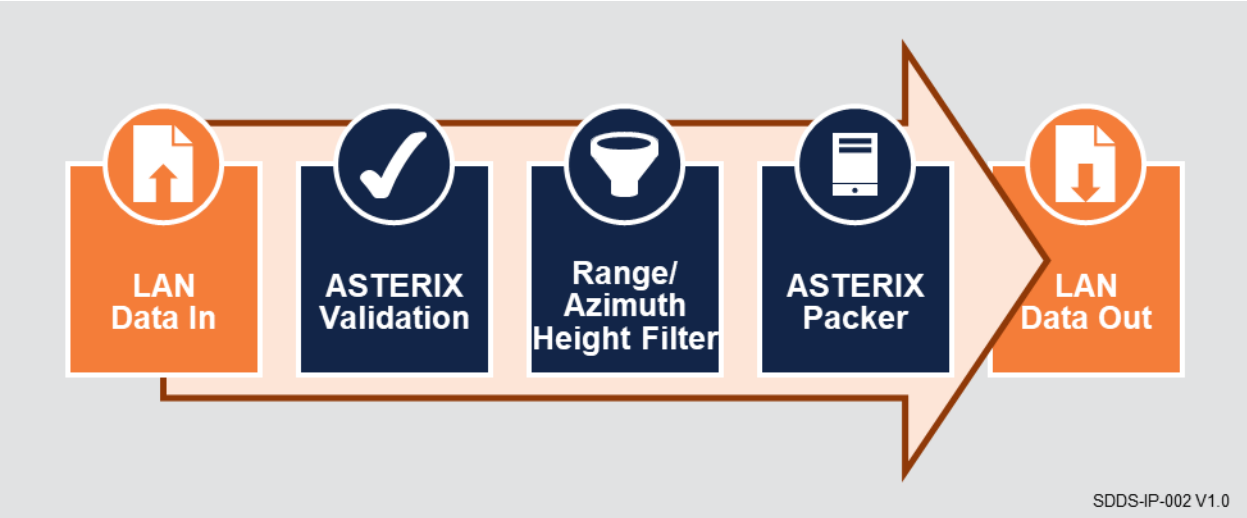


Figure 2: Nodes are Chained Together to Pass Data Through the SDDS

ASTERIX Toolkit

ASTERIX message processing and validation within SureLine is performed using our ASTERIX Toolkit library, which is part of the SureLine application software. This library is used across our products to decode, modify and validate ASTERIX data.

ASTERIX Validation

As seen in **Figure 3**, the toolkit utilizes a data driven model to interpret and validate ASTERIX data and allows users to define new ASTERIX categories and variants using an XML based ASTERIX definition file called the ASTERIX Markup Language (AML). There are many AML files provided with the SureLine SDDS, however; the end user is enabled to create custom or new AML files to match ASTERIX Validation needs – even for new ASTERIX formats. When the ASTERIX Validator node is present in the data flow, an ASTERIX message that does not

meet the criteria defined in the AML file is dropped from the data flow and does not pass any further in the data flow.

Our ASTERIX Toolkit ingests ASTERIX frames and, using the AML ASTERIX definitions, validates each message in the frame, gives the calling application access to each Data Item in the message, and delimits the boundaries between ASTERIX messages in the frame. The Toolkit uses the AML description file to define ASTERIX Categories and UAPs including:

- Field Reference Number (FRN)/Data Item order
- Required FRNs
- Conditionally required FRNs
- Data Items
- Field and Subfield definitions
- Valid and invalid field options

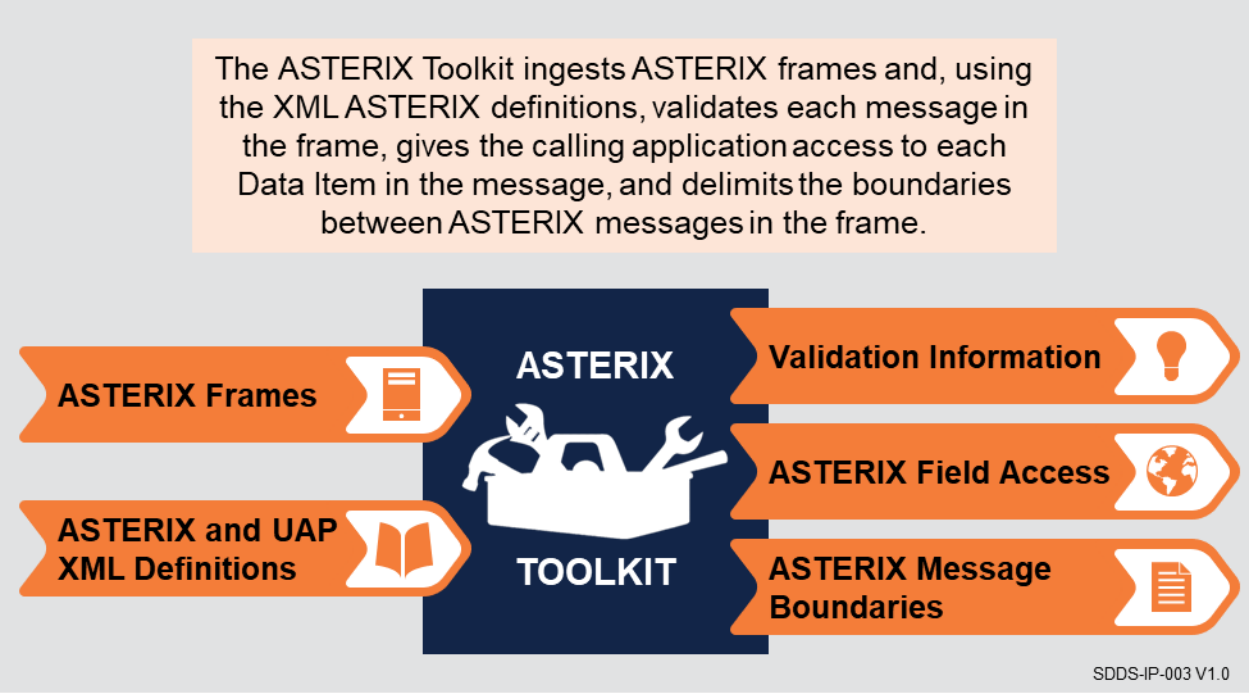


Figure 3: Our Toolkit is Used by Multiple Users for Validation and Decoding

ASTERIX Data Modifier

The ASTERIX Toolkit also powers the SureLine ASTERIX Data Modifier node. This powerful node functions as an inline ASTERIX message rules engine that allows you to conditionally filter or modify messages, data items or individual fields. The ASTERIX Data Modifier node allows you to act on conditions such as presence/absence of a data item or sub field or the value of a particular field. When a message meets the condition, the action, including discarding the entire message, data item or subfield, or setting the field value or incrementing/decrementing a value can be taken.

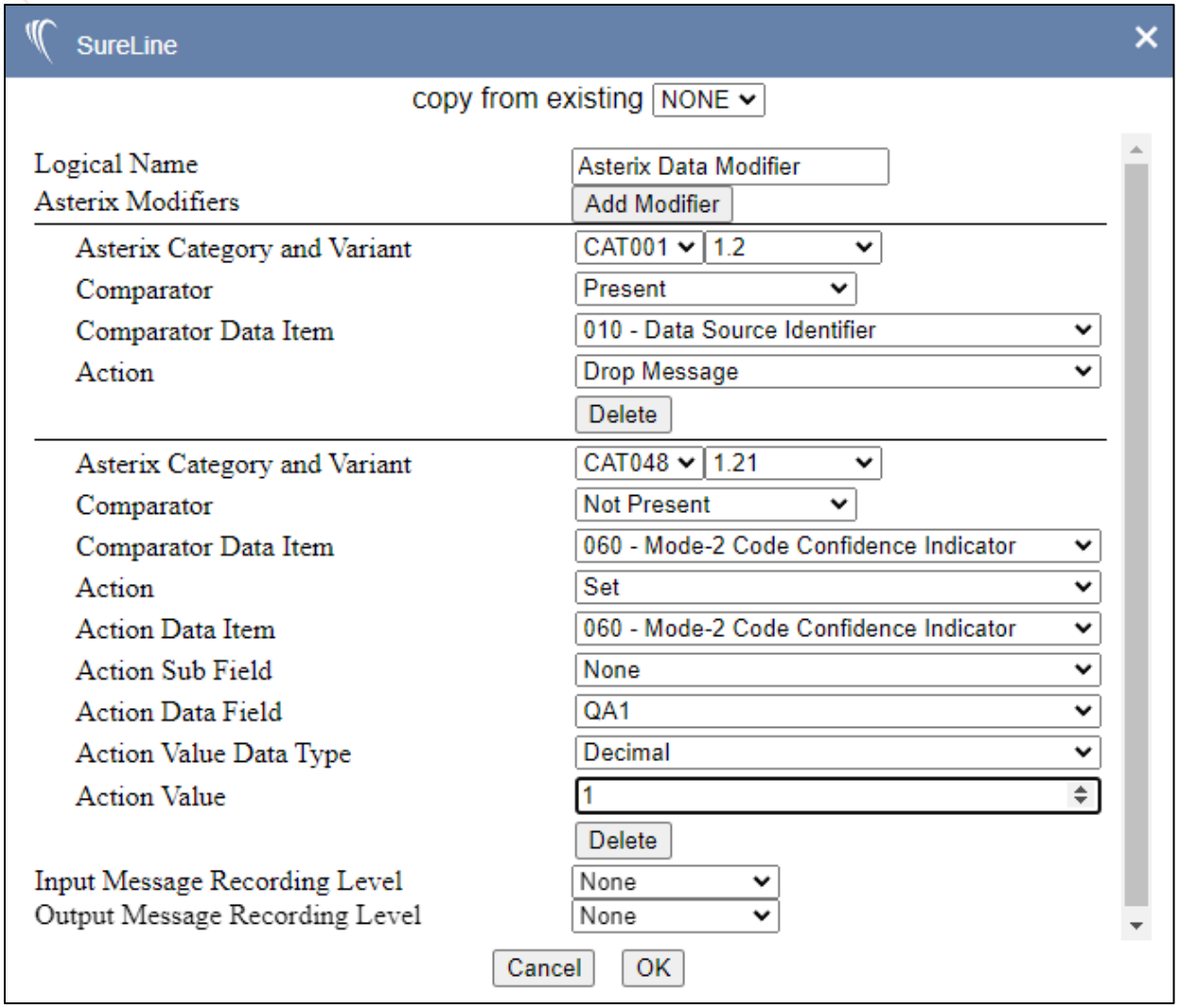


Figure 4: ASTERIX Data Modifier Node Detail

Record and Replay

SureLine supports recording in the following formats, raw (binary), and packet capture (PCAP). The recording locations can be set for each node, so it is possible to record the data at different locations in the data flow.

The recording format is set with the Data Recording File Type parameter, and may be any of the following:

- PCAP (Wireshark/TCPDump) – Creates a PCAP (.pcap) recording file
- Raw – Creates a .dat binary recording file.
- Cassandra – Creates a connection to an external Cassandra database for recording

All files, regardless of format, are created with the filename *sunlogDDMMYYYY-HHMMSS*, where DDMMYYY-HHMMSS is replaced by the day/month/year-hour/minute/second of the recording (in 24-hour format). This filename can be prefixed with customizable text by setting

the Data Recording File Prefix parameter. Additionally, data can be output in XML or to a Cassandra database that can be used for data mining and analysis.

Recorded data can be replayed either through Wireshark or our raw file input node to reproduce any issues. These are also requested by our Helpdesk support team to analyze issues.

SDDS Network Diagram

SureLine uses 802.1Q Virtual LANs (VLAN) to extend a server's physical networks using smart switches. With this technique, any grouping of switch ports can be used as an individual physical port by SureLine software. The switch ensures that all 802.1Q VLANs are segregated. In the SDDS configuration, the primary and redundant systems each have a paired 802.1Q-capable switch with 48 ports that they can trunk up to 20 external networks through two bonded 1 gigabit network links.

Redundancy

When running redundantly, each network switch is connected to its redundant server with a monitor port allowing all traffic into and out of the server to be viewed by the redundant system. The two gateways are interconnected on a separate redundant LANs to create a heartbeat network between the redundant servers. This redundant configuration ensures no single point of failure as seen in **Figure 5**.

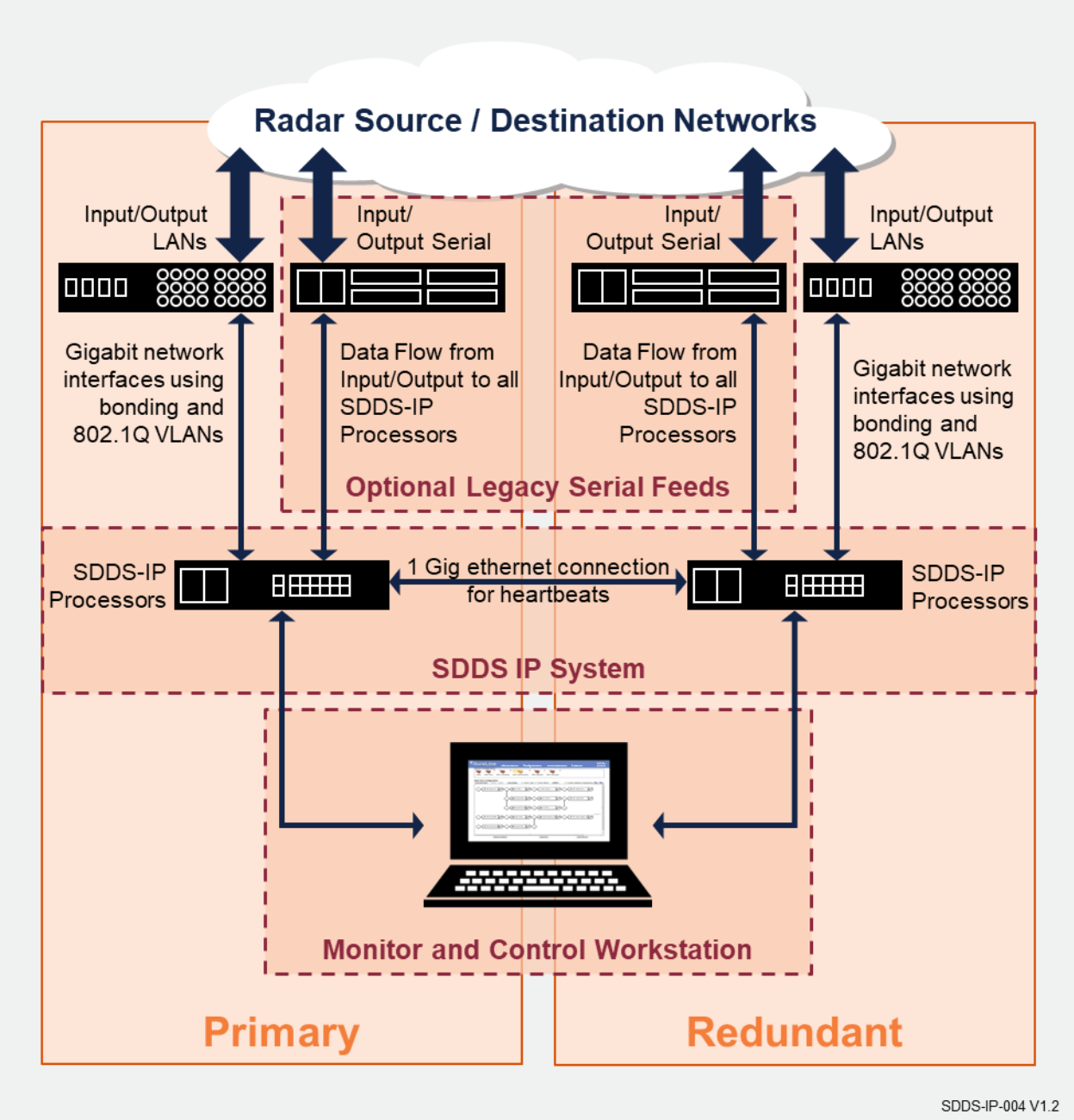


Figure 5: Modern COTS Hardware Provides Seamless Network Redundancy

Hardware Characteristics

Sunhillo's SDDS design draws from the rich array of COTS products we have been providing to the aviation sector for decades. Our components go through a strict ISO9001 certified process for manufacture and have the pedigree expected as proven and deployed products.

Our COTS Brigantine Surveillance Gateway Processor (SGP), running our standard SureLine software, is used as the core of the SDDS-IP System. Standard off the shelf switches provide a front end for the Input/Output LANs.

Legacy Serial Ports

Sunhillo acknowledges the reality that there are still legacy serial interfaces in some networks, whether ASTERIX, CD2, ASR9, MAR or other 13-bit formats. Our COTS Surveillance Data solutions, running our standard SureLine software, can act as a front end to the SDDS system to convert serial data to IP. Once converted the data is forwarded directly to the SDDS-IP system.

Performance

The SureLine SDDS platform architecture depicted in **Figure 5** supports a throughput capability 60,000 surveillance messages per second. That capability is scalable to include more throughput capacity, or less, with the addition or subtraction of the Surveillance Gateway Processor (SGP) units.

Track Limiting

SureLine also provides a Track Limiter node which can be used in a data flow to control the rate of data that a downstream system will receive. When configured in the data flow, the Track Limiter determines the track rate based on the mode configured. When mode is set to Fixed, the limiter will send the same track no less than the number of seconds configured. When set to Dynamic, it will limit track output to meet the Tracks Per Second value defined.

Monitoring Using SureLine

SureLine Status Display

SureLine provides a basic toolset for monitoring the SDDS over an HTTPS connection. The web-based GUI offers a top view of the data passing through the device using the live Dataflow Status page.

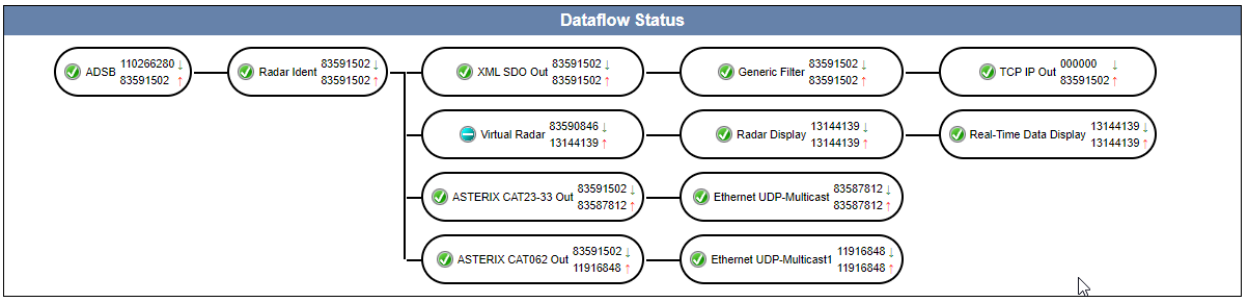


Figure 6: Example SureLine Data flow

The data flow is the configured “schematic” of how the received data is processed from the left to the final output on the right. The Dataflow Status page provides a visual indication of the health of the data flow using color-coded icons to represent the state of each. Additionally, the count of data packets entering and exiting each dataflow node allows the viewer to identify if data is being prevented from passing through to the next node. Upon clicking a specific dataflow node, any detailed information about that specific node is displayed.

The image below is an example of the specific node detail for the ADS-B input node. It provides detailed count statistics of the various messages processed. The data displayed is also

dependent upon the node configuration parameters which can also be viewed from the node detail perspective.

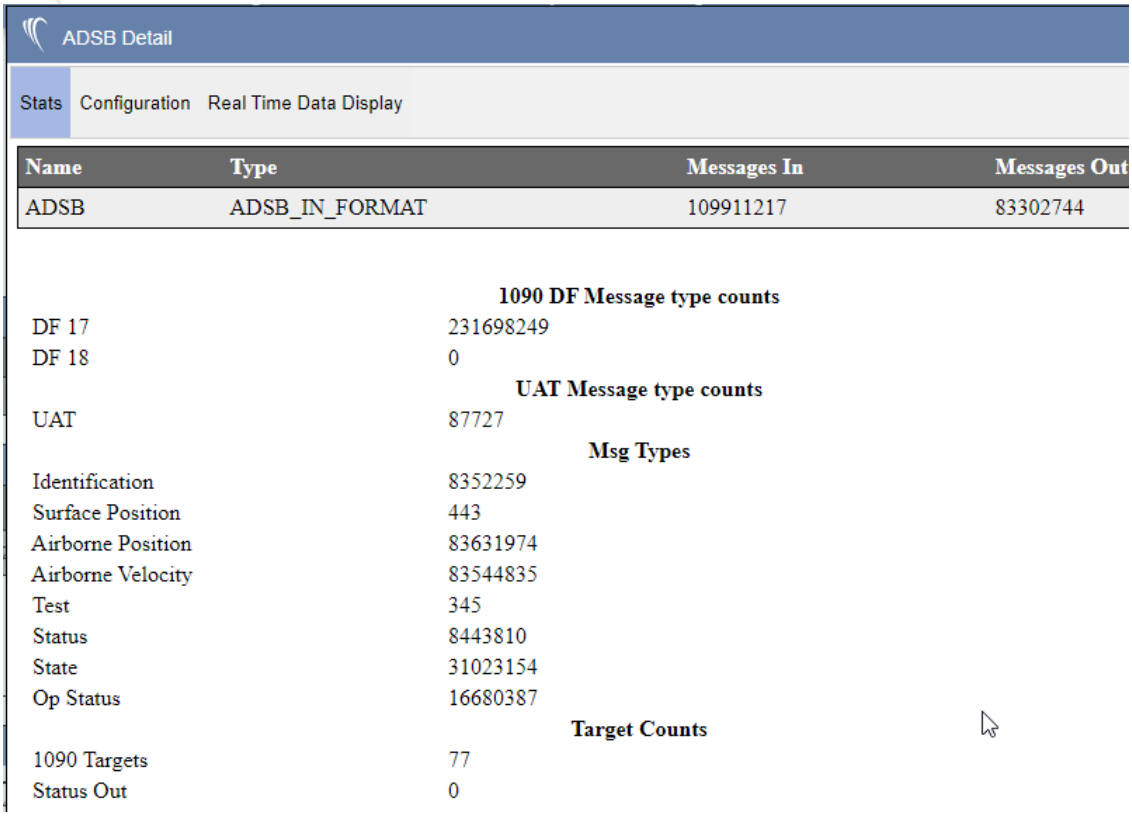


Figure 7: Example Node Detail

SureLine Radar Display

With the SureLine Radar Display function node, a view of radar plot data passing through the data flow is possible and available through the web-based GUI.

The optional Virtual Radar add-on implicitly provides a conversion from track data to plot data which may also prove useful in feeding legacy equipment. Through the use of Virtual Radar, track data can also be displayed on the Radar Display as virtualized plots.

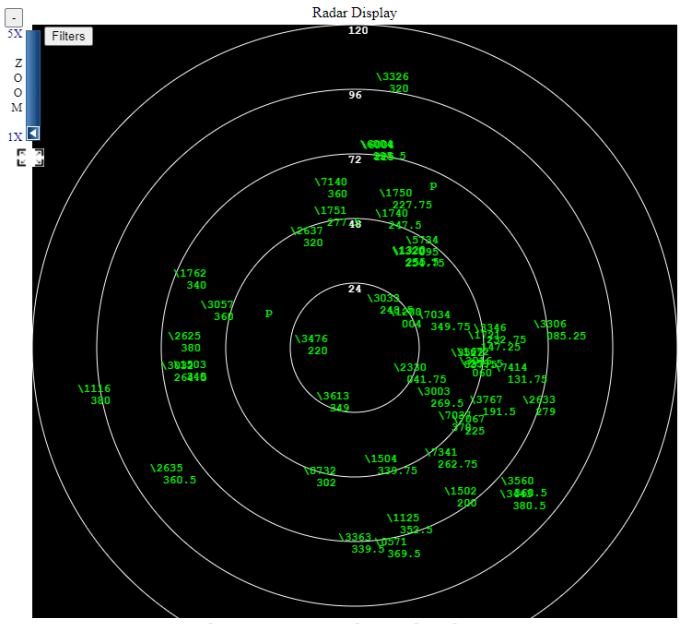
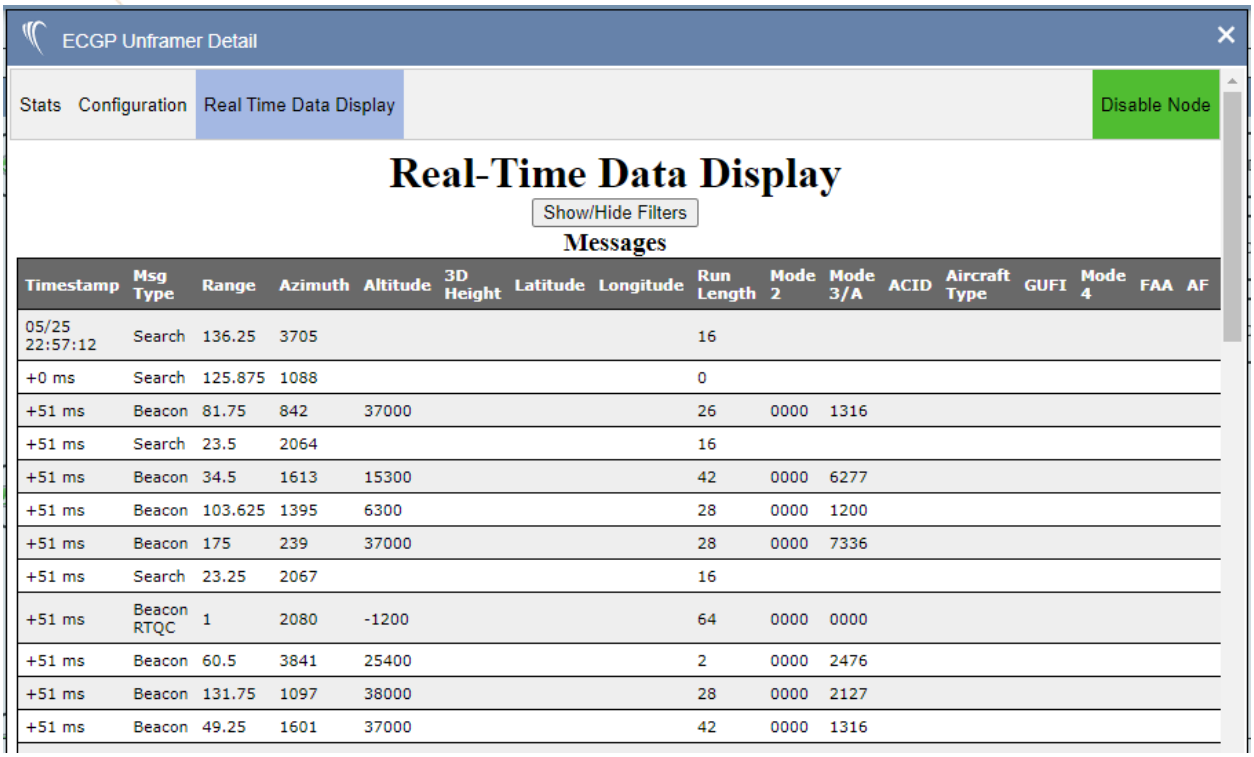


Figure 8: Radar Display

SureLine Real-Time Data Display

SureLine also provides a means to view the live data passing through the data flow using the Real-Time Data Display (RTDD). The RTDD provides a view of the message data at each specific node

in the data flow. The RTDD provides live data views as raw hex data, or radar generic decodes, while also providing filtering and the ability to save the data to a CSV file for off-device analysis.



Timestamp	Msg Type	Range	Azimuth	Altitude	3D Height	Latitude	Longitude	Run Length	Mode 2	Mode 3/A	ACID	Aircraft Type	GUFI	Mode 4	FAA	AF
05/25 22:57:12	Search	136.25	3705					16								
+0 ms	Search	125.875	1088					0								
+51 ms	Beacon	81.75	842	37000				26	0000	1316						
+51 ms	Search	23.5	2064					16								
+51 ms	Beacon	34.5	1613	15300				42	0000	6277						
+51 ms	Beacon	103.625	1395	6300				28	0000	1200						
+51 ms	Beacon	175	239	37000				28	0000	7336						
+51 ms	Search	23.25	2067					16								
+51 ms	Beacon RTQC	1	2080	-1200				64	0000	0000						
+51 ms	Beacon	60.5	3841	25400				2	0000	2476						
+51 ms	Beacon	131.75	1097	38000				28	0000	2127						
+51 ms	Beacon	49.25	1601	37000				42	0000	1316						

Figure 9: Real-Time Data Display

Monitoring Using SNMP

The SureLine software platform provides SNMP v1, v2, and v3 support for remotely monitoring and basic control of the SDDS sub-components. SNMP v3 user management is provided in the SureLine GUI to establish validated access to the MIB data unless configured for SNMP community access. The SureLine platform SNMP MIB provides detailed information for:

- Overall Status – this section of the MIB provides access to unit status, up-time, and software version information. It also provides SNMP Set objects for things like restarting the unit, resetting message counts, and renaming the Community strings.
- Network Table – the network table provides the status of the Ethernet interface and the surrounding statistics.
- Traps – traps are provided and are configurable for sending to a maximum of eight management stations. Traps are triggered for events such as a change in device or network state, a change in redundancy, and others.

Software Assurance

Sunhillo has a Quality Management System (QMS) that is compliant with ISO9001:2015 and EUROCAE ED-109A for Communication and Navigation and Surveillance and Air Traffic Management (CNS/ATM) Systems. The QMS provides the processes, and templates necessary to qualify the SureLine software used in our SDDS components to Assurance Level 4 (AL4).

Sunhillo's software development lifecycle processes defined in the QMS conform with the rigor necessary to meet Assurance Level 4 (AL4) as defined in ED-109A and are part of normal Sunhillo operations.

Cyber Security

Sunhillo has an information security management system (ISMS) certified to ISO27001. Sunhillo's Cyber Security plan is organized in accordance with *SUN9031 – Information Security Procedures* and intersects the software development life cycle of the SureLine platform software. As part of Sunhillo's cyber plan, Software development coding standards (SUN9107) include secure coding practices and guidelines for developers.

To ensure vulnerabilities are not introduced into releases, all Sunhillo SureLine products undergo a Tenable Nessus Vulnerability scan at each release of the device operating system (OS) software. The scan summary ensures that each release package hasn't introduced new vulnerabilities while the scanner itself is updated daily by Tenable with any new vulnerabilities to keep up with the latest impacts known at the time of release.

Sunhillo is committed to the security posture of its surveillance appliances and software as we provide systems and products to government and military entities. This commitment is evidenced by our security test regression which is automated in our release plans and also our participation in the Common Vulnerabilities and Exposures (CVE) database.

Cyber Features in SureLine

SureLine's cyber features represent an ongoing commitment to the evolving world of cyber security. SureLine's early security features are derived from the Common Criteria Network Device Protection Profile (NDPP) and NIST 800-53 but are also influenced by the direct requests and needs of our customer base.

Access Control

SureLine provides the interface to manage and configure the security footprint of the SDDS devices. By default, all SureLine products are shipped "open" so that they may be properly configured for the destination site by an administrator and then locked down to a specific security footprint. All administrator setup of the device can be accomplished through the SureLine user interface.

SureLine defines three classes of users to provide appropriate access limits through the following user roles: Administrator, Maintainer, and Operator. Users defined as Administrator have access to menu items related specifically to security:

- Network Configuration – allows the definition of the unit IP address and other network setups
- Security– provides access to enable/disable various services, configure security banners and define Access Control Lists (ACLs) based on the cyber requirements of the network environment
- Account Management – provides access to create user accounts and define the user class
- System – allows for software updating and system restarts. Additionally, allow SureLine software update packages are signed ensuring originality of source.

Logging

An important topic in the security realm is logging. SureLine SDDS provides logging of both operational events (e.g. warnings, errors, etc.) and also security events such as user access and change of configuration. SDDS logs are available for viewing on the SureLine GUI but can also be configured to be forwarded to other Syslog forwarding locations.

About Sunhillo

Company Overview

Sunhillo Corporation is an ISO9001:2015 and ISO27001:2013 certified employee-owned private company headquartered in West Berlin, NJ USA. We successfully handle all lifecycle aspects of surveillance data distribution systems for the FAA, US Military, civil aviation authorities, and national defense organizations across the globe.

We are a registered Small Business (SB), which allows us to accommodate customer requests and adapt to schedule or needs changes that are outside the Statement of Work (SOW). Being an ISO 9001 / 27001 certified company, we strive for customer satisfaction and have the ability to react quickly and cooperatively to resolve customer requests and issues promptly while maintaining control of the products and programs.

For over 30 years Sunhillo has been providing Air Traffic Control (ATC) solutions to customers worldwide. Our long history with the FAA has provided Sunhillo with expertise and knowledge very few companies have achieved including:

- Over 30 years of a proven track record of successfully executing FAA Programs
- Experience with FAA Prime contracts with on-time delivery of products
- Familiar with FAA requirements and assembly, kitting, and testing
- Superior supply chain management processes
- Large 32,000 square foot facility