SPx
Radar Processing and Display

Primary Radar Acquisition, Processing and Display Solutions
Introducing SPx

SPx is a collection of software libraries and applications that provide advanced software solutions for primary radar capture, processing, tracking and display. SPx provides system integrators with a field-proven collection of software modules offering high-performance, easy-to-use solutions for radar processing.

System integrators can use SPx at the level of a software component or a complete application. For server applications, SPx provides the choice of using one of its pre-built servers for radar video distribution, plot extraction or target tracking, or else of building a custom server using the library modules of SPx.

For Radar Display requirements, SPx provides powerful software-based radar scan conversion to allow system integrators to add radar display into new or existing Windows or Linux/X11-based applications. With an industry-leading feature set and highly flexible software options that include a C++ library, a .NET interface, an application co-processor and an image server, Cambridge Pixel offers solutions for all radar display problems.

SPx for System Integrators

SPx provides system integrators with a powerful set of libraries, sample applications, tools, comprehensive documentation and first-class technical support. The software provides a modern, open, extensible framework that can be used to build radar video servers, client applications or radar processors. The ability to extend and customize SPx solutions gives system integrators the capability to add value, provide localisation and maintain close control of the solution for in-country support.

SPx delivers modules of radar processing and display into the application. System integrators can maintain control of the application software, using SPx to provide specific capabilities.

SPx is well suited for the upgrade of legacy radar systems. The combination of flexible hardware interfacing and advanced software architecture options means that SPx is cost-effective for radar upgrades. Many of the world’s leading system integrators and radar manufacturers have already seen the benefits of partnering with Cambridge Pixel.

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SPx Software Library

Windows XP/Vista/7 and Linux

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SPx Solutions

SPx provides ready-to-run software products for radar visualization (RadarView), radar video distribution, plot extraction and target tracking (SPx Server). These products are themselves built from the SPx library. For many users, it is the underlying library of software components, which may be integrated into customized applications, that is the attraction of SPx. A customized server application can be constructed from source code of a sample framework supplied by Cambridge Pixel. This allows the basic functions of a server to be implemented very quickly, with subsequent customization to implement the full requirements. By leveraging the existing toolbox of software components, a user of the SPx library can combine standard and customized processing to gain the benefits of COTS, without sacrificing the ability to customize, maintain and enhance the solution.

SPx Software Library

The SPx radar processing capabilities are available as a Windows or Linux C++ class library. An application can use a single SPx class, for example to provide radar capture or compression, or may combine a number of classes into a server or client application. The flexibility of the solution comes from the ease-of-use of the class library and the ability to modify and expand it with custom code. The standard SPx library provides the following capabilities:

- HPx family interfacing
- Polar interface module (PIM)
- Sector scan, random scan support
- Radar interface buffer (RIB)
- Compression and decompression
- Network distribution
- Test generator for testing
- Scenario generator for simulation
- Radar processing functions:
  - Range blanking
  - Sector blanking
  - Thresholding
  - STC filter
  - CFAR thresholding
  - FTC filter
  - Averager
  - A-Scan display
  - LUT conversion
  - Scan to scan integration
  - PIM combine
  - Clutter mapping
  - Area-masking
  - Range ring insertion
  - Record and replay
  - Plot extraction
  - Trail history retention
- Scan conversion (PPI, B-Scan, A-Scan)
- Radar display mixing with graphics
- Navigation data (NMEA) interface
- Plugin process management
- Server interface framework
- Client interface framework
- .NET support classes
- ASTERIX Track Output

Test and Simulation

For system test and validation, SPx provides a set of test and simulation objects. Test patterns may be inserted into the video at the server or client stage and system performance verified. The SPx Scenario Generator supports the definition of moving targets.

Navigation Data

When building applications for moving platforms, the SPx Scan Converter supports true and relative display modes. A class is available for receipt of NMEA navigation data, which may be used to maintain a heading-up display as the platform moves.

Scan Conversion

The SPx Scan Converter provides a full range of capabilities from multi-window, multi-channel PPI windows, through to parallax-compensated B-Scan views for fire-control radars. A comprehensive collection of sample applications with source code provide examples for most requirements.

Plot Extraction

The SPx Plot Extractor is a configurable module that identifies target-like video in the input stream and generates plot descriptions characterised by centroid, bounding box, size and time-stamp. These plots may then be input to a tracker for correlation and filtering.

Radar Video Compression

The SPx library supports two types of radar video compression. The ZLIB mode generally provides high compression, although requires a modest level of CPU resource for compression and decompression. As an alternative, Cambridge Pixel’s ORC (Open Radar Coding) provides good compression with much lower CPU demands on both server and client.
SPx Radar Scan Conversion

The SPx library supports industry-leading, software-based radar scan conversion using a high-performance double transform method, which ensures that all window pixels are filled from the best radar sample, and that all radar samples contribute to the display picture. There are no holes, no missing spokes and no missing data.

In 2007, Cambridge Pixel became the first company to introduce a commercially available software scan converter that could work with third party graphics applications. Working under Windows or Linux, the SPx Scan Converter adds scan converted radar video into any graphic application exploiting the full power of modern multi-core CPU and GPU architectures. Our Radar Insertion technology allows radar to be added into an existing Windows or Linux application with minimal changes to the existing software. This is especially important when considering the upgrade of existing legacy solutions that might have a considerable investment in the application’s graphics. By leaving the existing graphics application substantially unchanged, the costs of revalidation can be significantly reduced.

The current generation of the SPx Scan Converter is compatible with many different software architectures. As a C++ library, the scan converter can be included into a client application using a simple class interface that takes the client’s existing graphics window as an input and inserts scan converted video as an overlay or underlay. For Microsoft .NET programmers, the scan converter can be accessed from any of the standard .NET programming languages. In place of adding the scan conversion into the application process, it can be run as a separate Windows/Linux process (see RDC below), with a simple socket interface used for exchanging message and status.

Radar Display Co-processor (RDC)

One method of using the SPx library is to include the relevant SPx classes directly into the application to gain access to radar capture, processing and scan conversion capabilities. A single application program (Windows or Linux) then handles the radar and graphics. An alternate implementation is to use the Radar Display Co-processor (RDC), which is a software component of the SPx library. The RDC is supplied as a ready-to-run application for Windows or Linux that handles radar receipt, processing and scan conversion. The RDC can be viewed as a service that runs on the client processor as a co-process. The RDC is controlled from your application using a simple API, which is responsible for sending commands to the RDC process. The RDC scan converts the radar and updates the client’s nominated graphics window with the radar image.

Radar Image Server (RIS)

For cost-sensitive applications, or where scan conversion in each client console is not required, the SPx Radar Image Server (RIS) may be used. The RIS implements scan conversion in a server application and delivers a bitmap of scan converted radar to any number of clients over a UDP interface. Each client sees the same image, so there is no per-client control. The image shows a predefined view and is updated in quadrants of radar rotation. The RIS supports multiple channels so that images may be distributed for a selection of range scales and offsets. Client applications may choose to receive one or more channels of scan converted data. When using the RIS a single software license is required for the server application, but no SPx client side licensing is required. The SPx library provides a set of convenience classes to receive the bitmap data and allow the client application to handle display.
SPx Server – Radar Distribution, Plot Extraction and Tracking

SPx Server is a multi-function radar processor, which is available for Windows or Linux, and may be configured for radar distribution, plot extraction and target tracking, according to license options. Radar video is received either from a Radar Interface Card, or else direct from a network source. The video may be processed using a pre-defined set of processing modules, with the additional option of a user-defined processing chain being provided as an external plug-in. Video may be compressed and distributed to any number of client displays, where it may be scan converted. In addition, the video may be further processed by SPx Server for target tracking.

The SPx Server GUI provides a detailed maintenance display of video, plots, tracks and system status. Although the GUI typically does not form part of an operational system (the software can be used in minimal GUI mode), the interface provides an invaluable tool during system configuration and set-up. Options are provided to see the raw and processed video, as well as the details of each plot and track.

When extracted data is correlated from scan to scan, SPx Server uses multiple hypotheses to support ambiguous interpretations of the radar video. The tracking filter uses position, size and historical measurements to correlate existing tracks with new data, providing updated positions and dynamics, as well as a confidence estimate. Track data may be output in SPx or Asterix formats.
SPx Licensing

SPx is a licensed software product. There are two types of license, Development and Runtime.

SPx Development License

An SPx Development License is needed when developing custom SPx applications, but is not required when running standard applications, such as SPx Server or RadarView. The Development License is available for Windows or Linux and for one, two or multiple developers (site or project license). The Development License provides the following:

- The SPx development libraries and include files, including the C++ class library and .NET interface.
- Printed documentation for the class library, developer support manuals and tutorials.
- Source code of sample applications, framework solutions, test and demo programs.
- Programmed dongle (2 dongles supplied for two seat or multi-user license) to be used for testing of developed applications.
- First-class technical support direct from Cambridge Pixel engineers, available by telephone or email. Cambridge Pixel engineers offer a wealth of expertise and practical experience in radar processing and software engineering and this is available to you for the duration of your project development (see “Technical Support from Cambridge Pixel” below).
- Free software updates with access to all new features.
- Utility programs, including network record and replay, test utilities, debug tools etc.

SPx Runtime License

When an SPx application has been developed using the Development License, the software may be deployed with a Runtime license. This is a perpetual (never expires) software license that enables the SPx capabilities on the deployed hardware. There are different licenses for deployed SPx capabilities, with the common ones including:

- SPx Server for Radar Distribution
- SPx Server for Target Tracking
- SPx Scan Conversion
- SPx Record and Replay

The runtime licensing is enforced using one of a number of methods, including dongle or MAC-addressing.
Case Study 1: Adding scan converted radar video into a legacy graphics application

A customer wanted to add software radar scan conversion into a legacy graphics application showing maps and targets. The software scan converter would replace an old hardware device that was obsolete and expensive to maintain.

The SPx Scan Converter was able to insert its output image into the graphics display of an existing application. The legacy application remained unchanged as far as the graphics handling was concerned. Changes to the legacy application were needed only to control the presentation of the radar data as the displayed view and window geometry changes. This was easily implemented through a small number of API calls from the application into the scan converter.

Licenses Needed:
SPx Development: Yes
SPx Runtime: Scan Conversion

Case Study 2: Building a Custom Radar Server

A customer wanted a radar video server to capture and distribute radar video across a standard network.

Although the standard SPx Server met many of the requirements, the customer needed a number of custom features in the server that were not part of the standard SPx Server product. The solution was to use the SPx modules to provide radar capture, compression, distribution and local scan conversion, together with custom code providing the features needed by the project. The system integrator was free to concentrate on the value-added components of the server, leaving the core capabilities of the radar capture and processing to the SPx library.

License Needed:
SPx Development: Yes
SPx Runtime: Distribution Server (Custom)

Case Study 3: Radar Tracker

A customer needed a radar processor and tracker to interface to a radar sensor and report track information in Asterix format through a network to a client application.

The solution was to use the standard SPx Tracking Server. The track reports were reported onto the network and SPx client libraries were used to control the server and receive the track reports. The same SPx Server distributed the video to each client console using multicast UDP. On the client systems, SPx modules received the data, scan converted the data and presented a real-time radar update.

License Needed:
SPx Development: No
SPx Runtime: Tracking Server

Case Study 4: Radar Tracker with Distributed Video

A customer wanted a radar processor and tracker to interface to a radar sensor and report track information through a network to a client application. In addition, the server needed to distribute radar video, which would be scan converted independently on each of 10 client consoles.

The solution was to use the standard SPx Tracking Server. The track reports were reported onto the network and SPx client libraries were used to control the server and receive the track reports. The same SPx Server distributed the video to each client console using multicast UDP. On the client systems, SPx modules received the data, scan converted the data and presented a real-time radar update.

License Needed:
SPx Development: Yes
SPx Runtime: Tracking Server, Client Scan Conversion
### SPx Product Summary and Part Numbers

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Note: With a “1 Developer” license, a single software engineer is assumed to be working on the project and that engineer is the point of contact with Cambridge Pixel’s support team. A single dongle is supplied. With a “2 Developers” license, there can be two software engineers actively using the software and requesting support from Cambridge Pixel. With a Project or Site license, any number of engineers may be requesting support. Two dongles are supplied for both the “2 Developer” and Project/Site license, although additional dongles can be supplied at a nominal extra cost for the Project/Site license – consult Cambridge Pixel for details.

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<td>For further details see RadarView brochure.</td>
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<tr>
<td>RadarView with B-Scan and Record/Replay</td>
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<td>110-640</td>
<td>Radar input from HPx hardware or network source. Supports pre-processing of radar video prior to UDP network distribution to any number of connected clients. Local GUI option for radar viewing and server configuration. Client-side licensing needed for radar receipt and scan conversion.</td>
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<td>Adds plot extraction capability to above server. Plots output as SPx messages on UDP. Client-side software provided to receive and decode these plots. Plot extraction process fully configurable and viewable through optional server GUI.</td>
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<td>SPx Server (Radar Distribution + Plot Extraction + Target Tracking), Static Radar, Linux</td>
<td>110-700</td>
<td>Add target tracking to above server. For further details see SPx Tracker data sheet. Track outputs as SPx or Asterix format. Client-side software provided (no license needed) to receive and decode tracks. Tracking process fully configurable and viewable through optional server GUI. This version is for static radar installations.</td>
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<td>As above, but applicable for moving platforms (ships, aircraft). Navigation data input through NMEA serial or network interface.</td>
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<td>SPx Server (Radar Distribution + Plot Extraction + Target Tracking), Moving Platform, Windows</td>
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<td>SPx Fusion Server</td>
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<td>Combines tracks from two or more SPx Tracking servers into single fused track source.</td>
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<td>SPx Radar Image Server, Windows</td>
<td>110-751</td>
<td>May be used standalone (radar from HPx or network) or with SPx Server for additional processing. Supports up to 4 channels (different views) which are distributed to any number of clients over UDP.</td>
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