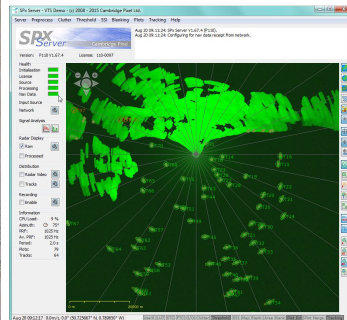
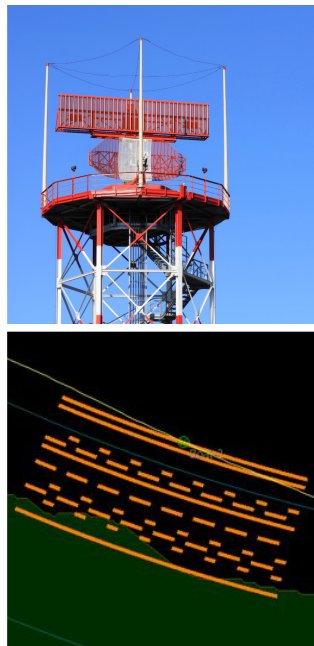
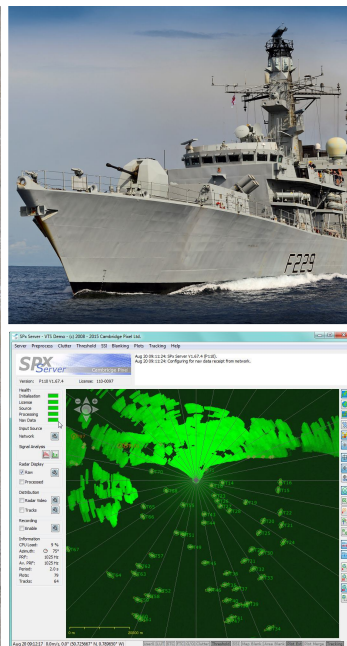


SPx Server

Radar Target Tracking & Video Distribution



SPx Server

SPx Server, a component of Cambridge Pixel's SPx radar processing family of software, is a ready-to-run COTS radar plot extraction, tracking and distribution server application. Interfacing to radar signals or network streams, SPx Server accepts polar format radar video and processes it to identify targets, which are then correlated from scan-to-scan to output positional and motion updates. The radar video may optionally be recorded to disk and distributed over a network.

The software is highly configurable and may be used to identify target-like shapes according to defined rules. These candidate tracks may be output directly after detection, for example into an existing correlator, or may be further processed by SPx Server to estimate speed and heading.



Target Tracking

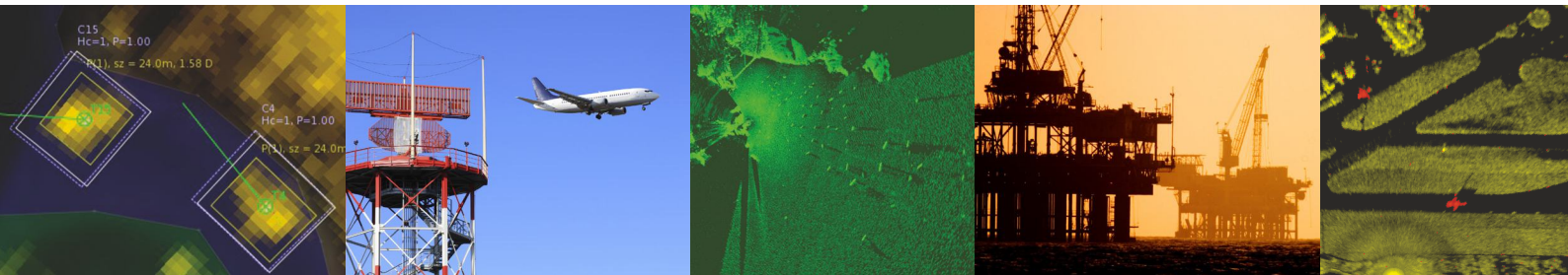
The function of a tracker is to interpret radar observations to distinguish real targets from noise, and to construct models to describe the motion of the targets. Since measurements from the radar are imperfect, there will be noise from the detection process, in addition to clutter from the environment and unpredicted manoeuvres of targets. This means that the tracker will be presented with noisy, and possibly multiple, measurements from the target of interest. The tracker's responsibility is to provide the best interpretation of the data using assumed or calculated statistics for the noise and the likelihood of change.

Video and Track Distribution

SPx Server supports network distribution of radar video and track reports to remote clients. Video and track messages may be output as UDP packets in a number of different formats including SPx, ASTERIX (CAT-240 for video and CAT-048 and CAT-010 for tracks) and NMEA 0183 "TTM".

SPx Server supports up to three separate video distribution channels and each one may contain the raw, processed, clutter or auxiliary radar video.

The auxiliary video is derived from the primary input source, via a look-up table, and could be a selected portion of the input sample (for example, the second input channel from an HPx radar input card).

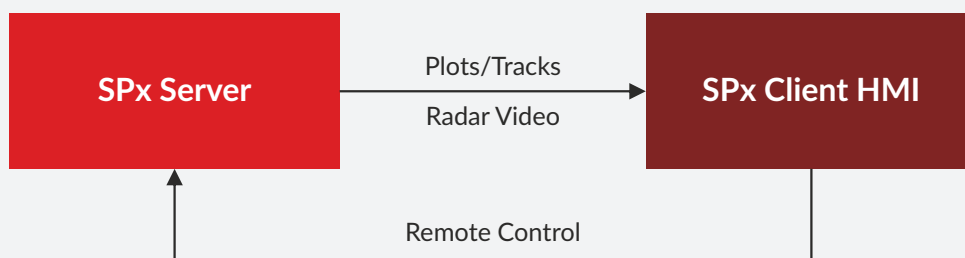


SPx Server outputs plot and track data onto a standard Ethernet network for delivery to remote clients for data fusion or display. The time-stamped reports are delivered with low latency, and may include both the filtered and measured components of the track's state vector.

Additionally, SPx Server supports target track designation, wherein the user may select a single or multiple tracks to report within a separate stream. This track stream may be used to drive an optical tracker to follow a specific target or simply as a means to output tracks in multiple formats.

On the client side, Cambridge Pixel's SPx software modules receive and decompress the radar video to recover the original data. The full capabilities of the SPx software are then available for processing or scan conversion of the radar video. Track reports may be received and conveniently decoded into data structures for processing or display.

Cambridge Pixel's SPx Fusion Server product is available for correlation of track reports from multiple instances of SPx Server or for a combination of SPx Servers and secondary source, such as AIS and ADS-B.



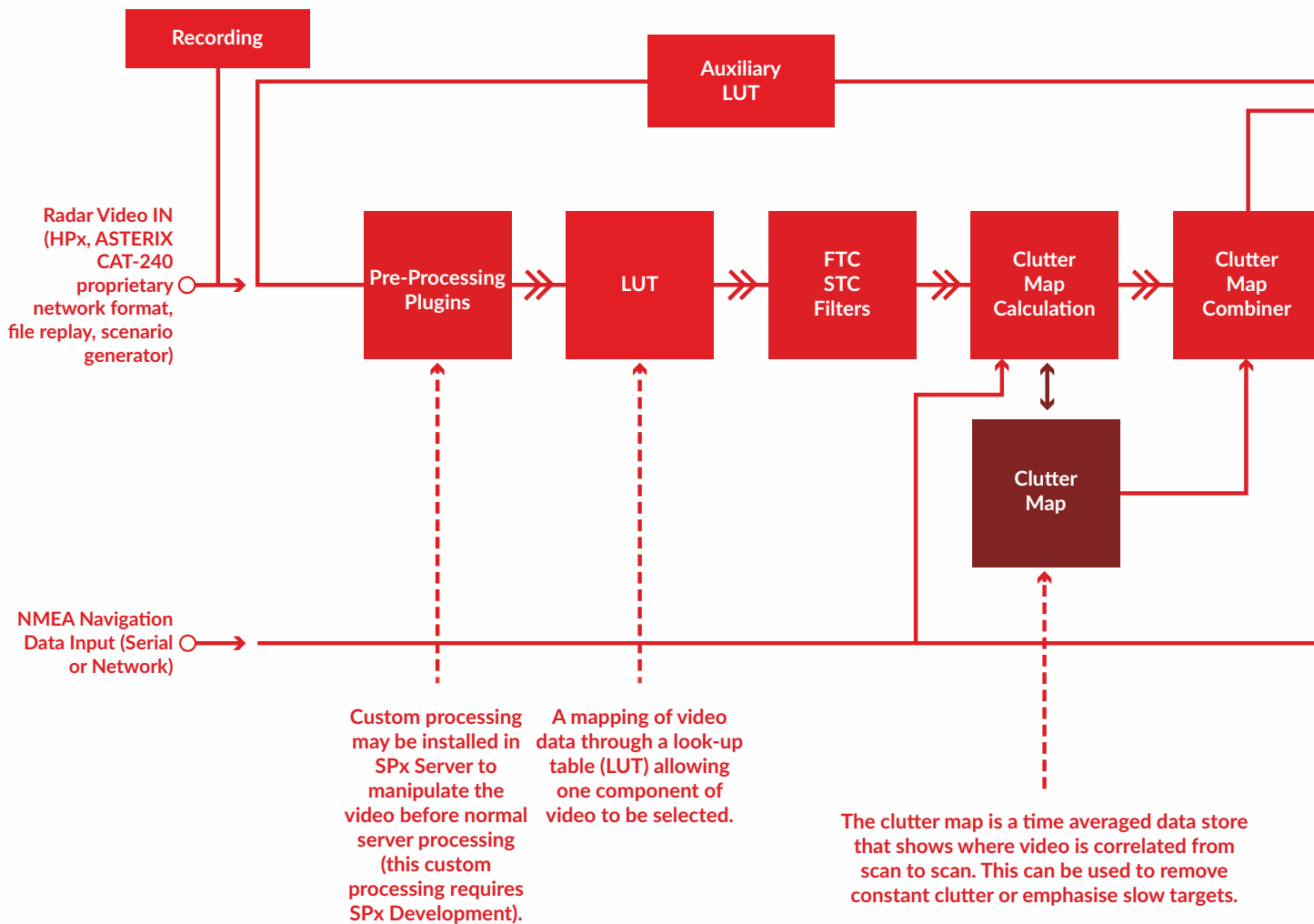
Remote Client Control

SPx Server presents a network interface for control and monitoring. Commands may be sent to the server to configure and modify parameters of high-level processing, including:

- Change current radar source
- Change parameters of source object
- Change network addresses for output
- Enable/disable processing objects
- Change parameters of processing objects
- Start/stop radar recording
- Start/stop network distribution of video
- Control HPx hardware input source
- Manually initiate, repair or delete a track
- Download new tracking area polygons and range-azimuth segments

SPx Server Modules

Processing from Video to Tracks.



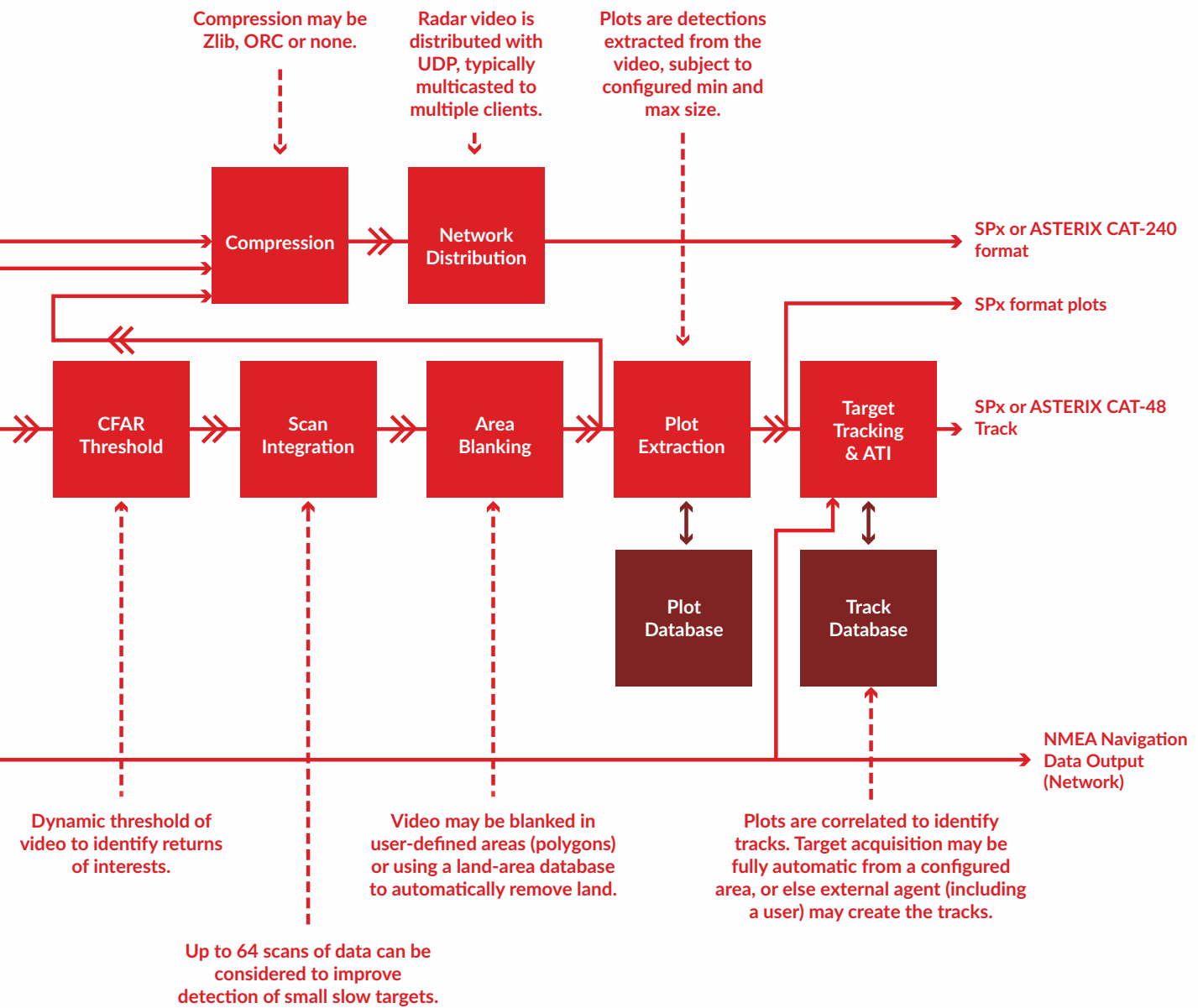
Plot Extraction

The plot extraction process examines the processed video to search for returns that form a connected target-like shape. A set of configurable parameters define the target size of interest, eliminating small noise returns or larger clutter or land masses early in the processing.

Track Initiation

The tracker maintains an active track database. The contents of the database are updated with new plot data derived from the extraction stage. New tracks are added to the database either from a manual request or else automatically.

The automatic track creation occurs when plots entered into the database are seen to be uncorrelated with any existing known target. A new preliminary track is created and is updated with future detections until confidence is established that the track is likely to be a target of interest.



→ Track Association →

Established tracks are updated using new measurements provided by the extraction process.

The first stage of this is association, by which a measurement is attached to the most likely track. In a simple situation, a true target will give rise to a single plot that can be directly associated with the expected target position. However, in the general case, there may be ambiguity as to which measurement relates to which track. A gating function is used to calculate an area around the expected position of a track, within which the next measurement must lie for it to be considered for association.

→ Track Filtering

The tracker updates the current estimated position using the new measurement. If the measurement were known to be completely accurate, the update process would entirely believe the measurement and the new estimate would be exactly the measured value.

However, the measurement will contain errors, so the update process must use filtering to take a weighted combination of the expected position and the measured position. The filter works by computing a dynamic gain, based on estimated system noise and measurement noise models.

Local Engineering and Maintenance Display

SPx Server provides a choice of native or web-based user interfaces for set-up, monitoring and configuration. The server software can be configured without these interfaces, but for most situations they provide an extremely valuable display capability to assist in the initial deployment and maintenance of the tracker.



Submenus for application and processing control.

Server health indicators provide an instant visual warning of any problems.

Input source selection.

Local radar display control (colour, fading and brightness). Raw and processed video may be displayed simultaneously.

Radar video and track distribution controls (enable/disable, set distribution address, message format, compression method).

Radar Video Recording

The server features a built-in radar video recorder, which can capture, compress and store radar video to disk. This happens without affecting tracking or network distribution activities. If available, platform navigation data and AIS data is also captured, allowing the recorded scenario to be analysed in full at a later date.

Recordings may be replayed back through the tracker for processing or distribution. The recordings may also be removed from the tracker and transferred to a remote replay client, for example for incident analysis. The operation of the recording process can be controlled across the network interface, allowing a remote client to start and stop the recording as required.

Current status information, including an indication of the source PRF and current antenna bearing.

The screenshot shows the SPx Server VTS Demo interface. At the top, there's a menu bar with options: Server, Preprocess, Clutter, Threshold, SSI, Blanking, Plots, MBTI, Tracking, Help. Below the menu is a status bar showing 'SPx Server - VTS Demo - (c) 2008 - 2018 Cambridge Pixel Ltd.' and 'V1.80.2 P110 CPL-999-0031'. The main interface is divided into several sections:

- Health Indicators:** A vertical bar on the left shows status for Health, Initialisation, License, Source, Processing, and Nav Data.
- Input Source:** A section with a 'File' button and a signal analysis graph.
- Radar Display:** A section with checkboxes for 'Raw' and 'Processed' video.
- Distribution:** A section with checkboxes for 'Radar Video' and 'Tracks'.
- Recording:** A section with an 'Enable' checkbox.
- Information:** A section showing system metrics: CPU Load (3%), Azimuth (6°), PRF (1786 Hz), Av. PRF (1786 Hz), Period (5.9 s), Plots (26699), Tracks (145), MBT Trks (0), and Track Cls (0).
- Radar Display:** A large central area showing a green radar scan over a dark map with various target icons.
- MHT Tracker:** A pop-up window with a 'Command' field, 'Execute' button, and various configuration options for tracking parameters like 'mhtTrackCanExist', 'mhtGenerateReport', 'mhtMinTrackingRange', etc.

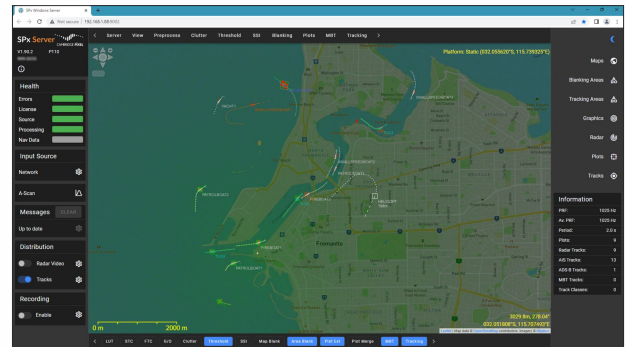
Area Based Processing

SPx Server supports the processing of the radar video in user-defined areas. These areas may be sectors or complex polygons and may be relative to the platform or fixed, in world coordinates. The built-in world vector shoreline database may also be used to provide a processing boundary, for example suppressing tracking over land. The maintenance display provides a convenient graphical tool for defining areas.

Areas may also be used within the tracking process, so that different parameter values may be set in each defined area. This is an extremely powerful capability, allowing a single tracking process to be optimised for each area. For example, in areas of high noise (woodlands, sandbanks, windfarms etc.), it may be desirable to suppress automatic initiation of tracks whilst still permitting established tracks to be maintained.

Model Based Tracking (MBT)

The MBT extensions to SPx Server (Windows version only) provides a method for different sets of tracking parameters to be used to process the same input data. Models may be created that are tuned to look for specific types of target.



Web GUI

Track inspector provides detailed information about a selected radar track, including details of the tracking gate.

Track Inspector (T970)			
Track ID	Centre PPI on Track		Debug To File
Created	MHT (4 scans)	Age (scans)	39
Range (m)	19406.6	Azimuth (deg)	103.22
X (m)	18892.3	Y (m)	-4437.6
Speed (m/s)	0.00	Course (deg)	0.00
Speed SD (m/s)	0.04	Course SD (deg)	70.94
Speed CR (m/s)	0.00	Course CR (deg/s)	0.00
Xdot (m/s)	0.00	Ydot (m/s)	0.00
R-dot (m/s)	-0.49	A-dot (deg/s)	0.00
Last Rerr (m)	-2.05	Last Aerr (deg)	0.01
Ran M-Err SD	4.75	Azi M-Err SD	0.045
Range Gain	0.301	Azi Gain	0.201
Range Rate Gain	0.0338	Azi Rate Gain	0.02243
Range Gate (m)	150.9	Azi Gate (deg)	1.95
R-Size (m)	180.9	A-Size (deg)	1.95
Weight	367.1	R-Doppler (m/s)	0.00
Hits	32 : 32	Hconf	1.00
Pdetect	1.00	Last Signal (S/W)	48%
TTM Id	0	Class	0
IFF Id	None	IFF Altitude	None

Tracked targets are drawn with a symbol, label, velocity vector and history trail.

Graphical tools, such as an A-scan display, are available to assist with process configuration.

Local display graphics controls (e.g. turn on/off plot markers).

Graphical controls are provided to configure parameters for each of the processes in SPx Server, including tracking. A graphical area editor is also available, to assist with configuration of area-based processing.

AIS inspector provides detailed information about a selected AIS track.

AIS Inspector (304933000)			
Centre PPI on AIS		No Image	
Log To Console			
Vessel Name	304933000	Vessel IMO	---
Latitude (deg)	51.507167	Longitude (deg)	0.970400
Speed (m/s)	0.0	Course (deg)	158.0
Heading (deg)	268.0	ROT (deg/min)	0.0
Dimensions (m)	---	Draught (m)	---
Call Sign	Unknown	ETA	---
Destination	Unknown		
Cargo Type	---		
Nav Status	Not Defined		
ENI	---	ERI	---
Hazardous Cargo	---		

Indicators show which processes are currently enabled.

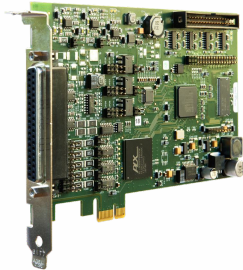
Radar Input Sources

SPx Server works with Cambridge Pixel's HPx range of radar input cards and is also capable of receiving network radar video from SPx applications that distribute radar video or from radars that provide a network video output directly (ASTERIX CAT-240 and various proprietary formats).

HPx Radar Input Cards

HPx cards are compatible with a wide range of commercial and military radars using video, trigger and ACP/ARP or parallel azimuth signals. HPx cards provide a flexible range of options to support dual analogue and up to eight digital video inputs. The cards are software programmable to allow the analogue and digital video inputs to be mixed to a single intensity level for each sample.

HPx cards are available in PCI, PCIe, XMC form-factors and as a box-level radar-to-network solution.



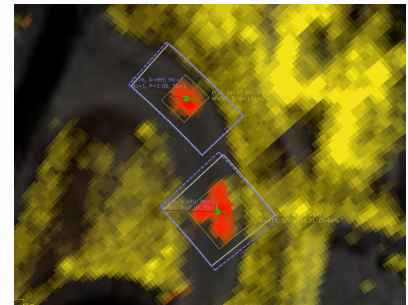
Network Sources

SPx Server can accept network radar video input directly in a number of different formats, including SPx format and ASTERIX CAT-240. This makes it possible for software applications to send data into SPx Server for processing. It is also possible for SPx Server to receive the network video data directly from certain radars, such as Kelvin Hughes' SharpEye, Simrad, Furuno and Raymarine.

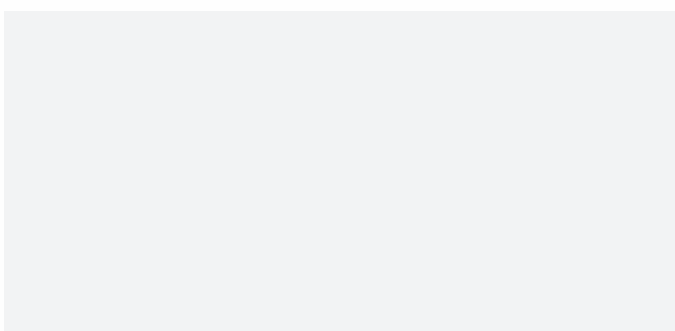


Simulation and Test

SPx Server supports a built-in test generator to create radar video for testing. A more sophisticated option is to use SPx Radar Simulator which permits complex target and radar movements to be modelled. The ASTERIX CAT-240 output of SPx Radar Simulator may then be input directly into SPx Server.



SPx Server Ordering Information	Part Number (Linux)	Part Number (Windows)
SPx Server for target tracking and radar video distribution	110-702	110-703
SPx Server radar video distribution only (does not include target extraction and tracking)	110-640	110-641
Upgrade of SPx Server to include radar video record and replay	110-715	110-715
IFF plot extraction	110-730	110-731



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