Open Standards for the Provision of Radar Video and Tracks

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Commercial Standards for Radar Data

Many proprietary standards have emerged for radar video, due, at least in part, to the desire of a radar manufacturer to control the connectivity of equipment to their sensor. This makes interoperability of equipment very difficult. The selection of a radar sensor can easily limit the available choices for associated equipment.

Standards based on NMEA 0183 have been successful in providing an open interface for GPS and navigation devices and there is a realistic expectation that devices adopting these standards will be interoperable for the information they exchange.

As a supplier of core technology radar processing modules, including radar scan conversion, tracking and fusion, Cambridge Pixel are frequently requested to provide component solutions that add capabilities to commercial radars. Where the radar provides network video in a proprietary format that is not published nor licensable, there is no capability for third party products to interface with the network radar. In such situations, it may be possible to drop back to interfacing to the radar at the original analogue signal interface (analogue video, trigger, acp/arp signals etc). Cambridge Pixel has a PCI/PCIe interface card that can be used for this. The digitized signal can then be retransmitted in open Asterix format, ignoring the proprietary network data. It is, however, not ideal to use this approach since it brings the additional cost of the re-digitization.

For the most part, it is to the benefit of the end user that the format of radar video being distributed is open and standardized. To this end, Asterix is a mature technology with established deployment in the air traffic control market. The issue is then one of the preference of end users to have an open standard for data exchange, versus the desire of some radar manufactures to provide a closed solution.

The Asterix Standard

The Asterix standard includes support for primary and secondary track messages (CAT-048), control messages (CAT-034) and primary radar (CAT-240). The use of Asterix CAT-048 for track messages is mature, especially in the air traffic control community.

For video data, Asterix CAT-240 messages are used. It should be noted that the Asterix standard for CAT-240 video defines a packet structure for the video, but it does not define a compression standard for the data. Many current implementations do not compress the data area, which has the benefit that the network load is deterministic, but this may not always the best option due to the additional network bandwidth. If compression is used, the Asterix standard does not define the compression type. Provided that the server and the client agree on the standard then any compression method can be used. However, for interoperability of equipment this lack of standardisation is a weakness and therefore the uncompressed data option is commonly used.

Middleware Software Library

Cambridge Pixel's core product, SPx, is a middleware library of radar processing and interfacing components that can be used to build server or client applications. The library provides a collection of software modules that provide core capabilities for C2, ECDIS or VTS applications, including:

- Receipt of radar video in Asterix and proprietary radar formats
- Radar scan conversion (PPI, B-Scan)
- A-Scan display
- Record and replay of video
- AIS decoding
- Clutter processing
- Filtering
- Simulation of video with synchronised GPS and track data
- Area-based processing
- Primary tracking
- Fusion
- Compression
- Network streaming
- Graphics underlay/overlay compositing

These core capabilities are provided as software functions/classes that can be included in Windows or Linux application software. A typical application for a C2, VTS or ECDIS display will include a number of SPx software modules in addition to custom code – for example see Figure 1.

For radar distribution, Cambridge Pixel supports both Asterix and a proprietary SPx network format. For most applications, the Asterix standard provides the most flexibility.

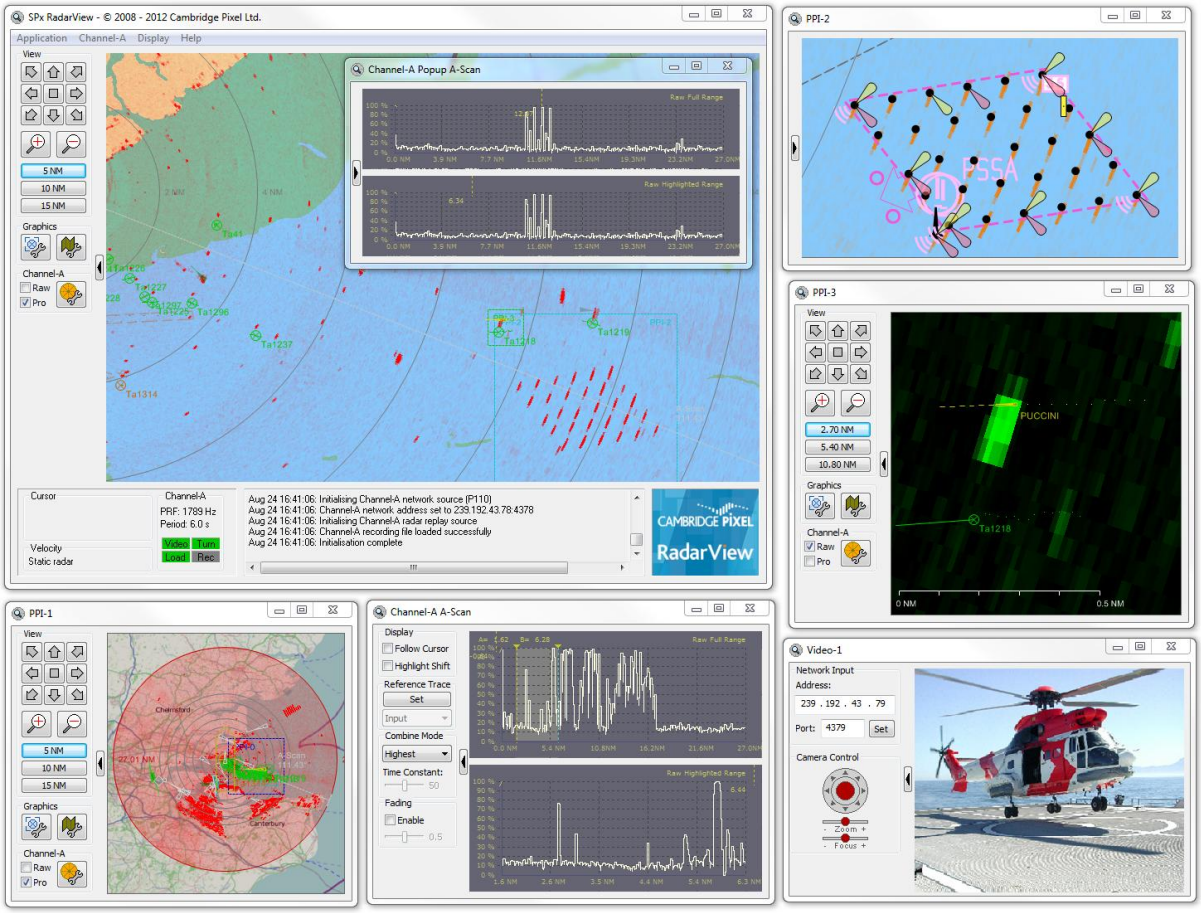


Figure 1 - The SPx software library may be used to build complex radar processing and display applications. The open framework software architecture means that library SPx modules can be mixed and matched with custom application and GUI software.

Within the SPx software library, the Asterix format data can be received, created and recorded. For example, tools are available to generate synthetic radar video in Asterix format, along with associated GPS and navigation data. The ability to generate a synthetic, synchronised data set provides essential test data for system validation, for example. The simulation tool may be used to build complex target scenarios comprising moving platforms, multiple moving targets and terrain effects. All outputs of the simulator (CAT-240 video, CAT-48 tracks, NMEA GPS) are open standards. An example screen shot is shown in Figure 2.

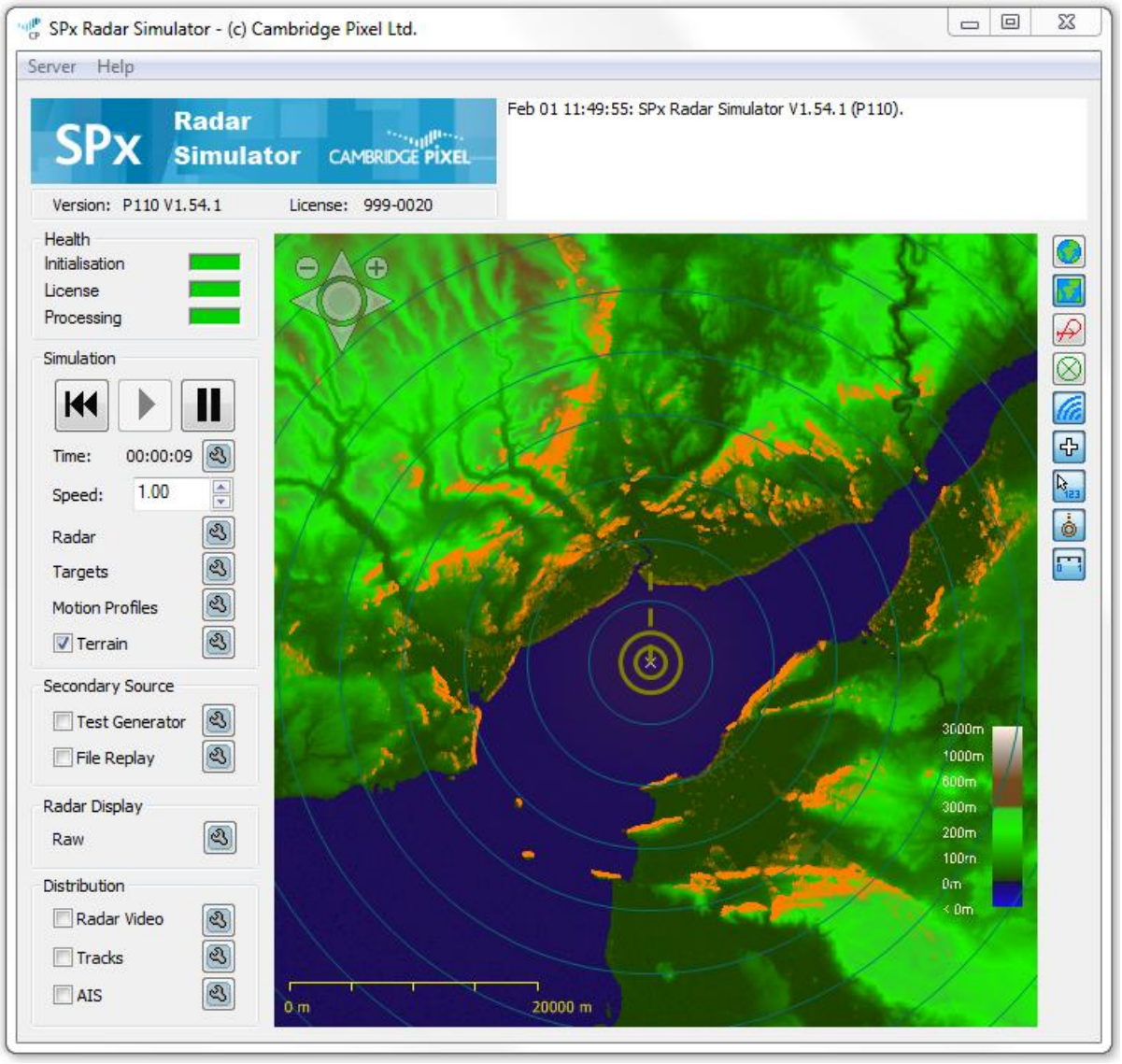


Figure 2 - SPx Simulator may be used to create simulated radar video, along with related GPS, navigation and track information. The video may be output in Asterix format along with standard TTM track messages and NMEA GPS signals. The display above shows the display of the product.

Software Scan Conversion

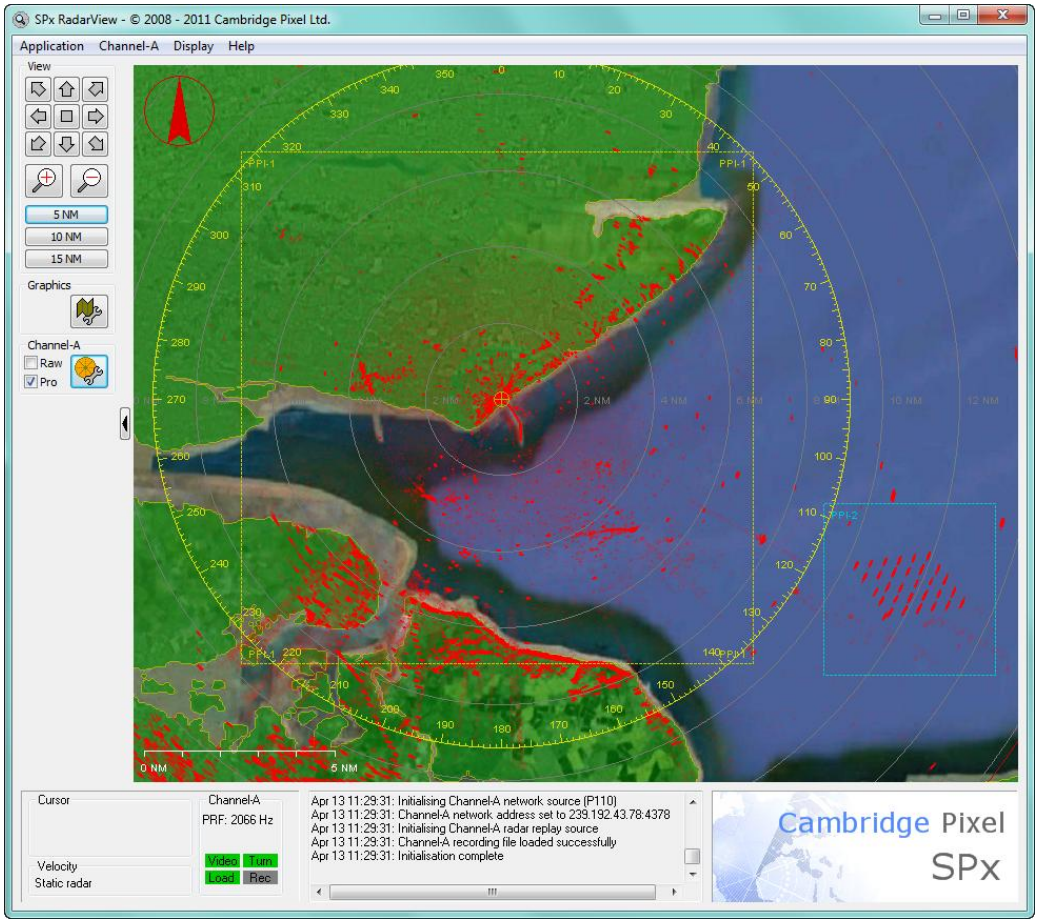
Historically, radar scan conversion was provided by a hardware card, and these still feature in legacy systems with older technology. Developments in CPU and GPU processing architectures have enabled software scan conversion to provide enhanced capabilities and flexibility over the hardware. A key consideration in the implementation of a software scan converter is the interoperability of the scan conversion with the graphics of the application software. To understand this, it is preferable to recognise that there are two stages to the scan conversion process:

1. Scan conversion of polar-format video to PPI image (polar to Cartesian)
2. Compositing of radar picture with underlay/overlay graphics from application, including charts, targets etc.

It would be convenient to think of the scan conversion as being step 1 and handle the display compositing in step 2 as a separate function. In practice the two stages need to be considered together. The requirement is to create the scan converter radar image and then present that image within graphics that are created and managed by third party software. Significantly, the scan converter should not require any specific graphics library, toolkit or platform.

Cambridge Pixel first introduced its modular SPx Scan software scan converter in 2007. Since then the product has been enhanced and improved to provide a powerful plugin software component that works across Windows and Linux and operates with virtually any third party graphics toolkit.

When provided with data from a server application, or directly from a radar, the SPx modules may be combined to receive Asterix video packets, decompress video, scan convert and create a composite window of radar and graphics.



Example of Use – Kelvin Hughes Collaboration

Cambridge Pixel has supplied selected modules of its SPx software to Kelvin Hughes for its Sharpeye product range. This radar provides support for Asterix video and Asterix-based control. The Cambridge Pixel RadarView application - Figure 3 – provides a radar display capability that:

1. Receives Asterix CAT-240 video from the Sharpeye radar
2. Controls the Sharpeye radar over serial or Asterix interface

The RadarView application is a complete application that handles the above function in addition to providing a software scan converter and a suite of other radar-related display functions. In general, however, the underlying SPx software modules handle the receipt of Asterix video packets, decompression of data (if appropriate), scan conversion and display. These modules can easily be incorporated into new or existing applications for ECDIS, C2, or VTS requirements.

Example of Use – Adding SPx Software to an ECDIS Application

Selected modules of the SPx software provide a way of adding core capabilities into an ECDIS application. For the radar input, data may be received as either as Asterix or radar signals (video, trigger, azimuth etc). The SPx modules provides the radar scan conversion that creates the radar image. This image is then inserted into the graphics

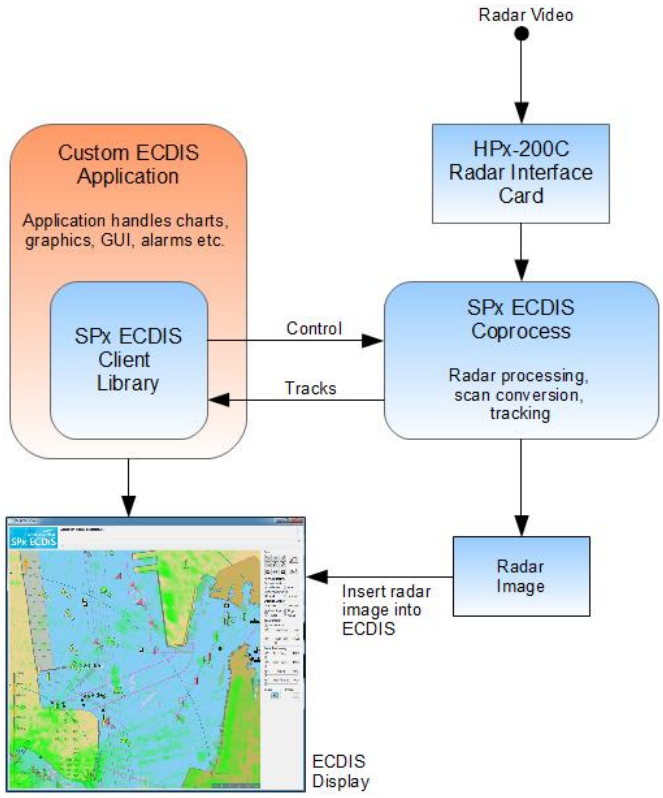


Figure 3 - Cambridge Pixel's RadarView application is built on the SPx libraries and software scan converter. The software can receive Asterix video from a network and scan convert for display with maps and targets.

application, with the SPx routines handling the combination of the radar image with the application's graphics to give underlays and overlays.

Further Reading

Relevant articles written by Cambridge Pixel on the use of open systems for radar display are available at:

http://www.cambridgepixel.com/files/Articles/cots1105.pdf

http://www.cambridgepixel.com/files/Articles/NewElectronics110912.pdf

Additional product information on Cambridge Pixel's products that mentioned in this document is available as follows:

SPx Software Library - http://www.cambridgepixel.com/products/SPx-Radar-Software/

RadarView – http://www.cambridgepixel.com/products/RadarView/

SPx ECDIS - http://www.cambridgepixel.com/products/SPx-ECDIS/

SPx Simulator - http://www.cambridgepixel.com/products/SPx-Radar-Simulator/

SPx Server - http://www.cambridgepixel.com/products/SPx-Server/

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