SPx

Radar Video Processing and Display

SPx Server
Overview and Specification

V1.41

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CAMBRIDGE PIXEL
SENSOR PROCESSING & DISPLAY SOLUTIONS

Contents

Document Change Log

1.18
Documented support for pre-process plugin

1.18A
Add support for Asterix track output
Minor changes to spec.

1.26 (10th May 2010)
New logo and address on front cover.

1.32 (7th Sept 2010)
Updated specification

1.34 (15th Dec 2010)
New GUI supported.

1.39 (24th May 2011)
HPx-200 supported.
Updated specifications.

1.41 (7th July 2011)
New logo

1. Introduction

The document presents a general overview and specification of Cambridge Pixel's SPx Server product.

SPx Server is a multi-function primary radar video processor, which may be used for radar video acquisition, network distribution and plot and target extraction.

SPx Server can receive radar video from signals using the HPx series of radar interface cards, or from a network source, for example where the radar is directly providing network video or plot data. Additionally, to support testing and maintenance, SPx Server can be configured to use simulated data from its built-in scenario generator. Finally, radar video may be recorded to a local hard disk and SPx Server configured to receive data from this recorded source.

1.1. External Interfacing

Although SPx Server has a Graphical User Interface (GUI) to support configuration and maintenance, its normal operational mode is to run as a black-box server that receives radar video (or plots), processes the data and outputs a combination of either video or tracks onto a network. In this situation, the GUI is available to display activity and report status and messages.

The video or track data distributed from SPx Server may be received by one or more client applications. These can include Cambridge Pixel's RadarView Windows application, or a custom-written client application. A custom client application can use Cambridge Pixel's SPx Library to receive track data and communicate with the server. For the distribution of radar video, the SPx software library provides software module to receive, decompress and scan convert radar video. The external interface options are shown in Figure 1.

Note that additional client-side licenses will be required for receipt and scan conversion of radar video. Additional client-side licenses are not required to receive status messages, heartbeats and track reports.

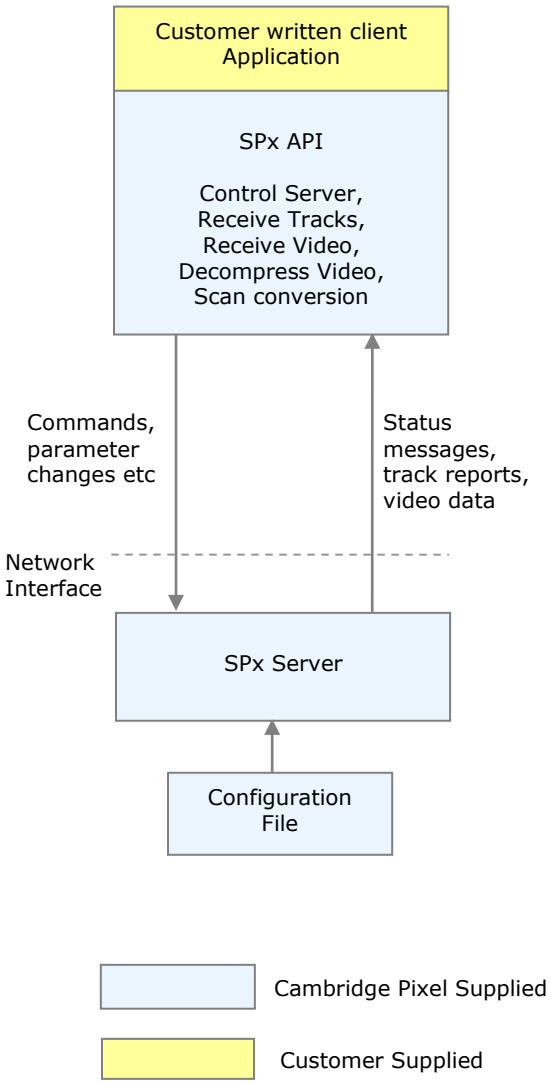


Figure 1 - SPx Server Interfacing

1.2. Overview of Server Configuration

When the server starts it reads a configuration file. The configuration file contains a set of parameter assignments that initialise the state of the server. Once the server has read the file and completed its initialisation it immediately starts processing data and providing output. The contents of the configuration file define which processes are active, parameters for the processing, addresses for the network output etc.

The server can function as a black box radar processor, configured to start automatically at power-up of the machine with no user-interaction or GUI configuration needed. However, the server also provides a GUI, which may be used for monitoring of the server status and adjustment of the server configuration. Additionally, the server can accept a network connection from a remote client, which can send commands to remotely change the server configuration.

1.3. GUI Connection

The GUI is designed to run on the same machine as the server software. In the Linux version of the server the X-Windows based GUI client must connect to an X Server running on the server machine.

1.4. Software Licenses

SPx Server is a licensed software product, which requires a software key or dongle to function. If a suitable license is not found the software will typically operate for 60 minutes before stopping.

To verify that the software is licensing, check the GUI for error codes.

1.5. Moving Platform Support

SPx Server may be used for static or moving platform applications. When used on a moving platform, the target tracker requires an input of platform navigation information, which as a minimum comprises ship course and speed.

Navigation information may be provided as input using a standard NMEA serial data format or a network message format. The network message format uses the same NMEA ASCII sentence structure, but stores the strings in simple message blocks that can be delivered over a UDP interface.

2. Processing Modules

The standard SPx Server processing sequence is shown in Figure 2. This defines the set of processing components built into the standard SPx Server. If you are working with a customized version then your processing sequence may be different to that illustrated.

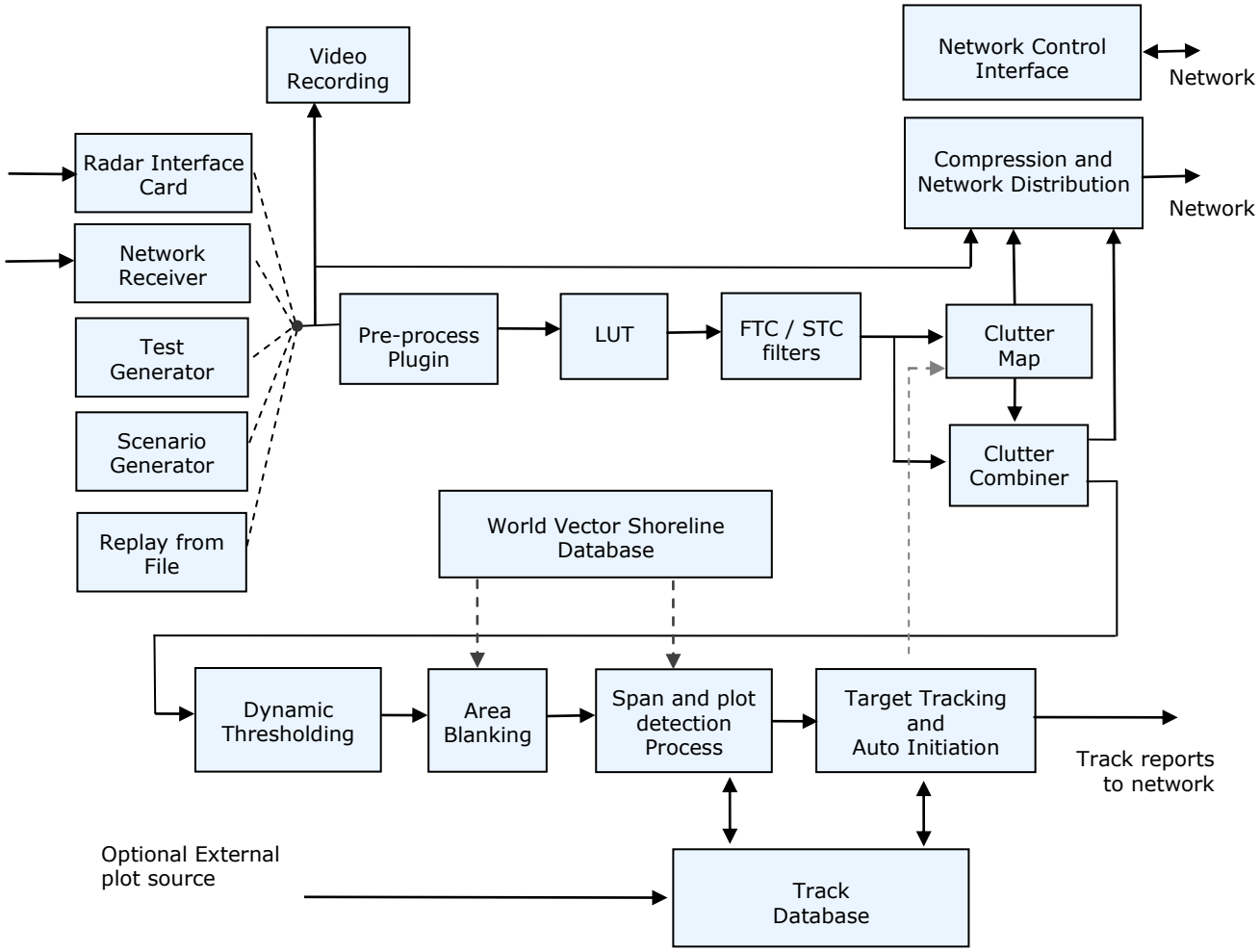
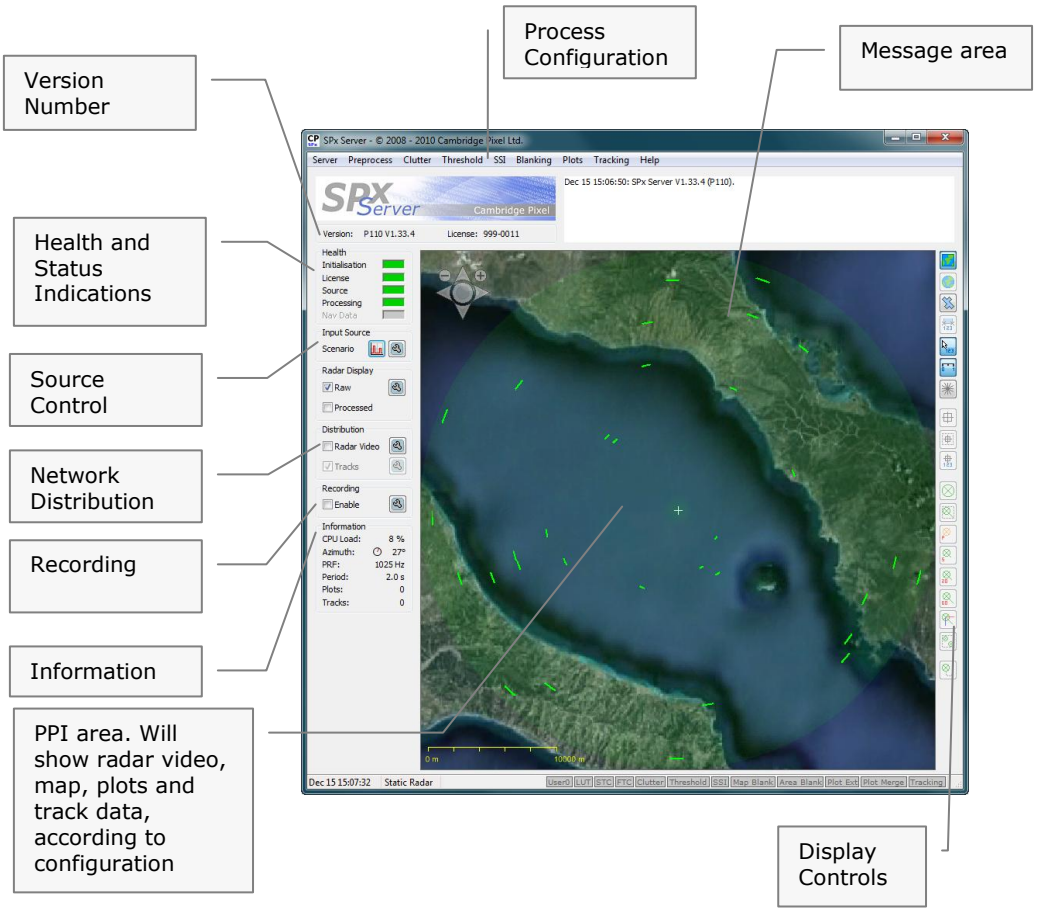


Figure 2 - SPx Server processing - standard configuration.

3. Server Controls and Interface

The Graphical User Interface for Windows and Linux version of SPx Server is similar but slightly different.

When started, the Server GUI should be similar to that shown below:



Video data, and optionally plots and tracks, will be displayed in the main PPI area. The view in this area can be adjusted with the PPI View navigation controls (left, right, up, down, zoom in and zoom out). In the Linux version of the GUI, the PPI area may be adjusted using the mouse the drag the view left, right, down or up, or using the mouse scroll wheel to zoom or out.

The Source Control buttons allow configuration of the source of radar video or plot data.

The Process Configuration boxes allow different processing stages to be enabled and configured. Not all options may be available, depending on licensing options and radar input restrictions.

The Network Distribution may be enabled and configured.

The Recording may be activated and configured.

Various status information is shown at the bottom left of the window, including ship navigation information when a moving platform is being used.

The Cursor position shows the range, azimuth and x,y position of the pointer relative to the radar position. An azimuth of 0 represents North and positive values increase clockwise.

4. Specification

4.1. Product Options

Component Supply	Available as software CD, Documentation and hardware interface card for OEM system installation
System	Available as complete server installation configured in PC-based system or single board computer
Functional	Optional licensing options for: Radar video distribution Plot extraction, Target extraction Record and Replay

4.2. System Requirements

Processor	X86 Architecture Recommended processor is 2.0 GHz Pentium Core-2-Duo or higher. 2 GB system memory recommended.
Operating System	Windows XP, Vista, 7 Linux (Redhat, Ubuntu, RHEL v5) For other operating systems consult factory
Graphics	Requires 1024 x 768 graphics display or higher for maintenance and configuration. Recommended PCIe or XMC graphics card. GUI is not needed for operational system.
Disk	Disk storage is optional for radar video recording.
Network	100 Mbit or 1 Gbit Ethernet adaptor recommended.
Expansion Slot	PCI or PMC expansion slot required if using a HPx radar interface cards. Refer to the user manual for these cards for full details.

4.3. Software Licensing

Functional	SPx Server may be licensed for: Radar Video Distribution Server Plot Extraction Target Tracker Radar Record and Replay Moving Platform

License Protection Method	USB Dongle, MAC-address or License file (Other schemes are possible, consult factory for details)

4.4. Radar Interface

Radar Input	Hardware interface card using HPx100/150/200 Network input from supported radar types
Radar Trigger	PRF: Up to 10 kHz with HPx cards Amplitude: Up to 30V. Single ended (opto-coupled) or differential (RS422). Impedance: 75R or high impedance
Radar Video	Amplitude: 5V (positive or negative) Impedance: 75 R or high impedance
Azimuth Turning Data ACP/ARP	Single ended signal up to 30V or differential RS422. ACP count: 60, 180, 300, 360, 1024, 2048, 4096, 8192, 16384 pulses per ARP. Software automatically detects ACP count. ACP Interpolation supported for low counts. ARP: One pulse per scan Rotation rate: Up to 240 rpm
Azimuth Turning Data Parallel Azimuth	12 bit RS422 differential azimuth value with data strobe.
Azimuth Turning Data Synchro/Resolver input (Uses HPx-180 Synchro/resolver to parallel converter option)	115V Reference voltage, 90V synchro (3 wire) or resolver (5 wire) input. Reference voltage is standard 115V input. (Other synchro voltages on request)
Plot Inputs	Option to receive plot data from proprietary radars. Consult factory for details.

4.5. Navigation Information

Platform Navigation	NMEA-0183 input GPRMC sentences used interpreted by server.
Physical interface	Standard serial port on PC or single board computer Network input (uses NMEA 0183 sentences in network packets)
Navigation Reporting	Optional network distribution of NMEA

	sentences received on serial input. Programmable IP and port address for output
North Offset Adjustment	Incoming azimuths may be ship or north referenced, with automatic conversion to north referenced from navigation data, as required.

4.6. Performance

4.6.1. Video Processing with HPx Radar Interface cards

Video Bandwidth	25 MHz (When used with HPx-100, HPx-150 or HPx-200 radar interface cards)
A-to-D Conversion	Programmable 2 to 50 MHz sampling rate. 10 bit high-performance capture (12 bits on HPx-200) Data is reduced to 8 bits through a programmable LUT.
Threshold Detection	Adaptive threshold CFAR technique with geographical area thresholding
Clutter Processing	Software-based scan-to-scan correlation Clutter subtraction Land mass blanking

4.6.2. Processing

Land Mask	Static mask Complex polygon of any shape or size, optionally containing holes. World vector shoreline land masking using built-in database of world shoreline data (static or moving platforms supported). Polygon set is defined in world x,y coordinates and is automatically converted into polar space. Typical azimuth resolution is 0.18 degree and range resolution matches input data resolution.
Area Dependent Processing	Tracker parameters can be assigned different values in different areas (static platforms only). Polygon set is defined in world x,y coordinates and is automatically converted into polar space. Typical azimuth resolution is 0.18 degree and range resolution matches input data resolution.
Automatic Initiation Areas (ATI)	Static mask. Complex polygons defined in x,y

Plot Extraction	coordinates. Can be any shape or size. Independent areas can be configured for radar processing, track initiation and tracking. Optional automatic suppression of plots over land areas using world vector shoreline database (supplied as standard). Configurable plot geometry (min/max range and azimuth) Optional plot merging (multiple modes)

4.6.3. Digital Video Distribution

Network Distribution	Distribution onto LAN of radar video data
Compression	ZLIB or ORC (Open Radar Coding)
Data Rates	Highly dependent on input data and configured resolution. Typical figures from 2 Mbits/sec for processed video to 10 Mbits/sec.
Network Protocol	UDP Unicast or Multicast distribution
Video Store for Distribution	Raw input data Processed data Clutter map (One of above with standard server. Multiple channels of distribution are supported with customized server variants, including options for multi-resolution data)

4.7. Target Tracking

Maximum number of targets	500 (typical, but not limited by software)
Track Initiation	Automatic, with programmable extraction areas defined as polygons or range-azimuth segments (static radar only). Automatic wake area elimination (configurable geometry) Shadow area elimination from known targets. Manual track initiation from remote system Configurable min/max initiation speeds, which may be area dependent. Max initiation speed: 1000 m/s

	Minimum initiation range at maximum speed: 10NM for targets moving tangential to radar 3 NM for targets moving radially towards or away from radar Programmable initiation time from 2 scans upwards using M:N or SPRT integrator. Initiation criteria may be area dependent.
Signal to Clutter	Typically 8 dB or higher expected.
Target Speeds	Programmable minimum and maximum target speed for initiation in the range 0 to 1000 m/s Programmable minimum and maximum target speed for tracking in the range 0 to 1000 m/s
Operating Range	From 0.5% to 100% of programmed video capture range.
Tracking Performance	Figures are very dependent on sensor, operating conditions and configuration data. Sample configuration: 200NM radar range, sea state 1, 100 m^2 RCS target at100 NM. Position accuracy: σ= 90m Range accuracy: σ= 90m Azimuth accuracy: σ= 10 secs arc Speed: σ= 5% of true speed for speeds above 5 m/s σ= 10% of true speed for speeds below 5 m/s Course: σ=1 degree For radar range 70NM, target at 35NM Position accuracy: σ= 25m Range accuracy: σ= 25m Azimuth accuracy: σ= 10 secs arc Speed: As above Course: As above For radar range 35NM, target at 18NM Position accuracy: σ= 20m Range accuracy: σ= 20m Azimuth accuracy: σ= 10 secs arc Speed: As above Course: As above Notes: Performance figures are typical, but depend on exact characteristics of radar and target. Target assumed to be moving in straight line. If server is applying north offset compensation, timely updates of ship's heading are critical for good tracking performance. Quoted values of σ are standard deviations of errors.

4.8. Track Messages and Reporting

Heartbeats	Regular heartbeat for health and status output every 1 second
Status Message	Output once per scan on North crossing
Track Messages	Output on track creation, update and delete. SPx format, Asterix format supported.
Report Latency	Reports generated approximately 30 degrees behind antenna position.
Track Report Format	Can be configured as minimal, normal or extended track reports (SPx format) or Asterix CAT048 format.
Network Address	Configurable IP address and port number. Multicast or unicast distribution

4.9. Remote Control

Control	Remote control of server parameters and operation using network messages. Full client-side API provided.
Software API	C++ software interface for client control (Windows and Linux) .NET supported for Windows-based client applications

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